RV-C

Full Layer Document

RV INDUSTRY ASSOCIATION

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1 Scope & Introduction

RV-C is a CAN-based communication network for recreation vehicles. This document details physical, administration, diagnostic, and application requirements to allow all RV-C network connected devices to interoperate and be maintained. It was developed by the Recreation Vehicle Industry Association (RV Industry Association). RV Industry Association, 1899 Preston White Drive, Reston, VA 20191, United States of America, Tel. +1-703-620-6003.

Any corrections or changes to this document can be requested at www.rv-c.com.

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2 Physical layer

2.1 General

2.1.1 Cable

The physical medium shall be unshielded twisted pair wire; shielding is optional. It is acceptable for the drops to be of a different gauge than the main trunk. The wires are defined in 2.1.1a.

Table 2.1.1a: Wire characteristics

Wire	Characteristics
Material	Stranded copper
Type	Main trunk: 15 to 24 AWG Drops: 15 to 24 AWG
Impedance	95 to 140 Ohm
Propagation delay (max)	5 ns/m
Twists (min)	25 /m

If the wires are not labeled, they shall be color-coded as defined in 2.1.1b.

Table 2.1.1b: Wire color code

Code	CAN_H	CAN_L	PS-	PS+	SHIELD
Two Wire	White	Blue	-	-	-
Two Wire w/ Shield	White	Blue	-	-	Bare
Three Wire	White	Blue	Black	-	Bare
Four Wire	White	Blue	Black	Red	-
Five Wire	White	Blue	Black	Red	Bare
Alternative Colors	Yellow	Green			
	White	Black			

2.1.2 Bus length, termination and topology

The network topology is a linear bus with drops of limited length. Each drop must connect no more than one node to the main trunk. Both ends of the trunk shall be terminated with a 120 Ω resistor, and these shall be the only terminating resistors on the bus. Table 2.1.2 sets limits on the number of nodes (devices) on the network, the trunk length, and the length of drops. The value in the table for the maximum node-to-node path is longest distance between any two nodes – typically the length of the trunk plus the length of the drops nearest the ends.

Table 2.1.2: Bus Length

CAN_H, CAN_L data wire gauge	16 AWG	18 AWG	20 AWG	22 AWG	24 AWG
Number of Nodes	172				
Maximum Node-to-Node Path	660m	425m	265m	160m	105m
Longest Drop	6m				
Total Drop Length	30m				

2.1.3 Data rate, signal levels and slope

The data rate for all transmitters shall be 250 kbit/s. The sample point shall be in the range of 85% to 90% of the bit-time (recommended location or the sample point is 3.5 µs). The signal levels are specified in 2.1.3.

Table 2.1.3: Signal level

State	Voltage
Dominant	CAN_H = 3.5 V, CAN_L = 1.5 V, Vdiff = 2.0 V
Recessive	CAN_H = 2.5 V, CAN_L = 2.5 V, Vdiff = 0.0 V

NOTE Some CAN transceivers provide options for "slope control", which slows the bit rise and fall times to reduce EMI. This practice creates unacceptable interoperability challenges and should be avoided.

2.1.4 Connectors

Network cable conductors shall be spliced or tapped and properly joined with connectors, pressure connectors or by soldering. Individual conductor insulation displacement attachments are not recommended. This protocol recommends that suggested connectors be used for the network trunk. A list of suggested connectors follows for the network trunk in Table 2.1.4a, but designers are free to use connectors according to their utility in their specific application. All trunk connectors should use standardized pin-out convention listed in Table 2.1.4a except for established circular connectors. If the standard pin-out convention is not used then the equipment or connectors must be labeled with the pin-outs used. The chassis routing should only use sealed connectors and the interior may use sealed or unsealed connectors. Connections to the network trunk cable should be direct or short drop cables connecting to network devices and should use connectors appropriate to the device manufacturer's products. Table

2.1.4b shows recommended trunk connectors.

Table 2.1.4a - Connector standard pin-out convention

PIN #	DESCRIPTION	
1 or A	CAN-H	
2 or B	CAN-L	
3 or C	PS- (or SHIELD)	OPTIONAL
4 or D	PS+	OPTIONAL
5 or E	SHIELD	OPTIONAL
…	OTHER(s)	OPTIONAL
Unless labeled or documented otherwise.		

Table 2.1.4b Trunk connectors

RV-C Connector recommendations	Figure	CONNECTOR PINOUTS					
		CAN_H	CAN_L	PS-	PS+	Shield	N.C.
SEALED							
Automotive style 2 pin (Requires external network ground)	2.1.4a	1	2				
Automotive style 3 pin (Requires external network ground)	2.1.4b	A	B			C	
Automotive style 4 pin (Allows power over network)	2.1.4c	1	2	3	4		
Automotive/Marine/RV blade style (Allows power over network)	2.1.4d	1	2	3	4		
SEALED MARINE							
Circular Industrial/Marine style 5 pin	2.1.4e	4	5	3	2	1	

(Allows power over network)							
UNSEALED							
Pin & Socket 0.165” 4 pin (Allows power over network)	2.1.4f	1	2	3	4		

The end views are the mating sides of the connectors.

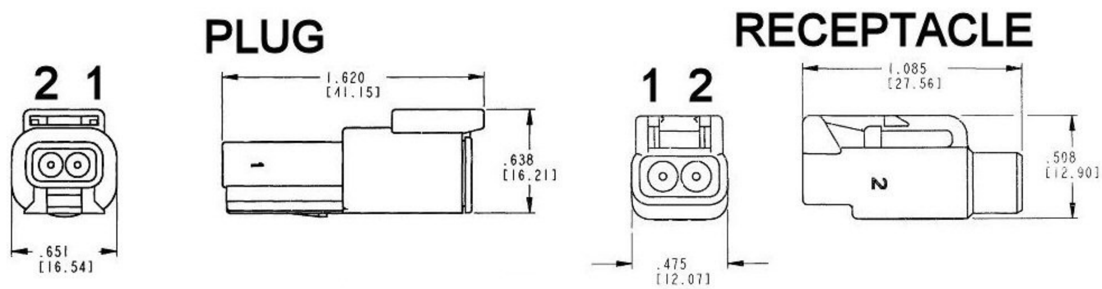


Figure 2.1.4a

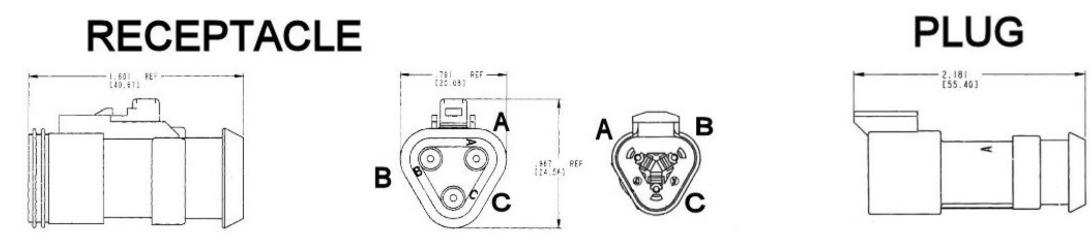


Figure 2.1.4b

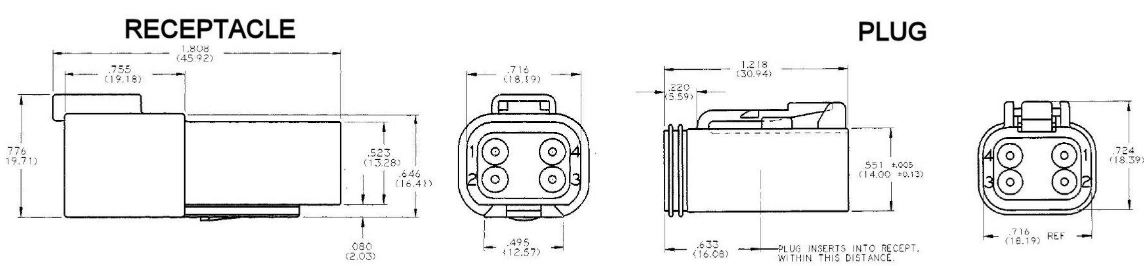


Figure 2.1.4c

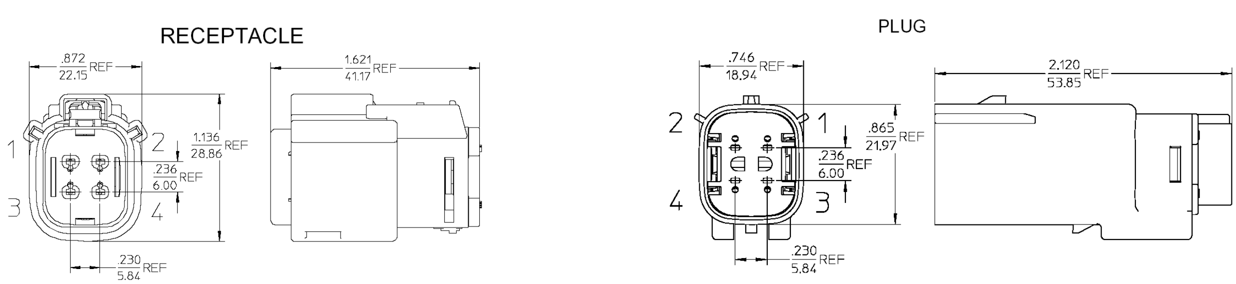


Figure 2.1.4d

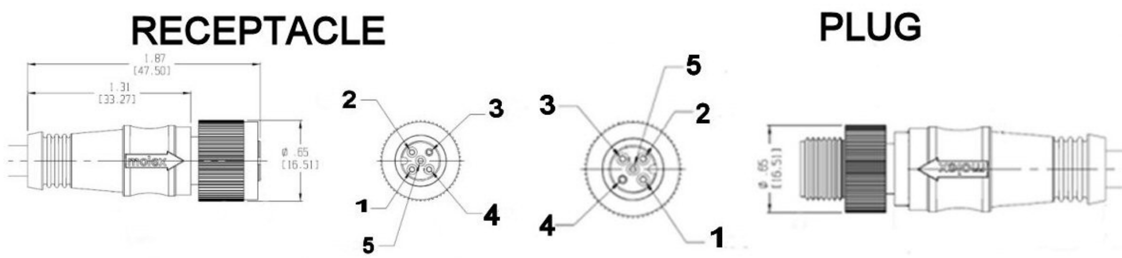


Figure 2.1.4e

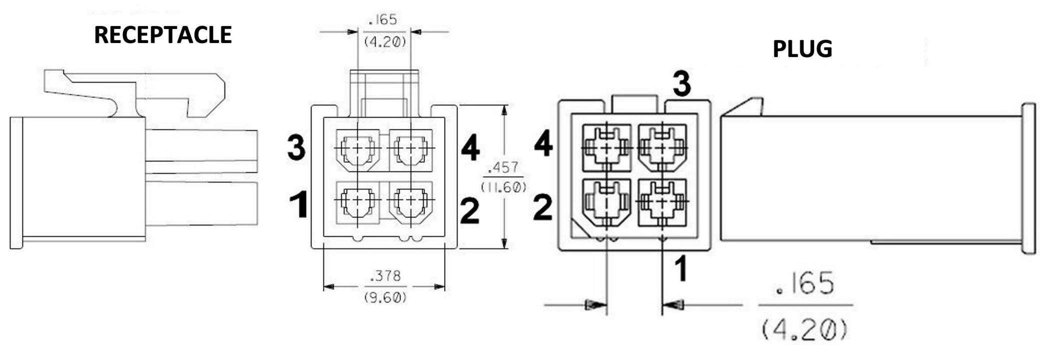


Figure 2.1.4f

2.1.5 *Environmental standards*

The definition of environmental features such as temperature, EMI, vibration, et cetera is not in the scope of this document.

2.2 Diagnostic Connector

A recreation vehicle equipped with a RV-C network shall be equipped with a standard connector specifically for the attachment of diagnostic tools. The connector shall be from the amp circular plastic connector (CPC) series, with 9 pins. A typical member designed for bulkhead mounting is Amp 206705-01 as shown in Figure 2.2. Any exact mechanic equivalent is acceptable.

Figure 2.2 — Diagnostic connector

Table 2.2 defines the pin assignments.

Table 2.2 — Pin assignment

Pin	Description
1	Power (12 VDC). This may be tapped by the diagnostic tool.
2	reserved
3	reserved
4	reserved
5	Ground

6	reserved
7	Shield (optional)
8	RV-C data (+) (CAN_H)
9	RV-C data (-) (CAN-L)

2.3 Network Power

Network power may be supplied over the network cable. Low power devices may be operated on network power within specified limits.

a) Devices must operate over the minimum voltage range of 9.0 to 16.0 Vdc that use the network cable power.

b) Device current not to exceed 200mA per node supplied from network cable power source.

c) Maximum current per conductor over network trunk cable according to wire gauge and network bus length shall not exceed in Table 2.3 and must comply with “ANSI/RVIA Standard for Low Voltage Systems in Conversion and Recreational Vehicles”.

d) Network devices operating on network power shall be electrically isolated and not connect PS- to RV ground.

e) Network devices and power supplies shall not degrade network performance and may not introduce noise, ripple or transients in excess of 250mVpp with a frequency of greater than 1 Hz and up to 15Vpp allowed with a frequency of less than 1 Hz.

f) Network power supplies shall limit the current per conductor size and length not to exceed the values in table 2.3.

g) Network power supplies shall have a nominal output voltage of 12.5 Vdc.

h) Network power supplies shall be able to be paralleled if current limited to fractions of the maximum network current capacity. Multiple power sources should be current mode outputs with a maximum voltage range of 12.5 +/- 3.5 Vdc. Paralleled power supplies total currents shall not exceed the current in table 2.3.

i) Network power supply source(s) must bond PS- to RV chassis ground at power supply with a least 18 AWG wire or equivalent.

Table 2.3 — Total current over network cable for length (10% voltage drop per 12V conductor)

Gauge / Current	0.25 amp	0.5 amp	1 amp	2 amps	3 amps	4 amps	5 amps
24 AWG	56 m	28 m	14 m	-	-	-	-
22 AWG	89 m	44 m	22m	-	-	-	-
20 AWG	141 m	70 m	35 m	18 m	12 m	-	-
18 AWG	225 m	112 m	56 m	28 m	19 m	14 m	11 m
16 AWG	358 m	179 m	89 m	45 m	30 m	22 m	18 m
“-“ Denotes not acceptable.							

3 Intermediate Layers

3.1 Data Frame Structure

Messages shall use only CAN data frames in extended frame format with a DLC (Data Length) of 8. CAN remote frames shall not be used. Figure 3.1 shows the structure of the CAN data frame in extended frame format.

Figure 3.1 CAN data frame structure

3.2 Network and Transport Layers

The network, transport, and application layer protocols shall use the base and extended ID field as well as the data field of the CAN data frame. The network, transport, and application layer message structure is defined in 3.2

Table 3.2: Structure of the network, transport, and application layer message

DLL fields		RV-C name (abbreviation)	Description
Name	Bit		
Base ID	28 to 26	Priority	111b – Lowest priority 000b – Highest priority
	25	Reserved	Always 0b
	24 to 18	Data Group Number - High	Identifies how the data packet should be parsed, possibly in combination with the DGN-Low
Extended ID	17 and 16		
	15 to 8	Data Group Number - Low	Either determines the target node for the message, or with the DGN-High determines how the data packet should be parsed.
	7 to 0	Source address (SA)	Shall be unique for each node
Data	64 to 0	Data	Defined in detail in the RV-C application profile specification

The priority bits and SA bits are essential for bus arbitration. When two RV-C nodes attempt to transmit simultaneously, the priority bits determine which message will get on the bus first. And as all RV-C nodes have a unique source address, the SA serves as the transmission tiebreaker-of-last-resort. In general, receiving nodes are to ignore these fields. These fields are not to be used for any other purpose, and in particular they are not to be parsed as meaningful data, except as specifically described in certain specialized applications.

The network, transport, and application layer protocol demands that all RV-C nodes respond to certain messages. All messages on the network shall conform to this specification.

3.2.1 Source addresses

3.2.1.1 Introduction

Every RV-C node shall have a unique source address to serve as a final tiebreaker during bus arbitration. The source address does not fully identify the RV-C node, and shall not be used by other RV-C nodes to interpret data from that node, except in matters of address claiming, proprietary messaging, and diagnostics.

Source addresses shall be assigned in one of two ways. RV-C node designers may choose to "hard wire" a standard address for the particular RV-C node type as defined in clause 3.2.1.2. Integrators shall take care to ensure that no two RV-C nodes using this technique are installed with the very same address.

A designer seeking greater flexibility may use the address claiming procedure, which dynamically assigns an SA when the RV-C node is powered up. The procedure is described in clause 3.3.

3.2.1.2 Predefined source addresses

A list of RV-C node types, the recommended static SA assignment and the starting SA for dynamic SA assignment (node claiming procedure) is given in Table 7.2

3.2.2 Data group number

The DGN identifies uniquely the parameter group. The data group is a set of signals that are transmitted in the same network, transport, and application layer message. The DGN shall be a 17-bit value that shall be built from the bits in the extended data from as indicated in Table 3.2.

NOTE All data will be explicitly assumed to have a single source, which is explicit in the assigned DGN. A common example of a datum that may have many sources is "DC system voltage". This reading may come from the battery charger, inverter, system monitor, and even from other components that have an analog-to-digital converter with a spare channel. But the protocol does not support the concept of a global "System voltage". Instead, each RV-C nodes may transmit the DC Voltage as part of one of the DGNs it transmits. There is no "DC system voltage" – only "DC Voltage @ Refrigerator", "DC voltage @ Inverter #1", and so on.

3.2.3 Data type definitions

The data field contains one or more signals or parameters. For each signal or parameter the type of data is assigned. Alphanumeric data shall be transmitted with the most significant byte first; other data consisting of 2 or more byte shall be transmitted least significant byte first.

Within the byte the bits are transmitted most significant bit first as shown in Table 3.2.3a.

Table 3.2.3a - Transfer syntax for bit sequences

Byte 0	Byte 1	Byte n (n = 2 to 7)
b7 to b0	b15 to b8	b8n-1 to b8n-8

The value ranges and value definitions for the data types are defined in Table 3.2.3b.

Table 3.2.3b – Standard data types

Description	Range	Size	Type	Value definition
Bit field	0 to 1	2 bit	uint2	11b – Data not available 10b – Error 01b – On 00b – Off
Character	1 to 253	1 byte	char	255 – Data not available 254 – Out of range 0 – Reserved
Integer, 16 bit unsigned	0 to 65532	2 byte	uint16	65535 – Data not available 65534 – Out of range

Description	Range	Size	Type	Value definition
				65533 – Reserved NOTE LSB first
Integer, 32 bit unsigned	0 to 4294967292	4 byte	uint32	4294967295 – Data not available 4294967294 – Out of range 4294967293 – Reserved NOTE LSB first
Integer, 8 bit unsigned	0 to 252	1 byte	uint8	255 – Data not available 254 – Out of range 253 – Reserved

3.2.4 Network, transport, and application layer message types

3.2.4.1 Instance

One of the fundamental issues RV-C had to address is the plethora of devices in an RV that have multiple installations. An RV may have seven or more awnings, four climate control zones, two or more inverters, and dozens of lights, keypads, and the like. This factor had to be addressed in a simple, direct manner. The means the committee devised is called "Instancing".

Devices in RV-C are defined as either single-instance or multiple-instance. There are very few of the former items - generator, GPS and chassis being examples. Data packets for these devices have no special provisions for identifying the source or target of the packet. But data packets involving multiple-instance devices always have as the first data byte the "Instance" for the source or target device. The Instance is a tag that identifies which specific physical device of a particular type within the RV is referenced in the DGN. For example, Awning Instance 1 refers to the main patio awning, whereas Awning Instance 2 refers to a different awning on the same RV.

Instances are always in reference to a device type, so instance numbers can be duplicated across devices. There may be an Awning Instance 1, a Thermostat Instance 1, and a DC Load Instance 1, all coexisting on the network. Every instanced DGN is specific to a particular device type, and are organized accordingly in the RV-C protocol document.

The Instance is completely distinct from the Source Address. The Source Address identifies the CAN node - that is, the microprocessor that is sending and receiving data. The Instance identifies the physical device - awning, inverter, tank, etc.. - being described or commanded in the message. The Instance is always a single data byte, usually with a value from 1 to 250. (Some devices have limitations on the range of values, and some devices have more complicated schemes.) In most cases the value is arbitrary, though for some devices RV-C assigns a specific meaning to certain numbers. In almost all cases, zero is not a valid Instance.

For example, for an Awning Instance 1 is defined as the Main Patio Awning. A large RV may have several smaller awnings assigned Instances 2 and higher. Any command to the patio awning would have a first data byte of 1, and any status information about that awning would also have the same first data byte. The same would be true for the other awnings, with the appropriate Instance put in the first data byte.

The Instances always refer to the physical device rather than the microprocessor that is processing the message. A single microprocessor often handles several device Instances. For example, a wall thermostat may handle several climate control zones. The microprocessor in that thermostat would send and parse messages for each climate control zone Instance independently. It is even possible (though rare) for one device Instance to be spread over multiple microprocessors. Each processor would have different Source Address, but use the same Instance.

RV-C does not specify how the Instance is assigned to a device. A general DGN is provided, but manufacturers may also use dip switches, jumpers, or even hard-coding to establish which physical device is assigned each Instance.

3.2.4.2 Information sharing

Most RV-C nodes have associated with them a set of data, which it broadcasts on the network. For example, a generator transmits data on it loading, fuel consumption, AC amperage and voltage, coolant temperature, and so on. To accomplish this, messages may be defined and DGNs assigned to these messages. All information sharing may be accomplished through these pre-formatted messages.

Information sharing messages are generally set at priority 6. Exceptionally, higher priorities may be used for time-sensitive data (such as data used in mechanical controls). Information sharing messages requiring more than 8 data bytes are distributed to several network, transport, and application layer messages. Even if the RV-C node does not support every item in the packet, the entire packet shall be sent. Certain values are used to indicate that a particular datum is not supported or is not available at the moment.

Each RV-C node may have several messages associated with it. It is also possible that two RV-C nodes may "share" a message – each may transmit different data items from the same group.

Many data packets may be set to broadcast "on change" rather than on a schedule – that is, whenever certain data items change in value. Some may adjust their broadcast frequency according to whether the RV-C node is "active".

The minimum broadcast gap for data packets is 50 ms unless otherwise specified in the DGN table for each device. For a command signal data packet, the minimum broadcast gap is "as needed" unless otherwise specified by the DGN table for that device.

3.2.4.3 Information request

Most information request messages are broadcast repeatedly at a set rate, but sometimes a RV-C node may need to request a datum be transmitted immediately. To accomplish this, a RV-C node broadcasts a "request for DGN" message. All RV-C nodes that support that DGN are required to respond to such requests.

The request for DGN message is defined in Table 3.2.4.3a.and 3.2.4.3b.

Table 3.2.4.3a - Request for DGN

Attribute	Value definition
DGN	EA00h
DGN-High	EAh
DGN-Low	Destination address or FFh (global)
Priority:	6
Broadcast gap	As needed

Table 3.2.4.3b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	
0 to 2	-	Desired DGN	uint17	-	0h - 1FFFFh. LSB in Byte 0.
3	-	Instance	uint8	-	0 - 253 - Instance desired, if multi-instanced. FFh if not multi-instanced, or reports from all instances is desired.
4	-	Instance Bank or Secondary Instance	uint8	-	0 - 253 - Instance Bank or Secondary Instance desired, if applicable. FFh - Reports from all matching units is desired.

Note that for single-instance devices, this is identical to corresponding SAE J1939 message, with the difference being that the SAE protocol uses a data packet with just 3 bytes. However, for multi-instanced devices, this is not true. All RV-C messages are 8 bytes in length (see section 3.1), including this message.

Instancing was added to this message in 2019. It remains acceptable for nodes to respond to this per the earlier practice, which had no reference to the Instance or Secondary Instance. That is, receiving nodes may ignore Byte 3 and Byte 4 and report their status regardless of their Instance.

3.2.4.4 Acknowledgment

Certain messages require an Acknowledgment from the node they target. An ACK or NAK message is required in the following circumstances:

1. A Request for DGN is directed to a specific address, and the node at that address does not support that DGN. If the Request is directed globally then no NAK is required. If the DGN is supported, then the node shall not send an acknowledgment, but instead shall send the requested DGN.

2. A command DGN is broadcast that the node supports and for which an acknowledgment is indicated in the DGN definition. If the definition calls for an ACK, the node shall respond, either in a positive or a negative way. If the result is negative, an appropriate code shall be provided in the response. If the definition calls for a NAK, the node shall only respond if the result is negative.

If the definition of a command DGN contains more than one possible command, and a node sends a command that the receiving node does not support, the receiving node shall not send an acknowledgment. It shall only send an acknowledgment if the specific command is supported by the receiving node. For example, AWNING_COMMAND includes both a manual movement command byte and an automatic movement command byte. If an awning receives a DGN directing an automatic movement, but the device does not support that feature, it shall not send an acknowledgment. If it does support the feature but is prevented from acting (say, due to movement of the RV) then it shall send the acknowledgment (NAK), with an appropriate code indicating the problem.

The ACK/NAK DGN shall be sent as a destination-specific DGN, with DGN-Low equal to the address of the node that sent the original command or request. It should be noted that many legacy devices and devices designed for certain other protocols might send this DGN as a global DGN, with DGN-Low equal to 255 (0xFF).

Table 3.2.4.4a and 3.2.4.4b defines the acknowledgment.

Table 3.2.4.4a: Acknowledgment

Attribute	Value definition
DGN	E800h
DGN-High	E8h
DGN-Low	Destination Address, or FFh
Priority	6
Broadcast gap	As needed.

Table 3.2.4.4b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	
0	-	Acknowledgment Code	uint8	-	see Table 7.5
1	-	Instance	uint8	-	Instance of the transmitter, if multi-instanced. 0xFF if not multi-instanced.
2	0 to 3	Instance Bank	uint4	-	Instance Bank of transmitter, if multi-banked.
2	4 to 7	Reserved	uint4	-	Reserved for compatibility with SAE J1939. Do not parse.
3		Reserved	uint8	-	Reserved for compatibility with SAE J1939. Do not parse.
4		Source Address	uint8	-	Source Address being Acknowledged
5 – 7	-	DGN Acknowledged	uint24	-	DGN being Acknowledged. LSB first.

The ACK/NAK DGN contains a data field containing the command DGN, and a field containing the response code (“ACK Code”). If the command is successfully implemented, the node shall place a 0 (zero) in the ACK Code field. (This is often referred to as an “ACK” message.) If the command cannot be implemented, the node shall indicate the nature of the failure by placing an appropriate code in this field. (This is often referred to as a “NAK” message.) The list of valid codes is provided in Table 7.5.

To provide greater detail, a ranges of codes is set aside that vary with the specific command DGN. These codes shall be set in the range 128-250, and documented with the DGN definition. Thus, the NAK code 250 may have a different meaning in response to a AWNING_COMMAND than to a GENERATOR_COMMAND.

Any non-zero code indicates that the command was not successfully completed.

3.2.4.5 Control message

Control messages are similar to information sharing messages, but are usually set at a higher priority. All control messages trigger a specific information sharing message in response, thus providing feedback to the controlling RV-C node. Often a control message will trigger a series of responses as the receiving RV-C node attempts to implement the command.

For example, a control panel may send a message to "command" the generator to start. The generator should immediately respond with a message indicating that the generator will attempt to start (or with a message indicating that the generator can't start). Once the generator has started, a second message should provide that feedback to the control panel.

In certain cases, controls may require acknowledgment in both directions. This is the case with many mechanical controls. Consider a leveling system and a control panel. In an "automatic" mode it is generally sufficient for the panel to send a control message to level the RV. The mechanism should send two messages in response – an immediate message confirming that it is now leveling and a second message when it is complete. But in a "manual" mode, the control panel should repeat the message periodically (and the mechanism should respond to each again), thus providing assurance that the system is correctly following the user input. When the user is done, the control panel should send an explicit "stop" message. The frequency of these messages depends somewhat on the physical characteristics of the system and the consequences of an error. If the mechanism does not receive any message within the expected time, it should respond in the safest manner possible.

These control and response behaviors shall be defined, approved and documented by the RVIA technical subcommittee as part of the RV-C standard.

3.2.5 Diagnostics message

3.2.5.1 Introduction

All devices compliant to this communication profile shall support the "DM_RV" message. This message allows the communication of diagnostic information and general operating status. If there are no active faults, data bytes 2 to 5 shall be set to FFh. The DM_RV is still broadcast, allowing other nodes to see its operating status.

The broadcast gap of the DM-RV varies with the diagnostic status and other parameters. If a device is in a fault condition, the DM-RV shall be sent at a rate between 100 ms and 1000 ms, with the faster rate reserved for faults that might cause damage to other systems or compromise the safety of the occupants of the RV. If a device is not in a fault condition, the DM-RV is sent only on request, or every 5000 ms if the device has not broadcast any status information. Thus every device shall send at least one message every 5000ms – either a status DGN or a DM-RV.

Regardless of the diagnostic status, the device shall send a DM-RV upon request. The DM-RV is also to be broadcast within 1000 ms of when a previously broadcast fault is cleared.

Table 3.2.5.1a defines the DG definition and Table 3.2.5.1b defines the signal and parameter definition for the active diagnostic message ("DM_RV").

Table 3.2.5.1a — DG definition

DG attribute	Value
Name	DM_RV
DGN	1FECAh
Default priority	6
Maximum broadcast gap	100 ms where necessary for safety or to prevent damage. 1000 ms for other fault conditions.
Normal broadcast gap	On Change of Status

Minimum broadcast gap	5000 ms if no other status information has been sent by this device.
Number of frames	1
ACK requirements	None

Table 3.2.5.1b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	
0	0 to 1	Operating status	uint2	-	see 3.2.5.2
	2 to 3	Operating status	uint2		see 3.2.5.2
	4 to 5	Yellow Lamp status	uint2		see 3.2.5.3
	6 to 7	Red Lamp status	uint2		see 3.2.5.3
1	-	DSA	uint8	-	see 3.2.5.4
2	-	SPN-MSB	uint8	-	see 3.2.5.5
3	-	SPN-ISB	uint8	-	see 3.2.5.5
4	5 to 7	SPN-LSB	uint3	-	see 3.2.5.5
	0 to 4	FMI	uint5	-	see 3.2.5.8
5	0 to 6	Occurrence count	uint7	-	7Fh if not available
	7	reserved	N/A	-	always 1
6	-	DSA extension	uint8	-	FFh — No DSA extension defined for product
7	0-3	Bank Select	uint4	-	0-13. For devices where bank selection is supported. Fh otherwise.

3.2.5.2 Operating status

The DM_RV provides a simple way for devices to indicate their general operating status. Generally there are two broad types of nodes

- those that are simply ON or OFF (defined in Table 3.2.5.2a), such as a lamp, and those that have a degree of automation (defined in Table 3.2.5.2b), such as a climate control device or a charger.

Table 3.2.5.2a — Operating status for simple devices

Bit 0 and 1	Bit 2 and 3	Description
00b (OFF)	00b (standby)	Device is disabled and not operating. Generally a fault condition or the result of a manual override.
00b (OFF)	01b (active)	Device is disabled, but is running. Generally a fault conditions or the result of a manual override.
01b (ON)	00b (standby)	Device is not operating, but will accept commands to operate. This is the'normal' OFF condition.
01b (ON)	01b (active)	Device is operating and will accept command. This is the'normal' ON condition.

Table 3.2.5.2b — Operating status for intelligent devices

Bit 0 and 1	Bit 2 and 3	Description
00b (OFF)	00b (standby)	Device is disabled and not operating.
00b (OFF)	01b (active)	Device is disabled, but is running. Generally a fault condition or the result of a manual override.
01b (ON)	00b (standby)	Device is enabled, but is waiting for some conditions to be fulfilled before it will start running.

		EXAMPLE: A thermostat-controlled device may be waiting for the temperature to reach a set point.
01b (ON)	01b (active)	Device is enabled and running.

3.2.5.3 Fault status

The DM_RV provides a simple way for RV-C nodes to indicate the general fault status for the node. Every DM_RV includes bits for encoding whether the node is in a "Yellow" and/or a "Red" fault state. If either type of fault is indicated, the RV-C node shall broadcast the SPN and FMI identifying the fault in addition.

The DM_RV is considered the "last choice" for indicating a problem condition. If there are provisions in the RV-C protocol for indicating a problem other than through the DM_RV, then that alternative method shall be preferred.

> **EXAMPLE** - An intelligent AC transfer switch uses the provisions in AC_STATUS_1 for indicating an Open Ground from a shore line, rather than send a DM_RV. In this case the transfer switch is working properly, and is not in a fault condition. The same might not apply to the output of a generator or inverter, since the open ground probably indicates a wiring problem within the RV.

The classification of faults into "Yellow" and "Red" is subjective. In general, "Yellow" faults usually refer to conditions that are manageable by the user or require little or no intervention. "Red" faults generally require a service technician or other substantial intervention. It is possible for both a Yellow and a Red condition to be active at the same time, if multiple faults are occurring simultaneously.

> **EXAMPLE** - A low battery level to an inverter signal is a 'Yellow' fault.

3.2.5.4 Default Source Address (DSA)

The DSA is used by a device attempting to interpret the specific failure. Each device type has its own list of SPNs. The interpretation of the SPN requires inspecting the DSA. Devices with more than one DSA assigned to them shall use the lowest DSA value available, regardless of the source address used by the device and whether multiple devices of the same type are installed on the network.

> **EXAMPLE** - The DM-RV for a Slide Room shall always use the DSA of 84."

To provide capacity for more devices than can be identified with the 8-bit DSA, the "Extended DSA" is defined. By default a device for which the Extended DSA is not defined shall use FFh (255) in the Extended DSA field. The Extended DSA is not used for Source Address assignment, and only serves to identify the device type in the diagnostic message.

> **NOTE** - The system integrator takes care that only one statically addressed device with the same DSA and the same DSA extension, or the same DSA and different DSA extension is installed in a network.

3.2.5.5 Service Point Number (SPN)

The SPN encodes the specific feature, component or sub-component that has failed in a device. There do exist common SPNs (see Table 7.3), which are common for all device types, and specific SPNs which are specific for a device type and depend on the DSA of the device type.

Depending on whether the device is a single-instance or multiple -instance device the SPN is encoded differently. Single-instance devices have a 19-bit SPN identifier. Multiple-instance devices have an 11-bit SPN identifier and an 8-bit instance identifier.

Table 3.2.5.5 — SPN format

Data byte	Single instance device	Multiple instance device
MSB (Byte 2:Bits 0 to 7)	Most significant byte of the SPN	Most significant byte of the SPN 00h – Fault applies to all sub-device instances 01h-FAh – Fault applies to specific instance.
ISB (Byte 3)	Intermediate byte of the SPN	Instance on the device
LSB (Byte 4:Bits 5 to 7)	Least significant bits of the SPN	Least significant bits of the SPN

EXAMPLE -
Byte 3 = 01h = 0000 0001b (SPN = 0000 0001 b)
Byte 4 = 03h = 0000 0011b
Byte 5 = C0h = 1100 0000b (SPN = 110b)

If Single instance device – SPN = 00 0001 0000 0011 110b = 081E= 2078h
If Multiple instance device - Instance = 3; SPN = 00 0001 110b = 000Eh = 15

3.2.5.6 Generic faults in multiple instance devices

SPN values of 00h to FFh are reserved for faults that are common to all RV-C devices. They refer to faults which are generic to all devices, e.g. faults in the communication itself or the microprocessor.

Multiple instance devices shall signal those faults without reference to the specific instance. The encoding of a single instance device shall apply for those faults on a multiple instance device.

3.2.5.7 Devices with multiple instances of sub-devices

Universal faults shall be signaled with the MSB set to 00h. Faults specific to the instance of a device shall have a MSB unequal to 00h, except generic faults (see 3.2.5.6).

NOTE - The number of universal faults for a multiple instance device is limited to 2048 SPNs.

EXAMPLE - A slide room controller has universal faults, e.g. the lack of a park brake signal, and instance specific faults, e.g. the slide room limit switch.

3.2.5.8 Failure mode identifier

The failure mode identifiers (FMI) are defined in Table 3.2.5.8. The FMI is universal to all devices, regardless of type.

Table 3.2.5.8 - Failure mode identifier

Value	Description
0	Datum value above normal range
1	Datum value below normal range
2	Datum value erratic or invalid
3	Short circuit to high voltage (or complete sensor input failure)
4	Short circuit to low voltage (or complete sensor input failure)
5	Open circuit, or output current below normal
6	Grounded circuit, or output current above normal
7	Mechanical device not responding
8	Datum value showing error of frequency, pulse width, or period
9	Datum not updating at proper rate
10	Datum value fluctuating at abnormal rate
11	Failure not identifiable
12	Bad intelligent RV-C node
13	Calibration required
14	"None of the above" (use sparingly!)
15	Datum valid but above normal operational range (least severe)
16	Datum valid but above normal operational range (moderately severe)

17	Datum valid but below normal operational range (least severe)
18	Datum valid but below normal operational range (moderately severe)
19	Received invalid network datum
20	Network Device Not Responding
21	Networked Device Not Responding (failure due to the unresponsiveness of a second networked device)
22	Reverse polarity
23 to 30	Reserved
31	Failure mode not available

3.2.5.9 Reporting multiple failures

A device is able to implement multiple functions, multiple instances of a single function, or a combination thereof. Such a device may have multiple errors at the very same time; a separate DM_RV for each function or for each instance shall be sent by the device.

A device with multiple instances of the same function may broadcast faults either by sending a separate DM_RV for each instance, or combining all faults in a multiple packet message.

> **NOTE 1** - A device combining all faults in a multiple packet message is unable to signal the status of each instance independently, because only one operating status byte is sent for the entire message. This is appropriate where the instances are integral sub-system of the device. This is not appropriate where the instances have their own operating status.
>
> **EXAMPLE** - The legs of a transfer switch are instances, which are integral sub-systems of a device. An AC load switching device has instances, where each instance has its own status.
>
> **NOTE 2** - A diagnostic device has to be careful in deciding when a fault is no longer active, because of the ambiguity inherent in the handling of multiple instance devices. A device that transmits a DM_RV with both faults (Yellow and Red) set to zero and a particular DSA surely indicates that there are no faults for that function within the device. But there may be another device with the same function. A second SPN -RV from the same device and function does not necessarily mean the first fault is no longer active. Any diagnostic device that needs to track the appearance and disappearance of faults have to take advantage of the 1000 ms update rate of the DM_RV. The device may have to use a timer to track the last appearance of the fault and the last appearance of a DM_RV from the source device.

3.2.5.10 Encoding multiple faults in a multiple packet message

Although similar protocols suggest using the multi-packet protocol when multiple faults are present, this practice has been deprecated in RV-C. Table 3.2.5.10 defines the former practice for the benefit of designers for whom compatibility with older products is necessary. New designs should not use this format.

When multiple faults are present in a product, a DM_RV shall be broadcast for each fault. This specifically allows the alarm level (red, yellow) to be communicated for each SPN/FMI combination, which is often essential for proper analysis. Each transmission shall be repeated every 5000ms while the fault is active.

A device with multiple faults from the same DSA may signal the faults using a multiple packet message. In this case the SPN, FMI and occurrence count shall be transmitted for each subsequent fault. The operating status and DSA shall be sent once and shall apply to all encoded faults.

The use of a multiple packet message is optional. It is defined in Table 3.2.5.10. All attributes not listed shall be identical to the active diagnostic message (see 3.2.5.1b).

(DEPRECATED) Table 3.2.5.10 — Signal and parameter definition (DEPRECATED)

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Operating Status	uint8	-	see 3.2.5.2

1	-	DSA	uint8	-	see 3.2.5.4
First fault					
2	-	SPN-MSB	uint8	-	see 3.2.5.5
3	-	SPN-ISB	uint8	-	see 3.2.5.5
4	5 to 7	SPN-LSB	uint3	-	see 3.2.5.5
	0 to 4	FMI	uint5	-	see 3.2.5.8
5	0 to 6	Occurrence count	uint7	-	7Fh if not available
	7	reserved	-	-	Always 1
6	-	DSA extension	uint8	-	FFh — No DSA extension defined for product
Second Fault					
7	-	SPN-MSB	uint8	-	see 3.2.5.5
8	-	SPN-ISB	uint8	-	see 3.2.5.5
9	5 to 7	SPN-LSB	uint3	-	see 3.2.5.5
	0 to 4	FMI	uint5	-	see 3.2.5.8
10	0 to 6	Occurrence count	uint7	-	7Fh if not available
	7	reserved	-	-	always 1
11	-	DSA extension	uint8	-	FFh — No DSA extension defined for product
Subsequent faults					
n	-	SPN-MSB	uint8	-	see 3.2.5.5
n+1	-	SPN-ISB	uint8	-	see 3.2.5.5
n+2	5 to 7	SPN-LSB	uint3	-	see 3.2.5.5
	0 to 4	FMI	uint5	-	see 3.2.5.8
n+3	0 to 6	Occurrence count	uint7	-	7Fh if not available
	7	reserved	-	-	always 1
n+4	-	DSA extension	uint8	-	FFh — No DSA extension defined for product

3.2.6 Proprietary messages

RV-C supports proprietary messages. The proprietary message is defined in Table 3.2.6.

Table 3.2.6: Proprietary message

Attribute	Value definition
DGN	EF00h
DGN-High	EFh
DGN-Low	Destination address, global messages (FFh) are not allowed
Priority	6, RV-C node may increase priority if appropriate.
Broadcast gap	As needed
Data 0 to 7	Manufacturer-specific

There are two main applications for this DGN: for advanced configuration (usually via a service tool), and for adding features to the protocol without publishing. Both should be handled with care. It is particularly important that the RV-C nodes involved properly identify each other and use the destination address properly to prevent other RV-C nodes from trying to parse their messages. (Consider that your message to calibrate a sensor may also be another manufacturer's message to run a slide room in).

> **NOTE 1** - There is a complete lack of controls on this DGN. There is nothing in the protocol to protect RV-C nodes from incompatible messages. Therefore this DGN should be used very sparingly and carefully.
>
> **NOTE 2** - A safe technique for using this method for advanced configuration is to begin any sequence with a "password" from the configuration tool. The RV-C node should ignore all proprietary messages until it receives the

desired password. The password should "expire" eventually, so the when the configuration process ends the RV-C node stops parsing. Although it is possible to use this message to implement functionality without publishing the method, this technique is to be used only when the desired function is not supported in the published protocol.

3.2.7 Multi packet message

Data groups longer than eight bytes shall be sent using the multi-packet message protocol, which allows messages up to 1785 bytes. Each 'long message' is identified with a particular DGN, but the DGN definition is no longer limited to 8 data bytes. The method uses an initial packet to set up the transfer, followed by up to 255 data packets.

This technique has several severe limitations. There are no provisions for flow control. The receiving nodes do not communicate their readiness to receive data. The transmitter has no assurance that the data is being processed. There is no method for a receiver to request a specific packet. If the entire DGN is not received correctly the receiving node shall request the entire DGN again. A node shall only transmit one long message at a time, since data packets are not specifically identified in any way other than the packet number. And long messages are relatively slow, because of the 50 ms gap between data packets. Therefore long messages shall not be used for control and instrumentation purposes.

Long messages are implicitly required for the PRODUCT_ID, and are optionally used for the DM_RV DGN when multiple faults are active. They are used rarely in the Application profile; generally for configuration purposes where substantial tables have to be downloaded or uploaded.

3.2.7.1 Initial packet message

Table 3.2.7.1a defines the DG definition and Table 3.2.7.1b defines the signal and parameter definition for the initial packet message.

Table 3.2.7.1a - DG definition

DG attribute	Value
Name	INITIAL_PACKET
DGN	ECFFh
Default priority	Per Encapsulated DGN
Maximum broadcast gap	N/A
Normal broadcast gap	Per Encapsulated DGN
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 3.2.7.1b - Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	-	reserved	uint8	-	always 20h
1,2	-	Message length	uint16	bytes	Value range = 0 to 1785
3	-	Packet count	uint8	packets	FFh — 255 packets Note: Unlike most data fields, a 0xFF in this position is to be parsed and interpreted as 255 packets.
5	-	DGN	uint8	-	DGN transmitted (LSB)
6	-	DGN	uint8	-	DGN transmitted (ISB)
7	-	DGN	uint8	-	DGN transmitted (MSB)

3.2.7.2 Subsequent packet message

Table 3.2.7.2a defines the DG definition and Table 3.2.7.2b defines the signal and parameter definition for the subsequent packet message. Each subsequent data packet shall be separated by at least 50 ms to reduce bus traffic.

Table 3.2.7.2a — DG definition

DG attribute	Value
Name	DATA_PACKET
DGN	0EBFFh
Default priority	6
Maximum broadcast gap	500 ms
Normal broadcast gap	N/A
Minimum broadcast gap	50 ms
Number of frames	1
ACK requirements	None

Table 3.2.7.2b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	
0	-	Packet number	uint8	-	1 to 255
1 to 7	-	Data	-	-	Encapsulated DGN data

3.2.8 Product identification message

The product identification message is a string of 8-bit single-byte coded graphic characters /ISO8859-1/ of arbitrary length. It is (usually) transmitted using the long-message protocol given above. (It is possible to use short IDs that are sent in one message).

> **NOTE** - Product identification is different than the ADDRESS_CLAIM described below. ADDRESS_CLAIM requires the identification information to be looked up in a table, which may not be available in the service tool or display node.

Table 3.2.8 defines the product identification message.

Table 3.2.8: Product identification message

Attribute	Value definition
DGN	65259 (FEEBh)
DGN-High	254
DGN-Low	235
Priority	6
Broadcast gap	On request
Data	8-bit single-byte coded graphic character text, with four field delimited by "*" Field 1: Make Field 2: Model Field 3: Serial number Field 4: Unit number (for products where the RV-C node is separate from the mechanical unit.)
NOTE All fields are optional, but the delimiting "*" is not. Examples:	

ACME*QX-125*A4323443* INTERMEGACORP*FLUXMASTER 2000** (The minimal response would be ***)

3.3 Address claiming procedure

3.3.1 Introduction

The RV-C node that has no assigned SA address may use the node claiming procedure to get an unique SA address.

3.3.2 Source Address claiming

The RV-C node requesting dynamically an SA begins with an address request message. Every RV-C node shall be able to respond to the address request message with an address claimed message. RV-C nodes that are "hard wired" to an SA shall respond to the address request in order to prevent a dynamically addressed RV-C node from taking its address. A dynamically addressed RV-C node will try addresses until it finds one unclaimed. Once it finds an unclaimed address, it sends the address claimed message.

Table 3.3.2a defines the address request message.

Table 3.3.2a - Address request message

Attribute	Value definition
DGN	EA00h
DGN-High	EAh
DGN-Low	Address desired
Priority:	6
Data length	8 bytes
Broadcast gap	As needed
Source address	254 (no address has been claimed)
Data 0	0
Data 1	238
Data 2	0
NOTE It will be seen that that this is just an ordinary request for DGN EE00h, but directed at a particular address.	

Table 3.3.2b defines the address claimed message.

Table 3.3.2b - Address claimed

Attribute	Value definition
DGN	EE00h
DGN-High	EEh
DGN-Low	00h
Piority	6
Broadcast gap	On request only
Source address	Assigned SA
Data 0 to 7	"ADDRESS_CLAIM" (8-byte identifier, see clause 3.3.3)

In order to reduce the possibility of mis-configured RV-C nodes (ending up with the very same SA), RV-C nodes used in the same network should try to claim different SAs. RV-C nodes should start with the address given for its RV-C node type in Table 7.2. The RV-C node shall not attempt to claim an address that might be used by a statically addressed RV-C node. If an address is already claimed, the RV-C node shall try the next address lower, and thus count downwards.

The ADDRESS_CLAIM field as described in Section 3.3.3 is used to determine the priority of RV-C nodes in address claiming. RV-C nodes with a higher priority ADDRESS_CLAIM field may "take" an address from a lower priority RV-C node. Statically addressed RV-C nodes may keep their address. Dynamically addressed RV-C nodes shall yield to static RV-C nodes, or to dynamic RV-C nodes with a higher priority ADDRESS_CLAIM field .

An RV-C node with dynamic addresses shall monitor network traffic and if they see another RV-C node using its address and it has a higher priority ADDRESS_CLAIM field it shall automatically run through the procedure and claim a new address.

3.3.3 ADDRESS_CLAIM field

The ADDRESS_CLAIM field is used as a method of uniquely identifying RV-C nodes during the address claiming procedure and for network troubleshooting. When two or more nodes attempt to claim the same source address, the ADDRESS_CLAIM field is used for arbitration. The ADDRESS_CLAIM field should be treated as an eight byte value with the “Arbitrary Address Capable” bit being the most significant bit. This ensures statically addressed nodes will always have the highest priority.

The ADDRESS_CLAIM field is defined in Table 3.3.3.

Table 3.3.3: ADDRESS_CLAIM field

Byte	Bit	Name	Description
0	0 to 7	Serial number (LSB)	Optional. Required if multiple nodes from the same manufacturer may be present on the network.
1	0 to 7	Serial number	
2	0 to 4	Serial number (MSB)	
	5 to 7	Manufacturer code (LSB)	Required. Code obtained from SAE or RVIA.
3	0 to 7	Manufacturer code	
4	0 to 2	Node instance	For devices implementing multiple RV-C nodes (normally 0)
	3 to 7	Function instance	Optional, intended to allow multiple instances of the same RV-C node, normally 0
5	0 to 7	Compatibility Field	Optional, normally 0
6	0	Reserved	Always 0
	1 to 7	Compatibility Field	Optional, normally 0
7	0 to 3	Compatibility Field	Optional, normally 0
	4 to 6	Compatibility Field	Always 0
	7	Arbitrary address capable	Required. 1 – Node supports address claiming 0 – Node uses a fixed source address

3.3.4 Manufacturer-Specific ADDRESS_CLAIM Request

The purpose of this DGN is to facilitate manufacturers in building a cross reference table of their own or other manufacturers' devices without using a global request for Address Claim. Only nodes whose Manufacturer Code matches the 11 bit value in bytes 0-1 should respond.

Table 3.3.4a defines the DG attributes. The signal and parameter attributes are found in Table 3.3.4b.

Table 3.3.4a – DG definition

DG attribute	Value
Name	MFG_SPECIFIC_CLAIM_REQUEST
DGN	1FED6h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	as needed
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	ADDRESS CLAIMED MESSAGE (0EE00h)

Table 3.3.4b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 2	Manufacturer Code	uint3	-	LSb Manufacturer Code in ADDRESS CLAIM field
1	-	Manufacturer Code	uint8	-	MSb Manufacturer Code in ADDRESS CLAIM field

4 Conformance requirements

4.1 Required messages

Every RV-C node compliant to this communication profile shall support the features indicated in Table 4.1.

Table 4.1 – Required DGs

ADDRESS_CLAIM	Node must transmit DG on request, and if dynamically addressed, must honor higher-priority ADDRESS_CLAIM values.	See 3.3
PRODUCT_ID	Must transmit on request.	See 3.2.8
DM_RV	Must transmit per specifications.	See 3.2.5
Multi packet messages	Required for transmission of PRODUCT_ID	See 3.2.7
DG_REQUEST	Must process requests per specification.	See 3.2.4.3

4.2 Prohibited Messages.

4.2.1 Undocumented Messages

The transmission of messages not documented here or in the official business of the committee (available on-line) is prohibited. Transmitting of these unregistered messages creates the potential for conflicts between devices from different manufacturers. The RV-C committee does not reserve DGs for unpublished purposes - all DGs and their contents are publicly defined through this publication and the RV-C web site. Note that node designers may use the Proprietary Message protocol (Section 3.2.6) to provide functionality for any device beyond what is listed, and the contents of Proprietary Messages do not have to be published in this protocol.

4.2.2 SAE J1939 Compatibility

The sole exception to the prohibition in section 4.2.1 is the the use of SAE J1939 protocol, as specific care has been made by the RV-C committee to preserve a measure of compatibility between RV-C and J1939. The SAE does not reciprocate these efforts and some differences have been created by the SAE since the publication of the first RV-C specification, such as in the DG_REQUEST message. It is incumbent upon the node designer to respond appropriately to any ambiguities between the two protocols if both are operating on the data bus.

4.3 Level One Compliance

4.3.1 Maintenance of Network Integrity

In all tests (at all levels) requiring the device to respond to a specific RV-C message, the Priority and Source Address of that message shall be arbitrary, unless specifically stated otherwise in the test description.

4.3.1.1 Profile 00S: Static Addressing

Reporting

ID	Datum	Test	Required Response
00S-S-01	ADDRESS_CLAIM	Unit powered up.	Sends ADDRESS_CLAIM. No other messages sent beforehand. Arbitrary

			Address Capable bit (Byte 7, Bit 7) equal to 0, indicating static addressing.
00S-S-02	Request for ADDRESS_CLAIM	A DG request for ADDRESS_CLAIM broadcast.	Sends ADDRESS_CLAIM, as above.

Command Response

ID	Datum	Test	Required Response	Required Behavior
00S-C01	ADDRESS_CLAIM	ADDRESS_CLAIM broadcast by a dynamically addressed product.	ADDRESS_CLAIM is broadcast.	No other messages are broadcast from the product between the reception of the competing claim and the response. Source Address does not change.

4.3.1.2 Profile 00D: Dynamic Addressing

Note that RV-C specifies that the Request for Address Claim is a request for DG EE00h, and the ADDRESS_CLAIMED DG is also EE00h. This is not the case for similar protocols such as NMEA 2000 and SAE J1939, which use EEFFh for the same purpose. It is not the intention of this profile to prevent devices from supporting both claiming procedures. The broadcast of incidental messages using the EEFFh identifiers are acceptable as long as the device correctly supports the EE00h messages as well.

Reporting

ID	Datum	Test	Required Response
00D-R01	Request for ADDRESS_CLAIM, ADDRESS_CLAIM	Unit powered up on an empty network.	1. Requests ADDRESS_CLAIM for the desired address using SA FEh. No other messages sent beforehand. 2. Broadcasts ADDRESS_CLAIM, Arbitrary Address Capable bit (Byte 7, Bit 7) equal to 1, indicating dynamic addressing. 3. No other message broadcast between steps 1 and 2.
00D-R- 02	Request for ADDRESS_CLAIM, ADDRESS_CLAIM	Unit is powered up on a network with a higher claim priority product at the desired address.	1. Requests ADDRESS_CLAIM for the desired address using SA FEh. No other messages sent beforehand. 2. After receiving the response, requests ADDRESS_CLAIM for the next lower address using SA FEh. 3. Broadcasts ADDRESS_CLAIM, Arbitrary Address Capable bit (Byte 7, Bit 7) equal to 1, indicating dynamic addressing, using the second address. 4. No other message broadcast between each step.
00D-R03	Request for ADDRESS_CLAIM	After claiming is complete, an address-specific request for ADDRESS_CLAIM is broadcast to the product.	
00D-R04	Uncontested claim.	Product is started on an empty network.	1. After sending Request for ADDRESS_CLAIM, a gap of at least 250ms

			is observed before the product broadcasts ADDRESS_CLAIM. 2. After sending ADDRESS_CLAIM, a gap of at least 250ms is observed before any further broadcasts.

Command response

ID	Datum	Test	Required Response	Required Behavior
00D-C01	ADDRESS_ CLAIM	On an otherwise empty network, after initial claiming is complete, an ADDRESS_CLAIM with a higher claim priority is broadcast.	1. Requests ADDRESS_CLAIM at the next lower address, with source address FEh. 2. Broadcasts ADDRESS_CLAIM at the new address.	No other message is broadcast during the process.
00D-C02	ADDRESS_ CLAIM	After claiming is complete on an empty network, a higher-priority product is allowed to claim the next lower address. ADDRESS_CLAIM with a higher claim priority is broadcast with the same address.	1. Requests ADDRESS_CLAIM for the next lower address using SA FEh. 2. After receiving the ADDRESS_CLAIM response, requests ADDRESS_CLAIM for the next lower address using SA FEh. 3. Broadcasts ADDRESS_CLAIM at the new address	No other message is broadcast during the process.
00D-C03	ADDRESS_ CLAIM	After claiming is complete on an empty network, a lower-priority product is allowed to claim the next lower address. ADDRESS_CLAIM with a higher claim priority is broadcast with the same address.	1. Requests ADDRESS_CLAIM for the next lower address using SA FEh. 2. After receiving the ADDRESS_CLAIM response, broadcasts ADDRESS_CLAIM at the new address.	No other message is broadcast during the process.

4.3.1.3 Profile 01A: Level One Compliance

Prerequisite: Profile 00S-Static Addressing, or 00D-Dynamic Addressing. The Level One profile is independent of all Level Three profiles. Certain tests within this profile require the vendor to provide the means of testing all RV-C functions. In all such cases, “all functions” means “all functions and feature supported by the product”, regardless of whether the function or feature is part of a Level Three profile for which the product is claiming compliance, or any Level Three profile whatsoever. Level One compliance does not require the support of any particular commands or status messages, save those specifically called out in the test descriptions. The Level One profile is not concerned with the accuracy or relevance of the contents of status and command messages. The contents of a data field are relevant to compliance only where specifically stated in the test.

All tests assume that the device being tested is operating independently of any other device, save as specifically called out in the test. A product is not considered compliant if it requires another specific device to be present on the network.

Reporting

ID	Datum	Test	Required Response
01A-S-01	Request for DGN (Global)	On an otherwise empty network, global Requests for DGN are broadcast for all status DGNs in the 18000h-1FFFFh range.	Unit shall respond the status messages for all supported DGNs. Unit shall not respond for other DGNs.
01A-S-02	Request for DGN (Address-specific)	On an otherwise empty network, Requests for DGN are broadcast for all status DGNs in the 18000h-1FFFFh range, directed at the SA of the product.	Unit shall respond the status messages for all supported DGNs. Unit shall respond with a NAK, value 1, for other DGNs.
01A-S-03	Request for DGN (Address-specific)	On an otherwise empty network, Requests for DGN are broadcast for all status DGNs in the 18000h-1FFFFh range, directed to random SA's, not including that of the product.	Unit shall respond the status messages for all supported DGNs. Unit shall not respond to any request.
01A-S-04	PRODUCT_ID	An Address-specific Request for PRODUCT_ID is broadcast.	A meaningful PRODUCT_ID is broadcast, including at minimum a Make and Model sufficient to identify the product well enough to access product documentation.
01A-S-05	DM_RV	The product is placed on an empty network.	1. A DM_RV is broadcast every five seconds, one for each type of device implemented in the node. Each DM_RV shall have a DSA corresponding to the function. All fields in Bytes 0-4 shall be correctly populated. 2. For all status DGNs supported in test above, a DM_RV with the corresponding DSA shall be present.
01A-S-06	DM_RV	For each device type supported: 1. A fault is created. 2. The fault is removed. The vendor shall provide the means of creating at least one fault for each device implemented in the product.	1. A DM_RV is transmitted within 250ms, with values appropriate to the fault. Subsequently, the product transmits the DM_RV every 1 second. 2. A DM_RV is transmitted within 250ms indicating the fault is no longer active. The broadcast gap returns to 5 seconds.
01A-S-07	DM_RV (MultiInstanced)	If the product supports multiple instances of any device type. 1. A fault is created for one device instance. 2. A fault is created for a second device instance. 3. The fault is removed for the first instance. 4. The fault is removed for the second instance.	1. A DM_RV is transmitted within 1 second, with values appropriate to the fault. Subsequently, the product transmits the DM_RV every 1 second. 2. A DM_RV is transmitted within 1 second, with values appropriate to the fault. Subsequently, the product transmits two DM_RV's every 1 second, one for each fault. 3. Every one second, one DM_RV for the second instance is transmitted. 4. A DM_RV is transmitted showing all faults of that device type have been cleared.

01A-S-08	Undocumented Messages	All RV-C functions are exercised, in both ordinary operations modes and diagnostic/configuration modes. The vendor shall provide the means of exercising all such operations.	1. The product shall not broadcast using any DGNs which are not part of the approved RV-C protocol. 2. The values of all fields in nonproprietary messages shall be as described in the protocol. If the datum is not supported, the field shall be filled with a “Data Not Available” value per Table 3.2.3b.
01A-S-09	Proprietary Messages	A set of randomly created proprietary messages are broadcast, all directed to source addresses other than the SA of the product.	The product shall not respond. The configuration and operation of the product shall not change.
01A-S-10	Message Gap	All RV-C functions are exercised in ordinary operations mode. The vendor shall provide the means of exercising all such operations. Note that the PRODUCT_ID is a diagnostic message, not considered part of ordinary operations.	The minimum gap between messages broadcast shall be 50ms, with the following exceptions: - When responding to requests or commands, the first required response (status or NAK) may be sent with an arbitrarily short gap. If the response requires multiple messages (e.g. the status of multiple instances), subsequent messages must be separated by at least 50ms. - A product with multiple functions or instances is allowed shorter gaps if necessary to comply with the reporting requirements of the status DGNs for its multiple devices. In no case may the gap be less than 5ms. - When a shorter gap is indicated in the DGN definition.
01A-S-11	Message Length	All RV-C functions are exercised, in both ordinary operations modes and diagnostic/configuration modes. The vendor shall provide the means of exercising all such operations.	The length of all messages shall be eight bytes.
01A-S-12	Byte Filling	All RV-C functions are exercised, in both ordinary operations modes and diagnostic/configuration modes. The vendor shall provide the means of exercising all such operations.	1. In all messages, all bits which are not defined by the RV-C protocol shall be filled with 1-values.
01A-S-13	CAN Header	All RV-C functions are exercised, in both ordinary operations modes and diagnostic/configuration modes. The vendor shall provide the means of exercising all such operations.	1. Bit 25 of the CAN Header is always 0. 2. The priority of each DGN is no higher than the value specified for the DGN. i.e. The numerical value of the Priority Bits are equal to or higher than the specified value.
01A-S-14	Instancing Applies only to Multi-Instanced Devices	1. All RV-C functions are exercised, in both ordinary operations modes and diagnostic/configuration modes. The vendor shall provide the means of exercising all such operations. 2. A fault is created for one device	1. The Instance field is always populated and Instance values are consistent throughout all operations. 2. The DM_RV reports the fault with the correct, consistent Instance.

		instance	
01A-S-15	Response Time	All RV-C functions are exercised in ordinary operations mode. The vendor shall provide the means of exercising all such operations.	Upon receiving a command or request, the product shall broadcast a response message within 250ms. The response may be a status message or a ACK/NAK, per the requirements of the command/request.
01A-S-16	NAK	A command which cannot be fulfilled is broadcast to the product. The vendor shall provide documentation of all such conditions and the means to test at least one. If there are no such conditions, the test is ignored.	Within 250ms, the product shall respond with a NAK with appropriate acknowledgment code.
01A-S-17	NAK-7	A command which cannot be fulfilled within 250ms is broadcast to the product. The vendor shall provide the means to test at least one such condition. If there are no such conditions, the test is ignored.	Within 250ms, the product shall respond with a NAK with acknowledgment code 7 (Requires more time). Upon completion of the task or upon task failure, the product shall respond with a ACK or appropriate NAK, plus the applicable status message.
01A-S-18	Accuracy of Gap Timing	In ordinary operation, the gap between broadcasts of each specific DGN is measured and compared to the gap specified.	The gap between two specific broadcasts must be within 20% of the gaps specified.
01A-S-19	9 Accuracy of Response Timing	In ordinary operation, the response time for specific operations is measured and compared to the times required in their test profiles.	Response times shall not exceed the values indicated in the test profiles, with an allowance for priority and measurement delays of 5ms.

4.4 Level Two Compliance

4.4.1 Discoverability, diagnostics, and serviceability

General Requirements

4.4.1.1 Use of Appropriate DGNs per Device Type

Products shall use the status and command DGNs designated for their device type(s). For example, an awning shall process AWNING_COMMAND and report AWNING_STATUS DGNs, rather than DC_MOTOR_CONTROL_COMMAND/STATUS or other messages. It shall use the Awning DSA rather than the DC Motor Control DSA.

Where a device type has not been defined for the product's purpose, it is acceptable to use a generic type such as DC Motor, Generic AC Source, and Generic DC Load. Note that the Generic AC Load and Generic DC Load are also used for load management, and it is acceptable for a product to use the associated DGNs (e.g. AC_LOAD_STATUS) for this purpose in addition to the DGNs designated for their type. It is noted that new device types may be added to the protocol at any time, and a reasonable amount of time must be allowed for vendors to update their product. Moreover, backwards compatibility of products is desirable, that is, new products may need to be able to inter-operate with older products that predate the change in protocol. Therefore there are two principle exceptions to the general rule.

1. Products shall have a two year “grace period” from the time of adoption of the new device type in the protocol to implement the new DSA and DGNs.

2. Products may respond to generic messages from complementary devices and broadcast using the corresponding DGNs, as long as the product also supports the new DSA and DGNs. It shall always use the new DSA.

To clarify, suppose hypothetically that a vendor introduced a Coffee Warmer, which it implements as a Generic AC Load. A few years later, a Coffee Warmer device type is added to the protocol, along with COFFEE_WARMER_STATUS and COFFER_WARMER_COMMAND DGNs. The vendor has two years to transition to the new DSA and DGNs. After that deadline, the product may continue to accept AC_LOAD_COMMAND's and respond with AC_LOAD_STATUS, thus allowing the product to be a direct service replacement for older RVs, but it must also support the new DGNs and DSA in parallel.

4.4.1.2 Inappropriate Limits on Interoperability

Devices shall not place limits on the use of standard commands in ordinary operation. When receiving any standard command, the device shall process the command with no regard to the source. Proprietary messages shall not used as a mechanism for limiting interoperability in ordinary operation. This does not apply to configuration, diagnostic, recovery, or test operations. This rule implies that all safety interlocks shall be implemented locally by the device, and not at the control panel or other commanding device.

4.4.1.3 Inappropriate Use of Proprietary Messages

Proprietary messages shall be used only in a service context and not in ordinary operation. The DEVICE_STATE_SYNCHRONIZATION message shall only be used when active synchronization is required. The contents of the message shall conform to documentation supplied by the vendor.

4.4.1.4 Documented Diagnostics

Devices shall use the DM-RV to report all diagnostic conditions. Diagnostic codes shall be as precise as reasonably possible, using documented SPNs. If any fault requires specific acknowledgment to “clear” (for example, a short circuit has been detected and the unit does not want to energize the circuit until the short has been fixed), the product shall support the Clear Faults flag in the GENERAL_RESET DGN for this purpose.

4.4.1.5 Documented Alarms

Alarm events shall be communicated using the GENERIC_ALARM DGN, using standard codes when available. Proprietary alarm instances shall be documented.

4.4.1.6 Meaningful NAKs

When a device receives a commands that it cannot immediately fulfill, it shall respond with a NAK which includes an appropriate code describing the failure. When the command is fulfilled, it shall transmit the appropriate STATUS message.

4.4.1.7 Transparency of Control Activity

Devices that have methods of control that are independent of RV-C shall report their status regardless of the control source. For example, an awning that has a set of switches connected directly to its circuitry shall report its motion and position via RV-C even when the motion is due to the use of the direct switches. Devices shall accept RV-C commands for the same operations without inappropriate limits, per section 4 - Conformance requirements.

4.4.2 Profile 02A: Level Two Compliance

Prerequisite: Profile 01A-Level One Compliance.

The Level Two profile is independent of all Level Three profiles. Certain tests within this profile require the vendor to provide the means of testing all RV-C functions. In all such cases, “all functions” means “all functions and feature supported by the product”, regardless of whether the function or feature is part of a Level Three profile for which the product is claiming compliance, or any Level Three profile whatsoever. Level Two compliance does not require the support of any particular commands or status messages, save those specifically called out in the test descriptions.

Level Two compliance requires that DGNs used and their contents shall conform in format to the RV-C protocol. This applies to all messages and their contents, whether or not a Level Three compliance test has been defined for the particular function. However, Level Two compliance only requires that the data is properly formatted - that is, the appropriate data types are encoded per table 3.2.3b and the DGN description - and that the “No Data” and “Error” values are used in conformance to table 3.2.3b.

Reporting

ID	Datum	Test	Required Response
02A-S-01	Appropriate DGNs	All RV-C functions are exercised in ordinary operations mode. The vendor shall provide the means of exercising all such operations.	All operations shall use the command and status DGNs designated for the purpose. Exceptions are granted per section 4.4.1.1.
02A-S-02	Appropriate DGN Contents	All RV-C functions are exercised in ordinary operations mode. The vendor shall provide the means of exercising all such operations.	The contents of all DGNs shall conform in format to the published RV-C protocol, as described above.
02A-S-03	Appropriate DSA	The unit is placed on an empty network and the DM_RV's are monitored.	All DM_RV's shall use a DSA appropriate to the product function. Exceptions are granted per section 4.4.1.4.
02A-S-04	Limits on Interoperability	All ordinary RV-C functions are exercised. Commands are sent from arbitrary addresses and control devices. The vendor shall provide the means of exercising all such operations.	The product responds to all applicable RV-C commands without regards to the source address or source device.
02A-S-05	Use of Proprietary DGNs	All RV-C functions are exercised in ordinary operations mode. The vendor shall provide the means of exercising all such operations.	No Proprietary DGNs are used, either as commands or status messages.
02A-S-06	Use of DEVICE_STATE_S YNCHRONIZATIO N DGN	All RV-C functions are exercised in ordinary operations mode. The vendor shall provide the means of exercising all such operations. The vendor shall also supply documentation for all applications of this DGN. Note: This documentation shall be retained as part of the product's compliance document.	1. The DGN is used only when the product is actively coordinating elements across the network. 2. The contents of all such messages matches the supplied documentation.
02A-S-07	DM-RV Status Fields	1. The product is exercised in ordinary operations. 2. A fault condition is triggered. The vendor shall provide the means for triggering at least one failure.	In both tests, all DM-RV messages shall include Operating Status, Red Lamp Status, and Yellow Lamp Status appropriate to circumstances.
02A-S-08	Documented Diagnostics	The vendor shall provide a complete table of diagnostic messages. This documentation shall be retained as part of the product's compliance document.	There is no specific requirement regarding the number of SPN/FMI combinations any product must support. The data is maintained to allow RV manufacturers to properly evaluate the diagnostic capabilities of products.
02A-S-09	Documented Alarms	The vendor shall provide a complete table of GENERIC_ALARM_STATUS	All non-proprietary alarm instances shall be as described in the protocol. All proprietary

		instances supported. Proprietary alarms shall include a brief description. This documentation shall be retained as part of the product's compliance documentation.	alarms instances shall be in the 80h-FDh range, and shall be as described in the document.
02A-S-10	Meaningful NAKs	The product is exercised in ordinary operations.	All NAK codes shall be as described in the protocol. No non-standard codes shall be used.
02A-S-11	Transparency of Control Activity - Reporting	If non-RV-C means of control are available, such as mechanical controls, non-multiplexed inputs, or a second multiplexing network, all such operations are exercised. The vendor shall provide the means of exercising all such functions.	The product shall broadcast status messages as though responding to the equivalent RV-C commands.
02A-S-12	Transparency of Control Activity - Operating	All control operations listed in test 02A-S-11 are also accessible through a corresponding RV-C command.	The product shall accept RV-C commands and operate in fashion equivalent to the non-RV-C method of control.
02A-S-13	Response to Commands	Each RV-C command supported by the product is broadcast in turn. Each data field, save the Instance, shall be filled with “No Data” values. The vendor shall provide a full list of such commands.	For each command, the unit shall respond with the status message(s) indicated in the protocol document, or an appropriate NAK.
02A-S-14	Clear Faults Command	If any fault requires manual “clearing”, 1 - Such a fault is triggered in the product. 2 - The cause of the fault is removed. 3 - The GENERAL_RESET is sent to the device, with the Clear Faults flag 01b (Clear).	1. The product sends a DM_RV appropriate to the fault condition. 2. No change. 3. The product sends a DM_RV with no faults reported. 3. The product sends a DM_RV with no faults reported.

4.4.3 Profile 02N: Non-Volatility

Compliance with this Level Two profile ensures the proper function of the device through power outages and network issues.

Reporting

ID	Datum	Test	Required Response
02N-S-001	Reboot	While in normal operation, power to the unit is interrupted long enough to force the device to reboot. The test shall be repeated in all of the device's normal operating modes.	Upon rebooting, device will resume exact state as before, or another state if working in conjunction with another node and the combined states has been modified during reboot time. The exception is that moving devices for which a timeout has been defined in a Level Three profile (e.g. slide rooms, awnings) shall stop all motion and not resume.

02N-S-002	Network Interruption	While in normal operation, RV-C communications to the unit is interrupted for at least five seconds and then restored. The test shall be repeated in all of the device's normal operating modes.	With network interruption, device will resume normal operation, but may enter a fall-back mode during interruption and upon network restore will resume normal operation, or another state if working in conjunction with another node. The exception is that moving devices for which a timeout has been defined in a Level Three profile (e.g. slide rooms, awnings) shall stop all motion and not resume.

4.4.4 Profile 00U: Bit Sampling Point

This test corresponds to the requirement laid out in Section 2.1.3. The limits on trunk and drop length given in section 2.1.2, assume that all products on the network meet this test. A product that does not meet this test would severely impact the maximum trunk and drop lengths possible on the network.

Reporting

ID	Datum	Test	Required Response
00U-01	CAN Bit Sampling Point	[A] Verify in CAN firmware the position of the bit sample point, measured from the leading edge of the signal, relative to the total bit time.	[A1] The data bit is sampled at a point between 85% and 90% of the full bit time.

4.5 General Requirements

The following is a list of general requirements. These are specified elsewhere in the protocol and are repeated here for clarity. This is not an exhaustive list of conformance requirements.

4.5.1 All messages have eight bytes of data

Even if a DGN only defines the meaning of seven or fewer bytes, all eight bytes are transmitted, with the undefined bytes filled with 0xFF values. The extra data bytes may be defined in future versions of the protocol, and this practice avoids ambiguity.

4.5.2 All unused bits are filled with 1 values

An examination of Table 3.2.3 shows that, regardless of the type and length of the data field being transmitted, a maximum value (i.e. all bits set to 1) explicitly means that the data item is unavailable and the value should not be parsed. Therefore, filling in unused fields with maximum values (e.g. FFh for a eight-bit field, 11b for a two-bit field) is always safe, and devices shall ignore those fields when parsing the message. In contrast, filling in unused fields with zeroes is rarely safe - zero values usually have specific meanings, and other devices will parse them accordingly.

4.5.3 Send DMRV's even when nothing is wrong

The DMRV has several purposes. It serves as a heartbeat to show that the device exists on the network. It gives a rough idea of the type of device, which is often critical for the correct operation of other devices. And it gives an indication of the device's operating status. Therefore, broadcasting the DMRV on schedule is critical. If no faults are active, fill in the SPN and FMI fields with 7FFFFh and 1Fh values, respectively.

4.5.4 Send DMRVs for every different function

It is not unusual for a node to have multiple functions - e.g. Generator and AutoGenStart, or Furnace and Thermostat. If so, send a DMRV for each device function. This is essential for diagnostics and in some case, product interoperability.

4.5.5 Encode values in Little-Endian format

Be aware whether your microprocessor and its toolchain process 16-bit and 32-bit values in "Big-Endian" or "Little-Endian" form. RV-C uses Little-Endian encoding exclusively, and if your environment is Big-Endian you may need some extra code to convert multi-byte values accordingly.

4.5.6 Maintain a gap between messages

It is often the case that a device has a significant number of messages transmitted on the same schedule or in response to the same DGN request - for example, a transfer switch has multiple legs to report upon every 500ms, each requires several messages. If all of these messages are sent in immediate order, with no gap between, other devices may see their CAN buffers overflow and messages get dropped. The general rule is that a device should maintain a 50ms gap between messages. It is acceptable to reduce this gap if the number of messages a device is required to send in a particular interval requires it, but the gap should not be reduced any further than necessary. It is also acceptable to temporarily reduce the gap in a service context, such as a firmware download or diagnostic test.

5 RV-C Device Definitions

5.1 Introduction

The RV-C application profile describes the communication behavior of several devices. The RV-C devices are described by attributes as shown in Table 5.1.

Table 5.1 - RV-C device definition

Device attribute	Value
Category	{<Name>}
Default Source Address	{<number>}
Dynamic Address Range	{<number> to <number>}
Instance	{single, multi-instance}

5.2 Data Groups

RV-C signals and parameters are transmitted in Data Groups (DG) that fit into a single CAN message. Each DG is assigned a unique Data Group Number (DGN), which in turn is divided into several parts, as described in Table 3.2.

The DG is defined by the DG attributes as shown in Table 5.2a. Signals and parameters mapped into a DG are defined by the signal and parameter attributes as shown in Table 5.2b.

Table 5.2a — DG definition

Attribute	Value
Name	{<NAME>}
DGN	{00000h to 1FFFFh}
Default priority	{<number>}
Maximum broadcast gap	{<number> ms}
Normal broadcast gap	{<number> ms}
Minimum broadcast gap	{<number> ms}
Number of frames	{<number>}
ACK requirements	{none, <condition>}

Table 5.2b - Data Parameter Definition

Byte	Bit	Name	Data type	Unit	Value definition
{0 to 7}	{0 to 7}	{<name>}	{<e.g. uint8, uint16, bit, char, etc.>}	{<e.g. m, Hz, V, etc.>}	{<detailed description>}

5.3 Standard Physical Units

Table 5.3 defines the basic data scales for different physical units.

Table 5.3 - Basic data scale definition

Unit	Data type	Min	Max	Precision	Special values

%	uint8	0	125	0.5%	-
Instance	uint8	0	250		0 = all
°C	uint8	-40	210	1 °C	-
	uint16	-273	1735	0.03125 °C	-
V (volt)	uint8	0	250	1 V	-
	uint16	0	3212.5	0.050 V	-
A (amperage)	uint8	0	250	1 A	-
	uint16	-1600	1612.5	0.05 A	0A = 0x7D00
	uint32	–2,000,000.000A	2,221,081.200A	0.001 A	0A = 0x77359400
Hz (hertz)	uint8	0	250	1 Hz	
W (watts)	uint16	0	65530	1 W	
Amp-Hours	uint16	0	65530	1 A•h	

Often a device may be called upon to report a value as a percent but the device may only be capable of a few discrete levels. For example, an Air Conditioner may report Fan Speed (a percent value), but have only two (Low and High) or three (Low, Medium, High) possible speeds. In such cases, the following method for reporting is recommended.

First, note that 0 always means Off (or the equivalent). Other values are divided as equally as possible among the possible states. Thus a two-stage fan would consider values from 1-100 (50%) as "Low" and 101-200 (100%) as "High". A three-stage fan would use 1-66 (33%) as "Low", 67-133 (66.5%) as "Medium", and 134-200 (100%) as "High". A five-stage fan would use intervals of 1-40, 41-80, 81-120, 121-160, and 161-200.
When reporting the status, the device should use the highest value in the applicable range. e.g. For a three-stage fan, 0, 66, 133, and 200. When parsing commands, it should accept any value in the range. e.g. If the three-stage fan receives a command to go to 100 (50%), it would consider this "Medium" and report a speed of 133.

This scheme assumes that the steps or levels are evenly distributed along the spectrum from Off to 100% On. If the steps are not reasonably uniform, a more precise representation of the values is recommended.

6 RV-C Devices

6.1 AC point

6.1.1 Introduction

The AC points may be implemented in several devices. All devices that report the generation or demand for AC power use the following formats to describe the AC power use at their input, output, or measurement point (see Table 6.1.1).

Table 6.1.1 — AC point definition

Device attribute	Value
Category	Common DG format
Default Source Address	N/A
Dynamic Address Range	N/A
Instance	Multi-instance

The DGs defined in the following clauses supply a common format to simplify the interpretation of AC information.

The instance field differs in interpretation according to the device type. The meaning of the instance field is defined within each device description.

Devices that support one AC_STATUS message are not required to support the others.

6.1.2 AC Point Status 1

Table 6.1.2a defines the DG attributes, and Table 6.1.2b defines the signal and parameter attributes.

Table 6.1.2a — DG definition

DG attribute	Value
Name	AC_STATUS_1
DGN	Defined in device specific definition
Default priority	Defined in device specific definition
Maximum broadcast gap	Defined in device specific definition
Normal broadcast gap	Defined in device specific definition
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	N/A

Table 6.1.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	The interpretation depends on the device.
1 to 2	-	RMS voltage	uint16	V	see Table 5.3
3 to 4	-	RMS current	uint16	A	see Table 5.3
5 to 6	-	Frequency	uint16	Hz	Precision = 1/128 Hz Value range = 0 to 500 Hz

7	0 to 1	Fault – open ground	uint2	-	00b — no fault 01b — open ground fault detected
	2 to 3	Fault – open neutral	uint2	-	00b — no fault 01b — open neutral fault detected
	4 to 5	Fault – reverse polarity	uint2	-	00b — no fault 01b — reverse polarity fault detected
	6 to 7	Fault – ground current	uint2	-	00b — no fault 01b — ground current fault detected

6.1.3 AC Point Status 2

Table 6.1.3a defines the DG attributes, and Table 6.1.3b defines the signal and parameter attributes.

Table 6.1.3a — DG definition

DG attribute	Value
Name	AC_STATUS_2
DGN	Defined in device specific definition
Default priority	Defined in device specific definition
Maximum broadcast gap	Defined in device specific definition
Normal broadcast gap	Defined in device specific definition
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	N/A

Table 6.1.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	The interpretation depends on the device.
1 to 2	-	Peak voltage	uint16	V	see Table 5.3
3 to 4	-	Peak current	uint16	A	see Table 5.3
5 to 6	-	Ground current	uint16	A	see Table 5.3
7	-	Capacity	uint8	A	see Table 5.3 This generally shall indicate the size of the breaker on the circuit. In demand applications it may indicate the peak current requirements for the device.

6.1.4 AC Point Status 3

Table 6.1.4a defines the DG attributes, and Table 6.1.4b defines the signal and parameter attributes.

Table 6.1.4a — DG definition

DG attribute	Value
Name	AC_STATUS_3
DGN	Defined in device specific definition
Default priority	Defined in device specific definition

Maximum broadcast gap	Defined in device specific definition
Normal broadcast gap	Defined in device specific definition
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	N/A

Table 6.1.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	The interpretation depends on the device.
1	0 to 1	Waveform	uint2	-	00b — sine wave 01b — not a true sine wave This shall apply to inverters with “modified” or “quasi” sine wave outputs.
	2 to 5	Phase status	uint4	-	0000b - No complementary leg 0001b - In phase (240 VAC not available) 0010b - 180 Degrees out of phase (240 VAC available) 0011b - Phase relationship is variable 1110b - Error 1111b - No data
2 to 3	-	Real power	uint16	W	Precision = 1 W Value range = 0 to 65530 W
4 to 5	-	Reactive power	uint16	VAr	Precision = 1 VAr Value range = -32000 to +33530 Var 0 = -32000 VAr, 32000 (7D00h) = 0 VAr Negative values are “lagging”, positive values are “leading”.
6	-	Harmonic distortion	uint8	%	see Table 5.3
7	-	Complementary Leg	uint8	-	Instance of complementary leg (see Phase status [bytes 0 & 1 of this Table])

6.1.5 AC Point Status 4

Table 6.1.5a defines the DG attributes, and Table 6.1.5b defines the signal and parameter attributes.

Table 6.1.5a — DG definition

DG attribute	Value
Name	AC_STATUS_4
DGN	Defined in device specific definition
Default priority	Defined in device specific definition
Maximum broadcast gap	Defined in device specific definition
Normal broadcast gap	Defined in device specific definition
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	N/A

Table 6.1.5b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	The interpretation depends on the device.
1	-	Voltage fault	uint8	-	0 - Voltage OK 1 - Extremely low voltage 2 - Low voltage 3 - High voltage 4 - Extremely high voltage 5 = Open Line 1 Detected 6 = Open Line 2 Detected
2	0 to 1	Fault – Surge protection	uint2	-	00b - No fault 01b - Surge fault detected (Service request for surge protector)
	2 to 3	Fault – High frequency	uint2	-	00b - No fault 01b - Frequency over high limit
	4 to 5	Fault – Low frequency	uint2	-	00b - No fault 01b - Frequency below low limit
	6 to 7	Bypass mode active	uint2	-	00b - Normal mode 01b - Bypass mode (Circuit protection is overridden)
3	0 to 3	Qualification Status	uint4	-	0 – Unqualified (No AC present) 1 – Unqualified (Bad AC) 2 – Waiting to Qualify 3 – Qualifying 4 – Qualified (Good AC)

6.1.6 AC Point Fault Control Status

This is one of two DGs that define the fault control for an AC Point. Table 6.1.6a defines the DG attributes, and Table 6.1.6b defines the signal and parameter attributes.

Table 6.1.6a — DG definition

DG attribute	Value
Name	AC_CONFIGURATION_STATUS_1
DGN	Defined in device specific definition
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	N/A

Table 6.1.6b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	-	Instance	uint8	-	The interpretation depends on the device.
1	-	Extreme low voltage level	uint8	V	see Table 5.3
2	-	Low voltage level	uint8	V	see Table 5.3

3	-	High voltage level	uint8	V	see Table 5.3
4	-	Extreme high voltage level	uint8	V	see Table 5.3
5	-	Qualification time	uint8	s	Time measured in seconds Precision = 1s Max = 0 to 250s
6	0 to 1	Bypass mode	uint2	-	00b — Normal Mode 01b — Bypass Mode Circuit Protection is off

6.1.7 AC Point Fault Control Status 2

This is one of two DGs that define the fault control for an AC Point. Table 6.1.7a defines the DG attributes, and Table 6.1.7b defines the signal and parameter attributes.

Table 6.1.7a — DG definition

DG attribute	Value
Name	AC_CONFIGURATION_STATUS_2
DGN	Defined in device specific definition
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	N/A

Table 6.1.7b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	-	Instance	uint8	-	The interpretation depends on the device.
1	-	High frequency limit	uint8	Hz	Precision = 1 Hz Value Range = 0 to 250 Hz
2	-	Low frequency limit	uint8	Hz	Precision = 1 Hz Value Range = 0 to 250 Hz

6.1.8 AC Point Fault Control Configuration Command

The format is identical to AC_CONFIG_STATUS_1 and AC_CONFIG_STATUS_2. Note that changing the configuration of one AC Point may affect other AC Points on the same device. The target device should respond with the AC_CONFIG_STATUS for every affected AC Point. Table 6.1.8 defines the DG attributes.

Table 6.1.8 — DG definition

DG attribute	Value
Name	ACFAULT_CONFIGURATION_COMMAND_1 ACFAULT_CONFIGURATION_COMMAND_2
DGN	Defined in device specific definition
Default priority	6

Maximum broadcast gap	N/A
Normal broadcast gap	N/A
Minimum broadcast gap	As needed
Number of frames	N/A
ACK requirements	ACK/NAK, AC_CONFIG_STATUS_1, AC_CONFIG_STATUS_2

6.1.9 Alarms

Alarms Table 6.1.9

Alarm Instance	Description
1	History Cleared
2	High solar voltage limit
100	Solar charge controller enabled
101	Solar charge controller disabled
102	Solar charge controller over temperature
103	Solar controller configuration changed
104	Solar controller configuration 2 changed
105	Solar controller configuration 3 changed
106	Solar controller configuration 4 changed
107	Solar controller configuration 5 changed
108	Solar controller equalization configuration changed
110	Transition to bulk stage
111	Transition to absorption stage
112	Transition to Overcharge stage
113	Transition to Equalize stage
114	Transition to float stage
115	Transition to CC/CV stage
116	Charging complete
119	Low battery warning
120	Low battery voltage limit
121	High battery voltage limit
122	Battery over temperature
123	Battery under temperature
124	Battery Disconnected

6.1.10 Test Profiles

The AC_POINT DGs apply to a number of different products, including transfer switches, gensets, inverters, and others. The test profiles apply to these products as well. In this document, the tests have been given the prefix 02, rather than a specific DSA. This is simply a placeholder, and in actual use the tests shall be numbered per the DSA of the device the test is being applied to.

6.1.10.1 Profile 02B-3A: AC Point (Base) Profile

Reporting

ID	Datum	Test	Required Response	Required Behavior
02B-S-01	AC_STATUS_1	Instance Voltage Current	The ATS shall broadcast this DGN at least once every 5000 ms.	N/A

6.1.10.2 Profile 02M-3A: AC Point (Phase Detection Support) Profile

The following profile requirements are in addition to the 02B-3A – AC Point (Base) Profile requirements. Note that the AC_STATUS_1 is included again. This is to indicate that the additional Frequency field is required in the status message.

Reporting

ID	Datum	Test	Required Response	Required Behavior
02M-S-01	AC_STATUS_1	Frequency	The ATS shall broadcast this DGN at least once every 5000 ms.	N/A
02M-S-02	AC_STATUS_3	Instance Phase Status Complementary Leg	The ATS shall broadcast this DGN at least once every 5000 ms.	N/A

6.1.10.3 Profile 02C-3A: AC Point (Fault Control Support) Profile

The following profile requirements are in addition to the 02B-3A – AC Point (Base) Profile requirements.

Reporting

ID	Datum	Test	Required Response	Required Behavior
02C-S-02	AC_STATUS_4	Instance Voltage Fault Fault – Surge Protection Fault – High Frequency Fault – Low Frequency Bypass Mode Active Qualification Status	The ATS shall broadcast this DGN at least once every 5000 ms.	N/A

Command Response

ID	Datum	Test	Required Response	Required Behavior
02C-C-01	ACFAULT_CONFIGURATION_COMMAND_1	Set AC_CONFIGURATION_STATUS_1 parameters: Arbitrary Parameters	Reports: AC_CONFIGURATION_STATUS_1 immediately with updated parameters from command.	N/A
02C-C-02	ACFAULT_CONFIGURATION_COMMAND_2	Set AC_CONFIGURATION_STATUS_2 parameters: Arbitrary Parameters	Reports: AC_CONFIGURATION_STATUS_2 immediately with updated parameters from command.	N/A
02C-C-03	AC_CONFIGURATION_STATUS_1	A request for AC_CONFIGURATION_STATUS_1	Reports: AC_CONFIGURATION_STATUS_1 immediately.	N/A
02C-C-04	AC_CONFIGUR	A request for	Reports:	N/A

	ATION_STATUS _2	AC_CONFIGURATION_ST ATUS_2	AC_CONFIGURATION_STATUS_2 immediately.	

6.2 General Purpose Data Groups

6.2.1 General Purpose Reset

A general purpose reset supplies a method of resetting a device on the network. Like the Proprietary DG, it is directed at a specific source address. Nodes are not required to support this DGN.

If Reset to Default Settings is indicated, the node should also respond with the appropriate configuration status DGNs. Table 6.2.1a defines the DG attributes, and Table 6.2.1b defines the signal and parameter attributes.

Table 6.2.1a — DG definition

DG attribute	Value
Name	GENERAL_RESET
DGN	17F00h DGN-Low - Destination Address
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	ACK Always

Table 6.2.1b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	0 to 1	Reboot	uint2	-	00b - No action 01b - Reboot
	2 to 3	Clear faults	uint2	-	00b - No action 01b - Clear faults
	4 to 5	Reset to default settings	uint2	-	00b - No action 01b - Restore settings to default values
	6 to 7	Reset Statistics	uint2	-	00b - No action 01b – Reset Communication Status Statistics (see 6.6)
1	0 to 1	Test Mode	uint2	-	00b – Quit testing node 01b – Initiate testing node
	2 to 3	Reset to OEM-Specific Settings	uint2	-	00b - No action 01b - Restore settings to default values
	4 to 5	Reboot/Enter Bootloader Mode	uint2	-	00b - No action 01b - Reboot or enter bootloader/programming mode.

6.2.2 Download

If a block of data must be transferred that is longer than 1785 bytes, or requires a more robust protocol than the multipacket message format provided for general use, the data can be sent using a block of DGNs reserved for the purpose. These transfers are always source and destination specific.

The specific data transfer format is not specified. Nodes may use proprietary protocols of any kind, according to their specific application. Typically the protocol will involve some sort of responses from the destination node. These responses shall also use this DGN series, with the destination being the origin of the data block.

Table 6.2.2 - DG Definition

DG Attribute	Value
Name	DOWNLOAD
DGN	0x17D00 DGN-Low = Destination Address. Must not be 255 (0xFF).
Default Priority	7
Maximum Broadcast gap	N/A
Normal Broadcast gap	N/A
Minimum Broadcast gap	50 ms
Number of Frames	1
ACK Requirements	None

6.2.3 Virtual Terminal

A virtual terminal host is a useful tool for troubleshooting. An RV-C node can serve as a text server which can be accessed by any text terminal that supports the same protocol. The specific node features do not have to be known to the terminal, making this a particularly effective technique to use with complicated nodes that may have a variety of configurations.

RV-C reserves a block of DGNs for the purpose of transporting text between an RV-C terminal and a server. Typically the terminal is a PC service tool being operated by a technician, while the server is an RV-C node. The protocol simply bridges ASCII text between the devices, with no provisions for flow control, acknowledgment, or data validation. It is not recommended for routine communication between nodes.

The DGN is always used in the destination-specific form. A global destination is not supported. This is true for both devices that are interacting.

Table 6.2.3a - DG Definition

DG Attribute	Value
Name	TERMINAL
DGN	0x17E00 DGN-Low = Destination Address. Must not be 255 (0xFF).
Default Priority	7
Maximum Broadcast gap	N/A
Normal Broadcast gap	N/A
Minimum Broadcast gap	50 ms
Number of Frames	1
ACK Requirements	None

Table 6.2.3b - Signal and parameter definition

Byte 0-7	ASCII Character	uint8	ASCII text. If a message contains fewer than eight characters, the unused data bytes should be filled with values of 255 (0xFF).

6.2.4 *Instance Assignment*

Many multi-instanced devices require a method of assigning a specific Instance or set of Instances for RV-C messaging. The INSTANCE_ASSIGNMENT and INSTANCE_STATUS DGNs provide a generalized method for configuring the instances used by a device.

Devices are not required to support instance assignment via RV-C. Some aspects of Instance Assignment is necessarily proprietary, and specific product knowledge is generally required to use these DGNs.

Both DGNs are destination-specific. The DGN-Low of the DGN indicates the source address of the target of the message.

Table 6.2.4a – DG Definition

DG Attribute	Value
Name	INSTANCE_ASSIGNMENT
DGN	0x17C00 DGN-Low = Destination Address. Must not be 255 (0xFF).
Default Priority	7
Maximum Broadcast gap	N/A
Normal Broadcast gap	N/A
Minimum Broadcast gap	50 ms
Number of Frames	1
ACK Requirements	NAK INSTANCE_STATUS

Table 6.2.4b – Signal and Parameter Definition

Byte	Name	Data Type	Definition
0	Device Type	uint8	DSA of the target device Instance.
1	Base Instance	uint8	0xFF = Send INSTANCE_STATUS for all Instances of the indicated device type.
2	Max Instance	uint8	0xFF = Update single instance only.
3 to 4	Base Internal Address	uint16	0xFFFF = Do not change assignment but send INSTANCE_STATUS for indicated Instances.
5 to 6	Max Internal Address	uint16	
7	Reserved	uint8	

A multi-function device may support multiple DSA values. For example, a climate control device may include a thermostat, air conditioners, and furnace instances that might be assigned independently. This would require multiple uses of this DGN, with different DSA values for each device type.

If a device supports multiple instances of a particular type, it may be configured in one of two ways. If a contiguous block of instances is desired, the Base and Max Instance fields define the block. Or, the instances can be assigned one at a time by setting the Max Instance field to 255 (0xFF), or equal to the Base Instance.

The most common use of this DGN is to assign Instances to a device. For example, to assign climate control zones to a thermostat. It can also be used to set the Instance values used in commands sent by a control panel, or Instances monitored by a display or control. The format does not change, even though conceptually the two cases are diametrically opposite. For example, a keypad might be configurable to control an Awning. This DGN can be used to set which Awning Instance the keypad shall control.

The Internal Address fields are defined by the node designer. If the device supports only a single instance of the indicated type these fields could be left blank (i.e. 0xFFFF) at the option of the node designer. If the device supports multiple instances of the indicated type, these fields identify how the RV-C Instance will be mapped to the internal resource. It cannot be assumed that the Internal Addresses follow any particular numbering scheme. The Internal Address could be from a numeric sequence, but they could be a memory address, resource identifier, or table index. Their interpretation is a proprietary feature of the device.

As an example, consider a keypad (with source address 0xA0) that is programmed to control four DC loads, an awning, and a generator. The designer has chosen to maintain the configuration information in a serial EEPROM, which is addressed by the bit. For programming convenience the designer has chosen to make the Internal Address value correspond to the actual bit addresses in the EEPROM. The first 32 bits are used for the door lock Instance values, the next 8 bits are used for the awning Instance values. Since the Generator is not an instanced device, no memory is required nor any configuration message.

Then the following messages would assign the DC Loads (DSA 0x92) to a block from 4 to 7, and the Awning (DSA 0x82) to Instance 3. (All data values are in hexadecimal.)

DGN: 17CA0 Data: 92 04 07 00 00 1F 00 FF (DC Loads 4-7 at addresses 0-31)

DGN: 17CA0 Data: 82 03 FF 20 00 FF FF FF (Awning 3 at address 32)

The node designer could have defined the Internal Address differently, and in the case of the Awning Instance eliminated the field altogether.

If a Base Instance and/or Max Instance is indicated, the INSTANCE_STATUS shall report the instance data for the indicated Instances. If no Base Instance is indicated, one or more INSTANCE_STATUS packets shall be broadcast indicating the status of all Instances of that type.

Table 6.2.4c – DG Attributes

DG Attribute	Value
Name	INSTANCE_STATUS
DGN	0x17B00 DGN-Low = Destination Address. Must not be 255 (0xFF).
Default Priority	7
Maximum Broadcast gap	N/A
Normal Broadcast gap	N/A
Minimum Broadcast gap	50 ms
Number of Frames	1
ACK Requirements	None

Table 6.2.4d – Signal and Parameter Definition

Byte	Name	Data Type	Definition
0	Device Type	uint8	DSA of the target device Instance.
1	Base Instance	uint8	
2	Max Instance	uint8	0xFF = Applies to single instance only.

3 to 4	Base Internal Address	uint16	
5 to 6	Max Internal Address	uint16	0xFFFF = Applies to single instance only.
7	Reserved	uint8	

This DGN is only sent in response to a INSTANCE_ASSIGNMENT DGN, and is always sent to a specific destination, the source of the INSTANCE_ASSIGMENT message.

6.2.5 Device Synchronization

This DGN allows timing-sensitive devices to synchronize their states across the network. Sample applications include coordinating the motion of individual leveling jacks, the pulse-width modulation of dimmers, the coordination of video signals, the synchronization of power system state changes, and the action of mechanical devices with multiple motors or actuators. It is allowable during operation for this message to be broadcast as rapidly as every 5ms. When the group of devices is not active, the DGN is not allowed.

Each manufacturer may define the payload and payload ID for their application. The payload specification is required to be included in the product documentation.

Table 6.2.5a describes the DG attributes and Table 6.2.5b defines the signal and parameter attributes.

Table 6.2.5a – DG Attributes

DG Attribute	Value
Name	DEVICE_STATE_SYNCHRONIZATION
DGN	1FDD1h
Default Priority	1
Maximum Broadcast gap	N/A
Normal Broadcast gap	As needed when device actively requires synchronization
Minimum Broadcast gap	5 ms
Number of Frames	1
ACK Requirements	None

Table 6.2.5b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0 to 1	-	Manufacturer Code	uint16	-	Unique manufacturer code, as defined in section 7.1. As Manufacturer Code is an 11 bit number, the most significant 5 bits of Byte 1 shall be zeros.
2	-	Payload Identifier	uint8	-	Defined by the manufacturer.
3 to 7	-	Payload	-	-	Defined by the manufacturer.

6.3 Generic Configuration Status

6.3.1 Introduction

This DGN provides a method of checking the configuration status of complex devices. It is intended to allow devices to compare their configuration with compatible devices on the network, and indicate that their configuration is invalid or out-of-date. A configuration master can request this DGN to determine the configuration status of all applicable devices, and if a device determines that its configuration file is not valid, it will transmit this DGN periodically to indicate that it needs to be configured.

6.3.2 Generic Configuration Status

Table 6.3.2a defines the DG attributes and Table 6.3.2b defines the signal and parameter attributes.

Table 6.3.2a – DG Definition

DG attribute	Value
Name	GENERIC_CONFIGURATION_STATUS
DGN	1FED8h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	Every 2000 ms when configuration required Or on request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.3.2b - Signal and parameter definition

Byte	Bit	Name	Description
0		Manufacturer Code (LSB)	Manufacturer Code. (Same as in field from ADDRESS CLAIM DGN)
1	0-2	Manufacturer Code (MS bits)	
	3-7	Function Instance	Function instance. (Same as in field from ADDRESS CLAIM DGN)
2		Function	Function code. (Same as in field from ADDRESS CLAIM DGN)
3		Firmware Revision	Manufacturer specific firmware revision number.
4		Configuration Type (LSB)	Manufacture specific configuration type. A configuration type of FFFFFF indicates an invalid configuration.
5		Configuration Type	
6		Configuration Type (MSB)	
7		Configuration Revision	Manufacturer specific configuration revision number. Configuration master can use this to determine if a node's configuration file is up to date.

6.4 Time and Date

6.4.1 Introduction

This DG provides for the reporting and setting of time and date information within the network. Since many nodes may have a clock and be capable of broadcasting time and date information, the following scheme has been devised to ensure that only one clock is broadcasting at a time. The highest priority clock shall be considered the system time "master" and broadcaster of the "official" system time. The node with the highest Source Address has the highest priority clock and other clocks should synchronize their actions according to that time. All devices that report or set time and date use the following formats.

Table 6.4.1 — Date and Time definition

Device attribute	Value
Category	Multi-source DG format
Default Source Address	N/A

Dynamic Address Range	N/A
Instance	N/A

6.4.2 System Date and Time Status

This DG establishes the date and time to be used by all nodes. Any unit capable of broadcasting this DGN may serve as the system time "master". Upon initialization to the network, the node should wait for 3 seconds before beginning broadcasting. If it acknowledges any other node broadcasting this DGN with a Source Address higher than its own, the node should stop broadcasting this DG. It should resume broadcasting if at any time three seconds passes without this message being seen.

When a node receives this message from another node with a higher Source Address, it should set its own clock to match. Table 6.4.2a defines the DG attributes, and Table 6.4.2b defines the signal and parameter attributes.

Table 6.4.2a — DG definition

DG attribute	Value
Name	DATE_TIME_STATUS
DGN	1FFFFh
Default priority	6
Maximum broadcast gap	1000 ms
Normal broadcast gap	1000 ms
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.4.2b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	-	Year	uint8	Year	Precision = 1 year Offset = 2000 AD Value range = 2000 to 2250
1	-	Month	uint8	Month	1 – January, 2 – February , . . . , 12 - December
2	-	Day of month	uint8	Day Number	Precision = 1 day Value range = 0 to 31
3	-	Day of week	uint8	Day Name	1 – Sunday, 2 – Monday, . . . , 7 - Saturday
4	-	Hour	uint8	h	Precision = 1 h Value range = 0 to 23 0 - 12:00 AM 12 – 12:00 Noon 23 – 11:00 PM This shall be in Local Time
5	-	Minute	uint8	min	Precision = 1 min Value range = 0 to 59
6	-	Second	uint8	s	Precision = 1s Value range = 0 to 59
7	-	Time zone	uint8	h	0 - Greenwich Mean Time

					4 - Eastern Daylight Time 5 - Eastern Standard Time 7 - Pacific Daylight Time 8 - Pacific Standard Time 0 - Western European Time 22 - Central European Summer Time

6.4.3 Set System Date and Time Command

This command forces all clocks to set to a specific date and time. It is typically used to indicate a user setting. It could also be used by a node that has access to a more accurate clock (e.g. a GPS). In the latter case, the node should send this only if it observes the “master” clock sending DATA_TIME_STATUS messages that have a variance of more than two seconds.

This message can also indicate a change in time zone if all fields are set to a value of 255 except Hour and Time Zone.

Table 6.4.3 defines the DG attributes. The signal and parameter attributes are identical to DATE_TIME_STATUS (see Table 6.4.2b).

Table 6.4.3 — DG definition

DG attribute	Value
Name	SET_DATE_TIME_COMMAND
DGN	1FFFEh
Default priority	5
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	ACK Always Nodes shall not respond with DATE_TIME_STATUS unless acting as the system time “master”.

6.4.4 GPS-Based Date and Time Status

This status provides the date and time from a GPS or similar globally synchronized time source. This is not meant to replace DATE_TIME_STATUS, as no mechanism for prioritization is provided. Devices sending DATE_TIME_STATUS generally should update their internal clocks to synchronize with the device sending this message.

Table 6.4.4 — DG definition

DG attribute	Value
Name	GPS_DATE_TIME_STATUS
DGN	1FEA0h
Default priority	5
Maximum broadcast gap	N/A
Normal broadcast gap	On Unit Initialization On Change of Time Zone
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

The format is identical to DATE_TIME_STATUS, given in table 6.4.2b.

6.5 DC Source

6.5.1 Introduction

DC Source is a virtual device typically consisting of a battery or bank of batteries and their associated DC Bus. It may also utilize another source of DC power, such as a fuel cell, another DC Source / bus, or a combination of sources such as multiple battery packs and related monitoring devices such as an SOC meter or BMS. These DGs are not specifically associated with any particular product and may be broadcast by any device that monitors the condition of the associative DC Source. This could be a battery monitoring node (BMS/SOC meter), a charger, or some other node with sufficient capabilities to appropriately report the status of a given DC Source.

DC Source messages provide for the ability to report the status as well as charging needs (in the case of batteries) and may be implemented in one of three levels of sophistication: Basic, Reporting, or Managed. See section 6.5.23 for additional details and requirements for each of these levels. Only the highest priority (which is presumably the most accurate) such device should be broadcasting the DGN at any given time. The following formats apply (see Table 6.5.1).

Table 6.5.1 — DC source definition

Device attribute	Value
Category	Multi-source DG format
Default Source Address	N/A
Dynamic Address Range	N/A
Instance	Multi-instance

DC Source uses the concept of node priority. Only the highest priority node (which is presumably the most accurate) should be broadcasting the DGNs at any given time. At any given time all DC Source DGNs must come from one device. When a DC monitoring device initiates on the network, it should wait 2 seconds before beginning transmission of these message types. If a higher priority device is transmitting these DGNs for the same DC-Source instance, the new device should not transmit. After a period of no transmission of these DGNs by any higher priority node is noted, the device may begin transmission.

While transmitting these DGNs, if another device of higher priority begins transmission, the lower priority device should stop transmission and at the same time consumers of these messages should ignore the lower priority messages. Even if a node does not support all DC Source DGNs, if it is the highest priority node it shall be the only node broadcasting - even if another node supports the missing DGN. This ensures that all the DC Source information currently being broadcast is coming from the same measuring source. And as a result, devices with limited instrumentation capabilities should refrain from assuming the role of transmitting or be assigned a low priority.

If two devices have the same published priority, the device with the higher CAN source address shall have priority.

It is possible for more than one DC_Instance to be physically connected to the same physical power bus. And example, one bank of batteries in the front of a vehicle, with an additional bank in the rear engine compartment – both being connected to the same DC “House” power bus. In such a case an aggregation function shall be utilized to provide a consolidated, or aggregated view with a unique DC Instance. In most cases other devices will interact with the DC SOURCE using this aggregated view, and a such will be associated with the same aggregated DC Instance. Each individual DC SOURCE may in addition optionally report its own status via a separate DC_SOURCE Instance number in which case the DC_ SOURCE_CONNECTION_STATUS DGN using the relevant DSA (Battery DSA in this example) would be used to indicate linkage between individual DC_SOURCES and the aggregated view.

A global request for these DGNs should trigger all measurement devices that support the DGN to transmit, regardless of whether they are the current “master”.

6.5.2 DC Source Status 1

DC Source Status 1 through 3 are intended to transmit the current status of a given DC Source. These may be used for display, monitoring, remote instrumentation, or any other purpose where the condition of a DC Source is needed.

Table 6.5.2a defines the DG attributes, and Table 6.5.2b defines the signal and parameter attributes.

Table 6.5.2a — DG attributes definition

DG attribute	Value
Name	DC_SOURCE_STATUS_1
DGN	1FFFDh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	500 ms
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.5.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	DC Instance	uint8	-	0 – Invalid 1 - Main House Battery Bank 2 - Chassis Start Battery 3 - Secondary House Battery Bank 4 - Generator Starter Battery 5...250 - Other instances in the RV. The use of Other instances is arbitrary, not determined by this document, though it is suggested in the case of Aggregation the components of an aggregated instance be made up to 10* the base DC Instance. Example: An Aggregated House DC Instance (#1) consist of DC Instance 10 and 11.
1	-	Device priority	uint8	-	120 - Battery SOC/BMS device 100 – Inverter/Charger 80 – Charger 60 – Inverter 40 – Voltmeter/Ammeter 20 – Voltmeter 0 – No priority, always reporting Designers should consider making this value configurable.
2 to 3	-	DC voltage	uint16	V	see Table 5.3
4 to 7	-	DC current	uint32	A	see Table 5.3

					A positive value indicates current flowing from the source - e.g. battery discharge or fuel cell output, while a negative value would be indicative of a battery being recharged.

6.5.3 DC Source Status 2

The Instance and Priority are the same format as DC_SOURCE_STATUS_1. Table 6.5.3a defines the DG attributes, and Table 6.5.3b defines the signal and parameter attributes.

Table 6.5.3a — DG definition

DG attribute	Value
Name	DC_SOURCE_STATUS_2
DGN	1FFFCh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	500 ms
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.5.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	DC Instance	uint8	-	see 6.5.2b
1	-	Device priority	uint8	-	see 6.5.2b
2 to 3	-	Source temperature	uint16	°C	see Table 5.3
4	-	State of charge (SOC)	uint8	%	see Table 5.3 For batteries, this shall indicate the approximate amount of energy remaining in the battery bank, relative to its as designed full capacity. For sources such as fuel cells, this shall indicate its current potential remaining capacity relative to its maximum potential capacity. Refer to DC_SOURCE_STATUS_11 (6.5.12) for additional explanation.
5 to 6	-	Time remaining	uint16	min	Depending on the value in the Time Remaining Interpretation, the expected amount of time before the state of charge reaches 0 or 100%. Generally applicable to batteries or DC sources that require fuel.
7	0 to 1	Time remaining Interpretation	uint2	-	00b = Time to Empty. 01b = Time to Full. If no value (11b) provided, the value in the Time Remaining field shall be interpreted as Time to Empty.

6.5.4 DC Source Status 3

The Instance and Priority are the same format as DC_SOURCE_STATUS_1. Table 6.5.4a defines the DG attributes, and Table 6.5.4b defines the signal and parameter attributes.

Table 6.5.4a — DG definition

DG attribute	Value
Name	DC_SOURCE_STATUS_3
DGN	1FFFBh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	500 ms
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.5.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	DC Instance	uint8	-	see 6.5.2
1	-	Device priority	uint8	-	see 6.5.2
2	-	State of health	uint8	%	see Table 5.3 The expected remaining lifetime of the source, relative to the total expected lifetime. Typically applied to batteries.
3 to 4	-	Capacity remaining	uint16	A•h	see Table 5.3 The remaining capacity of the source relative to its *present capacity* when fully charged (which may have been reduced due to age, etc) Typically applied to batteries. Refer to DC_SOURCE_STATUS_11 (6.5.12) for additional explanation.
5	-	Relative capacity	uint8	%	see Table 5.3 The capacity remaining, relative to present capacity when fully charged. Typically applied to batteries Refer to DC_SOURCE_STATUS_11 (6.5.12) for additional explanation.
6 to 7	-	AC RMS ripple	uint16	mV	Precision = 1 mV Value range = 0 to 65530 mV The total measured AC Ripple detected on the DC bus.

6.5.5 DC Source Status 4

Table 6.5.5a defines the DG attributes, and Table 6.5.5b defines the signal and parameter attributes.

DC Source 4 is primarily intended to allow for a single device to provide commands and to coordinate the changing needs of the associated DC Instance. This may optionally be used by charging sources that are able to receive commands from an associated DC source (battery BMS) as to what the charging goal should be. (For example, Chargers which are able to support

Profile 74D: Directed Chargers) In its simplest application, charging sources will work toward the Desired DC Voltage and Desired DC Current for the DC Source (e.g. battery) and disregard which 'state' the system is in.

This will be transmitted every 5000ms or as required (e.g. when the desired charge-mode state is changed).

Table 6.5.5a — DG definition

DG attribute	Value
Name	DC_SOURCE_STATUS_4
DGN	1FEC9h
Default priority	6
Maximum broadcast gap	5000ms
Normal broadcast gap	On Change
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

Table 6.5.5b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	DC Instance	uint8	-	see table 6.5.2b
1	-	Device priority	uint8	-	see table 6.5.2b
2	-	Desired charge state	uint8	-	Specifies the desired charging state of associated charging sources. 0 – Undefined, charging source decides (Default) 1 – Do not charge 2 – Bulk 3 – Absorption 4 – Overcharge 5 – Equalize 6 – Float 7 – Constant voltage / Current (Note that the same values are used when charging devices report their charge state status)
3 to 4	-	Desired DC voltage	uint16	V	see Table 5.3 The desired voltage the battery is targeting during charging.
5 to 6	-	Desired DC current	uinit16	A	see Table 5.3 The desired maximum acceptance current the battery is targeting from all charging sources during charging. Positive values indicate amount of current the DC Source is requesting.
7	0 to 3	Battery Type	uint4	-	0 – Flooded 1 – Gel 2 – AGM 3 – Lithium-Iron-Phosphate

					12-13 – Reserved for Vendor-defined proprietary types.

6.5.6 DC Source Status 5

Table 6.5.6a defines the DG attributes, and Table 6.5.6b defines the signal and parameter attributes.

This DG provides support for high-precision measurement of voltage. This may (optionally) be used to support Remote Instrumentation of a DC Source, precluding the need for dedicated sensing wires from a charging device.

Table 6.5.6a — DG definition

DG attribute	Value
Name	DC_SOURCE_STATUS_5
DGN	1FEC8h
Default priority	6 in normal operation 2 when over-voltage or fluctuating voltage conditions are active.
Maximum broadcast gap	N/A
Normal broadcast gap	500 ms in normal operation 100 ms when over-voltage or fluctuating voltage conditions are active.
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.5.6b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	DC Instance	uint8	-	see table 6.5.2b
1	-	Device priority	uint8	-	see table 6.5.2b
2 to 5	-	HP DC voltage	uint32	V	Precision = 0.001 V
6 to 7	-	DC Voltage Rate of Change (dV/dT, dt means change in temperature)	uint16	mV/s	Precision = 1 mV/s 0 = -32000 mV/s 32000 = 0 mV/s 65530 = 33530 mV/s (Max)

dV/dt allows communication of moderately short-term transient events which charging sources need to respond to. Examples would include the removal of a large DC load causing a sudden rise in voltage (load dump). If such events, or other events (over voltage, excess Amps, etc) pose a risk to the health of the battery, the priority of messages as well as the transmission rate, may be increased.

6.5.7 DC Source Status 6

Table 6.5.7a defines the DG attributes, and Table 6.5.7b defines the signal and parameter attributes.

Provides signaling and safety of battery bank by indicating upper and lower operational limit events, as well as conditions out of operational bounds. Typically provided by a BMS device which may also trip safety disconnects when safety limits are reached (Reference DC_SOURCE_STATUS_11 6.5.12).

This DG provides status and safety of battery-bank management by indicating upper and lower operational limits, as well as conditions out of operational bounds. Typically provided by a BMS device which may also activate safety disconnects when safety limits are reached. This DG is often used to support needed protection around LiFePO4 chemistry; typically, a BMS will alert the world when limits are being approached and action is required. If no action is taken, the BMS may take positive action to disconnect the battery-bank, protecting it from conditions which may cause damage and/or danger to the physical environment. In such a case, DC Source Status 6 must transmit the disconnect status at least 2 seconds before the actual disconnect event occurs – to allow for safe shutdown of charging sources and loads.

When an aggregated view is being represented by this DNG this message should reflect the fault status of ALL other sources and only indicate an error if in total all source are in the same condition.

Note that this DG provides additional details as to the reason for a disconnect of the Charge and/or Discharge bus which should also be reflected in DC_SOURCE_STATUS_11

Table 6.5.7a — DG definition

DG attribute	Value
Name	DC_SOURCE_STATUS_6
DGN	1FEC7
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	On Change
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

Table 6.5.7b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	DC Instance	uint8	-	see table 6.5.2b
1	-	Device priority	uint8	-	see table 6.5.2b
2	0 to 1	High Voltage Limit Status	uint2	-	00b - Not reached 01b - Limit reached Indicates whether DC Source (e.g. battery) has reached its upper operation voltage limit and charging sources should terminate.
	2 to 3	High Voltage Disconnect Status	uint2	-	00b - Connected 01b - Charge bus disconnected. Indicates whether the DC Source has been disconnected due to reaching its upper operation voltage limit.
	4 to 5	Low Voltage Limit Status	uint2	-	00b - Not reached 01b - Limit reached Indicates whether DC Source (e.g. battery) has reached its lower operation voltage limit and loads should terminate.
	6 to 7	Low Voltage Disconnect Status	uint2	-	00b - Connected 01b - Load bus disconnected Indicates whether the DC Source has been disconnected due to reaching its lower operation voltage limit.

3	0 to 1	Low state of charge limit status	uint2	-	00b - Not reached 01b - Limit reached Indicates whether DC Source (e.g. battery) has reached its lower state of charge limit and loads should be terminated.
	2 to 3	Low state of charge disconnect status	uint2	-	00b - Connected 01b – Load bus disconnected Indicates whether the DC Source (e.g. battery) has been disconnected from the load due to reaching the lower state of charge limit.
	4 to 5	Low DC source temperature limit status	uint2	-	00b - Not reached 01b - Limit reached Indicates whether DC Source (e.g. battery) has reached its lower temperature limit and charging sources or loads should terminate. Refer to the amperage value in DC_SOURCE_STATUS_1 to determine whether charging sources or loads should terminate.
	6 to 7	Low DC source temperature disconnect status	uint2	-	00b - Connected 01b - Charge or load bus disconnected Indicates whether the DC Source has been disconnected from the charge or load bus due to reaching its lower temperature limit. Refer to the charge on/off status and discharge on/off status in DC_SOURCE_STATUS_11 to determine whether load bus or charge bus has been disconnected.
4	0 to 1	High DC source temperature limit status	uint2	-	00b - Not reached 01b - Limit reached Indicates whether DC Source (e.g. battery) has reached its upper temperature limit and loads or charging sources should terminate. Refer to the amperage value in DC_SOURCE_STATUS_1 to determine whether charging sources or loads should terminate.
	2 to 3	High DC source temperature disconnect status	uint2	-	00b - Connected 01b - Charge or load bus disconnected Indicates whether the DC Source has been disconnected from the charge or load bus due to reaching its upper temperature limit. Refer to the charge and discharge on/off status in DC_SOURCE_STATUS_11 to determine whether load bus or charge bus has been disconnected.
	4 to 5	High Current DC Source Limit	uint2	-	00b - Not reached 01b - Limit reached Indicates whether DC Source (e.g. battery) has reached its upper current limit and loads or charging sources should be disconnected.

					Refer to the amperage value in DC_SOURCE_STATUS_1 to determine whether charging sources or loads should terminate.
	6 to 7	High Current DC Source Disconnect	uint2	-	00b - Connected 01b – Charge or load bus disconnected Indicates whether the DC Source has been disconnected from the charge or load bus due to reaching its upper current limit. Refer to the charge and discharge on/off status in DC_SOURCE_STATUS_11 to determine whether load bus or charge bus has been disconnected.

6.5.8 DC Source Status 7

DC Source Status 7 through 13 are often associated with a device capable of monitoring and tracking the SOC of a given DC Source. An SOC meter is one example, though many BMS devices may support these messages. Table 6.5.8a defines the DG attributes, and Table 6.5.8b defines the signal and parameter attributes.

Table 6.5.8a — DG definition

DG attribute	Value
Name	DC_SOURCE_STATUS_7
DGN	1FEAC
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	On Request
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

Table 6.5.8b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	DC Instance	uint8	-	see table 6.5.2b
1	-	Device priority	uint8	-	see table 6.5.2b
2 to 3	-	Today's Input Amp-Hours	uint16	A•h	see Table 5.3
4 to 5	-	Today's Output Amp-Hours	uint16	A•h	see Table 5.3

6.5.9 DC Source Status 8

Table 6.5.9a defines the DG attributes, and Table 6.5.9b defines the signal and parameter attributes.

Table 6.5.9a — DG definition

DG attribute	Value
Name	DC_SOURCE_STATUS_8
DGN	1FEAB

Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.5.9b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	DC Instance	uint8	-	see table 6.5.2b
1	-	Device priority	uint8	-	see table 6.5.2b
2 to 3	-	Yesterday's Input Amp-Hours	uint16	A•h	see Table 5.3
4 to 5	-	Yesterday's Output Amp-Hours	uint16	A•h	see Table 5.3

6.5.10 DC Source Status 9

Table 6.5.10a defines the DG attributes, and Table 6.5.10b defines the signal and parameter attributes.

Table 6.5.10a — DG definition

DG attribute	Value
Name	DC_SOURCE_STATUS_9
DGN	1FEAA
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.5.10b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	DC Instance	uint8	-	see table 6.5.2b
1	-	Device priority	uint8	-	see table 6.5.2b
2 to 3	-	Day Before Yesterday's Input Amp-Hours	uint16	A•h	see Table 5.3
4 to 5	-	Day Before Yesterday's Output Amp-Hours	uint16	A•h	see Table 5.3

6.5.11 DC Source Status 10

Table 6.5.11a defines the DG attributes, and Table 6.5.11b defines the signal and parameter attributes.

Table 6.5.11a — DG definition

DG attribute	Value
Name	DC_SOURCE_STATUS_10
DGN	1FEA9
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.5.11b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	DC Instance	uint8	-	see table 6.5.2b
1	-	Device priority	uint8	-	see table 6.5.2b
2 to 3	-	Last 7 days Input Amp-Hours	uint16	A•h	see Table 5.3
4 to 5	-	Last 7 days Output Amp-Hours	uint16	A•h	see Table 5.3

6.5.12 DC Source Status 11

DC Source Status 11 provides charge status. Often part of a BMS and an associated Lithium-based battery, this message conveys critical details as to the charge and/or discharge connection status of the battery. Unlike 6.42.2a and 6.42.2b DC_DISCONNECT_STATUS – which has broad application and may even include manual switching devices under operator control, this message is more centered to automatic connection and disconnection under the direct control of the DC Source and may reflect the outcome of DC Source Status 6 events.

Charging and load devices should monitor this message in addition to DC Source Status 6 if there is any need to be informed of connection status. For example, a load should not be applied if Power on/off indicates the load bus is in the Off state. As with DC Source Status 6, any changes in this connection status should be broadcast 2 seconds before the actual physical disconnect occurs to allow charging and/or load devices time to prepare.

The Instance and Priority are the same format as DC_SOURCE_STATUS_1. Table 6.5.12a defines the DG attributes, and Table 6.5.12b defines the signal and parameter attributes.

Table 6.5.12a — DG definition

DG attribute	Value
Name	DC_SOURCE_STATUS_11
DGN	1FEA5h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	1000 ms
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.5.12b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	-	DC Instance	uint8	-	see table 6.5.2b
1	-	Device Priority	uint8	-	see table 6.5.2b
2	0 to 1	Discharge On/Off Status	uint2	-	State of Battery Discharge Bus switch / contactor. 00b = Discharge Bus disconnected. 01b = Discharge Bus connected.
	2 to 3	Charge On/Off Status	uint2	-	State of Charge Bus switch / contactor. 00b = Charge Bus disconnected 01b = Charge Bus connected.
	4 to 5	Charge Detected	uint2	-	State of Charge source. Usually valid only when Power off. 00b = No charge detected. 01b = Charge detected.
	6 to 7	Reserve Status	uint2	-	Reserve level status. 00b = Battery charge is above the reserve level. 01b = Battery charge is at or below reserve level.
3 to 4	-	Full Capacity	uint16	Ah	Designed capacity of a fully charged battery when new (SOH = 100%). Precision = 1 Ah Value range = 0 to 65530 Ah
5 to 6	-	DC Power	uint16	W	Current DC Power input or output. Consult the amperage value in DC_SOURCE_STATUS_1 to determine whether this is input or output. Precision = 1 W Value range = 0 to 65530 W

For batteries, State of Charge, State of Health, Capacity Remaining, Relative Capacity, and Full Capacity are related as follows:

Relative Capacity = State of Charge * State of Health

Capacity Remaining = Relative Capacity * Full Capacity

If State of Health is not supported, Relative Capacity = State of Charge. In this case, State of Charge is the preferred means of communicating this value.

Note that "battery bank size" is defined for use by several other device types (e.g. charger) and typically the Full Capacity value is used for this as a example:

Example Battery Bank Size		
Full Capacity:	100 Ah	Specified capacity battery was designed to deliver
SOH:	90%	
Present Capacity:	90 Ah	Amount of capacity taking into account age and battery degradation
Capacity Remaining:	40 Ah	Example battery, with 40Ah of energy remaining until fully discharged

Relative Capacity:	45%	Charge relative to present capacity of battery (Accounting for SOH)
SOC:	40%	Charge relative to its designed capacity (No SOH adjustment)

DC Sources with a common charge/discharge switch/contactor should adjust the state of BOTH Discharge On/Off and Charger On/Off status bits in unison when change occurs.

6.5.13 DC Source Status 12

The Instance and Priority are the same format as DC_SOURCE_STATUS_1. Table 6.5.13a defines the DG attributes, and Table 6.5.13b defines the signal and parameter attributes.

Table 6.5.13a — DG definition

DG attribute	Value
Name	DC_SOURCE_STATUS_12
DGN	1FDF8h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.5.13b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	DC Instance	uint8	-	see table 6.5.2b
1	-	Device priority	uint8	-	see table 6.5.2b
2 to 3	-	Cycles	uint16	-	The number of charge cycles since the last time the history was cleared
4 to 5	-	Deepest discharge depth	uint16	-	The deepest discharge in Ah since the last time the history was cleared.
6 to 7	-	Average discharge depth	uint16	-	Average discharge depth since the last time the history was cleared.

6.5.14 DC Source Status 13

The Instance and Priority are the same format as DC_SOURCE_STATUS_1. Table 6.5.14a defines the DG attributes, and Table 6.5.14b defines the signal and parameter attributes.

Table 6.5.14a — DG definition

DG attribute	Value
Name	DC_SOURCE_STATUS_13
DGN	1FDE7h

Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.5.14b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	-	DC Instance	uint8	-	see table 6.5.2b
1	-	Device Priority	uint8	-	see table 6.5.2b
2 to 3	-	Lowest DC source voltage	uint16	-	see Table 5.3 The lowest voltage of the DC source since the last time the history was cleared.
4 to 5	-	Highest DC source voltage	uint16	-	see Table 5.3 The highest voltage of the DC source since the last time the history was cleared

6.5.15 DC Source Command

The DC Source command allows for an external device to issue directions to a DC Source. For example, a human user interface (HUI) device may send the DC Source Command to a DC Source BMS when the user has decided to "turn off" an associated battery bank.

The Instance and Priority are the same format as DC_SOURCE_STATUS_1. Table 6.5.15a defines the DG attributes, and Table 6.5.15b defines the signal and parameter attributes.

Table 6.5.15a — DG definition

DG attribute	Value
Name	DC_SOURCE_COMMAND
DGN	1FEA4h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	ACK Always

Table 6.5.15b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	-	DC Instance	uint8	-	see table 6.5.2b
1	0-1	Desired Power On/Off Status	uint2	-	00b = Disconnect Battery main power switch / contactor. 01b = Connect Battery main power switch / contactor. 11b = Do not change status
	2-3	Desired Charge On/Off Status	uint2	-	00b = Disconnect Charge Bus switch / contactor.

					01b = Connect Charge Bus switch / contactor. 11b = Do not change status

This command describes an intelligent battery management controller. The Battery and Charge bus switches as noted here are not generally the same as the Main Battery Disconnect typically installed in an RV (and often under human manual control). The main disconnect is supported under DC_DISCONNECT_STATUS and DC_DISCONNECT_COMMAND.

6.5.16 DC Source Configuration Status 1

DC Source Configuration Status 1 & 2 and their associated commands are primarily to be used to configure a SOC capability in the DC Source. Though some of the parameters may also be communicated out via other DC Source messages, this command should not be utilized outside the DC Source devices – e.g., charging devices should not use these messages to change their charge profiles.

Table 6.5.16a defines the DG attributes, and Table 6.5.16b defines the signal and parameter attributes.

Table 6.5.16a — DG definition

DG attribute	Value
Name	DC_SOURCE_CONFIGURATION_STATUS _1
DGN	1FDF7h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.5.16b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	DC Instance	uint8	-	see table 6.5.2b
1	-	Peukert exponent	uint8	-	The higher the Peukert exponent the faster the effective capacity 'shrinks' with increasing discharge rate. Precision = 0.01 Value range = 0 - 2.53.
2	-	Temperature coefficient	uint8	-	The percentage the battery capacity changes with temperature. The unit of this value is "%cap/°C" or percent capacity per degree Celsius. Precision = 0.1 %CAP/°C Value range = 0 to 20 %CAP/°C
3	-	Charge efficiency factor	uint8	%	See Table 5.3 The charge efficiency factor compensates for the Ah losses during charging. 100% means no loss.

4	-	Time remaining averaging period	uint8	-	Specifies the time window (in minutes) that the moving averaging filter works. A value of 0 disables the filter and gives a real-time readout. Precision = 1 minute Value range = 0 to 12 minutes
5 to 6	-	Full capacity	uint16	A-h	See Table 5.3 Nominal capacity of a fully charged battery.
7	-	Tail current	uint8	%	See Table 5.3 Once the charge current has dropped to less than the tail current (expressed as a percentage of the battery capacity), the battery is considered to be fully charged.

6.5.17 DC Source Configuration Command 1

Table 6.5.17a defines the DG attributes, and Table 6.5.17b defines the signal and parameter attributes.

Table 6.5.17a — DG definition

DG attribute	Value
Name	DC_SOURCE_CONFIGURATION_COMMAND _1
DGN	1FDF6h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, DC_SOURCE_CONFIGURATION_STATUS _1

6.5.18 DC Source Configuration Status 2

Table 6.5.18a defines the DG attributes, and Table 6.5.18b defines the signal and parameter attributes.

Table 6.5.18a — DG definition

DG attribute	Value
Name	DC_SOURCE_CONFIGURATION_STATUS _2
DGN	1FDF5h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.5.18b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	DC Instance	uint8	-	see table 6.5.2b
1	-	Reserved	uint8	-	Must be 0xFF
2 to 3	-	Charged Voltage	uint16	V	See Table 5.3 The battery voltage must be above this voltage level to consider the battery to be fully charged
4	-	Shunt Voltage	uint8	mV	Rated voltage of the shunt Precision = 1 mV Value range = 1 to 253 mV
5 to 6	-	Shunt Current	uint16	A	See Table 5.3 Rated current of the shunt

6.5.19 DC Source Configuration Command 2

Table 6.5.19a defines the DG attributes, and Table 6.5.19b defines the signal and parameter attributes.

Table 6.5.19a — DG definition

DG attribute	Value
Name	DC_SOURCE_CONFIGURATION_COMMAND_2
DGN	1FDF4h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	ACK Always if Clear History or Set Capacity included. NAK, DC_SOURCE_CONFIGURATION_STATUS _2

Table 6.5.19b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	DC Instance	uint8	-	see table 6.5.2b
1	0 to 1	Clear history	uint2	-	00b — No action 01b — Clear history
	2 to 3	Set capacity to 100%	uint2	-	When the battery or battery bank is known to be fully charged, this command is used to set the state of charge to 100%. 00b — No action 01b — Set capacity to 100%
2 to 3	-	Charged Voltage	uint16	V	See Table 5.3 The battery voltage must be above this voltage level to consider the battery to be fully charged
4	-	Shunt Voltage	uint8	mV	Rated voltage of the shunt Precision = 1 mV Value range = 1 to 253 mV
5 to 6	-	Shunt Current	uint16	A	See Table 5.3 Rated current of the shunt

6.5.20 DC Source Connection Status

DC Source Connection Status is used to report the connections of devices to their associated DC Instanced. Commonly used to allow notification of which DC Instance (DC Bus) a device is connected to, this DGN may also be used reporting bridged connection of one DC source to another DC source. An N-to-1 relation is also support, for example in the aggregation of multiple battery banks on one DC bus. Not all variants of a given device need support DC_SOURCE_CONNECTION_STATUS, example minimal Chargers do not require it, however more capable variants do. Refer to each individual device section for details on if, and at what level, DC_SOURCE_CONNECTION_STATUS is utilized.

Table 6.5.20a defines the DG attributes, and Table 6.5.20b defines the signal and parameter attributes.

Table 6.5.20a — DG definition

DG attribute	Value
Name	DC_SOURCE_CONNECTION_STATUS
DGN	1FDD0h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Change, On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	DC_SOURCE_CONNECTION_STATUS ,NAK

Table 6.5.20b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Device Instance	uint8	-	Instance of Device broadcasting this DGN (Instance is as defined by the Device DSA)
1	-	Device DSA	uint8	-	DSA of Device broadcasting this DGN See table 7.2
2	0-3	Function	uint4	-	The Function further defines to operation of the connecting device. 0 – Invalid 1 – Source Connection 2 – Load Connection 3 – Primary to Secondary Bridge (DC-DC Chargers, Disconnect switches ,Aggregation of Batteries, etc.) 4 – Main Battery Contactor (total disconnection of battery from DC bus – the associated DC Source Instance becomes unavailable / unusable in the case of the Main Battery Contactor opening) 5...14 Reserved 15 – Unspecified
	4-7	Reserved			Reserved
3	-	Primary DC instance	uint8	-	Instance of primary connected DC_Source
4	-	Secondary DC instance	uint8	-	Instance of secondary (or bridged to) connected DC_Source if used FFh – if not used

6.5.21 DC Source Configuration Command 3

This command is used to set fields of DC_SOURCE_CONNECTION_STATUS (6.5.20) as well as a devices DC_SOURCE priority.

Table 6.5.21a defines the DG attributes, and Table 6.5.21b defines the signal and parameter attributes.

Table 6.5.21a — DG definition

DG attribute	Value
Name	DC_SOURCE_CONFIGURATION_COMMAND_3
DGN	1FDDEh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	N/A
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, DC_SOURCE_CONFIGURATION_STATUS _1

Table 6.5.21b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Device Instance	uint8	-	Instance of the device that needs to respond to this command (Instance is as defined by the Device DSA)
1	-	Device DSA	uint8	-	DSA of the device that needs to respond to this command
2	0-3	Function	uint4	-	0 = Do not modify Assigned Function
	4-7	RESERVED	uint4	-	Set = Fh
3	-	Primary DC instance	uint8	-	0 = Do not modify Assigned Instance
4	-	Secondary DC instance	uint8	-	0 = Do not modify Assigned Instance 255 = Secondary DC Instance not used.

6.5.22 Alarms

Alarms

Alarm Instance	Description
1	History cleared
2	Reserved
3	Reserved
100	High Voltage Limit Warning
101	High Voltage Disconnect
102	Low Voltage Limit Warning
110	Low Voltage Disconnect
111	Low SOC Warning
112	Low SOC Disconnect

113	High SOC Warning
114	High SOC Disconnect
115	Low Temperature Warning
116	Low Temperature Disconnect
120	High Temperature Warning
121	High Temperature Disconnect
122	High Current Warning
123	High Current Disconnect

6.5.23 *Test Profiles*

DC SOURCE messages are a key element of DC Systems in RV-C, most commonly used by batteries and their associated SOC/BMS device, these messages may also originate from other devices (example, chargers or solar controllers) if those devices have the capability to properly instrument and mange the associated DC Source. Though the use of DC SOURCE, RV-C allows for well coordinated management of batteries and their associated charging sources to assure all are working towards the same goal, implement prioritization of charging resource to optimize operational costs, as well as provide for installation simplification through remote instrumentation.

The following profiles (Basic, Reporting, Managed) define three different levels of sophistication that DC Sources may offer, each delivering additional values to the rest of the RV-C installation and allowing for simple deployments to complex highly integrated DC systems.

Note that in all cases Instance and Priority *MUST* be included where noted in DC_SOURCE_xx messages. Also a general note, some DC Source devices feature internal disconnects for the charge and/or load bus. In the case where these are present and a DC Source will be opening those disconnects, the associated status message MUST be transmitted at least 2 seconds before the actually physical disconnect occurs. This is to allow for loads and charging sources time to properly prepare.

6.5.23.1 Profile 01B: Basic DC Source

In the simplest form a DC Source consists of a battery with an associated measurement device. This device may be contained in another device such as a Charger or Solar MPPT controller, or may be a device dedicated to the battery such as a BMS or SOC meter. A Basic DC source may or may not include internal disconnects. If disconnects are included, the associated RV-C Disconnect messages must also be supported.

Prerequisites: None

Reporting

ID	Datum	Test	Required Response	Required Behavior
01B-S-01	Status	Minimum reporting status	Reports DC_SOURCE_STATUS_1: Required fields: - Instance - Device Priority - DC Voltage - DC Current DC_SOURCE_STATUS_2: Required fields: - Instance	At a very minimum, a DC SOURCE must report out its voltage, current, and internal temperature. Instance and Priority are required field in any DC SOURCE message which contains them. In this minimum tests, monitor

			- Device Priority - Source Temperature	reported status and confirm it accurately reflects the status of the DC Source.
01B-S-02	Powered Status (Optional)	DC Source powered on/off status changes by external switch on the battery.	Reports: DC_SOURCE_STATUS 11 Required fields: - Instance - Device Priority - Power On/Off Status - Charger On/Off Status Power On/Off field immediately alters status of Power On/Off field. (If supported): DC_SOURCE_STATUS 4 change "Desired charge state" to "Do not charge"	This is testing the ability of the DC Source to be powered on and off and reports its condition. Upon power on, the DC Source device must begin transmission of all Required status messages, and upon powering off it must cease such transmissions with the exception of DC_SOURCE_STATUS 11, which may (optionally) be transmitted indicating the powered off status. When powered off, no external device should attempt to charge or draw energy from the DC Source. Some DC Sources may also have an internal disconnect which is opened when the device is powered off or in a faulted state. In such cases, the Power on/off message must be transmitted at least 2 seconds before the physical disconnect occurs. DC Source 11 is optional and not all DC Sources will support it, but if there is the ability for the DC Source to power on/off, and as a result connect or disconnect itself from the DC bus, this message must be supported.
01B-S-03	Disconnect Status (Required if DC Source has internal DC Bus disconnects)	DC Source Charger On/Off Status changes	Reports: DC_SOURCE_STATUS 11 Required fields: - Instance - Device Priority - Power On/Off Status - Charger On/Off Status	A companion to the Power On/Off field, this status reflects the desire to have charging sources enabled or not. Upon the DC Source deciding that charging should be

			Charger On/Off field immediately alters status of Charger On/Off field. (If supported): DC_SOURCE_STATUS 4 change "Desired charge state" to "Do not charge"	allowed, DC Source 11's state should change. At that point charging sources may begin to charge the DC Source, but it is not required (example, a solar panel at nighttime may not be able to provide charging energy). Some DC Source devices also have internal disconnects which are opened during times when charging is not allowed and/or the DC Source is in a faulted state. Charger On/Off field must be transmitted at least 2 seconds reflecting the Off state before the physical disconnect is opened. Note that Charger On/Off may or may not reflect the NEED for charging, only that it is allowed. The decision to actually charge a DC Source (ala, battery) may be communicated through this command, but at this BASIC level the decision to charge or not is more commonly left to the discretion of the attached chargers. Refer to the Managed profile section for more direct capabilities.
01B-S-04	Charge Detected Status	DC Source of powered on and charging is allowed. Apply a charging device delivering energy to the DC Source.	Reports: Charge Detected field of DC_SOURCE_STATUS_11 should change to reflect the present of an active charger.	This status field is often derived by noting the incoming flow of current into a battery, and as such may not always 100% reflect an active charger or not (example, if house loads are consuming all the output of a charger and no energy is available for the battery). As such, this field is named Charger Detected, as opposed to Charger Active. It reflects only that a given DC Source has detected a charging energy is being delivered.
01B-S-05	Limit Status (Required if DC Source has	DC Source upper voltage limit reached	Upon reaching Upper Voltage Limit, DC_SOURCE 6 *High Voltage Limit Status* field	Typically these events are only provided by batteries with BMS or other protection device. But

	internal DC Bus disconnect capabilities based off of reported limits)		should change from 00 or 01 (Limit reached) (If supported): DC_SOURCE_4 *Desired Charge State* should change to “Do Not Charge”.	if there is the ability for battery to disconnect from one of the events listed in DC_SOURCE_6, this is the required behavior.
01B-S-06	Limit Disconnect Status (Required if DC Source has internal DC Bus disconnect capabilities based off of reported limits)	DC Source upper voltage limit reached and Charge Bus disconnected	Upon deciding to disconnect Charge Bus: DC_SOURCE 6 *High Voltage Limit Status* field should change from 00 or 01 (Limit reached) DC_SOURCE 6 *High Voltage Disconnect Status* field should change from 00 or 01 (disconnected) DC_SOURCE _11 *Charger On/Off* field should change to Off. (disconnected) (If supported): DC_SOURCE_4 *Desired Charge State* should change to “Do Not Charge”.	This event occurs if the Upper Limit is reached and conditions do not change elevating the situation. At such a time the DC Source may initiate a protective disconnect. The Required Response messages must be transmitted at least 2 seconds before the actual disconnect occurs.
01B-S-07	Limit Status (Required if DC Source has internal DC Bus disconnect capabilities based off of reported limits)	DC Source lower voltage limit reached	Upon reaching Lower Voltage Limit, DC_SOURCE 6 *Low Voltage Limit Status* field should change from 00 or 01 (Limit reached)	In this even, the DC Source has become over loaded or over-discharged.
01B-S-08	Limit Disconnect Status (Required if DC Source has internal DC Bus disconnect capabilities based off of reported limits)	DC Source lower voltage limit reached and Load Bus disconnected	Upon deciding to disconnect Load Bus: DC_SOURCE 6 *Low Voltage Limit Status* field should change from 00 or 01 (Limit reached) DC_SOURCE 6 *Low Voltage Disconnect Status* field should change from 00 or 01 (disconnected) (If common charge/load bus) DC_SOURCE _11 *Charger*	This event occurs if the lower Limit is reached and conditions do not change elevating the situation. (example, over discharging). At such a time the DC Source may initiate a protective disconnect. The Required Response messages must be transmitted at least 2 seconds before the actual disconnect occurs. A notable detail is if the DC

			On/Off field should change to Off. (disconnected) (If common charge/load bus and if supported) DC_SOURCE_4 *Desired Charge State* should change to "Do Not Charge".	Source has one common bus and disconnect, or separate Load and Discharge busses. In the case of a common bus, any load-disconnect event must also take steps to report to charging devices to cease operation and related messages (Such as DC_SOURCE_STATUS_4 & 11) must also be updated.
01B-S-09	Limit Status (Required if DC Source has internal DC Bus disconnect capabilities based off of reported limits)	DC Source lower SOC limit reached	Upon reaching Lower SOC Limit, DC_SOURCE 6 *Low SOC Limit Status* field should change from 00 or 01 (Limit reached)	In this even, the DC Source has become over-discharged.
01B-S-010	Limit Disconnect Status (Required if DC Source has internal DC Bus disconnect capabilities based off of reported limits)	DC Source lower SOC limit reached and Load Bus disconnected	Upon deciding to disconnect Load Bus: DC_SOURCE 6 *Low SOC Limit Status* field should change from 00 or 01 (Limit reached) DC_SOURCE 6 *Low SOC Disconnect Status* field should change from 00 or 01 (disconnected) If common charge/load bus) DC_SOURCE _11 *Charger On/Off* field should change to Off. (disconnected) (If common charge/load bus and if supported) DC_SOURCE_4 *Desired Charge State* should change to "Do Not Charge".	As with the low voltage events, a low SOC event must consider if a common disconnect is implemented or separate charge/discharge buses
01B-S-11	Limit Status (Required if DC Source has internal DC Bus disconnect capabilities based off of reported limits)	DC Source lower Temperature limit reached	Upon reaching Lower Temperature Limit, DC_SOURCE 6 *Low Temperature Limit Status* field should change from 00 or 01 (Limit reached)	In this even, the DC Source has become over loaded or over-discharged.

01B-S-12	Limit Disconnect Status (Required if DC Source has internal DC Bus disconnect capabilities based off of reported limits)	DC Source lower Temperature limit reached and Load Bus disconnected	Upon deciding to disconnect Charge Bus: DC_SOURCE 6 *Low Temperature Limit Status* field should change from 00 or 01 (Limit reached) DC_SOURCE 6 *Low Temperature Disconnect Status* field should change from 00 or 01 (disconnected) DC_SOURCE _11 *Charger On/Off* field should change to Off. (disconnected) If supported) DC_SOURCE_4 *Desired Charge State* should change to Do Not Charge.	This event occurs if the DC Source is below its temperate limit and ability to accept a charge. At such a time the DC Source may initiate a protective disconnect. The Required Response messages must be transmitted at least 2 seconds before the actual disconnect occurs.
01B-S-13	Limit Status (Required if DC Source has internal DC Bus disconnect capabilities based off of reported limits)	DC Source upper Temperature limit reached	Upon reaching Upper Temperature Limit, DC_SOURCE 6 *Upper Temperature Limit Status* field should change from 00 or 01 (Limit reached)	In this even, the DC Source has become too warm or overcharged.
01B-S-14	Limit Disconnect Status (Required if DC Source has internal DC Bus disconnect capabilities based off of reported limits)	DC Source upper Temperature limit reached and Load Bus disconnected	Upon deciding to disconnect Charge Bus: DC_SOURCE 6 *Upper Temperature Limit Status* field should change from 00 or 01 (Limit reached) DC_SOURCE 6 *Upper Temperature Disconnect Status* field should change from 00 or 01 (disconnected) DC_SOURCE _11 *Charger On/Off* field should change to Off. (disconnected) (If supported) DC_SOURCE_4 *Desired Charge State* should change to “Do Not Charge”.	This event occurs if the DC Source is above its temperate limit and ability to accept a charge. At such a time the DC Source may initiate a protective disconnect. The Required Response messages must be transmitted at least 2 seconds before the actual disconnect occurs.

Command Response

ID	Datum	Test	Required Response	Required Behavior
01B-C-01	Conflicting DC SOURCE node	Node on CAN bus transmits *any* DC_SOURCE_STATUS message with same DC-Instance and a higher 'priority'	Stop all DC_SOURCE_STATUS transmissions	Only nodes with the highest priority should transmit DC SOURCE STATUS messages for a given DC-Instance. Even if a lower priority node is able to provide a wider range of messages.
01B-C-02	Power On	Send DC_SOURCE_COMMAN D "Desired Power On/Off Status" = On	DC_SOURCE_STATUS_11 changes "Power On/Off Status" to On	The use of DC_SOURCE_COMMAND Power On/Off allows and external device to turn on and off the DC Source. Shown here is the basic requirement for response, as a given DC Source may also have additional capabilities and when turned On will begin to transmit them (Example, Disconnects, Goal Voltages, etc)
01B-C-03	Power Off	Send DC_SOURCE_COMMAN D "Desired Power On/Off Status" = Off	DC_SOURCE_STATUS_11 changes "Power On/Off Status" to Off DC_SOURCE_STATUS_4 "Desired charge state" (If supported) changes to "Do not charge"	In addition, when turned Off, other supported DC_SOURCE messages *may* also stop – example: transmission of goal voltages, DC Voltages/currents via DC_SOURCE_STATUS_1,2
01B-C-04	Charger On	Send DC_SOURCE_COMMAN D "Desired Charger On/Off Status" = On	DC_SOURCE_STATUS_11 changes "Charger On/Off Status" to On	The use of DC_SOURCE_COMMAND Charger On/Off allows and external device to turn on and off *all* charging sources associated with the given DC Source. Shown here is the basic requirement for response, as a given DC Source may also have additional capabilities and when turned On will begin to transmit them (Example, Disconnects, Goal Voltages, etc)
01B-C-05	Power Off	Send DC_SOURCE_COMMAN D "Desired Power On/Off Status" = Off	DC_SOURCE_STATUS_11 changes "Power On/Off Status" to Off DC_SOURCE_STATUS_4 "Desired charge state" (If supported) changes to "Do not	In addition, when turned Off, other supported DC_SOURCE messages *may* also stop – example: transmission of goal voltages, DC Voltages/currents via DC_SOURCE_STATUS_1,2

			charge"	
01B-C-06	Request DC_SOURCE_CONNECTION_STATUS	Send ISO_REQUEST for DC_SOURCE_CONNECTION_STATUS	If supported, device responds with DC_SOURCE_CONNECTION_STATUS If not supported, NAK should be sent.	Refer to individual device definitions for details on support of DC_SOURCE_CONNECTION_STATUS. Some levels are optional, while some require support.
01B-C-07	Modify DC_SOURCE_CONNECTION_STATUS	Send DC_SOURCE_CONFIGURATION_COMMAND_3 with changes to fields: - Set Priority - Function - Primary DC Instance - Secondary DC Instance	If DC_SOURCE_CONNECTION_STATUS is supported: DC_SOURCE_CONNECTION_STATUS with modified details. If not supported, NAK should be sent.	Note that if device does not support "Seconday DC Instance", the reported field should be set = 0xFF even if the configuration command attempted to set it otherwise.
01B-C-08	Modify DC_SOURCE_CONNECTION_STATUS Instance	Send INSTANCE_ASSIGNMENT (6.2.4) with matching DSA and new Instance value.	If DC_SOURCE_CONNECTION_STATUS is supported: confirm device broadcasted DC_SOURCE_CONNECTION_STATUS with modified details If not supported, NAK should be sent.	

6.5.23.2 Profile 01R: Reporting DC Source

A Reporting DC Source has additional capabilities associated with it to give insight into its present condition. Ah's consumed, SOC, SOH, Time to depletion, capacity are examples of reporting information which may be supplied for a Reporting DC Source.

Prerequisites: 01B, Basic DC Source

Reporting

ID	Datum	Test	Required Response	Required Behavior
01R-R-01	Status	Connect DC Source to charging sources and loads and operate for a period of time.	DC_SOURCE_STATUS12 and DC_SOURCE_STATUS_13 shall transmit appropriate information.	SOC/ SOH reporting devices all have different capabilities. This test should precondition the system to allow observation of those supported parameters and if they are transmitted appropriately. The test may need to be ran for extended periods of time, depending on the capabilities of the device under test.

Command Response

ID	Datum	Test	Required Response	Required Behavior
01R-C-01	Command	Send DC_SOURCE_CONFIGURATION_COMMAND_1 with matching DC-instance, testing each field one at a time.	Unit shall respond with NAK indicating it does not support Reporting Commands, --or— Corresponding field in DC_SOURCE_CONFIGURATION_STATUS_1 shall update.	When processing a command, a device should respond with an overall NAK if it does not accept the configuration direction (e.g., is not a Reporting Level device) If the device does process configuration commands, supported field should be updated. It is NOT a requirement that all fields in the configuration command be supported, and if a command is received which is only partiality supported, unsupported fields may be ignored.
01R-C-02	Command	Send DC_SOURCE_CONFIGURATION_COMMAND_2 with matching DC-instance, testing each field one at a time.	Unit shall respond with NAK indicating it does not support Reporting Commands, --or— Corresponding field in DC_SOURCE_CONFIGURATION_STATUS_2 shall update.	
01R-C-03	Reset Counters	Send DC_SOURCE_CONFIGURATION_COMMAND_2 with matching DC-instance and “Clear history” set = On	All re-settable fields in DC_SOURCE_STATUS_12 and DC_SOURCE_STATUS_13 shall be reset to their initial state.	This is a way to test the ‘clearing’ of short term logged data.
01R-C-03	Force 100% SOC	Send DC_SOURCE_CONFIGURATION_COMMAND_2 with matching DC-instance and “Set capacity to 100%” set = On	DC_SOURCE_STATUS2 “State of charge (SOC)” shall change to 100%	

6.5.23.3 Profile 01M: Managed DC Source

A Managed DC Source has additional capabilities associated with it that not only provide reporting and status capabilities, but also offers partial, or full, management oversight of the DC Source – specifically the management of associated charging sources through the application of DC_SOURCE_STATUS 4. A noted example is Lithium batteries with their associated BMS. Managed DC Sources may also (optional) provide the Remote Monitor (RBM) capabilities to provide full direction to associated charging sources in a well coordinated fashion. Refer to the Chargers section “Profile 74D: Directed Charger” for additional details around RBMs and their usage.

In managing charging sources, a DC device may provide simple Yes/No direction, or it may provide detailed voltage/current goals. These are known as BASIC and FULL capabilities.

Prerequisites: 01B: Basic DC Source, optional 01R: Reporting DC Source

Reporting

ID	Datum	Test	Required Response	Required Behavior
01M-R-01	Charging Direction (BASIC)	Device determines Charging is required	Reports: DC_SOUCE_STATUS_4 shall be broadcast with Desired Charge State set equal to Undefined Desired DC Voltage and Desired DC Current should be set = 0xFFFF to indicate no direction outside of On/Off is being provided.	This is the minimum coordination of chargers, where the Desired Charge State simply indicated Yes or No. Note that with this simple Yes/No Associated charging sources should utilize their own internal configuration as goals for voltage and/or current.
01M-R-02	Charging Direction (FULL)	Device determines Charging is required and wishes to provide goals	Reports: DC_SOUCE_STATUS_4 shall be broadcast with Desired Charge State set equal to CV/CC (7) Desired DC Voltage and/or Desired DC Current should be populated with goals charges should work towards.	A slight advancement over the BASIC On/Off direction, in this case not only ON/OFF provides, but goals for voltage and/or current are provided. Associated charging sources should utilize these goals. 01M-R-01 and 01M-R-02 provide for the very minimum capabilities for a DC Source to direct charging.
01M-R-03	Charging Direction (FULL, WITH STATE)	Device determines Charging is required and wishes to provide goals and charging state	Reports: DC_SOUCE_STATUS_4 shall be broadcast with Desired Charge State set equal to Bulk..Float.	This is a slight variation of 01M-R-02, in that in addition to charge goals, the charging 'state' is also provided. A DC Source may chose to use this approach so that in the case of a failure of handoff, the rest of the system will have a better idea of the exact charging phase to continue from.
01M-R-04	Charging Direction	Device determines Charging is no longer required	Reports: DC_SOUCE_STATUS_4 shall be broadcast with Desired Charge State set equal to Do Not Charge.	Chargers shall discontinue providing charging energy to the DC Source. Not that this does NOT preclude charging sources from continuing to servicing other non DC Source loads

Command Response

ID	Datum	Test	Required Response	Behavior

01M-C-01	Command			

6.6 Communication Status

6.6.1 Introduction

Communication status provides a standard way for devices to transmit data network standing. They may be used for troubleshooting communication problems. These are not required to be supported by all nodes. The following formats apply (see Table 6.6.1).

Table 6.6.1 — Communication status definition

Device attribute	Value
Category	Multi-source DG format
Default Source Address	N/A
Dynamic Address Range	N/A
Instance	N/A

These DGNs are transmitted only on request, typically by a service tool. However, a node that does not transmit any other message on a regular basis (for example, a data logging device) may elect to send one of these every 5000 ms to provide a "heartbeat".

Note that these DGs have no explicit method of identifying the type or instance of the transmitter. The Source Address must be examined to identify the sender.

6.6.2 Communication Status 1

Table 6.6.2a defines the DG attributes, and Table 6.6.2b defines the signal and parameter attributes. All counts are from node power-on.

Table 6.6.2a — DG definition

DG attribute	Value
Name	COMMUNICATION_STATUS_1
DGN	1FFFAh
Default priority	7
Maximum broadcast gap	N/A
Normal broadcast gap	on request
Minimum broadcast gap	N/A
Number of frames	1
ACK requirements	None

Table 6.6.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0 to 3	-	Timer count	uint32	ms	Precision = 1 ms Value range = 0 to 4,221,081.200 ms The number of ms since the node powered up.

4 to 5	-	Receive error count	uint16	-	The number of errors encountered receiving incoming CAN messages.
6 to 7	-	Transmit error count	uint16	-	The number of errors encountered transmitting CAN messages.

6.6.3 Communication Status 2

Table 6.6.3a defines the DG attributes, and Table 6.6.3b defines the signal and parameter attributes. All counts are from node power-on.

Table 6.6.3a — DG definition

DG attribute	Value
Name	COMMUNICATION_STATUS_2
DGN	1FFF9h
Default priority	7
Maximum broadcast gap	N/A
Normal broadcast gap	on request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.6.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0 to 3	-	Transmitted frames count	uint32	-	The number of CAN packets transmitted by this node.
4 to 7	-	Received frames count	uint32	-	The number of CAN packets received by this node.

6.6.4 Communication Status 3

Table 6.6.4a defines the DG attributes, and Table 6.6.4b defines the signal and parameter attributes. All counts are from node power-on.

Table 6.6.4a — DG definition

DG attribute	Value
Name	COMMUNICATION_STATUS_3
DGN	1FFF8h
Default priority	7
Maximum broadcast gap	N/A
Normal broadcast gap	on request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.6.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0 to 1	-	Bus-off error count	uint16	-	The number of bus-off errors detected.
2 to 3	-	Receive frames dropped count	uint16	-	The number of receive frames dropped.
4 to 5	-	Transmit frames dropped count	uint16	-	The number of transmit frames dropped.

6.7 Proprietary DGNs

6.7.1 Introduction

The standard requires no limits on the use of the Proprietary DGN for node-specific configuration, monitoring, and control. However, since many different products have similar requirements in this area, a group of special applications are recommended for node builders to use. This will make it easier to provide multi-purpose service and configuration tools. The following formats apply (see Table 6.7.1).

Table 6.7.1 — Proprietary DGNs definition

Device attribute	Value
Category	Special
Default Source Address	N/A
Dynamic Address Range	N/A
Instance	N/A

6.7.2 Password Validation

Some operations may require a password before access will be granted to certain features. When a node refuses a command due to lack of authorization, the recipient shall send a Proprietary DGN (DGN_High = 239, DGN_Low = Destination Address) with the first byte set to 0 and the other bytes set to 255.

The node shall respond with an eight-byte "challenge", again using the Proprietary DGN with the Destination being the Source Address of the node attempting the control. The data bytes in this challenge may be pseudo-random numbers. The controlling node then shall send a "response". The response shall be a packet with the first byte set to 0, and the rest of the packet consisting of values determined by the challenge . The node then shall respond with an ACK, with the ACK value indicating whether the password was accepted.

By using a challenge-response system, it makes it very difficult for a third node listening in to determine the formula for the password. Even a simple combination of XOR masks and bit shifts would require observing a huge number of transactions to decipher. More elaborate formulae are possible, including virtually unbreakable public-key schemes.

6.7.3 Instance and Address Assignment

The configuration of many types of nodes includes the assignment of Instance codes and source addresses.

Table 6.7.3a defines the DG attributes, and Table 6.7.3b defines the signal and parameter attributes. All counts are from node power-on. The first byte contains a mode value for determining how the remaining bytes are to be interpreted.

Table 6.7.3a — DG definition

DG attribute	Value
Name	Special Application – proprietary DGN
DGN	1EF00h DGN_Low = Destination Address
Default priority	7
Maximum broadcast gap	N/A
Normal broadcast gap	N/A
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	ACK

Table 6.7.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Operation	uint8	-	0 — Password (see Section 3.2.6) 1 — Set source address 2 — Set instance 3 — Set secondary instance
1	0 to 1	Permanence	uint2	-	00b — Temporary 01b — Permanent

If Operation = 1

Byte	Bit	Name	Data type	Unit	Value definition
2	-	Source address	uint8	-	

If Operation = 2

Byte	Bit	Name	Data type	Unit	Value definition
2	-	Internal instance	uint8	-	If the node contains only one instance this value shall be ignored.
3	-	Public instance	uint8	-	This Instance value that shall be reported by the node.

If Operation = 3

Byte	Bit	Name	Data type	Unit	Value definition
2	-	Internal instance	uint8	-	If the node contains only one instance this value shall be ignored.
3	-	Public association	uint8	-	This refers to a secondary association, for example, each Instance of a Battery Charger is associated with a DC Source. This operation shall set that Instance.

6.8 Standardized Subnetworking (Obsolete)

6.8.1 Introduction

The Standardized Subnetworking DGNs have been removed from the specification. The 1FF9Eh and 1FF9Dh DGNs and the 1EF00h block are available for future assignment for other purposes.

6.9 Water Heater

6.9.1 Introduction

The DGs defined in the following clauses support all types of water heaters – typically LP gas, often with electrical elements, and occasionally with diesel burners. Although a single heater is normal, multiple instances are supported. The following formats apply (see Table 6.9.1).

Table 6.9.1 — Water heater definition

Device attribute	Value
Category	Appliances
Default Source Address	101, 102
Dynamic Address Range	208 to 223
Instance	Multi-instance

6.9.2 Water Heater Status

This DG provides the general water heater status. Table 6.9.2a defines the DG attributes, and Table 6.9.2b defines the signal and parameter attributes.

Table 6.9.2a — DG definition

DG attribute	Value
Name	WATERHEATER_STATUS
DGN	1FFF7h
Default priority	6
Maximum broadcast gap	5000ms
Normal broadcast gap	2000ms or on change
Minimum broadcast gap	500ms
Number of frames	1
ACK requirements	None

Table 6.9.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	0 – all 1 to 250 - Instance number
1	-	Operating modes	uint8	-	0 – off 1 – combustion 2 – electric 3 - gas/electric (both) 4 - automatic (electric if available, otherwise combustion

					5 - test combustion (forced on) 6 - test electric (forced on)
2 to 3	-	Set point temperature	uint16	°C	see Table 5.3 The desired water temperature.
4 to 5	-	Water temperature	uint16	°C	see Table 5.3 The actual water temperature.
6	0 to 1	Thermostat status	uint2	-	00b - set point met 01b - set point not met (heat is being applied)
	2 to 3	Burner status	uint2	-	00b – off 01b – burner is lit
	4 to 5	AC element status	uint2	-	00b – AC element is inactive 01b - AC element is active
	6 to 7	High temperature limit switch status	uint2	-	00b - limit switch not tripped 01b - limit switch tripped
7	0 to 1	Failure to ignite status	uint2	-	00b - no failure 01b - device has failed to ignite
	2 to 3	AC power failure status	uint2	-	00b - AC power present 01b - AC power not present
	4 to 5	DC power failure status	uint2	-	00b - DC power present 01b - DC power not present
	6 to 7	DC power warning status	uint2	-	00b - DC power sufficient 01b - DC power warning

6.9.3 Water Heater Command

This DGN provides external control of the water heater. Table 6.9.3a defines the DG attributes, and Table 6.9.3b defines the signal and parameter attributes.
An instance of zero indicates that the settings should be applied to all water heater instances. Values of 255 (or 65535) indicate that the particular datum should not be changed.

Table 6.9.3a — DG definition

DG attribute	Value
Name	WATERHEATER_COMMAND
DGN	1FFF6h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, WATERHEATER_STATUS

Table 6.9.3b — Signal— Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	0 – all

					1 to 250 - Instance number
1	-	Operating modes	uint8	-	0 – off 1 – combustion 2 – electric 3 - gas/electric (both) 4 - automatic (electric if available, otherwise combustion 5 - test combustion (forced on) 6 - test electric (forced on)
2 to 3	-	Set point temperature	uint16	°C	see Table 5.3 The desired water temperature.
6	0 to 3	Electric Element Level	uint4	-	Desired Level (1 to 13). Must be less than or equal to the maximum level available. Does not change the operating mode.

6.9.4 Water Heater Status 2

This DG provides the general water heater status. Table 6.9.4a defines the DG attributes, and Table 6.9.4b defines the signal and parameter attributes.

Table 6.9.4a — DG definition

DG attribute	Value
Name	WATERHEATER_STATUS_2
DGN	1FE99h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	2000 ms or on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.9.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	0 – all 1 to 250 - Instance number
1	0 to 3	Electric Element Level	uint4	-	Desired Level (1 to 13)
	4 to 7	Max Electric Element Level	uint4	-	Desired Level (1 to 13). Typically 1 (single element) or 2 (dual low/high element)
2	0 to 3	Engine Preheat	uint4	-	0000b - Off 0001b - On 0101b - Test (Forced On)
	4 to 5	Coolant Level Warning	uint2	-	00b - Coolant level sufficient 01b - Coolant level low.
	6 to 7	Hot Water Priority	uint2	-	00b - Domestic water priority 01b - Heating priority
3	0 to 1	Output Status:Burner	uint2	-	00b - Off

					01b - On
	2 to 3	Output Status:Burner Indicator	uint2	-	00b - Off 01b - On
	4 to 5	Output Status:Electric Low	uint2	-	00b - Off 01b - On
	6 to 7	Output Status:Electric High	uint2	-	00b - Off 01b - On
4	0 to 1	Burner Overcurrent Status	uint2	-	00b - No overcurrent detected 01b - Overcurrent detected
	2 to 3	Burner Undercurrent Status	uint2	-	00b - No undercurrent detected 01b - Undercurrent detected
	4 to 5	Burner Temperature Status	uint2	-	00b - Temperature normal 01b - Temperature warning
	6 to 7	Burner Input Status	uint2	-	00b - Off (Inactive) 01b - On (Active)
5	0 to 1	Burner Indicator Overcurrent Status	uint2	-	00b - No overcurrent detected 01b - Overcurrent detected
	2 to 3	Burner Indicator Undercurrent Status	uint2	-	00b - No undercurrent detected 01b - Undercurrent detected
	4 to 5	Burner Indicator Temperature Status	uint2	-	00b - Temperature normal 01b - Temperature warning
6	0 to 1	Electric Low Element Overcurrent Status	uint2	-	00b - No overcurrent detected 01b - Overcurrent detected
	2 to 3	Electric Low Element Undercurrent Status	uint2	-	00b - No undercurrent detected 01b - Undercurrent detected
	4 to 5	Electric Low Element Temperature Status	uint2	-	00b - Temperature normal 01b - Temperature warning
	6 to 7	Electric Low Element Input Status	uint2	-	00b - Off (Inactive) 01b - On (Active)
7	0 to 1	Electric High Element Overcurrent Status	uint2	-	00b - No overcurrent detected 01b - Overcurrent detected
	2 to 3	Electric High Element Undercurrent Status	uint2	-	00b - No undercurrent detected 01b - Undercurrent detected
	4 to 5	Electric High Element Temperature Status	uint2	-	00b - Temperature normal 01b - Temperature warning
	6 to 7	Electric High Element Input Status	uint2	-	00b - Off (Inactive) 01b - On (Active)

6.9.5 Water Heater Command 2

This DGN provides external control of the water heater. Table 6.9.5a defines the DG attributes. The signals and attributes are identical to WATERHEATER_STATUS (see Table 6.9.2b).

Table 6.9.5a — DG definition

DG attribute	Value
Name	WATERHEATER_COMMAND_2
DGN	1FE98h
Default priority	6
Maximum broadcast gap	N/A

Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, WATERHEATER_STATUS_2

Table 6.9.5b — Signal— Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	0 – all 1 to 250 - Instance number
1	0 to 3	Engine Preheat	uint4	-	0000b - Off 0001b - On 0101b - Test (Forced On)
2		Command	uint8	-	0 = Electric Low - Enable 1 = Electric Low - Disable 2 = Electric Low - Toggle 3 = Electric High - Enable 4 = Electric High - Disable 5 = Electric High - Toggle 6 = Burner - Enable 7 = Burner - Disable 8 = Burner - Toggle 9 = Electric - Cycle (low to high to off) 10 = Electric - Cycle (high to low to off) 11 = Electric Low Test - Toggle 12 = Electric High Test - Toggle 13 = Burner Test - Toggle

6.9.6 Circulation Pump Status

This DGN allows networked devices to display and troubleshoot circulation pumps in a hydronic heating system. The DG format assumes a single hydronic system is installed, and the instance of the pump is independent of the instance of the water heater. Table 6.9.6a defines the DG attributes, and Table 6.9.6b defines the signal and parameter attributes.

Table 6.9.6a — DG definition

DG attribute	Value
Name	CIRCULATION_PUMP_STATUS
DGN	1FE97h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	2000 ms or on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.9.6b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	0 – all 1 to 250 - Instance number
1	0 to 3	Output Status	uint4	-	0000b - Off 0001b - On 0101b - Test (Forced On)
2	0 to 1	Pump Overcurrent Status	bit	-	00b - No overcurrent detected 01b - Overcurrent detected
	2 to 3	Pump Undercurrent Status	bit	-	00b - No undercurrent detected 01b - Undercurrent detected
	4 to 5	Pump Temperature Status	bit	-	00b - Temperature normal 01b - Temperature warning

6.9.7 Circulation Pump Command

The DG format assumes a single hydronic system is installed, and the instance of the pump is independent of the instance of the water heater. Table 6.9.7a defines the DG attributes, and Table 6.9.7b defines the signal and parameter attributes.

Table 6.9.7a — DG definition

DG attribute	Value
Name	CIRCULATION_PUMP_COMMAND
DGN	1FE96h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, CIRCULATION_PUMP_STATUS

Table 6.9.7b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	0 – all 1 to 250 - Instance number
1	0 to 3	Output Mode	uint4	-	0000b - Off (End of Test) 0101b - Test (Forced On)

6.9.8 Service Points

The SPNs follow the general method for multi-instance products. Faults are reported with the Instance in the Intermediate Byte (ISB) and a non-zero value in the Most Significant Byte (MSB). It is assumed that all Instances are independent nodes. The Least Significant Bits (LSb) may vary.

Table 6.9.8 — Service Points

MSB	ISB	LSb	Description

0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	Set Point Temperature
1	Instance	1	Water Temperature
1	Instance	2	Thermostat
1	Instance	3	Burner
1	Instance	4	AC Element
1	Instance	5	DC Power
1	Instance	6	Igniter
1	Instance	7	AC Power
2	Instance	0	Primary High Temp Limit Switch
2	Instance	1 to 7	Additional High Temp Limit Switches
3	Instance	0	Circulation Pump Motor. Note that the Instance is the pump instance, not the water heater instance.
3	Instance	1	Burner start failure
3	Instance	2	Flame failure
3	Instance	3	Burner voltage
3	Instance	4	Burner premature flame recognition
3	Instance	5	Flame monitor
3	Instance	6	Coolant temperature sensor
3	Instance	7	Metering pump
4	Instance	0	Combustion air fan
4	Instance	1	Glow plug
4	Instance	2	Burner assembly overheating
4	Instance	3	Circulation pump
4	Instance	4	Power supply
4	Instance	5	Output fan
4	Instance	6	Overheating protection system
4	Instance	7	Reference resistance
5	Instance	0	Exhaust gas temperature
5	Instance	1	Exhaust gas temperature sensor
5	Instance	2	Burner Control Unit

6.9.9 Test Profiles

6.9.9.1 Water Heater Combustion Base Profile

(WATERHEATER_COMMAND/WATERHEATER_STATUS)

ID	Datum	Test	Required Response	Required Behavior
101A-C-01	Operating modes	On WATERHEATER_COMMAND, send Operating modes = 1 (combustion) On	WATERHEATER_STATUS reports Operating modes = 1 (combustion) WATERHEATER_STA	Burner starts ignition process Burner shuts off

		WATERHEATER_COMMAND, send Operating modes = 0 (off)	TUS reports Operating modes = 0 (off)	
	Burner Status	Enable burner and ensure that it is lit While the burner is lit, shut off the burner	WATERHEATER_STATUS reports Burner status = 01b (burner is lit) WATERHEATER_STATUS reports Burner status = 00b (off)	Burner is lit Burner shuts off
	Failure to ignite status	While the burner should be enabled, shut off gas (or other method) to simulate a failure to ignite	WATERHEATER_STATUS reports Failure to ignite status = 01b (device has failed to ignite)	Burner is not lit

6.9.9.2 Water Heater Electric Base Profile
(WATERHEATER_COMMAND/WATERHEATER_STATUS)

ID	Datum	Test	Required Response	Required Behavior
101A-C-01	Operating modes	On WATERHEATER_COMMAND, send Operating modes = 2 (electric) On WATERHEATER_COMMAND, send Operating modes = 0 (off)	WATERHEATER_STATUS reports Operating modes = 2 (electric) WATERHEATER_STATUS reports Operating modes = 0 (off)	Electric element enables Electric element disables

6.10 Gas Sensors

6.10.1 Introduction

These DGs cover all types of gas detectors generally found in RVs - LP Gas, CO, and Smoke.
The DGs defined in the following clauses support all types of water heaters - typically LP gas, often with electrical elements, and occasionally with diesel burners. Although a single heater is normal, multiple instances are supported. The following formats apply (see Table 6.10.1).

Table 6.10.1 — Gas sensors definition

Device attribute	Value
Category	Appliances
Default Source Address	120 to 125
Dynamic Address Range	208 to 223

Instance	Multi-instance

Multiple source addresses are allocated, but detectors are identified by the Instance in each DGN. This is a multi -instance DGN, and a combination detector would broadcast using multiple Instance identifiers. There is no way to identify the physical location of a detector from the Instance or the Source Address.

6.10.2 Sensor Status

This DGN communicates user intentions, along with the temperature readings. Table 6.10.2a defines the DG attributes, and Table 6.10.2b defines the signal and parameter attributes.

Table 6.10.2a — DG definition

DG attribute	Value
Name	GAS_SENSOR_STATUS
DGN	1FFF5h
Default priority	2
Maximum broadcast gap	5000 ms
Normal broadcast gap	on change
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

Table 6.10.2b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	-	Instance	uint8	-	see Table 5.3
1	-	Type	uint8	-	1 — CO 2 — LP Gas 3 — Smoke
2 to 3	-	PPM	uint16	ppm	See Table 5.3 Precision = 1 ppm Value range = 0 to 65530 ppm
4	0 to 1	Alarm	uint2	-	00b — No alarm 01b — Alarm
	2 to 3	Warning	uint2	-	00b — No alarm 01b — Warning (less serious than Alarm)
	4 to 5	DC supply failure	uint2	-	00b — No failure 01b — DC supply failure
	6 to 7	sensor failure	uint2	-	00b — No failure 01b — Sensor failure

6.10.3 Service Points

The SPNs follow the general method for multi-instance products (see Table 59). Faults are reported with the Instance in the Intermediate Byte (ISB) and a non-zero value in the Most Significant Byte (MSB). In the case of a single node controlling multiple instances an ISB of zero indicates the fault applies to the central controller. The Least Significant bits (LSb) may vary.

Table 6.10.3 — Service Points

MSB	LSB	LSb	Description

0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	Sensor
1	Instance	1	Annunciator

6.10.4 Test Profile

6.10.4.1 Gas Sensor Status Base Profile

(GAS_SENSOR_STATUS)

ID	Datum	Test	Required Response	Desired Response
120A-C-01	PPM	Plug in Sensor	GAS_SENSOR_STATUS reports PPM	Status message sent out less than 5000ms in duration

6.11 Chassis Motion

6.11.1 Introduction

These DGNs describe a method that allows components to monitor the motion of the RV, and control its mobility. Although SAE J1939 offers some of this functionality of these DGs, it does not include a way to immobilize the chassis, and is not universally available. More detailed information on chassis components such as the engine and transmission should be handled through SAE J1939 emulation. The following formats apply (see Table 6.11.1).

Table 6.11.1 — Chassis motion definition

Device attribute	Value
Category	Chassis
Default Source Address	252
Dynamic Address Range	144 to 159
Instance	Single

6.11.2 Chassis Mobility Status

This DG can be queried by any device that needs to know whether the RV is in motion or immobilized. Table 6.11.2a defines the DG attributes, and Table 6.11.2b defines the signal and parameter attributes.

Table 6.11.2a — DG definition

DG attribute	Value
Name	CHASSIS_MOBILITY_STATUS
DGN	1FFF4h
Default priority	4
Maximum broadcast gap	5000 ms
Normal broadcast gap	on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.11.2b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0 to 1	-	Engine RPMs	uint16	rpm	Precision = 0.125 rpm Value Range = 0 to 8191.625 rpm 65534 – Error 65535 - Unknown
2 to 3	-	Vehicle speed	uint16	kph	Precision = 1/256 kph Value Range = 0 to 255 kph 65534 - Error 65535 - Unknown
4	0 to 1	Park brake status	uint2	-	00b - Park Brake Released. Coach is free to roll 01b - Park Brake Engaged. Coach is immobilized
	2 to 3	Transmission lock status	uint2	-	00b - Transmission is not locked 01b - Transmission is locked (shall not go into gear)
	4 to 5	Engine lock status	uint2	-	00b - Engine is free to start 01b - Engine is locked
5	0 to 1	Ignition switch status	uint2	-	00b - Off 01b - On
	2 to 4	Accessory switch status	uint2	-	00b - Off 01b - On
6		Transmission Current Gear	uint8	-	124 = Reverse 1 125 = Neutral 126 = Forward 1 127 = Forward 2 etc. 251 = Park (Note: Most heavy transmissions do not have a 'Park', but are parked in Neutral.)
7		Transmission Gear Selected	uint8	-	Same format as Current Gear

6.11.3 Chassis Mobility Status 2

Table 6.11.3a defines the DG attributes, and Table 6.11.3b defines the signal and parameter attributes.

Table 6.11.3a — DG definition

DG attribute	Value
Name	CHASSIS_MOBILITY_STATUS_2
DGN	1FEA8h
Default priority	4
Maximum broadcast gap	1000 ms
Normal broadcast gap	50 ms when the RV is in Reverse and Steering Wheel Angle is broadcast. On Change of discrete inputs.
Minimum broadcast gap	50 ms
Number of frames	1

ACK requirements	None

Table Error: Reference source not foundb — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0 to 1	-	Steering Wheel Angle	uint16	rad	Precision = 1/1024 radian Offset = -31.374 radian Value Range = -31.374 to +31.374 radian. 65534 – Error 65535 – Unknown Positive values indicate turning to the left (counter-clockwise).
2	0 to 1	Headlight Switch	uint2	-	00b – Headlight Switch Off 01b – Headlight Switch On
3	-	Fuel Level Percent	uint8	%	See table 5.3 The amount of fuel in the tank, relative to its capacity
4 to 7	-	Odometer	uint32	m	Precision = 5m. 0 = 0m. Value Range = 0m to 21,474,836,465m. Scaling is identical to SAE J1939 Total Vehicle Distance (High Resolution).

6.11.4 Chassis Mobility Command

Any device that wishes to immobilize the RV (e.g. to prevent it being driven while an awning is extended) shall use this command. First, the device should issue this command before extending and must monitor for the acknowledgment. Secondly, the device must respond to any request for this DGN, and properly report whether it still wants the chassis system locked. Third, it should send the command again to unlock the chassis after retracting. (The same principle applies to the other interlocks supported here).

The device implementing the DG should monitor the incoming commands and keep a list of devices that have requested a lock. Before releasing a lock, it should broadcast a request for this DGN and compare the results with the list in memory. The chassis device shall be careful not to completely trust either method - a locking device may be off-line, and thus not respond to the request for the DGN or fail to send the unlocking command.

Table 6.11.4a defines the DG attributes, and Table 6.11.4b defines the signal and parameter attributes.

Table 6.11.4a — DG definition

DG attribute	Value
Name	CHASSIS_MOBILITY_COMMAND
DGN	1FFF3h
Default priority	4
Maximum broadcast gap	N/A
Normal broadcast gap	as needed
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.11.4b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	0 to 1	Park brake command	uint2	-	00b - Please release chassis 01b - Please immobilize chassis 10b – Error 11b - Do not care about immobilizer status Note that the command 00b is an active request to release the immobilizer (e.g. Park brake). In contrast, the value 11b indicates the node does not need the immobilizer to be in either state.
	2 to 3	Park brake user override	uint2	-	00b - Normal priority 01b - Override 10b - Error 11b - N/A This should only be used to implement an emergency override, under the control of the user (typically in a diagnostic or troubleshooting mode.)
1	0 to 1	Transmission command	uint2	-	00b - Please release transmission 01b - Please prevent transmission from engaging 10b – Error 11b - Do not care about transmission status. Note that the command 00b is an active request, as above.
	2 to 3	Transmission lock user override	uint2	-	00b - Normal priority 01b - Override 10b - Error 11b - N/A This should only be used to implement an emergency override, under the control of the user (typically in a diagnostic or troubleshooting mode.)
2	0 to 1	Engine lock command	uint2	-	00b - Please release engine. 01b - Please prevent engine from starting 10b - Error 11b - Do not care about engine status. Note that a 00b command is an active request, as above.
	2 to 4	Engine lock user override	uint3	-	00b - Normal priority 01b - Override 10b - Error 11b - N/A This should only be used to implement a emergency override, under the control of the user (typically in a diagnostic or troubleshooting mode.)

6.11.5 Vehicle Environment Status

This DGN works in parallel with the CHASSIS_MOBILITY_STATUS to allow devices to modify their behavior according to the context in which the RV is being used. In most situations, the status is determined through user input, as communicated via the VEHICLE_ENVIRONMENT_COMMAND. However, some data items may be derived through sensors or by monitoring other network devices.

If more than one device is capable of transmitting a specific value within the VEHICLE_ENVIRONMENT_STATUS, the device with the higher source address shall have priority. See DATE_TIME_STATUS for details regarding this process. If a lower-priority device transmits a portion of the data which is not included in the higher-priority message, the lower-priority device shall transmit just the unique data items.

Table 6.11.5a defines the DG attributes, and Table 6.11.5b defines the signal and parameter attributes.

Table 6.11.5a – DG definition

DG attribute	Value
Name	VEHICLE_ENVIRONMENT_STATUS
DGN	1FE87h
Default priority	6
Maximum broadcast gap	500 ms
Normal broadcast gap	On change
Minimum broadcast gap	50 ms
Number of frames	1
ACK requirements	None

Table 6.11.5b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0-1	Ventilated Space	uint2	-	00b - RV is in a ventilated space. 01b - Space is not ventilated. Combustion devices should not operate. 10b – Cannot be Determined
	2-3	Heated Space	uint2	-	00b - RV is in a heated space or mild climate. 01b - Space is not heated. Cold-sensitive components may need additional heat. 10b – Cannot be Determined
	4-5	Shore Power Available	uint2	-	00b - No Shore Power 01b - AC power from the shore cord is available. This is typically derived from the ATS_STATUS messages, if an ATS is connected to the network.
	6-7	Open Space	uint2	-	00b - RV is in an open space. 01b - RV is in a confined space. Mechanical components such as slide rooms and awnings should not extend. 10b – Cannot be Determined
1	0-1	Water Hookup	uint2	-	00b - No hookup. 01b - The vehicle is connected to a fresh water supply. This may be derived from the WATER_PUMP_STATUS message, if present.
	2-3	Sewer Hookup	uint2	-	00b – No hookup.

					01b - The vehicle is connected to a sewer system and either the sewer valves are open or an automatic valve control is active.
	4-5	Internet Connection Available	uint2	-	00b - No internet connection is available. 01b - An internet connection is available.
	6-7	Trailer is Hitched	uint2	-	00b – This trailer is not hitched to a tow vehicle. 01b – This trailer is hitched to a tow vehicle. For towable units only.
2	0-1	Tow Car or Trailer in Tow	uint2	-	00b - No trailer or tow car is present. 01b - A trailer or tow car is presently hitched behind. For motorized units only.
	2-3	Vehicle Stabilized	uint2	-	00b - Not stabilized. 01b - Jacks or other stabilization method is fully deployed.
3	-	Ambient Light Level	uint8	%	0 = Dark 200 = Daylight Conditions. Typically used to determine appropriate backlight levels for screens and indicators. For Solar Intensity, see WEATHER_STATUS_2.

6.11.6 Vehicle Environment Command

This DG allows the user to control the environment status. Device which sense or calculate one or more environmental conditions automatically shall use VEHICLE_ENVIRONMENT_STATUS to communicate that data.

Table 6.11.6a – DG definition

DG attribute	Value
Name	VEHICLE_ENVIRONMENT_COMMAND
DGN	1FE86h
Default priority	6
Maximum broadcast gap	500 ms
Normal broadcast gap	As needed
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	NAK, VEHICLE_ENVIRONMENT_STATUS

The message contents are identical to VEHICLE_ENVIRONMENT_STATUS. This message is typically broadcast by a user-interface device to allow the user to indicate changes in the environment or status of the vehicle. If this command contradicts the information available from a sensor or other device, the receiving device shall give the sensor information priority and respond with an appropriate NAK. This DGN shall not be used to provide a manual override of any automatic safety feature in the vehicle. If a devices uses the VEHICLE_ENVIRONMENT_STATUS message for safety reasons and a manual override is desired, such as for service, that override shall be implemented through messages specific to that device - typically, a proprietary message.

6.11.7 Service Points

These are the allowable Service Points for this DGN (see Table 6.11.6a).

Table 6.11.7 — Service Points

SPN	Description
0 to 255	Standard SPNs (see Table 7.3)
256	Engine RPMs
257	Vehicle Speed
258	Park Brake
259	Transmission Lock
260	Engine Lock
261	Ignition Switch
262	Accessory Switch

6.11.8 Alarms

Alarms

Alarm Instance	Description
1	Park Brake Set
2	Park Brake Released
3	RV Starts Moving
4	Engine Starts
5	Engine Stops
6	Ignition Switched On
7	Ignition Switched Off
21	RV Enters Non-Ventilated Space
22	RV Enters Ventilated Space
23	RV Enters Heated Space
24	RV Enters Non-Heated Space
25	RV Enters Open Space
26	RV Enters Confined Space
27	Shore Power Becomes Available
28	Shore Power No Longer Available
29	Water Hookup Detected
30	Water Hookup No Longer Detected
31	Sewer Hookup Detected
32	Sewer Hookup No Longer Detected
33	Internet Connection Detected
34	Internet Connection No Longer Detected

35	Trailer is Now Hitched
36	Trailer is No Longer Hitched
37	Tow Car/Trailer is Now in Tow
38	Tow Car/Trailer is No Longer in Tow
39	RV is Stabilized
40	RV is No Longer Stabilized
41	Motion While Shore Power Connected
42	Motion While Fresh Water Connected
43	Motion While Sewer Connected
44	Motion While Stabilized

6.11.9 Test Profiles

Testing Chassis Profiles

It is not appropriate for the testing of an RV-C profile to require extensive operation (including driving and/or towing) of a full RV. To test these profiles, the applicant must describe the means in which the various operations, such as applying/releasing the park brake or setting the vehicle in motion, shall be simulated. This description shall be included in the approval documentation and available for examination.

Simulation methods may include:

Discrete Signal Input. Typically an Active High (12v) or Active Low (Ground) signal. The interpretation of the signal must be documented. (e.g. whether an active value means “On” or “Off”.) The test shall use a signal of like type.

Analog Signal Input. Typically a resistance (e.g. 0-90 ohms) or voltage (e.g. 0-5V) signal. The full interpretation of the signal must be documented. The test shall use a signal of like type.

SAE J1939 Data Item. A datum from the SAE J1939 data bus. The specific message DGN and data byte/bits must be documented. A simulated SAE J1939 data bus shall be used for testing.

Advanced Sensors. Examples include accelerometers and GPS. It may not be practical to test these under lab conditions. If so, for testing the applicant may supply a version in which the actual sensor readings are “spoofed” to simulate typical operation.

Products may support more than one means of simulating an input or operation, in which case each method documented shall be tested. For example, the park brake status may be an Active High input, an Active Low input, or a SAE J1939 data item. In no case should an item be documented in the submission without being tested.

Note that these tests do not affirm compliance to the SAE J1939 specification, compatibility with any particular chassis, or product performance. The tests only affirms compliance with the RV-C protocol in the simulated environment.

6.11.9.1 Chassis Mobility Status Base Test Profile

ID	Datum	Test	Required Response
252T-S-01	Engine RPMs	Change state or request DGN Starting at rest, the engine simulated with an RPM of at least 500. Over a	Report value if known Report 65534 if an error is present Report 65535 if unknown Within 500ms of reaching 500 rpm, CHASSIS_MOBILITY_STATUS is broadcast

		period of at least 10 seconds, RPMs are increased arbitrarily, then reduced over time to zero.	with Engine RPMs set as appropriate. The broadcast is repeated within 5000ms. GENERIC_ALARM_STATUS is broadcast with DSA 252, Instance 4 (Engine Starts). Upon reaching an RPM of zero, CHASSIS_MOBILITY_STATUS is broadcast within 500ms, and GENERIC_ALARM_STATUS is broadcast with DSA 252, Instance 5 (Engine Stops)
252U-S-01	Engine RPMs (A chassis device may be capable of sensing that the engine is running but not capable of measuring actual rpms. This profile is an alternative to 252T for such devices.)	Same as 252T-S-01	Same as 252T-S-01, with Engine RPMs set to F000h (7680 rpms) when running, or 0000h (0 kph) when stopped.
252M-S-01	Vehicle Speed	Change state or request DGN Starting at rest, the vehicle is accelerated to a (simulated) speed of 0.5 mph (~0.7 fps). Over a period of at least 10 seconds, acceleration is continued to 10 mph, then decelerated at roughly the same rate until stopped.	Report value if known Report 65534 if an error is present Report 65535 if unknown Within 500ms of reaching 0.5 mph, CHASSIS_MOBILITY_STATUS is broadcast with Vehicle Speed set as appropriate. (A lower speed threshold is acceptable.) The broadcast is repeated within 5000ms. GENERIC_ALARM_STATUS is broadcast with DSA 252, Instance 3 (RV Starts Moving). Upon reaching a speed of zero, CHASSIS_MOBILITY_STATUS is broadcast within 500ms.
252N-S-01	Vehicle Speed (A chassis device may be capable of sensing that the vehicle is in motion but not capable of measuring actual speed. This profile is an alternative to 252M for such devices.)	Same as 252M-S-01	Same as 252M-S-01, with Vehicle Speed set to F000h (240 kph) when in motion, or 0000h (0 kph) when at rest.
252A-S-01	Park Brake Status	Change state or request DGN With the park brake (as simulated) in	If known, report 00b for released or 01b for engaged CHASSIS_MOBILITY_STATUS is broadcast

		a off state, the park brake is set.	immediately with Park Brake Status 01b (Engaged). The broadcast is repeated within 5000ms. GENERIC_ALARM_STATUS is broadcast with DSA 252, Instance 1 (Park Brake Set)
	Transmission lock status	Change state or request DGN	If known, report 00b for not locked or 01b for locked
	Engine lock status	Change state or request DGN	If known, report 00b for free to start engine or 01b for locked
252I-S-01	Ignition Switch status	Change state or request DGN With the ignition switch (as simulated) in an off state, the ignition switch is switched on.	If known, report 00b for off or 01b for on CHASSIS_MOBILITY_STATUS is broadcast within 500ms with Ignition Switch Status 01b (On). The broadcast is repeated within 5000ms. GENERIC_ALARM_STATUS is broadcast with DSA 252, Instance 6 (Ignition Switched On)
252I-S-02	Ignition Switch status	With the ignition switch (as simulated) in an on state, the ignition switch is switched off.	CHASSIS_MOBILITY_STATUS is broadcast within 500ms with Ignition Switch Status 00b (Off). The broadcast is repeated within 5000ms. GENERIC_ALARM_STATUS is broadcast with DSA 252, Instance 7 (Ignition Switched Off)
	Accessory switch status	Change state or request DGN	If known, report 00b for off or 01b for on
	Transmission current gear	Change state or request DGN	Report 251 for park or parked in neutral Report 125 for neutral Report 1 under 125 for every reverse gear Report 1 over 125 for every forward gear
	Transmission gear selected	Change state or request DGN	Report 251 for park or parked in neutral Report 125 for neutral Report 1 under 125 for every reverse gear Report 1 over 125 for every forward gear

6.11.9.2 Vehicle Environment Base Test Profile:

The simplest implementation of the VEHICLE_ENVIRONMENT_STATUS data items is a device which parses VEHICLE_ENVIRONMENT_COMMANDs - say, from a UI device - and stores the values for later broadcast on the network. This “passive” approach can be applied to any datum in the DGN. The tests for compliance for any of data items implemented in this way share the same general structure. Most require three tests. The first test, labeled 252V*-S-01, begins with the product in a default state. A second state is triggered or simulated by some means, and then a third state (which may be the default state) is triggered or simulated. With each of the two changes in state, the VEHICLE_ENVIRONMENT_STATUS is broadcast within 500ms with the indicated datum, and GENERIC_ALARM_STATUS is broadcast with the indicated alarm.

The second test (not shared by all profiles) checks the behavior as the vehicle is in motion. Test 252V*-S-02 begins with the product in a default state. RV motion is then simulated, which triggers VEHICLE_ENVIRONMENT_STATUS within 500ms, and may trigger a GENERIC_ALARM. Motion then ends, which triggers VEHICLE_ENVIRONMENT_STATUS again.

Test 252V*-S-03 (not shared by all profiles) tests behavior when the vehicle is in motion. The test begins with the vehicle in simulated motion. VEHICLE_ENVIRONMENT_COMMAND is then sent with the indicated value. The device should respond with a NAK-3 (Conditions Do Not Allow).

The applicant must specify a means of simulating vehicle motion. Possibilities include receiving CHASSIS_MOBILITY_STATUS or any of the simulation methods listed in the section above. The method of simulation must be documented as part of the submission.

This profile is a prerequisite for all profiles 252V*. It ensures that the device does not broadcast an excessive number of messages when multiple fields are changing in rapid order, as may happen when the RV goes into motion or is parked.

ID	Datum	Test	Required Response
	Vehicle Environment Command	Send updated status of system with attached sensor	If sensor information does not contradict the command report appropriate status.
252V-S-01	VEHICLE_ENVIRONMENT_STATUS	A series of VEHICLE_ENVIRONMENT_COMMAND messages are sent, 50ms apart, each containing a different field from the message previous (unless the device only supports one message). Each field must be a field supported by the device. The series continues for at least five seconds (100 messages).	VEHICLE_ENVIRONMENT_STATUS is broadcast, with the first broadcast within 500ms of the first command, and subsequent broadcasts 500ms (+/- 100ms) apart. No more than 11 messages should be sent in the 5 second span.

6.11.9.3 Profile 252VA – Ventilated Space (Passive Controller)

Prerequisite - Profile 252V - Vehicle Environment Base Profile (Passive Controller)

ID	Datum	Test	Required Response
252VA-S-01	Default State: 10b (Cannot be determined)		
	Second State: 01b (Not Ventilated)	VEHICLE_ENVIRONMENT_COMMAND is sent with Ventilated Space 01b (Not Ventilated).	21 (RV Enters Non-Ventilated Space)
	Third State: 00b (Ventilated)	VEHICLE_ENVIRONMENT_COMMAND is sent with Ventilated Space 00b (Ventilated).	22 (RV Enters Ventilated Space)
252VA-S-02	Default State: 01b (Not Ventilated)		
	State in Motion: 10b (Cannot be determined)		
252VA-S-03	State in Motion: 10b (Cannot be determined)		

6.11.9.4 Profile 252VB – Heated Space (Passive Controller)

Prerequisite - Profile 252V - Vehicle Environment Base Profile (Passive Controller)

ID	Datum	Test	Required Response
252VB-S-01	Default State : 10b (Cannot be determined)		
	Second State: 01b (Not Heated)	VEHICLE_ENVIRONMENT_COMMAND is sent with Heated Space 01b (Not Heated).	23 (RV Enters Non-Heated Space)
	Third State: 00b (Heated)	VEHICLE_ENVIRONMENT_COMMAND is sent with Heated Space 00b (Heated).	24 (RV Enters Heated Space)
252VB-S-02	Default State: 01b (Not Heated)		
	State in Motion: 10b (Cannot be determined)		
252VB-S-03	State in Motion: 10b (Cannot be determined)		

6.11.9.5 Profile 252VC – Open Space (Passive Controller)

Prerequisite - Profile 252V - Vehicle Environment Base Profile (Passive Controller)

ID	Datum	Test	Required Response
252VC-S-01	Default State : 10b (Cannot be determined)		
	Second State: 01b (Confined Space)	VEHICLE_ENVIRONMENT_COMMAND is sent with Open Space 01b (Confined Space).	26 (RV Enters Confined Space)
	Third State: 00b (Open Space)	VEHICLE_ENVIRONMENT_COMMAND is sent with Open Space 00b (Open Space).	25 (RV Enters Open Space)
252VC-S-02	Default State: 00b (Open Space)		
	State in Motion: 10b (Cannot be determined)		
252VC-S-03	State in Motion: 10b (Cannot be determined)		

6.11.9.6 Profile 252VD – Shore Power (Passive Controller)

Prerequisite - Profile 252V - Vehicle Environment Base Profile (Passive Controller)

ID	Datum	Test	Required Response
252VD-S-01	Default State : 00b (No Shore Power)		
	Second State: 01b (Shore Power Available)	VEHICLE_ENVIRONMENT_COMMAND is sent with Shore Power 01b (Shore Power Available)	27 (Shore Power Becomes Available)
	Third State: 00b (No Shore Power)	VEHICLE_ENVIRONMENT_COMMAND is sent with Shore Power 00b (No Shore Power)	28 (Shore Power No Longer Available)
252VD-S-02	Default State: 01b (Shore Power Available)		41 Motion While Shore Power Connected
	State in Motion: 00b (No Shore Power)		
252VD-S-03	State in Motion: 00b (No Shore Power)		

6.11.9.7 Profile 252VE – Water Hookup (Passive Controller)

Prerequisite - Profile 252V - Vehicle Environment Base Profile (Passive Controller)

ID	Datum	Test	Required Response
252VE-S-01	Default State : 00b (No hookup)		
	Second State: 01b (Water hooked up)	VEHICLE_ENVIRONMENT_COMMAND is sent with Water Hookup 01b (Water hooked up)	29 (Water Hookup Detected)
	Third State: 00b (No hookup)	VEHICLE_ENVIRONMENT_COMMAND is sent with Water Hookup 00b (No hookup)	30 (Water Hookup No Longer Detected)
252VE-S-02	Default State: 01b (Water hooked up)		42 Motion While Fresh Water Connected
	State in Motion: 00b (No hookup)		
252VE-S-03	State in Motion: 00b (No hookup)		

6.11.9.8 Profile 252VF – Sewer Hookup (Passive Controller)

Prerequisite - Profile 252V - Vehicle Environment Base Profile (Passive Controller)

ID	Datum	Test	Required Response
252VF-S-01	Default State : 00b (No hookup)		
	Second State: 01b (Sewer hooked up)	VEHICLE_ENVIRONMENT_COMMAND is sent with Sewer Hookup 01b (Sewer hooked up)	31 (Sewer Hookup Detected)
	Third State: 00b (No hookup)	VEHICLE_ENVIRONMENT_COMMAND is sent with Sewer Hookup 00b (No hookup)	32 (Sewer Hookup No Longer Detected)
252VF-S-02	Default State: 01b (Sewer hooked up)		43 Motion While Sewer Connected
	State in Motion: 00b (No hookup)		
252VF-S-03	State in Motion: 00b (No hookup)		

6.11.9.9 Profile 252VG – Internet Connection (Passive Controller)

Prerequisite - Profile 252V - Vehicle Environment Base Profile (Passive Controller)

ID	Datum	Test	Required Response
252VG-S-01	Default State : 00b (No connection)		
	Second State: 01b (Internet connection available)	VEHICLE_ENVIRONMENT_COMMAND is sent with Internet Connection 01b (Internet connection available)	33 (Internet Connection Detected)
	Third State: 00b (No connection)	VEHICLE_ENVIRONMENT_COMMAND is sent with Internet Connection 00b (No connection)	34 (Internet Connection No Longer Detected)

6.11.9.10 Profile 252VH – Trailer is Hitched (Passive Controller)

Prerequisite - Profile 252V - Vehicle Environment Base Profile (Passive Controller)

ID	Datum	Test	Required Response
252VH-S-01	Default State : 00b (Not hitched)		
	Second State: 01b (Hitched)	VEHICLE_ENVIRONMENT_COMMAND is sent with Trailer is Hitched 01b (Hitched)	35 (Trailer is Now Hitched)

	Third State: 00b (No connection)	VEHICLE_ENVIRONMENT_COMMAND is sent with Trailer is Hitched 00b (Not hitched)	36 (Trailer is No Longer Hitched)

6.11.9.11 Profile 252VI - Tow Car/Trailer in Tow (Passive Controller)
Prerequisite - Profile 252V - Vehicle Environment Base Profile (Passive Controller)

ID	Datum	Test	Required Response
252VI-S-01	Default State : 00b (No tow)		
	Second State: 01b (Trailer in tow)	VEHICLE_ENVIRONMENT_COMMAND is sent with Trailer in Tow 01b (Trailer in tow)	37 (Tow Car/Trailer is Now in Tow)
	Third State: 00b (No tow)	VEHICLE_ENVIRONMENT_COMMAND is sent with Trailer in Tow 00b (No tow)	38 (Tow Car/Trailer is No Longer in Tow)

6.11.9.12 Profile 252VJ - Vehicle Stabilized (Passive Controller)
Prerequisite - Profile 252V - Vehicle Environment Base Profile (Passive Controller)

ID	Datum	Test	Required Response
252VJ-S-01	Default State : 00b (Not stabilized)		
	Second State: 01b (Stabilized)	VEHICLE_ENVIRONMENT_COMMAND is sent with Vehicle Stabilized 01b (Stabilized)	39 (RV is Stabilized)
	Third State: 00b (Not stabilized)	VEHICLE_ENVIRONMENT_COMMAND is sent with Vehicle Stabilized 00b (Not stabilized)	40 (RV is No Longer Stabilized)
252VJ-S-02	Default State: 01b (Stabilized)		44 Motion While Stabilized
	State in Motion: 00b (Not stabilized)		
252VJ-S-03	State in Motion: 00b (Not stabilized)		

6.11.10 Vehicle Environment Profiles - Active Controller

A device may implement some portion of VEHICLE_ENVIRONMENT_STATUS directly, without accepting data from the

VEHICLE_ENVIRONMENT_COMMAND. It may do so using data from other devices on the network, e.g. discerning the shore power status from the status of the charger and genset, from its own internal sensors, or a combination of inputs.

The tests for compliance for any of data items implemented in this way share the same general structure. Most require three tests. The first test, labeled 252W*-S-01, begins with the product in a default state. A second state is triggered or simulated by some means, and then a third state (which may be the default state) is triggered or simulated. With each of the two changes in state, the VEHICLE_ENVIRONMENT_STATUS is broadcast within 500ms with the indicated datum, and GENERIC_ALARM_STATUS is broadcast with the indicated alarm.

The second test (not shared by all profiles) checks the behavior as the vehicle is in motion. Test 252W*-S-02 is conducted twice, each time with a different starting status. In each test, the product starts in one of the two states (00b or 01b), and RV motion is simulated. This must trigger a VEHICLE_ENVIRONMENT_STATUS broadcast within 500ms, and may trigger a GENERIC_ALARM.

Test 252W*-S-03 is shared by all profiles, and tests that the device provides a NAK to all VEHICLE_ENVIRONMENT_COMMANDs in which the data item is included. The device should respond with a NAK-1 (Command will not be executed).

In each profile, the means of simulating the triggers must be documented by the applicant, and may include any combination of RV-C messages and conventional sensors or inputs.

6.11.10.1 Profile 252WD - Shore Power (Active Controller)

ID	Datum	Test	Required Response
252WD-S-01	Default State : 00b (No Shore Power)		
	Second State: 01b (Shore Power Available)		27 (Shore Power Becomes Available)
	Third State: 00b (No Shore Power)		28 (Shore Power No Longer Available)
252WD-S-02	State in Motion: 00b (No Shore Power)		Starting from 00b (No Shore Power), none Starting from 01b (Shore Power Available), 41 Motion While Shore Power Connected
252WD-S-03		VEHICLE_ENVIRONMENT_COMMAND Shore Power	

6.11.10.2 Profile 252WE - Water Hookup (Active Controller)

ID	Datum	Test	Required Response
252WE-S-01	Default State : 00b (No hookup)		
	Second State: 01b (Water hooked up)		29 (Water Hookup Detected)
	Third State: 00b (No		30 (Water Hookup No Longer Detected)

	hookup)		
252WE-S-02	State in Motion: 00b (No hookup)		Starting from 00b (No hookup), none Starting from 01b (Water hooked up), 42 Motion While Fresh Water Connected
252WE-S-03		VEHICLE_ENVIRONMENT_COMMAND Water Hookup	

6.11.10.3 Profile 252WF - Sewer Hookup (Active Controller)

ID	Datum	Test	Required Response
252WF-S-01	Default State : 00b (No hookup)		
	Second State: 01b (Sewer hooked up)		31 (Sewer Hookup Detected)
	Third State: 00b (No hookup)		32 (Sewer Hookup No Longer Detected)
252WF-S-02	State in Motion: 00b (No hookup)		Starting from 00b (No hookup), none Starting from 01b (Sewer hooked up), 43 Motion While Sewer Connected Connected
252WF-S-03		VEHICLE_ENVIRONMENT_COMMAND Sewer Hookup	

6.11.10.4 Profile 252WJ - Vehicle Stabilized (Active Controller)

ID	Datum	Test	Required Response
252WJ-S-01	Default State : 00b (Not stabilized)		
	Second State: 01b (Stabilized)		39 (RV is Stabilized)
	Third State: 00b (Not stabilized)		40 (RV is No Longer Stabilized)
252WJ-S-02	State in Motion: 00b (Not stabilized)		Starting from 00b (No hookup), none Starting from 01b (Sewer hooked up), 44 Motion While Stabilized
252WJ-S-03		VEHICLE_ENVIRONMENT_COMMAND Vehicle Stabilized	

6.11.10.5 Profile 252WG - Internet Connection (Active Controller)

ID	Datum	Test	Required Response
252WG-S-01	Default State : 00b (No connection)		
	Second State: 01b (Internet connection available)		33 (Internet Connection Detected)
	Third State: 00b (No connection)		34 (Internet Connection No Longer Detected)
252WG-S-02			
252WG-S-03		VEHICLE_ENVIRONMENT_COMMAND Internet Connection Stabilized	

6.11.10.6 Profile 252WH - Trailer is Hitched (Active Controller)

ID	Datum	Test	Required Response
252WH-S-01	Default State : 00b (Not hitched)		
	Second State: 01b (Hitched)		35 (Trailer is Now Hitched)
	Third State: 00b (No connection)		36 (Trailer is No Longer Hitched)
252WH-S-02			
252WH-S-03		VEHICLE_ENVIRONMENT_COMMAND Trailer is Hitched	

6.11.10.7 Profile 252WI - Tow Car/Trailer in Tow (Active Controller)

ID	Datum	Test	Required Response
252WI-S-01	Default State : 00b (No tow)		
	Second State: 01b (Trailer in tow)		37 (Tow Car/Trailer is Now in Tow)
	Third State: 00b (No tow)		38 (Tow Car/Trailer is No Longer in Tow)

252WI-S-02			
252WI-S-03		VEHICLE_ENVIRONMENT_COMMAND Tow Car/Trailer in Tow	

6.12 Active Air Suspension

6.12.1 Introduction

These DGNs describe an RV -specific suspension system - an active air suspension (AAS). It generally works in conjunction with an air leveling system, but is active while the vehicle is in motion to adjust ride height according to road conditions. The following formats apply (see Table 6.12.1).

Table 6.12.1 — Active air suspension definition

Device attribute	Value
Category	Chassis
Default Source Address	126
Dynamic Address Range	144 to 159
Instance	Single

6.12.2 Air Suspension Command

This DGN reports the configuration of the AAS. Table 6.12.2a defines the DG attributes. The signal and parameter attributes have the same format as AAS_CONFIG_STATUS (see Table 6.12.2b).

Table 6.12.2a — DG definition

DG attribute	Value
Name	AAS_COMMAND
DGN	1FFF1h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	as needed
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	NAK, AAS_STATUS

Table 6.12.2b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	0 to 1	AAS Operating State	uint2	-	00b - Off 01b - On
	2 to 5	AAS Mode	uint4	-	0000b - Normal 0001b - Fly Mode 0010b – Reset

					1110b – Error 1111b - NA
1	-	Left front sensor mode	uint8	%	See Table 5.3 0 — Full Dump (0%) 200 – Full Raise (100%)
2	-	Right front sensor mode	uint8	%	See Table 5.3 0 — Full Dump (0%) 200 – Full Raise (100%)
3	-	Right rear sensor mode	uint8	%	See Table 5.3 0 — Full Dump (0%) 200 – Full Raise (100%)
4	-	Left rear sensor mode	uint8	%	See Table 5.3 0 — Full Dump (0%) 200 – Full Raise (100%)
5	0 to 1	Tag axle position	uint2	-	00b – Tag Axle Position Down 01b – Tag Axle Position Up

6.12.3 Air Suspension Status

This DGN is the heartbeat for the AAS controller. Table 6.12.3a defines the DG attributes, and Table 6.12.3b defines the signal and parameter attributes.

Table 6.12.3a — DG definition

DG attribute	Value
Name	AAS_STATUS
DGN	1FFF2h
Default priority	6
Maximum broadcast gap	1000ms
Normal broadcast gap	On change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.12.3b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	0 to 1	AAS Operating Status	uint2	-	00b - Off 01b - On
	2 to 5	AAS Mode	uint4	-	0000b - Normal 0001b - Fly Mode 0010b – Reset 1110b – Error 1111b - NA
1	-	Left front sensor mode	uint8	%	see Table 5.3 0 — Full Dump (0%) 200 – Full Raise (100%)

2	-	Right front sensor mode	uint8	%	see Table 5.3 0 — Full Dump (0%) 200 – Full Raise (100%)
3	-	Right rear sensor mode	uint8	%	see Table 5.3 0 — Full Dump (0%) 200 – Full Raise (100%)
4	-	Left rear sensor mode	uint8	%	see Table 5.3 0 — Full Dump (0%) 200 – Full Raise (100%)
5	0 to 1	Tag axle position	uint2	-	00b – Tag Axle Position Down 01b – Tag Axle Position Up

6.12.4 Air Suspension Sensor Status

This DG reports the status of the AAS sensors. If there is only a single front ride height control, then it is reported as the Left Front and the Right Front sensor will report No Data. Table 6.12.4a defines the DG attributes, and Table 6.12.4b defines the signal and parameter attributes.

Table 6.12.4a — DG definition

DG attribute	Value
Name	AAS_SENSOR_STATUS
DGN	1FFEFh
Default priority	6
Maximum broadcast gap	1000 ms
Normal broadcast gap	On Change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.12.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	0 to 1	Left front sensor status - Low ride	uint2	-	00b - Under set point 01b - Over set point
	2 to 3	Left front sensor Status - Medium ride	uint2	-	00b - Under set point 01b - Over set point
	4 to 5	Left front sensor status - High ride	uint2	-	00b - Under set point 01b - Over set point
	6 to 7	Left front sensor transition	uint2	-	00b – No Transition 01b – Transition was made (low->high or high->low)
1	0 to 1	Left front quadrature encoder status – Channel A	uint2	-	00b - 0 01b - 1
	2 to 3	Left front quadrature encoder status - Channel B	uint2	-	00b - 0 01b - 1
2	0 to 1	Right front sensor status - Low ride	uint2	-	00b - Under set point 01b - Over set point

	2 to 3	Right front sensor status - Medium ride	uint2	-	00b - Under set point 01b - Over set point
	4 to 5	Right front sensor status - High ride	uint2	-	00b - Under set point 01b - Over set point
	6 to 7	Right front sensor transition	uint2	-	00b – No Transition 01b – Transition was made (low->high or high->low)
3	0 to 1	Right front quadrature encoder status – Channel A	uint2	-	00b - 0 01b - 1
	2 to 3	Right front quadrature encoder status - Channel B	uint2	-	00b - 0 01b - 1
	4 to 5	Steering sensor quadrature encoder status – Channel A	uint2	-	00b - 0 01b - 1
	6 to 7	Steering sensor quadrature encoder status – Channel B	uint2	-	00b - 0 01b - 1
4	0 to 1	Left rear sensor status - Low ride	uint2	-	00b - Under set point 01b - Over set point
	2 to 3	Left rear sensor status - Medium ride	uint2	-	00b - Under set point 01b - Over set point
	4 to 5	Left rear sensor status - High ride	uint2	-	00b - Under set point 01b - Over set point
	6 to 7	Left rear sensor transition	uint2	-	00b – No Transition 01b – Transition was made (low->high or high->low)
5	0 to 1	Left rear quadrature encoder status – Channel A	uint2	-	00b – 0 01b - 1
	2 to 3	Left rear quadrature encoder status - Channel B	uint2	-	00b – 0 01b - 1
6	0 to 1	Right rear sensor status - Low ride	uint2	-	00b - Under set point 01b - Over set point
	2 to 3	Right rear sensor status - Medium ride	uint2	-	00b - Under set point 01b - Over set point
	4 to 5	Right rear sensor status - High ride	uint2	-	00b - Under set point 01b - Over set point
	6 to 7	Right rear sensor transition	uint2	-	00b – No Transition 01b – Transition was made (low->high or high->low)
7	0 to 1	Right rear quadrature encoder status – Channel A	uint2	-	00b – 0 01b - 1
	2 to 3	Right rear quadrature encoder status - Channel B	uint2	-	00b – 0 01b - 1

6.12.5 Air Suspension Pressure Status

This DG reports the air pressures within the suspension. Table 6.12.5a defines the DG attributes, and Table 6.12.5b defines the signal and parameter attributes.

Table 6.12.5a – DG definition

DG attribute	Value
Name	SUSPENSION_AIR_PRESSURE_STATUS
DGN	1FED1h
Default priority	3
Maximum broadcast gap	N/A
Normal broadcast gap	100 ms
Minimum broadcast gap	50 ms
Number of frames	1
ACK requirements	None

Table 6.12.5b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Suspension System Supply Pressure	uint8	psi	Precision = 1 psi Value Range = 0 to 250 psi
1	-	Steer Axle, Left Air Spring	uint8	psi	Precision = 1 psi Value Range = 0 to 250 psi
2	-	Steer Axle, Right Air Spring	uint8	psi	Precision = 1 psi Value Range = 0 to 250 psi
3	-	Drive Axle, Left Air Spring	uint8	psi	Precision = 1 psi Value Range = 0 to 250 psi
4	-	Drive Axle, Right Air Spring	uint8	psi	Precision = 1 psi Value Range = 0 to 250 psi
5	-	Tag Axle, Left Air Spring	uint8	psi	Precision = 1 psi Value Range = 0 to 250 psi
6	-	Tag Axle, Right Air Spring	uint8	psi	Precision = 1 psi Value Range = 0 to 250 psi

6.12.6 Service Points

These are the allowable Service Points for this DGN (see Table 6.12.6).

Table 6.12.6— Service Points

SPN	Description
0 to 255	Standard SPNs (see Table 7.3)
256	Left Front Sensor Mode
257	Right Front Sensor Mode
258	Right Rear Sensor Mode
259	Left Rear Sensor Mode
260	Height Correction Threshold Time
261	Solenoid On Time

262	AAS Mode
263	Left Front Sensor - Low Ride
264	Left Front Sensor - Medium Ride
265	Left Front Sensor - High Ride
266	Left Front Quadrature Encoder - Channel A
267	Left Front Quadrature Encoder - Channel B
268	Right Front Sensor - Low Ride
269	Right Front Sensor - Medium Ride
270	Right Front Sensor - High Ride
271	Right Front Quadrature Encoder - Channel A
272	Right Front Quadrature Encoder - Channel B
273	Left Rear Sensor - Low Ride
274	Left Rear Sensor - Medium Ride
275	Left Rear Sensor - High Ride
276	Left Rear Quadrature Encoder - Channel A
277	Left Rear Quadrature Encoder - Channel B
278	Right Rear Sensor - Low Ride
279	Right Rear Sensor - Medium Ride
280	Right Rear Sensor - High Ride
281	Right Rear Quadrature Encoder - Channel A
282	Right Rear Quadrature Encoder - Channel B

6.12.7 Alarms

Table 6.12.7a

Alarm Instance	Description
1	Tag Axle Dumped
2	Operating Status Off
3	Operating Status On
4	Not at Ride Height

6.12.8 Test Profiles

6.12.8a AAS Command & Status

ID	Datum	Test	Response
	AAS Command	User initiated command	AAS_Status responds with correct information or NAK

6.12.8b AAS Sensor Status

ID	Datum	Test	Response
	AAS Sensor Status	On change or on DGN request	Report sensor status

6.12.8c Suspension Air Pressure Status

ID	Datum	Test	Response
	Suspension Air Pressure Status	On change or on DGN request	Report pressure for each axle present along with system supply pressure.

6.13 Leveling System Controller

6.13.1 Introduction

These DGNs provide an interface for the controller for an RV leveling system. It may include an integrated control panel. No provisions have been made for two leveling controllers in the system. The protocol as defined only allows a single controller that has both air and hydraulic modes. The following formats apply (see Table 6.13.1).

Table 6.13.1 — Leveling system controller definition

Device attribute	Value
Category	Mechanical Components
Default Source Address	81 for Controller Only 82 for Hydraulic System 83 for Air System
Dynamic Address Range	176 to 191
Instance	Single

6.13.2 Leveling Control Status

This is the primary status response for controlling leveling systems. The addressing of the jacks or bags follows the convention in LEVELING_CONTROL_COMMAND. Note that the Air and Hydraulic levelers share this DGN when reporting their status. The first byte indicates whether the Lower/Raise operations in subsequent bytes refer to air or hydraulic actions. Table 6.13.2a defines the DG attributes, and Table 6.13.2b defines the signal and parameter attributes.

6Table 6.13.2a — DG definition

DG attribute	Value
Name	LEVELING_CONTROL_STATUS
DGN	1FFEDh
Default priority	3
Maximum broadcast gap	1000 ms when system active
Normal broadcast gap	On change
Minimum broadcast gap	100 ms when system active
Number of frames	1
ACK requirements	None

Table 6.13.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Operating mode	uint8	-	0 - Inactive 1 - Suspension raise (all air springs) active 2 - Suspension dump (all air springs) active 3 - Store active (store jacks/go to ride height) 4 - Manual air leveling. 5 - Automatic air leveling active 6 - Start deploy kick-down jacks 7 - Manual hydraulic leveling 8 - Automatic hydraulic/electric leveling active 9 - Kneel active (dump front bags only) 10 - Auto Hitch Height 11 - Abort Function 12 – Careen Left. (i.e. Tilt towards street side.) 13 – Careen Right. (i.e. Tilt towards curb side.) 14 – Squat. (i.e. Dump rear bags only.) 34 - Jack calibration mode 41 - Manual air leveling - Four point 42 - Manual air leveling - Biax mode 43 - Manual air leveling - 3 point mode 44 - Manual air leveling - Multi point mode 5+ 51 – Automatic air leveling – Four point 52 – Automatic air leveling – Biax mode 53 - Automatic air leveling – 3 point mode 54 - Automatic air leveling - Multi point mode 5+ 71 - Manual hydraulic/electric leveling - Four point 72 - Manual hydraulic/electric leveling - Biax mode 73 - Manual hydraulic/electric leveling - 3 point mode 74 - Manual hydraulic leveling - Multi point mode 5+ 81 – Automatic hydraulic leveling – Four point 82 – Automatic hydraulic leveling – Biax mode 83 – Automatic hydraulic leveling – 3 point mode 84 - Automatic hydraulic leveling - Multi point mode 5+ 99 - Acknowledge / Clear jack error
1	0 to 1	Automatic Jack stabilization status	uint2	-	00b - Automatic jack stabilization not in process 01b - Automatic jack stabilization in process
	2 to 3	Air leveling sleep mode	uint2	-	00b - Air leveling in active mode 01b - Air leveling in sleep mode (Unit shall awaken periodically to re-level RV)
	4 to 5	Air re-leveling mode	uint2	-	00b - Re-leveling not active 01b - Air re-leveling in process
2	0 to 1	Excessive slope initial warning	uint2	-	00b - No warning 01b – Warning - excessive slope prevents leveling; unit shall try again later.
	2 to 3	Excessive slope final warning	uint2	-	00b - No warning 01b – Warning - excessive slope prevents leveling; no further attempt shall be made

	4 to 5	Leveling system master warning	uint2	-	00b - No warning 01b – Warning This bit field was added as a way to signal a general warning such as jacks are deployed, etc. This should be deprecated in favor of the newer "GENERIC_ALARM" DGN's
3	0 to 1	Jack Retracting -OR- Air Spring Dumping - Left rear	uint2	-	00b - Off 01b - On
	2 to 3	Jack Extending -OR- Air Spring Filling - Left rear	uint2	-	00b - Off 01b - On
	4 to 5	Jack Retracting -OR- Air Spring Dumping - Right front - N/A (three point)	uint2	-	00b - Off 01b - On
	6 to 7	Jack Extending -OR- Air Spring Filling - Right front - N/A (three point)	uint2	-	00b - Off 01b - On
4	0 to 1	Jack Retracting -OR- Air Spring Dumping - Right rear	uint2	-	00b - Off 01b - On
	2 to 3	Jack Extending -OR- Air Spring Filling - Right rear	uint2	-	00b - Off 01b - On
	4 to 5	Jack Retracting -OR- Air Spring Dumping - Left front - Front (three point)	uint2	-	00b - Off 01b - On
	6 to 7	Jack Extending -OR- Air Spring Filling - Left front - Front (three point)	uint2	-	00b - Off 01b - On
5	0 to 1	Jack Retracting -OR- Air Spring Dumping -Left Middle	uint2	-	00b - Off 01b - On
	2 to 3	Jack Extending -OR- Air Spring Filling - Left Middle	uint2	-	00b - Off 01b - On
	4 to 5	Jack Retracting -OR- Air Spring Dumping - Right Middle	uint2	-	00b - Off 01b - On
	6 to 7	Jack Extending -OR- Air Spring Filling - Right Middle	uint2	-	00b - Off 01b - On
6	0 to 1	Jack Retracting - Tongue	uint2	-	00b - Off 01b - On
	2 to 3	Jack Extending - Tongue	uint2	-	00b - Off 01b - On

7	0 to 1	Park Brake	uint2	-	00b - Leveling system may operate 01b - Leveling system may not operate because of Park Brake status. The status of the park brake lock, typically derived from the Chassis Mobility Status DGN but possibly from another source.
	2 to 3	Ignition Key	uint2	-	00b - Leveling system may operate 01b - Leveling system may not operate because of Ignition status. The status of the ignition lock, typically derived from the Chassis Mobility Status DGN but possibly from another source.
	4 to 5	Low Voltage	uint2	-	00b - Leveling system may operate 01b - Leveling system may not operate because of Low Voltage status.
	6 to 7	Other Lockout	uint2	-	00b - Leveling system may operate 01b - Leveling system may not operate because of an additional lockout.

6.13.3 Leveling Control Command

This is the primary DG command for controlling the leveling systems. The Operating Mode determines the nature of the command. When a manual mode is chosen (#4 or #6), the remainder of the DG must be analyzed to determine which jacks or bags are being controlled. In the other modes the rest of the DG is ignored.

There are two general methods for levelers to be addressed. In a conventional four-point system, they are labeled left-front, right-front, left-rear, and right-rear. In a bi-axis system, units move in pairs and are labeled front, rear, left, and right. In a three-point system they are front, left rear, and right rear.

Table 6.13.3a defines the DG attributes, and Table 6.13.3b defines the signal and parameter attributes.

Table 6.13.3a — DG definition

DG attribute	Value
Name	LEVELING_CONTROL_COMMAND
DGN	1FFEEh
Default priority	3
Maximum broadcast gap	N/A
Normal broadcast gap	on change or 100 ms when manually controlling the system
Minimum broadcast gap	100 ms when system active
Number of frames	1
ACK requirements	ACK always, LEVELING_CONTROL_STATUS

Table 6.13.3b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	-	Operating mode	uint8	-	0 – Inactive 1 - Suspension raise (all air springs) active 2 - Suspension dump (all air springs) active 3 - Store active (store jacks/go to ride height) 4 - Manual air leveling (Deprecated in favor of 41-44) 5 - Automatic air leveling started 6 - Start deploy kick-down jacks 7 - Manual hydraulic leveling (Deprecated in favor of 71-74) 8 - Automatic hydraulic/electric leveling started 9 - Kneel started (dump front air springs only) 10 – Auto hitch height 11 - Abort Function

					12 – Careen Left. (i.e. Tilt towards street side.) 13 – Careen Right. (i.e. Tilt towards curb side.) 14 – Squat. (i.e. Dump rear bags only.) 34 - Jack calibration mode 41 - Manual air leveling - Four point 42 - Manual air leveling - Biax mode 43 - Manual air leveling - 3 point mode 44 - Manual air leveling - Multi point mode 5+ 51 – Automatic air leveling – Four point 52 – Automatic air leveling – Biax mode 53 - Automatic air leveling – 3 point mode 54 - Automatic air leveling - Multi point mode 5+ 71 - Manual hydraulic/electric leveling - Four point 72 - Manual hydraulic/electric leveling - Biax mode 73 - Manual hydraulic/electric leveling - 3 point mode 74 - Manual hydraulic leveling - Multi point mode 5+ 81 – Automatic hydraulic leveling – Four point 82 – Automatic hydraulic leveling – Biax mode 83 – Automatic hydraulic leveling – 3 point mode 84 - Automatic hydraulic leveling - Multi point mode 5+ 99 - Clear Jack error
1	0 to 1	Jack Retract -OR- Air Spring Dump - Left rear	uint2	-	00b - Off 01b - On
	2 to 3	Jack Extend -OR- Air Spring Fill	uint2	-	00b - Off 01b - On
	4 to 5	Jack Retract -OR- Air Spring Dump - Right front - N/A (three point)	uint2	-	00b - Off 01b - On
	6 to 7	Jack Extend -OR- Air Spring Fill - Right front - N/A (three point)	uint2	-	00b - Off 01b - On
2	0 to 2	Jack Retract -OR- Air Spring Dump -Right rear	uint2	-	00b - Off 01b - On
	2 to 3	Jack Extend -OR- Air Spring Fill - Right rear	uint2	-	00b - Off 01b - On
	4 to 5	Jack Retract -OR- Air Spring Dump - Left front	uint2	-	00b - Off 01b - On
	6 to 7	Jack Extend -OR- Air Spring Fill - Left front	uint2	-	00b - Off 01b - On
3	0 to 1	Jack Retract -OR- Air Spring Dump - Left middle (multi	uint2	-	00b - Off 01b - On

		point)			
	2 to 3	Jack Extend -OR- Air Spring Fill - Left middle (multi point)	uint2	-	00b - Off 01b - On
	4 to 5	Jack Retract -OR- Air Spring Dump - Right middle (multi point)	uint2	-	00b - Off 01b - On
	6 to 7	Jack Extend -OR- Air Spring Fill - Right middle (multi point)	uint2	-	00b - Off 01b - On
4	0 to 1	Jack Retract - Tongue (multi point)	uint2	-	00b - Off 01b - On
	2 to 3	Jack Extend - Tongue (multi point)	uint2	-	00b - Off 01b - On

6.13.4 Leveling Jacks Status

This is the primary status response for controlling the leveling systems. The addressing of the jacks or bags follows the convention in LEVELING_CONTROL_COMMAND. The Auxiliary Jack provisions enable the addressing of more than four jacks, which occasionally occurs in some unusual applications. Table 6.13.4a defines the DG attributes, and Table 6.13.4b defines the signal and parameter attributes.

Table 6.13.4a — DG definition

DG attribute	Value
Name	LEVELING_JACK_STATUS
DGN	1FFECh
Default priority	3
Maximum broadcast gap	1000 ms
Normal broadcast gap	on change
Minimum broadcast gap	50 ms
Number of frames	1
ACK requirements	None

Table 6.13.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	0 to 3	Jack type	uint4	-	0 – Straight Acting 1 - Kick-Down
	4 to 7	Number of jacks	uint4	-	
1	0 to 1	Extension - Left rear (four point) - Left rear (three point)	uint2	-	00b - No Action 01b - Jack is Extended. Coach is not safe to move.
	2 to 3	Extension - Right front (four point) - N/A (three point)	uint2	-	00b - No Action 01b - Jack is Extended. Coach is not safe to move.

	4 to 5	Extension - Right rear (four point) - Right rear (three point)	uint2	-	00b - No Action 01b - Jack is Extended. Coach is not safe to move.
	6 to 7	Extension - Left front (four point) - Front (three point)	uint2	-	00b - No action 01b - Jack is extended. Coach is not safe to move.
2	0 to 1	Extension - Auxiliary jack #1	uint2	-	00b - No action 01b – Jack is extended. Coach is not safe to move.
	2 to 3	Extension - Auxiliary jack #2	uint2	-	00b - No action 01b – Jack is extended. Coach is not safe to move.
	4 to 5	Extension - Auxiliary jack #3	uint2	-	00b - No action 01b – Jack is extended. Coach is not safe to move.
	6 to 7	Extension - Auxiliary jack #4	uint2	-	00b - No action 01b – Jack is extended. Coach is not safe to move.
3	0 to 1	Stability - Left rear (four point) - Left rear (three point)	uint2	-	00b - No action 01b - Pressure detected. Jack is bearing weight on the ground.
	2 to 3	Stability - Right front (four point) - N/A (three point)	uint2	-	00b - No action 01b - Pressure detected. Jack is bearing weight on the ground.
	4 to 5	Stability - Right rear (four point) - Right rear (three point)	uint2	-	00b - No action 01b - Pressure detected. Jack is bearing weight on the ground.
	6 to 7	Stability - Left front (four point) - Front (three point)	uint2	-	00b - No action 01b - Pressure detected. Jack is bearing weight on the ground.
4	0 to 1	Stability - Auxiliary jack #1	uint2	-	00b - No action 01b - Pressure detected. Jack is bearing weight on the ground.
	2 to 3	Stability - Auxiliary jack #2	uint2	-	00b - No action 01b - Pressure detected. Jack is bearing weight on the ground.
	4 to 5	Stability - Auxiliary jack #3	uint2	-	00b - No action 01b - Pressure detected. Jack is bearing weight on the ground.
	6 to 7	Stability - Auxiliary jack #4	uint2	-	00b - No action 01b - Pressure detected. Jack is bearing weight on the ground.

6.13.5 Level Sensor Status

Level sensors may be analog or simple switches. Instancing is optional for Level Sensors. Some systems may have a single sensor, in which case Byte 7 can be filled with FFh. Table 6.13.5a defines the DG attributes, and Table 6.13.5b defines the signal and parameter attributes.

Table 6.13.5a — DG definition

DG attribute	Value
Name	LEVELING_SENSOR_STATUS
DGN	1FFEBh
Default priority	3

Maximum broadcast gap	5000 ms
Normal broadcast gap	on change
Minimum broadcast gap	50 ms
Number of frames	1
ACK requirements	None

Table 6.13.5b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	0 to 1	Vehicle attitude – Driver side	uint2	-	00b - Side is at or above level 01b - Side is below level
	2 to 3	Vehicle attitude – Front	uint2	-	00b - Side is at or above level 01b - Side is below level
	4 to 5	Vehicle attitude – Passenger side	uint2	-	00b - Side is at or above level 01b - Side is below level
	6 to 7	Vehicle attitude – Rear	uint2	-	00b - Side is at or above level 01b - Side is below level
1 to 2	-	Pitch	uint16	deg	Precision = 1/128 Deg Offset = –200 Deg Value range = –200 to 300 Deg Negative = Nose is low Positive = Nose is high 0 = Level
3 to 4	-	Roll	uint16	deg	Precision = 1/128 Deg 0ffset = –200 Deg Value range = –200 to 300 Deg Negative = Driver side is low Positive = Driver side is high 0 = Level
5 to 6	-	Secondary Pitch	uint16	deg	Precision = 1/128 Deg Offset = –200 Deg Value range = –200 to 300 Deg Negative = Nose is low Positive = Nose is high 0 = Level
7	-	Instance	uint8	-	0 - 250 = Sensor instance 255 = Single sensor system

6.13.6 Leveling Sensor Pitch Configuration

This DG allows the configuration of one or more level sensors to report the vehicle pitch attitude as described in LEVELING_SENSOR_STATUS according to a defined set of parameters. It also allows setting a relative “zero” level point. Table 6.13.6a defines the DG attributes, and Table 6.13.6b defines the signal and parameter attributes.

Table 6.13.6a — DG definition

DG attribute	Value
Name	LEVELING_SENSOR_PITCH_CONFIG_STATUS
DGN	1FDE9h
Default priority	6

Maximum broadcast gap	N/A
Normal broadcast gap	on change
Minimum broadcast gap	100 ms when system is active
Number of frames	1
ACK requirements	None

Table 6.13.6b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	0 = All sensors 1-250 = Sensor Instance
1 to 2		Pitch setting for out of level condition	uint16	deg	Precision = 1/128 deg Offset = -200 deg Value Range = -200 to 300 deg
3 to 4		Pitch setting for within level condition.	uint16	deg	Precision = 1/128 deg Offset = -200 deg Value Range = -200 to 300 deg
5	0 to 1	Set relative zero point (pitch)	uint2		00b - no action 01b - set relative zero point to current pitch value

6.13.7 Leveling Sensor Roll Configuration Status

This DG allows the configuration of one or more level sensors to report the vehicle pitch attitude as described in LEVELING_SENSOR_STATUS according to a defined set of parameters. It also allows setting a relative “zero” level point. Table 6.13.7a defines the DG attributes, and Table 6.13.7b defines the signal and parameter attributes.

Table 6.13.7a — DG definition

DG attribute	Value
Name	LEVELING_SENSOR_ROLL_CONFIG_STATUS
DGN	1FDEBh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change
Minimum broadcast gap	100 ms when system is active
Number of frames	1
ACK requirements	None

Table 6.13.7b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	0 = All sensors 1-250 = Sensor i\Instance
1 to 2		Roll setting for out of level condition	uint16	deg	Precision = 1/128 deg Offset = -200 deg Value Range = -200 to 300 deg

3 to 4		Roll setting for within level condition.	uint16	deg	Precision = 1/128 deg Offset = -200 deg Value Range = -200 to 300 deg
5	0 to 1	Set relative zero point (roll)	uint2		00b - no action 01b - set relative zero point to current roll value

6.13.8 Leveling Sensor Pitch and Roll Configuration Commands

These DGs allows the configuration of one or more level sensors to report the vehicle pitch/roll attitude as described in LEVELING_SENSOR_STATUS. They also allow setting a relative “zero” level point. Table 6.13.8a defines the DG attributes. The signal and parameter attributes are given in the corresponding status DGs, in Table 6.13.6b and Table 6.13.7b.

Table 6.13.8a — DG definition

DG attribute	Value
Name	LEVELING_SENSOR_PITCH_CONFIG_COMMAND LEVELING_SENSOR_ROLL_CONFIG_COMMAND
DGN	1FDE8h 1FDEAh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	as needed
Minimum broadcast gap	100 ms when system is active
Number of frames	1
ACK requirements	ACK Always if Set Relative Zero Point is included in command. NAK, LEVELING_SENSOR_PITCH_CONFIG_STATUS NAK, LEVELING_SENSOR_ROLL_CONFIG_STATUS

6.13.9 Hydraulic Pump Status

The hydraulic pump may also be used for slide room control. Table 6.13.9a defines the DG attributes, and Table 6.13.9a defines the signal and parameter attributes.

Table 6.13.9a — DG definition

DG attribute	Value
Name	HYDRAULIC_PUMP_STATUS
DGN	1FFEAh
Default priority	6
Maximum broadcast gap	100 ms when commanding pump on
Normal broadcast gap	on change
Minimum broadcast gap	200 ms
Number of frames	1
ACK requirements	NAK, HYDRAULIC_PUMP_STATUS

Table 6.13.9b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	0 to 1	Pump manifold high pressure switch	uint2	-	00b - Switch is inactive 01b - Maximum pressure is attained
	2 to 3	Pump manifold minimum pressure switch	uint2	-	00b - Switch is inactive 01b - Minimum operating pressure attained
	4 to 5	Pump manifold low fluid switch	uint2	-	00b - Switch is inactive 01b - Low fluid level detected
	6 to 7	Pump Run Status	uint2	-	00b - Pump is not running 01b - Pump is running
1	0 to 1	Pump Direction	uint2	-	00b - Pump is running forwards 01b - Pump is reversed, or a reversing valve is active
2 to 3	-	Voltage	uint16	V	see Table 5.3
4	-	Current	uint8	A	see Table 5.3
5	-	Motor temperature	uint8	°C	see Table 5.3

6.13.10 Hydraulic Pump Command

The hydraulic pump may also be used for slide room control. Table 6.13.10a defines the DG attributes, and Table 6.13.10b defines the signal and parameter attributes.

Table 6.13.10a — DG definition

DG attribute	Value
Name	HYDRAULIC_PUMP_COMMAND
DGN	1FEBCh
Default priority	6
Maximum broadcast gap	100 ms
Normal broadcast gap	on change or when commanding when pump is on
Minimum broadcast gap	50 ms
Number of frames	1
ACK requirements	NAK, HYDRAULIC_PUMP_STATUS

Table 6.13.10b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	0 to 1	Pump Run	uint2	-	00b - Command Pump Off 01b - Command Pump On
	2 to 3	Pump Direction	uint2	-	00b - Pump to run forwards 01b - Pump to run reversed, or a reversing valve is activated

6.13.11 Air Leveling Status

This is the air leveling equivalent to the hydraulic jack status above. Table 6.13.11a defines the DG attributes, and Table 6.13.11b defines the signal and parameter attributes.

Table 6.13.11a — DG definition

DG attribute	Value
Name	LEVELING_AIR_STATUS
DGN	1FFE9h
Default priority	3
Maximum broadcast gap	1000 ms
Normal broadcast gap	on change
Minimum broadcast gap	50 ms
Number of frames	1
ACK requirements	None

Table 6.13.11b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	0 to 1	Air bag pressure - Left rear (four point) - Left rear (three point)	uint2	-	00b - Pressure OK 01b - Low air pressure detected
	2 to 3	Air bag pressure - Right front (four point) - N/A (three point)	uint2	-	00b - Pressure OK 01b - Low air pressure detected
	4 to 5	Air bag pressure - Right rear (four point) - Right rear (three point)	uint2	-	00b - Pressure OK 01b - Low air pressure detected
	6 to 7	Air bag pressure - Left front (four point) - Front (three point)	uint2	-	00b - Pressure OK 01b - Low air pressure detected
1	0 to 1	Tag axle air pressure - Left	uint2	-	00b - Pressure OK 01b - Low air pressure detected
	2 to 3	Tag axle air pressure - Right	uint2	-	00b - Pressure OK 01b - Low air pressure detected
2	0 to 1	System air pressure	uint2	-	00b - Pressure OK 01b - Low air pressure detected

6.13.12 Service Points

These are the allowable Service Points for this DGN (see Table 6.13.12).

Table 6.13.12 — Service Points

SPN	Description
0 to 255	Standard SPNs (see Table 7.3)
256	Jack Extension Sensor - Left Rear
257	Jack Extension Sensor - Right Front
258	Jack Extension Sensor - Right Rear
259	Jack Extension Sensor - Left Front (four point) / Front (three point)

260	Jack Extension Sensor - Auxiliary Jack #1
261	Jack Extension Sensor - Auxiliary Jack #2
262	Jack Extension Sensor - Auxiliary Jack #3
263	Jack Extension Sensor - Auxiliary Jack #4
264	Jack Stability Sensor - Left Rear
265	Jack Stability Sensor - Right Front
266	Jack Stability Sensor - Right Rear
267	Jack Stability Sensor - Left Front (four point) / Front (three point)
268	Jack Stability Sensor - Auxiliary Jack #1
269	Jack Stability Sensor - Auxiliary Jack #2
270	Jack Stability Sensor - Auxiliary Jack #3
271	Jack Stability Sensor - Auxiliary Jack #4
272	Vehicle Attitude Sensor
273	Pitch
274	Roll
275	Secondary Pitch
276	Hydraulic Pump manifold high pressure switch
277	Hydraulic Pump manifold minimum pressure switch
278	Hydraulic Pump manifold low fluid switch
279	Hydraulic Pump Run Status
280	Hydraulic Pump Motor Voltage
281	Hydraulic Pump Motor Current
282	Hydraulic Pump Motor Temperature
284	Air Bag Pressure Sensor – Left Rear
285	Air Bag Pressure Sensor – Right Front (four point)
286	Air Bag Pressure Sensor – Right Rear
287	Air Bag Pressure Sensor – Left Front (four point) / Front (three point)
288	Tag Axle Air Pressure Sensor – Left
289	Tag Axle Air Pressure Sensor - Right
290	System Air Pressure Sensor
291	Air Compressor Run Status
292	Jack Motor/Harness – Left Rear
293	Jack Motor/Harness – Right Front
294	Jack Motor/Harness – Right Rear

295	Jack Motor/Harness – Left Front
296	Jack Motor/Harness – Auxiliary Jack #1
297	Jack Motor/Harness – Auxiliary Jack #2
310	Level Sensor
311	Front Remote Sensor
312	Rear Remote Sensor
320	Jack Extension – Left Front
321	Jack Extension – Auxiliary Jack #1
322	Jack Extension – Left Rear
323	Jack Extension – Right Front
324	Jack Extension – Auxiliary Jack #2
325	Jack Extension – Right Rear
326	Jack Extension – Auxiliary Jack #3
327	Jack Extend/Retract Solenoid Valve – Left Rear (Single valve application)
328	Jack Retract Solenoid Valve – Left Rear
329	Jack Extend/Retract Solenoid Valve – Right Front (Single valve application)
330	Jack Retract Solenoid Valve – Right Front
331	Jack Extend/Retract Solenoid Valve – Right Rear (Single valve application)
332	Jack Retract Solenoid Valve – Right Rear
333	Jack Extend/Retract Solenoid Valve – Left Front (Single valve application)
334	Jack Retract Solenoid Valve – Left Front
335	Jack Extend/Retract Solenoid Valve – Auxiliary Jack #1 (Single valve application)
336	Jack Retract Solenoid Valve – Auxiliary Jack #1
337	Jack Extend/Retract Solenoid Valve – Auxiliary Jack #2 (Single valve application)
338	Jack Retract Solenoid Valve – Auxiliary Jack #2
339	Hydraulic Pump Motor Contactor

6.13.13 Alarms

Table 6.13.13

Alarm Instance	Description
1	Vehicle not level
2	Jacks not stowed (one more more jacks not fully retracted)
3	Jacks extending
4	Jacks retracting
5	Jack retraction triggered by external event (park brake, etc)

6.13.14 Test Profile

6.13.14.1 Profile 81B: Basic Hydraulic/Electric Leveling System

A Leveling System with no automation or an automatic system in manual mode.
Prerequisites: None

Reporting

ID	Datum	Test	Required Response
81B-R-01	User Initiated Manual Leveling Command	a. Trigger Manual Leveling by user command	a. User initiated manual leveling command is broadcast.

Command Response

ID	Datum	Test	Required Response
81C-R-01	Operating Mode	a. Send 0	a. Unit shall stop within 50ms
		b. Send 71 in conjunction with bit fields as shown in table 6.13.3b	b. Unit shall send ACK and begin to extend or retract appropriate jacks, and continue for up to 250ms, OR send NAK if this mode is not supported.
		c. Send 72 in conjunction with bit fields as shown in table 6.13.3b	c. Unit shall send ACK and begin to extend or retract appropriate jacks, and continue for up to 250ms, OR send NAK if this mode is not supported.
		d. Send 73 in conjunction with bit fields as shown in table 6.13.3b	d. Unit shall send ACK and begin to extend or retract appropriate jacks, and continue for up to 250ms, OR send NAK if this mode is not supported.

Table 6.13.14.1a – Four Point (Independent) Operating Mode 71

Function	Byte 1 0 to 1	Byte 1 2 to 3	Byte 1 4 to 5	Byte 1 6 to 7	Byte 2 0 to 1	Byte 2 2 to 3	Byte 2 4 to 5	Byte 2 6 to 7
Left Rear Lower	01b	00b	00b	00b	00b	00b	00b	00b
Left Rear Raise	00b	01b	00b	00b	00b	00b	00b	00b
Right Front Lower	00b	00b	01b	00b	00b	00b	00b	00b
Right Front Raise	00b	00b	00b	01b	00b	00b	00b	00b
Right Rear Lower	00b	00b	00b	00b	01b	00b	00b	00b
Right Rear Raise	00b	00b	00b	00b	00b	01b	00b	00b
Left Front Lower	00b	00b	00b	00b	00b	00b	01b	00b
Left Front Raise	00b	00b	00b	00b	00b	00b	00b	01b

Table 6.13.14.1b – Bi-Axis Operating Mode 72

Function	Byte 1 0 to 1	Byte 1 2 to 3	Byte 1 4 to 5	Byte 1 6 to 7	Byte 2 0 to 1	Byte 2 2 to 3	Byte 2 4 to 5	Byte 2 6 to 7
Rear Lower	01b	00b	00b	00b	00b	00b	00b	00b
Rear Raise	00b	01b	00b	00b	00b	00b	00b	00b
Front Lower	00b	00b	01b	00b	00b	00b	00b	00b
Front Raise	00b	00b	00b	01b	00b	00b	00b	00b
Right Lower	00b	00b	00b	00b	01b	00b	00b	00b
Right Raise	00b	00b	00b	00b	00b	01b	00b	00b
Left Lower	00b	00b	00b	00b	00b	00b	01b	00b
Left Raise	00b	00b	00b	00b	00b	00b	00b	01b

Table 6.13.14.1c – Three Point Operating Mode 73

Function	Byte 1 0 to 1	Byte 1 2 to 3	Byte 1 4 to 5	Byte 1 6 to 7	Byte 2 0 to 1	Byte 2 2 to 3	Byte 2 4 to 5	Byte 2 6 to 7
Left Rear Lower	01b	00b	00b	00b	00b	00b	00b	00b
Left Rear Raise	00b	01b	00b	00b	00b	00b	00b	00b
Right Rear Lower	00b	00b	00b	00b	01b	00b	00b	00b
Right Rear Raise	00b	00b	00b	00b	00b	01b	00b	00b
Front Lower	00b	00b	00b	00b	00b	00b	01b	00b
Front Raise	00b	00b	00b	00b	00b	00b	00b	01b

6.14 Slide Room

These DGNs contain control information for the slide rooms, including generator and step slides. Convention numbers room slides beginning with room 1 at the driver's side front and increments counter clockwise to room 4 at passenger side front. Exceptions to this convention occur when there are fewer than 4 rooms. For example: If there are 3 rooms but there is no passenger side rear room, the passenger side front is room 3 rather than room 4. The following formats apply (see Table 5.3). Though Steps have historically been covered under Slides any current Step slides should refer to the Step DGN.

Table 6.14 — Slide room definition

Device attribute	Value
Category	Mechanical Components
Default Source Address	84 to 87
Dynamic Address Range	176 to 191
Instance	Multiple

6.14.1 Slideout Status

Many of the status items in the DGN are data items that may be derived from other nodes on the network. For example, the Brake Status here may be derived from the Park Brake Status from CHASSIS_MOBILITY_STATUS. The specific meaning here is that the slide is prevented from moving because it believes that the park brake is not set. Other nodes should consult the CHASSIS_MOBILITY_STATUS to determine whether the brake is actually set, not this DGN. Table 6.14.1a defines the DG attributes, and Table 6.14.1b defines the signal and parameter attributes.

Table 6.14.1a — DG definition

DG attribute	Value
Name	SLIDE_STATUS
DGN	1FFE8h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change 100 ms when the slide is in motion.
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

Table 6.14.1b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	-	Instance	uint8	-	1 - Room 1 2 - Room 2 3 - Room 3 4 - Room 4 5 – Generator
1	-	Motion	uint8	-	0 - No motion 1 – Extending 2 - Retracting
2	-	Position	uint8	%	see Table 5.3 0 – Retracted 200 - 100% Extended Products that only know that the slide is neither in nor out shall report 50%.
3	0 to 1	Lock status	uint2	-	00b - Slide is secured 01b - Slide is not secured
	2 to 3	Unlock status	uint2	-	00b - Slide is unlocked and ready to move 01b - Slide is not unlocked and shall not be moved
	5 to 6	User lock status	uint2	-	00b - User lock is not activated (Slide is OK to move) 01b - User lock is activated (Slide shall not move)
	6 to 7	Brake status	uint2	-	00b - All motor brake are not locked 01b - One or more motor brake is locked
4	0 to 1	Park brake	uint2	-	00b - Slide may move 01b - Slide shall not move because of park

					brake status
	2 to 3	Leveling jacks	uint2	-	00b - Slide may move 01b - Slide shall not move because of leveler status
	4 to 5	Ignition key	uint2	-	00b - Slide may move 01b - Slide shall not move because of ignition status
	6 to 7	Air seal	uint2	-	00b - Slide may move 01b - Slide shall not move because of air seal status
5	0 to 1	Low voltage	uint2	-	00b - Slide may move 01b - Slide shall not move because of low voltage status

6.14.2 Slideout Command

This DGN triggers slide actions. The Direction of Movement command to Extend or Retract must be repeated every 100ms to keep the slide in motion. The Direction of Movement to Stop does not need to be repeated, but it should be sent to stop the motion.
Table 6.14.2a defines the DG attributes, and Table 6.14.2b defines the signal and parameter attributes.

Table 6.14.2a — DG definition

DG attribute	Value
Name	SLIDE_COMMAND
DGN	1FFE7h
Default priority	3
Maximum broadcast gap	N/A
Normal broadcast gap	on change 100 ms when slide is in motion
Minimum broadcast gap	50 ms
Number of frames	1
ACK requirements	NAK, SLIDE_STATUS

Table 6.14.2b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	-	Instance	uint8	-	1 - Room 1 2 - Room2 3 - Room3 4 - Room4 5 - Generator 6 – Step (deprecated) 7 - Step cover Step can now be located on the Step Command and Step Status DGN's. Any new products should refer to said DGN's

1	0 to 1	User lock	uint2	-	00b - Release user lock 01b - Set user lock
	2 to 3	Air seal deflate	uint2	-	00b – Off 01b - Begin deflation
	4 to 5	Air seal vacuum	uint2	-	00b - Off 01b - Begin evacuation
	6 to 7	Mechanical lock	uint2	-	00b - Disengage lock 01b - Engage lock
2	-	Direction of movement	uint8	-	0 - Stop 1 - Extend 2 – Retract 255 – Do not change status

6.14.3 Slide Sensor Status

If the slide has sensors to detect its position and the status of various locks and switches, this is the DGN to report that information. Table 6.14.3a defines the DG attributes, and Table 6.14.3b defines the signal and parameter attributes.

Table 6.14.3a — DG definition

DG attribute	Value
Name	SLIDE_SENSOR_STATUS
DGN	1FFE6h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	on change or 500ms when slide is in motion
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

Table 6.14.3b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	-	Instance	uint8	-	1 - Room 1 2 - Room2 3 - Room3 4 - Room4 5 - Generator 6 – Step (deprecated) 7 - Step cover Step can now be located on the Step Command and Step Status DGN's. Any new products should refer to said DGN's
1	0 to 1	Slide lock limit switch - Upper front	uint2	-	00b - Slide is not locked 01b - Slide is locked
	2 to 3	Slide lock limit switch -	uint2	-	00b - Slide is not locked

		Upper rear			01b - Slide is locked
	4 to 5	Slide lock limit switch - Lower front	uint2	-	00b - Slide is not locked 01b - Slide is locked
	6 to 7	Slide lock limit switch - Lower rear	uint2	-	00b - Slide is not locked 01b - Slide is locked
2	0 to 1	Slide unlock limit switch – Upper front	uint2	-	00b - Slide is not unlocked 01b - Slide is unlocked
	2 to 3	Slide unlock limit switch - Upper rear	uint2	-	00b - Slide is not unlocked 01b - Slide is unlocked
	4 to 5	Slide unlock limit switch - Lower front	uint2	-	00b - Slide is not unlocked 01b - Slide is unlocked
	6 to 7	Slide unlock limit switch - Lower rear	uint2	-	00b - Slide is not unlocked 01b - Slide is unlocked
3	0 to 1	Slide retraction limit switch - Upper front	uint2	-	00b - Slide is not retracted 01b - Slide is retracted
	2 to 3	Slide retraction limit switch - Upper rear	uint2	-	00b - Slide is not retracted 01b - Slide is retracted
	4 to 5	Slide retraction limit switch - Lower front	uint2	-	00b - Slide is not retracted 01b - Slide is retracted
	6 to 7	Slide retraction limit switch - Lower rear	uint2	-	00b - Slide is not retracted 01b - Slide is retracted
4	0 to 1	Slide extension limit switch - Upper front	uint2	-	00b - Slide is not extended 01b - Slide is extended
	2 to 3	Slide extension limit switch - Upper rear	uint2	-	00b - Slide is not extended 01b - Slide is extended
	4 to 5	Slide extension limit switch - Lower front	uint2	-	00b - Slide is not extended 01b - Slide is extended
	6 to 7	Slide extension limit switch - Lower rear	uint2	-	00b - Slide is not extended 01b - Slide is extended
5	0 to 1	Retractable floor limit switch - Up	uint2	-	00b - Retractable floor is not up 01b - Retractable floor is up
	2 to 3	Retractable floor limit switch - Down	uint2	-	00b - Retractable floor is not retracted 01b - Retractable floor is retracted
6	0 to 1	Air seal vacuum switch	uint2	-	00b - Air seal is not evacuated 01b - Air seal is evacuated

6.14.4 Slide Motor Status

Electric slides may have multiple motors. This DGN provides status information about them. Table 6.14.4a defines the DG attributes, and Table 6.14.4b defines the signal and parameter attributes.

Table 6.14.4a — DG definition

DG attribute	Value
Name	SLIDE_MOTOR_STATUS
DGN	1FFE5h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	on change or 500ms when slide is in motion
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

Table 6.14.4b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	-	Instance	uint8	-	1 - Room 1 2 - Room2 3 - Room3 4 - Room4 5 - Generator 6 – Step (deprecated) 7 - Step cover Step can now be located on the Step Command and Step Status DGN's. Any new products should refer to said DGN's
1 to 2	-	Voltage	uint16	V	see Table 5.3
3	-	Current – Motor 1	uint8	A	see Table 5.3
4	-	Current – Motor 2	uint8	A	see Table 5.3
5	-	Current – Motor 3	uint8	A	see Table 5.3
6	-	Current – Motor 4	uint8	A	see Table 5.3

6.14.5 Service Points

As with other multi-instance items, SPNs assigned to a specific instance are coded with a nonzero value in the Most Significant byte (MSB) and the Instance in the Intermediate Significant byte (ISB). These are the allowable Service Points for this DGN (see Table 6.14.5). The least significant bits (LSb) may vary.

Table 6.14.5 — Service Points

MSB	ISB	LSb	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
0	32	0	User Lock
0	32	1	(Unused)
0	32	2	Park Brake
0	32	3	Leveling Jacks
0	32	4	Ignition Key
0	32	5	Voltage
1	Instance	0	Motion
1	Instance	1	Position
1	Instance	2	Lock Status

1	Instance	3	Unlock Status
1	Instance	4	Air Seal
2	Instance	0	Slide Lock Limit Switch – Upper Front
2	Instance	1	Slide Lock Limit Switch – Upper Rear
2	Instance	2	Slide Lock Limit Switch – Lower Front
2	Instance	3	Slide Lock Limit Switch – Lower Rear
3	Instance	0	Slide Unlock Limit Switch – Upper Front
3	Instance	1	Slide Unlock Limit Switch – Upper Rear
3	Instance	2	Slide Unlock Limit Switch – Lower Front
3	Instance	3	Slide Unlock Limit Switch – Lower Rear
4	Instance	0	Slide Retraction Limit Switch – Upper Front
4	Instance	1	Slide Retraction Limit Switch – Upper Rear
4	Instance	2	Slide Retraction Limit Switch – Lower Front
4	Instance	3	Slide Retraction Limit Switch – Lower Rear
5	Instance	0	Slide Extension Limit Switch – Upper Front
5	Instance	1	Slide Extension Limit Switch – Upper Rear
5	Instance	2	Slide Extension Limit Switch – Lower Front
5	Instance	3	Slide Extension Limit Switch – Lower Rear
6	Instance	0	Retractable Floor Limit Switch – Up
6	Instance	1	Retractable Floor Limit Switch – Down
6	Instance	2	Air Seal Vacuum Switch
7	Instance	0	Current – Motor 1
7	Instance	1	Current – Motor 2
7	Instance	2	Current – Motor 3
7	Instance	3	Current – Motor 4
8	Instance	0	Motor Brake – Motor 1
8	Instance	1	Motor Brake – Motor 2
8	Instance	2	Motor Brake – Motor 3
8	Instance	3	Motor Brake – Motor 4
9	Instance	0	Voltage
9	Instance	1	Motor Brake Control

6.14.6 Alarms

Table 6.14.6

Alarm Instance	Description
1	Slide activity Started
2	Slide Stowed
3	Slide is not fully extended
4	Slides is not fully stowed
5	Slide in motion
6	Slides locked
7	Slides unlocked

6.14.7 Test Profile

6.14.7.1 Slide Room Base Profile

ID	Datum	Test	Required Response	Required Behavior
	SLIDE_COMMAND	Send 0x01h on Byte 2	SLIDE_STATUS responds on	Slideout stops moving

		to desired slide instance	the same slide instance with 0x01h on byte 1. Respond with Generic Alarm, Instance 1. Alarm should not be sent again unless no activity is noted for ten seconds.	within 50ms.
	SLIDE_COMMAND	Send 0x02h on Byte 2 to desired slide instance	SLIDE_STATUS responds on the same slide instance with 0x02h on byte 1. Respond with Generic Alarm, Instance 1. Alarm should not be sent again unless no activity is noted for ten seconds.	Slideout extends until fully extended, a stop command is received, or a gap of 100ms or more is detected between commands.
	SLIDE_COMMAND	Send 0x03h on Byte 2 to desired slide instance	SLIDE_STATUS responds on the same slide instance with 0x03h on byte 1. Respond with Generic Alarm, Instance 1. Alarm should not be sent again unless no activity is noted for ten seconds.	Slideout retracts until fully retracted, a stop command is received, or a gap of 100ms or more is detected between commands.
	Stop Response	A Stop command is sent	Respond with Generic Alarm, Instance 1. Alarm should not be sent again unless no activity is noted for ten seconds.	The controller must respond within 50ms.
	Command Timeout	A series of motion commands are sent at 100ms intervals	Slide Status is broadcast with each command, and at the termination of motion.	The slide moves continuously in the indicated direction. After the last message is broadcast, motion terminates within 250ms.

6.14.7.2 Slide Control Panel Profile

ID	Datum	Test	Required Response	Required Behavior
	Stop Command	After motion has commenced, the user removes his finger (or analogous input device) from the button or control	A stop command is broadcast within 100ms. No subsequent Motion commands are allowed	
	Motion Command	The user places his finger (or analogous input device) on the button or control and maintains the input for a period of time	A series of Motion commands is broadcast with a message gap between 50ms and 100ms	

6.15 Furnace

6.15.1 Introduction

The furnace is a primary source of comfort heat in the RV. Heat elements that are part of an air conditioning unit are supported under Air Conditioner. Table 6.15.1 defines the furnace DGs.

Table 6.15.1 — Furnace definition

Device attribute	Value
Category	Comfort systems
Default Source Address	94 to 96
Dynamic Address Range	192 to 207
Instance	Multiple

Multiple source addresses are allocated, but furnaces are identified by the Instance in each DGN. These correspond to “zones” in the general terminology. There is no set definition for the location of each zone in a coach.
The furnace generally operates in an “automatic” mode, consulting the thermostat assigned to the same Instance for the necessary temperature and user input data. The mode may be overridden for diagnostic purposes, or as part of a larger climate control scheme.
Systems that use multiple heat exchangers with a single combustion unit should report as multiple instances. Each heat exchanger reports as a “furnace”, with the fan speed set appropriately and the heat output level being that of the central combustion unit. Commands to set the heat output level for any instance should be applied to the central unit.

6.15.2 Furnace Status

This is the general furnace status DGN. Table 6.15.2a defines the DG attributes, and Table 6.15.2b defines the signal and parameter attributes.

Table 6.15.2a — DG definition

DG attribute	Value
Name	FURNACE_STATUS
DGN	1FFE4h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.15.2b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	-	Instance	uint8	-	see Table 5.3 Corresponds to “Zones” in user terminology.
1	0 to 1	Operating mode	uint2	-	00b — Automatic 01b — Manual (Furnace shall ignore thermostat information.)

	2 to 7	Heat source	uint6	-	0 — Combustion 1 — AC power primary 2 — AC power secondary 3 — Engine heat
2	-	Circulation fan speed	uint8	%	see Table 5.3 One-speed fans shall use 0% and 100%. Two-speed fans shall use 0%, 50%, and 100%.
3	-	Heat output level	uint8	%	see Table 5.3
4	-	Dead band	uint8	°C	Precision = 0,1 °C Value range = 0,0 to 25,0 °C This is the amount over and under the set point that the furnace will tolerate. A larger value reduces cycling.
5	-	Second stage dead band	uint8	°C	Precision = 0,1 °C Value range = 0,0 to 25,0 °C This is the amount over the set point that will trigger a second stage (“high power”), if available on the furnace.
6	0 to 1	ZoneOvercurrent Status	uint2	-	00b - No overcurrent detected 01b - Overcurrent detected
	2 to 3	ZoneUndercurrent Status	uint2	-	00b - No undercurrent detected 01b - Undercurrent detected
	4 to 5	ZoneTemperature Status	uint2	-	00b - Temperature normal 01b - Temperature warning
	6 to 7	ZoneAnalog Input Status	uint2	-	00b - Off (Inactive) 01b - On (Active)

6.15.3 Furnace Command

This DGN allows external control of the furnace. The format is identical to FURNACE_STATUS. An Instance of Zero indicates that the settings should be applied to all furnace instances. Values of 255 indicate that the particular datum should not be changed. Table 6.15.3 defines the DG attributes, and Table 6.15.3b defines the signal and parameter attributes.

Table 6.15.3 — DG definition

DG attribute	Value
Name	FURNACE_COMMAND
DGN	1FFE3h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, FURNACE_STATUS

Table 6.15.3b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	-	Instance	uint8	-	see Table 5.3
1	0 to 1	Operating mode	uint2	-	see Table 6.15.2b

	2 to 7	Heat source	uint6	-	see Table 6.15.2b
2	-	Circulation fan speed	uint8	%	see Table 5.3 see Table 6.15.2b
3	-	Heat output level	uint8	%	see Table 5.3
4	-	Dead band	uint8	°C	see Table 6.15.2b
5	-	Second stage dead band	uint8	°C	see Table 6.15.2b

6.15.4 Service Points

The SPNs follow the general method for multi-instance products. Faults are reported with the Instance in the Intermediate Byte (ISB) and a non-zero value in the Most Significant Byte (MSB). In the case of a single node controlling multiple instances (for example, a hydronic heat system with multiple heat exchangers) an ISB of zero indicates the fault applies to the central controller. These are the allowable Service Points for this DGN (see Table 6.15.5).

Table 6.15.5 — Service Points

MSB	ISB	LSb	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	Fan
1	Instance	1	Heat Source – Combustion
1	Instance	2	Heat Source – Primary AC
1	Instance	3	Temperature
1	Instance	4	Heat Source – Secondary AC
1	Instance	5	Heat Source – Engine Heat
1	Instance	6	Thermostat
1	Instance	7	Pump
2	Instance	0	Furnace Power
2	Instance	1	Furnace Start
3	Instance	0	Burner control unit
3	Instance	1	Burner start failure
3	Instance	2	Flame failure
3	Instance	3	Burner voltage
3	Instance	4	Burner premature flame recognition
3	Instance	5	Flame monitor
3	Instance	6	Coolant temperature sensor
3	Instance	7	Metering pump
4	Instance	0	Combustion air fan
4	Instance	1	Glow plug
4	Instance	2	Burner assembly overheating
4	Instance	3	Circulation pump
4	Instance	4	Power supply

4	Instance	5	Output fan
4	Instance	6	Overheating protection system
4	Instance	7	Reference resistance
5	Instance	0	Exhaust gas temperature
5	Instance	1	Exhaust gas temperature sensor

6.15.5 Test Profiles

Profiles: Basic Furnace

6.15.5.1 Base Profile Furnace Operation mode Status
(FURNACE_COMMAND/FURNACE_STATUS)

ID	Datum	Test	Required Response	Required Behavior
94.01	Command Operating Mode	On Furnace_COMMAND, send Command - Operating Mode = 0 (automatic)	Furnace_STATUS reports Operating Mode = 0 (Automatic)	Furnace Is in Automatic Operation Mode - The Furnace unit starts heating (timing may be delayed due to minimum on/off)
		On Furnace_COMMAND, send Command - Operating Mode = 1 (Manual- Ignores Thermostat)	Furnace_STATUS reports Operating Mode = 1 (Manual - Ignores Thermostat)	Furnace is in Manual(ignores Thermostat) Operation Mode
94. 2-7	Command Heat Source	On Furnace_COMMAND, send Command - Heat Source = 0 (Combustion) 1 (AC power primary) 2 (AC Power Secondary) 3 (Engine Heat)	Furnace_STATUS Reports Heat Source 0 (Combustion) 1 (AC power primary) 2 (AC Power Secondary) 3 (Engine Heat)	Furnace changes to matching Heat source 0 (Combustion) 1 (AC power primary) 2 (AC Power Secondary) 3 (Engine Heat)

6.15.5.2 Base Profile Circulation Fan Speed with Furnace
(FURNACE_COMMAND/FURNACE_STATUS)

ID	Datum	Test	Required Response	Required Behavior
94 2	Command circulation Fan Speed	On Furnace_COMMAND, send Command - Set circulation Fan Speed = % 0 -100 set circulation fan speed	The fan speed sets to requested circulation fan speed corresponding percentage %	Circulation Fan goes to desired speed

6.15.5.3 Base Profile with Heat output level
(FURNACE_COMMAND/FURNACE_STATUS)

ID	Datum	Test	Required Response	Required Behavior
94 3	Command Heat Output level	On Furnace_COMMAND, send Command - Set heat output level = % 0 -100 set furnace output.	The Heat output Level sets heat output to requested corresponding percentage %	Heat goes to desired operation output

6.15.5.4 Base Profile with Furnace Dead Band
(FURNACE_COMMAND/FURNACE_STATUS)

ID	Datum	Test	Required Response	Required Behavior
94.4	Command Dead Band	On Furnace_COMMAND, send Command - Dead Band = C° 0 to 25.0 Deg C° Precision = 0.1 Deg C°	The amount over and under the set point that the Furnace will tolerate. A larger value reduces cycling.	Furnace will not start until the desired Dead Band variance is achieved.

6.15.5.5 Base Profile with Furnace Second Stage Dead Band
(FURNACE_COMMAND/FURNACE_STATUS)

ID	Datum	Test	Required Response	Required Behavior
103A-C-07	Command Second Stage Dead Band	On AirConditioner_COMMAND, send Command - Second Stage Dead Band = C° 0 to 25.0 Deg C° Precision = 0.1 Deg C°	This is the amount below the set point that will trigger a higher A/C output.	Furnace starts at a higher Output based on Second Stage Dead Band setting.

6.16 Thermostat

6.16.1 Introduction

A thermostat may or may not be a standalone device. It is often integrated into a climate control device such as an air conditioner, and even if it is a standalone device, it may be a completely passive device that exists solely to store information regarding the desires of the operator.

A thermostat typically has a temperature sensor attached, and a thermostat device may have no other function than to report a temperature. However, it is possible for a thermostat to rely on a second thermostat for the temperature reading, in which case it shall echo the remote reading as though the reading came from an integrated sensor.

Note that a single physical thermostat may implement multiple thermostat Instances.

Although it may be convenient for the Instances of the thermostat to match the Instances of the Air Conditioners and Furnaces that it may control, this is not an absolute requirement. It is entirely possible - though confusing - for a climate control system to have completely different Instance numbers for every component - temperature sensors (which are treated as thermostats with only one function), thermostats, air conditioners, furnaces, etc.

The Instances correspond directly to the Instances of the furnace and air conditioners. The following formats apply (see Table 6.16.1).

Table 6.16.1 — Thermostat definition

Device attribute	Value
Category	Comfort systems
Default Source Address	88 to 93
Dynamic Address Range	192 to 207
Instance	Multiple

Multiple source addresses are allocated, but thermostats are identified by the Instance in each DGN. These correspond to “zones” in the general terminology. There is no set definition for the location of each zone in a coach.

6.16.2 Thermostat Status 1

This communicates user intentions. Table 6.16.2a defines the DG attributes, and Table 6.16.2b defines the signal and parameter attributes. When Aux Heat is implemented, "Heat" refers to heat sources that are integrated with the Air conditioning (e.g. heat strip, heat pump), "Aux Heat" refers to heat sources that are not integrated (e.g. furnace)

Table 6.16.2a — DG definition

DG attribute	Value
Name	THERMOSTAT_STATUS_1
DGN	1FFE2h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	on change and every 2000 ms
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.16.2b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	-	Instance	uint8	-	see Table 5.3 A value of 0 indicates that the fan speed shall be set automatically according to the demand for cooling. A non-zero value indicates that the speed shall be manually overridden.
1	0 to 3	Operating mode	uint4	-	0000b — Off 0001b — Cool 0010b — Heat 0011b — Auto heat/Cool 0100b — Fan only 0101b — Aux Heat 0110b — Window Defrost/Dehumidify
	4 to 5	Fan mode	uint2	-	00b — Auto 01b — On Note that this is different than the “Fan Only” above. This forces the fan to be on all the time, but allows the heat and cool turn on and off according to the Operating Mode.
	6 to 7	Schedule mode	uint2	-	00b — Disabled 01b — Enabled If enabled, the set point will change according to a programmed schedule.
2	-	Fan speed	uint8	%	see Table 5.3 A value of 0 indicates that the fan speed shall be set automatically according to the demand

					for cooling. A non-zero value indicates that the speed shall be manually overridden.
3 to 4	-	Setpoint temp – Heat	uint16	Deg C	see Table 5.3
5 to 6	-	Setpoint temp – Cool	uint16	Deg C	see Table 5.3

6.16.3 Thermostat Status 2

This communicates user intentions. Table 6.16.3a defines the DG attributes, and Table 6.16.3b defines the signal and parameter attributes.

Table 6.16.3a — DG definition

DG attribute	Value
Name	THERMOSTAT_STATUS_2
DGN	1FEFAh
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.16.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	see Table 5.3 A value of 0 indicates that the fan speed shall be set automatically according to the demand for cooling. A non-zero value indicates that the speed shall be manually overridden.
1	-	Current schedule instance	uint8	-	see Table 5.3 Indicates which schedule instance is currently active.
2	-	Number of schedule instances	uint8	-	Indicates total capacity for schedule instances.
3	0-1	Reduced noise mode	bit	-	Indicates that the units shall operate in a low noise emission mode 00b – Disabled 01b – Enabled

6.16.4 Thermostat Command 1

This DGN allows a device to communicate user intentions to a thermostat. For example, the thermostat device may be a wall thermostat with its own user interface. These two DGNs would allow a service tool or second display device to make settings at that thermostat. Table 6.16.4a defines the DG attributes, and Table 6.16.2b defines the signal and parameter attributes.

Table 6.16.4a — DG definition

DG attribute	Value
Name	THERMOSTAT_COMMAND_1

DGN	1FEF9h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, THERMOSTAT_STATUS_1

6.16.5 Thermostat Command 2

This DGN provides several methods to manually adjust the set point. If Schedule Mode is Enabled while the setpoint is manually adjusted, the setpoint will change with the next scheduled change. If Schedule Mode is Disabled, then the setpoint will not change. Some thermostats may automatically revert to the original setpoint after a period of time. This behavior is not specifically addressed in this DGN.

To put the thermostat in a “Storage” mode, this DGN should be used in conjunction with THERMOSTAT_COMMAND_1 and the Schedule Mode should be set to Disabled. To force the thermostat to resume the scheduled mode the Current Schedule Instance should be set to 251. For example, when bringing the thermostat out of Storage (Instance 250), the Instance should be set to 251. The thermostat should check its schedule and choose the appropriate Instance (e.g. “Wake”) accordingly. Table 6.16.5a defines the DG attributes, and Table 6.16.5b defines the signal and parameter attributes.

Table 6.16.5a — DG definition

DG attribute	Value
Name	THERMOSTAT_COMMAND_2
DGN	1FEF8h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, THERMOSTAT_STATUS_2

Table 6.16.5b— Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	see Table 5.3 Corresponds to “Zones” in user terminology.
1	-	Current schedule instance	uint8	-	see Table 5.3 251 — Reset to “current” instance. Shall Force the unit into the indicated mode.
2	0-1	Reduced noise mode	bit	-	Indicates that the units shall operate in a low noise emission mode 00b – Disabled 01b – Enabled

6.16.6 Thermostat Scheduling - Introduction

These DGNs allow the programming of scheduled changes in the Setpoints. Note that each “Zone” Instance may have several Schedule Instances.

There is no specific process to coordinate the schedules across multiple zones. If a single thermostat handles all zones, it is the designer's decision whether to have all zones follow the same schedule. If there are multiple thermostats, each will have its own schedule.

Schedule Instances indicate that specific changes in set points will occur at specific times. Although terminology such as “Sleep” and “Wake” are defined, there is no enforcement of these conventions. There are no provisions for adjusting the schedule for the day of the week. If the user desired to have a different schedule for Saturday than for the rest of the week, different Instances must be programmed for that day.

A request for these DGNs should result in the reporting of all Schedule Instances available for the device.

6.16.7 Thermostat Schedule Status 1

Table 6.16.7a defines the DG attributes, and Table 6.16.7b defines the signal and parameter attributes.

Table 6.16.7a — DG definition

DG attribute	Value
Name	THERMOSTAT_SCHEDULE_STATUS_1
DGN	1FEF7h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.16.7b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	see Table 5.3 Corresponds to “Zones” in user terminology.
1	-	Schedule mode instance	uint8	-	0 — “Sleep” 1 — “Wake” 2 — “Away” 3 — “Return” 4 to 249 — Additional Instances 250 — Storage
2	-	Start hour	uint8	h	Precision = 1 h Value range = 0 to 23 0 - 12:00 AM 12 – 12:00 Noon 23 – 11:00 PM This shall be in Local Time
3	-	Start minute	uint8	min	Precision = 1 min Value range = 0 to 59
4 to 5	-	Setpoint temp - Heat	uint16	Deg C	see Table 5.3
6 to 7	-	Setpoint temp - Cool	uint16	Deg C	see Table 5.3

6.16.8 Thermostat Schedule Status 2

Table 6.16.8a defines the DG attributes, and Table 6.16.8b defines the signal and parameter attributes.

Table 6.16.8a— DG definition

DG attribute	Value
Name	THERMOSTAT_SCHEDULE_STATUS_2
DGN	1FEF6h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.16.8b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	see Table 5.3 Corresponds to “Zones” in user terminology.
1	-	Schedule mode Instance	uint8	-	0 — “Sleep” 1 — “Wake” 2 — “Away” 3 — “Return” 4 to 249 — Additional Instances 250 — Storage
2	0 to 1	Sunday	uint2	-	00b - Not scheduled for this day 01b - Schedule applies to this day
	2 to 3	Monday	uint2	-	00b - Not scheduled for this day 01b - Schedule applies to this day
	4 to 5	Tuesday	uint2	-	00b - Not scheduled for this day 01b - Schedule applies to this day
	6 to 7	Wednesday	uint2	-	00b - Not scheduled for this day 01b - Schedule applies to this day
3	0 to 2	Thursday	uint2	-	00b - Not scheduled for this day 01b - Schedule applies to this day
	2 to 3	Friday	uint2	-	00b - Not scheduled for this day 01b - Schedule applies to this day
	4 to 5	Saturday	uint2	-	00b - Not scheduled for this day 01b - Schedule applies to this day

6.16.9 Thermostat Schedule Command 1

There are two DGNs defined for thermostat schedule command. Generally, changing the set points for the currently active schedule instance will not change the actual set points active at the moment. To trigger that change, a THERMOSTAT_COMMAND_2 should be sent immediately after the change, with Current Schedule Instance set appropriately. Table 6.16.9 defines the DGN attributes. The format for the signal and parameter attributes is identical to THERMOSTAT_SCHEDULE_STATUS_1 (see Table 6.16.7b).

Table 6.16.9 — DG definition

DG attribute	Value
Name	THERMOSTAT_SCHEDULE_COMMAND_1
DGN	1FEF5h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, THERMOSTAT_SCHEDULE_STATUS_1

6.16.10 Thermostat Schedule Command 2

Table 6.16.10 defines the DGN attributes. The format for the signal and parameter attributes is identical to THERMOSTAT_SCHEDULE_STATUS_1 (see Table 6.16.8b). Changing the schedule will not change the current set points until a THERMOSTAT_COMMAND_2 is sent (typically with the Instance set to 251).

Table 6.16.10 — DG definition

DG attribute	Value
Name	THERMOSTAT_SCHEDULE_COMMAND_2
DGN	1FEF4h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, THERMOSTAT_SCHEDULE_STATUS_2

6.16.11 Ambient Temperature

This communicates the temperature readings. Table 6.16.11a defines the DG attributes, and Table 6.16.11b defines the signal and parameter attributes.

Table 6.16.11a — DG definition

DG attribute	Value
Name	THERMOSTAT_AMBIENT_STATUS
DGN	1FF9Ch
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.16.11b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	see Table 5.3 Corresponds to “Zones” in user terminology.
1 to 2	-	Ambient temp	uint16	Deg C	see Table 5.3

6.16.12 Service Points

The SPNs follow the general method for multi-instance products. Faults are reported with the Instance in the Intermediate Byte (ISB) and a non-zero value in the Most Significant Byte (MSB). In the case of a single node controlling multiple instances an ISB of zero indicates the fault applies to the central controller. These are the allowable Service Points for this DGN (see Table 6.16.14.10).

Table 6.16.14.10 — Service Points

MSB	ISB	LSb	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	Set Point Temperature - Cool
1	Instance	1	Set Point Temperature - Heat
1	Instance	2	Ambient Temperature
2	Instance	3	Internal Temperature Sensor
2	Instance	4	Pressure Switch
2	Instance	5	Networked A/C
2	Instance	6	Networked Furnace

6.16.13 Alarms

Table 6.16.13 - Alarms

Alarm Instance	Description
1	Entering New Scheduled Mode
2	Entering Away Mode
3	Leaving Away Mode
4	Entering Storage Mode
5	Leaving Storage Mode

6.16.14 Test Profiles

6.16.14.1 Profile 88B: base Thermostat

This profile is the base for all thermostat profiles, and describes a passive thermostat – that is, a thermostat that holds the necessary settings for active air conditioning, fans, and furnaces, but does not actively direct their operation.

Reporting

ID	Datum	Test	Desired Response

88B-S-01	THERMOSTAT_COMMAND_1, THERMOSTAT_STATUS_1	THERMOSTAT_COMMAND_1 is sent, with arbitrary Operating Mode, Fan Mode, Fan Speed, Set Point Heat, and Set Point Cool.	THERMOSTAT_STATUS_1 is broadcast with the indicated values. The broadcast is repeated at least every 5000ms.

6.16.14.2 Profile 88C: base Thermostat with Scheduling

Prerequisite: 88B – Base Thermostat
This profile adds scheduling to the basic profile. The minimal requirement for scheduling is the support of instances 0 (Sleep), 1 (Wake) and 2 (Away).

Reporting

ID	Datum	Test	Desired Response
88C-S-01	THERMOSTAT_SCHEDULE_COMMAND_1, THERMOSTAT_SCHEDULE_STATUS_1	THERMOSTAT_SCHEDUKE_COMMAND_1 is sent with Schedule Mode 0 (Sleep) and arbitrary values for Start Hour, Start Minute, Set Point Heat and Set Point Cool. The test is repeated for Schedule Mode 1 (Wake) with distinct set points and start times; and 2 (Away) with distinct set points and FFh (No Data) values for start times.	THERMOSTAT_SCHEDULE_STATUS_1 is broadcast with the indicated values.
88C-S-02	THERMOSTAT_COMMAND_2, THERMOSTAT_STATUS_2	After test 88C-S-01 is complete, THERMOSTAT_COMMAND_2 is sent with Schedule Mode 0 (Sleep). The test is repeated with values of 1 (Wake) and 2 (Away).	THERMOSTAT_STATUS_2 is broadcast with the indicated Schedule Mode Instance. THERMOSTAT_STATUS_1 is broadcast with the Set Points used in test 88C-S-01. When entering Away mode, GENERIC_ALARM_STATUS is sent with Instance 2 (Entering Away Mode).
88C-S-03	THERMOSTAT_STATUS_1, Schedule Mode	THERMOSTAT_COMMAND_1 is sent with Schedule Mode 1 (Enabled). The test is repeated with Schedule Mode 0 (Disabled).	THERMOSTAT_STATUS_1 is sent with the appropriate Schedule Mode value.
88C-S-04	DATE_TIME_STATUS	After test 88C-S-02, and with Scheduling Mode 1 (Enabled) and Current Schedule 0 (Sleep), DATE_TIME_STATUS is sent over the course of three minutes, starting with values two minutes previous to the Wake starting time and incremented normally. The test is repeated with the time beginning three minutes before the Sleep start time.	Within one minute of the programmed Wake start time, the product broadcasts THERMOSTAT_STATUS_1 and THERMOSTAT_STATUS_2 with values consistent with being in Wake mode. Within one minute of the programmed Sleep start time, the same DGNs are broadcast with values consistent with Sleep mode. In both tests, GENERIC_ALARM_STATUS is sent with Instance 1 (Entering New Schedule Mode).
88C-S-05	Away Mode	As in 88C-S-04, but beginning with Current Schedule 2 (Away).	The unit shall remain in Away mode throughout the test.
88C-S-06	THERMOSTAT_COMM	After test 88C-S-02, and with	The unit shall broadcast

	AND_2, Reset to Current	Scheduling Mode 1 (Enabled) and Current Schedule 2 (Away), THERMOSTAT_COMMAND_2 is sent with Current Schedule Instance 251 (Reset to Current).	THERMOSTAT_STATUS_1 and THERMOSTAT_STATUS_2 with values consistent with the Schedule Mode appropriate to the current time. GENERIC_ALARM_STATUS is sent with Instance 3 (Leaving Away Mode).
88C-S-07	DATE_TIME_STATUS	DATE_TIME_STATUS is not broadcast for one minute.	A DM_RV is broadcast with Standardized SPN 8 (Node Date/Time). This test is unnecessary if the device meets the requirements of an RV-C-compliant clock

6.16.14.3 Profile 88Z: Temperature Sensor

Reporting

ID	Datum	Test	Required Response
88Z-S-01	AMBIENT_TEMPERATURE_STATUS, Ambient Temperature	The unit is operated under normal conditions.	AMBIENT_TEMPERATURE_STATUS is broadcast with a gap of no more than 5000ms, and Ambient Temperature equal to the current sensor reading. The accuracy must be reasonably appropriate for use as a room thermostat.

6.16.14.4 Profile 88A: Active Thermostat w/ Internal Temperature Sensor

This profile applies to thermostats that actively manage a networked air conditioner and which have an internal temperature sensor. The air conditioner(s) is required to be compliant with Profile 103H (Slave Air Conditioner with Hysteresis).

Prerequisite: 88B Base Thermostat, 88Z Temperature Sensor

Reporting

ID	Datum	Test	Required Response
88A-S-01	THERMOSTAT_COMMAND_1 - OpMode Cool/Auto/Off	1. THERMOSTAT_COMMAND_1 is sent with Operating Mode = 1 (Cool), Set Point Cool set 5 degF below the current temperature, Fan Speed 0 (Automatic). 2. After step 1 is complete, the test continues with Operating Mode = 0 (Off). 3. As step 1, but with Operating Mode = 3 (Auto) 4. After step 3 is complete, the test continues with Operating Mode = 0 (Off).	1. AIR_CONDITIONER_COMMAND is sent immediately with Operating Mode 1 (Manual), Output Level 200 (100%), Fan Speed 0 (Automatic). 2. AIR_CONDITIONER_COMMAND is sent immediately with Operating Mode 1 (Manual), Output Level 0 (0%). 3. Same as Step 1 4. Same as Step 2.
88A-S-02	THERMOSTAT_COMMAND_1 – Set Point Cool	1. THERMOSTAT_COMMAND_1 is sent with Operating Mode = 1 (Cool), Set Point Cool 5 degF below the current temperature. The temperature	1. Same as 88A-S-01. When the temperature reaches a point below the Set Point Cool, AIR_CONDITIONER_COMMAND is sent immediately with Operating Mode 1 (Manual),

		sensor is slowly cooled until it reaches a point where cooling is no longer demanded. 2. After step 2 is complete, the temperature sensor is slowly warmed until it reaches a point where cooling is again demanded.	Output Level 0 (0%). 2. When the temperature reaches a point above the Set Point Cool, AIR_CONDITIONER_COMMAND is sent immediately with Operating Mode 1 (Manual), Output Level 200 (100%). The test does not specify the precise point where the command shall be sent, only that the point is below/above the Set Point Cool.
88A-S-03	Fan Speed	1. THERMOSTAT_COMMAND_1 is sent with Operating Mode = 1 (Cool), Set Point Cool set 5 degF below the current temperature, Fan Speed 200 (100%). 2. After Step 1, the test continues with arbitrary values for Fan Speed. 3. After Step 2, the test continues with Fan Speed 0 (Automatic). The temperature sensor is then cooled until it reaches the point where air conditioning is no longer demanded.	1. AIR_CONDITIONER_COMMAND is sent immediately with Operating Mode 1 (Manual), Output Level 200 (100%), Fan Speed 200 (100%). 2. As Step 1, with the Fan Speed per the command. 3. As Step 1, with the Fan Speed initially at 200 (100%). As the temperature cools, the Fan Speed may be allowed to decrease, but implementation of a specific algorithm is not required.
88A-S-04	THERMOSTAT_COMMAND_1: OpMode 4 (Fan Only)	1. THERMOSTAT_COMMAND_1 is sent with Operating Mode = 4 (Fan Only), Set Point Cool 5 degF below the current temperature, Fan Speed 0 (Automatic). 2. After step 1 is complete, the test continues with Operating Mode = 0 (Off). 3. Step 1 is repeated with Set Point Cool 5 degF higher than the current temperature. 4. Step 1 is repeated with arbitrary non-zero values for THERMOSTAT_STATUS_1, Fan Speed,	5. Step 1 is repeated with Fan Speed 0 (Automatic). The temperature sensor is then slowly cooled until it reaches the point where no cooling is demanded. 1. AIR_CONDITIONER_COMMAND is sent immediately with Operating Mode 1 (Manual), Output Level 0 (0%), Fan Speed 200 (100%). 2. AIR_CONDITIONER_COMMAND is sent immediately with Operating Mode 1 (Manual), Output Level 0 (0%), Fan Speed 0 (0%). 3. Same. 4. As Step 1, with the Fan Speed per the command. 5. As Step 1, with the Fan Speed initially at 200 (100%). As the temperature cools, the Fan Speed may be allowed to decrease, but implementation of a specific algorithm is not required.
88A-S-05	THERMOSTAT_COMMAND_1: Fan Mode = 1 (Forced)	1. THERMOSTAT_COMMAND_1 is sent with Operating Mode = 0 (Off), Fan Mode 1 (On), Fan Speed 0 (Auto). 2. After step 1 is complete, the test continues with THERMOSTAT_COMMAND_1 Fan Mode 0 (Off). 3. Step 1 is repeated with arbitrary non-zero values for Fan Speed.	1. AIR_CONDITIONER_COMMAND is sent with Operating Mode 1 (Manual), Fan Speed 200 (100%), and Output Level 0 (0%). 2. AIR_CONDITIONER_COMMAND is sent with Operating Mode 1 (Manual), Fan Speed 0 (100%), and Output Level 0 (0%). 3. AIR_CONDITIONER_COMMAND is sent with Operating Mode 1 (Manual), Fan Speed matching the value given, and Output Level 0 (0%).

		4. Step 1 is repeated with arbitrary values for Set Point Cool.	4. Same. The unit shall ignore the Set Point.
88A-S-06	SPN - Networked A/C Not Responding	1. An air conditioner is removed from the network. 2. The air conditioner is replaced on the network.	1. Within 20 seconds, a DM_RV with SPN Networked A/C , FMI 21 (Networked Device Not Responding), and Red Lamp 1 (On). The broadcast is repeated every 1000ms. 2. Within 20 seconds, DM_RV is broadcast with no SPN and Red Lamp 0 (Off).

6.16.14.5 Profile 88X: Active Thermostat w/ Network Temperature Sensor

This profile applies to thermostats that actively manage a networked air conditioner and which use a remote (networked) temperature sensor. The air conditioner(s) is required to be compliant with Profile 103H (Slave Air Conditioner with Hysteresis).

Prerequisite: 88B Base Thermostat

Reporting

ID	Datum	Test	Required Response
88X-S-01	THERMOSTAT_COMMAND_1 - OpMode Cool/Auto/Off	Same as 88A-S-01, with the network temperature in place of the current temperature.	Same as 88A-S-01, with the network temperature in place of the current temperature.
88X-S-02	THERMOSTAT_COMMAND_1 – Set Point Cool	Same as 88A-S-02, with the network temperature in place of the current temperature.	Same as 88A-S-02, with the network temperature in place of the current temperature.
88X-S-03	Fan Speed	Same as 88A-S-03, with the network temperature in place of the current temperature.	Same as 88A-S-03, with the network temperature in place of the current temperature.
88X-S-04	THERMOSTAT_COMMAND_1: OpMode 4 (Fan Only)	Same as 88A-S-04, with the network temperature in place of the current temperature.	Same as 88A-S-04, with the network temperature in place of the current temperature.
88X-S-05	THERMOSTAT_COMMAND_1: Fan Mode = 1 (Forced)	Same as 88A-S-05	Same as 88A-S-05
88X-S-06	SPN - Networked A/C Not Responding	Same as 88A-S-06	Same as 88A-S-06
88X-S-07	SPN - Temperature Not Received	1. The networked temperature source is removed from the network. 2. The temperature source is restored on the network.	1. Within 20 seconds, a DM_RV with SPN Ambient Temperature, FMI 21 (Networked Device Not Responding), and Red Lamp 1 (On). The broadcast is repeated every 1000ms. 2. DM_RV is broadcast with no SPN and Red Lamp 0 (Off).

6.16.14.6 Profile 88H: Hysteresis Capability

This profile is implemented in addition to Profile 88A or 88X. To be considered compliant with this profile, the product is tested for either 88A or 88X, but with the following change. In every test in which an air conditioner is turns on or off, logic must be present to prevent short-cycling the air conditioner. Delays based on time, temperature, or some combination are required any time the

Output Level is changed repeatedly. Each test which changes the level from on to off or off to on shall be repeated at least twice, rapidly enough to require the operation to be delayed. The specific algorithm need not be specified.

During a delay which keeps the A/C off, AIR_CONDITIONER_COMMAND is sent with a non-zero Output Level and a Max Output Level 0 (0%). At the end of the delay, the same is sent with Max Output Level 200 (100%), or other appropriate non-zero value.

An active thermostat compliant with Profile 88H is compatible with Air Conditioners satisfying Profile 103A.

6.16.14.7 Profile 88M: Multi-Zone Coordination

This profile is implemented in addition to Profile 88A or 88X for devices which manage multiple thermostat instances.

Reporting

ID	Datum	Test	Desired Response
88M-S-01	THERMOSTAT_COMMAND_1 - OpMode	Note: No step begins until the previous step is fully completed. 1. Same as 88A-S-01 or 88X-S-01, Step 1, but with all instances set to OpMode Cool in immediate sequence with a 25ms gap. 2. Same as 88A-S-01 or 88X-S-01, Step 2, but with all instances commanded in immediate sequence. 3. Same as 88A-S-01 or 88X-S-01, Step 3, but with all instances commanded in immediate sequence. 4. Same as 88A-S-01 or 88X-S-01, Step 4, but with all instances commanded in immediate sequence.	1. As in test 88A-S-01 or 88X-S-01, but initially with Max Output Level set to 0 (0%) for all but one instance. After a delay, AIR_CONDITIONER_COMMAND shall be sent with non-zero Max Output Level to a second instance, and the process repeated until all instances are running. The delay shall be reasonably sufficient to allow a generator to stabilize its AC output. 2. Same as 88A-S-01, Step 2. 3. Same as Step 1. 4. Same as Step 2.
88M-S-02	THERMOSTAT_COMMAND_1 - Set Point Cool	1. Same as 88A-S-02 or 88X-S-02, Step 1, but with all instances set in immediate sequence with a 25ms gap. 2. Same as 88A-S-01 or 88X-S-01, Step 2, but with all instances commanded in immediate sequence. 3. Same as 88A-S-01 or 88X-S-01, Step 3, but with all instances commanded in immediate sequence. 4. Same as 88A-S-01 or 88X-S-01, Step 4, but with all instances commanded in immediate sequence.	1. As in test 88A-S-02 or 88X-S-02, but initially with Max Output Level set to 0 (0%) for all but one instance. After a delay, AIR_CONDITIONER_COMMAND shall be sent with non-zero Max Output Level to a second instance, and the process repeated until all instances are running. The delay shall be reasonably sufficient to allow a generator to stabilize its AC output. 2. Same as 88A-S-02, Step 2. 3. Same as Step 1. 4. Same as Step 2.

6.16.14.8 Profile 88S: Integrated Thermostat/Air Conditioner /w Internal Temp. Sensor

This profile applies to thermostats that are integrated with one or more air conditioners, and which have an internal temperature sensor(s).

Hysteresis to prevent short-cycling the compressor is required as part of this profile. In all tests, a delay to prevent short-cycling the compressor or preventing AC power sags is allowed. During the delay, AIR_CONDITIONER_STATUS should be sent with Max Output Level 0 (0%) and Output Level 0 (0%). At the end of the delay, AIR_CONDITIONER_STATUS should be sent with

Max Output Level 200 (100%) and Output Level 200 (100%).

Prerequisite: 88B Base Thermostat, 88Z Temperature Sensor

Reporting

ID	Datum	Test	Required Response
88S-S-01	AIR_CONDITIONER_STATUS	The unit is operated under normal conditions	Every five seconds, and on change, AIR_CONDITIONER_STATUS is broadcast with correct values for Fan Speed, Max Fan Speed, Output Level, and Max Output Level. Note that Operating Mode is not required.
88S-C-01	THERMOSTAT_COMMAND_1 - OpMode Cool/Auto/Off	1. Same THERMOSTAT_COMMAND_1 is sent with Operating Mode = 1 (Cool), Set Point Cool set 5 degF below the current temperature, Fan Speed 0 (Automatic). 2. After step 1 is complete, the test continues with Operating Mode = 0 (Off). 3. As step 1, but with Operating Mode = 3 (Auto) 4. After step 3 is complete, the test continues with Operating Mode = 0 (Off).	1. The air conditioner turns on. AIR_CONDITIONER_STATUS is sent immediately with Output Level 200 (100%), Fan Speed 200 (100%). 2. The air conditioner turns off. AIR_CONDITIONER_STATUS is sent immediately with Output Level 0 (0%), Fan Speed 0 (0%). 3. Same as Step 1 4. Same as Step 2.
88S-C-02	THERMOSTAT_COMMAND_1 – Set Point Cool	1. THERMOSTAT_COMMAND_1 is sent with Operating Mode = 1 (Cool), Set Point Cool 5 degF below the current temperature. The temperature sensor is slowly cooled until it reaches a point where cooling is no longer demanded. 2. After step 2 is complete, the temperature sensor is slowly warmed until it reaches a point where cooling is again demanded.	1. Same as 88A-S-01. When the temperature reaches a point below the Set Point Cool, AIR_CONDITIONER_STATUS is sent immediately with Output Level 0 (0%). 2. The air conditioner turns on. When the temperature reaches a point above the Set Point Cool, AIR_CONDITIONER_STATUS is sent immediately with Output Level 200 (100%). The test does not specify the precise point where the command shall be sent, only that the point is below/above the Set Point Cool.
88S-C-03	Fan Speed	1. THERMOSTAT_COMMAND_1 is sent with Operating Mode = 1 (Cool), Set Point Cool set 5 degF below the current temperature, Fan Speed 200 (100%). 2. After Step 1, the test continues with arbitrary values for Fan Speed. 3. After Step 2, the test continues with Fan Speed 0 (Automatic). The temperature sensor is then cooled until it reaches the point where air	1. AIR_CONDITIONER_STATUS is sent with Output Level 200 (100%), Fan Speed 200 (100%). 2. As Step 1, with the Fan Speed per the command. 3. As Step 1, with the Fan Speed initially at 200 (100%). As the temperature cools, the Fan Speed may be allowed to decrease, but implementation of a specific algorithm is not required. Note that THERMOSTAT_STATUS_1 Fan Speed shall

		conditioning is no longer demanded.	be 0 (Automatic).
88S-C-04	THERMOSTAT_COMMAND_1: OpMode 4 (Fan Only)	1. THERMOSTAT_COMMAND_1 is sent with Operating Mode = 4 (Fan Only), Set Point Cool 5 degF below the current temperature, Fan Speed 0 (Automatic). 2. After step 1 is complete, the test continues with Operating Mode = 0 (Off). 3. Step 1 is repeated with Set Point Cool 5 degF higher than the current temperature. 4. Step 1 is repeated with arbitrary non-zero values for THERMOSTAT_STATUS_1, Fan Speed,	5. Step 1 is repeated with Fan Speed 0 (Automatic). The temperature sensor is then slowly cooled until it reaches the point where no cooling is demanded. 1. AIR_CONDITIONER_ STATUS is sent immediately with Output Level 0 (0%), Fan Speed 200 (100%). 2. AIR_CONDITIONER_ STATUS is sent immediately with Output Level 0 (0%), Fan Speed 0 (0%). 3. Same. 4. As Step 1, with the Fan Speed per the command. 5. As Step 1, with the Fan Speed initially at 200 (100%). As the temperature cools, the Fan Speed may be allowed to decrease, but implementation of a specific algorithm is not required. Note that THERMOSTAT_STATUS_1 Fan Speed shall be 0 (Automatic).
88S-C-05	THERMOSTAT_COMMAND_1: Fan Mode = 1 (Forced)	1. THERMOSTAT_COMMAND_1 is sent with Operating Mode = 0 (Off), Fan Mode 1 (On), Fan Speed 0 (Auto). 2. After step 1 is complete, the test continues with THERMOSTAT_COMMAND_1 Fan Mode 0 (Off). 3. Step 1 is repeated with arbitrary non-zero values for Fan Speed. 4. Step 1 is repeated with arbitrary values for Set Point Cool.	1. AIR_CONDITIONER_STATUS is sent with Fan Speed 200 (100%), and Output Level 0 (0%). 2. AIR_CONDITIONER_STATUS is sent with Fan Speed 0 (100%), and Output Level 0 (0%). 3. AIR_CONDITIONER_STATUS is sent with Fan Speed matching the value given, and Output Level 0 (0%). 4. Same. The unit shall ignore the Set Point.

6.16.14.9 Profile 88T: Integrated Thermostat/Air Conditioner /w Network Temp. Sensor

This profile applies to thermostats that are integrated with one or more air conditioners, and which obtain a temperature reading from a network temperature sensor(s).

Hysteresis to prevent short-cycling the compressor is required as part of this profile. In all tests, a delay to prevent short-cycling the compressor or preventing AC power sags is allowed. During the delay, AIR_CONDITIONER_STATUS should be sent with Max Output Level 0 (0%) and Output Level 0 (0%). At the end of the delay, AIR_CONDITIONER_STATUS should be sent with Max Output Level 200 (100%) and Output Level 200 (100%).

Prerequisite: 88B Base Thermostat

Reporting

ID	Datum	Test	Required Response
88T-S-01	AIR_CONDITIONER_STATUS	Same as 88S-S-01.	Same as 88S-S-01.

88T-S-02	SPN - Temperature Not Received	Same as 88X-S-07	Same as 88X-S-07
88T-C-01	THERMOSTAT_COMMAND_1 - OpMode Cool/Auto/Off	Same as 88S-C-01, with the network temperature in place of the current temperature.	Same as 88S-C-01, with the network temperature in place of the current temperature.
88T-C-02	THERMOSTAT_COMMAND_1 – Set Point Cool	Same as 88S-C-02, with the network temperature in place of the current temperature.	Same as 88S-C-02, with the network temperature in place of the current temperature.
88T-C-03	Fan Speed	Same as 88S-C-03, with the network temperature in place of the current temperature.	Same as 88S-C-03, with the network temperature in place of the current temperature.
88T-C-04	THERMOSTAT_COMMAND_1: OpMode 4 (Fan Only)	Same as 88S-C-04, with the network temperature in place of the current temperature.	Same as 88S-C-04, with the network temperature in place of the current temperature.
88T-C-05	THERMOSTAT_COMMAND_1: Fan Mode = 1 (Forced)	Same as 88S-C-05	Same as 88S-C-05

6.16.14.10 Profile 88U: Integrate Thermostat/Air Conditioner /w Multi-Zone Coordination

Reporting

ID	Datum	Test	Required Response
88U-S-01	AIR_CONDITIONER_STATUS	Same as 88S-S-01. AIR_CONDITIONER_STATUS message must be sent as described for each air conditioner instance.	Same as 88S-S-01. AIR_CONDITIONER_STATUS message must be sent as described for each air conditioner instance.
88U-C-01	THERMOSTAT_COMMAND_1 - OpMode	Same as 88M-S-01, with the requirements for AIR_CONDITIONER_COMMAND replaced by AIR_CONDITIONER_STATUS in a manner consistent with profiles 88S or 88T.	Same as 88M-S-01, with the requirements for AIR_CONDITIONER_COMMAND replaced by AIR_CONDITIONER_STATUS in a manner consistent with profiles 88S or 88T.
88U-S-02	THERMOSTAT_COMMAND_1 - Set Point Cool	Same as 88M-S-02, with the requirements for AIR_CONDITIONER_COMMAND replaced by AIR_CONDITIONER_STATUS in a manner consistent with profiles 88S or 88T.	Same as 88M-S-02, with the requirements for AIR_CONDITIONER_COMMAND replaced by AIR_CONDITIONER_STATUS in a manner consistent with profiles 88S or 88T.

6.17 Air Conditioner

6.17.1 Introduction

The Air Conditioner is the primary cooling device in the RV, and may also include a heat pump or other heating element. Like the furnace, the AC monitors the output of the thermostat to determine whether to blow, heat, or cool. The Instance corresponds to the same Instances for the furnace and thermostat. Thus it is highly likely that there is an AC Instance 1 and a Furnace Instance 1, which would roughly correspond to the same zone within the RV. The following formats apply (see Table 6.17.1).

Table 6.17.1 — Air conditioner definition

Device attribute	Value
Category	Comfort systems
Default Source Address	103 to 106
Dynamic Address Range	192 to 207
Instance	Multiple

Multiple source addresses may be allocated, but thermostats are identified by the Instance in each DGN. These correspond to "zones" in the general terminology. There is no set definition for the location of each zone in a coach.

6.17.2 Air Conditioner Status

This DG communicates the air conditioner status. Table 6.17.2a defines the DG attributes, and Table 6.17.2b defines the signal and parameter attributes.

Table 6.17.2a — DG definition

DG attribute	Value
Name	AIR_CONDITIONER_STATUS
DGN	1FFE1h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	On Change. If the A/C is operating as a "slave" to an external thermostat (i.e. Operating Mode = 1 (Manual), 5000ms. Otherwise, 2000ms)
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.17.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	see Table 5.3 A value of 0 indicates that the fan speed shall be set automatically according to the demand for cooling. A non-zero value indicates that the speed shall be manually overridden.
1	-	Operating mode	uint8	-	0 - Automatic 1 - Manual (AC will ignore thermostat information.)
2	-	Max fan speed	uint8	%	see Table 5.3

					Used to control the fan speed for power-sharing purposes. See Fan Speed below.
3	-	Max air conditioning output level	uint8	%	see Table 5.3 Used to control the compressor output for power-sharing and to maintain intervals between when loads are added to the AC line. This value can typically be set by a thermostat using the corresponding value in AC_CONDITIONING_COMMAND, by an AC load manager using the AC_LOAD_COMMAND, or it may be generated internally due to a built-in delay. All of these mechanisms may be implemented at one time, with the greatest constraint being reported.
4	-	Fan speed	uint8	%	see Table 5.3 If Operating Mode is 1 (Manual), indicates the current fan speed, with 0 indicating the fan is off. If Operating Mode is 0 (Automatic), a value of 0 indicates that the fan speed is being set automatically by the air conditioner, and a non-zero value indicates that the speed is being manually overridden. If the air conditioner has an integrated thermostat, this value shall indicate the actual fan speed, with 0 indicating the fan is off, and the value in THERMOSTAT_STATUS_1 shall indicated whether the speed is being manually overridden, with a 0 indicating automatic behavior.
5	-	Air conditioning output level	uint8	%	see Table 5.3
6	-	Dead band	uint8	°C	Value range = 0 to 25.0 °C Precision = 0.1 °C This is the amount over and under the set point that the AC will tolerate. A larger value reduces cycling.
7	-	Second stage dead band	uint8	°C	Value range = 0 to 25.0 °C Precision = 0.1 °C This is the amount over the set point that will trigger a higher A/C output.

6.17.3 Air Conditioner Status 2

This DG communicates the air conditioner status 2. Table 6.17.3a defines the DG attributes, and Table 6.17.3b defines the signal and parameter attributes.

Table 6.17.3a — DG definition

DG attribute	Value
Name	AIR_CONDITIONER_STATUS_2

DGN	1FDC9h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	On Change. If the A/C is operating as a “slave” to an external thermostat (i.e. Operating Mode = 1 (Manual), 5000ms. Otherwise, 2000ms)
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.17.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	See Table 5.3 Corresponds to “Zones” in user terminology.
1	0 to 3	Compressor status	uint4	-	Reports the status of the compressor 0d – Off 1d – Compressor intends to start 2d – Compressor is starting 3d – Compressor is running
2	3 to 4	Reduced noise mode	bit	-	Indicates that the unit is operating in a low noise emission mode 00b – Disabled 01b – Enabled
3 to 4	-	Exterior Temperature	uint16	°C	See Table 5.3
5 to 6	-	Coil Temperature	uint16	°C	See Table 5.3
7	0 to 1	Coil Temp Error	uint2	-	0 – Coil temperature reading valid 1 – Coil temperature reading invalid Note: An invalid reading means the sensor is disconnected or damaged
	2 to 3	Coil Freeze detected	uint2	-	0 – Coil freeze not detected 1 – Coil freeze detected Note: Coil freeze occurs when the coil temperature drops too low while cooling.
	4 to 5	Exterior Temp Error	uint2	-	0 – Exterior temperature reading valid 1 – Exterior temperature reading invalid Note: An invalid reading means the sensor is disconnected or damaged
	6 to 7	Defrost cycle active	uint2	-	0 – Defrost cycle not active 1 – Defrost cycle active

6.17.4 Air Conditioner Command

This DGN allows external control of the air conditioner. Table 6.17.4 defines the DG attributes. The signal and parameter attributes are identical to AIR_CONDITIONER_STATUS (see Table 6.17.2b). An Instance of Zero indicates that the settings should be applied to all AC instances. Values of 255 indicate that the particular datum should not be changed.

Note that setting Max Air Conditioner Output Level may be determined by more than one factor, and thus setting it to 100% may not cause the status to change accordingly. Even if the output level is constrained for other reasons, the Air Conditioner shall still accept such a command and shall not respond with a NAK. The status shall continue to report the lowest limitation.

Table 6.17.4 — DG definition

DG attribute	Value
Name	AIR_CONDITIONER_COMMAND
DGN	1FFE0h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, AIR_CONDITIONER_STATUS

6.17.5 Heat Pump Status

Note that the Heat Pump typically shares the fan with the Air Conditioner. Control of the fan may be shared with AIR_CONDITIONER_STATUS and AIR_CONDITIONER_CONTROL. Table 6.17.5a defines the DG attributes, and Table 6.17.5b defines the signal and parameter attributes

Table 6.17.5a — DG definition

DG attribute	Value
Name	HEAT_PUMP_STATUS
DGN	1FF9Bh
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	on change and every 2000 ms
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.17.5b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	see Table 5.3 A value of 0 indicates that the fan speed shall be set automatically according to the demand for cooling. A non-zero value indicates that the speed shall be manually overridden.
1	-	Operating mode	uint8		0 - Automatic 1 - Manual (AC will ignore thermostat information.)
2	-	Max heat output level	uint8	%	see Table 5.3 Used to control the output level for power-sharing purposes.

3	-	Heat output level	uint8	%	see Table 5.3
4	-	Dead band	uint8	Deg C	Value range = 0 to 25.0 Deg C Precision = 0.1 Deg C This is the amount over and under the set point that the heater will tolerate. A larger value reduces cycling.
5	-	Second stage dead band	uint8	Deg C	Value range = 0 to 25.0 Deg C Precision = 0.1 Deg C This is the amount over the set point that will trigger a higher A/C output.
6	-	Fan speed	uint8	%	see Table 5.3 See AIR_CONDITIONER_STATUS

6.17.6 Heat Pump Command

This DGN allows external control of the heat pump. Table 6.17.6 defines the DG attributes. The signal and parameter attributes are identical to HEAT_PUMP_STATUS (see Table 6.17.5b). An Instance of Zero indicates that the settings should be applied to all instances. Values of 255 indicate that the particular datum should not be changed.

Table 6.17.6 — DG definition

DG attribute	Value
Name	HEAT_PUMP_COMMAND
DGN	1FF9Ah
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, HEAT_PUMP_STATUS

6.17.7 Service Points

The SPNs follow the general method for multi-instance products. Faults are reported with the Instance in the Intermediate Byte (ISB) and a non-zero value in the Most Significant Byte (MSB). These are the allowable Service Points for this DGN (see Table 6.17.7).

Table 6.17.7 — Service Points

MSB	ISB	LSb	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	Fan
1	Instance	1	Compressor
1	Instance	2	Heat Source
1	Instance	3	Temperature
1	Instance	4	Outside Air Sensor

1	Instance	5	Coil Sensor
1	Instance	6	No AC Available
1	Instance	7	Defrosting
2	Instance	0	Subnet Communication
2	Instance	1	Heat Configuration
2	Instance	2	Dehumidifier Configuration
2	Instance	3	Internal Temperature Sensor
2	Instance	4	Pressure Switch
2	Instance	5	Air Flap
2	Instance	6	Outdoor Coil
2	Instance	7	Defrost Lockout
3	Instance	0	DC Voltage
3	Instance	1	Outdoor Coil Sensor

6.17.8 Test Profiles

6.17.8.1 Basic Air Conditioner (Base) Profile

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS) Base Profile Air Conditioner Operation mode Status.

ID	Datum	Test	Required Response	Required Behavior
103A-C-01	Command Operating Mode	On AIR_CONDITIONER_COMMAND, send Command - Operating Mode = 0 (automatic)	AIR_CONDITIONER_STATUS reports Operating Mode = 0 (Automatic)	A/C Is in Automatic Operation Mode - The AC unit starts cooling (timing may be delayed due to minimum on/off)
		On AIR_CONDITIONER_COMMAND, send Command - Operating Mode = 1 (Manual- Ignores Thermostat)	AIR_CONDITIONER_STATUS reports Operating Mode = 1 (Manual - Ignores Thermostat)	A/C is in Manual(ignores Thermostat) Operation Mode

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS) Base Profile Max Fan Speed with Air Conditioner: in regards to power sharing.

ID	Datum	Test	Required Response	Required Behavior
103A-C-02	Command Max Fan Speed	On AIR_CONDITIONER_COMMAND, send Command - Set Fan Speed = % 0 -100 set fan speed	The fan speed sets to requested fan speed corresponding percentage %	Fan goes to desired speed

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS) Base Profile with Max Air Conditioner output level: in regards to power sharing.

ID	Datum	Test	Required Response	Required Behavior
103A-C-03	Command Air Conditioner Max Output	On AIR_CONDITIONER_COMMAND, send Command - Set A/C	The A/C Max output Level sets compressor output to requested corresponding	Compressor goes to desired operation output in regards to Max output level

	level	Max output level = % 0 -100 set Compressor output operation	percentage %	

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS) Base Profile Fan Speed with Air Conditioner.

ID	Datum	Test	Required Response	Required Behavior
103A-C-04	Command Max Fan Speed	On AIR_CONDITIONER_COMMAND, send Command - Set Fan Speed = % 0 -100 set fan speed	The fan speed sets to requested fan speed corresponding percentage %	Fan goes to desired speed

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS) Base Profile with Air Conditioner output level.

ID	Datum	Test	Required Response	Required Behavior
103A-C-05	Command Output level	On AIR_CONDITIONER_COMMAND, send Command - Set A/C output level = % 0 -100 set air conditioner output operation	The A/C output Level sets Air Conditioner output to requested corresponding percentage %	Air Conditioner goes to desired operation output

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS) Base Profile with Air Conditioner Dead Band.

ID	Datum	Test	Required Response	Required Behavior
103A-C-06	Command Dead Band	On AIR_CONDITIONER_COMMAND, send Command - Dead Band = C° 0 to 25.0 Deg C° Precision = 0.1 Deg C°	The amount over and under the set point that the Air Conditioner will tolerate. A larger value reduces cycling.	Air Conditioner will not start until the desired Dead Band variance is achieved.

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS) Base Profile with Air Conditioner Second Stage Dead Band.

ID	Datum	Test	Required Response	Required Behavior
103A-C-07	Command Second Stage Dead Band	On AIR_CONDITIONER_COMMAND, send Command - Second Stage Dead Band = C° 0 to 25.0 Deg C° Precision = 0.1 Deg C°	This is the amount below the set point that will trigger a higher A/C output.	Air Conditioner starts at a higher Output based on Second Stage Dead Band setting.

6.17.8.2 Basic Air Conditioner w/ Heat Pump Profile

Profile of the basic air conditioner plus heat pump

Heat Pump Status(HEAT_PUMP_COMMAND/HEAT_PUMP_STATUS) Base Profile Heat Pump Operation mode Status.

ID	Datum	Test	Required Response	Required Behavior
103A-C-01	Command Operating Mode	On HEAT_PUMP_COMMAND, send Command - Operating Mode = 0 (automatic)	HEAT_PUMP_STATUS reports Operating Mode = 0 (Automatic)	Heat Pump Is in Automatic Operation Mode - The Heat Pump unit starts Heating (timing may be delayed due to minimum on/off)

		On HEAT_PUMP_COMMAND, send Command - Operating Mode = 1 (Manual- Ignores Thermostat)	HEAT_PUMP_STATUS reports Operating Mode = 1 (Manual - Ignores Thermostat)	Heat Pump is in Manual(ignores Thermostat) Operation Mode

Heat Pump Status(HEAT_PUMP_COMMAND/HEAT_PUMP_STATUS) Base Profile Max Het Pump Output: in regards to power sharing.

ID	Datum	Test	Required Response	Required Behavior
103A-C-2	Command Max heat pump output level	On HEAT_PUMP_COMMAND, send Command - Max Heat pump Output = % 0 -100	The Heat pump output is sets to requested Max output based on percentage %	Heat Pump is restricted to a max output based on Power Sharing

Heat Pump Status(HEAT_PUMP_COMMAND/HEAT_PUMP_STATUS) Base Profile with Het Pump Output level.

ID	Datum	Test	Required Response	Required Behavior
103A-C-3	Command Output level	On HEAT_PUMP_COMMAND, send Command - Set Heat Pump output level = % 0 -100 set Heat Pump output operation	The Heat Pump output Level sets Heat pump output to requested corresponding percentage %	Heat Pump goes to desired operation output

Heat Pump Status(HEAT_PUMP_COMMAND/HEAT_PUMP_STATUS) Base Profile Max Het Pump Output: in regards to power sharing.

ID	Datum	Test	Required Response	Required Behavior
103A-C-2	Command Max heat pump output level	On HEAT_PUMP_COMMAND, send Command - Max Heat pump Output = % 0 -100	The Heat pump output is sets to requested Max output based on percentage %	Heat Pump is restricted to a max output based on Power Sharing

Heat Pump Status(HEAT_PUMP_COMMAND/HEAT_PUMP_STATUS) Base Profile with Het Pump Dead Band.

ID	Datum	Test	Required Response	Required Behavior
103A-C-4	Command Dead Band	On HEAT_PUMP_COMMAND, send Command - Dead Band = C° 0 to 25.0 Deg C° Precision = 0.1 Deg C°	The amount over and under the set point that the heat pump will tolerate. A larger value reduces cycling.	Heat Pump will not start until the desired Dead Band variance is achieved.

Heat Pump Status(HEAT_PUMP_COMMAND/HEAT_PUMP_STATUS) Base Profile with Het Pump Second Stage Dead Band.

ID	Datum	Test	Required Response	Required Behavior
103A-C-5	Command Second Stage Dead Band	On HEAT_PUMP_COMMAND, send Command - Second Stage Dead Band = C° 0 to 25.0 Deg C° Precision = 0.1 Deg C°	This is the amount below the set point that will trigger a higher Heat Pump output.	Heat Pump starts at a higher Output based on Second Stage Dead Band setting.

6.17.8.3 Slave Air Conditioner Profile

This profile describes a product that acts as a slave to a thermostat implemented in a different network node. Note that this profile is not a requirement for an A/C product in general.

ID	Datum	Test	Required Response
103A-S-01	AIR_CONDITIONING_S	AIR_CONDITIONING_COMMAND is	1. The unit responds per Level Two

	TATUS	broadcast with correct instance and any data values	requirements for response time with correct values for Operating Status, Fan Speed, Max Fan Speed, Output Level, and Max Output Level. 2. The unit sends the message repeatedly on a 5 second schedule.

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response	Required Behavior
103A-C-01	Command Operating Mode	On AIR_CONDITIONER_COMMAND, send Command - Operating Mode = 0 (automatic)	AIR_CONDITIONER_STATUS reports Operating Mode = 0 (Automatic)	If on, the air conditioner turns off. Note that a slave unit has no automatic mode, and thus 0 means Off
		On AIR_CONDITIONER_COMMAND, send Command - Operating Mode = 1 (Manual- Ignores Thermostat)	AIR_CONDITIONER_STATUS reports Operating Mode = 1 (Manual - Ignores Thermostat)	Behavior shall be determined by the current Output Level and Fan Speed values

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response	Required Behavior
103A-C-02	Command Fan Speed	While in Manual Mode, and with Max Fan Speed at 200 (100%), AIR_CONDITIONER_COMMAND is broadcast with an arbitrary value (0-200) in Fan Speed. The test is repeated with a variety of values	AIR_CONDITIONER_STATUS is sent with Fan Speed matching the current fan speed after the command	The fan speed shall adjust to the most appropriate value supported by the hardware. If the command was to turn the fan to Off and circumstances do not allow it, the unit shall respond with a NAK-3 (Conditions do not allow)
		While in Auto Mode, AIR_CONDITIONER_COMMAND is broadcast with an arbitrary value (0-200, 0-100%) in Fan Speed	AIR_CONDITIONER_STATUS is sent with Fan Speed 0 (0%)	The unit remains off

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response	Required Behavior
103A-C-03	Command Max Fan Speed	While in Manual Mode, and with Fan Speed at 200 (100%), AIR_CONDITIONER_COMMAND is broadcast with an arbitrary value (0-200) in Max Fan Speed. The test is repeated with a variety of values for Max Fan Speed	AIR_CONDITIONER_STATUS is sent with Max Fan Speed matching the setting (with no rounding). Fan Speed is sent with the current fan speed after the command	The fan speed shall adjust to the lower value between Max Fan Speed and Fan Speed, rounded according to the capabilities of the unit but never higher than Max Fan Speed. If circumstances do not permit the fan to be turned all the way off, it is acceptable to respond with the lowest speed possible at the moment and no NAK is required
		The test is repeated with a variety of initial values for Fan Speed. A variety of combinations shall be tested		

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response	Required Behavior
103A-C-04	Command Output Level	While in Manual Mode, and with Max Output Level at 200 (100%), AIR_CONDITIONER_COMMAND is broadcast with an arbitrary value (0-200) in Output Level. The test is repeated with a variety of values	AIR_CONDITIONER_STATUS is sent with Output Level matching the current fan speed after the command	The output level shall adjust to the most appropriate value supported by the hardware
		While in Auto Mode, AIR_CONDITIONER_COMMAND is broadcast with an arbitrary value (0-200, 0-100%) in Output Level	AIR_CONDITIONER_STATUS is sent with Output Level 0 (0%)	The unit remains off

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response	Required Behavior
103A-C-05	Command Max Output Level	While in Manual Mode, and with Output Level at 200 (100%), AIR_CONDITIONER_COMMAND is broadcast with an arbitrary value (0-200) in Max Output Level. The test is repeated with a variety of values for Max Output Level	AIR_CONDITIONER_STATUS is sent with Max Output Level matching the setting (with no rounding). Output Level is sent with the current fan speed after the command	The output level shall adjust to the lower value between Max Output Level and Output Level, rounded according to the capabilities of the unit but never higher than Max Output Level. If circumstances do not permit the compressor to be turned all the way off, it is acceptable to respond with the lowest value possible at the moment and no NAK is required
		The test is repeated with a variety of initial values for Output Level. A variety of combinations shall be tested		

6.17.8.4 Slave Air Conditioner w/ Hysteresis Profile

This profile is identical to Profile 103A Slave Air Conditioner (6.17.8.3), but it requires the device to implement a dead band, dwell time, or other mechanism for avoiding the short-cycling of the compressor.

ID: 103H-S-01
Identical to 103A-S-01. Note that Max Output Level shall be 0 during any period in which the output is suppressed.

ID: 103H-C-01
Identical to 103A-C-01, with the a delay in the behavior being acceptable if consistent with the hysteresis mechanism.

ID: 103H-C-03
Identical to 103A-C-03, with the a delay in the behavior being acceptable if consistent with the hysteresis mechanism.

ID: 103H-C-04
Identical to 103A-C-04, with the a delay in the behavior being acceptable if consistent with the hysteresis mechanism.

ID: 103H-C-05
Identical to 103A-C-05, with the a delay in the behavior being acceptable if consistent with the hysteresis mechanism.

6.17.8.5 Slave Air Conditioner w/ Network Temperature Profile

This profile describes a product that works autonomously but relies on an separate thermostat to maintain the set points and a networked sensor to obtain an ambient temperature reading. Note that the thermostat and temperature sensor may possibly be different devices.

If the product also supports Profile 103A – Slave Air Conditioner, then the Operating Mode of 0 (Auto) indicates that it is running as a “Simple” A/C, and an Operating Mode of 1 indicates it is running as a “Slave”.

ID	Datum	Test	Required Response
103S-S-01	AIR_CONDITIONING_STATUS	AIR_CONDITIONING_COMMAND is broadcast with correct instance and any data values	1. The unit responds per Level Two requirements for response time with correct values for Operating Status, Fan Speed, Max Fan Speed, Output Level, Max Output Level, and Dead Band. 2. The unit sends the message repeatedly on a 2000 ms schedule.

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response	Required Behavior
103S-C-01	Command Operating Mode	On AIR_CONDITIONER_COMMAND, send Command - Operating Mode = 0 (automatic)	AIR_CONDITIONER_STATUS reports Operating Mode = 0 (Automatic)	The unit shall operate consistent with the current context
		On AIR_CONDITIONER_COMMAND, send Command - Operating Mode = 1 (Manual- Ignores Thermostat)	AIR_CONDITIONER_STATUS reports Operating Mode = 1 (Manual - Ignores Thermostat)	The unit shall turn off

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response	Required Behavior
103S-C-02	THERMOSTAT_STATUS_1 OpMode Cool/Auto/Off	With the unit in Operating Mode 0 (Automatic), Max Fan Speed 200 (100%), Max Output Level 200 (100%), the following sequence of tests is implemented		
		Step 1: THERMOSTAT_STATUS_1 is sent with Operating Mode = 1 (Cool), Set Point Cool = 246Ah (65 deg F°), Fan Speed 0 (Automatic), AMBIENT_TEMPERATURE_STATUS is sent with Ambient Temp = 24C3h (70 deg F°). The broadcasts are repeated every 5 seconds	AIR_CONDITIONER_STATUS is sent immediately, and subsequently every 2000ms, per the requirements in test 103S-S-01. See below if the unit has a hold-off timer that delays the output	The unit shall begin turning on. If the unit has a hold-off timer, the unit shall broadcast Max Output Level 0 (0%) and Output Level 0 (0%) until the timer has expired and the unit begins operation, at which time the Max Output Level shall report 200 (100%) and the Output Level shall be the current level. The fan speed shall be set by the unit
		Step 2: After Step 1 is complete, the test continues with THERMOSTAT_STATUS_1 Operating Mode = 0 (Off)		The unit shall begin turning off. If the unit has a hold-on timer, the unit shall continue to report the current Output Level and Fan Speed until the timer has expired, and then report 0 (0%) for both

				fields
		Step 3: As Step 1, but with Operating Mode = 3 (Auto)		Same behavior as Step 1
		Step 4: After Step 3 is complete, the test continues with THERMOSTAT_STATUS_1 Operating Mode = 0 (Off)		Same behavior as Step 2

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response	Required Behavior
103S-C-03	THERMOSTAT_STATUS_1 Dead Band / Dwell	With the unit in Operating Mode 0 (Automatic), Max Fan Speed 200 (100%), Max Output Level 200 (100%), the following sequence of tests in implemented		
		Step 1: THERMOSTAT_STATUS_1 is sent with Operating Mode = 1 (Cool), Set Point Cool = 24C3h (70 deg F°), Fan Speed 0 (Automatic), AMBIENT_TEMPERATURE_STATUS is sent with Ambient Temp = 251Ch (75 deg F°). The broadcasts are repeated every 5 seconds	AIR_CONDITIONER_STATUS is sent immediately, and subsequently every 2000ms, per the requirements in test 103S-S-01. See below if the unit has a hold-off timer that delays the output	The unit shall begin turning on. If the unit has a hold-off timer, the unit shall broadcast Max Output Level 0 (0%) and Output Level 0 (0%) until the timer has expired and the unit begins operation, at which time the Max Output Level shall report 200 (100%) and the Output Level shall be the current level. The fan speed shall be set by the unit
		Step 2: After step 1 is complete, the test continues with AMBIENT_TEMPERATURE_STATUS Ambient Temperature 2513h (74.5 deg F°). After 10 seconds, the Ambient Temperature is reduced another 0.5 deg F°, and the process is continued until the Ambient Temperature reaches 246Ah (65 deg F°)		After reaching a temperature less than 70 deg F° minus the Dead Band, the unit turns off. An acceptable alternative is for the stopping point to be determined by a dwell timer, or in some combination of dead band and timer. It is not acceptable for the mechanism to allow for rapid cycling
		Step 3: After step 2 is complete, the AMBIENT_TEMPERATURE_STATUS Ambient Temperature is incremented in 0.5 deg F° steps every 10 seconds until the Ambient Temperature reaches 251Ch (75 deg F°)		After reaching a temperature greater than 70 deg F° plus the Dead Band, the unit turns on. An acceptable alternative is for the starting point to be determined by a dwell timer, or in some combination of dead band and timer. It is not acceptable for the mechanism to allow for rapid cycling. Note: The test assumes a Dead Band of less than 5 deg F°

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response
103S-C-04	Command Fan Speed	With the unit in Operating Mode 0 (Automatic), Max Fan Speed 200 (100%), Max Output Level 200 (100%), the following sequence of tests in implemented	
		Step 1: THERMOSTAT_STATUS_1 is sent with Operating Mode = 1 (Cool), Set Point Cool = 246Ah (65 deg F°), Fan Speed 200 (100%). AMBIENT_TEMPERATURE_STATUS is sent with Ambient Temp = 24C3h (70 deg F°). The broadcasts are repeated every 5 seconds	The unit shall begin turning on. If the unit has a hold-off timer, the unit shall broadcast Max Output Level 0 (0%) and Output Level 0 (0%) until the timer has expired and the unit begins operation, at which time the Max Output Level shall report 200 (100%) and the Output Level shall be the current level. The fan speed shall be set by the unit
		Step 2: After Step 1, the test continues with arbitrary values for Fan Speed	The Fan Speed adjusts according to its capabilities, rounded as described above
		Step 3: After Step 2, the test continues with Fan Speed 0 (Automatic). AMBIENT_TEMPERATURE_STATUS is then sent with values adjusted downward at 1 deg F° per minute until it reaches 246Ah (65 deg F°)	The Fan Speed changes to 100%. If the unit supports automatic speed adjustment, it adjusts accordingly as the temperature decreases and reports the actual fan speed. At some point, based on either a dead band or dwell time, it stops

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response
103S-C-05	Command Max Fan Speed, Max Output Level	Step 1: THERMOSTAT_STATUS_1 is sent with Operating Mode = 1 (Cool), Set Point Cool = 246Ah (65 deg F°), Fan Speed 0 (Automatic), AMBIENT_TEMPERATURE_STATUS is sent with Ambient Temp = 24C3h (70 deg F°). The broadcasts are repeated every 5 seconds	The unit shall begin turning on. If the unit has a hold-off timer, the unit shall broadcast Max Output Level 0 (0%) and Output Level 0 (0%) until the timer has expired and the unit begins operation, at which time the Max Output Level shall report 200 (100%) and the Output Level shall be the current level. The fan speed shall be set by the unit
		Step 2: AIR_CONDITIONER_COMMAND is sent with Max Fan Speed set to an arbitrary value from 0-200 (0-100%) and Max Output Level set to another arbitrary value 0-200 (0-100%). The test is repeated with a variety of values, including values of 0 and 200 (100%)	The unit shall report Max Fan Speed and Max Output Level with the same values as received. The Fan Speed and Output Level shall be reported according to the actual speed and level, rounded as necessary to match the capabilities of the unit. Note that hold-off and hold-on timers may delay the implementation of the speed and level changes, and this does not require a NAK
		Step 3: Step 2 is repeated several times, with arbitrary non-zero values in THERMOSTAT_STATUS_1 for Fan Speed. Several combinations of Max Fan Speed and Max Output Level (from AIR_CONDITIONER_COMMAND) and Fan Speed (from THERMOSTAT_STATUS_1) are to be tested	For each combination, the unit shall adjust the Fan Speed to the lesser of Max Fan Speed (not rounded) and Fan Speed (rounded as above). Output Level adjusts a level no greater than the Max Output Level (not rounded)
		Step 4: Step 2 is repeated with THERMOSTAT_STATUS_1 Fan Speed set	The fan speed shall adjust according to the programming of the unit, but never exceeding Max

		to 0 (Automatic)	Fan Speed (not rounded)
		Step 5: THERMOSTAT_STATUS_1 is sent with Operating Mode 0 (Off)	The unit turns off
		Step 6: After a pause, THERMOSTAT_STATUS_1 is sent with Operating Mode 1 (Cool)	The unit returns to its previous state, with fan speed and output level never exceeding the Max Fan Speed and Max Output Levels

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response	Required Behavior
103S-C-06	THERMOSTAT_STATUS_1: OpMode 4 (Fan Only)	With the unit in Operating Mode 0 (Automatic), Max Fan Speed 200 (100%), Max Output Level 200 (100%), the following sequence of tests in implemented		
		Step 1: THERMOSTAT_STATUS_1 is sent with Operating Mode = 4 (Fan Only), Set Point Cool = 246Ah (65 deg F°), Fan Speed 0 (Automatic), AMBIENT_TEMPERATURE_STATUS is sent with Ambient Temp = 24C3h (70 deg F°). The broadcasts are repeated every 5 seconds	AIR_CONDITIONER_STATUS is sent immediately, and subsequently every 2000ms, per the requirements in test 103S-S-01. See below if the unit has a hold-off timer that delays the output	The unit shall begin turning on the fan, but not the compressor. The fan speed shall be set by the unit
		Step 2: After step 1 is complete, the test continues with THERMOSTAT_STATUS_1 Operating Mode = 0 (Off)		The unit shall begin turning off the fan
		Step 3: Step 1 is repeated with Set Point Cool = 251Ch (75 deg F°)		No change
		Step 4: Step 3 is repeated with AMBIENT_TEMPERATURE_STATUS Ambient Temp = 2575h (80 deg F°)		Same behavior as Step 1
		Step 5: Step 4 is repeated with arbitrary non-zero values for THERMOSTAT_STATUS_1, Fan Speed		Same behavior as Step 1, with the fan speed corresponding to the value broadcast, rounded as above
		Step 6: Step 5 is repeated with arbitrary values for AIR_CONDITIONER_COMMAND Max Fan Speed. A variety of values for Fan Speed and Max Fan Speed are to be tested	Same as above, the AIR_CONDITIONER_STATUS Fan Speed shall match the actual fan speed, as rounded	For each combination, the unit shall adjust the Fan Speed to the lesser of Max Fan Speed (not rounded) and Fan Speed (rounded as above)

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response	Required Behavior

<table>
<tr><td rowspan="6">103S-C-07</td><td rowspan="6">THERMOSTAT_STATUS_1: Fan Mode = 1 (Forced)</td><td colspan="3">With the unit in Operating Mode 0 (Automatic), Max Fan Speed 200 (100%), Max Output Level 200 (100%), the following sequence of tests in implemented</td></tr>
<tr><td>Step 1: THERMOSTAT_STATUS_1 is sent with Operating Mode = 0 (Off), Fan Mode 1 (On), Fan Speed 0 (Auto). The broadcasts are repeated every 5 seconds</td><td rowspan="5">AIR_CONDITIONER_STATUS is sent immediately, and subsequently every 2000ms, per the requirements in test 103S-S-01. See below if the unit has a hold-off timer that delays the output</td><td>The unit shall begin turning on the fan, but not the compressor. The fan speed shall be set by the unit</td></tr>
<tr><td>Step 2: After step 1 is complete, the test continues with THERMOSTAT_STATUS_1 Fan Mode 0 (Off)</td><td>The unit shall begin turning off the fan</td></tr>
<tr><td>Step 3: Step 1 is repeated with arbitrary non-zero values for Fan Speed</td><td>The unit shall begin turning on the fan, but not the compressor. The fan speed shall be as broadcast, rounded as above</td></tr>
<tr><td>Step 4: Step 3 is repeated with arbitrary values for AIR_CONDITIONER_COMMAND Max Fan Speed. A variety of values for Fan Speed and Max Fan Speed are to be tested</td><td>For each combination, the unit shall adjust the Fan Speed to the lesser of Max Fan Speed (not rounded) and Fan Speed (rounded as above)</td></tr>
<tr><td>Step 5: Step 1 is repeated with arbitrary values for Set Point Cool and Ambient Temperature</td><td>Same behavior as Step 1, The unit shall ignore the temperature and set points</td></tr>
</table>

6.17.8.6 Simple Air Conditioner w/ Internal Temperature Profile

This profile describes a product that works autonomously, but relies on an separate thermostat to maintain the set points. The temperature sensor is integrated into the product and the unit broadcasts its reading on the network.

If the product also supports Profile 103A – Slave Air Conditioner, then the Operating Mode of 0 (Auto) indicates that it is running as a “Simple” A/C, and an Operating Mode of 1 indicates it is running as a “Slave”.

Prerequisite: 88Z - Temperature Sensor

ID	Datum	Test	Required Response
103T-S-01	AIR_CONDITIONING_STATUS	AIR_CONDITIONING_COMMAND is broadcast with correct instance and any data values	1. The unit responds per Level Two requirements for response time with correct values for Operating Status, Fan Speed, Max Fan Speed, Output Level, Max Output Level, and Dead Band. 2. The unit sends the message repeatedly on a 2000 ms schedule.

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response	Required Behavior
103T-C-01	Command Operating	On AIR_CONDITIONER_COMMAND	AIR_CONDITIONER_STATUS reports Operating	The unit shall operate consistent with the current context

	Mode	, send Command - Operating Mode = 0 (automatic)	Mode = 0 (Automatic)	
		On AIR_CONDITIONER_COMMAND, send Command - Operating Mode = 1 (Manual- Ignores Thermostat)	AIR_CONDITIONER_STATUS reports Operating Mode = 1 (Manual - Ignores Thermostat)	The unit shall turn off

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response	Required Behavior
103T-C-02	THERMOSTAT_STATUS_1 OpMode Cool/Auto/Off	With the unit in Operating Mode 0 (Automatic), Max Fan Speed 200 (100%), Max Output Level 200 (100%), the following sequence of tests in implemented		
		Step 1: THERMOSTAT_STATUS_1 is sent with Operating Mode = 1 (Cool), Set Point Cool 5 deg F° lower than the reported temperature, Fan Speed 0 (Automatic). The broadcast is repeated every 5 seconds	AIR_CONDITIONER_STATUS is sent immediately, and subsequently every 2000ms, per the requirements in test 103S-S-01. See below if the unit has a hold-off timer that delays the output	The unit shall begin turning on. If the unit has a hold-off timer, the unit shall broadcast Max Output Level 0 (0%) and Output Level 0 (0%) until the timer has expired and the unit begins operation, at which time the Max Output Level shall report 200 (100%) and the Output Level shall be the current level. The fan speed shall be set by the unit
		Step 2: After step 1 is complete, the test continues with THERMOSTAT_STATUS_1 Operating Mode = 0 (Off)		The unit shall begin turning off. If the unit has a hold-on timer, the unit shall continue to report the current Output Level and Fan Speed until the timer has expired, and then report 0 (0%) for both fields
		Step 3: As step 1, but with Operating Mode = 3 (Auto)		Same behavior as step 1
		Step 4: After step 3 is complete, the test continues with THERMOSTAT_STATUS_1 Operating Mode = 0 (Off)		Same behavior as step 2

Note: The test assumes a Dead Band of less than 5 deg F°.

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response	Required Behavior
103T-C-03	THERMOSTAT_STATUS_1 Dead Band / Dwell	With the unit in Operating Mode 0 (Automatic), Max Fan Speed 200 (100%), Max Output Level 200 (100%), the following sequence of tests in implemented		
		Step 1: THERMOSTAT_STATUS_1 is sent with Operating Mode = 1 (Cool), Set Point Cool 5 deg F° lower than the reported	AIR_CONDITIONER_STATUS is sent immediately, and subsequently every 2000ms, per the	The unit shall begin turning on. If the unit has a hold-off timer, the unit shall broadcast Max Output Level 0 (0%) and Output Level 0 (0%) until the timer has expired

		temperature, Fan Speed 0 (Automatic). The broadcast is repeated every 5 seconds	requirements in test 103S-S-01. See below if the unit has a hold-off timer that delays the output	and the unit begins operation, at which time the Max Output Level shall report 200 (100%) and the Output Level shall be the current level. The fan speed shall be set by the unit
		Step 2: After step 1 is complete, temperature sensor is cooled over a span of 1-2 minutes until it reaches a temperature less than 5 deg F° below the Set Point		After reaching a temperature less than the Cool Point minus the Dead Band, the unit turns off. An acceptable alternative is for the stopping point to be determined by a dwell timer, or in some combination of dead band and timer. It is not acceptable for the mechanism to allow for rapid cycling
		Step 3: After step 2 is complete, the temperature sensor is warmed over a span of 1-2 minutes until it reaches the original temperature		After reaching a temperature greater than the Cool Point plus the Dead Band, the unit turns on. An acceptable alternative is for the starting point to be determined by a dwell timer, or in some combination of dead band and timer. It is not acceptable for the mechanism to allow for rapid cycling

Note: The test assumes a Dead Band of less than 5 deg F°.

Air Conditioner Status (AIR_CONDITIONER_COMMAND/AIR_CONDITIONER_STATUS).

ID	Datum	Test	Required Response
103T-C-04	Command Fan Speed	With the unit in Operating Mode 0 (Automatic), Max Fan Speed 200 (100%), Max Output Level 200 (100%), the following sequence of tests in implemented	
		Step 1: THERMOSTAT_STATUS_1 is sent with Operating Mode = 1 (Cool), Set Point Cool = 5 deg F° lower than the reported temperature, Fan Speed 200 (100%). The broadcast is repeated every 5 seconds	The unit shall begin turning on. If the unit has a hold-off timer, the unit shall broadcast Max Output Level 0 (0%) and Output Level 0 (0%) until the timer has expired and the unit begins operation, at which time the Max Output Level shall report 200 (100%) and the Output Level shall be the current level. The fan speed shall be set by the unit
		Step 2: After Step 1, the test continues with arbitrary values for Fan Speed	The Fan Speed adjusts according to its capabilities, rounded as described above
		Step 3: After Step 2, the test continues with Fan Speed 0 (Automatic). The temperature sensor is then cooled over a 1-2 minute period until it reaches a temperature 5 deg F° lower than the Set	The Fan Speed changes to 100%. If the unit supports automatic speed adjustment, it adjusts accordingly as the temperature decreases and reports the actual fan speed. At some point, based on either a dead band or dwell time, it

		Point Cool	stops

Test 103T-C-06
Datum: Max Fan Speed, Max Output Level
Test: Same as 103S-C-06, with the obvious modification for use of the internal temperature sensor.

Test 103T-C-07
Datum: THERMOSTAT_STATUS_1: OpMode 4 (Fan Only)
Test: Same as 103T-C-06, with the obvious modification for use of the internal temperature sensor.

Test 103T-C-07
Datum: THERMOSTAT_STATUS_1: Fan Mode = 1 (Forced)
Test: Same as 103S-C-07

6.18 Generator

6.18.1 Introduction

The generator is typically the primary on-board AC (and possibly DC) power supply for the RV and powered by gasoline, LP gas, or diesel. The following formats apply (see Table 6.18.1).

Table 6.18.1 — Generator definition

Device attribute	Value
Category	Power components
Default Source Address	64
Dynamic Address Range	128 to 143
Instance	Unique

6.18.2 AC Output Introduction

The Generator reports the AC output using the standard AC Point formats (see 6.1). The Instance field is defined in Table 6.18.2. Note that each of these DGNs may have to be transmitted multiple times to provide information on each line.

Table 6.18.2 — Instance field definition

Byte	Bit	Name	Data type	Unit	Value definition
0	0 to 3	Output Instance	uint4	-	1 to 10 – Valid instances 0 & 11 to 15 – Invalid instances
	4 to 7	Line	uint4	-	1 — Line 1 2 — Line 2

6.18.3 AC Output Page 1

Table 6.18.3 defines the DG attributes, and Table 6.18.2 defines the instance. The remaining signal and parameter of the data is defined as AC_STATUS_1 (see Table 6.1.2b).

Table 6.18.3 — DG definition

DG attribute	Value

Name	GENERATOR_AC_STATUS_1
DGN	1FFDFh
Default priority	6
Maximum broadcast gap	None
Normal broadcast gap	500 ms when generator running
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.18.4 AC Output Page 2

Table 6.18.4 defines the DG attributes, and Table 6.18.2 defines the instance. The remaining signal and parameter of the data is defined as AC_STATUS_2 (see Table 6.1.3b).

Table 6.18.4 — DG definition

DG attribute	Value
Name	GENERATOR_AC_STATUS_2
DGN	1FFDEh
Default priority	6
Maximum broadcast gap	None
Normal broadcast gap	500 ms when generator running
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.18.5 AC Output Page 3

Table 6.18.5 defines the DG attributes, and Table 6.18.2 defines the instance. The remaining signal and parameter of the data is defined as AC_STATUS_3 (see Table 6.1.4b).

Table 6.18.5 — DG definition

DG attribute	Value
Name	GENERATOR_AC_STATUS_3
DGN	1FFDDh
Default priority	6
Maximum broadcast gap	None
Normal broadcast gap	500 ms when generator running
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.18.6 AC Output Page 4

Table 6.18.6 defines the DG attributes, and Table 6.18.2 defines the instance. The remaining signal and parameter of the data is defined as AC_STATUS_4 (see Table 6.1.5b).

Table 6.18.6 — DG definition

DG attribute	Value
Name	GENERATOR_AC_STATUS_4
DGN	1FF94h
Default priority	6
Maximum broadcast gap	None
Normal broadcast gap	500 ms when generator running
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.18.7 AC Fault Configuration Status and Command

Fault Control configuration and status DGNs are defined for the generator. These DGNs follow the formats as indicated in the following Table 6.18.7. Instances are defined in Table 6.18.2 above.

Table 6.18.7 - DG Reference

Name	DGN	Format	Table
GENERATOR_ACFAULT_CONFIGURATION_STATUS_1	1FF93h	AC_CONFIGURATION_STATUS_1	6.1.6
GENERATOR_ACFAULT_CONFIGURATION_STATUS_2	1FF92h	AC_CONFIGURATION_STATUS_2	6.1.7
GENERATOR_ACFAULT_CONFIGURATION_COMMAND_1	1FF91h	ACFAULT_CONFIGURATION_COMMAND_1	6.1.8
GENERATOR_ACFAULT_CONFIGURATION_COMMAND_2	1FF90h	ACFAULT_CONFIGURATION_COMMAND_2	6.1.8

The status DGNs are broadcast on request. The command DGNs should be acknowledged with an ACK and the corresponding status DGN.

6.18.8 DC Output Introduction

A generator which outputs DC reports the status of its DC functions and outputs with a series of generator-specific DGNs. It may also report using the DC Source Status DGNs, as appropriate. It is possible for a generator to have both AC and DC outputs. When reporting DC output, the generator uses an Instance field as defined in Table 6.18.8. Note that each of these DGNs may have to be transmitted multiple times to provide information on each line.

Table 6.18.8 — Instance field definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Output Instance	uint8	-	1 to 10 -Valid instances 0 & 11 to 255 – Invalid instances

6.18.9 DC Generator Status 1

Table 6.18.9a defines the DG attributes and Table 6.18.9b defines the signal and parameter attributes.

Table 6.18.9a — DG definition

DG attribute	Value
Name	GENERATOR_DC_STATUS_1
DGN	1FEC6h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	5000 ms or on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.18.9b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8		see Table 6.18.8
1 to 2	-	Charge voltage	uint16	V	see Table 5.3 Control voltage: The voltage desired to be delivered to the battery.
3 to 4	-	Charge current	uint16	A	see Table 5.3 Control current: The current desired to be delivered to the battery.
5	-	Charge current percent of maximum	uint8	%	see Table 5.3 Control current as a percent of the maximum.
6	-	Operating state	uint8	-	Specifies the current operating state of the DC Generator for the identified DC source. See table 6.5.5b
7	0 to 1	Default state on power-up	uint2	-	00b – Charger disabled 01b – Charger enabled
	2 to 3	Reserved			
	4 to 7	Force charge	uint4	-	0 – Charging is not forced 1 – Force charge to bulk 2 – Force charge to float

6.18.10 DC Generator Status 2

The DC Generator status2 DGN communicants the linkage of a given device instance with its associated DC battery instance. It also allows for the reporting of the generators priority relative to other charging sources as well as additional operating conditions vs. the goals from DC Generator Status 1. Table 6.18.10a defines the DG attributes and Table 6.18.10b defines the signal and parameter attributes.

Table 6.18.10a defines the DG attributes and Table 6.18.10b defines the signal and parameter attributes.

Table 6.18.10a — DG definition

DG attribute	Value
Name	GENERATOR_DC_STATUS_2
DGN	1FDDCh
Default priority	6

Maximum broadcast gap	None
Normal broadcast gap	500 ms
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.18.10b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	see Table 6.18.8
1	-	DC Source instance (DEPRECATED) Field 1 is being deprecated and replaced with new DC_SOURCE_CONNECTION_STATUS message	uint8	-	DC Source generator is associated with 0 = invalid 255 = Unknown
2	-	DC Charging priority	uint8	-	Priority of DC Generator relative to other charging sources 0 = Unassigned Higher value indicates higher priority.
3 to 4	-	Charging voltage	uint16	A	see Table 5.3 Voltage as measured at DC Generator output.
5 to 6	-	Charging current	uint16	A	see Table 5.3 Current being delivered by DC Generator.
7	-	Device Temperature	uint8	°C	see Table 5.3 Temperature of charging element (alternator, rectified pack) in DC Generator

6.18.11 Generator DC Configuration Status

This DG provides configuration information for the DC Generator. Table 6.18.11a defines the DG attributes and Table 6.18.11b defines the signal and parameter attributes.

Table 6.18.11a — DG definition

DG attribute	Value
Name	GENERATOR_DC_CONFIGURATION_STATUS
DGN	1FEC5h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.18.11b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	See Table 6.18.8
1	-	Charging algorithm	uint8	-	See Table 6.20.11b
2	-	Charger mode	uint8	-	Configuration of charger modes to allow multiple chargers on one battery. 0-Stand-alone 1 – Primary 2 – Secondary 3 – Linked to DC source See Table 6.20.11b
3	0 to 1	Battery sensor present	uint2	-	00b — No battery temperature sensor in use 01b — Sensor is present and active
	2 to 3	<RESERVED>			
	4 to 7	Battery type	uint4	-	see table 6.5.5b
4 to 5	-	Battery bank size	uint16	A•h	see Table 5.3
6 to 7	-	Maximum charging current	uint16	A	see Table 5.3

6.18.12 Generator DC Command

This command enables or disables the DC generator output. Note that Enabling/Disabling the DC generator does not necessarily start or stop the generator. See 6.18.25, Generator Command, and 6.35.3, Generator Demand Command. Table 6.18.12a defines the DG attributes and Table 6.18.12b defines the signal and parameter attributes.

Table 6.18.12a — DG definition

DG attribute	Value
Name	GENERATOR_DC_COMMAND
DGN	1FEC4h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, GENERATOR_DC_STATUS

Table 6.18.12b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	see Table 6.18.8
1	-	DC output status	uint8	-	0 — Disable DC generator DC output 1 — Enable DC generator DC output 2 — Start equalization
2	0 to 1	Default state on power- up	uint2	-	00b — DC output disabled on power-up 01b — DC output enabled on power-up
	2 to 3	<RESERVED>			
	4 to 7	Force charge	uint4	-	0 - Cancel forcing 1 – Force charge to bulk 2 – Force charge to float

6.18.13 Generator DC Configuration Command

This DGN is applicable when Instance indicates a Generator supporting DC output and is used to provide configuration information to the generator.. Table 6.18.13a defines the DG attributes and Table 6.18.13b defines the signal and parameter attributes.

Table 6.18.13a — DG definition

DG attribute	Value
Name	GENERATOR_DC_CONFIGURATION_COMMAND
DGN	1FEC3h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, GENERATOR_DC_CONFIGURATION_STATUS

Table 6.18.13b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	see Table 6.18.8
1	-	Charging algorithm	uint8	-	see 6.20.11b
3	0 to 1	Battery sensor present	uint2	-	00b — No battery temperature sensor in use 01b — Sensor is present and active
	2 to 3	Linkage mode	uint2	-	00b – Independent 01b – Linked to DC Source Indicates that operation is linked to a DC source which reports through the DC_SOURCE_STATUS DGNs.
	4 to 7	Battery type	uint4	-	see table 6.5.5b
4 to 5	-	Battery bank size	uint16	A•h	see Table 5.3
6 to 7	-	Maximum charging current	uint16	A	see Table 5.3

6.18.14 Generator DC Configuration Status 2

Table 6.18.14a defines the DG attributes and Table 6.18.14b defines the signal and parameter attributes.

Table 6.18.14a — DG definition

DG attribute	Value
Name	GENERATOR_DC_CONFIGURATION_STATUS_2
DGN	1FDDBh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change
Minimum broadcast gap	50 ms, see 3.2.4.2

Number of frames	1
ACK requirements	None

Table 6.18.14b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	see Table 6.18.8
1	-	Maximum charge current as percent	uint8	%	See Table 5.3 see notes above
2	-	Charge rate limit as percent of bank size	uint8	%	See Table 5.3 see notes above
3	-	<RESERVED>	uint8		
4	-	Default Battery Temperature	uint8	°C	See Table 5.3 May be used in the absence of a battery temperature sensor on the charger
5 to 6	-	Recharge Voltage	uint16	V	See Table 5.3 Generator may initiate charging when battery drains past this value

6.18.15 Generator DC Configuration Command 2

Table 6.18.15 defines the DG attributes. The signal and parameter attributes have the same format as GENERATOR_DC_CONFIGURATION_STATUS_2 (see Table 6.18.14b).

Table 6.18.15a — DG definition

DG attribute	Value
Name	GENERATOR_DC_CONFIGURATION_COMMAND_2
DGN	1FDDAh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, GENERATOR_DC_CONFIGURATION_STATUS_2

6.18.16 Generator DC Configuration Status 3

Table 6.18.16a defines the DG attributes and Table 6.18.16b defines the signal and parameter attributes.

Table 6.18.16a — DG definition

DG attribute	Value
Name	GENERATOR_DC_CONFIGURATION_STATUS_3
DGN	1FDD9h
Default priority	6

Maximum broadcast gap	N/A
Normal broadcast gap	on change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.18.16b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	
1 to 2	-	Bulk Voltage	uint16	V	See Table 5.3
3 to 4	-	Absorption Voltage	uint16	V	See Table 5.3
5 to 6	-	Float Voltage	uint16	V	See Table 5.3
7	-	Temperature Compensation Constant	uint8	MV/K	0 – 250 mV/K Magnitude of charging voltage adjustment due to temperature

6.18.17 Generator DC Configuration Command 3

Table 6.18.17a defines the DG attributes. The signal and parameter attributes have the same format as GENERATOR_DC_CONFIGURATION_STATUS_3 (see Table 6.18.16b).

Table 6.18.17a — DG definition

DG attribute	Value
Name	GENERATOR_DC_CONFIGURATION_COMMAND_3
DGN	1FDD8h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, GENERATOR_DC_CONFIGURATION_STATUS_3

6.18.18 Generator DC Configuration Status 4

Table 6.18.18a defines the DG attributes and Table 6.18.18b defines the signal and parameter attributes.

Table 6.18.18a — DG definition

DG attribute	Value
Name	GENERATOR_DC_CONFIGURATION_STATUS_4
DGN	1FDD7h
Default priority	6
Maximum broadcast gap	N/A

Normal broadcast gap	on change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.18.16b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	
1 to 2	-	Bulk Time	uint16	min	Precision = 1 minute Value range = 0 to 65530 minutes
3 to 4	-	Absorption Time	uint16	min	Precision = 1 minute Value range = 0 to 65530 minutes
5 to 6	-	Float Time	uint16	min	Precision = 1 minute Value range = 0 to 65530 minutes

6.18.19 Generator DC Configuration Command 4

Table 6.18.19a defines the DG attributes. The signal and parameter attributes have the same format as GENERATOR_DC_CONFIGURATION_STATUS_4 (see Table 6.18.18b).

Table 6.18.17a — DG definition

DG attribute	Value
Name	GENERATOR_DC_CONFIGURATION_COMMAND_4
DGN	1FDD6h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, GENERATOR_DC_CONFIGURATION_STATUS_4

6.18.20 Generator DC Equalization Status

This describes the status of the Equalization process. Table 6.18.20a defines the DG attributes and Table 6.18.20b defines the signal and parameter attributes. This DGN is normally broadcast only during the equalization process.

Table 6.18.20a — DG definition

DG attribute	Value
Name	GENERATOR_DC_EQUALIZATION_STATUS
DGN	1FEC2h
Default priority	6
Maximum broadcast gap	5000 ms if active
Normal broadcast gap	1000 if active

Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.18.20b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	see Table 6.18.8
1 to 2	-	Time remaining	uint16	min	Precision = 1 min Value range = 0 to 65 530 min
3	-	Pre-charging status	uint2	-	00b — Pre-charging is not in process 01b — Generator is charging the batteries to prepare for equalization

6.18.21 Generator DC Equalization Configuration Status

This describes configuration information for the Equalization mode of a DC generator. Table 6.18.21a defines the DG attributes and Table 6.18.21b defines the signal and parameter attributes.

Table 6.18.21a — DG definition

DG attribute	Value
Name	GENERATOR_DC_EQUALIZATION_CONFIGURATION_STATUS
DGN	1FEC1h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.18.21b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	see Table 6.18.8
1 to 2	-	Equalization voltage	uint16	V	see Table 5.3
3 to 4	-	Equalization time	uint16	min	Precision = 1 min Value range = 0 to 65 530 min

6.18.22 Generator DC Equalization Configuration Command

This changes the configuration information for the Equalization mode of a DC Generator. Table 6.18.22 defines the DG attributes. The signal and parameter attributes have the same format as GENERATOR_DC_EQUALIZATION_CONFIGURATION_STATUS (see Table 6.18.21b).

Table 6.18.22 — DG definition

DG attribute	Value
Name	GENERATOR_DC_EQUALIZATION_CONFIGURATION_COMMAND

DGN	1FEC0h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, GENERATOR_DC_EQUALIZATION_CONFIGURATION_STATUS

6.18.23 Generator Status 1

This DGN describes the physical status of the generator. Table 6.18.23a defines the DG attributes, and Table 6.18.23b defines the signal and parameter attributes.

Table 6.18.23a — DG definition

DG attribute	Value
Name	GENERATOR_STATUS_1
DGN	1FFDCh
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	1000 ms when running 5000 ms when not running On change to Status field
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

Table 6.18.23b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Status	uint8	-	0 – Stopped 1 – Preheat 2 – Cranking 3 – Running 4 – Priming 5 – Fault 6 – Engine run only 7 - Test mode 8 - Voltage adjust mode 9 - Fault bypass mode 10 - Configuration mode All other values reserved
1 to 4	-	Engine run time	uint32	min	Number of minutes logged on genset.
5	-	Engine load	uint8	%	see Table 5.3 Indicates the current engine load as a percent of capacity. Does not necessarily correspond to current output.
6 to 7	-	Start battery voltage	uint16	V	see Table 5.3

6.18.24 Generator Status 2

This DGN describes the physical status of the generator. Table 6.18.24a defines the DG attributes, and Table 6.18.24b defines the signal and parameter attributes.

Table 6.18.24a — DG definition

DG attribute	Value
Name	GENERATOR_STATUS_2
DGN	1FFDBh
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	1000 ms when running 5000 ms when not running.
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

Table 6.18.24b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	0 to 1	Temperature shutdown switch	uint2	-	00b - Temperature shutdown not active 01b - Temperature shutdown active (Genset shall not run)
	2 to 3	Oil pressure shutdown switch	uint2	-	00b - Oil pressure shutdown not active 01b - Oil pressure shutdown active (Genset shall not run)
	4 to 5	Oil level switch	uint2	-	00b - Oil level switch not active 01b - Low oil level detected
	6 to 7	Caution light	uint2	-	00b - Caution light not active 01b - Caution light on
1	-	Eng coolant temperature	uint8	°C	see Table 5.3
2	-	Eng oil pressure	uint8	kPa	Precision = 4 kPa Value range = 0 to 1000 kPa (145.04 PSI)
3 to 4	-	Engine RPM	uint16	RPM	Precision = 0.125 rpm Value range = 0 to 8191.25 rpm
5 to 6	-	Fuel rate	uint16	lph	Precision = 0.05 lph (liter per hour) Value range = 0 - 3212.5 lph

6.18.25 Generator Command

This DG command starts and stops the generator. Table 6.18.25a defines the DG attributes, and Table 6.18.25b defines the signal and parameter attributes.

Table 6.18.25a — DG definition

DG attribute	Value
Name	GENERATOR_COMMAND
DGN	1FFDAh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed

Number of frames	1
ACK requirements	NAK, GENERATOR_STATUS_1

Table 6.18.25b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	-	Command	uint8	-	0 – Stop 1 – Start 2 - Manual prime 3 - Manual preheat Normally prime and preheat are handled automatically by the controller.

6.18.26 Generator Starter Configuration

This is DG is primarily used by modules that control an otherwise “dumb” generator, although it could be directly supported by a generator's ECM. Table 6.18.26a defines the DG attributes, and Table 6.18.26b defines the signal and parameter attributes.

Table 6.18.26a — DG definition

DG attribute	Value
Name	GENERATOR_START_CONFIG_STATUS
DGN	1FFD9h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.18.26b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value definition
0	-	Generator type	uint8	-	Indicates the inputs used to control the generator. 1 — Run/Crank inputs (Run input shall be held on to run. Crank input shall energize the starter.) 2 — Crank/Glow & Stop inputs (No run input is required. One input shall energize the starter, the other shall stop the generator and may energize the preheat.) 3 — Preheat/Start input and Prime/Stop input 4 — Single On/Off input
1	-	Generator pre-crank time	uint8	s	Precision = 1s Value range = 0 to 250s Indicates the amount of time the preheat will be energized before cranking.
2	-	Generator max crank time	uint8	s	Precision = 1s

					Value range = 0 to 250s Indicates the maximum amount of time the starter will be energized in one attempt.
3	-	Generator stop time	uint8	s	Precision = 1s Value range = 0 to 250s Indicates the amount of time the stop signal will be triggered to stop the generator.

6.18.27 Generator Starter Configuration Command

Table 6.18.27 defines the DG attributes. The signal and parameter attributes are identical to GENERATOR_START_CONFIG_STATUS (see Table 6.18.26b). A value of 255 in any position indicates that the value should not be changed.

Table 6.18.27 — DG definition

DG attribute	Value
Name	GENERATOR_START_CONFIG_COMMAND
DGN	1FFD8h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, GENERATOR_START_CONFIG_STATUS

6.18.28 Service Points

These are the allowable Service Points for this Device (see Table 6.18.28a).

Table 6.18.28a — Service Points

SPN	Description
0 to 255	Standard SPNs (see Table 7.3)
256	Engine Run Time
257	Engine Load
258	Start Battery Voltage
259	Temperature Shutdown Switch
260	Oil Pressure Shutdown Switch
261	Oil Level Switch
262	Caution Light
263	Eng Coolant Temperature
264	Eng Oil Pressure
265	Engine RPM
266	Fuel Rate
267	Generator Type

268	Generator Pre-crank Time
269	Generator Max Crank Time
270	Generator Stop Time
271	Fuel Pump
272	Preheat
273	Starter
274	Generic temperature
275	Generic fault
276	Governor actuator
277	Starter solenoid
278	Governor actuator duty cycle
279	Cutoff switch
280	PMA (generator) sense
281	DC sense
282	Cranking speed
283	Inverter temperature
284	Engine stop
285	Ambient temperature
286	Pre-heat relay
287	Fuel pump relay
288	Start relay
289	Engine Coolant Level
290	Alternator
291	Engine Start
292	Fuel Level
293	Air Pressure
294	Hydraulic Pressure
295	DEF Tank Level
296	AC Breaker
297	Diesel Particulate Filter
298	DPF Soot Level
299	J1939 Support
300	Battery Charger
301	Fuel Tank Rupture Basin
302	Fuel Temperature
303	Exhaust Temperature

304	Remote Start

The SPNs defined in Table 6.18.28b apply to the AC output, and thus may have several instances. The 19-bit SPN is divided into three sections, the Most Significant Byte (MSB), the Intermediate Byte (ISB), and the Least Significant Bits (LSb). The ISB indicates the Instance of the AC Output that is suspect. If the problem is global to all instances, the ISB is 0.

Table 6.18.28b — Service Points

MSB	ISB	LSb	Description
1	Instance	0	RMS AC Voltage
1	Instance	1	RMS AC Current
1	Instance	2	AC Frequency
1	Instance	3	Open AC Ground
1	Instance	4	Open AC Neutral
1	Instance	5	Reverse AC Polarity
1	Instance	6	AC Ground Fault
1	Instance	7	Peak AC Voltage
2	Instance	0	Peak AC Current
2	Instance	1	AC Ground Current
2	Instance	2	Real AC Power
2	Instance	3	Reactive AC Power
2	Instance	4	AC Harmonic Distortion
2	Instance	5	DC Voltage
2	Instance	6	DC Current
2	Instance	7	Reverse DC Polarity
3	Instance	0	Peak DC Voltage
3	Instance	1	Peak DC Current
3	Instance	2	Real DC Power
3	Instance	3	DC Harmonic Distortion
3	Instance	4	Discrete Input
3	Instance	5	Auxiliary Sensor
3	Instance	6	AC Phase Status

6.18.29 Alarms

Alarm Instance	Description
1	History cleared
2	Generator Started
3	Generator Stopped

100	DC Generator alternator enabled
101	DC Generator alternator disabled
102	DC Generator alternator over temperature
110	DC Generator Transition to bulk stage
111	DC Generator Transition to absorption stage
112	DC Generator Transition to Overcharge state
113	DC Generator Transition to Equalize state
114	DC Generator Transition to float stage
115	DC Generator Transition to CC/CV Stage
116	DC Generator Transition to maintenance stage
120	DC Generator Low battery voltage limit
121	DC Generator High Battery voltage limit
122	DC Generator Battery over temperature
123	DC Generator Battery under temperature
124	DC Generator Battery Disconnected

6.18.30 Test Profiles

The following test profiles shall be used to test adherence with the RV-C specification as it was intended to be implemented for various use cases. They outline specific tests that can be performed and indicate the required response the device is expected to produce under the test conditions.

6.18.30.1 Profile 64A: Generator Base Profile

A generator with basic status reporting. Start/Stop of the generator can be accomplished by method other than RV-C command such as local start/stop switch, control wiring, or a generator's remote panel.

This base profile for generators tests the basic functionality every generator must have in order to be used on an RV-C network.

Prerequisites: Level One compliance testing

Reporting

ID	Datum	Test	Required Response
64A-R-01	Generator Running	a. Start the generator	The generator shall broadcast the following DGNs as defined in their appropriate section: GENERATOR_STATUS_1(see 6.18.23) GENERATOR_STATUS_2(see 6.18.24) If the The generator is an AC Generator, it shall broadcast the following DGNs as defined in their appropriate section and broadcast for each available Line as defined in section 6.18.2: GENERATOR_AC_STATUS_1(see 6.18.3) GENERATOR_AC_STATUS_2(see 6.18.4) GENERATOR_AC_STATUS_3(see 6.18.5)

			GENERATOR_AC_STATUS_4(see 6.18.6) If the generator is a DC Generator, it shall broadcast the following DGNs: GENERATOR_DC_STATUS_1 (see 6.18.9) GENERATOR_DC_STATUS_2 (see 6.18.10) GENERATOR_DC_EQUALIZATION_STATUS (If in Equalize mode, see 6.18.20)
64A-R-02	Generator Stopped	a. Stop the generator	The generator shall broadcast the following DGNs as defined in their appropriate section: GENERATOR_STATUS_1(see 6.18.23) GENERATOR_STATUS_2(see 6.18.24)

Command Response: none

ID	Datum	Test	Required Response	Behavior

6.18.30.2 Profile 64B: Generator with Command Profile

A generator with Start/Stop capability via RV-C command.

Prerequisites: 64A Generic Base Profile

Reporting

ID	Datum	Test	Required Response

Command Response

ID	Datum	Test	Required Response	Behavior
64B-C-01	Command	Send command GENERATOR_COMMAND with Command Value set to 01h (with generator stopped)	Reports GENERATOR_STATUS_1 with appropriate Status value and broadcast gap(see 6.18.23)	The generator shall immediately initiate its start cycle
64B-C-02	Command	Send command GENERATOR_COMMAND with Command Value set to 00h (with generator running)	Reports GENERATOR_STATUS_1 with appropriate Status value and broadcast gap(see 6.18.23)	The generator shall immediately initiate its stop cycle
64B-C-03	Command Timeout	Send command GENERATOR_COMMAND with Command Value set to 00h (while generator is starting)	Reports GENERATOR_STATUS_1 with appropriate Status value and broadcast gap(see 6.18.23)	The generator shall immediately quit its start cycle and initiate its stop cycle
64B-C-04	Instance	Send command GENERATOR_COMMAND with Command Value set to 01h and using Instance 0 (with generator stopped)	Reports GENERATOR_STATUS_1 with appropriate Status value and broadcast gap(see 6.18.23)	The generator shall not enter its starting cycle

64B-C-05	Instance	Send command GENERATOR_COMMAND with Command Value set to 01h and using Instance 0 (with generator running)	Reports GENERATOR_STATUS_1 with appropriate Status value and broadcast gap(see 6.18.23)	The generator shall immediately initiate its stop cycle

6.18.30.3 Profile 64C: Generator with Starter Configuration

A generator (or generator starting module) with the ability to setup starting parameters via RV-C commands.

Prerequisites: 64B Generator with Command Profile

Reporting

ID	Datum	Test	Required Response

Command Response

ID	Datum	Test	Required Response	Behavior
64C-C-01	Command	Send command GENERATOR_START_CONFIG_COMMAND with all parameters set to FFh	Reports GENERATOR_START_CONFIG_STATUS immediately (save these original parameter values for returning the device to them when done testing)	The parameter values are as expected
64C-C-02	Command	Send command GENERATOR_START_CONFIG_COMMAND with all parameters set to values other than FFh	Reports GENERATOR_START_CONFIG_STATUS immediately	The parameter values are as expected
64C-C-03	Command	Send command GENERATOR_START_CONFIG_COMMAND with all parameters set to their original values	Reports GENERATOR_START_CONFIG_STATUS immediately	The parameters are returned to their original values

6.18.30.4 Profile 64D: Generator with Fault Configuration

A generator with the ability to setup AC fault parameters via RV-C commands.

Prerequisites: 64A Generator Base Profile

Reporting

ID	Datum	Test	Required Response

Command Response

ID	Datum	Test	Required Response	Behavior

64D-C-01	Command	Send command GENERATOR_ACFAULT_CONFIGURATION_COMMAND_1 with all parameters set to FFh (do this for each Line value per 6.18.2)	Reports GENERATOR_ACFAULT_CONFIGURATION_STATUS_1 immediately (save these original parameter values for returning the device to them when done testing)	The parameter values are as expected
64D-C-02	Command	Send command GENERATOR_ACFAULT_CONFIGURATION_COMMAND_1 with all parameters set to values other than FFh (do this for each Line value per 6.18.2)	Reports GENERATOR_ACFAULT_CONFIGURATION_STATUS_1 immediately	The parameter values are as expected
64D-C-03	Command	Send command GENERATOR_ACFAULT_CONFIGURATION_COMMAND_1 with all parameters set to their original values (do this for each Line value per 6.18.2)	Reports GENERATOR_ACFAULT_CONFIGURATION_STATUS_1 immediately	The parameters are returned to their original values
64D-C-04	Command	Send command GENERATOR_ACFAULT_CONFIGURATION_COMMAND_2 with all parameters set to FFh (do this for each Line value per 6.18.2)	Reports GENERATOR_ACFAULT_CONFIGURATION_STATUS_2 immediately (save these original parameter values for returning the device to them when done testing)	The parameter values are as expected
64D-C-05	Command	Send command GENERATOR_ACFAULT_CONFIGURATION_COMMAND_2 with all parameters set to values other than FFh (do this for each Line value per 6.18.2)	Reports GENERATOR_ACFAULT_CONFIGURATION_STATUS_2 immediately	The parameter values are as expected
64D-C-06	Command	Send command GENERATOR_ACFAULT_CONFIGURATION_COMMAND_2 with all parameters set to their original values (do this for each Line value per 6.18.2)	Reports GENERATOR_ACFAULT_CONFIGURATION_STATUS_2 immediately	The parameters are returned to their original values

6.18.30.5 Profile 64E: Generator Control Panel

Prerequisites: 64A Generator Base Profile

Reporting

ID	Datum	Test	Required Response

6.18.30.6 Profile 64DC-B: Basic DC Generator

For Generators which are able to directly supply DC power, an additional set of profiles is required. These directly reflect the Charger Profiles in section 6.20.29, such that a DC Generator may have the ability to receive Charge/Do-Not-Charge commands and be configured via RV-C, but it does not have the ability to take charging directions outside of On/Off (Refer to Directed DC Generator below for DC Generators which are able to respond to on/off as well as charging goals and/or charging modes/states).

When receiving commands, the Instance Number must match, or be 0 indicating All instances. Reception of commands with non-matching instance numbers should be ignored.

Prerequisites:

64A: Generator Base Profile (required)
64C: Generator with Starter Configuration (Optional)
64B: Generator with Command Profile (Optional)
64E: Generator Control Panel (Optional)
DC_SOURCE_CONNECTION_STATUS (6.5.20) (Optional)

Reporting

ID	Datum	Test	Required Response	Behavior
64DC-B-R-01	Generator started	a. Charging starts	a. Unit begins delivery of energy to battery, as determined by internal charging profiles and configuration of charger.	Generator begins operation per its existing configuration. It begins sending basic status messages.
			b. GENERATOR_DC_STATUS_1 message is transmitted per 6.18.9 and configuration Required fields: Instance, Operating State.	
			c.GENERATOR_DC_STATUS_2 (Optional) message is transmitted. If supplied, assure information is per 6.18.10 and configuration. Required fields: Instance	
			d.GENERATOR_DC_EQUALIZATION_STATUS (Optional) message is transmitted. If supplied, assure information is per 6.18.20 and configuration. Required fields: Instance, Pre-charge status	
64DC-B-R-02	Charging requested to stop charging via external wire signal (Optional: If capable)	a. Activation of external Enable/Disable signal wire to disable DC Charging.	a. Unit shall cease deliver of energy (Current <= 1A) within 500ms of application of signal. GENERATOR_DC_STATUS_1 message shall set Operating State field = Not Charging, Float, or Disabled (Device and / or configuration dependent)	If hardware supports a physical hardwire 'Enable' signal, the DC generator will respond as directed by that wire, as well as modify the status messages to accordingly indicate its present condition.

Command Response

ID	Datum	Test	Required Response	Behavior
64DC-B-C-01	Configuration Command	a. Send 6.18.13 GENERATOR_DC_CONFIGURATION_COMMAND verifying each field at a time (Other fields set = 0xff).	a. Unit shall respond with NAK indicating it does not respond to generator Configuration Commands –OR— b. Unit shall respond with GENERATOR_DC_CONFIGURATION_STATUS 6.18.11 message noting change in field requested, or indicating 0xff if that field is not supported.	When processing a command, a generator should respond with an overall NAK if it does not accept configuration directions via the RV-C commands. If generator does process configuration commands, supported field should be updated. It is NOT a requirement that a given DC Generator support all fields in the configuration command, and if a command is received which is only partiality supported, unsupported fields may be ignored.
64DC-B-C-03	Configuration Command 2	a. Send 6.18.15 GENERATOR_DC_CONFIGURATION_COMMAND_2 verifying each field at a time (Other fields set = 0xff).	a. Unit shall respond with NAK indicating it does not respond to Configuration Commands –OR— b. Unit shall respond with GENERATOR_DC_CONFIGURATION_STATUS_2 6.18.14 message noting change in field requested, or indicating 0xff if that field is not supported.	
64DC-B-C-04	Configuration Command 3	a. Send 6.18.17 GENERATOR_DC_CONFIGURATION_COMMAND_3 verifying each field at a time (Other fields set = 0xff).	a. Unit shall respond with NAK indicating it does not respond to Configuration Commands –OR— b. Unit shall respond with GENERATOR_DC_CONFIGURATION_STATUS_3 6.18.16 message noting change in field requested, or indicating 0xff if that field is not supported.	
64DC-B-C-05	Configuration Command 4	a. Send 6.18.19 GENERATOR_DC_CONFIGURATION_COMMAND_4 verifying each field	a. Unit shall respond with NAK indicating it does not respond to Configuration Commands	

		at a time (Other fields set = 0xff).	–OR— b. Unit shall respond with GENERATOR_DC_CONFIGURATION_STATUS_4 6.18.18 message noting change in field requested, or indicating 0xff if that field is not supported.	
64DC-B-C-06	Configuration Command 5	a. Send Error: Reference source not found GENERATOR_DC_CONFIGURATION_COMMAND_5 verifying each field at a time (Other fields set = 0xff).	a. Unit shall respond with NAK indicating it does not respond to Configuration Commands –OR— b. Unit shall respond with GENERATOR_DC_CONFIGURATION_STATUS_5 Error: Reference source not found message noting change in field requested, or indicating 0xff if that field is not supported.	
64DC-B-C-07	Equalization Configuration Command	a. Send 6.18.22 GENERATOR_DC_EQUALIZATION_CONFIGURATION_COMMAND verifying each field at a time (Other fields set = 0xff).	a. Unit shall respond with NAK indicating it does not respond to Configuration Commands –OR— b. Unit shall respond with GENERATOR_DC_EQUALIATION_CONFIGURATION_STATUS 6.18.21 message noting change in field requested, or indicating 0xff if that field is not supported.	
64DC-B-C-08	Command	Send any Command with non-zero Instance Number not equal to that of DC Generator.	Ignore	

6.18.30.7 Profile 64DC-D: Directed DC Generator

A Directed DC Generator is one which has the ability to take guidance from an external device for the real-time setting of charging state and goals. Often this is a BMS (Battery Management System) or SOC (State of Charge) device, but it could also be another charging device associated with the same DC Instance or DC Bus. Such a device is known as a Remote Battery Master (RBM).

A RBM must at minimum broadcast DC_SOURCE_STATUS_4 indicating its Instance, Priority, as well as desired Charge State to provided direction to DC Generators. An RBM must also broadcast DC_SOURCE_STATUS_1, and DC_SOURCE_STATUS_2 to provide a periodic heart-beat indicating the RBM is still present and active. (Refer to section 6.5 DC Source for additional details on additional minimum requirements, including required fields, for an RBM as well as the presence of multiple potential RBMs and the handling of such).

- Directed DC Generators shall respond to the highest priority RBM associated with its Battery or DC Bus Instance.
- Directed DC Generators may (optionally) act as an RBM, providing it has sufficient capability and is configures to act as an RBM.
- Only one RBM shall be followed at any given time: Even if that RBM is unable to supply full battery status information (e.g., does not supply a battery temperature value)
- In the absence of an RBM, Directed DC Generators shall behave according to the Basic DC Generators profile 64DC-B above.

Prerequisites: 64DC-B: Basic DC Generator, RBM associated with same DC Instance / Bus ID.
DC_SOURCE_CONNECTION_STATUS (6.5.20)

Reporting

ID	Datum	Test	Required Response	Behavior
64DC-D-R-01	Application of energy – No RBM present.	a. Charging starts with no RBM indicated.	a. Unit behaves per Basic DC Generators Profile above.	When no validated direction has been received from an external RBM, a DC Generator shall proceed based on its existing configuration in a stand-alone fashion. Care needs to be taken by the evaluator, as some DC Generators may have an option to enter a standby or even faulted mode in the lack of a validated RBM.
64DC-D-R-02	Introduction of RBM with different DC Instance / bus.	a. Validated RBM begins broadcasting direction using a DC Instance / bus not matching the DC Instance / bus the DC Generator is configured for.	a. DC Generator ignores RBM and continues to behave per the Basic DC Generator Profile.	The arrival of any directional messages not associated with the configured DC Instance should be ignored. Only messages which match the same DC Instance (indicating the DC Generator and the battery are on the same DC bus) should be processed.
64DC-D-R-03	Introduction of RBM with matching DC Instance / bus.	a. Validated RBM begins broadcasting direction of DC Instance using a matching DC Generator's configured DC Instance.	a. DC Generator will begin following requested charging state.	When a validated charging direction message is received, the DC Generator should begin following those directions. Directions may be as simple as 'Start / Stop charging', in which case the DC Generator will follow its
		b. Validated RBM	b. DC Generator shall utilize those	

		supplies DC Voltage and / or current goals or targets.	as its targets. Limiting its energy output to meet the most restrictive voltage or current goal supplied.	configured charging profile. Or the directions may include specific goals / limits for battery voltage and / or current, in which case those goals should override any internal charger configuration.
		c. Validated RBM ceases broadcasting of DC_STATUS_x messages.	c. DC Generator shall revert to Basic DC Generator Profile behavior above. It may restart a new charging cycle, or continue on the present charging cycle and mode, A DC Generator may also be able to take other actions depending on its configuration and capability.	
64DC-D-R-04	DC Generator requested to stop charging via external wire signal (Optional: If capable)	a. Activation of external DC Generator Enable / Disable signal wire to disable DC Generator.	a. Unit shall cease delivery of energy (Current <= 1A) within 500mS of application of signal. – overriding any RBM directions. GENERATOR_DC_STATUS_1 message shall set Operating State field = Not Charging, Float, or Disabled (Device and / or configuration dependent)	Even in the presence of validated charging direction messages via RV-C, if the DC Generator is equipped with a physical charge / do not charge wire, that capability should override any CAN based directions. This allows for a kind of belts-and-suspenders installation with the hardware signal being a safety backstop.

Command Response

ID	Datum	Test	Required Response	Behavior
64DC-D-C-01	High Voltage Condition	Send DC_SOURCE_STATUS_6 with matching DC-Instance and “High Voltage Limit Status” set = Limit Reached	Unit shall terminate charging. GENERATOR_DC_STATUS_1 “Operating State” shall change to 'Disabled' or 'No Charging'	A Directed DC Generator must monitor for relevant commands outside the DC Generator section and respond accordingly. Limit conditions shall be respected even if other directions are received, example if a DC_SOURCE_STATUS_4 is still asking for Charging, but a High Limit is received, charging shall stop.
64DC-D-C-02	High Voltage Disconnect	Send DC_SOURCE_STATUS_6 with matching DC-Instance and “High Voltage Disconnect Status” set = Limit	Unit shall terminate charging and prepare for disconnect status. GENERATOR_DC_STATUS_1 “Operating State” shall change to 'Disabled' or 'No	Some DC Generators may chose to enter a Faulted state when a Disconnect command is received.

		Reached	Charging'	
64DC-D-C-03	High Temperature Condition	Send DC_SOURCE_STATUS_6 with matching DC-Instance and “High DC source temperature limit status” set = Limit Reached	Unit shall terminate charging. GENERATOR_DC_STATUS_1 “Operating State” shall change to 'Disabled' or 'No Charging'	
64DC-D-C-04	High Temperature Disconnect	Send DC_SOURCE_STATUS_6 with matching DC-Instance and “High DC source temperature disconnect status” set = Limit Reached	Unit shall terminate charging and prepare for disconnect status. GENERATOR_DC_STATUS_1 “Operating State” shall change to 'Disabled' or 'No Charging'	Some DC Generators may chose to enter a Faulted state when a Disconnect command is received.
64DC-D-C-05	Global Battery Off	Send DC_SOURCE_COMMAND with matching DC-Instance and “Desired Power On/Off Status” = off	Unit shall terminate charging. GENERATOR_DC_STATUS_1 “Operating State” shall change to 'Disabled' or 'No Charging'	Reception of global DC_SOURCE off commands shall cause all associated charging sources to terminate charging. Upon receiving On command, the DC Generator may resume its prior mode of operation.
64DC-D-C-06	Global Charger Off	Send DC_SOURCE_COMMAND with matching DC-Instance and “Desired Charge On/Off Status” = off	Unit shall terminate charging. GENERATOR_DC_STATUS_1 “Operating State” shall change to 'Disabled' or 'No Charging'	

6.18.30.8 Profile 64DC-P: Prioritizing DC Generator

A Prioritizing DC Generator is one which has the ability to follow guidance from an RBM, and also monitor other charging sources adjusting its output as needed to assure the charging devices with higher priority are fully utilized (90% or above) by adjusting its own output as needed to meet the total energy goals supplied by the RBM. In order for a Prioritizing DC Generator to operate, the RBM must supply a Goal Current value as part of DC_SOURCE_STATUS_4 and chargers must supply their utilization as part of GENERATOR_DC_STATUS_1.

Prerequisites:

64DC-B: Basic DC Generator,
764DC-D: Directed DC Generator,
RBM associated with same DC Instance / Bus ID supplying charging current goals.
DC_SOURCE_CONNECTION_STATUS (6.5.20)

Reporting

ID	Datum	Test	Required Response	Behavior
64DC-P-R-01	Communication	a. Broadcast DC Generator Utilization	a. Charger broadcasts GENERATOR_DC_STATU	To allow for prioritization of charging sources, it is

			S_1 per 6.18.9 Required fields: DC Generator current as percent of maximum (% utilization of DC Generator)	important to send out an accurate representation of the DC Generator's utilization. But this must be relative to the real-time capabilities of the DC Generator, not the idealized capabilities.
		b Broadcast DC Generator DC Bus and priority.	b. DC Generator broadcasts GENERATOR_DC_STATUS_2 per 6.18.10 Required fields: DC Source Instance, DC Generator Priority	
64DC-P-R-02	RBM Goal Current Exceeded	a. Lower Priority charging devices present on same DC Instance / bus with indicated utilization above 10%	a. No change in unit's behaviors – lower priority chargers to adjust their output down.	During prioritization, when the current is over goal, the DC Generator should ascertain if it is the lowest priority active charging source, taking into account charges, Solar, AC Chargers –all charging sources and their priority. If indeed it is one of the lowest priority sources, it should reduce its output to lower total system current delivery.
		b. Charging device is lowest priority device associated with DC Instance / bus	b. Unit reduces energy output until its output is 0A, or total charging current is at or below RBM goal.	
64DC-P-R-03	RBM Goal Current not met	a. Higher Priority charging devices present on same DC Instance / bus with indicated utilization under 90%	a. No change in units behaviors – higher priority chargers to adjust their output up.	Likewise, if current deliver is under goal the DC Generator should assess if it is the lower priority source and increase its output. During this time it is also important that a DC Generator assures higher priority sources are operating at a high level of utilization.
		b. Higher Priority charging devices present on same DC Instance / bus with indicated utilization at or above 90%	b. Unit increases energy output until it reaches 90+% or the total charging current is at the RBM goal.	

6.19 Inverter

6.19.1 Introduction

The Inverter converts DC power into AC power. It is often combined with a Charger, in which case the node shall support the Charger DGN. There may be more than one inverter; two inverters are common.

In the case of a combination Inverter/Charger, the unit shall use the same instance number for both. Due to the prevalence of combination units, no Inverter shall share an instance with a Charger unless they are a combination unit.

The format is defined in Table 6.19.1.

NOTE The DC Source Instance does not correspond to the Inverter or Charger Instance.

Table 6.19.1 — Inverter definition

Device attribute	Value
Category	Power components
Default Source Address	66, 67
Dynamic Address Range	128 to 143
Instance	Multiple

6.19.2 AC Status

An inverter may have several AC inputs and outputs, which are reported using the AC Point Status formats. The Instance field is defined in Table 6.19.2.

Table 6.19.2 — Instances

Byte	Bit	Name	Data Type	Unit	Value description
0	0 to 3	Instance of Inverter	uint4	-	0000b - not used 1110b - not used 1111b - not used
	4 to 5	Line	uint2	-	00b - Line 1 01b - Line 2
	6 to 7	Input / Output	uint2	-	00b - Input 01b - Output

If there are multiple inverters on the network, they should not share Instance values. Furthermore, this instance does not necessarily correspond to the Instance used to identify the inverter in the other inverter DGNs. A single inverter may support multiple AC Point Instances, and a single node may include multiple inverters.
Note that each of these DGNs may have to be transmitted multiple times to provide information on each line.

6.19.3 AC Output Page 1

Table 6.19.3 defines the DG attributes. The signal and parameter attributes are the same as AC_STATUS_1 (see Table 6.1.2).

Table 6.19.3 — DG definition

DG attribute	Value
Name	INVERTER_AC_STATUS_1
DGN	1FFD7h
Default priority	6
Maximum broadcast gap	500 ms
Normal broadcast gap	100 ms
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.19.4 AC Output Page 2

Table 6.19.4 defines the DG attributes. The signal and parameter attributes are the same as AC_STATUS_2 (see Table 6.1.3).
Table 6.19.4 — DG definition

DG attribute	Value
Name	INVERTER_AC_STATUS_2

DGN	1FFD6h
Default priority	6
Maximum broadcast gap	500 ms
Normal broadcast gap	100 ms
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.19.5 AC Output Page 3

Table 6.19.5 defines the DG attributes. The signal and parameter attributes are the same as AC_STATUS_3 (see Table 6.1.4).

Table 6.19.5 — DG definition

DG attribute	Value
Name	INVERTER_AC_STATUS_3
DGN	1FFD5h
Default priority	6
Maximum broadcast gap	500 ms
Normal broadcast gap	100 ms
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.19.6 AC Output Page 4

Table 6.19.6 defines the DG attributes. The signal and parameter attributes are the same as AC_STATUS_4 (see Table 6.1.5).

Table 6.19.6 — DG definition

DG attribute	Value
Name	INVERTER_AC_STATUS_4
DGN	1FF8Fh
Default priority	6
Maximum broadcast gap	None
Normal broadcast gap	500 ms
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.19.7 AC Fault Configuration Status and Command

Fault Control configuration and status DGNs are defined for the inverter. These DGNs follow the formats as indicated in the following table.

Table 6.19.7 - DG Reference

Name	DGN	Format	Table
INVERTER_ACFAULT_CONFIGURATION_STATUS_1	1FF8Eh	AC_CONFIGURATION_STATUS_1	6.1.6
INVERTER_ACFAULT_CONFIGURATION_STATUS_2	1FF8Dh	AC_CONFIGURATION_STATUS_2	6.1.7
INVERTER_ACFAULT_CONFIGURATION_COMMAND_1	1FF8Ch	ACFAULT_CONFIGURATION_COMMAND_1	6.1.10.3
INVERTER_ACFAULT_CONFIGURATION_COMMAND_2	1FF8Bh	ACFAULT_CONFIGURATION_COMMAND_2	6.1.10.3

The status DGNs are broadcast on request. The command DGNs should be acknowledged with a NAK if necessary, and the corresponding status DGN.

6.19.8 Inverter Status

Table 6.19.8a defines the DG attributes and Table 6.19.8b defines the signal and parameter attributes.

Table 6.19.8a — DG definition

DG attribute	Value
Name	INVERTER_STATUS
DGN	1FFD4h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	500 ms or On Change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.19.8b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value description
0	-	Instance	uint8	-	see Table 5.3
1	-	Status	uint8	-	0 - Disabled 1 - Invert 2 - AC passthru 3 - APS Only 4 - Load sense (Unit is waiting for a load.) 5 - Waiting to Invert 6. Generator support
2	0 to 1	Battery temperature sensor present	uint2	-	00b - No battery temperature sensor in use 01b - Sensor is present and active
	2 to 3	Load sense enabled	uint2	-	00b - Load sense disabled 01b - Load sense enabled
	4 to 5	Inverter enabled	uint2	-	00b - Inverter disabled 01b - Inverter enabled
	6 to 7	Pass-through Enable	uint2	-	00b - Pass-through disabled 01b - Pass-through enabled

3	0 to 1	Generator support enabled	uint2	-	00b - Generator support disabled 01b - Generator support enabled

The “Waiting to Invert” status indicates that the inverter is enabled but is not yet actually producing AC power due to an initialization or qualification process or timer being incomplete. The Status field combines the state of several Inverter functions and the addition of separate status fields for the Invert, Pass-through and Generator-support functions provides an unequivocal report of the state of the Inverter.

The “Generator Support” feature allows the Inverter to use the battery energy, under certain conditions, to supplement the AC power from a Generator or shore input to handle loads higher than the capacity of the Generator or shore input.

6.19.9 Inverter Command

This command DGN starts or stops the inverter. Note that “enabling” the inverter does not necessarily enable the unit to convert power. The inverter may instead go into AC Pass-Through or Load Sense mode.
Table 6.19.9a defines the DG attributes and Table 6.19.9b defines the signal and parameter attributes.

Table 6.19.9a— DG definition

DG attribute	Value
Name	INVERTER_COMMAND
DGN	1FFD3h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, INVERTER_STATUS

Table 6.19.9b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value description
0	-	Instance	uint8	-	1 to 250 — Inverter Instance
1	0 to 1	Inverter enable	uint2	-	00b - Disable 01b - Enable inverter
	2 to 3	Load sense enable	uint2	-	00b - Disable load sense 01b - Enable load sense
	4 to 5	Pass-through enable	uint2	-	00b - Disable pass-through 01b - Enable pass-through
	6 to 7	Generator support enable	uint2	-	00b - Disable generator support 01b – Enable generator support
2 to 6	-	Reserved			
7	0 to 1	Inverter enable on startup	uint2	-	00b - Inverter is disabled on startup 01b - Inverter is enabled on startup
	2 to 3	Load sense enable on startup	uint2	-	00b - Load sense is disabled on startup 01b - Load sense is enabled on startup

	4 to 5	AC pass-through enable on startup	uint2	-	00b - Pass-through is disabled on startup 01b - Pass-through is enabled on startup
	6 to 7	Generator support enable on startup	uint2	-	00b - Generator support disabled on startup 01b - Generator support enabled on startup

6.19.10 Inverter Configuration Status 1

This is the first of two DGNs describe configuration information for the Inverter. Table 6.19.10a defines the DG attributes and Table 6.19.10b defines the signal and parameter attributes.

Table 6.19.10a — DG definition

DG attribute	Value
Name	INVERTER_CONFIGURATION_STATUS_1
DGN	1FFD2h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.19.10b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8		1 to 250 — Inverter Instance
1 to 2	-	Load sense power threshold	uint16	W	See Table 5.3 This is the load required to exit Load Sense mode and enter Inverting Mode.
3 to 4	-	Load sense interval	uint16	s	Precision= 0.5 s Value range = 0 to 3 125 s This is the frequency of load sense checks.
5 to 6	-	DC source shutdown voltage – Minimum	uint16	V	see Table 5.3
7	0 to 1	Inverter enable on startup	uint2	-	00b - Inverter is disabled on startup 01b - Inverter is enabled on startup
	2 to 3	Load sense enable on startup	uint2	-	00b - Load sense is disabled on startup 01b - Load sense is enabled on startup
	4 to 5	AC Pass-through enable on startup	uint2	-	00b - Pass-through is disabled on startup 01b - Pass-through is enabled on startup

6.19.11 Inverter Configuration Status 2

This is the second of two DGNs that describe configuration information for the Inverter. Table 6.19.11a defines the DG attributes and Table 6.19.11b defines the signal and parameter attributes.

Table 6.19.11a — DG definition

DG attribute	Value

Name	INVERTER_CONFIGURATION_STATUS_2
DGN	1FFD1h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.19.11b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 to 250 — Inverter Instance
1 to 2	-	DC source shutdown voltage - Maximum	uint16	V	see Table 5.3
3 to 4	-	DC source warning voltage - Minimum	uint16	V	see Table 5.3
5 to 6	-	DC source warning voltage - Maximum	uint16	V	see Table 5.3

6.19.12 Inverter Configuration Status 3

This is the third of three DGNs that describe configuration information for the Inverter. Table 6.19.12a defines the DG attributes and Table 6.19.12b defines the signal and parameter attributes.

Table 6.19.13a — DG definition

DG attribute	Value
Name	INVERTER_CONFIGURATION_STATUS_3
DGN	1FECEh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.19.12b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 to 250 — Inverter Instance
1 to 2	-	DC Source shutdown delay	uint16	s	Precision = 0.5 s Value range = 0 to 32765 s
3	-	Stack Mode	uint8	-	0 – Stand-alone 1 – Master

					2 – Slave 3 – Line 2 Master (for series stacking) 4 – Line 1 Master (for series stacking) 5 – Line 2 Slave (for series stacking) 6 – Line 1 Slave (for series stacking) 7 - Phase 1 Master (3-for-phase stacking) 8 – Phase 2 Master (3-for-phase stacking) 9 - Phase 3 Master (3-for-phase stacking) 10 – Phase 1 Slave (3-for-phase stacking) 11 – Phase 2 Slave (3-for-phase stacking) 12- Phase 3 Slave (3-for-phase stacking)
4 to 5	-	DC Source shutdown - Recovery Level	uint16	V	see Table 5.3
6 to 7	-	Generator Support Engage Current	uint16	A	see Table 5.3

6.19.13 Inverter Configuration Status 4

This is the third of three DGNs that describe configuration information for the Inverter. Table 6.19.13a defines the DG attributes and Table 6.19.13b defines the signal and parameter attributes.

Table 6.19.13a — DG definition

DG attribute	Value
Name	INVERTER_CONFIGURATION_STATUS_4
DGN	1FE9Bh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.19.13b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 to 250 — Inverter Instance
1 to 2	-	Output AC Voltage	uint16	V	See Table 5.3
3	-	Output Frequency	uint8	Hz	See Table 5.3
4 to 5	-	AC Output Power Limit	uint16	W	See Table 5.3
6 to 7	-	AC Output Power Time Limit	uint16	s	Precision = 0.5 s Value Range = 0 to 32765 s

6.19.14 Inverter Configuration Command 1

This DGN allow changes in the Inverter configuration. Table 6.19.14a defines the DG attributes and Table 6.19.14b defines the signal and parameter attributes.

Table 6.19.14a — DG definition

DG attribute	Value
Name	INVERTER_CONFIGURATION_COMMAND_1
DGN	1FFD0h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, INVERTER_CONFIGURATION_STATUS_1

Table 6.19.14b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 to 250 — Inverter Instance
1 to 2	-	Load sense power threshold	uint16	W	see 6.19.10
3 to 4	-	Load sense interval	uint16	s	see 6.19.10
5 to 6	-	DC source shutdown voltage – Minimum	uint16	V	see 6.19.10

6.19.15 Inverter Configuration Command 2

This DGN allow changes in the Inverter configuration. Table 6.19.15a defines the DG attributes and Table 6.19.15b defines the signal and parameter attributes.

Table 6.19.15a — DG definition

DG attribute	Value
Name	INVERTER_CONFIGURATION_COMMAND_2
DGN	1FFCFh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, INVERTER_CONFIGURATION_STATUS_2

Table 6.19.15b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 to 250 — Inverter Instance
1 to 2	-	DC source shutdown voltage – Maximum	uint16	V	see 6.19.11

3 to 4	-	DC source warning voltage – Minimum	uint16	V	see 6.19.11
5 to 6	-	DC source warning voltage – Maximum	uint16	V	see 6.19.11

6.19.16 Inverter Configuration Command 3

This DGN allow changes in the Inverter configuration. Table 6.19.16a defines the DG attributes and Table 6.19.16b defines the signal and parameter attributes.

Table 6.19.16a — DG definition

DG attribute	Value
Name	INVERTER_CONFIGURATION_COMMAND_3
DGN	1FECDh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, INVERTER_CONFIGURATION_STATUS_3

Table 6.19.16b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 to 250 — Inverter Instance
1 to 2	-	DC Source shutdown delay	uint16	s	Precision = 0.5 s Value range = 0 to 32765 s
3	-	Stack Mode	uint8	-	0 – Stand-alone 1 – Master 2 – Slave 3 – Line 2 Master (for series stacking) 4 – Line 1 Master (for series stacking) 5 – Line 2 Slave (for series stacking) 6 – Line 1 Slave (for series stacking) 7 - Phase 1 Master (3-for-phase stacking) 8 – Phase 2 Master (3-for-phase stacking) 9 - Phase 3 Master (3-for-phase stacking) 10 – Phase 1 Slave (3-for-phase stacking) 11 – Phase 2 Slave (3-for-phase stacking) 12- Phase 3 Slave (3-for-phase stacking)
4 to 5	-	DC Source shutdown - Recovery Level	uint16	V	see Table 5.3
6 to 7	-	Generator Support Engage Current	uint16	A	see Table 5.3 When the Generator support mode is enabled and the AC loads are drawing more than the Generator Support Engage Current defined (in amps) for a pre-defined time, the inverter will

					come on-line and assist the generator or shore power with operating the load (drawing power from the battery). The battery bank must be well charged for the inverter to engage this mode. The actual battery voltage required by this feature to operate, and the load current hysteresis used to disengage this feature shall be specified by the manufacturer.

6.19.17 Inverter Configuration Command 4

This DGN allow changes in the Inverter configuration. Table 6.19.17a defines the DG attributes and Table 6.19.17b defines the signal and parameter attributes.

Table 6.19.17a — DG definition

DG attribute	Value
Name	INVERTER_CONFIGURATION_COMMAND_4
DGN	1FE9Ah
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, INVERTER_CONFIGURATION_STATUS_4

Table 6.19.17b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 to 250 — Inverter Instance
1 to 2	-	Output AC Voltage	uint16	V	See Table 5.3
3	-	Output Frequency	uint8	Hz	See Table 5.3
4 to 5	-	AC Output Power Limit	uint16	W	See Table 5.3
6 to 7	-	AC Output Power Time Limit	uint16	s	Precision = 0.5 s Value Range = 0 to 32765 s

6.19.18 Inverter Statistics

This is a multi-frame DGN with information intended primarily for diagnostic purposes. Table 6.19.18a defines the DG attributes and Table 6.19.18b defines the signal and parameter attributes.

Table 6.19.18a — DG definition

DG attribute	Value
Name	INVERTER_STATISTIC_STATUS
DGN	1FFCEh
Default priority	6
Maximum broadcast gap	N/A

Normal broadcast gap	on request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	4
ACK requirements	None

Table 6.19.18b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 to 250 — Inverter Instance
1to 2	-	Number of DC under voltage detections	uint16	-	
3 to 4	-	Number of inverter AC output over-loads	uint16	-	
5 to 6	-	Number of times load sense has been engaged	uint16	-	
7 to 8	-	Lowest DC voltage	uint16	V	see Table 5.3
9 to 10	-	Highest DC voltage	uint16	V	see Table 5.3
11 to 12	-	Lowest AC input voltage	uint16	V	see Table 5.3
13 to 14	-	Highest AC input voltage	uint16	V	see Table 5.3
15 to 16	-	Lowest AC output voltage	uint16	V	see Table 5.3
17 to 18	-	Highest AC output voltage	uint16	V	see Table 5.3
19 to 27	-	Reserved		-	

6.19.19 Internal Auxiliary Power Supply Status

The Auxiliary Power Supply is a secondary DC-DC power supply that is typically used to power external control panels and peripherals. There may be multiple instances within the node, and the Instance field identifies to which power supply is being referred. This Instance is not unique on the network. Products must examine the Source Address to associate the APS Instance with an Inverter Instance. (Note that there is not necessarily a direct correlation. A single node may contain multiple inverters and a single APS, or vice-versa.)

If this DGN is requested, the node should respond with one message for each Instance it contains. Table 6.19.19a defines the DG attributes and Table 6.19.19b defines the signal and parameter attributes.

Table 6.19.19a — DG definition

DG attribute	Value
Name	INVERTER_APS_STATUS
DGN	1FFCDh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	4
ACK requirements	None

Table 6.19.19b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description

0	-	Instance	uint8	-	see Table 5.3 Instance within the Inverter, not the Inverter Instance.
1	-	Total instance count	uint8	-	Total number of APS units within the Inverter.
2 to 3	-	Voltage	uint16	-	see Table 5.3
4 to 5	-	Current	uint16	-	see Table 5.3
6	-	Temperature	uint8	-	see Table 5.3

6.19.20 Internal High Voltage DC Bus Status

This is an optional DGN that shall only be implemented for high frequency inverters or other inverter topologies that make use of an intermediate high voltage DC bus for the AC/DC power conversion, that is, Inverters that have a DC bus whose voltage is much higher or very different than the battery voltage.
The same Instance scheme used in the above APS DGN is used for the DC Bus. Therefore there is not necessarily a direct association between Inverter Instance and DC Bus Instance.
Table 6.19.20 defines the DG attributes. The signal and parameter attributes have the same format as INVERTER_APS_STATUS (see Table 6.19.19b).

Table 6.19.20 — DG definition

DG attribute	Value
Name	INVERTER_DCBUS_STATUS
DGN	1FFCCh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

6.19.21 Internal Offline Power Supply Status

An Offline Power Supply is an AC-DC power supply which works like the APS to power peripherals and internal components.
The same Instance scheme used in the above APS DGN is used for the DC Bus. Therefore there is not necessarily a direct association between Inverter Instance and DC Bus Instance.
This is an optional DGN that shall only be implemented for Inverters that contain such additional AC-DC power supply.
Table 6.19.21 defines the DG attributes. The signal and parameter attributes have the same format as INVERTER_APS_STATUS (see Table 6.19.19b).

Table 6.19.21 — DG definition

DG attribute	Value
Name	INVERTER_OPE_STATUS
DGN	1FFCBh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on request
Minimum broadcast gap	50 ms, see 3.2.4.2

Number of frames	1
ACK requirements	None

6.19.22 Inverter DC Status

Table 6.19.22a defines the DG attributes and Table 6.19.22b defines the signal and parameter attributes. Note that the Inverter may also be broadcasting similar data under the DC Source Status DGN. However, in systems with more than one inverter the DC Source Status amperage will clearly differ from the amperage shown here. And even in systems with a single inverter, the DC Source Status amperage will likely differ considerably due to other loads in the DC system.

Table 6.19.22a — DG definition

DG attribute	Value
Name	INVERTER_DC_STATUS
DGN	1FEE8h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	5000 ms on request
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.19.22b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 to 250 — Inverter instance
1 to 2	-	DC Voltage	uint16	V	see Table 5.3
3 to 4	-	DC Amperage	uint16	A	see Table 5.3 As measured at the Inverter.

6.19.23 Inverter Temperature Status

Table 6.19.23a defines the DG attributes and Table 6.19.23b defines the signal and parameter attributes.

Table 6.19.23a — DG definition

DG attribute	Value
Name	INVERTER_TEMPERATURE_STATUS
DGN	1FEBDh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	500 ms or On Change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.19.23b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value description
0	-	Instance	uint8	-	1 to 250 — Inverter instance
1 to 2	-	FET1 Temperature	uint16	°C	see Table 5.3
3 to 4	-	Transformer Temperature	uint16	°C	see Table 5.3
5 to 6	-	FET2 Temperature	uint16	°C	see Table 5.3

6.19.24 Inverter Temperature Status 2

Table 6.19.24a defines the DG attributes and Table 6.19.24b defines the signal and parameter attributes.

Table 6.19.24a — DG definition

DG attribute	Value
Name	INVERTER_TEMPERATURE_STATUS_2
DGN	1FDCB
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	500 ms or On Change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.19.24b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value description
0	-	Instance	uint8	-	1 to 250 — Inverter instance
1 to 2	-	Control/Power Board Temperature	uint16	°C	see Table 5.3
3 to 4	-	Capacitor Temperature	uint16	°C	see Table 5.3
5 to 6	-	Ambient Temperature	uint16	°C	see Table 5.3

6.19.25 Service Points

See section 6.20.27, Charger (Converter) Service Points, for a list of SPNs that apply to the Inverter.

6.19.26 Alarms

Table 6.19.26 — Alarms

Alarm Instance	Description
1	Low Battery Cutoff
2	High Battery Cutoff
3	AC back-feed
4	AC Output Overload
5	High Battery Temperature
6	Charging a dead battery
7	Over temperature Shutdown

6.19.27 Test Profiles

6.19.27.1 Inverter (Base) Profile

The Inverter Base profile defines the minimum basic features of every Inverter that will work on RV-C communication. The inverters in this category will have the basic enable & disable functionality, along with broadcasting the inverter states on to the RVC network.

Reporting

ID	Datum	Test	Required Response	Behavior
67A-S-01	Last Command	Send INVERTER_COMMAND, with 'Inverter enable' field set to 00b	Reports INVERTER_STATUS with Status field set to '0' and the Inverter Enable field set to '00b'	(Disabled): Inverter shuts off.
67A-S-02	Last Command	Send INVERTER_COMMAND, with 'Inverter enable' field set to 01b	Reports INVERTER_STATUS with Status field set to '1' and the Inverter Enable field set to '01b'	(Invert): Inverter is providing AC Power. If not able to start, then report '5 -Waiting to invert.'
67A-S-03	Last Command	Send INVERTER_COMMAND, with 'Inverter enable' field set to 01b, with AC pass through enabled	Reports INVERTER_STATUS with Status field set to '2' and the Inverter Enable field set to '01b' and the Pass-Through Enable field set to '01b'	(AC Pass thru): Bypassing the inverter as there is AC power available.
67A-S-04	Last Command	Send INVERTER_COMMAND, with 'Inverter enable' field set to 01b, with APS mode enabled	Reports INVERTER_STATUS with Status field set to '3' and the Inverter Enable field set to '01b'	(APS only): Just powering external control panels through DC-Dc power supply, but not generating any AC Power.
67A-S-05	Last Command	Send INVERTER_COMMAND, with 'Inverter enable' field set to 01b, and 'Load Sense Enable' field set to 01b	Reports INVERTER_STATUS with Status field set to '4' or 'Load Sense' (Unit is waiting for a load), and the Inverter Enable field set to '01b'and the 'Load Sense Enable Field' set to 01b	(Load Sense): Inverter is enabled and waiting for a load to generate AC Power.
67A-S-06	Last Command	Send INVERTER_COMMAND, with 'Inverter enable' field set to 01b	Reports INVERTER_STATUS with Status field set to '5' or 'Waiting to Invert' and the Inverter Enable field set to '01b'	(Waiting to Invert): Inverter is enabled but is not actually ready to provide AC power to the loads.
67A-S-07			INVERTER_AC_STATUS_1	Broadcasts at every 500ms
67A-S-08			INVERTER_DC_STATUS	Broadcasts every 5000 ms on request, also broadcasts for DC source status DGN

67A-S-09	Last Command	Send INVERTER_COMMAND, with 'Inverter enable' field set to 01b, and 'Generator Support Enable' field set to 01b	Reports INVERTER_STATUS with Status field set to '2' or 'AC Passthrough', and the Inverter Enable field set to '01b'and the 'Generator Support Enable Field' set to 01b	(AC Pass thru): Inverter is enabled and waiting for the AC load current to exceed the Generator Support Engage Current to tun the Inverter to supplement the AC Power. At that point the state changes tp Generator Support (unit supplements AC input power).

Command Response

ID	Datum	Test	Required Response	Behavior
67A-C-01	Command	Send INVERTER_COMMAND, with 'Inverter enable' field set to 00b	Reports INVERTER_STATUS with Status field set to '0' and the Inverter Enable field set to '00b'	(Disabled): Inverter shuts off
67A-C-02	Command	Send INVERTER_COMMAND, with 'Inverter enable' field set to 01b	Reports INVERTER_STATUS with Status field set to '1' and the Inverter Enable field set to '01b'	(Invert): Inverter is waiting to Invert
67A-C-03	Command	Send INVERTER_COMMAND, with 'Inverter enable' field set to 01b	Reports INVERTER_STATUS with Status field set to '2' and the Inverter Enable field set to '01b'	(AC Pass thru): Bypassing the inverter as there is AC power available
67A-C-04	Command	Send INVERTER_COMMAND, with 'Inverter enable' field set to 01b	Reports INVERTER_STATUS with Status field set to '3' and the Inverter Enable field set to '01b'	(APS Only): Just powering external control panels through DC-Dc power supply, but not generating any AC Power
67A-C-05	Command	Send INVERTER_COMMAND, with 'Inverter enable' field set to 01b	Reports INVERTER_STATUS with Status field set to '4' or 'Load Sense' (Unit is waiting for a load) and the Inverter Enable field set to '01b'	(Load Sense): Inverter is enabled and waiting for a load to generate AC Power
67A-C-06	Command	Send INVERTER_COMMAND, with 'Inverter enable' field set to 01b	Reports INVERTER_STATUS with Status field set to '5' or 'Waiting to Invert' and the Inverter Enable field set to '01b'	(Waiting to Invert): Inverter is enabled but is not actually ready to provide AC power to the loads

6.19.27.2 Inverter (Medium) Profile

The Inverter Medium Profile will have the extra information for AC point's statuses.

ID	Datum	Test	Required Response	Behavior
67M-S-01			INVERTER_AC_STATUS_2	Broadcasts at every 500ms
67M-S-02			INVERTER_AC_STATUS_3	Broadcasts at every 500ms
67M-S-03			INVERTER_AC_STATUS_4	Broadcasts at every 500ms
67M-S-04			INVERTER_STATISTIC_STATUS	Broadcasts on request
67M-S-05			INVERTER_TEMPERATURE_STATUS	Broadcasts every 500ms On Change

6.19.27.3 Inverter (Load Sensing) Profile

The Inverter Load sensing profile defines the basic features for load sensing on the advanced RVC inverters. If the Inverter detects any current draw on the load terminal then the Inverter will turn itself into ON state, vice versa.

ID	Datum	Test	Required Response	Behavior
67B-C-01	Command	Send INVERTER_COMMAND, with ‘Load Sense Enable’ field set to 00b	Reports INVERTER_STATUS, with ‘Load Sense enable’ field set with 00b	Load sensing is disabled
67B-C-02	Command	Send INVERTER_COMMAND, with ‘Load Sense Enable’ field set to 01b	Reports INVERTER_STATUS, with ‘Load Sense enable’ field set with 01b	Load sensing is enabled. If the inverter is detecting any current draw on the load it will turn ON the inverter automatically
67B-C-03	Command	Send INVERTER_COMMAND, with ‘Load Sense Enable on Startup’ field set to 00b. Restart unit.	Reports INVERTER_STATUS, with existing ‘Load Sense Enable’ field unchanged. Reports INVERTER_CONFIGURATION_STATUS_1 with ‘Load Sense Enable at Startup’ field set to 00b	Load Sense behavior unchanged until inverter is re-started. After restart, INVERTER_STATUS should return ‘Load Sense Enable’ field as 00b
67B-C-04	Command	Send INVERTER_COMMAND, with ‘Load Sense Enable on Startup’ field set to 01b	Reports INVERTER_STATUS, with existing ‘Load Sense Enable’ field unchanged. Reports INVERTER_CONFIGURATION_STATUS_1 with ‘Load Sense Enable at Startup’ field set to 01b	Load Sense behavior unchanged until inverter is re-started. After restart, INVERTER_STATUS should return ‘Load Sense Enable’ field as 01b. If the inverter detects sufficient current draw, the unit will begin

				inverting.

6.19.27.4 Inverter (AC Pass-through) Profile

The Inverter AC Pass-through profile defines the basic features for bypassing the inverting state and passing the AC power from the grid to the Loads directly, while charging the batteries in parallel.

ID	Datum	Test	Required Response	Behavior
67C-C-01	Command	Send INVERTER_COMMAND, with 'Pass- through Enable' field set to 00b	Reports INVERTER_STATUS, with Status field set to '1' and the 'Pass-Through Enable' field set to 00b	(Invert): Even if there is shore Power, the Inverter goes to Invert state
67C-C-02	Command	Send INVERTER_COMMAND, with 'Pass- through Enable' field set to 01b	Reports INVERTER_STATUS, with Status field set to '2' and the 'Pass-Through Enable' field set to 01b	(AC Pass thru): Bypassing the inverter as there is AC power available
67C-C-03	Command	INVERTER_COMMAND, with 'AC Pass-through Enable on Startup' field set to 00b	Reports INVERTER_STATUS, with existing 'AC Pass-Through Enable' field unchanged. Reports INVERTER_CONFIGURATION_STATUS_1 with 'AC Pass-Through Enable at Startup' field set to 00b	AC pass through behavior unchanged until inverter is re-started. After restart, INVERTER_STATUS should return 'AC Pass-Through Enable' field as 00b
67C-C-04	Command	INVERTER_COMMAND, with 'AC Pass-through Enable on Startup' field set to 01b	Reports INVERTER_STATUS, with existing 'AC Pass-Through Enable' field unchanged. Reports INVERTER_CONFIGURATION_STATUS_1 with 'AC Pass-Through Enable at Startup' field set to 01b	AC pass through behavior unchanged until inverter is re-started. After restart, INVERTER_STATUS should return 'AC Pass-Through Enable' field as 01b

6.19.27.5 Inverter (Startup) Profile

This will include the features like enabling the Inverter on start up.

ID	Datum	Test	Required Response	Behavior
67D-C-01	Command	Send INVERTER_COMMAND, with 'Inverter Enable on Startup' field set to 00b	Reports INVERTER_STATUS, with status field set to '0' on start up	The Inverter is disable on the startup
67D-C-02	Command	INVERTER_COMMAND, with 'Inverter Enable on Startup' field set to 01b	Reports INVERTER_STATUS, with existing 'Inverter Enable' field unchanged. Reports INVERTER_CONFIGURATION_STATUS_1 with	Inverter Enable behavior unchanged until inverter is re-started. After restart, INVERTER_STATUS should return 'Inverter

			'Inverter Enable on Startup' field set to 01b	Enable' field as 01b

6.19.27.6 Inverter (Configuration) Profile

The Inverter customization profile defines the basic configurations for the advanced RVC inverters.

ID	Datum	Test	Required Response	Behavior
67E-C-01	Command	Send INVERTER_COMMAND, with 'Inverter Enable on Startup' field set to 00b	Reports INVERTER_CONFIGURATION_STATUS_1, with 'Inverter Enable on Startup' field set to 00b	Inverter behavior unchanged until inverter is re-started. After restart, INVERTER_STATUS should return 'Inverter Enable' field as 00b
67E-C-02	Command	Send INVERTER_COMMAND, with 'Inverter Enable on Startup' field set to 01b	Reports INVERTER_CONFIGURATION_STATUS_1, with 'Inverter Enable on Startup' filed set to 01b	Inverter Enable behavior unchanged until inverter is re-started. After restart, INVERTER_STATUS should return 'Inverter Enable' field as 01b
67E-C-03	Command	Send INVERTER_COMMAND, with 'Load Sense Enable on Startup' field set to 00b	Reports INVERTER_CONFIGURATION_STATUS_1, with 'Load Sense Enable on Startup' filed set to 00b. Reports INVERTER_STATUS, with existing 'Load Sense Enable' field unchanged.	Load Sense behavior unchanged until inverter is re-started. After restart, INVERTER_STATUS should return 'Load Sense Enable' field as 00b
67E-C-04	Command	Send INVERTER_COMMAND, with 'Load Sense Enable on Startup' field set to 01b	Reports INVERTER_CONFIGURATION_STATUS_1, with 'Load Sense Enable on Startup' filed set to 01b	Load Sense behavior unchanged until inverter is re-started. After restart, INVERTER_STATUS should return 'Load Sense Enable' field as 01b. If the inverter detects sufficient current draw, the unit will begin inverting.
67E-C-05	Command	Send INVERTER_COMMAND, with 'AC Pass-through Enable on Startup' field set to 00b	Reports INVERTER_CONFIGURATION_STATUS_1, with 'AC Pass-through Enable on Startup' filed set to 00b	AC pass through behavior unchanged until inverter is re-started. After restart, INVERTER_STATUS should return 'AC Pass-Through Enable' field as 00b
67E-C-06	Command	Send INVERTER_COMMAND,	Reports	AC pass through

		with 'AC Pass-through Enable on Startup' field set to 01b	INVERTER_CONFIGURATION_STATUS_1, with 'AC Pass-through Enable on Startup' filed set to 01b	behavior unchanged until inverter is re-started. After restart, INVERTER_STATUS should return 'AC Pass-Through Enable' field as 01b
67E-C-07	Command	Send, INVERTER_CONFIGURATION_COMMAND_1, with 'Load Sense Power Threshold' field set to appropriate value (Refer Table 5.3, uint16, V)	Reports INVERTER_CONFIGURATION_STATUS_1, with 'Load Sense Power Threshold' filed set with value given	
67E-C-08	Command	Send, INVERTER_CONFIGURATION_COMMAND_1, with 'Load Sense Interval' field set to appropriate value (Refer Table 5.3, uint16, s)	Reports INVERTER_CONFIGURATION_STATUS_1, with 'Load Sense Interval' field set with given value	
67E-C-09	Command	Send, INVERTER_CONFIGURATION_COMMAND_1, with 'DC Shut down Voltage - Minimum' field set to appropriate value (Refer Table 5.3, uint16, V)	Reports INVERTER_CONFIGURATION_STATUS_1, with 'DC Shut down Voltage - Minimum' field set to given value	
67E-C-10	Command	Send, INVERTER_CONFIGURATION_COMMAND_2, with 'DC Shut down Voltage - Maximum' field set to appropriate value (Refer Table 5.3, uint16, V)	Reports INVERTER_CONFIGURATION_STATUS_2, with 'DC Shut down Voltage - Maximum' field set to given value	
67E-C-11	Command	Send, INVERTER_CONFIGURATION_COMMAND_2, with 'DC Source Warning Voltage - Minimum' field set to appropriate value (Refer Table 5.3, uint16, V)	Reports INVERTER_CONFIGURATION_STATUS_2, with 'DC Source Warning Voltage - Minimum' field set to given value	
67E-C-12	Command	Send, INVERTER_CONFIGURATION_COMMAND_2, with 'DC Source Warning Voltage - Maximum' field set to appropriate value (Refer Table 5.3, uint16, V)	Reports INVERTER_CONFIGURATION_STATUS_2, with 'DC Source Warning Voltage - Maximum' field set to given value	
67E-C-13	Command	Send, INVERTER_CONFIGURATION_COMMAND_3, with 'DC Source shutdown delay' field set to appropriate value (Refer Table 5.3, uint16, s)	Reports INVERTER_CONFIGURATION_STATUS_3, with 'DC Source shutdown delay' field set to given value	
67E-C-14	Command	Send, INVERTER_CONFIGURATION_	Reports INVERTER_CONFIGURA	

		COMMAND_3, with 'Stack Mode' filed set to '0-3d'	TION_STATUS_3, with 'Stack Mode' field set to '0-3d' respectively	
67E-C-15	Command	Send, INVERTER_CONFIGURATION_ COMMAND_3, with 'DC Source shutdown – Recovery Level' field set to appropriate value (Refer Table 5.3, uint16, V)	Reports INVERTER_CONFIGURA TION_STATUS_3, with 'DC Source shutdown – Recovery Level' field set to given value	
67E-C-16	Command	Send, INVERTER_CONFIGURATION_ COMMAND_4, with 'Output AC Voltage' field set to appropriate value (Refer Table 5.3, uint16, V)	Reports INVERTER_CONFIGURA TION_STATUS_4, with 'Output AC Voltage' field set to given value	
67E-C-17	Command	Send, INVERTER_CONFIGURATION_ COMMAND_4, with 'Output Frequency' field set to appropriate value (Refer Table 5.3, uint8, Hz)	Reports INVERTER_CONFIGURA TION_STATUS_4, with 'Output Frequency' field set to given value	
67E-C-18	Command	Send, INVERTER_CONFIGURATION_ COMMAND_4, with 'AC Output Power Limit' field set to appropriate value (Refer Table 5.3, uint16, W)	Reports INVERTER_CONFIGURA TION_STATUS_4, with 'AC Output Power Limit' field set to given value	
67E-C-19	Command	Send, INVERTER_CONFIGURATION_ COMMAND_4, with 'AC Output Power Time Limit' field set to appropriate value (Refer Table 5.3, uint16, s)	Reports INVERTER_CONFIGURA TION_STATUS_4, with 'AC Output Power Time Limit' field set to given value	
67E-C-20	Command	Send INVERTER_COMMAND, with 'Generator Support Enable on Startup' field set to 00b	Reports INVERTER_CONFIGURA TION_STATUS_1, with 'Generator Support Enable on Startup' filed set to 00b	Generator Support Enable behavior unchanged until inverter is re-started. After restart, INVERTER_STATUS should return 'Generator Support Enable' field as 00b
67E-C-21	Command	Send INVERTER_COMMAND, with 'Generator Support Enable on Startup' field set to 01b	Reports INVERTER_CONFIGURA TION_STATUS_1, with 'Generator Support Enable on Startup' filed set to 01b	Generator Support Enable behavior unchanged until inverter is re-started. After restart, INVERTER_STATUS should return 'Generator Support Enable' field as 01b

67E-C-22	Command	Send, INVERTER_CONFIGURATION_COMMAND_3, with 'Generator Support Engage Current' field set to appropriate value (Refer Table 5.3, uint16, A)	Reports INVERTER_CONFIGURATION_STATUS_3, with 'Generator Support Engage Current' field set to given value	

6.19.27.7 Inverter Generator Support Profile

The Inverter Generator support profile defines the basic features for Generator Support on the advanced RVC inverters. If the Inverter is in AC pass-through mode and detects that the AC output current is greater than the Generator Support Engage Current, then the Inverter will start inverting and enter the Generator Support state in which it uses battery power to supplement the Generator power. If the output current becomes less than Generator Support Engage Current minus the manufacturer defined hysteresis, the Inverter stops Inverting, exits the Generator Support state, and goes back to the AC Pass-through state.

ID	Datum	Test	Required Response	Behavior
67F-C-01	Command	Send INVERTER_COMMAND, with 'Generator Support Enable' field set to 00b	Reports INVERTER_STATUS, with 'Generator Support enable' field set with 00b	Generator Support is disabled
67F-C-02	Command	Send INVERTER_COMMAND, with 'Generator Support Enable' field set to 01b	Reports INVERTER_STATUS, with 'Generator Support enable' field set with 01b	Generator Support is enabled. If the inverter is detecting AC load greater than Generator Support Engage Current, it will turn ON the inverter automatically to support the Generator.
67F-C-03	Command	Send INVERTER_COMMAND, with 'Generator Support Enable on Startup' field set to 00b. Restart unit.	Reports INVERTER_STATUS, with existing 'Generator Support Enable' field unchanged. Reports INVERTER_CONFIGURATION_STATUS_1 with 'Generator Support Enable at Startup' field set to 00b	Generator Support behavior unchanged until inverter is re-started. After restart, INVERTER_STATUS should return 'Generator Support Enable' field as 00b
67F-C-04	Command	Send INVERTER_COMMAND, with 'Generator Support Enable on Startup' field set to 01b	Reports INVERTER_STATUS, with existing 'Generator Support Enable' field unchanged. Reports INVERTER_CONFIGURATION_STATUS_1 with 'Generator Support Enable at Startup' field set to 01b	Generator Support behavior unchanged until inverter is re-started. After restart, INVERTER_STATUS should return 'Generator Support Enable' field as 01b. If the inverter is detecting AC load greater than Generator Support Engage Current, it will turn ON the inverter

				automatically to support the Generator

6.20 Charger (Converter)

6.20.1 Introduction

A Converter changes AC power into DC power. A Charger is a sophisticated version of the Converter, and typically includes such features as multi-stage battery charging. It is often combined with an Inverter, in which case the node should support the Inverter DGNs as well. There may be more than one charger as two chargers are common.
In the case of a combination Inverter/Charger, the unit should use the same instance number for both. Due to the prevalence of combination units, no Charger should share an instance with an Inverter unless they are a combination unit.
Note that the DC Source Instance does not correspond to the Inverter or Charger Instance but rather indicates the DC subsystem the charger is attached to and supporting. The following formats apply (see Table 6.20.1).

Table 6.20.1 — Charger definition

Device attribute	Value
Category	Power components
Default Source Address	74, 75
Dynamic Address Range	128 to 143
Instance	Multiple

6.20.2 AC Status

A charger will have AC inputs, which are reported using the same DGNs as the Inverter AC Status. If the charger is part of an Inverter/Charger package, the AC Input can be the same as the Inverter AC Inputs. In this case the Instance could be the same. Otherwise, the Charger Instances should be unique among the Charger and Inverter AC Points. The Instance field is defined in the same manner as the Inverter AC Instances.
The only distinction is that the Charger AC Status is only transmitted every 5000 ms when the charger is not actively charging. If the charger is part of an inverter/charger, the data does not have to be transmitted twice.

6.20.3 AC Input Page 1

Table 6.20.3 defines the DG attributes. The signal and parameter attributes are the same as AC_STATUS_1 (see Table 6.1.2).

Table 6.20.3 — DG definition

DG attribute	Value
Name	CHARGER_AC_STATUS_1
DGN	1FFCAh
Default priority	6
Maximum broadcast gap	None
Normal broadcast gap	500 ms when charging 5000 ms when inactive
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.20.4 AC Input Page 2

Table 6.20.4 defines the DG attributes. The signal and parameter attributes are the same as AC_STATUS_2 (see Table 6.1.3).

Table 6.20.4 — DG definition

DG attribute	Value
Name	CHARGER_AC_STATUS_2

DGN	1FFC9h
Default priority	6
Maximum broadcast gap	None
Normal broadcast gap	500 ms when charging 5000 ms when inactive
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.20.5 AC Input Page 3

Table 6.20.5 defines the DG attributes. The signal and parameter attributes are the same as AC_STATUS_3 (see Table 6.1.4).

Table 6.20.5 — DG definition

DG attribute	Value
Name	CHARGER_AC_STATUS_3
DGN	1FFC8h
Default priority	6
Maximum broadcast gap	None
Normal broadcast gap	500 ms when charging 5000 ms when inactive
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.20.6 AC Input Page 4

Table 6.20.6 defines the DG attributes. The signal and parameter attributes are the same as AC_STATUS_4 (see Table 6.1.5).

Table 6.20.6 — DG definition

DG attribute	Value
Name	CHARGER_AC_STATUS_4
DGN	1FF8Ah
Default priority	6
Maximum broadcast gap	None
Normal broadcast gap	500 ms when charging 5000 ms when inactive
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.20.7 AC Fault Configuration Status and Command

Fault Control configuration and status DGNs are defined for the charger. Fault Control configuration and status DGNs are defined for the inverter. These DGNs follow the formats as indicated in the following table.

Table 6.19.7 - DG Reference

Name	DGN	Format	Table
CHARGER_ACFAULT_CONFIGURATION_STATUS_1	1FF89h	AC_CONFIGURATION_STATUS_1	6.1.6
CHARGER_ACFAULT_CONFIGURATION_STATUS_2	1FF88h	AC_CONFIGURATION_STATUS_2	6.1.7
CHARGER_ACFAULT_CONFIGURATION_CO	1FF87h	ACFAULT_CONFIGURATION_COMMAND_1	6.1.10.3

Name	DGN	Format	Table
MMAND_1			
CHARGER_ACFAULT_CONFIGURATION_COMMAND_2	1FF86h	ACFAULT_CONFIGURATION_COMMAND_2	6.1.10.3

The status DGNs are broadcast on request. The command DGNs should be acknowledged with an ACK and the corresponding status DGN.

6.20.8 Charger Status

The charger status DGN describes the general operating status of the Charger on a particular DC Source (Battery Bank). Table 6.20.8a defines the DG attributes and Table 6.20.8b defines the signal and parameter attributes.

Table 6.20.8a — DG definition

DG attribute	Value
Name	CHARGER_STATUS
DGN	1FFC7h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	5000 ms or on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.20.8b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8		0 = Invalid 1 to 250 - Charger Instance
1 to 2	-	Charge voltage	uint16	V	see Table 5.3 Control voltage: The voltage desired to be delivered to the battery.
3 to 4	-	Charge current	uint16	A	see Table 5.3 Control current: The current desired to be delivered to the battery.
5	-	Charge current percent of maximum	uint8	%	see Table 5.3 Control current as a percent of the maximum.
6	-	Operating state	uint8	-	Specifies the current operating state of the charger for the identified DC source. 0 – Disable 1 - Not charging 2 – Bulk 3 – Absorption 4 – Overcharge 5 – Equalize 6 – Float 7 - Constant voltage/Current
7	0 to 1	Default state on power- up	uint2	-	00b - Charger disabled 01b - Charger enabled

	2 to 3	Auto recharge enable	uint2	-	00b – Auto recharge disabled 01b – Auto recharge enabled Auto recharge reinitializes charging if battery voltage drops below a certain voltage
	4 to 7	Force charge	uint2	-	0 – Charging is not forced 1 – Force charge to bulk 2 – Force charge to float

6.20.9 Charger Status 2

The charger status2 DGN communicants the linkage of a given charging device instance with its associated DC battery instance. It also allows for the reporting of the chargers priority relative to other charging sources as well as additional operating conditions vs. the goals from Charger Status 1. Table 6.20.9a defines the DG attributes and Table 6.20.9b defines the signal and parameter attributes.

Table 6.20.9a — DG definition

DG attribute	Value
Name	CHARGER_STATUS_2
DGN	1FEA3h
Default priority	6
Maximum broadcast gap	n/a
Normal broadcast gap	500 ms
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.20.9b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Charger Instance	uint8		0 = Invalid 1 to 250 - Charger Instance
1	-	DC Source Instance(DEPRECATED)	uint8		DC Source charger is associated with. 0 = invalid 255 = Unknown
2	-	Charger priority	uint8		Priority of charger 0 = Unassigned Higher value indicates higher priority.
3 to 4	-	Charging voltage	uint16	A	see Table 5.3 Voltage as measured at Charger.
5 to 6	-	Charging current	uint16	A	see Table 5.3 Current being delivered by Charger
7	-	Charger temperature	uint8	°C	see Table 5.3 Temperature of Charger

6.20.10 Charger Status 3

Table 6.20.10a defines the DG attributes and Table 6.20.10b defines the signal and parameter attributes.

Table 6.20.10a — DG definition

DG attribute	Value
Name	CHARGER_STATUS_3
DGN	1FDCA
Default priority	6
Maximum broadcast gap	n/a
Normal broadcast gap	500 ms
Minimum broadcast gap	50 ms
Number of frames	1
ACK requirements	None

Table 6.20.10b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Charger Instance	uint8	-	0 = Invalid 1 to 250 - Charger Instance
1	0 to 1	Derating Status	uint2	-	00b – Charger not derating 01b – Charger derating
2	-	Derating Reason	uint8	-	0 – Not derating 1 – High Internal Temperature 2 – High Battery Temperature 3 – Battery Voltage 4 – AC Input Voltage 5 – AC Input Current

6.20.11 Charger Configuration

This DG provides configuration information for the Charger. Table 6.20.11a defines the DG attributes and Table 6.20.11b defines the signal and parameter attributes.

Table 6.20.11a — DG definition

DG attribute	Value
Name	CHARGER_CONFIGURATION_STATUS
DGN	1FFC6h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on charge
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.20.11b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 = Invalid 1 to 250 - Charger instance
1	-	Charging algorithm	uint8	-	The algorithm currently being applied to the battery. 0 - Constant voltage 1 - Constant current 2 – 3-Stage 3 – 2-Stage 4 – Trickle 249 - Custom algorithm #2 250 - Custom algorithm #1
2	-	Charger mode	uint8	-	Configuration of charger modes to allow multiple chargers on one battery. 0 - Stand-alone 1 – Primary 2 – Secondary 3 – Linked to DC Source
3	0 to 1	Battery sensor present	uint2	-	00b - No Battery Temperature sensor in use. 01b - Sensor is present and active.
	2 to 3	Charger Installation Line	uint2	-	00b - Line 1 01b - Line 2 Indicates which line the charger has been installed on in the coach distribution panel.
	4 to 7	Battery type	uint4	-	See table 6.5.5b
4 to 5	-	Battery bank size	uint16	A•h	see Table 5.3
6 to 7	-	Maximum charging current	uint16	A	see Table 5.3 Note that the precision does not match the precision of the same datum in CHARGER_CONFIGURATION_COMMAND

6.20.12 Charger Command

This command starts or stops the charger. Note that Enabling the charger does not necessarily start the unit to converting power. Table 6.20.12a defines the DG attributes and Table 6.20.12b defines the signal and parameter attributes.

This command also provides the control voltage and current to be used for the Constant Current and Constant Voltage charging algorithms. These values can be updated as needed by a *System Master Charging Control Device*.

Table 6.20.12a — DG definition

DG attribute	Value
Name	CHARGER_COMMAND
DGN	1FFC5h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on charge

Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, CHARGER_STATUS

Table 6.20.12b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 = All 1 to 250 - Charger Instance
1	-	Status	uint8	-	0 — Disable 1 — Enable charger 2 — Start equalization
2	0 to 1	Default state on power- up	uint2	-	00b — Charger disabled on power-up 01b — Charger enabled on power-up
	2 to 3	Auto recharge enable	uint2	-	00b – Auto recharge disabled 01b – Auto recharge enabled Auto recharge reinitializes charging if battery voltage drops below a certain voltage
	4 to 7	Force charge	uint4	-	0 – Cancel forcing 1 – Force charge to bulk 2 – Force charge to float
3 to 4	-	Control Voltage for CC/CV Mode	uint16	A	see Table 5.3 The value provided via this parameter shall be used during the Constant Voltage Charging Algorithm. This field applies only for the CC/CV charger operating state and this value shall be reflected in the Charge Voltage value from the CHARGER_STATUS DGN.
5 to 6	-	Control Current for CC/CV Mode	uint16	A	see Table 5.3 The value provided via this parameter shall be used during the Constant Current Charging Algorithm. This field applies only for the CC/CV charger operating state and this value shall be reflected in the Charge Current value from the CHARGER_STATUS DGN.

6.20.13 Charger Configuration Command

This DGN provides changes in the Charger configuration. Table 6.20.13a defines the DG attributes and Table 6.20.13b defines the signal and parameter attributes.
Placing a No Data (255, 65535) in a field will cause that setting to be ignored. Thus it is possible to adjust any single setting without changing any others.

Table 6.20.13a — DG definition

DG attribute	Value
Name	CHARGER_CONFIGURATION_COMMAND
DGN	1FFC4h

Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, CHARGER_CONFIGURATION_STATUS

Table 6.20.13b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 = All 1 to 250 - Charger Instance
1	-	Charging algorithm	uint8	-	see 6.20.11 255 – No Data (Skip Setting)
2	-	Charger mode	uint8	-	see 6.20.11 255 – No Data (Skip Setting)
3	0 to 1	Battery sensor present	uint2	-	00b — No battery temperature sensor in use 01b — Sensor is present and active
	2 to 3	Charger Installation Line	uint2	-	00b - Line 1 01b - Line 2 Indicates which line the charger has been installed on in the coach distribution panel.
	0 to 7	Skip Setting	uint8	-	255 – No Data (Skip Setting)
4 to 5	-	Battery bank size	uint16	A•h	see Table 5.3 No Data = 65535 (Skip Setting)
6	0 to 3	Battery type	uint4	-	see 6.20.11
	4 to 7	Reserved	-	-	
	0 to 7	Skip Setting	uint8	-	255 – No Data (Skip Setting)
7	-	Maximum charging current	uint8	A	see Table 5.3 255 – No Data (Skip Setting) Note that the precision does not match the precision of the same datum in CHARGER_CONFIGURATION_STATUS

6.20.14 Charger Configuration Status 2

This DGN supplements CHARGER_CONFIGURATION_STATUS. Table 6.20.14a defines the DG attributes and Table 6.20.14b defines the signal and parameter attributes. Typically, Maximum Charge Current = Battery Bank Size * Charge Rate Limit * Max Charge as Percent. However, specific implementations do not necessarily allow the configuration of all of these parameters.

Table 6.20.14a — DG definition

DG attribute	Value
Name	CHARGER_CONFIGURATION_STATUS_2
DGN	1FF96h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change

Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.20.14b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 = Invalid 1 to 250 - Charger Instance
1	-	Maximum charge current as percent	uint8	Pct	see Table 5.3 see notes above
2	-	Charge rate limit as percent of bank size	uint8	Pct	see Table 5.3 see notes above
3	-	Shore Breaker Size	uint8	A	see Table 5.3
4	-	Default Battery Temperature	uint8	°C	see Table 5.3 May be used in the absence of a battery temperature sensor on the charger
5 to 6	-	Recharge Voltage	uint16	V	see Table 5.3 Charger may initiate charging when battery drains past this value

6.20.15 Charger Configuration Command 2

This changes the configuration information for the Charger. Table 6.20.15 defines the DG attributes. The signal and parameter attributes have the same format as CHARGER_CONFIGURATION_STATUS_2 (see Table 6.20.14b).

Table 6.20.15 — DG definition

DG attribute	Value
Name	CHARGER_CONFIGURATION_COMMAND_2
DGN	1FF95h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, CHARGER_CONFIGURATION_STATUS_2

6.20.16 Charger Configuration Status 3

This DGN supplements CHARGER_CONFIGURATION_STATUS. Table 6.20.16a defines the DG attributes and Table 6.20.16b defines the signal and parameter attributes.

Table 6.20.16a — DG definition

DG attribute	Value
Name	CHARGER_CONFIGURATION_STATUS_3
DGN	1FECCh
Default priority	6

Maximum broadcast gap	N/A
Normal broadcast gap	on change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.20.16b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 = Invalid 1 to 250 - Charger Instance
1 to 2	-	Bulk Voltage	uint16	V	see Table 5.3
3 to 4	-	Absorption Voltage	uint16	V	see Table 5.3
5 to 6	-	Float Voltage	uint16	V	see Table 5.3
7	-	Temperature Compensation Constant	uint8	mV/K	0 – 250 mV/K Magnitude of charging voltage adjustment due to temperature

6.20.17 Charger Configuration Command 3

This changes the configuration information for the Charger. Table 6.20.17a defines the DG attributes. The signal and parameter attributes have the same format as CHARGER_CONFIGURATION_STATUS_3 (see Table 6.20.16b).

Table 6.20.17a — DG definition

DG attribute	Value
Name	CHARGER_CONFIGURATION_COMMAND_3
DGN	1FECBh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, CHARGER_CONFIGURATION_STATUS_3

6.20.18 Charger Configuration Status 4

This DGN supplements CHARGER_CONFIGURATION_STATUS. Table 6.20.18a defines the DG attributes and Table 6.20.18b defines the signal and parameter attributes.

Table 6.20.18a — DG definition

DG attribute	Value
Name	CHARGER_CONFIGURATION_STATUS_4
DGN	1FEBFh
Default priority	6
Maximum broadcast gap	N/A

Normal broadcast gap	on change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.20.18b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 = Invalid 1 to 250 - Charger Instance
1 to 2	-	Bulk Time	uint16	min	Precision = 1 minute Value range = 0 to 65530 minutes
3 to 4	-	Absorption Time	uint16	min	Precision = 1 minute Value range = 0 to 65530 minutes
5 to 6	-	Float Time	uint16	min	Precision = 1 minute Value range = 0 to 65530 minutes

6.20.19 Charger Configuration Command 4

This changes the configuration information for the Charger. Table 6.20.19 defines the DG attributes. The signal and parameter attributes have the same format as CHARGER_CONFIGURATION_STATUS_3 (see Table 6.20.19b).

Table 6.20.19 — DG definition

DG attribute	Value
Name	CHARGER_CONFIGURATION_COMMAND_4
DGN	1FEBEh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, CHARGER_CONFIGURATION_STATUS_4

6.20.20 Charger Configuration Status 5 & Charger Configuration Command 5

(Charger Configuration Status 5 is deprecated and replaced with the DC_SOURCE_CONNECTION_STATUS and DC_SOURCE_CONFIGURATION_COMMAND_3)

6.20.21 Charger Equalization Status

This describes the status of the Equalization process. Table 6.20.21a defines the DG attributes and Table 6.20.21b defines the signal and parameter attributes. This DGN is normally broadcast only during the equalization process.

Table 6.20.21a — DG definition

DG attribute	Value
Name	CHARGER_EQUALIZATION_STATUS

DGN	1FF99h
Default priority	6
Maximum broadcast gap	5000ms if active
Normal broadcast gap	1000ms if active
Minimum broadcast gap	500ms
Number of frames	1
ACK requirements	None

Table 6.20.21b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 = Invalid 1 to 250 - Charger Instance
1 to 2	-	Time remaining	uint16	min	Precision = 1 min Value range = 0 to 65 530 min
3	0 to 1	Pre-charging status	Bit	-	00b — Pre-charging is not in process 01b — Charger is charging the batteries to prepare for equalization

6.20.22 Equalization Configuration Status

This describes configuration information for the Equalization mode of the Charger. Table 6.20.22a defines the DG attributes and Table 6.20.22b defines the signal and parameter attributes.

Table 6.20.22a — DG definition

DG attribute	Value
Name	CHARGER_EQUALIZATION_CONFIGURATION_STATUS
DGN	1FF98h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.20.22b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 = Invalid 1 to 250 - Charger Instance
1 to 2	-	Equalization voltage	uint16	V	see Table 5.3
3 to 4	-	Equalization time	uint16	min	Precision = 1 min Value range = 0 to 65 530 min

6.20.23 Equalization Configuration Command

This changes the configuration information for the Equalization mode of the Charger. Table 6.20.23 defines the DG attributes. The signal and parameter attributes have the same format as CHARGER_EQUALIZATION_CONFIGURATION_STATUS (see Table 6.20.22b).

Table 6.20.23 — DG definition

DG attribute	Value
Name	CHARGER_EQUALIZATION_CONFIGURATION_COMMAND
DGN	1FF97h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, CHARGER_EQUALIZATION_CONFIGURATION_STATUS

6.20.24 Internal Auxiliary Power Supply Status

The Charger reports the status of its APS in the same manner as an Inverter. In the case of an Inverter/Charger, the data is transmitted only once per APS. See 6.19.19.

6.20.25 Internal High Voltage DC Bus Status

The Charger reports the status of its HV DC Bus in the same manner as an Inverter. In the case of an Inverter/Charger, the data is transmitted only once per HV DC Bus. See 6.19.20.

6.20.26 Internal Offline Power Supply Status

The Charger reports the status of its HV DC Bus in the same manner as an Inverter. In the case of an Inverter/Charger, the data is transmitted only once per HV DC Bus. See 6.19.21.

6.20.27 Service Points

The SPNs defined in Table 6.20.27a shall apply to the Inverter and Charger.

Table 6.20.27a — Service Points

MSB	ISB	LSb	Description	Notes
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3	
1	Instance	0	DC Voltage	
1	Instance	1	DC Current	
1	Instance	2	Battery Temperature	
1	Instance	3	DC Source State of Charge	
1	Instance	4	DC Source State of Health	
1	Instance	5	DC Source Capacity	
1	Instance	6	DC Source AC Ripple	
1	Instance	7	AC Backfeed	AC Transfer Relay Welded
2	Instance	0	FET #1 Temperature	

2	Instance	1	FET #2 Temperature	
2	Instance	2	Control/Power Board Temperature	
2	Instance	3	Cooling Fan	Un – operational / locked, too slow/ too fast
3	Instance	0	DC Bulk Capacitor Temperature	
3	Instance	1	Transformer Temperature	
3	Instance	2	Ambient Temperature	
3	Instance	3	Battery Charger Timeout	
3	Instance	4	Battery Equalization	
3	Instance	5	DC Bridge	
3	Instance	6	Transfer Relay	
3	Instance	7	Stacking Configuration	
4	Instance	0	Stacking Communication	
4	Instance	1	Stacking Sync Clock	

The SPNs defined in Table 6.20.27b shall apply to the AC input or output, and thus may have several instances. The 19-bit SPN is divided into three sections, the Most Significant Byte (MSB), the Intermediate Byte (ISB), and the Least Significant Bits (LSb). The ISB indicates the Instance of the AC Point that is suspect . If the problem is global to all instances, the ISB is 0.

Table 6.20.27b — Service Points

MSB	ISB	LSb	Description
81h	Instance	0	RMS Voltage
81h	Instance	1	RMS Current
81h	Instance	2	Frequency
81h	Instance	3	Open Ground
81h	Instance	4	Open Neutral
81h	Instance	5	Reverse Polarity
81h	Instance	6	Ground Fault
81h	Instance	7	Peak Voltage
82h	Instance	0	Peak Current
82h	Instance	1	Ground Current
82h	Instance	2	Real Power
82h	Instance	3	Reactive Power
82h	Instance	4	Harmonic Distortion
82h	Instance	5	AC Phase Status
83h	Instance	0	Anti-Islanding Frequency
83h	Instance	1	Anti-Islanding Voltage

The SPNs defined in Table 6.20.27c shall apply to the APS, DC Bus, and OPS. As with the AC Input and Output, the ISB indicates the Instance of the internal component. The MSB indicates the type of component, and the LS Bits indicate the specific failed item. If the problem is global to all instances, the ISB is Zero. If the problem is global to all instances, the ISB is 0.

Table 6.20.27c — Service Points

MSB	ISB	LSb	Description
84h – APS 85h – OPS 86h - DC Bus	Instance	0	Voltage
84h – APS 85h – OPS 86h - DC Bus	Instance	1	Current
84h – APS 85h – OPS 86h - DC Bus	Instance	2	Temperature

6.20.28 Alarms

Table 6.20.27 lists the alarms.

Table 6.20.28 — Alarms

Alarm Instance	Description
1	History cleared
2	Source (AC/DC) power applied
3	Source (AC/DC) power disabled
16	Derating Ending
17	Derate Starting – High Internal Temperature
18	Derate Starting – High Battery Temperature
19	Derate Starting – Battery Voltage
20	Derate Starting – AC Input Voltage
21	Derate Starting – AC Input Current
100	Charger enabled
101	Charger disabled
102	Charger over temperature
110	Transition to bulk stage
111	Transition to absorption stage
112	Transition to Overcharge State
113	Transition to Equalize State
114	Transition to float stage
115	Transition to CC/CV Stage
116	Transition to maintenance stage
120	Low battery voltage limit
121	High battery voltage limit
122	Battery over temperature
123	Battery under temperature
124	Battery Disconnected

6.20.29 Test Profiles

6.20.29.1 Profile 74B: Basic Charger

Simple charger that is configured manually and starts/stops with the application of an external energy source. Such a charger may have the ability to receive Charge/Do-Not-Charge commands and be configured via RV-C, but it does not have the ability to take charging directions outside of On/Off (Refer to Directed Charger below for chargers which are able to respond to on/off as well as charging goals and/or charging modes/states).

When receiving commands, the Instance Number must match, or be 0 indicating All Chargers. Reception of commands with non-matching instance numbers should be ignored.

Prerequisites: None
DC_SOURCE_CONNECTION_STATUS (6.5.20) (if CHARGER_STATUS_2 is supported)

Reporting

ID	Datum	Test	Required Response	Required Behavior
74B-R-01	Application of energy	a. Charging starts	a. Unit begins delivery of energy to battery, as determined by internal charging profiles and configuration of charger.	Charger begins operation per its existing configuration. It begins sending basic status messages.
			b. CHARGER STATUS message is transmitted per 6.20.8 and charger configuration / status. Required fields: Instance, Operating State.	
			c. CHARGER STATUS 2 (Optional) message is transmitted. If supplied, assure information is per 6.20.9 and charger configuration. Required fields: Instance	
			d. CHARGER EQUAIZATION STATUS (Optional) message is transmitted. If supplied, assure information is per 6.20.21 and charger configuration. Required fields: Instance, Pre-charge status	
74B-R-02	Charger requested to stop charging via external wire signal (Optional: If capable)	a. Activation of external Charger Enable/Disable signal wire to disable charger.	a. Unit shall cease delivery of energy (Current <= 1A) within 500mS of application of signal. CHARGER STATUS message shall set Operating State field = Not Charging, Float, or Disabled (Device and / or configuration dependent)	If charger hardware supports a physical hardwire ‘Enable’ signal, charger will respond as directed by that wire, as well as modify the status messages to accordingly indicate its present condition.

Command Response

ID	Datum	Test	Required Response	Required Behavior

74B-C-01	Unsupported Command	Send any CHARGER command which is not supported.	a. Unit shall respond with NAK indicating it does not respond to Charger Commands.	In the Basic Charger, there is no ability to receive directions from an external CAN based source (example, a BMS). This capacity is for the Directed Charger level
74B-C-02	Configuration Command	a. Send 6.20.12 Charger Configuration Command verifying each field at a time (Other fields set = 0xff).	a. Unit shall respond with NAK indicating it does not respond to Charge Configuration Commands –OR— b. Unit shall respond with Charger Configuration Status 6.20.10 message noting change in field requested, or indicating 0xff if that field is not supported.	When processing a command, a charger should respond with an overall NAK if it does not accept configuration directions via the RV-C commands. If charger does process configuration commands, supported field should be updated. It is NOT a requirement that a charger supports all bit fields in the configuration command, and if a command is received which is only partiality supported, unsupported fields may be ignored.
74B-C-03	Configuration Command 2	a. Send 6.20.14 Charger Configuration Command 2 verifying each field at a time (Other fields set = 0xff).	a. Unit shall respond with NAK indicating it does not respond to Charge Configuration Commands –OR— b. Unit shall respond with Charger Configuration Status 2 6.20.13 message noting change in field requested, or indicating 0xff if that field is not supported.	
74B-C-04	Configuration Command 3	a. Send 6.20.16 Charger Configuration Command 3 verifying each field at a time (Other fields set = 0xff).	a. Unit shall respond with NAK indicating it does not respond to Charge Configuration Commands –OR— b. Unit shall respond with Charger Configuration Status 3 6.20.15 message noting change in field requested, or indicating 0xff if that field is not supported.	
74B-C-05	Configuration Command 4	a. Send 6.20.18 Charger Configuration Command 4 verifying each field at a time (Other fields set = 0xff).	a. Unit shall respond with NAK indicating it does not respond to Charge Configuration Commands –OR— b. Unit shall respond with Charger Configuration Status 4 6.20.17 message noting change in field requested, or indicating 0xff if that field is not supported.	
74B-C-06	Configuration Command 5	a. Send 6.20.20 Charger	a. Unit shall respond with NAK indicating it does not respond to	

		Configuration Command 5 verifying each field at a time (Other fields set = 0xff).	Charge Configuration Commands –OR— b. Unit shall respond with Charger Configuration Status 5 6.20.19 message noting change in field requested, or indicating 0xff if that field is not supported.	
74B-C-07	Equalization Configuration Command	a. Send 6.20.23 Equalization Configuration Command verifying each field at a time (Other fields set = 0xff).	a. Unit shall respond with NAK indicating it does not respond to Charge Configuration Commands –OR— b. Unit shall respond with Equalization Configuration Status 6.20.22 message noting change in field requested, or indicating 0xff if that field is not supported.	
74B-C-08	Command	Send any Command with non-zero Instance Number not equal to that of charger.	Ignore	Commands not directed to charger via matching instance, or use of ‘All Instance’ (0), shall be ignored. Note that a NAK should not be returned, the command should be ignored.

6.20.29.2 Profile 74D: Directed Charger

A Directed Charger is one that has the ability to take guidance from an external device for the real-time setting of charging state and goals. This external device is a Remote Battery Master (RBM). The RBM can be a BMS (Battery Management System) or SOC (State of Charge) device as well as another charging device associated with the same DC Instance or DC bus.

An RBM must at minimum broadcast DC_STATUS_4 indicating its Instance, Priority, as well as desired Charge State to provided direction to chargers. An RBM must also broadcast DC_STATUS_1, and DC_STATUS_2 to indicate its presence and activity on the RV-C Bus. (Refer to DC_STATUS for additional details on additional minimum requirements, including required fields for an RBM as well as the presence of multiple potential RMBs and the handling of such).

Directed Chargers shall respond to the highest priority RBM associated with its Battery or DC Bus Instance.

Directed Chargers may (optionally) act as an RBM, providing it has sufficient capability and is configures to act as an RBM.

Directed Charges may (optionally) utilize information supplied from an RBM to augment instrumentation (Remote Instrumentation).

Only one RBM shall be followed at any given time: Even if that RBM is unable to supply full battery status information (e.g., does not supply a battery temperature value) only the highest priority RMB shall be followed at any given time.

In the absence of no RBM, Directed Chargers shall behave according to the Basic Charger profile 74B above.

Prerequisites: 74B - Basic Charger, RBM associated with same DC Instance / Bus ID.
DC_SOURCE_CONNECTION_STATUS (6.5.20)

Reporting

ID	Datum	Test	Required Response	Required Behavior
74D-R-01	Application of energy – No RBM present.	a. Charging starts with no RBM indicated.	a. Unit behaves per Basic Charger Profile above.	When no validated direction has been received from an external RBM, the charger shall proceed

				based on its existing configuration in a stand-alone fashion. Care needs to be taken by the evaluator, as some chargers may have an option to enter a standby or even faulted mode in the lack of a validated RBM.
74D-R-02	Introduction of RBM with different DC Instance / bus.	a. Validated RBM begins broadcasting direction using a DC Instance/bus not matching the DC Instance/bus the charger is configured for.	a. Charger ignores RBM and continues to behave per the Basic Charger Profile.	The arrival of any directional messages not associated with the configured DC Instance should be ignored. Only messages which match the same DC Instance (indicating the charger and the battery are on the same DC bus) should be processed.
74D-R-03	Introduction of RBM with matching DC Instance / bus.	a. Validated RBM begins broadcasting direction of DC Instance using a matching Charger's configured DC Instance	a. Charger will begin following requested charging state.	When a validated charging direction message is received, the charger should begin following those directions. Directions may be as simple as 'Start/stop charging', in which case the charger will follow its configure charging profile. Or the directions may include specific goals / limits for battery voltage and/or current, in which case those goals should override any internal charger configuration.
		b. Validate RBM supplies DC Voltage and/or current goals or targets.	b. Charger shall utilize those as its targets. Limiting its energy output to meet the most restrictive voltage or current goal supplied.	
		c. Validated RBM ceases broadcasting of DC_STATUS_x messages	c. Charger shall revert to Basic Charge Profile behavior above. It may restart a new charging cycle, or continue on the present charging cycle and mode, A charger may also be able to take other actions depending on its configuration and capability.	
74D-R-04	Charger requested to stop charging via external wire signal (Optional: If capable)	a. Activation of external Charger Enable/Disable signal wire to disable charger.	a. Unit shall cease deliver of energy (Current <= 1A) within 500mS of application of signal. – overriding any RBM directions. CHARGER STATUS message shall set Operating State field = Not Charging, Float, or Disabled (Device and / or configuration dependent)	Even in the presence of validated charging direction messages via RV-C, if the charger is equipped with a physical charger/do not charge wire, that capability should override any CAN based directions. This allows for a kind of belts-and-suspenders installation with the hardware signal being a safety backstop.

Command Response

ID	Datum	Test	Required Response	Required Behavior
74D-C-01	High Voltage Condition	Send DC_SOURCE_STATUS_6 with matching DC-Instance and “High Voltage Limit Status” set = Limit Reached	Unit shall terminate charging. CHARGER_STATUS "Operating State" shall change to 'Disabled' or 'No Charging'	A Directed Charger must monitor for relevant commands outside the Charger section and respond accordingly. Limit conditions shall be respected even if other Directions are received, example if a DC_SORUCE_STATUS_4 is still asking for Charging, but a High Limit is received, charging shall stop.
74D-C-02	High Voltage Disconnect	Send DC_SOURCE_STATUS_6 with matching DC-Instance and “High Voltage Disconnect Status” set = Limit Reached	Unit shall terminate charging and prepare for disconnect status. CHARGER_STATUS "Operating State" shall change to 'Disabled' or 'No Charging'	Some chargers may chose to enter a Faulted state when a Disconnect command is received.
74D-C-03	High Temperature Condition	Send DC_SOURCE_STATUS_6 with matching DC-Instance and “High DC source temperature limit status” set = Limit Reached	Unit shall terminate charging. CHARGER_STATUS "Operating State" shall change to 'Disabled' or 'No Charging'	
74D-C-04	High Temperature Disconnect	Send DC_SOURCE_STATUS_6 with matching DC-Instance and “High DC source temperature disconnect status” set = Limit Reached	Unit shall terminate charging and prepare for disconnect status. CHARGER_STATUS "Operating State" shall change to 'Disabled' or 'No Charging'	Some chargers may chose to enter a Faulted state when a Disconnect command is received.
74D-C-05	Global Battery Off	Send DC_SOURCE_COMMAND with matching DC-Instance and “Desired Power On/Off Status” = off	Unit shall terminate charging. CHARGER_STATUS "Operating State" shall change to 'Disabled' or 'No Charging'	Reception of global DC_SOURCE off commands shall cause all associated charging sources to terminate charging. Upon receiving On command, the charger may resume its prior mode of operation.
74D-C-06	Global Charger Off	Send DC_SOURCE_COMMAND with matching DC-Instance and “Desired Charge	Unit shall terminate charging. CHARGER_STATUS "Operating State" shall change to 'Disabled' or 'No Charging'	.

		On/Off Status" = off		

6.20.29.3 Profile 74P: Prioritizing Charger

A Prioritizing Charger is one which has the ability to follow guidance from an RBM, and also monitor other charging sources adjusting its output as needed to assure the charging devices with higher priority are fully utilized (90% or above) by adjusting its own output as needed to meet the total energy goals supplied by the RBM. In order for a Prioritizing Charger to operate, the RBM must supply a Goal Current value as part of DC_STATUS_4 and chargers must supply their utilization as part of CHARGER_STATUS

Prerequisites: 74B: Basic Charger, 74D: Directed Charger, RBM associated with same DC Instance / Bus ID supplying charging current goals.
DC_SOURCE_CONNECTION_STATUS (6.5.20)

Reporting

ID	Datum	Test	Required Response	Required Behavior
74P-R-01	communication	a. Broadcast Charger Utilization	a. Charger broadcasts CHARGER_STATUS per 6.20.8 Required fields: Charger current as percent of maximum (% utilization of charger)	To allow for prioritization of chargers, it is important to send out an accurate representation of charger utilization. But this must be relative to the real-time capabilities of the charger, not the idealized capabilities. Example, if a given charger is able to operate from either a 220v / 50A source and able to provide upwards of 100A, or a 120v/15A source and is limited to 25A in this case, it must adjust its utilization accurately. In this case, if it is being powered by a 120v/15A source and delivering 20A, its utilization is 80%, not 20%
		b Broadcast Charger DC Bus and priority.	b. Charger broadcasts CHARGER_STATUS_2 per 6.20.9 Required fields: DC Source Instance, Charger Priority,	
74P-R-02	RBM Goal Current Exceeded	a. Lower Priority charging devices present on same DC Instance/bus with indicated utilization above 10%	a. No change in unit's behaviors – lower priority chargers to adjust their output down.	During prioritization, when the current is over goal, the charger should ascertain if it is the lowers priority active charging source, taking into account charges, Solar, DC Generators –all charging sources and their priority. If indeed it is one of the lowest priority sources, it should reduce its output to lower total system current delivery.
		b. Charging device is lowest priority device associated with DC Instance/bus	b. Unit reduces energy output until its output is 0A, or total charging current is at or below RBM goal.	
74P-R-03	RBM Goal Current not met	a. Higher Priority charging devices present on same DC Instance/bus with indicated utilization under 90%	a. No change in units behaviors – higher priority chargers to adjust their output up.	Likewise, if current delivery is under goal the charging source should assess if it is the lower priority source and increase its output. During this time it is also important that a charging source

		b. Higher Priority charging devices present on same DC Instance/bus with indicated utilization at or above 90%	b. Unit increases energy output until it reaches 90+% or the total charging current is at the RBM goal.	assures higher priority sources are operating at a high level of utilization.

6.21 Generic AC Source

6.21.1 AC Output Introduction

When measuring AC power from a Generator, Inverter, or Transfer Switch, specific DGNs are defined. AC from other sources, such as the Shore Cord, is reported as a Generic AC Source. The following formats apply (see Table 6.21.1a).

Table 6.21.1a — Generic AC Source definition

Device attribute	Value
Category	Power components
Default Source Address	139
Dynamic Address Range	128 to 143
Instance	Multiple

AC output is reported using the standard AC Point formats (see Section 6.1). The Instance field is defined in Table 6.21.1b. Note that each of these DGNs may have to be transmitted multiple times to provide information on each line.

Table 6.21.1b — Instance field definition

Byte	Bit	Name	Data type	Unit	Value definition
0	0 to 3	Instance	uint4	-	1 — Shore Power
	4 to 7	Line	uint4	-	1 — Line 1 2 — Line 2

6.21.2 Generic AC Output Status 1

Table 6.21.2a defines the DG attributes and Table 6.21.1b defines the instance.
Signal and Parameter definition: See “AC Point” AC_STATUS_1

Table 6.21.2a — DG definition

DG attribute	Value
Name	GENERIC_AC_STATUS_1
DGN	1FEBBh
Default priority	6
Maximum broadcast gap	None
Normal broadcast gap	500 ms when AC active
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.21.3 AC Output Status 2

Table 6.21.3a defines the DG attributes and Table 6.21.1b defines the instance.

Signal and parameter definition: See "AC Point" AC_STATUS_2

Table 6.21.3a — DG definition

DG attribute	Value
Name	GENERIC_AC_STATUS_2
DGN	1FEBAh
Default priority	6
Maximum broadcast gap	None
Normal broadcast gap	500 ms when AC active
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.21.4 AC Output Status 3

Table 6.21.4a defines the DG attributes and Table 6.21.4b defines the instance.

Signal and parameter definition: "AC Point" AC_STATUS_3

Table 6.21.4a — DG definition

DG attribute	Value
Name	GENERIC_AC_STATUS_3
DGN	1FEB9h
Default priority	6
Maximum broadcast gap	None
Normal broadcast gap	500 ms when AC active
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.21.5 AC Output Status 4

Table 6.21.5a defines the DG attributes, and Table 6.21.1b defines the instance.
Signal and parameter definition: "AC Point" AC_STATUS_4

Table 6.21.5a — DG definition

DG attribute	Value
Name	GENERIC_AC_STATUS_4
DGN	1FEB8h
Default priority	6

Maximum broadcast gap	None
Normal broadcast gap	500 ms when AC active
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

6.21.6 AC Fault Configuration Status and Command

These DGNs follow the format of AC Point: ACFAULT_CONFIGURATION_STATUS_1, ACFAULT_CONFIGURATION_STATUS_2, ACFAULT_CONFIGURATION_COMMAND_1, and ACFAULT_CONFIGURATION_COMMAND_2. Instances are defined as above.

The status DGNs are broadcast on request. The command DGNs should be acknowledged with a NAK if necessary and the corresponding status DGN.

DGN	Hex	Decimal
GENERIC_ACFAULT_CONFIGURATION_STATUS_1	1FEB7h	130743
GENERIC_ACFAULT_CONFIGURATION_STATUS_2	1FEB6h	130742
GENERIC_ACFAULT_CONFIGURATION_COMMAND_1	1FEB5h	130741
GENERIC_ACFAULT_CONFIGURATION_COMMAND_2	1FEB4h	130740

6.21.7 Alarms

Table 6.20.27 lists the alarms.

Table 6.20.28 — Alarms

Alarm Instance	Description
1	History cleared
2	Source (AC/DC) power applied
3	Source (AC/DC) power disabled
100	Charger enabled
101	Charger disabled
102	Charger over temperature
110	Transition to bulk stage
111	Transition to absorption stage
112	Transition to Overcharge State
113	Transition to Equalize State
114	Transition to float stage
115	Transition to CC/CV Stage
116	Transition to maintenance stage
120	Low battery voltage limit
121	High battery voltage limit

122	Battery over temperature
123	Battery under temperature
124	Battery Disconnected

6.21.8 Test Profiles

The Generic AC Source profiles are directly inherited from the AC Point profiles, with the only exception being that the instance field shall follow the Instance Field Definition of Table 6.21.1b.

6.21.8.1 Profile 75A: Basic generic AC source

Prerequisites: None

Reporting:

ID	Datum	AC Point Reference Test ID
75A-S-01	GENERIC_AC_STATUS_1	02B-S-01 (see 6.1.10.1)

6.21.8.2 Profile 75M: Phase Detection Support

Reporting:

ID	Datum	AC Point Reference Test ID
75M-S-01	GENERIC_AC_STATUS_2	02M-S-01 (see 6.1.10.2)
75M-S-02	GENERIC_AC_STATUS_3	02M-S-02 (see 6.1.10.2)

6.21.8.3 Profile 75C: Fault Control Support

Reporting:

ID	Datum	AC Point Reference Test ID
75C-S-01	GENERIC_AC_STATUS_4	02C-S-01 (see 6.1.10.3)

Command Response:

ID	Datum	AC Point Reference Test ID
75C-C-01	GENERIC_ACFAULT_CONFIGURATION_COMMAND_1	02C-C-01 (see 6.1.10.3)
75C-C-02	GENERIC_ACFAULT_CONFIGURATION_COMMAND_2	02C-C-02 (see 6.1.10.3)
75C-C-03	GENERIC_ACFAULT_CONFIGURATION_STATUS_1	02C-C-03 (see 6.1.10.3)
75C-C-04	GENERIC_ACFAULT_CONFIGURATION_STATUS_2	02C-C-04 (see 6.1.10.3)

6.22 Generic AC Load

6.22.1 Introduction

These DGNs are for an AC circuit. The function of the circuit is not explicit in the DGN - there is generally no way to identify the purpose of a circuit in RV-C. As this DGN is for generic loads it may not be the most suitable for all AC loads. Please ensure that a more suitable DGN is not available before using the Generic AC load DGN. The following formats apply (see Table 6.22.1).

Table 6.22.1 — Generic AC definition

Device attribute	Value

Category	Power components
Default Source Address	137
Dynamic Address Range	128 to 143
Instance	Multiple

Each circuit is identified with an Instance from 1 to 250. In practice multiple instances are likely to be contained in a single controller. These DGNs include provisions for automatic load management. Load management may also be implemented independently by using the manual modes provided in the DGNs.

Static addressing is discouraged in this product.

6.22.2 AC Load Status

This should not be used with the Multi-Packet protocol. If multiple switches are to be reported, each should be reported in its own packet. Table 6.22.2a defines the DG attributes and Table 6.22.2b defines the signal and parameter attributes.

Loads can be assigned to groups, which is a mechanism to allow global changes to multiple loads. There are up to seven groups, and a load may belong to more than one group or no group.

Table 6.22.2a — DG definition

DG attribute	Value
Name	AC_LOAD_STATUS
DGN	1FFBFh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.22.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 – Invalid 1 to 250 - Valid
1	-	Group	uint8	bitmap	One bit is assigned to each of seven groups. Highest bit is not used to indicate a group. If 0, the other bits refer to the groups. 0 in any other position indicates the load is a member of the corresponding group. If the high bit is a 1, the remainder should not be interpreted as group indicators. 00000000b - All groups 11111111b - No data
2	-	Operating status (level)	uint8	%	see Table 5.3 If not dimmable, report 100%.

					252 - Load delay active
3	0 to 1	Operating mode	bit	-	00b - Automatic (Load may be shed or activated without user intervention) 01b – Manual (Status shall not change without additional commands)
	2 to 3	Variable level capability	bit	-	00b - Not variable (not dimmable) 01b – Variable (dimmable)
	4 to 7	Priority	uint4	-	0000b - Highest priority 1101b - Lowest priority 1110b - Error 1111b - No data This determines the order in which loads shall be shed or added. Low priority loads shall be shed first and restored last.
4	-	Delay	uint8	s	Precision = 1s Value range = 0 to 240 s (241 to 250 are in minute increments from 5 minutes to 14 minutes) The time to elapse after an on command before the load is activated.
5	-	Demanded current	uint8	A	see Table 5.3 The maximum anticipated amperage demanded by the load.
6 to 7	-	Present current	uint16	A	see Table 5.3

6.22.3 AC Load Status 2

This should not be used with the Multi-Packet protocol. If multiple switches are to be reported, each should be reported in its own packet. Table 6.22.3a describes the DG attributes, Table 6.22.3b defines the signal and parameter attributes.

Table 6.22.3a – DG definition

DG attribute	Value
Name	AC_LOAD_STATUS_2
DGN	1FEDDh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.22.3b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 - Invalid 1 to 250 - Valid
1	0 to 1	Lock Status	uint2	-	00b – Load is unlocked 01b – Load is locked

					11b – Lock command is not supported When locked the instance will ignore certain commands (device specific) until an unlock command is received.
	2 to 3	Overcurrent Status	uint2	-	00b – Load is not in overcurrent 01b – Load is in overcurrent 11b – Overcurrent status is unavailable or not supported
	4 to 5	Override Status	uint2	-	00b – External override is inactive 01b – External override is active 11b – Override status is unavailable or not supported When the override is active, the output has been physically changed by a user outside of the device.
	6 to 7	Enable Status	uint2	-	00b – Load is enabled 01b – Load is disabled 11b – Enable status is unavailable or not supported When the disable is active, it has been set through an external signal input.
2	-	Last Command	uint8		Indicates the last command (function) executed by this instance. This is the last command executed by the AC_LOAD_COMMAND (See 6.22.4) See Table 6.22.3c below for a list of possible commands.
3	0 to 1	Interlock Status	uint2		00b – Interlock command is not active 01b – Interlock command is active (last command was an interlock command and both interlock A and B were present) 11b – Interlock command is not supported
4-7	-	Reserved			

6.22.4 AC Load Command

Table 6.22.4a defines the DG attributes, Table 6.22.4b defines the signal and parameter attributes, and Table 6.22.4c describes the possible values for the “Command” parameter passed inside of the signal and parameter definition.

If multiple loads are changed, for example by using a group function, then each load should respond with the NAK if necessary, and the AC_LOAD_STATUS.

Table 6.22.4a — DG definition

DG attribute	Value
Name	AC_LOAD_COMMAND
DGN	1FFBEh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1

ACK requirements	NAK, AC_LOAD_STATUS

Table 6.22.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — All loads, regardless of group 255 — All loads in indicated groups
1	-	Group	uint8	bitmap	see Table 6.22.2b If bit 7 = 1 and bit 6 = 0, it is a node group. Node groups support more than seven groups where multiple groups cannot be selected in one command. This is required to handle the physical grouping of multiple control instances within one node. 10000001 – Node Group 1 10111111 – Node Group 63 11111111 – For non-group commands
2	-	Desired Level	uint8	%	see Table 5.3 The load shall set its level to the lowest level equal to or greater than this value. Thus a load that is not capable of intermediate levels shall interpret any value greater than 0 as “On”. A product with two levels shall treat 0.5% to 50% as 50%, 50.5% to 100% as 100%. A value of 250 toggles the load On/Off A value of 251 selects the Master Memory Value. A value of 253 represents Fault OFF. A value of 254 represents ERROR.
3	0 to 1	Desired Operating Mode	bit		00b – Automatic 01b – Manual (This load will not be shed or added automatically.)
	2 to 3	Interlock	uint2	-	00b – no Interlock active 01b – Interlock A 10b – Interlock B A command message with either interlock A or B set will not be activated until an identical message is received from a different source with the opposing interlock set.
	4 to 7	Priority	uint4	-	0000b – Highest Priority 1101b – Lowest Priority 1110b – Error 1111b – No Data This determines the order in which loads shall be shed or added. Lower priority loads shall be shed first and restored last.
4	-	Command	uint8		See Table 6.22.4c for command descriptions.
5	-	Delay/Duration	uint8	Sec	Number of seconds to wait before executing

					command (for delayed commands) or the number of seconds of duration for the specified command (for duration commands) before reverting to previous state. Max 240 seconds. Additional minute increment values: 241 = 5 min 242 = 6 min . . . 250 = 14 min For Duration Commands: A value of 0 indicates a momentary command (instance will revert to previous state after 100 ms (0.1 seconds) if another command is not received). A value of 255 indicates continuous duration.
6 to 7		Reserved			

Table 6.22.4c – Supported Command Descriptions

Command	Lock Support	Description
0x00 – Set Level (delay)	Yes	Set output level directly to the ‘desired level’
0x01 – ON (duration)	Yes	Set output on directly to 100%
0x02 – ON (delay)	Yes	Set output on directly to 100% delayed by the value in ‘Delay’
0x03 – OFF (delay)	Yes	Set output off directly to 0%. This can be delayed by the value in ‘Delay’ if greater than 0.
0x04 – Stop	No	If ON, set output directly to 0%. If flash is active, stop the flash and set output to off.
0x05 – Toggle	Yes	Toggle output between 0% and ‘desired value’.
0x06 – Memory OFF	Yes	Store current output state to Master Memory Value for the instance and the set directly to 0%.
0x11 – Ramp Brightness	Yes	Ramp brightness to ‘desired level’.
0x12 – Ramp Toggle	Yes	Toggle brightness between 0% and ‘desired level’ each time received.
0x13 – Ramp Up	Yes	Ramp brightness up from current brightness until either at 100% or a ‘Stop’ is received.
0x14 – Ramp Down	Yes	Ramp brightness down from current brightness until either lowest brightness is reached or a ‘Stop’ is received.
0x15 – Ramp Up/Down	Yes	Ramp brightness down to the lowest level. Then start ramping up until 100% is reached. This continues until a ‘Stop’ is received.
0x16 – Increment One Level	Yes	Increase output one level to a maximum of 100%. The definition of level is device specific.
0x17 – Decrement One Level	Yes	Decrease output one level to a minimum of 0%. The definition of level is device specific.
0x21 – Lock	-	When received, certain commands for this instance will be ignored until an ‘Unlock’ is received. The commands to be locked (ignored) are device specific. In safety-critical applications, lock should not be the sole method of safety used.
0x22 – Unlock	-	When received, removes lock condition for instance allowing all other commands to be actuated.
0x31 – Flash	Yes	Alternately set the output to 0% and 100%. Delay/Duration value sets the flash period. Desired level sets the duty cycle as a percent (1-199) of the duration. For

		example, a duration of 30 with a brightness of 33% would be on for 10 seconds and then off for 20 seconds. Invalid brightness values (0, 255, etc) will default to 50%.
0x32 – Flash Momentary	Yes	Flash output alternately to 0% and 100% once or continue only while the command is being repeated at least once every 2 seconds. Otherwise, flashing will stop.

If a node does not support some of the above commands, it must return a NAK – Command Not Supported.

6.22.5 Service Points

As with most multiple instance devices, if the Most Significant Byte is zero the Intermediate Byte provides the Instance associated with the failure. These are the allowable Service Points for this DGN (see Table 6.22.5).

Table 6.22.5 — Service Points

MSB	ISB	LSb	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	Current
	Instance	1	Operating Status
	Instance	2	Variable (Dimmable) Control

6.22.6 Test Profile

6.22.6.1 Generic AC Load with two levels (two level – on/off) Base Profile

ID	Datum	Test	Required Response	Required Behavior
137A-C-01	Command, Desired Level	On AC_LOAD_COMMAND, send a Command=00 with Desired Level=0 or Command=03 (Off)	AC_LOAD_STATUS reports the Operating status=0	Output shuts off
		On AC_LOAD_COMMAND, send a Command=00 with Desired Level=200 or Command=01 (On)	AC_LOAD-STATUS Reports the Operating status=200	Output turns on

6.23 Generic DC Load

6.23.1 Introduction

The DGN describes a DC circuit. The function of the circuit is not explicit in the DGN - there is generally no way to identify the purpose of a circuit in RV-C. As this DGN is for generic loads it may not be the most suitable for all DC loads. Please ensure that a more suitable DGN is not available before using the Generic DC load DGN. The following formats apply (see Table 6.23.1).

Table 6.23.1 — Generic DC load definition

Device attribute	Value
Category	Power components
Default Source Address	146

Dynamic Address Range	128 to 143
Instance	Multiple

The DGNs and schemes are identical to the AC Load DGNs. Each circuit is identified with an Instance from 1 to 250, which are independent of the AC Instances.
Static addressing is discouraged in this product.

6.23.2 DC Load Status

This DGN should not be used with the Multi-Packet protocol. If multiple switches are to be reported, each should be reported in its own packet. Table 6.23.2 defines the DG attributes. The signal and parameter attributes are the same as AC_LOAD_STATUS (see Table 6.22.2b), including the group mechanism. Note that the groups are also independent of the AC Load groups.

Table 6.23.2 — DG definition

DG attribute	Value
Name	DC_LOAD_STATUS
DGN	1FFBDh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.23.2a – Signal and parameter definition

byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 - Invalid 1 to 250 - Valid
1	-	Group	uint8	bitmap	One bit is assigned to each of seven groups. Highest bit is not used to indicate a group. If 0, the other bits refer to the groups. 0 in any other position indicates the load is a member of the corresponding group. If the high bit is a 1, the remainder should not be interpreted as group indicators.

					00000000b - All groups 11111111b - No data
2	-	Operating Status(level)	uint8	%	see Table 5.3 If not dimmable, report 100%. 252 - Load delay active
3	0 to 1	Operating Mode	uint2	-	00b - Automatic (Load may be shed or activated without user intervention) 01b – Manual (Status shall not change without additional commands)
	2 to 3	Variable level capability	uint2	-	00b - Not variable (not dimmable) 01b - Variable (dimmable)
	4 to 7	Priority	uint4	-	0000b - Highest priority 1101b - Lowest priority 1110b - Error 1111b - No data This determines the order in which loads shall be shed or added. Low priority loads shall be shed first and restored last.
4	-	Delay	uint8	s	Precision = 1s Value range = 0 to 240 s (241 to 250 are in minute increments from 5 minutes to 14 minutes) The time to elapse after an on command before the load is activated.
5	-	Demanded Current	uint8	A	see Table 5.3 The maximum anticipated amperage demanded by the load.
6 to 7	-	Present Current	uint16	A	see Table 5.3

6.23.3 DC Load Status 2

This should not be used with the Multi-Packet protocol. If multiple switches are to be reported, each should be reported in its own packet. Table 6.23.3a describes the DG attributes and Table 6.23.3b defines the signal and parameter attributes.

Table 6.23.3a – DG definition

DG attribute	Value
Name	DC_LOAD_STATUS_2
DGN	1FEDCh
Default priority	6

Maximum broadcast gap	N/A
Normal broadcast gap	On change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.23.3b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 - Invalid 1 to 250 - Valid
1	0 to 1	Lock Status	uint2	-	00b – Load is unlocked 01b – Load is locked 11b – Lock command is not supported When locked the, instance will ignore certain commands (device specific) until an unlock command is received.
	2 to 3	Overcurrent Status	uint2	-	00b – Load is not in overcurrent 01b – Load is in overcurrent 11b – Overcurrent status is unavailable or not supported
	4 to 5	Override Status	uint2	-	00b – External override is inactive 01b – External override is active 11b – Override status is unavailable or not supported When the override is active, the output has been physically changed by a user outside of the device.
	6 to 7	Enable Status	uint2	-	00b – Load is enabled 01b – Load is disabled 11b – Enable status is unavailable or not supported When the disable is active, it has been set through an external signal input.
2	-	Last Command	uint8		Indicates the last command (function) executed by this instance. This is the last command executed by the DC_LOAD_COMMAND (DGN 1FFBC). See Table 6.23.4c below for a list of possible commands.
3	0 to 1	Interlock Status	uint2		00b – Interlock command is not active 01b – Interlock command is active 11b – Interlock command is not supported
4	0 to 3	Driver Direction Status	uint4		0 – Not being driven 1 – Driving low 2 – Driving High
	4 to 7	-	uint4		
5 - 7	-	-			

6.23.4 DC Load Command

Table 6.23.4a defines the DG attributes. The signal and parameter attributes are given in Table 6.23.4b.

Table 6.23.4 — DG definition

DG attribute	Value
Name	DC_LOAD_COMMAND
DGN	1FFBCh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, DC_LOAD_STATUS

Table 6.23.4b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — All loads, regardless of group 255 — All loads in indicated groups
1	-	Group	uint8	bitmap	see Table 6.22.2b If bit 7 = 1 and bit 6 = 0, it is a node group. Node groups support more than seven groups where multiple groups cannot be selected in one command. This is required to handle the physical grouping of multiple control instances within one node. 10000001 – Node Group 1 10111111 – Node Group 63 11111111 – For non-group commands
2	-	Desired Level	uint8	%	see Table 5.3 The load shall set its level to the lowest level equal to or greater than this value. Thus a load that is not capable of intermediate levels shall interpret any value greater than 0 as “On”. A product with two levels shall treat 0.5% to 50% as 50%, 50.5% to 100% as 100%. A value of 250 = Toggles the load On/Off A value of 251 selects the Master Memory Value.
3	0 to 1	Desired Operating Mode	uint2		00b – Automatic 01b – Manual (This load will not be shed or added automatically.)
	2 to 3	Interlock	uint2	Bitmap	Bit 0 – Interlock A Bit 1 – Interlock B A command message with either interlock bit set to ‘1’ will not be activated until an identical message is received from a different source with the opposing interlock bit set to ‘1’.
	4 to 7	Driver Direction	uint4		1 – Drive low 2 – Drive High
4	-	Command	uint8		See Table 6.24.1c below for command descriptions.
5	-	Delay/Duration	uint8	Sec	Number of seconds to wait before executing command (for delayed commands) or the number of seconds of duration for the specified command (for duration commands) before reverting to previous state. Max 240 seconds.

					Additional minute increment values: 241 = 5 min 242 = 6 min . . . 250 = 14 min For Duration Commands: A value of 0 indicates a momentary command (instance will revert to previous state after 2 seconds if another command is not received). A value of 255 indicates continuous duration.
6 to 7		-			

Table 6.23.4c – Command Descriptions

Command	Description
0x00 – Set Level (delay)	Set output level directly to the ‘desired level’
0x01 – ON (duration)	Set output on directly to 100%
0x02 – ON (delay)	Set output on directly to 100% delayed by the value in ‘Delay’
0x03 – OFF (delay)	Set output off directly to 0%. This can be delayed by the value in ‘Delay’ if greater than 0.
0x04 – Stop	If ON, set output directly to 0%. If flash is active, stop the flash and set output to off.
0x05 – Toggle	Toggle output between 0% and ‘desired value’.
0x06 – Memory OFF	Store current output state to Master Memory Value for the instance and the set directly to 0%.
0x21 – Lock	When received, certain commands for this instance will be ignored until an ‘Unlock’ is received. The commands to be locked (ignored) are device specific. In safety-critical applications, lock should not be the sole method of safety used.
0x22 – Unlock	When received, removes lock condition for instance allowing all other commands to be actuated.
0x31 – Flash	Alternately set the output to 0% and 100%. Delay/Duration value sets the flash period. Desired level sets the duty cycle as a percent (1-199) of the duration. For example, a duration of 30 with a brightness of 33% would be on for 10 seconds and then off for 20 seconds. Invalid brightness values (0, 255, etc) will default to 50%.
0x32 - Flash Momentary	Flash output alternately to 0% and 100% once or continue only while the command is being repeated at least once every 2 seconds. Otherwise, flashing will stop.

If a node does not support some of the above commands, it must return a NAK – Command Not Supported.

6.23.5 Service Points

As with most multiple instance devices, if the Most Significant Byte is zero the Intermediate Byte provides the Instance associated with the failure. These are the allowable Service Points for this DGN (see Table 6.23.6).

Table 6.23.6 — Service Points

MSB	ISB	LS Bits	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	Current
1	Instance	1	Operating Status
1	Instance	2	Variable Control

6.23.6 Test Profile

6.23.6.1 Generic DC Load Base Profile

ID	Datum	Test	Required Response	Required Behavior
146A-C-01	Desired Level Command	On DC_LOAD_COMMAND, send a Command=00 with Desired Level=0 or Command=03 (Off)	DC_LOAD_STATUS reports the Operating status=0	Output shuts off
	Desired Level Command	On DC_LOAD_COMMAND, send a Command=00 with Desired Level=200 or Command=01 (On)	DC_LOAD_STATUS reports the Operating status=200	Output turns on

6.24 DC Dimmer Load

6.24.1 Introduction

This device is a variation of the DC Load, and includes data specific to dimmable lights. The function of the circuit is not explicit in the DGN – there is generally no way to identify the purpose of a circuit in RV-C. The following formats apply (see Table 6.24.1).

Table 6.24.1 — DC dimmer load definition

Device attribute	Value
Category	Power components
Default Source Address	131
Dynamic Address Range	128 to 143
Instance	Multiple

Static addressing is discouraged in this product.

6.24.1.1 DC Dimmer Load (DC_DIMMER_COMMAND_2/DC_DIMMER_STATUS_3) Base Profile:

ID	Datum	Test	Required Response	Required Behavior
131A-C-01	Desired Level Command	On DC_DIMMER_COMMAND_2, send a Command=00 with Desired Level=0 or Command=03 (Off) On DC_DIMMER_COMMAND_2, send a Command=00 with Desired Level=200 or Command=01 (On) On DC_DIMMER_COMMAND_2,	DC_DIMMER_STATUS_3 reports the Operating status=0 DC_DIMMER_STATUS_3 reports the Operating status=200 DC_DIMMER_STATUS_3 reports the Operating status=the Desired Level that was set	Output shuts off Output turns on Output turns on at the Desired Level

		send a Command=00 with Desired Level of 1-199. Note: Not every instance within a DC Dimmer should be dimmed. This test only applies to outputs (instances) that specifically should be dimmed.		

6.24.2 DC Dimmer Status 1

This DGN should not be used with the Multi-Packet protocol. If multiple switches are to be reported, each should be reported in its own packet. Table 6.24.2a defines the DG attributes and Table 6.24.2b defines the signal and parameter attributes.
Unlike other loads, these products are not treated in groups. The On and Off duration control blinking. To turn a unit off, set the master brightness to zero.

Table 6.24.2a — DG definition

DG attribute	Value
Name	DC_DIMMER_STATUS_1
DGN	1FFBBh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.24.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 - Valid
1	-	Master brightness	uint8	%	see Table 5.3
2	-	Red brightness	uint8	%	see Table 5.3
3	-	Green brightness	uint8	%	see Table 5.3
4	-	Blue brightness	uint8	%	see Table 5.3
5	0 to 3	On duration	uint4	s	Precision - 1s Value range - 0 to 14 s 0 - Always on
	4 to 7	Off duration	uint4	s	Precision - 1s Value range - 0 to 14 s 0 - “One Shot” - Switch shall activate once, then stay off. Note: In case of conflicts between the Off duration and the On duration, the On duration takes priority.
6	-	White brightness	uint8	%	see Table 5.3

6.24.3 DC Dimmer Status 2

Table 6.24.3a defines the DG attributes and Table 6.24.3b defines the signal and parameter attributes. Burnt lights are not reported under the DM-RV, but through this DGN.

Table 6.24.3 — DG definition

DG attribute	Value
Name	DC_DIMMER_STATUS_2
DGN	1FFBAh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On change of fault fields
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.24.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 - Valid
1	-	Master current	uint8	A	see Table 5.3
2	-	Red current	uint8	A	see Table 5.3
3	-	Green current	uint8	A	see Table 5.3
4	-	Blue current	uint8	A	see Table 5.3
5	0 to 1	Master fault	uint2	-	00b — No fault 01b — Undercurrent (Open circuit) 10b — Overcurrent
	2 to 3	Red fault	uint2	-	00b — No fault 01b — Undercurrent (Open circuit) 10b — Overcurrent
	4 to 5	Green fault	uint2	-	00b — No fault 01b — Undercurrent (Open circuit) 10b — Overcurrent
	6 to 7	Blue fault	uint2	-	00b — No fault 01b — Undercurrent (Open circuit) 10b — Overcurrent
6	-	White Current	uint8	A	see Table 5.3
7	0 to 1	White fault	uint2	-	00b — No fault 01b — Undercurrent (Open circuit) 10b — Overcurrent
	2 to 7	Reserved	uint6	-	Reserved

6.24.4 DC Dimmer Status 3

This DGN should not be used with the Multi-Packet protocol. If multiple switches are to be reported, each should be reported in its own packet. Table 6.24.4a defines the DG attributes and Table 6.24.4b defines the signal and parameter attributes.

Table 6.24.4a – DG Definition

DG attribute	Value
Name	DC_DIMMER_STATUS_3
DGN	1FEDAh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.24.4b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 - Invalid 1 to 250 - Valid
1	-	Group	uint8	bitmap	Indicates group membership. One bit is assigned to each of seven groups. Highest bit is not used to indicate a group. If 0, the other bits refer to the groups. 0 in any other position indicates the load is a member of the corresponding group. 01111110 – Group 1 01111101 – Group 2 00000000b- All groups 11111111b- No data
2	-	Operating Status (Brightness)	uint8	%	See Table 5.3 251 = Value is changing (ramp command) 252 = Output is Flashing
3	0 to 1	Lock Status	uint2	-	00b – Load is unlocked 01b – Load is locked 11b – Lock command is not supported When locked the instance will ignore certain commands (device specific) until an unlock command is received.
	2 to 3	Overcurrent Status	uint2	-	00b – Load is not in overcurrent 01b – Load is in overcurrent 11b – Overcurrent status is unavailable or not supported
	4 to 5	Override Status	uint2	-	00b – External override is inactive 01b – External override is active 11b – Override status is unavailable or not supported When the override is active, the output has been physically changed by a user outside of the device.
	6 to 7	Enable Status	uint2	-	00b – Load is enabled. 01b – Load is disabled. 11b – Enable status is unavailable or not supported When the disable is active, it has been set through an external signal input.
4	-	Delay/Duration	uint8	Sec	Number of seconds remaining in a delayed or duration

					command. Max 240 seconds. 0 = delay/duration has expired 240 = 240 or more seconds remaining (as in the case of the minute increment values) 252 = output is flashing 253 = out of range (more than 240 seconds remaining) 255 = no delay/duration active
5	-	Last Command	uint8	-	Indicates last command (function) executed by this instance. This is the last command executed by the DC_DIMMER_COMMAND_2 See Table 6.24.4c below for a list of possible commands.
6	0 to 1	Interlock Status	uint2	-	00b – Interlock command is not active 01b – Interlock command is active 11b – Interlock command is not supported
	2 to 3	Load Status	uint2	-	00b – Operating status is zero. 01b – Operating status is non-zero or flashing, except it will be zero if the output is ramping down with a terminal value of zero.
	4 to 5	Reserved	unit2	-	Reserved
	6 to 7	Undercurrent	uint2	-	00b – Undercurrent not active 01b – Undercurrent active 10b – Undercurrent status timeout (Error) 11b – Undercurrent not supported
7	-	Master Memory Value (Last Level)	uint8	%	See Table 5.3 Note: This is the last saved brightness that, if the load is currently off, can be restored when it is enabled again.

Table 6.24.4c – Commands Possible for "Last Command"

Command	Description
0x00 – Set Brightness	Set Dimmer brightness directly to the 'desired level'
0x01 – ON	Set Dimmer brightness directly to 100%
0x02 – ON Delay	Set Dimmer brightness directly to 100% delayed by the value in 'Delay'
0x03 – OFF	Set Dimmer brightness directly to 0%.
0x04 – Stop	If ON, set brightness directly to 0%. If ramp is active, stop the brightness at its current setting.
0x05 – Toggle	Toggle brightness between 0% and 'desired value'.
0x06 – Memory OFF	Store current brightness to Master Memory Value for the instance and the set directly to 0%.
0x11 – Ramp Brightness	Ramp brightness to 'desired level'.
0x12 – Ramp Toggle	Toggle brightness between 0% and 'desired level' each time received.
0x13 – Ramp Up	Ramp brightness up from current brightness until either at 100% or a 'Stop' is received.
0x14 – Ramp Down	Ramp brightness down from current brightness until either lowest brightness is reached or a 'Stop' is received.
0x15 – Ramp Up/Down	Ramp brightness down to lowest level. Then start ramping up until 100% is reached. This continues until a 'Stop' is received.
0x21 – Lock	When received, certain commands for this instance will be ignored until an 'Unlock' is received.
0x22 – Unlock	When received, removes lock condition for the instance allowing all other commands to be recognized.
0x31 – Flash	Alternately set the output to 0% and 100%. Continue to flash until a 'Stop' is received.
0x32 – Flash Momentary	Flash output alternately to 0% and 100% once or continue only while the command is being

	repeated. Otherwise, flashing will stop.

6.24.5 DC Dimmer Command

Table 6.24.5 defines the DG attributes. The signal and parameter attributes have the same format that DC_DIMMER_STATUS_1 (see Table 6.24.5b).
If multiple loads are changed by using Instance 0 then each load should report a NAK if necessary, and DC_LOAD_STATUS .

Table 6.24.5 — DG definition

DG attribute	Value
Name	DC_DIMMER_COMMAND
DGN	1FFB9h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, DC_DIMMER_STATUS_1

Table 6.24.5b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 - Valid
1	-	Master brightness	uint8	%	see Table 5.3
2	-	Red brightness	uint8	%	see Table 5.3
3	-	Green brightness	uint8	%	see Table 5.3
4	-	Blue brightness	uint8	%	see Table 5.3
5	0 to 3	On duration	uint4	s	Precision - 1s Value range - 0 to 14 s 0 - Always on
	4 to 7	Off duration	uint4	s	Precision - 1s Value range - 0 to 14 s 0 - “One Shot” - Switch shall activate once, then stay off. Note: In case of conflicts between the Off duration and the On duration, the On duration takes priority.
6	-	White brightness	uint8	%	see Table 5.3
7	-	Ramp Time	uint8		0-250 - Full ramp time from current brightness to new brightness in 0.1 second increments (0 to 25.0 seconds)

6.24.6 DC Dimmer Command 2

Table 6.24.6a defines the DG attributes. The signal and parameter attributes are found in Table 6.24.6b.

Table 6.24.6a – DG definition

DG attribute	Value
Name	DC_DIMMER_COMMAND_2
DGN	1FEDBh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, DC_DIMMER_STATUS_3

Table 6.24.6b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	Instance number the command applies to. Valid = 1 to 250. Set to 0xFF for group commands.
1	-	Group	uint8	bitmap	see Table 6.22.2a If bit 7 = 1 and bit 6 = 0, it is a node group. Node groups support more than seven groups where multiple groups cannot be selected in one command. This is required to handle the physical grouping of multiple control instances within one node. 10000001 – Node Group 1 10111111 – Node Group 63 11111111 – For non-group commands
2	-	Desired Level (Brightness)	uint8	%	See Table 5.3 230-249 = Scene 1-20 Memory Value 250 selects the Dimmed Memory Value 251 selects the Master Memory Value
3	-	Command	uint8	-	See Table 6.24.6c for a list of possible commands and explanations.
4	-	Delay/Duration	uint8	Sec	Number of seconds to wait before executing command or the number of seconds of duration for the specified command (for duration commands) before reverting to previous state. Max 240 seconds. Additional minute increment values: 241 = 5 min 242 = 6 min . . . 250 = 14 min For Duration Commands: A value of 0 indicates a momentary command (instance will revert to previous state after 100 ms (0.1 seconds) if another command is not received). A value of 255 indicates continuous duration.

5	0 to 1	Interlock	uint2	-	00b – no Interlock active 01b – Interlock A 10b – Interlock B A command message with either interlock A or B set will not be activated until an identical message is received from a different source with the opposing interlock set.
	2 to 7	Reserved			
6	-	Ramp Time	uint8		0-250 - Full ramp time from current brightness to new brightness in 0.1 second increments (0 to 25.0 seconds)
7	-	Reserved			

Table 6.24.6c – Supported Command Descriptions

Command	Lock Support	Description
0x00 – Set Level (delay)	Yes	Set output level directly to the ‘desired level’
0x01 – ON (duration)	Yes	Set output on directly to 100%
0x02 – ON (delay)	Yes	Set output on directly to 100% delayed by the value in ‘Delay’
0x03 – OFF (delay)	Yes	Set output off directly to 0%. This can be delayed by the value in ‘Delay’ if greater than 0.
0x04 – Stop	No	If ON, set output directly to 0%. If flash is active, stop the flash and set output to off.
0x05 – Toggle	Yes	Toggle output between 0% and ‘desired level’.
0x06 – Memory OFF	Yes	Store current output state to Master Memory Value for the instance and the set directly to 0%.
0x07 – Save Scene	No	Store the current brightness to the scene memory value of the scene selected by the desired level (230-249).
0x11 – Ramp Brightness	Yes	Ramp brightness to ‘desired level’.
0x12 – Ramp Toggle	Yes	Toggle brightness between 0% and ‘desired level’ each time received.
0x13 – Ramp Up	Yes	Ramp brightness up from current brightness until either at 100% or a ‘Stop’ is received.
0x14 – Ramp Down	Yes	Ramp brightness down from current brightness until either lowest brightness is reached or a ‘Stop’ is received.
0x15 – Ramp Up/Down	Yes	Ramp brightness down to the lowest level. Then start ramping up until 100% is reached. This continues until a ‘Stop’ is received.
0x16 – Ramp Up/Down Toggle	Yes	Ramp brightness up/down to the highest/lowest level and then stop. Direction of ramp is depending of the current brightness before starting ramping.
0x21 – Lock	-	When received, certain commands for this instance will be ignored until an ‘Unlock’ is received. The commands to be locked (ignored) are device specific. In safety-critical applications, lock should not be the sole method of safety used.
0x22 – Unlock	-	When received, removes lock condition for instance allowing all other commands to be actuated.
0x31 – Flash	Yes	Alternately set the output to 0% and 100%. Delay/Duration value sets the flash period. Desired level sets the duty cycle as a percent (1-199) of the duration. For example, a duration of 30 with a brightness of 33% would be on for 10 seconds and then off for 20 seconds. Invalid brightness values (0, 255, etc) will default to 50%.
0x32 – Flash Momentary	Yes	Flash output alternately to 0% and 100% once or continue only while the

		command is being repeated at least once every 2 seconds. Otherwise, flashing will stop.

6.24.7 Service Points

As with most multiple instance devices, if the Most Significant Byte is 0 the Intermediate Byte provides the Instance associated with the failure. These are the allowable Service Points for this DGN (see Table 6.24.7).

Table 6.24.7 — Service Points

MSB	ISB	LS Bits	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	Current - Master
1	Instance	1	Current - Red
1	Instance	2	Current - Green
1	Instance	3	Current - Blue
2	Instance	0	Operating Status
3	Instance	0	Variable Control - Master
3	Instance	1	Variable Control - Red
3	Instance	2	Variable Control - Green
3	Instance	3	Variable Control - Blue

6.24.8 Test Profile

6.24.8.1 DC Dimmer Load Base Profile

(DC_DIMMER_COMMAND_2/DC_DIMMER_STATUS_3)

ID	Datum	Test	Required Response	Required Behavior
131A-C-01	Command, Desired Level	On DC_DIMMER_COMMAND_2, send a Command=00 with Desired Level=0 or Command=03 (Off)	DC_DIMMER_STATUS_3 reports the Operating status=0	Output shuts off
		On DC_DIMMER_COMMAND_2, send a Command=00 with Desired Level=200 or Command=01 (On)	DC_DIMMER_STATUS_3 reports the Operating status=200	Output turns on
		On DC_DIMMER_COMMAND_2, send a Command=00 with Desired Level of 1-199. Note: Not every instance within a DC Dimmer should be dimmed. This test only applies to outputs (instances) that specifically should be dimmed	DC_DIMMER_STATUS_3 reports the Operating status=the Desired Level that was set	Output turns on at the Desired Level

6.24.9 DC Lighting Controller Status 1

The lighting controller can still use DGN's for DC-Dimmer_Status_1. 6.24.2, DC-Dimmer_Status_3. 6.24.4, DC-Dimmer

Command 6.24.5, DC-Dimmer Command 2 6.24.6 & General Purpose Reset 6.2.1, Instance Assignment 6.2.4, Device Synchronization 6.2.5, Generic Configuration Status 6.3.2, & others.

This DGN should not be used with the Multi-Packet protocol. Table 6.24.9a defines the DG attributes and Table 6.24.9b defines the signal and parameter attributes.

Table 6.24.9a – DG definition

DG attribute	Value
Name	DC_LIGHTING_CONTROLLER_STATUS_1
DGN	1FDC2h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.24.9b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 – Valid 255 – Applies to all light instances
1	0-3	Color Fade Mode (See note 1, below)	uint4	-	0000b – Solid Color Mode, no fading 0001b = Red Fade mode – red color fades on/off 0010b = Green Fade mode – green color fades on/off 0011b = Blue Fade mode – blue color fades on/off 0100b = 4 Color Fade mode –Color fades between 4 preset colors – (White, blue, red, green) 0111b = 7 color Fade mode – Color fades between 7 preset colors – (yellow, white, cyan, blue, red, purple, green) 1000b = Custom color Fade mode – Color fades between user selected colors of tables 6.24.14b. 1111b = Enabled status is unavailable or not supported.
	4-5	Chasing Color Mode (See Note 1, below)	uint2	-	Chasing Mode – Addressable RGB (ARGB) LEDs only.

					00b – Chasing Mode disabled 01b – Chasing Mode enabled 11b - Enabled status is unavailable or not supported.
	6-7	Color Temperature Mode (See Note 1, below)	uint2	-	Color Temperature Mode- Adjust two different color LEDs to obtain the desired color temperature. 00b – Color Temperature Mode disabled 01b – Color Temperature enabled 11b - Enabled status is unavailable or not supported.
2	-	Fade Speed	uint8	ms	The RGB color or brightness value will change at the fade speed rate as it goes to the next values. Range: 1-250ms 250 = change fade value every 250ms 1 = change fade value every 1ms 0 = No fading
3	-	Fade Type	uint8	-	0 = Blend one RGB color into the next. 1= Dim RGB colors to 20% brightness then jump to next color.
4-5	-	Color Temperature Setting	uint16	°k	When in color temperature mode this is the desired color temperature setting. Precision = 1°K Range: 1°K - 65530°K Example: 3000 = 3000°k

Note 1: Either Color Fade mode, Chasing mode, or Color Temperature Mode can be active at one time. When one of these modes are enabled then the others are disabled.

6.24.10 DC Lighting Controller Status 2

This DGN should not be used with the Multi-Packet protocol. Table 6.24.10a defines the DG attributes and Table 6.24.10b defines the signal and parameter attributes.

Table 6.24.10a – DG definition

DG attribute	Value
Name	DC_LIGHTING_CONTROLLER_STATUS_2
DGN	1FDC1h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.24.10b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 – Valid

					255 – Applies to all light instances
1	-	Chasing Pattern	uint8	-	Selects the pattern of the Chasing fade: 0x00 Dots 0x01 Stripes 0x02 Custom Stripes 0x03 Rainbow 0x04 Comet 0x05 Stacking 0x06 Rainbow Dots 0x07 Wave 0x08 Wiping
2	-	Chasing Speed	uint8	%	0-100 which represents 0-100% of max chasing speed. 0 = Chasing stopped
3	-	Chasing Direction	uint8	-	0=Fade not moving, 1=Fade away from controller 2=Fade toward controller
4	-	Chasing Color Width	uint8	%	0 – invalid 1-100% of the max length of the color.

6.24.11 DC Lighting Controller Status 3

This DGN should not be used with the Multi-Packet protocol. Table 6.24.11a defines the DG attributes and Table 6.24.11b defines the signal and parameter attributes.

Table 6.24.11a – DG definition

DG attribute	Value
Name	DC_LIGHTING_CONTROLLER_STATUS_3
DGN	1FDC0h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.24.11b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 – Valid 255 – Applies to all light instances
1-2	-	Min Color Temperature	uint16	°k	Min. Color temperature of the light attached to controller. Precision = 1°K Range: 1°K - 65530°K Example: 1800 = 1800°k

3-4	-	Chasing Speed	uint16	°k	Max. Color temperature of the light attached to controller. Precision = 1°K Range: 1°K – 65530°K Example: 5000 = 5000°k
5	0-1	Color Temperature min/max switch	uint2	-	Switches the position of the current max color temperature setting with the min color temperature. For Color temperature output only. Normal connection is Red output = min color temperature. Green output = max color temperature. 00b – Set Green as max color temperature 01b – Set Red as max color temperature. 11b – Enable status is unavailable or not supported.

6.24.12 DC Lighting Controller Status 4

This DGN should not be used with the Multi-Packet protocol. Table 6.24.12a defines the DG attributes and Table 6.24.12b defines the signal and parameter attributes.

Table 6.24.12a – DG definition

DG attribute	Value
Name	DC_LIGHTING_CONTROLLER_STATUS_4
DGN	1FDBFh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.24.12b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 – Valid 255 – Applies to all light instances
1	0-1	Timer Action	uint2	-	00b –Turn off when timer expires 01b –Turn on when timer expires 11b – Enable status is unavailable or not supported.
	2-3	Timer Go	uint2	-	00b –Timer Activated and running 01b – Timer Deactivated 11b – Enable status is unavailable or not supported.
2-3	-	Timer Value	uint16	sec	1 = 1 second Will either turn on or off after time expires.

6.24.13 DC Lighting Controller Status 5

This DGN should not be used with the Multi-Packet protocol. Table 6.24.13a defines the DG attributes and Table 6.24.13b defines the signal and parameter attributes.

Table 6.24.13a – DG definition

DG attribute	Value
Name	DC_LIGHTING_CONTROLLER_STATUS_5
DGN	1FDBEh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.24.13b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 – Valid 255 – Applies to all light instances
1	0-1	External Input Enable – Light Off	uint2	-	Enable/Disable using external input control line. When activated the lights go off. 00b –Disable using external input Line 01b – Enable using external input Line 11b – Enable status is unavailable or not supported.
2	0-1	Save	uint2	-	Set to save settings. Cleared once save is completed. 00b – Value when save complete. 01b – Save settings to memory. 11b – Enable status is unavailable or not supported.
	2-3	Set to Default	uint2	-	When set it sets values to default. Cleared when complete. 00b – Value when set defaults is complete. 01b – Set default values. 11b – Enable status is unavailable or not supported.
3	0-1	Auto TX_Enable	uint2	-	When there is a change made to variables by something other than a CAN command (via Bluetooth) it will automatically transmit via CAN the status of the variable that was changed. It will transmit it only once. 00b – Disabled auto transmit.

					01b – Enable auto transmit when value changes. 11b – Enable status is unavailable or not supported.
4	0-1	Unlock Output Type	uint2	-	If available this allows for unlocking to allow changing the type 00b – Locked 01b – Unlocked. 11b – Enable status is unavailable or not supported.
	2-3	Unlock ARGB Type	uint2	-	If available this allows for unlocking to allow changing the type 00b – Locked 01b – Unlocked. 11b – Enable status is unavailable or not supported.
5	-	Output Control Type	uint2	-	This will set the Output Control type. 0 = RGB Output Control 1 = RGBW Output Control 2 = ARGB Output Control 3 = RGB Color temperature Tuning control (Red and Green outputs are used to control 2 color temperature lights) 4 = RGBW Color Temperature Tuning control uses RGB (white) with White LED to control color temperature. 5 = Single output PWM control - Uses R, G, B, and W outputs as a single output control with dimming. 6 = Relay Control - Uses R, G, B, and W outputs as a single output control with no dimming. 0x00 = OFF, 0x01 = ON
6	0-1	ARGB Type - WS2812B	uint2	-	Type of ARGB LED control is 24-bit serial WS2812B protocol. 00b – WS2812 disabled 01b – WS2812 enabled 11b - Enabled status is unavailable or not supported.
7	0-1	External Input Line Status	uint2	-	00b –External Line deactivated 01b – External Line activated 11b – Enable status is unavailable or not supported.

6.24.14 DC Lighting Controller Status 6

This DGN should not be used with the Multi-Packet protocol. Table 6.24.14a defines the DG attributes and Table 6.24.14b defines the signal and parameter attributes.

Table 6.24.14a – DG definition

DG attribute	Value
Name	DC_LIGHTING_CONTROLLER_STATUS_6
DGN	1FDBDh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.24.14b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 – Valid 255 – Applies to all light instances
1	-	Cell Index Nub	uint8	-	0 – Invalid 1-250 Cell number that the following red, green, and blue values will be stored in.
2	0-1	Cell Enable	uint2	-	Enables the color cell to be used in custom color fade. 00b – Disable Cell 01b – Enable Cell in custom color fade 11b – Enable status is unavailable or not supported.
3	-	Cell-red color	uint8	%	0-100%
4	-	Cell-green color	uint8	%	0-100%
5	-	Cell-blue color	uint8	%	0-100%

6.24.15 DC Lighting Controller Command 1

Table 6.24.15a defines the DG attributes. The signal and parameter attributes have the same format that DC_LIGHTING_CONTROLLER_STATUS_1 (see Table 6.24.15b). If requesting DGN status, bytes 1-7 should equal 0xff.

Table 6.24.15a – DG definition

DG attribute	Value
Name	DC_LIGHTING_CONTROLLER_COMMAND_1
DGN	1FDBCh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change and periodically when active

Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.24.15b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 – Valid 255 – Applies to all light instances
1	0-3	Color Fade Mode (See note 1, below)	uint4	-	0000b – Solid Color Mode, no fading 0001b = Red Fade mode – red color fades on/off 0010b = Green Fade mode – green color fades on/off 0011b = Blue Fade mode – blue color fades on/off 0100b = 4 Color Fade mode –Color fades between 4 preset colors – (White, blue, red, green) 0111b = 7 color Fade mode – Color fades between 7 preset colors – (yellow, white, cyan, blue, red, purple, green) 1000b = Custom color Fade mode – Color fades between user selected colors of tables 6.24.14b. 1111b = Enabled status is unavailable or not supported.
	4-5	Chasing Color Mode (See note 1, below)	uint2	-	Chasing Mode – Addressable RGB (ARGB) LEDs only. 00b – Chasing Mode disabled 01b – Chasing Mode enabled 11b - Enabled status is unavailable or not supported.
	6-7	Color Temperature Mode (See note 1, below)	uint2	-	Color Temperature Mode- Adjust two different color LEDs to obtain the desired color temperature. 00b – Color Temperature Mode disabled 01b – Color Temperature enabled 11b - Enabled status is unavailable or not supported.
2	-	Fade Speed	uint8	MS	The RGB color or brightness value will change at the fade speed rate as it goes to the next values. Range: 1-250ms 250 = change fade value every 250ms 1 = change fade value every 1ms 0 = No fading
3	-	Fade Type	uint8	-	Range: 0 - 250

					0 = Blend one RGB color into the next. 1= Dim RGB colors to 20% brightness then jump to next color.
4-5	-	Color Temperature Setting	uint16	°k	When in color temperature mode this is the desired color temperature setting. Precision = 1°K Range: 1°K - 65530°K Example: 3000 = 3000°k

Note 1: Either Color Fade mode, Chasing mode, or Color Temperature Mode can be active at one time. When one of these modes are enabled then the others are disabled.

6.24.16 DC Lighting Controller Command 2

Table 6.24.16a defines the DG attributes. The signal and parameter attributes have the same format that DC_LIGHTING_CONTROLLER_STATUS_2 (see Table 6.24.16b). If requesting DGN status, bytes 1-7 should equal 0xff.

Table 6.24.16a – DG definition

DG attribute	Value
Name	DC_LIGHTING_CONTROLLER_COMMAND_2
DGN	1FDBBh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.24.16b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 – Valid 255 – Applies to all light instances
1	-	Chasing Pattern	uint8	-	Selects the pattern of the Chasing fade: 0x00 Dots 0x01 Stripes 0x02 Custom Stripes 0x03 Rainbow 0x04 Comet 0x05 Stacking 0x06 Rainbow Dots 0x07 Wave 0x08 Wiping
2	-	Chasing Speed	uint8	%	0-100 which represents 0-100% of max chasing speed. 0 = Chasing stopped

3	-	Chasing Direction	uint8	-	0=Fade not moving, 1=Fade away from controller 2=Fade toward controller
4	-	Chasing Color Width	uint8	%	0 – invalid 1-100% of the max length of the color.

6.24.17 DC Lighting Controller Command 3

Table 6.24.17a defines the DG attributes. The signal and parameter attributes have the same format that DC_LIGHTING_CONTROLLER_STATUS_3 (see Table 6.24.17b). If requesting DGN status, bytes 1-7 should equal 0xff.

Table 6.24.17a – DG definition

DG attribute	Value
Name	DC_LIGHTING_CONTROLLER_COMMAND_3
DGN	1FDBAh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.24.17b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 – Valid 255 – Applies to all light instances
1-2	-	Min Color Temperature	uint16	°k	Min. Color temperature of the light attached to controller. Precision = 1°K Range: 1°K - 65530°K Example: 1800 = 1800°k
3-4	-	Chasing Speed	uint16	°k	Max. Color temperature of the light attached to controller. Precision = 1°K Range: 1°K – 65530°K Example: 5000 = 5000°k
5	0-1	Color Temperature min/max switch	uint2	-	Switches the position of the current max color temperature setting with the min color temperature. For Color temperature output only. Normal connection is Red output = min color temperature. Green output = max color temperature. 00b – Set Green as max color temperature

					01b – Set Red as max color temperature. 11b – Enable status is unavailable or not supported.

6.24.18 DC Lighting Controller Command 4

Table 6.24.18a defines the DG attributes. The signal and parameter attributes have the same format that DC_LIGHTING_CONTROLLER_STATUS_4 (see Table 6.24.18b). If requesting DGN status, bytes 1-7 should equal 0xff.

Table 6.24.18a – DG definition

DG attribute	Value
Name	DC_LIGHTING_CONTROLLER_COMMAND_4
DGN	1FDB9h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.24.18b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 – Valid 255 – Applies to all light instances
1	0-1	Timer Action	uint2	-	00b –Turn off when timer expires 01b –Turn on when timer expires 11b – Enable status is unavailable or not supported.
	2-3	Timer Go	uint2	-	00b –Timer Activated and running 01b – Timer Deactivated 11b – Enable status is unavailable or not supported.
2-3	-	Timer Value	uint16	sec	1 = 1 second Will either turn on or off after time expires.

6.24.19 DC Lighting Controller Command 5

Table 6.24.19a defines the DG attributes. The signal and parameter attributes have the same format that DC_LIGHTING_CONTROLLER_STATUS_5 (see Table 6.24.19b). If requesting DGN status, bytes 1-7 should equal 0xff.

Table 6.24.19a – DG definition

DG attribute	Value
Name	DC_LIGHTING_CONTROLLER_STATUS_5
DGN	1FDB8h
Default priority	6
Maximum broadcast gap	N/A

Normal broadcast gap	on change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	None

Table 6.24.19b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 – Valid 255 – Applies to all light instances
1	0-1	External Input Enable – Light Off	uint2	-	Enable/Disable using external input control line. When activated the lights go off. 00b –Disable using external input Line 01b – Enable using external input Line 11b – Enable status is unavailable or not supported.
2	0-1	Save	uint2	-	Set to save settings. Cleared once save is completed. 00b – Value when save complete. 01b – Save settings to memory. 11b – Enable status is unavailable or not supported.
	2-3	Set to Default	uint2	-	When set it sets values to default. Cleared when complete. 00b – Value when set defaults is complete. 01b – Set default values. 11b – Enable status is unavailable or not supported.
3	0-1	Auto TX_Enable	uint2	-	When there is a change made to variables by something other than a CAN command (via Bluetooth) it will automatically transmit via CAN the status of the variable that was changed. It will transmit it only once. 00b – Disabled auto transmit. 01b – Enable auto transmit when value changes. 11b – Enable status is unavailable or not supported.
4	0-1	Unlock Output Type	uint2	-	If available this allows for unlocking to allow changing the type 00b – Locked 01b – Unlocked. 11b – Enable status is unavailable or not supported.
	2-3	Unlock ARGB Type	uint2	-	If available this allows for unlocking to allow changing the type 00b – Locked 01b – Unlocked.

					11b – Enable status is unavailable or not supported.
5	-	Output Control Type	uint2	-	This will set the Output Control type. 0 = RGB Output Control 1 = RGBW Output Control 2 = ARGB Output Control 3 = RGB Color temperature Tuning control (Red and Green outputs are used to control 2 color temperature lights) 4 = RGBW Color Temperature Tuning control uses RGB (white) with White LED to control color temperature. 5 = Single output PWM control - Uses R, G, B, and W outputs as a single output control with dimming. 6 = Relay Control - Uses R, G, B, and W outputs as a single output control with no dimming. 0x00 = OFF, 0x01 = ON
6	0-1	ARGB Type - WS2812B	uint2	-	Type of ARGB LED control is 24-bit serial WS2812B protocol. 00b – WS2812 disabled 01b – WS2812 enabled 11b - Enabled status is unavailable or not supported.
7	0-1	External Input Line Status	uint2	-	00b –External Line deactivated 01b – External Line activated 11b – Enable status is unavailable or not supported.

6.24.20 DC Lighting Controller Command 6

Table 6.24.20a defines the DG attributes. The signal and parameter attributes have the same format that DC_LIGHTING_CONTROLLER_STATUS_6 (see Table 6.24.20b). If requesting DGN status, bytes 1 should equal the cell number requested and bytes 2-7 should equal 0xff.

Table 6.24.20a – DG definition

DG attribute	Value
Name	DC_LIGHTING_CONTROLLER_STATUS_6
DGN	1FDB7h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change and periodically when active
Minimum broadcast gap	100ms
Number of frames	1

ACK requirements	None

Table 6.24.20b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 – Valid 255 – Applies to all light instances
1	-	Cell Index Nub	uint8	-	0 – Invalid 1-250 Cell number that the following red, green, and blue values will be stored in.
2	0-1	Cell Enable	uint2	-	Enables the color cell to be used in custom color fade. 00b – Disable Cell 01b – Enable Cell in custom color fade 11b – Enable status is unavailable or not supported.
3	-	Cell-red color	uint8	%	0-100%
4	-	Cell-green color	uint8	%	0-100%
5	-	Cell-blue color	uint8	%	0-100%

6.25 Digital Inputs

6.25.1 Introduction

This could mean a momentary, rocker, push-button, or any other kind of simple discrete input. The following formats apply (see Table 6.25.1).

Table 6.25.1 — Digital inputs definition

Device attribute	Value
Category	Controls and displays
Default Source Address	68
Dynamic Address Range	144 to 159
Instance	Multiple

Static addressing is highly discouraged.
A switch or switch panel can be implemented in RV-C by two methods – “passively” or “actively”. In an “active” implementation, the switch node sends a DC_LOAD_COMMAND or similar command, directing the load with no intermediary. In a “passive” implementation, the switch sends an INPUT_STATUS DGN, which is read by the target device or an intermediary, and that device acts appropriately. Implementations may be mixed. Active implementations are generally preferred, since they allow more flexibility and complex actions.

6.25.2 Digital Input Status

Inputs are identified with an Instance, which may not correspond with any Load Instance. (In fact, a network may have many Inputs and no Loads, or vice-versa.) Table 6.25.2a defines the DG attributes and Table 6.25.2b defines the signal and parameter

attributes.
Momentary switches shall broadcast periodically when they are active, and again when the switch is released. Other types should broadcast only on change.

Table 6.25.2a — DG definition

DG attribute	Value
Name	DIGITAL_INPUT_STATUS
DGN	1FFB8h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change and periodically when active
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

Table 6.25.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Invalid 1 to 250 - Valid
1	-	Position	uint8	-	0 — Off 1 — On If multi-position, then this value shall indicate the position, with 0 always “Off”.
2	0 to 1	Configuration – Momentary	uint2	-	0 — Conventional 1 — Momentary
3	-	Number of positions	uint8	-	0, 1 — Invalid (Valid values of 2 through 255) Note: Typically 2 (off/on), though other values can be used where appropriate.
4	0 to 3	Bank Select	uint4	-	0 - 13 Each bank will support up to 250 instances. 0xF – Banking not supported in this installation
	4 to 7	Reserved	uint4	-	Reserved
5 to 7		Reserved	uint24	-	Reserved

6.25.3 Service Points

As with most multiple instance devices, if the Most Significant Byte (MSB) is zero the Intermediate Byte (ISB) provides the Instance associated with the failure. Table 6.25.4.1 lists the Service Points.

Table 6.25.4.1 — Service Points

MSB	ISB	LSb	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	Switch

6.25.4 Test Profile

Note: These test profiles only apply to passive digital input devices

6.25.4.1 Digital Input Base (Two position) Profile:

ID	Datum	Test	Required Response	Required Behavior
68A-S-01	Position	Switch Active (Momentary)	DIGITAL_INPUT_STATUS reports Position=1 (On) on change and periodically	N/A
		Switch Active (Conventional)	DIGITAL_INPUT_STATUS reports Position=1 (On) on change	N/A
		Switch Inactive	DIGITAL_INPUT_STATUS reports Position=0 (Off) on change	N/A

6.26 Generic Indicator

6.26.1 Introduction

These DGNs apply to commands that drive and control user indicators. This command can be sent from any device on the network to specify what the indicator should display. An example of this use could be a single illuminated indicator, a tell-tale cluster, or status display on a switch panel, etc.
The following formats apply (see Table 6.26.1).

Table 6.26.1 – Generic Indicator definition

Device attribute	Value
Category	Controls & Displays
Default Source Address	68
Dynamic Address Range	128-143
Instance	Multiple

Static addressing is discouraged in this product.

6.26.1.1 Generic Indicator Status

Table 6.26.1.1a defines the DG attributes and Table 6.26.1.1b defines the signal and parameter attributes.

Table 6.26.1.1a– DG Definition

DG attribute	Value
Name	GENERIC_INDICATOR_STATUS
DGN	1FED7h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change, as required
Minimum broadcast gap	250ms
Number of frames	1
ACK requirements	None

Table 6.26.1.1b - Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	Indicator instance targeted by this command. 1-250 = valid instance 0 = all instances 255 = no instances (use for group command)
1	-	Group	uint8	Bitmap	Indicates group membership. Bits 0 to 6 correspond to groups 1 to 7. A zero in one of these seven bits indicates that the command applies to that group. Bit 7 must be zero for a group command 01111110 – Group 1 01111101 – Group 2 11111111 – For non-group commands
2	-	Brightness	uint8	%	See Table 5.3 Ignored if not used by specified function.
3	0 to 3	Bank Select	uint4	uint4	0 - 13 Each bank will support up to 250 instances, An additional bank will allow support for up to 3500 instances. 0xF – Banking not supported in this installation
4	-	Delay/Duration	uint8	Sec	Number of seconds remaining in a delayed or duration command. Max 240 seconds. 0 = delay/duration has expired 253 = out of range (more than 240 seconds remaining) 255 = no delay/duration active
5	0 to 1	LED1 Status	uint2	-	00 = LED1 is off 01 = LED1 is on
	2 to 3	LED2 Status	uint2	-	00 = LED2 is off 01 = LED2 is on
	4 to 7	Reserved	uint4	-	
6	-	Last Command	uint8	-	Indicates last command (function) executed by this instance. This is the last command executed by the GENERIC_INDICATOR_COMMAND (See 6.26.3)
7	-	Reserved	uint8	-	

6.26.2 Generic Indicator Command

Table 6.26.2a defines the DG attributes and Table 6.26.2b defines the signal and parameter attributes.

Table 6.26.2a – DG Definition

DG attribute	Value
Name	GENERIC_INDICATOR_COMMAND
DGN	1FED9h
Default priority	6

Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, GENERIC_INDICATOR_STATUS

Table 6.26.2b - Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	Indicator instance targeted by this command. 1-250 = valid instance 0 = all instances 255 = no instances (use for group command)
1	-	Group	uint8	Bitmap	Bits 0 to 6 correspond to groups 1 to 7. A zero in one of these seven bits indicates that the command applies to that group. Bit 7 must be zero for a group command 01111110 – Group 1 01111101 – Group 2 11111111 – For non-group commands
2	-	Brightness	uint8	%	See Table 5.3
3	0 to 3	Bank Select	uint4	Bitmap	0 - 13 Each bank will support up to 250 instances, An additional bank will allow support for up to 3500 instances. 0xF – Banking not supported in this installation
4	-	Duration	uint8	Sec	Number of seconds of duration for the specified command, after which the instance will revert to its previous state. Max 240 seconds. Additional minute increment values: 241 = 5 min 242 = 6 min . . . 250 = 14 min 255 = Continuous command 0 = momentary command (revert to previous state if command is not repeated at least once every 2 seconds).
5	-	Reserved	uint8	-	
6	-	Function	uint8	-	0x00 – Set Brightness for both LED1 and LED2 (See below) 0x01 – LED1 Off, LED2 Off 0x02 – LED1 On, LED2 Off 0x03 – LED1 Off, LED2 On 0x04 – LED1 On, LED2 On 0x11 – Ramp Brightness from current value to new value specified in byte 2. 0x33 – Flash Alternate (alternate between LED1 on and LED on)
7	-	Reserved	uint8	-	

The set brightness command controls the general brightness of both indicator LEDs, but does not affect whether the LEDs are actually On or Off. This should be seen like a dimmer control for the indicators.

6.26.3 Test Profile

6.26.3.1 Generic Indicator Base Profile

(GENERIC_INDICATOR_COMMAND/GENERIC_INDICATOR_STATUS)

ID	Datum	Test	Required Response	Required Behavior
68A-C-01	Function Brightness	Send GENERIC_INDICATOR_COMMAND with Function = 0 (Set Brightness) and Brightness = 0xC8 (100%)	GENERIC_INDICATOR_STATUS reports Brightness = 0xC8	Expected LEDs turn on to full brightness
		Send GENERIC_INDICATOR_COMMAND with Function = 0 (Set Brightness) and Brightness = 0x00 (0%)	GENERIC_INDICATOR_STATUS reports Brightness = 0x00	Expected LEDs turn off

6.27 DC Motor Control

6.27.1 Introduction

This group of DGN's applies to devices that drive and control generic DC motor loads. As this DGN is for generic DC motor loads it may not be the most suitable for all DC motors (ex. slides, awnings, etc). Please Ensure a more suitable DGN is not available before using the generic DC motor DGN. The following formats apply (see Table 6.27.1).

Table 6.27.1 – DC Motor Control definition

Device attribute	Value
Category	Power components
Default Source Address	138
Dynamic Address Range	128-143
Instance	Multiple

Static addressing is discouraged in this product.

6.27.2 DC Motor Control Status

The following table (Table 6.27.2a) defines the DG attributes and Table 6.27.2b defines the signal and parameter attributes.

Table 6.27.2a – DG Definition

DG attribute	Value
Name	DC_MOTOR_CONTROL_STATUS
DGN	1FEE0h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change or as needed 100ms when motor operating
Minimum broadcast gap	As Needed

Number of frames	1
ACK requirements	None

Table 6.27.2b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	Valid = 1 to 250.
1	-	Group	uint8	bitmap	Indicates group membership. One bit is assigned to each of seven groups. Highest bit is not used to indicate a group. If 0, the other bits refer to the groups. 0 in any other position indicates the load is a member of the corresponding group. 01111110 – Group 1 01111101 – Group 2 00000000 - All groups 11111111 – No Data
2	-	Operating Status (Motor Duty)	uint8	%	See Table 5.3
3	0 to 1	Lock Status	uint2	-	00b – Load is unlocked 01b – Load is locked 11b – Lock command is not supported When locked, the instance will ignore certain commands (device specific) until an unlock command is received.
	2 to 3	Motor Status	uint2	-	00b — Neither 'Forward' nor 'Reverse' output is on. 01b — either 'Forward' or 'Reverse' output is on (Motor active in either direction)
	4 to 5	Forward Status	uint2	-	00b — 'Forward' output not on 01b — 'Forward' output is on
	6 to 7	Reverse Status	uint2	-	00b — 'Reverse' output not on 01b — 'Reverse' output is on
4	-	Duration	uint8	Sec	Number of seconds remaining in Duration command. Max = 240 seconds 0 = delay/duration expired 1 – 239 = seconds remaining 240 = 240 or more seconds remaining 255 = no delay/duration active
5	-	Last Command	uint8		Indicates last command (function) executed by this instance. This is the last command executed by the DC_MOTOR_CONTROL_COMMAND (DGN 1FEE1). See Table 6.27.3c below for a list of possible commands.
6	0 to 1	Overcurrent Status	uint2	-	00b — load output not in overcurrent 01b — load output has drawn overcurrent 11b – Overcurrent status is unavailable or not supported
	2 to 3	Override Status	uint2	-	00b – External override is inactive 01b – External override is active

					11b – Override status is unavailable or not supported When the override is active, the output has been physically changed by a user outside of the device.
	4 to 5	Disable1 Status	uint2	-	00b — Disable 1 is not active 01b — Disable 1 is active 11b – Disable 1 is not supported When disable 1 is active, it has been set through an external signal input.
	6 to 7	Disable2 Status	uint2	-	00b — Disable 2 is not active 01b — Disable 2 is active 11b – Disable 2 is not supported When disable 2 is active, it has been set through an external signal input.
7	-	Short Duration	uint8	ms	Resolution – 5ms Value Range – 0 to 995ms Additional time in milliseconds remaining in Duration command. To find total remaining duration, add this value to "Duration" field, byte 4 (e.g. duration of 1600ms would be byte 4 = 1, byte 7 = 120). FF if not supported/only the value in "Duration" should be read.

6.27.3 DC Motor Control Command

The following table (Table 6.27.3a) defines the DG attributes. The signal and parameter attributes are found in Table 6.27.3b.

Table 6.27.3a – DG Definition

DG attribute	Value
Name	DC_MOTOR_CONTROL_COMMAND
DGN	1FEE1h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	as needed 100 ms during momentary operation
Minimum broadcast gap	As Needed
Number of frames	1
ACK requirements	NAK, DC_MOTOR_CONTROL_STATUS

Table 6.27.3b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	Valid = 1 to 250. 0xFF for group commands.
1	-	Group	uint8	bitmap	see Table 6.27.2b If bit 7 = 1 and bit 6 = 0, it is a node group. Node groups support more then seven groups where multiple groups cannot be selected in one command. This is required to handle the physical grouping of multiple control instances within one node.

					10000001 – Node Group 1 10011111 – Node Group 31 (max for this mode) 11111111 – For non-group commands
2	-	Operating Status (Motor Duty)	uint8	%	See Table 5.3
3	-	Command	uint8	Bitmap	See Table 6.27.3c for a list of possible commands and explanations.
4	-	Duration	uint8	Sec	Number of seconds to enable motor for before stopping. Range: 1 to 240 seconds Additional minute increment values: 241 = 5 min 242 = 6 min . . . 250 = 14 min 255 = Continuous command 0 = momentary command. This command will only turn on the channel for 250 ms and therefore should be transmitted every 100 ms during operation. Duration is ignored if not supported by specified command
5	-	Interlock	uint8	Bitmap	Bit 0 – Interlock A Bit 1 – Interlock B A command message with either interlock “A” or “B” bit set to ‘1’ will not be activated until an identical message is received from a different source with the opposing interlock bit set to ‘1’. Bit 2-7 – Reserved
6	-	Reserved			
7	-	Short Duration	uint8	ms	Resolution – 5ms Value Range – 0 to 995ms Additional time in milliseconds to enable motor before stopping. To find total command duration, add this value to “Duration” field, byte 4 (e.g. duration of 2100ms would be byte 4 = 2, byte 7 = 20). FF if not supported/only the value in “Duration” should be read. If “Duration” contains a value of 0, and “Short Duration” contains a value other than 0 or FF, the value of “Short Duration” should be used as the total command duration. If “Duration” contains a value of 0, and “Short Duration” contains a value of 0 or FF, the ‘momentary command’ duration of 250ms should be used.

Table 6.27.3c – Supported Command Descriptions

Command	Description
0x04 – Stop	If motor is active in either direction, immediately stop it.
0x81 – Forward	Turn motor on in the “Forward” direction for specified duration (Controller may enforce a dead time for direction reversal)
0x41 – Reverse	Turn motor on in the “Reverse” direction for specified duration (Controller may enforce a dead time for direction reversal)

0x85 - Toggle Forward	If motor is off, turn on in the forward direction for specified duration. If motor is on in forward direction, stop it. If motor is on in reverse direction, stop it and turn on in forward direction (Controller may enforce a dead time for direction reversal).
0x45 - Toggle Reverse	If motor is off, turn on in the reverse direction for specified duration. If motor is on in reverse direction, stop it. If motor is on in forward direction, stop it and turn on in reverse direction (Controller may enforce a dead time for direction reversal).
0x10 – Tilt Forward	Output motor in the “Forward” direction in small increments for fine tuning.
0x21 – Lock	Lock instance preventing certain commands from affecting it until an “Unlock” command is received.
0x22 – Unlock	Unlock an instance that is currently locked.

6.27.4 Alarms

Alarms

Instance	Alarm
1	DC Motor started forward
2	DC Motor started reverse
3	DC Motor stopped
4	DC Motor stopped due to timeout
5	DC Motor stopped due to overcurrent
6	DC Motor locked
7	DC Motor unlocked

6.27.5 Test Profile

6.27.5.1 DC Motor Base Profile

(DC_MOTOR_CONTROL_COMMAND/DC_MOTOR_CONTROL_STATUS)

ID	Datum	Test	Required Response	Required Behavior
138A-C-01	Command	On DC_MOTOR_CONTROL_COMMAND, send Command=0x81 (Forward)	DC_MOTOR_CONTROL_STATUS reports Motor Status = 01b and Forward Status = 01b	Motor runs forward
		On DC_MOTOR_CONTROL_COMMAND, send Command=0x41 (Reverse)	DC_MOTOR_CONTROL_STATUS reports Motor Status = 01b and Reverse Status = 01b	Motor runs reverse
		While motor is active, on DC_MOTOR_CONTROL_COMMAND, send Command=0x04 (Stop)	DC_MOTOR_CONTROL_STATUS reports Motor Status = 00b, and Forward Status = 00b, and Reverse Status = 00b	Motor immediately stops

6.28 Tank Sensors

6.28.1 Introduction

This may be a single module monitoring multiple tanks, or multiple modules. The following formats apply (see Table 6.28.1). The Instances in these DGNs are specifically identified with particular tanks.

Table 6.28.1 — Tank sensors definition

Device attribute	Value
Category	Sensors
Default Source Address	72, 73
Dynamic Address Range	160 to 175
Instance	Multiple

6.28.2 Tank Status

This DGN outputs the tank level. Table 6.28.2a defines the DG attributes and Table 6.28.2b defines the signal and parameter attributes.
The Relative Tank Level is reported as a fraction, thus communicating the precision with which the sensors should be reported. This prevents a digital display from reporting “87.5%” and leaving the consumer with the impression of accuracy to three digits when the tank level sensor only reports in eighths.
When this DGN is requested, the node shall send one packet for each existing tank. This will be done by sending separate packets, not by using the Multi -Packet protocol.

Table 6.28.2a — DG definition

DG attribute	Value
Name	TANK_STATUS
DGN	1FFB7h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.28.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Fresh water 1 — Black waste (If only one waste tank is present, it shall be reported as Black.) 2 — Gray waste 3 — LPG 16 — Second fresh water 17 — Second black waste 18 — Second gray waste 19 — Second LPG

1	-	Relative level	uint8	-	Level = Relative level / Resolution
2	-	Resolution	uint8	-	-
3 to 4	-	Absolute level	uint16	l (Liter)	Precision = 1l Value range = 0 to 65 530 l
5 to 6	-	Tank size	uint16	l (Liter)	Precision = 1l Value range = 0 to 65 530 l

6.28.3 Tank Calibration

This DGN allows the calibration of the water tank sensors by defining the current level. Typically, the user would empty the tank and send this message with a level of zero, then fill the tank and send the message again with a level of "full". Some tanks may support calibrating to intermediate values, as well.

Table 6.28.3a defines the DG attributes and Table 6.28.3b defines the signal and parameter attributes.

Tank systems that use this calibration method should automatically convert the precision values. For example, if Level = 1 and Precision = 1, it should properly interpret this as 100% full, regardless of the inherent precision of the sensors.

Table 6.28.3a — DG definition

DG attribute	Value
Name	TANK_CALIBRATION_COMMAND
DGN	1FFB6h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, TANK_STATUS

Table 6.28.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Fresh water 1 — Black waste (If only one waste tank is present, it shall be reported as Black.) 2 — Gray waste 3 — LPG 16 — Second fresh water 17 — Second black waste 18 — Second gray waste 19 — Second LPG
1	-	Relative level	uint8	-	Level = Relative Level / Resolution
2	-	Resolution	uint8	-	
3 to 4	-	Absolute level	uint16	l (Liter)	Precision = 1l Value range = 0 to 65 530 l
5 to 6	-	Tank size	uint16	l (Liter)	Precision = 1 l Value range = 0 to 65 530 l

6.28.4 Tank Geometry

This DGN is for tank sensor systems that require the tank geometry to be configured into the system to be accurate. Since tanks

are not always rectangular, sensors that measure a linear depth may require this information. Also, sensor technologies that are non-linear may require some sort of similar calibration. But not all tank systems will use these DGNs. This set of DGNs is used in conjunction with the Tank Geometry Configuration DGNs.
Table 6.28.4a defines the DG attributes and Table 6.28.4b defines the signal and parameter attributes.
The report consists of a table of values, each entry of which corresponds to a specific tank level. The meaning of the data value itself is not defined. It conceivably could be a linear measurement, pressure level, ADC count – whatever might be appropriate for the specific application.

Table 6.28.4a — DG definition

DG attribute	Value
Name	TANK_GEOMETRY_STATUS
DGN	1FFB5h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	as request
Minimum broadcast gap	500 ms
Number of frames	Depends on table size
ACK requirements	None

Table 6.28.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 — Fresh water 1 — Black waste (If only one waste tank is present, it shall be reported as Black.) 2 — Gray waste 3 — LPG 16 — Second fresh water 17 — Second black waste 18 — Second gray waste 19 — Second LPG
1	-	Number of entries	uint8	-	Level = Relative level / Resolution
2	-	Point 1 – Level	uint8	-	
3	-	Point 1 – Precision	uint8	-	
4 to 5	-	Point 1 – Table value	uint16	-	Application specific interpretation
6	-	Point 2 – Level	uint8	-	
7	-	Point 2 – Precision	uint8	-	
8 to 9	-	Point 2 – Table value	uint16	-	Application specific interpretation

Additional table entries may follow in the same format. The number of entries is limited by the maximum message length to 394.

6.28.5 Tank Geometry Configuration

This DGN sets the Tank Geometry. Table 6.28.5 defines the DG attributes. The signal and parameter attributes format is the same as TANK_GEOMETRY_STATUS (see Table 6.28.4b). It is not defined in the protocol how the receiving node should handle partial table entries.

Table 6.28.5 — DG definition

DG attribute	Value

Name	TANK_GEOMETRY_COMMAND
DGN	1FFB4h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	Depends on table size
ACK requirements	NAK, TANK_GEOMETRY_STATUS

6.28.6 Service Points

As with all multi-instance nodes, if the Most Significant Byte is non-zero, the Intermediate Byte contains the Instance. Table 6.28.6 lists the Service Points.

Table 6.28.6 — Service Points

MSB	ISB	LSb	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	Absolute Level
1	Instance	1	Tank Size
1	Instance	2	Geometry Table

6.29 Water Pump

6.29.1 Introduction

Implicit in this protocol is that there is a single water pump supplying the RV. It could also be used by a pressure sensor on the fresh water system. The following formats apply (see Table 6.29.1).

Table 6.29.1 — Water pump definition

Device attribute	Value
Category	Appliances
Default Source Address	127
Dynamic Address Range	208 to 223
Instance	Single

6.29.2 Water Pump Status

Table 6.29.2a defines the DG attributes and Table 6.29.2b defines the signal and parameter attributes.

Table 6.29.2a — DG definition

DG attrib ute	Value
Name	WATER_PUMP_STATUS
DGN	1FFB3h
Default priority	6

Maximum broadcast gap	5000 ms
Normal broadcast gap	on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.29.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 1	Operating status	uint2	-	00b — Pump disabled 01b — Pump enabled (standby or running)
	2 to 3	Pump status	uint2	-	00b — Pump not running 01b — Pump running
	4 to 5	Water hookup detected	uint2	-	00b — RV is not hooked up 01b — RV is hooked to outside water source
1 to 2	-	Current system pressure	uint16	Pa	Precision = 100 Pa = 0.0145 PSI Value range = 0 to 6 553 200 Pa (0 to 950.214 PSI)
3 to 4	-	Pump pressure setting	uint16	Pa	Precision = 100 Pa = 0.0145 PSI Value range = 0 to 6 553 200 Pa (0 to 950.214 PSI)
5 to 6	-	Regulator pressure setting	uint16	Pa	Precision = 100 Pa = 0.0145 PSI Value range = 0 to 6 553 200 Pa (0 to 950.214 PSI)
7	-	Operating current	uint8	A	see Table 5.3

6.29.3 Water Pump Command

Table 6.29.3a defines the DG attributes and Table 6.29.3b defines the signal and parameter attributes.

Table 6.29.3a — DG definition

DG attribute	Value
Name	WATER_PUMP_COMMAND
DGN	1FFB2h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, WATER_PUMP_STATUS

Table 6.29.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 1	Command	uint2	-	00b – Disable pump 01b – Enable pump (standby)

1 to 2		Pump pressure setting	uint16	Pa	Precision = 100 Pa = 0,0145 PSI Value range = 0 to 6 553 200 Pa (0 to 950,214 PSI)
3 to 4		Regulator pressure setting	uint16	Pa	Precision = 100 Pa = 0,0145 PSI Value range = 0 to 6 553 200 Pa (0 to 950,214 PSI)

6.29.4 Service Points

Table 6.29.5.2 lists the allowable Service Points.

Table 6.29.5.2 — Service Points

SPN	Description
0 to 255	Standard SPNs (see Table 7.3)
256	Pump
257	Water Hookup
258	System Pressure
259	Pump Pressure Setting
260	Regulator Pressure Setting
261	Operating Power

6.29.5 Test Profiles

6.29.5.1 Water Pump Base Profile
(WATER_PUMP_COMMAND/WATER_PUMP_STATUS)

ID	Datum	Test	Required Response	Required Behavior
127A-C-01	Command	On WATER_PUMP_COMMAND, send Operating modes = 1 (pump on)	WATER_PUMP_STATUS reports Operating status = 1 (pump on)	Water Pump turns on
		On WATER_PUMP_COMMAND, send Operating modes = 0 (pump off)	WATER_PUMP_STATUS reports Operating status = 0 (pump off)	Water Pump shuts off
127A-C-01	Water hookup detected	On water connected to RV	WATER_PUMP_STATUS reports water hookup detected = 0 (water detected)	N/A
		On water disconnected from RV	WATER_PUMP_STATUS reports water hookup detected = 1 (water not detected)	N/A

6.29.5.2 Water Pump with pressure control
(WATER_PUMP_COMMAND/WATER_PUMP_STATUS)

ID	Datum	Test	Required Response	Required Behavior
127A-C-01	Pump pressure setting	Send desired pressure command to water pump	WATER_PUMP_STATUS reports correct pressure	The water pump goes to desired pressure

6.30 AutoFill

6.30.1 Introduction

The AutoFill device diverts water to the Fresh Water Tank when water is available from the hookup. Once the tank is full it then closes the diversion valve. The following formats apply (see Table 6.30.1). This is usually implemented as part of a tank sensor device.

Table 6.30.1 — Autofill definition

Device attribute	Value
Category	Appliances
Default Source Address	128
Dynamic Address Range	208 to 223
Instance	Single

6.30.2 AutoFill Status

Table 6.30.2a defines the DG attributes and Table 6.30.2b defines the signal and parameter attributes.

Table 6.30.2a — DG definition

DG attribute	Value
Name	AUTOFILL_STATUS
DGN	1FFB1h
Default priority	6
Maximum broadcast gap	5000 ms when active
Normal broadcast gap	on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.30.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 1	Operating status	uint2	-	00b - AutoFill off 01b - AutoFill on
	2 to 3	Valve status	uint2	-	00b - Diverter valve closed 01b - Valve open
	4 to 7	Last operation	uint4	-	0000b – Still running 0001b - Successful fill 0010b - Fill timed out 0011b - Fill manually aborted 0100b - Fill aborted due to error

6.30.3 AutoFill Command

Table 6.30.3a defines the DG attributes and Table 6.30.3b defines the signal and parameter attributes.

Table 6.30.3a — DG definition

DG attribute	Value
Name	AUTOFILL_COMMAND
DGN	1FFB0h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, AUTOF ILL_STATUS

Table 6.30.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 1	Command	uint2	-	00b - Stop AutoFill 01b - Start AutoFill
	2 to 3	Manual valve control	uint2	-	00b - Close valve manually 01b - Open valve Either ends the AutoFill.

6.30.4 Service Points

Table 6.30.5 lists the allowable Service Points.

Table 6.30.5 — Service Points

SPN	Description
0 to 255	Standard SPNs (see Table 7.3)
256	Valve
257	Water Supply
258	Fresh Water Tank

6.30.5 Test Profile

6.30.5.1 AutoFill Base Profile:

(AUTOFILL_COMMAND/AUTOFILL_STATUS)

ID	Datum	Test	Required Response	Required Behavior
128A-C-01	Command	On AUTOFILL_COMMAND, send Command = 1 (start autofill) On AUTOFILL_COMMAND, send Command = 0 (autofill off)	WATER_PUMP_STATUS reports Operating status = 1 (autofill on) WATER_PUMP_STATUS reports Operating status = 0 (autofill off)	Tanks autofill Tanks no longer autofill
128A-C-01	Manual Valve Control	Manual valve control = 01b (valve open)	WATER_PUMP_STATUS reports valve status = 01b (valve open)	Valve opens

		Manual valve control = 00b (valve close)	WATER_PUMP_STATUS reports valve status = 00b (valve close)	Valve closes

6.31 Waste Dump

6.31.1 Introduction

These DGs apply to an electronically controlled waste dump system. The following formats apply (see Table 6.31.1).

Table 6.31.1 — Waste dump definition

Device attribute	Value
Category	Appliances
Default Source Address	129
Dynamic Address Range	208 to 223
Instance	Single

6.31.2 Waste Dump Status

Table 6.31.2a defines the DG attributes and Table 6.31.2b defines the signal and parameter attributes.

Table 6.31.2a — DG definition

DG attribute	Value
Name	WASTEDUMP_STATUS
DGN	1FFAFh
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	on change
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

Table 6.31.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 1	Valve status - Black	uint2	-	00b - Closed 01b - Open
	2 to 3	Valve status - Gray	uint2	-	00b – Closed 01b - Open
	4 to 5	Safety lock	uint2	-	00b - Off (valves are free to open) 01b - On (valves shall not open)
1	-	Sewer hose status - Position	uint8	%	see Table 5.3 0 - Fully retracted

					200 – 100%, Fully extended (ready to dump)
2	-	Sewer hose status - Motion	uint8	-	0 - No motion 1 – Extending 2 - Retracting
3	0 to 1	Flush status - Black	uint2	-	00b – Closed 01b - Flushing
	2 to 3	Flush status - Gray	uint2	-	00b – Closed 01b - Flushing
	4 to 5	Tank additive - Black	uint2	-	00b - Additive required 01b - Additive delivered Typically the additive required value indicates that the tank has been dumped, but the automatic additive dispenser has not yet been triggered.
	6 to 7	Tank additive - Gray	uint2	-	00b - Additive required 01b - Additive delivered
4	0 to 3	Automatic dumping mode - Black	uint4	-	0000b - Manual 0001b - Automatic 0010b - Automatic, with additive
	4 to 7	Automatic dumping mode-Gray	uint4	-	0000b - Manual 0001b - Automatic 0010b - Automatic, with additive
5	-	Automatic dumping level - Black	uint8	%	see Table 5.3 Percent tank level which will trigger an automatic dump. 0 - Always open
6	-	Automatic dumping level -Gray	uint8	%	see Table 5.3 Percent tank level, which will trigger an automatic dump. 0 - Always open
7		Additive Reservoir Level	uint8	%	see Table 5.3 The level of additive remaining in the additive reservoir.

6.31.3 Waste Dump Command

Table 6.31.3a defines the DG attributes and Table 6.31.3b defines the signal and parameter attributes.

Table 6.31.3a — DG definition

DG attribute	Value
Name	WASTEDUMP_COMMAND
DGN	1FFAEh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, WASTE_DUMP_STATUS

Table 6.31.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Command - Black tank	uint8	-	0 - Close dump valve 1 - Open dump valve 2 - Stop tank flush 3 - Start tank flush 4 - Dispense additive 5 - Start Automatic Dump Cycle
1	-	Command - Gray tank	uint8	-	0 - Close dump valve 1 - Open dump valve 2 - Stop tank flush 3 - Start tank flush 4 - Dispense additive 5 - Start Automatic Dump Cycle
2	-	Command - Hose extension	uint8	-	0 - Stop extension/retraction. 1 - Begin extension. 2 - Begin retraction.
3	-	AutoDump command - Black	uint8	-	0 - End automatic mode 1 - Start automatic mode, no additive 2 - Start automatic mode, with additive
4	-	AutoDump command - Gray	uint8	-	0 - End automatic mode 1 - Start automatic mode, no additive 2 - Start automatic mode, with additive
5	-	AutoDump level - Black	uint8	%	see Table 5.3 Percent tank level, which will trigger an automatic dump. 0 - Always open
6	-	AutoDump level - Gray	uint8	%	see Table 5.3 Percent tank level, which will trigger an automatic dump. 0 - Always open

6.31.4 Service Points

Table 6.31.4 lists the allowable Service Points.

Table 6.31.4 — Service Points

SPN	Description
0 to 255	Standard SPNs (see Table 7.3)
256	Black Dump Valve
257	Gray Dump Valve
258	Hose Extension Air Valve
259	Local Control Panel
260	Remote Control Unit
261	Remote Control Receiver
262	Sewer Hose

263	Black Tank Data Source
264	Gray Tank Data Source
265	Tank Additive Dispenser

6.31.5 Test Profiles

6.31.5.1 Base Profile with Black Tank Valve
(WASTEDUMP_COMMAND/WASTEDUMP_STATUS)

ID	Datum	Test	Required Response	Required Behavior
129A-C-01	Command Black Tank	On WASTEDUMP_COMMAND, send Command - Black Tank = 1 (open dump valve)	WASTEDUMP_STATUS reports Valve status black = 1 (valve open)	Black Tank Valve opens
		On WATERDUMP, send Command - Black Tank = 0 (close dump valve)	WATERDUMP_STATUS reports valve status black =0 (valve off)	Black Tank Valve closes

6.31.5.2 Base Profile with Gray Tank Valve
(WASTEDUMP_COMMAND/WASTEDUMP_STATUS)

ID	Datum	Test	Required Response	Required Behavior
129A-C-01	Command Gray Tank	On WASTEDUMP_COMMAND, send Command - Gray Tank = 1 (open dump valve)	WASTEDUMP_STATUS reports valve status gray = 1 (valve open)	Gray Tank Valve opens
		On WATERDUMP, send Command - Gray Tank = 0 (close dump valve)	WATERDUMP_STATUS reports valve status gray =0 (valve off)	Gray Tank Valve closes

6.31.5.3 Base Profile with Black Tank Flush
(WASTEDUMP_COMMAND/WASTEDUMP_STATUS)

ID	Datum	Test	Required Response	Required Behavior
129A-C-01	Command Black Tank	On WASTEDUMP_COMMAND, send Command - Black Tank = 3 (start tank flush)	WASTEDUMP_STATUS reports flush status black = 1 (valve open)	Black Tank flush Valve open
		On WATERDUMP, send Command - Black Tank = 2 (stop tank flush)	WATERDUMP_STATUS reports flush status black =0 (valve off)	Black Tank flush Valve closes

6.31.5.4 Base Profile with Gray Tank Flush
(WASTEDUMP_COMMAND/WASTEDUMP_STATUS)

ID	Datum	Test	Required Response	Required Behavior
129A-C-01	Command	On WASTEDUMP_COMMAND,	WASTEDUMP_STATUS	Gray Tank flush Valve

	Gray Tank	send Command - Gray Tank = 3 (start tank flush)	reports flush status gray = 1 (valve open)	open
		On WATERDUMP, send Command - Gray Tank = 2 (stop tank flush)	WATERDUMP_STATUS reports flush status gray =0	Gray Tank flush Valve closes

6.31.5.5 Base Profile with additive dispense

(WASTEDUMP_COMMAND/WASTEDUMP_STATUS)

ID	Datum	Test	Required Response	Required Behavior
129A-C-01	Command Black Tank	On WASTEDUMP_COMMAND, send Command - Black Tank = 4 (start tank flush)	WASTEDUMP_STATUS reports Tank additive - Black = 01b (valve open)	Black Tank additive added

6.31.5.6 Base Profile with additive dispense

(WASTEDUMP_COMMAND/WASTEDUMP_STATUS)

ID	Datum	Test	Required Response	Required Behavior
129A-C-01	Command Gray Tank	On WASTEDUMP_COMMAND, send Command - Gray Tank = 4 (start tank flush)	WASTEDUMP_STATUS reports Tank additive - Gray = 01b (valve open)	Gray Tank additive added

6.31.5.7 Base Profile with hose extension

(WASTEDUMP_COMMAND/WASTEDUMP_STATUS)

ID	Datum	Test	Required Response	Required Behavior
129A-C-01	Command Hose extension	On WASTEDUMP_COMMAND, send Command - Hose extension = 1 (start extension)	WASTEDUMP_STATUS reports Sewer hose status motion = 1 (extension)	Gray Tank additive added Hose extends
		On WASTEDUMP_COMMAND, send Command - Hose extension = 2 (start retraction)	WASTEDUMP_STATUS reports Sewer hose status motion = 2 (retraction)	Hose retracts
		On WASTEDUMP_COMMAND, send Command - Hose extension = 0 (all stop)	WASTEDUMP_STATUS reports Sewer hose status motion = 0 (No motion)	Hose stops

6.31.5.8 Base Profile with Black tank Auto dump no additive

(WASTEDUMP_COMMAND/WASTEDUMP_STATUS)

ID	Datum	Test	Required Response	Required Behavior
129A-C-01	Command Black Tank	On WASTEDUMP_COMMAND, send AutoDump command -black = 1 (Auto dump with no additive) and send Command desired level AutoDump level - Black	WASTEDUMP_STATUS reports automatic dumping valve- black is automatic	Tank dumps when level reaches desired level
			WASTDUMP_STATUS reports AutoDump level - Black	
129A-C-01	Command	n WASTEDUMP_COMMAND, send	WASTEDUMP_STATUS	Dump cycle begins

	Black Tank	Command - Black Tank = 5 (start AutoDump cycle)	reports Flush status - black = 1 (flushing)	
		Upon completion of the dump	WASTEDUMP_STATUS reports Flush status - black = 0 (closed)	Dump cycle complete
129A-C-01	AutoDump Command Black Tank	On WASTEDUMP_COMMAND, send Command - AutoDump command -Black = 0 (auto dump off)	WASTEDUMP_STATUS reports Automatic dumping mode - Black = manual	Auto Dump off

6.31.5.9 Base Profile with Gray tank Auto dump no additive
(WASTEDUMP_COMMAND/WASTEDUMP_STATUS)

ID	Datum	Test	Required Response	Required Behavior
129A-C-01	Command Gray Tank	On WASTEDUMP_COMMAND, send AutoDump command -gray = 1 (Auto dump with no additive) and send Command desired level AutoDump level - Gray	WASTEDUMP_STATUS reports automatic dumping valve gray is automatic	Tank dumps when level reaches desired level
			WASTDUMP_STATUS reports AutoDump level - gray	
129A-C-01	Command Gray Tank	On WASTEDUMP_COMMAND, send Command - Gray Tank = 5 (start AutoDump cycle)	WASTEDUMP_STATUS reports Flush status - gray = 1 (flushing)	Dump cycle begins
		Upon completion of the dump	WASTEDUMP_STATUS reports Flush status - gray = 0 (closed)	Dump cycle complete
129A-C-01	AutoDump Command Gray Tank	On WASTEDUMP_COMMAND, send Command - AutoDump command -Gray = 0 (auto dump off)	WASTEDUMP_STATUS reports Automatic dumping mode - Gray = manual	Auto Dump off

6.32 Transfer Switch

6.32.1 Introduction

A transfer is an electrical switch that controls multiple AC input sources to a single AC output - typically two legs which may or may not be in phase.
RV-C supports up to six transfer switches, each with up to six inputs and one output of one or two legs. If additional output points are needed, then each should be considered a separate transfer switch. If only one transfer switch is installed, it should use a default Instance value of 1. The following formats apply (see Table 6.32.1).

Table 6.32.1 — Transfer switch definition

Device attribute	Value
Category	Power components
Default Source Address	79
Dynamic Address Range	128 to 143

Instance	Multiple

6.32.2 ATS AC Status

These DGNs broadcast the state of the AC power in and out of the transfer switch. One set of DGNs should be sent for each line and leg. Of course, not all switches will support all DGNs - only the supported DGNs should be broadcast.
The active input line should be broadcast every 500 ms. The inactive inputs should only be broadcast every 5000 ms, or when the DGN is requested.
Table 6.32.2a defines the DG attributes and Table 6.32.2b defines the Byte[0] - Transfer Switch Instance field. The remaining fields for the four DGNs follow the format of the four AC Point Status DGNs. See tables 6.1.2b, 6.1.3b, 6.1.4b, and 6.1.5b.

Table 6.32.2a — DG definition

DG attribute	Value
Name	ATS_AC_STATUS_1, ATS_AC_STATUS_2, ATS_AC_STATUS_3, ATS_AC_STATUS_4
DGN	1FFADh, 1FFACh, 1FFABh, 1FF85h
Default priority	3
Maximum broadcast gap	5000 ms
Normal broadcast gap	500 ms when active
Minimum broadcast gap	N/A
Number of frames	1
ACK requirements	None

Table 6.32.2b — Instance Field

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 2	Transfer Switch instance	uint3	-	1 to 6 – Valid Instances 0 & 7 – Invalid Instances
	3	Input/Output type	uint1	-	0b - Input 1b - Output
	4 to 6	Source	uint3	-	000b - Primary (for inputs, typically generator) 001b - Secondary 111b - Invalid (no data)
	7	Leg	uint1	-	0b - Leg1 1b - Leg2

6.32.3 AC Fault Configuration Status and Command

Fault Control configuration and status DGNs are defined for the transfer switch. These DGNs follow the formats as indicated in the following table.

Table 6.19.7 - DG Reference

Name	DGN	Format	Table
ATS_ACFAULT_CONFIGURATION_STATUS_1	1FF84h	AC_CONFIGURATION_STATUS_1	6.1.6
ATS_ACFAULT_CONFIGURATION_STATUS_2	1FF83h	AC_CONFIGURATION_STATUS_2	6.1.7
ATS_ACFAULT_CONFIGURATION_COMMAND_1	1FF82h	ACFAULT_CONFIGURATION_COMMAND_1	6.1.10.3
ATS_ACFAULT_CONFIGURATION_COMMAND_2	1FF81h	ACFAULT_CONFIGURATION_COMMAND_2	6.1.10.3

The status DGNs are broadcast on request. The command DGNs should be acknowledged with a NAK if necessary, and the corresponding status DGN.
If configuring one AC instance affects the configuration of other instances within the ATS, the node should respond with status

information for all affected instances.

6.32.4 ATS Status

This DGN shows which source is currently active. Table 6.32.4a defines the DG attributes and Table 6.32.4b defines the signal and parameter attributes. The Instance corresponds to the ATS Instance of the ATS_AC_STATUS DGN Instances.

Table 6.32.4a — DG definition

DG attribute	Value
Name	ATS_STATUS
DGN	1FFAAh
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	on change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.32.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 to 6 - Valid instances 0 & 7 to 255 – Invalid Instances
1	-	Source in use	uint8	-	0 - Primary 0 to 6 - Valid sources 253 - No source active
2	0 to 1	Mode	uint2	-	00b - Automatic 01b - Manual

6.32.5 ATS Command

This DGN forces the transfer switch to a certain source, or releases it to automatically select.
The Instance corresponds to the ATS Instance of the ATS_AC_STATUS DGN Instances. The Source in Use corresponds to the Source bits of that Instance field as well. If the Mode is set to Automatic, the Source to Use is ignored.
Table 6.32.5a defines the DG attributes and Table 6.32.5b defines the signal and parameter attributes. The Instance corresponds to the ATS Instance of the ATS_AC_STATUS DGN Instances.

Table 6.32.5a — DG definition

DG attribute	Value
Name	ATS_COMMAND
DGN	1FFA9h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1

ACK requirements	ATS_STATUS, NAK

Table 6.32.5b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 to 6 - Valid instances 0 & 7 to 255 – Invalid Instances
1	-	Source to use	uint8	-	0 - Primary 0 to 6 - Valid sources 253 - No source active
2	0 to 1	Mode	uint2	-	00b - Automatic 01b - Manual

6.32.6 Service Points

The Intermediate Byte of the SPN indicates the Instance of the component with a fault. For the ATS this is the Transfer Switch Instance only. Note that the AC power faults are not reported with the DM-RV. The DM-RV is reserved for failures of the ATS components. Table 6.32.8 lists the allowable Service Points.

Table 6.32.8 — Service Points

MSB	ISB	LSb	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0 to 6	Contactor. LSB indicates the input affected.
2	Instance	0 to 6	Contactor Neutral. LSB indicates the input affected.

6.32.7 Alarms

Table 6.32.7 — Alarms

Instance	Description
1	AC Source Switch Event
2	Impending AC Source Switch
3	AC Source Detected
4	AC Source Fault

6.32.8 Test Profile

6.32.8.1 Profile 79-3A: Automatic Transfer Switch (Base) Profile

Reporting

ID	Datum	Test	Required Response	Required Behavior
79-S-01	ATS_STATUS	Instance Source in Use Mode	The ATS shall broadcast this DGN at least once every 5000ms.	N/A
79-S-02	ATS_STATUS	(Automatic Mode) Supply an AC source to a higher priority input.	ATS_STATUS Source in Use = higher priority input used. GENERIC_ALARM_STATUS instance = 1	Switches to new higher priority AC Source

79-S-03	ATS_STATUS	(Automatic Mode) Supply an AC source to a lower priority input.	No Response.	Does not switch to new lower priority AC source.
79-S-04	ATS_STATUS	(Manual Mode) Supply an Ac source to higher priority input.	No Response.	Does not switch to new higher priority AC source.
79-S-05	ATS_STATUS_1	Requirements Defined in AC Point Base Profile 02A-S-01	Requirements Defined in AC Point Base Profile 02A-S-01	Requirements Defined in AC Point Base Profile 02A-S-01

Command Response

ID	Datum	Test	Required Response	Required Behavior
79-C-01	ATS_COMMAND	Set to Manual Mode: Source to Use = Desired Source Mode = 01b	ATS_STATUS Source in Use = Desired Source Mode = 01b GENERIC_ALARM_STATUS instance =1	Switches input source to the desired automatic switching.
79-C-02	ATS_COMMAND	Set to Auto Mode: Source to Use = N.A Mode = 00b	ATS_STATUS Source in Use = Source in Use Mode = 00b GENERIC_ALARM_STATUS, Instance = 1	Switches to highest priority active input and enables automatic switching.
79-C-03	ATS_COMMAND	Set to Manual Mode: Source to Use = Invalid Source Mode = 01b	Reports with an acknowledgment DG with Acknowledgment Code = NAK and the DGN Acknowledged = ATS_COMMAND	N/A

6.33 Weather Station

6.33.1 Introduction

This describes any cluster of sensors to describe ambient outdoor conditions. The following formats apply (see Table 6.33.1).

Table 6.33.1 — Weather station definition

Device attribute	Value
Category	Sensors
Default Source Address	80
Dynamic Address Range	160 to 175
Instance	Single

6.33.2 Weather Alarm Command

The purpose of this DGN is to set alarm values for WEATHER_STATUS_1 and WEATHER_STATUS_2.

Table 6.33.2a — DG definition

DG attribute	Value
Name	WEATHER_ALARM_COMMAND
DGN	1FDE0h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On change
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	WEATHER_ALARM_STATUS

Table 6.33.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0 to 1	-	Air temperature high level	uint16	°C	see Table 5.3
2 to 3	-	Air temperature low level	uint16	°C	see Table 5.3
4	-	Humidity level	uint8	%	see Table 5.3
5	-	Wind speed	uint8	kph	Precision = 1 kph Value range = 0 to 250 kph
6	-	Rain intensity	uint8	%	see Table 5.3

6.33.3 Weather Alarm Status

The purpose of this DGN is to report the alarm values which have been set by WEATHER_ALARM_COMMAND

Table 6.33.3a — DG definition

DG attribute	Value
Name	WEATHER_ALARM_STATUS
DGN	1FDE1h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On request or on change
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	None

Table 6.33.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0 to 1	-	Air temperature high level	uint16	°C	see Table 5.3

2 to 3	-	Air temperature low level	uint16	°C	see Table 5.3
4	-	Humidity level	uint8	%	see Table 5.3
5	-	Wind speed	uint8	kph	Precision = 1 kph Value range = 0 to 250 kph
6	-	Rain intensity	uint8	%	see Table 5.3

6.33.4 Weather Status 1

Table 6.33.4a defines the DG attributes and Table 6.33.4b defines the signal and parameter attributes.

Table 6.33.4a — DG definition

DG attribute	Value
Name	WEATHER_STATUS_1
DGN	1FFA5h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	5000 ms
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	None

Table 6.33.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0 to 1	-	Exterior air temperature	uint16	°C	see Table 5.3
2 to 3	-	Alternative air temperature	uint16	°C	see Table 5.3 The location of the Alternative Air Temperature is undefined, and is typically a storage bay or indoor temperature.
4 to 5	-	Absolute air pressure	uint16	mBar	Precision = 0.1 mBar Value range = 0 to 6,553 mBar
6	-	Relative humidity	uint8	%	see Table 5.3
7	0 to 1	Air temperature alarm	uint2	-	00b - Alarm Inactive 01b - Alarm Active
	2 to 3	Relative humidity alarm	uint2	-	00b - Alarm Inactive 01b - Alarm Active

6.33.5 Weather Status 2

Table 6.33.5a defines the DG attributes and Table 6.33.5b defines the signal and parameter attributes.

Table 6.33.5a — DG definition

DG attribute	Value

Name	WEATHER_STATUS_2
DGN	1FFA4h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	5000 ms
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	None

Table 6.33.5b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Wind speed	uint8	kph	Precision = 1 kph Value range = 0 to 250 kph
1 to 2		Wind direction	uint16	Deg	Precision = 1/128 Deg Value range = 0 to 359 0 - North 90 - East 180 -South 270 - West
3	-	Solar intensity	uint8	kLux	Precision = 1 kLux Value range = 0 to 250 kLux
4	-	Rain intensity	uint8	%	see Table 5.3 Exact reporting of rain intensity is not necessary. Simple systems which report either “precipitating” or “not precipitating” may report 0% for “not precipitating” and 100% for any level of precipitation they determine to be “precipitating”.
5	0 to 1	Wind speed alarm	uint2	-	00b - Alarm Inactive 01b - Alarm Active
	2 to 3	Rain alarm	uint2	-	00b - Alarm Inactive 01b - Alarm Active

6.33.6 Altimeter Status

The altimeter commonly uses the absolute air pressure reading and adjusts it to obtain a “corrected” air pressure reading and an altitude. This type of altimeter often has to be adjusted by the user.
Table 6.33.6a defines the DG attributes and Table 6.33.6b defines the signal and parameter attributes.
The Basis Pressure is the value used to calculate the altitude. The “standard” air pressure at sea level is approximately 1013 mBar. An absolute air pressure reading of 980 mBar could result on a Compensated Pressure reading of 1013 and an Altitude Basis of 980, or a Compensated Pressure of 980 and an Altitude Basis of 1013 (sea level) depending on the user input or last known altitude. (Of course it could be somewhere in between.)

Table 6.33.6a — DG definition

DG attribute	Value
Name	ALTIMETER_STATUS

DGN	1FFA3h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	5000 ms
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	None

Table 6.33.6b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0 to 1	-	Altitude compensated air pressure	uint16	mBar	Precision = 0.1 mBar Value range = 0 to 6,553 mBar
2 to 3	-	Basis air pressure for altitude	uint16	mBar	Precision = 0.1 mBar Value range = 0 to 6,553 mBar
4 to 5	-	Altitude	uint16	m	Precision = 0.1 m Offset = -500m Value range = -500 to 6,053.0 m

6.33.7 Altimeter Adjustment

This DGN allows the user to adjust the altimeter.
Table 6.33.7a defines the DG attributes and Table 6.33.7b defines the signal and parameter attributes. The first field determines the action and all of which adjust the basis and corrected pressures reported by the altimeter. They do not affect the absolute pressure reported in WEATHER_STATUS_1.

Table 6.33.7a — DG definition

DG attribute	Value
Name	ALTIMETER_COMMAND
DGN	1FFA2h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	as needed
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	NAK, ALTIMETER_STATUS

Table 6.33.7b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Command	uint8	mBar	0 - Set to sea level 1 - Set altitude compensated pressure 2 - Set altitude basis pressure 3 - Increment altitude basis pressure (decrements altitude) 4 - Decrement altitude basis pressure

					(increments altitude)
1 to 2	-	Value	uint16	mBar	Precision = 0.1 mBar Value range = 0 to 6,553 mBar

6.33.8 Weather Sensor Calibration

This DGN allows the user to calibrate the weather sensors. Table 6.33.8 defines the DG attributes. The signal and parameter attributes are defined the same as WEATHER_STATUS_1 (see Table 6.33.4b).

Table 6.33.8 — DG definition

DG attribute	Value
Name	WEATHER_CALIBRATE_COMMAND
DGN	1FFA1h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	as needed
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	NAK, WEATHER_STATUS_1

6.33.9 Service Points

Table 6.33.10 lists the Service Points.

Table 6.33.10 — Service Points

SPN	Description
0 to 255	Standard SPNs (see Table 7.3)
256	Temperature Sensor
257	Alternative Temperature Sensor
258	Humidity Sensor
259	Barometric Pressure Sensor
260	Wind Speed Sensor
261	Wind Direction Sensor
262	Rain Sensor
263	Solar Sensor
264	Altimeter

6.33.10 Test Profile

Basic Test Profile:
Weather Alarm

ID	Datum	Test	Required Response

	Alarm Configuration	Set alarm configuration level(s)	WEATHER_ALARM_STATUS reports levels set by WEATHER_ALARM_COMMAND.

Weather Status

ID	Datum	Test	Required Response
	Sensor Status	Temperature sensor service point	If present report the current value, if not present report FFh
		Alternative Temperature sensor service point	If present report the current value, if not present report FFh
		Humidity sensor service point	If present report the current value, if not present report FFh
		Barometric Pressure service point	If present report the current value, if not present report FFh
		Wind Speed sensor service point	If present report the current value, if not present report FFh
		Wind Direction sensor service point	If present report the current value, if not present report FFh
		Rain sensor service point	If present report the current value, if not present report FFh
		Solar sensor service point	If present report the current value, if not present report FFh

Altimeter Status

ID	Datum	Test	Required Response
	Status	Request current statuses	Report all available statuses

Weather Calibrate Command

ID	Datum	Test	Required Response
	Command	Send calibration command	Report all available statuses from WEATHER_STATUS_1

6.34 Compass & GPS

6.34.1 Compass & GPS Introduction

Table 6.34.1 describes Compass or GPS devices. The following formats apply (see Table 6.34.1).

Table 6.34.1 — GPS or Compass definition

Device attribute	Value
Category	Sensors
Default Source Address	136
Dynamic Address Range	160 to 175
Instance	Single

6.34.2 Compass Bearing

Table 6.34.2a defines the DG attributes and Table 6.34.2b defines the signal and parameter attributes. Electronic magnetic compasses are generally calibrated by driving the coach in a circle to allow the sensor to determine the effect of magnetic materials in the RV. The compass is put into a “calibration” mode and automatically exits when the circle is complete. In some cases the compass cannot calibrate, and the calibration mode will report as 2 (Error).

Table 6.34.2a — DG definition

DG attribute	Value
Name	COMPASS_BEARING_STATUS
DGN	1FFA0h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.34.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0 to 1	-	Adjusted compass bearing	uint16	Deg	Precision = 1/128 Deg Value range = 0 to 360 Deg 0 - North 90 - East 180 - South 270 - West
2 to 3	-	Compass offset	uint16	Deg	Precision = 1/128 Deg Value range = 0 to 360 Deg 0 - North 90 - East 180 - South 270 - West

4	0 to 1	Compass calibration status	uint2	-	00b - Compass is calibrated 01b - Compass in calibration process 10b - Error

6.34.3 Compass Calibration

Table 6.34.3a defines the DG attributes and Table 6.34.3b defines the signal and parameter attributes. This DGN uses a similar command method as ALTIMETER_COMMAND 6.33.7. If the first field is 1, 2, or 3, the second field provides the value with which to adjust the compass offset.

Table 6.34.3a — DG definition

DG attribute	Value
Name	COMPASS_CALIBRATE_COMMAND
DGN	1FF9Fh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	as needed
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	NAK, COMPASS_BEARING_STATUS

Table 6.34.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0 to 1	-	Command	uint8	-	0 - Enter self-calibration mod 1 - Set compass offset 2 - Increment compass offset 3 - Decrement compass offset
2 to 3	-	Compass offset / increment	uint16	Deg	Precision = 1/128 Deg Value range = 0 to 360 Deg 0 - North 90 - East 180 - South 270 - West

6.34.4 GPS Position

The following table (Table 6.34.4a) defines the DG attributes and Table 6.34.4b defines the signal and parameter attributes.

Table 6.34.4a — DG definition

DG attribute	Value
Name	GPS_POSITION
DGN	0FEF3h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request, or 1000 ms when in motion

Minimum broadcast gap	50 ms
Number of frames	1
ACK requirements	None

Table 6.34.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Value description
0 to 3	-	Latitude	uint32	0 = -210 Degrees bit = 0.0000001 Deg (10^-7) Positive values are Northern Hemisphere South Pole = 1,200,000,000 (-90 Deg) Equator = 2,100,000,000 (0 Deg) North Pole = 3,000,000,000 (90 Deg)
4 to 7	-	Longitude	uint32	0 = -210 Degrees bit = 0.0000001 Deg (10^-7) Prime Meridian = 2,100,000,000 (0 Deg) Negative Values are Western Hemisphere.

6.34.5 GPS Status

The following table (Table 6.34.5a) defines the DG attributes and Table 6.34.5b defines the signal and parameter attributes.

Table 6.34.5a — DG definition

DG attribute	Value
Name	GPS_STATUS
DGN	1FED3h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request, or 1000 ms when in motion
Minimum broadcast gap	50 ms
Number of frames	1
ACK requirements	None

Table 6.34.5b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0 to 1	-	Heading	uint16	Deg	1 bit = 1/128 degrees Range = 0 to 360 degrees 0 = North, 90 = East, 180 = South, 270 = West
2 to 3	-	Speed	uint16	kph	1 bit = 1/128 kph Range = 0 to 255 kph
4 to 5	-	Altitude	uint16	m	0 = -500m 1 bit = 0.1 m Range = -500 to 6053.0m
6	-	Satellites in View	uint8	-	Number of Satellites used for calculations
7	0 to 2	Fix Type	uint3	-	000b - No Fix 010b – 2D

					011b - 3D

The resolution of this DGN is adequate to identify the position of the RV to within six feet.

6.34.6 GPS Time Status

The following table (Table 6.34.6a) defines the DG attributes and Table 6.34.6b defines the signal and parameter attributes.

Table 6.34.6a — DG definition

DG attribute	Value
Name	GPS_TIME_STATUS
DGN	1FDDFh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request, or 1000 ms when in motion
Minimum broadcast gap	50 ms
Number of frames	1
ACK requirements	None

Table 6.34.6b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	UTC Year	uint8	-	0 = 2000 AD
1	-	UTC Month	uint8	-	0 = Invalid 1-12 = January, etc..
2	-	UTC Day	uint8	-	0 = Invalid 1-31 = Current Day UTC
4	-	UTC Hour	uint8	-	0-23
5	-	UTC Minute	uint8	-	0-59
6	-	UTC Second	uint8	-	0-59
7	-	Horizontal dilution of precision (HDOP)	uint8	-	Indication of accuracy, the higher the number the worse the accuracy. 0 = 0 1 bit = 0.5 Range = 0 - 127.5

6.34.7 Compass Service Points

Table 6.34.7 lists the Service Points.

Table 6.34.7 — Service Points

SPN	Description
0 to 255	Standard SPNs (see Table 7.3)
256	Compass - X Sensor
257	Compass - Y Sensor

6.34.8 GPS Service Points

Table 6.34.8 lists the Service Points.

Table 6.34.8 — Service Points

SPN	Description
0 to 255	Standard SPNs (see Table 7.3)

6.34.9 Alarms

Table 6.34.9 - Alarms

Alarm Instance	Description
1	Compass not Calibrated

6.34.10 Test Profiles

6.34.10.1 Compass

ID	Datum	Test	Response
	COMPASS_BEARING_STATUS	On DGN request or on change	Report compass heading statuses

6.34.10.2 GPS

ID	Datum	Test	Response
	GPS_POSITION GPS_STATUS GPS_TIME_STATUS	If there is a lock type present on GPS_STATUS	Available GPS data is reported

6.35 Automatic Generator Start

6.35.1 Introduction

Automatic Generator Start products have two responsibilities in an RV-C network. Whereas it possible to start the generator by using the GENERATOR_COMMAND DGN, there are no provisions within that DGN for dealing with multiple devices that wish to control the generator. One device may shut down the generator even as another device needs it to be on. This is generally not acceptable.

Products that wish to control the generator should first check to see whether an Automatic Generator Start device is present. It should only use the GENERATOR_COMMAND if no device supporting AUTO_GENERATOR_COMMAND is available. The following formats apply (see Table 6.35.1).

Table 6.35.1 — Device definition

Device attribute	Value
Category	Power components
Default Source Address	65
Dynamic Address Range	128 to 143
Instance	Single

The AGS Controller (not to be confused with the Generator Controller, which controls the start and stop logic for the generator) can be considered in two parts. First, it is a device similar in structure to the Chassis Mobility Control that maintains a list of devices that desire the generator to be on. It turns the generator on and off according to demand. Secondly, it may have its own internal criteria for starting and stopping the generator for a variety of purposes.

6.35.2 Generator Demand Status

This DGN allows products to determine the status of generator demand. Note that this is not the same as generator run status - the generator may be running or not, regardless of demand. This DGN also indicates whether there is demand for generator power from this system. The flags in the first byte indicate whether demand exists, and whether external activity is overriding the demand. Generally an external stop should take precedence over the network or internal demand. Such a stop may be a manual stop, for example for service, or caused by a generator failure. This flag may be reset by the next DGN, or by some automatic means.
Table 6.35.2a defines the DG attributes and Table 6.35.2b defines the signal and parameter attributes.

Table 6.35.2a — DG definition

DG attribute	Value
Name	GENERATOR_DEMAND_STATUS
DGN	1FF80h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.35.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 1	Generator demand	uint2	-	00b - No demand for generator 01b - Generator is demanded
	2 to 3	Internal generator demand	uint2	-	00b - No internal demand 01b - Internal AGS criterion is demanding generator
	4 to 5	Network generator demand	uint2	-	00b - No demand from other network nodes 01b - Network device is demanding generator
	6 to 7	External activity detected	uint2	-	00b - Automatic starting is allowed 01b - Automatic starting is disabled due to the detection of external activity
1	0 to 1	Manual override detected	uint2	-	00b - Normal Operation 01b - Manual Override
	2 to 3	Quiet time	uint2	-	00b - Unit is not in Quiet Time 01b - Unit is in Quiet Time
	4 to 5	Quiet time override	uint2	-	00b - Normal operation 01b - Quiet Time is being overridden
	6 to 7	Generator lock	uint2	-	00b - Normal operation 01b - Genset is locked. Node will not start generator for any reason
2	-	Quiet time begin hour DEPRECATED in favor of implementing Quiet Time using	uint8	h	Precision = 1 h Value range = 0 to 23 h 0 - 12:00AM 11 - 11:00AM

		AGS_CRITERION_STATUS/COMMAND			12 - 12:00 PM 23 - 11:00PM This should be Local Time.
3	-	Quiet time begin minute DEPRECATED	uint8	min	Precision = 1 min Value range = 0 to 59 min
4	-	Quiet time end hour DEPRECATED	uint8	h	Precision = 1 h Value range = 0 to 23 h 0 - 12:00AM 11 - 11:00AM 12 - 12:00 PM 23 - 11:00PM This should be Local Time.
5	-	Quiet time end minute DEPRECATED	uint8	min	Precision = 1 min Value range = 0 to 59 min
6	-	Minimum cycle time	uint8	min	Precision = 1 min Value range = 0 to 250 min 0 - No minimum. Minimum time generator will be run.

6.35.3 Generator Demand Command

This DGN allows devices to indicate their need for generator power. Devices that use this DGN must also support the request for this DGN. Before stopping the generator, the controller may poll devices for this DGN, and if any device indicates it demands power it should not stop the generator.
Note that this DGN is not the same as GENERATOR_COMMAND. That DGN starts or stops the generator without regard to Quiet Time or other demands upon the generator. If this DGN is implemented in the network it should be used in preference to GENERATOR_COMMAND. That DGN should be used only for testing and by the AGS controller itself.
The AGS controller may also maintain a list of devices that have demanded power, and base its decision on that list rather than polling the network. Either scheme is acceptable in RV-C, so products may use either or both methods.
Table 6.35.3a defines the DG attributes and Table 6.35.3b defines the signal and parameter attributes. If the AGS is in Quiet Time, the ACK should return a value of 3 (“Conditions do not allow command to be implemented”). The use of NAK 7 (“More time required to reply”) has been deprecated - formerly it could be used if the AGS is programmed to start the genset at the end of quiet time. If the AGS has detected external activity that takes precedence, then a value of 8 (“User override has priority”) should be returned. If the generator has a known fault, then it should return a 3.

Table 6.35.3a — DG definition

DG attribute	Value
Name	GENERATOR_DEMAND_COMMAND
DGN	1FEFFh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, GENERATOR_DEMAND_STATUS

Table 6.35.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 1	Generator demand	uint2	-	00b - No demand for generator 01b - Generator power is demanded
	2 to 3	Quiet time override	uint2	-	00b - Normal operation 01b - Override Quiet Time
	4 to 5	Clear External activity Flag	uint2	-	00b - No action. 01b - Clear External Activity flag.
	6 to 7	Manual override	uint2	-	00b - Normal operation 01b - Override other demand/criteria.
1	0 to 1	Generator lock	uint2	-	00b - Normal operation 01b - Generator is locked.
	2 to 3	Set External Activity Flag	uint2	-	00b - No action. 01b - Set External Activity flag.
2	-	Set quiet time begin hour DEPRECATED in favor of implementing Quiet Time using AGS_CRITERION_STATUS/COMMAND	uint8	h	Precision = 1 h Value range = 0 to 23 h 0 - 12:00AM 11 - 11:00AM 12 - 12:00 PM 23 - 11:00PM This should be Local Time.
3	-	Set quiet time begin minute DEPRECATED	uint8	min	Precision = 1 min Value range = 0 to 59 min
4	-	Set quiet time end hour DEPRECATED	uint8	h	Precision = 1 h Value range = 0 to 23 h 0 - 12:00AM 11 - 11:00AM 12 - 12:00 PM 23 - 11:00PM This should be Local Time.
5	-	Set quiet time end minute DEPRECATED	uint8	min	Precision = 1 min Value range = 0 to 59 min
6	-	Set minimum cycle time	uint8	min	Precision = 1 min Value range = 0 to 250 min Minimum time generator will be run.

If the Manual Override and Demand flags are set, the AGS shall run until another command is sent with the Manual Override, or until Quiet Time. If the Quiet Time override is set, then only another command will stop the generator.

6.35.4 AGS Criterion Status

This DGN shows the status of an internal AGS criterion and is multi-instance. The protocol assumes that only one AGS product is in the network and there are no provisions for multiple devices.
Table 6.35.4a defines the DG attributes and Table 6.35.4b defines the signal and parameter attributes. If requested, the device should report this DGN once for each internal criterion. This should not be done using the multi -packet DGN, but by repeated broadcasts of this DGN. (This will make it easier to ensure that future versions of this DGN are backwards-compatible.)
Unlike most DGNs, the format for this DGN is different for different types of criteria. Byte 3 must be examined to determine how to parse the rest of the packet.
It is likely that additional formats will be added to the RV-C protocol over time.

Table 6.35.4a — DG definition

DG attribute	Value
Name	AGS_CRITERION_STATUS

DGN	1FEFEh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on request
Minimum broadcast gap	100 ms
Number of frames	1 (repeated as necessary for each criterion)
ACK requirements	None

Table 6.35.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	see Table 5.3
1	0 to 1	Current demand status	uint2	-	00b - Not demanding generator now 01b - Currently demanding generator
	2 to 3	Active status	uint2	-	00b - Currently inactive 01b - Active (Shall generate demand as appropriate.)
2	-	Criterion type	uint8	-	0 - DC voltage 1 - DC state of charge 2 - DC current 3 - Ambient temperature 4 - Transfer switch AC point voltage 5 - Quiet Time 6 - Timed Start 7 – Air Conditioning 128 to 250 - Proprietary

If Criterion Type = 0 (DC voltage)

Byte	Bit	Name	Data type	Unit	Value description
3	-	DC instance	uint8	-	Instance of DC source being monitored
4 to 5	-	DC voltage threshold	uint16	V	see Table 5.3
6	-	Time under threshold	uint8	min	Precision = 0.1 min Value range = 0.0 to 25.0 min 0 - No minimum Indicates amount of time below the threshold before triggering demand.

If Criterion Type = 1 (DC state of charge)

Byte	Bit	Name	Data type	Unit	Value description
3	-	DC instance	uint8	-	Instance of DC source being monitored
4	-	DC State of Charge Start Threshold	uint8	%	see Table 5.3
5	-	DC State of Charge Stop Threshold	uint8	%	see Table 5.3
6	-	Time under threshold	uint8	min	Precision = 0.1 min Value range = 0.0 to 25.0 min

					0 — No minimum Indicates amount of time below the threshold before triggering demand.

If Criterion Type = 2 (DC current)

Byte	Bit	Name	Data type	Unit	Value description
3	-	DC Instance	uint8	-	Instance of DC Source being monitored
4 to 5	-	DC Current Threshold	uint16	A	see Table 5.3
6	-	Time over Threshold	uint8	min	Precision = 0.1 min Value range = 0.0 to 25.0 min 0 — No minimum Indicates amount of time below the threshold before triggering demand.

If Criterion Type = 3 (Ambient temperature)

Byte	Bit	Name	Data type	Unit	Value description
3	-	Thermostat ambient instance	uint8	-	Thermostat Instance being monitored.
4 to 5	-	Ambient temperature threshold	uint16	*C	see Table 5.3
6	-	Time under threshold	uint8	min	Precision = 0.1 min Value range = 0.0 to 25.0 min 0 — No minimum Indicates amount of time below the threshold before triggering demand.

If Criterion Type = 4 (Transfer switch AC point voltage)

Byte	Bit	Name	Data type	Unit	Value description
3	-	ATS instance	uint8	-	ATS AC Point being monitored. See ATS_AC_STATUS.
4 to 5	-	RMS voltage threshold	uint16	Vac	see Table 5.3
6	-	Time under threshold	uint8	min	Precision = 0.1 min Value range = 0.0 to 25.0 min 0 — No minimum Indicates amount of time below the threshold before triggering demand.

If Criterion Type = 5 (Quiet Time)

Byte	Bit	Name	Data type	Unit	Value description
3	-	Reserved	uint8	-	Reserved
4	-	Quiet Time Begin Hour	uint8	Hour	0 = 12:00 AM 12 = Noon 23 = 11:00 PM 24 to 255 = Undefined This should be Local Time
5		Quiet Time Begin Minute	uint8	Minute	Value Range = 0 - 59
6	-	Quiet Time End Hour	uint8	Hour	0 = 12:00 AM 12 = Noon 23 = 11:00 PM 24 to 255 = Undefined

					This should be Local Time
7		Quiet Time End Minute	uint8	Minute	Value Range = 0 - 59

If Criterion Type = 6 (Timed Start)

Byte	Bit	Name	Data type	Unit	Value description
3	-	Reserved	uint8	-	Reserved
4	-	Time Begin Hour	uint8	Hour	0 = 12:00 AM 12 = Noon 23 = 11:00 PM 24 to 255 = Undefined This should be Local Time
5	-	Time Begin Minute	uint8	Minute	Value Range = 0 - 59
6 to 7	-	Run Time	uint16	Minute	0 = Disable 1-1439 = Minutes to run genset.

If Criterion Type = 7 (Air Conditioning)

Byte	Bit	Name	Data type	Unit	Value description
3	-	Air Conditioner Instance	uint8	-	0- 250 Instance of Air Conditioner triggering demand.

6.35.5 AGS Criterion Status 2

This DGN provides additional AGS status information in parallel with the AGS_CRITERION_STATUS DGN. Like that DGN, the format of this DGN varies with the type of AGS criterion.

Table 6.35.5a — DG definition

DG Attribute	Value
Name	AGS_CRITERION_STATUS_2
DGN	1FED2h
Default Priority	6
Maximum Broadcast gap	N/A
Normal Broadcast gap	On Change or On Request
Minimum Broadcast gap	1000 ms
Number of Frames	1
ACK Requirements	None

Table 6.35.5b — DG definition

Byte	Name	Data Type	Definition
0	Instance	uint8	
1	Criterion Type	uint8	See AGS_CRITERION_STATUS, Byte 2.

If Criterion Type = 0 (DC Voltage), 1 (DC State of Charge), 2 (DC Current), 3 (Ambient Temperature), 4 (Transfer Switch AC Point Voltage)

Byte	Name	Data Type	Unit	Definition
2 to 3	Time-Under Counter	uint16	Sec	Counter indicating the amount of time the measured value

				has been below (above) the target value. When the time-under threshold is exceeded, the criterion will activate demand. 0 = Measured value is above (below)target value.

6.35.6 AGS Criterion Command

This allows the creation, deletion, or changing of AGS criteria. The format is generally the same as AGS_CRITERION_STATUS. This DGN also provides a method of querying the status of a specific instance without triggering a packet for each current Instance.

Table 6.35.6a defines the DG attributes and Table 6.35.6b defines the signal and parameter attributes. To query the status of an Instance set all data bytes other than the Instance to 255 (0xFF). If the Instance does not exist in the AGS criteria list, it should respond with a NAK and a return value of 5 (“Request Out of Range”).

Note the difference in data byte 2. Data bytes 4 through 8 are determined by the Criterion Type, and are of the same formats listed above for AGS_CRITERION_STATUS.

Table 6.35.6a — DG definition

DG attribute	Value
Name	AGS_CRITERION_COMMAND
DGN	1FEFDh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, GENERATOR_DEMAND_STATUS (only for indicated instances)

Table 6.35.6b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	see Table 5.3
1	0 to 1	Command	uint2	-	00b - Add or edit this criterion 01b - Delete this criterion
	2 to 3	Active status	uint2	-	00b - Deactivate criterion 01b - Activate criterion
2	-	Criterion type	uint8	-	0 - DC voltage 1 - DC state of charge 2 - DC current 3 - Ambient temperature 4 - Transfer switch AC point voltage 5 – Quiet Time 6 – Timed Start 128 to 250 - Proprietary

6.35.7 AGS Demand Configuration Status

The disable flags in this DGN indicate whether the AGS is configured to automatically disable all demands in response to various

inputs. Generally, if one of these flags is set and the indicated condition is ever satisfied the AGS will automatically disable all AGS Criteria. The AGS will not be re-enabled without user intervention. These flags do not indicate whether those inputs are currently active. These flags are intended primarily to allow OEMs and service technicians to view, test, and possibly modify the safety interlocks implemented in the AGS.
Due to an oversight, the same DGN was defined twice, as GENERATOR_DEMAND_CONFIGURATION_STATUS and AGS_DEMAND_CONFIGURATION_STATUS. The AGS_DEMAND_CONFIGURATION_STATUS (1FED5h) is preferred going forward, but devices implementing this message should support both to prevent incompatibilities with legacy products.

Table 6.35.7a — DG definition

DG attribute	Value
Name	GENERATOR_DEMAND_CONFIGURATION_STATUS AGS_DEMAND_CONFIGURATION_STATUS
DGN	1FEE7h 1FED5h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.35.7b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 1	Disable on Park Brake Release	uint2	-	00 = Inactive 01 = Active
	2 to 3	Disable on Ignition	uint2	-	00 = Inactive 01 = Active
	4 to 5	Disable on Drive	uint2	-	00 = Inactive 01 = Active
	6 to 7	Disable on Motion	uint2	-	00 = Inactive 01 = Active
1	0 to 1	Disable on OEM Switch	uint2	-	00 = Inactive 01 = Active
	2 to 3	Disable on Service Brake	uint2	-	00 = Inactive 01 = Active
	4 to 5	Disable on Monoxide Detect	uint2	-	00 = Inactive 01 = Active
	6 to 7	Disable on Opened Compartment	uint2	-	00 = Inactive 01 = Active
2	0 to 1	Disable on Fire Alarm	uint2	-	00 = Inactive 01 = Active
	2 to 3	Disable on Manual Operation	uint2	-	00 = Inactive 01 = Active
	4 to 5	Disable on Genset Fault	uint2	-	00 = Inactive 01 = Active
	6 to 7	Disable on System Fault	uint2	-	00 = Inactive 01 = Active
3	0 to 1	Disable on Shore Power	uint2	-	00 = Inactive 01 = Active
	2 to 3	Disable on 50 Amp Shore	uint2	-	00 = Inactive

					01 = Active
4		Disable AGS After Time Span	uint8	days	range = 0 to 250 days 0 = AGS is not automatically disabled
5		Days Remaining Before Automatic Disabling	uint8	days	range = 0 to 250 days 0 = AGS is not automatically disabled

6.35.8 AGS Demand Configuration Command

The command to configure the conditions for disabling the AGS system is provided in Table 6.35.8a and 6.35.8b.
Due to an oversight, the same DGN was defined twice, as GENERATOR_DEMAND_CONFIGURATION_COMMAND and AGS_DEMAND_CONFIGURATION_STATUS. The AGS_DEMAND_CONFIGURATION_ COMMAND (1FED4h) is preferred going forward, but devices implementing this message should support both to prevent incompatibilities with legacy products.

Table 6.35.8a — DG definition

DG attribute	Value
Name	GENERATOR_DEMAND_CONFIGURATION_COMMAN D AGS_DEMAND_CONFIGURATION_COMMAND
DGN	1FEE6h 1FED4h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, GENERATOR_DEMAND_CONFIGURATION_STATUS or AGS_DEMAND_CONFIGURATION_STATUS

Table 6.35.8b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 1	Disable on Park Brake Release	uint2	-	00 = Inactive 01 = Active
	2 to 3	Disable on Ignition	uint2	-	00 = Inactive 01 = Active
	4 to 5	Disable on Drive	uint2	-	00 = Inactive 01 = Active
	6 to 7	Disable on Motion	uint2	-	00 = Inactive 01 = Active
1	0 to 1	Disable on OEM Switch	uint2	-	00 = Inactive 01 = Active
	2 to 3	Disable on Service Brake	uint2	-	00 = Inactive 01 = Active
	4 to 5	Disable on Monoxide Detect	uint2	-	00 = Inactive 01 = Active
	6 to 7	Disable on Opened Compartment	uint2	-	00 = Inactive 01 = Active
2	0 to 1	Disable on Fire Alarm	uint2	-	00 = Inactive 01 = Active
	2 to 3	Disable on Manual Operation	uint2	-	00 = Inactive 01 = Active

	4 to 5	Disable on Genset Fault	uint2	-	00 = Inactive 01 = Active
	6 to 7	Disable on System Fault	uint2	-	00 = Inactive 01 = Active
3	0 to 1	Disable on Shore Power	uint2	-	00 = Inactive 01 = Active
	2 to 3	Disable on 50 Amp Shore	uint2	-	00 = Inactive 01 = Active
4		Disable AGS After Time Span	uint8	days	range = 0 to 250 days 0 = AGS is not automatically disabled

6.35.9 Service Points

As with most multiple instance devices, if the Most Significant Byte (MSB) is non-zero the Intermediate Byte (ISB) provides the Instance associated with the failure. Table 6.35.9 lists the Service Points.

Table 6.35.9 — Service Points

MSB	ISB	LSb	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
	32	0	Generator (This indicates the generator is not responding as desired. The Generator or Generator Start Controller should be queried for more details.)
1	Instance	0	Invalid Configuration
	Instance	1	Data Not Available

6.35.10 Alarms

All Alarms use DSA 65 - Genstart Controller

Alarm Instance	Description
1	AGS is attempting to start the genset.
2	AGS is attempting to stop the genset.
3	Manual Demand triggered
4	Manual Demand ended
5	External Activity detected
6	External Activity cleared.
7	Network Demand detected
8	No Network Demand detected
9	Conditions require the AGS to ignore a demand.
10	Conditions require the AGS to ignore the end of a demand.
64	DC Voltage Criterion - Demand Triggered
65	DC State of Charge Criterion - Demand Triggered

66	DC Current Criterion - Demand Triggered
67	Ambient Temperature Criterion - Demand Triggered
68	Transfer Switch AC Point - Demand Triggered
69	Entering Quiet Time
70	Timed Start - Demand Triggered
71	Air Conditioning - Demand Triggered
95	Proprietary Criterion - Demand Triggered
96	DC Voltage Criterion - Demand Ended
97	DC State of Charge Criterion - Demand Ended
98	DC Current Criterion - Demand Ended
99	Ambient Temperature Criterion - Demand Ended
100	Transfer Switch AC Point - Demand Ended
101	Leaving Quiet Time
102	Timed Start - Demand Ended
103	Air Conditioning - Demand Ended
127	Proprietary Criterion - Demand Ended
128	DC Voltage Criterion - Configuration Changed
129	DC State of Charge Criterion - Configuration Changed
130	DC Current Criterion - Configuration Changed
131	Ambient Temperature Criterion - Configuration Changed
132	Transfer Switch AC Point - Configuration Changed
133	Quiet Time - Configuration Changed
134	Timed Start - Configuration Changed
135	Air Conditioning - Configuration Changed
159	Proprietary Criterion - Configuration Changed
160	DC Voltage Criterion - Enabled
161	DC State of Charge Criterion - Enabled
162	DC Current Criterion - Enabled
163	Ambient Temperature Criterion - Enabled
164	Transfer Switch AC Point - Enabled
165	Quiet Time - Enabled
166	Timed Start - Enabled
167	Air Conditioning - Enabled

191	Proprietary Criterion - Enabled
192	DC Voltage Criterion - Disabled
193	DC State of Charge Criterion - Disabled
194	DC Current Criterion - Disabled
195	Ambient Temperature Criterion - Disabled
196	Transfer Switch AC Point - Disabled
197	Quiet Time - Disabled
198	Timed Start - Disabled
199	Air Conditioning - Disabled
223	Proprietary Criterion - Disabled

6.35.11 Test Profiles

6.35.11.1 Profile 65B: AGS Base Profile

Prerequisites: None

Note: Starting and Stopping the Genset

The AGS device may be implemented either as a device independent of the generator or as an integrated generator/autogenstart controller. In the former case, to start or stop the generator is to send the RV-C command GENERATOR_COMMAND, with the appropriate value in the Command field. In the latter case, to start or stop the generator involves the direct physical control of generator components. In the latter case testing may be done with a simulated generator, as long as the simulator can simulate all conditions required in the tests.

Note that the genset or AGS controller may have a built-in dwell time to prevent the rapid cycling of generator starts and stops. For the purpose of these tests, this dwell time enforcement shall be disabled or the tests shall be timed to avoid conflicts with the dwell timer. Dwell support in the AGS controller is tested under its own test profile.

It is possible for an AGS controller to not implement any AGS Criteria - depending on networked sources entirely for demand triggers. If the AGS controller implements any demand triggers internally, each trigger must satisfy at least an AGS Criterion profile, supporting the AGS_CRITERION_COMMAND and _STATUS messages accordingly. All sources of AGS demand must be controlled through these messages, ensuring that at a minimum, ensuring that all criteria can be enabled and disabled and their type and demand status determined. It is not necessary for all criteria to satisfy a specific criterion profile by type, and proprietary profiles are acceptable.

A complete test for the support for multiple demand criteria could require a prohibitively time-consuming and complex process, and it may not be possible to test all sequences in which AGS criteria can begin and end demand. To enable a reasonably comprehensive test, the product vendor must provide a suitable test sequence. The sequence must be such that all criteria supported by the product appear in at least one test step in which the criterion starts demand when at least one other criterion has demand and subsequently all other demand sources end (thus demonstrating that the criterion can maintain overall demand), and at least one test step in which the criterion ends demand when at least one other criterion has demand (thus demonstrating that the criterion can relinquish control properly.) If the product supports network demand, network demand must be tested in the same manner as the internal criteria.

ID	Datum	Test	Required Response
65B-S-01	Generator Demand Status	Unit is powered up, no commands	GENERATOR_DEMAND_STATUS is

		sent	broadcast every 5 sec. Generator Demand is 00b (No Demand). Internal Demand is 00b (No Demand), Manual Override Detected is 00b (Normal), External Activity is 00b (No Activity)
65B-S-02	Generator Demand Status	Generator is started by an non-RV-C mechanism, or by GENERATOR_COMMAND.	GENERATOR_DEMAND_STATUS is broadcast immediately, and subsequently every 5 sec. Generator Demand is 00b (No Demand), Internal Demand is 00b (No Demand), Manual Override Detected is 01b (Manual), External Activity is 01b (Disabled)
65B-S-03	Generator Demand Status	With the genset running due to any automatic trigger, the generator is stopped by an non-RV-C mechanism, or by GENERATOR_COMMAND.	GENERATOR_DEMAND_STATUS is broadcast immediately, and subsequently every 5 sec.Generator Demand is 01b (Demand), Manual Override Detected is 00b (Normal), External Activity is 01b (Disabled). If any internal AGS Criteria have demand, Internal Demand is 01b (Demand), otherwise it is 00b (No Demand).
65B-S-04	AGS_CRITERION_STATUS/COMMAND	All AGS Criteria supported by the product must meet an AGS Criterion profile as noted above.	All broadcasts of GENERATOR_DEMAND_STATUS include Internal Demand, which is set to 01b (Demand) when any criterion has demand, and 00b (No Demand) otherwise.

Command Response:

ID	Datum	Test	Required Response	Required Behavior
65B-C-01	Generator Demand - Manual Run	With genset off, GENERATOR_DEMAND_COMMAND is sent with Generator Demand 01b (On), Manual Override 01b (Manual Operation)	GENERATOR_DEMAND_STATUS, with Generator Demand 01b (On), Manual Override 01b (Manual), External Activity is 01b (Disabled). GENERIC_ALARM_STATUS, Instance 3 (Manual Start Rcvd), GENERIC_ALARM_STATUS, Instance 1 (Attempting to Start)	The product attempts to start the genset. See notes above.

65B-C-02	Generator Demand - Manual Stop	With genset running, with Manual Override 01b (Manual), GENERATOR_DEMAND_COMMAND is sent with Generator Demand 00b (Off), Manual Override 01b (Manual Operation)	GENERATOR_DEMAND_STATUS, with Generator Demand 00b (On), Manual Override 01b (Manual), External Activity is 01b (Disabled), GENERIC_ALARM_STATUS, Instance 4 (Manual Stop Rcvd), GENERIC_ALARM_STATUS, Instance 2 (Attempting to Stop)	The product attempts to stop the genset. See notes above.
65B-C-03	Clearing External Activity	With External Activity flag 01b (Activity Detected), send GENERATOR_DEMAND_COMMAND, Clear External Activity Flag = 01b (Clear Activity)	GENERATOR_DEMAND_STATUS, with External Activity Flag = 00b (No Activity), GENERIC_ALARM_STATUS, Instance 6 (Ext. Activity Cleared)	
65B-C-04	Clearing Manual Override	With Manual Override 01b (Manual) and Generator Demand 00b (No Demand), send GENERATOR_DEMAND_COMMAND Clear External Activity Flag = 01b (Clear Activity)	GENERATOR_DEMAND_STATUS, with Manual Override flag 00b (Normal), GENERIC_ALARM_STATUS, Instance 6 (Ext. Activity Cleared).	
65B-C-05	Manual Override - Running	1. When the genset is running due to either an automatic demand GENERATOR_DEMAND_COMMAND is sent with the Manual Override flag 01b (Manual) and Demand 00b (Off).	1. GENERATOR_DEMAND_STATUS is sent with Demand 00b (Off) and Manual Override 01b (Manual). GENERIC_ALARM_STATUS, Instance 4 (Manual Stop Rcvd), GENERIC_ALARM_STATUS, Instance 2 (Attempting to Stop)	1. The product attempts to stop the genset.
		2. The test is repeated with the genset running due to external activity.	2. Same.	2. Same
65B-C-06	External Activity Override - Internal Criterion	With the External Activity Flag 01b (Activity Detected), any AGS criterion is allowed to trigger.	GENERATOR_DEMAND_STATUS is sent with Demand 00b (Off), Internal Demand 01b (On), and External Activity 01b (Activity Detected).	The genset remains stopped.

			GENERIC_ALARM_STATUS, Instance 9 (Ignoring Demand) is sent.	
65B-C-07	Multiple Demand Sources	See Notes above. With no flags set and the genset off. 1. One AGS Criterion is triggered	AGS_CRITERION_STATUS and GENERATOR_DEMAND_STATUS broadcast with each status change. GENERIC_ALARM_STATUS, with instance appropriate to the criterion, is sent with each change in criterion status. GENERIC_ALARM_STATUS, Instance 1 (AGS Start) is sent with part 1, and with Instance 2 (AGS Stop) with part 3.	1. The product attempts to start the genset.
		2. Criteria (including, if applicable, Network Demand) are triggered and satisfied in rotation, with at least one criterion actively demanding the genset at all times.		2. The genset remains running.
		3. Demand from all criteria is ended.		3. The product attempts to stop the genset.

Note that profile 65B includes test 65B-S-04, which requires all AGS Criteria to satisfy an AGS Criterion profile. This profile is a catch-all to allow the certification of AGS controllers which support any number of criteria for which profiles have not been defined or are proprietary..

A complete test for the support for multiple demand criteria could require a prohibitively time-consuming and complex process, and it may not be possible to test all sequences in which AGS criteria can begin and end demand. To enable a reasonably comprehensive test, the product vendor must provide a suitable test sequence. The sequence must be such that all criteria supported by the product appear in at least one test step in which the criterion starts demand when at least one other criterion has demand and subsequently all other demand sources end (thus demonstrating that the criterion can maintain overall demand), and at least one test step in which the criterion ends demand when at least one other criterion has demand (thus demonstrating that the criterion can relinquish control properly.) If the product supports network demand, network demand must be tested in the same manner as the internal criteria.

6.35.11.2 Profile 65W: AGS – Run/Off Dwell Support

An AGS controller may implement dwell times to prevent frequent cycling. There may be an “off dwell” to prevent the genset from being stopped and then immediately restarted, and there may be a “run dwell” to prevent the genset from being started and then immediately stopped. The off dwell is usually short and there is currently no standard method for configuring it, if it exists. (Off dwells are often implemented as the “pre-crank time” in the generator controller, rather than the AGS controller.)
The run dwell is typically longer - on the order of several minutes - and it’s primary purpose is to limit the amount of cycling when multiple automatic criteria are active or when a particular criterion is particularly sensitive. The run dwell time is referred to as the

Minimum Cycle Time.
Reporting:

ID	Datum	Test	Required Response
65W-S-01	Minimum Cycle Time	GENERATOR_DEMAND_COMMAND is sent with a valid value for Minimum Cycle Time.	GENERATOR_DEMAND_STATUS is sent with the same value for Minimum Cycle Time.

Command Response

ID	Datum	Test	Required Response	Required Behavior
65W-C-01	Run Dwell - Manual Stop	The genset is started and before the dwell time is completed, a GENERATOR_DEMAND_COMMAND is sent with the Manual Override flag 01b (Manual) and Demand 00b (Off).	GENERATOR_DEMAND_STATUS, with Generator Demand 00b (On), Manual Override 01b (Manual), External Activity is 01b (Disabled)	The product attempts to stop the genset.
65W-C-02	Run Dwell - Normal Stop	The genset is started by any automatic process and the demand is ended before the dwell time is completed.	1. Initially, NAK is sent with code 7 (Requires more time), and GENERATOR_DEMAND_STATUS with Generator Demand 01b (On).	1. The genset remains running.
			2. After the dwell is completed, GENERATOR_DEMAND_STATUS with Generator Demand 00b (Off), GENERIC_ALARM_STATUS, Instance 2 (AGS Stop) is sent.	2. The product attempts to stop the genset.
65W-C-03	Off Dwell - Manual Start	If an off dwell is supported, the genset is cycled on and off, and before the dwell time is completed, a GENERATOR_DEMAND_COMMAND is sent with the Manual Override flag 01b (Manual) and Demand 01b (On).	1. Initially, NAK is sent with code 7 (Requires more time), and GENERATOR_DEMAND_STATUS with Generator Demand 01b (On).	1. The genset remains stopped.
			2. After the dwell is completed, GENERATOR_DEMAND_STATUS with Generator Demand 01b (On),	2. The product attempts to start the genset.

			GENERIC_ALARM_STATUS, Instance 1 (AGS Start) is sent.	
65W-C-04	Off Dwell - Normal Start	If an off dwell is supported, the genset is cycled on and off, and before the dwell time is completed, the genset is started by any automatic process.	1. Initially, NAK is sent with code 7 (Requires more time), and GENERATOR_DEMAND_STATUS with Generator Demand 01b (On).	1. The genset remains stopped.
			2. After the dwell is completed, GENERATOR_DEMAND_STATUS with Generator Demand 01b (On), GENERIC_ALARM_STATUS, Instance 1 (AGS Start) is sent.	2. The product attempts to start the genset.

6.35.11.3 Profile 65N: AGS – Network Demand Support

Prerequisite: 65B AGS Base Profile

Reporting

ID	Datum	Test	Required Responses
65N-S-01	GENERATOR_DEMAND_COMMAND	Unit is powered up.	A Global Request for GENERATOR_DEMAND_COMMAND is broadcast.
65N-S-02	GENERATOR_DEMAND_STATUS, Network Demand	Unit is powered up.	GENERATOR_DEMAND_STATUS is broadcast with Network Demand 00b (No Demand). The message is subsequently broadcast per the protocol, with Network Demand reported per the current conditions.

Command Response

This profile allows other products on the network to communicate a demand for generator power. This profile is complementary to the 65S-S-01 - AGS - Network Demand Source Profile.

ID	Datum	Test	Required Response	Required Behavior
65N-C-01	GENERATOR_DEMAND_COMMAND, Network Demand	GENERATOR_DEMAND_COMMAND is sent with Generator Demand = 01b (Demanded), Manual Override = 00b (Normal)	GENERATOR_DEMAND_STATUS, with Network Demand = 01b (Demanded), , , GENERIC_ALARM_STATUS, Instance 7 (Network Demand) is sent. GENERIC_ALARM_STATUS, Instance 1 (AGS Start) is sent.	The product attempts to start the genset.
65N-C-02	GENERATOR_DEMAND_CO	Subsequent to the previous test.		

	MMAND, Network Demand (End of Demand)	1.GENERATOR_DEMAND_COMMAND is sent with Generator Demand = 00b (No Demand), Manual Override = 00b (Normal)	1. A Global Request for GENERATOR_DEMAND_COMMAND is broadcast.	1. No change in genset activity.
		2. Within 250ms, GENERATOR_DEMAND_COMMAND is sent from three different addresses, two with Demand = 00b and Manual Override = 00b, one with Demand = 01b (Demanded) and Manual Override = 00b.	2. No subsequent Request for GENERATOR_DEMAND_COMMAND is broadcast. GENERATOR_DEMAND_STATUS is broadcast with Network Demand = 01b (Demanded).	2. No change in genset activity.
65N-C-03	GENERATOR_DEMAND_COMMAND, Network Demand (End of Demand)	Subsequent to the previous test.		
		1. GENERATOR_DEMAND_COMMAND is sent with Generator Demand = 00b (No Demand), Manual Override = 00b (Normal)	1. A Global Request for GENERATOR_DEMAND_COMMAND is broadcast.	1. No change in genset activity.
		2. Within 250ms, GENERATOR_DEMAND_COMMAND is sent from three different addresses, all with Demand = 00b and Manual Override = 00b.	2. No subsequent Request for GENERATOR_DEMAND_COMMAND is broadcast. GENERATOR_DEMAND_STATUS is broadcast with Network Demand = 00b (No Demand), , GENERIC_ALARM_STATUS, Instance 8 (No Network Demand) is sent, GENERIC_ALARM_STATUS, Instance 2 (AGS Stop) is sent.	2. The product attempts to stop the genset.
65N-C-04	External Activity Override	With the External Activity flag = 01b (Detected), GENERATOR_DEMAND_COMMAND is sent with Generator Demand = 01b (Demanded), Manual Override = 00b (Normal)	NAK, Code 8 (User override has priority). GENERATOR_DEMAND_STATUS, with Network Demand = 01b (Demanded), External Activity = 01b (Detected). GENERIC_ALARM_STATUS, Instance 9 (Ignoring Demand) is sent.	No change in genset activity.
65N-C-05	Manual Override	With the genset off and no flags set.		
		1. GENERATOR_DEMAND_COMMAND is sent with	1. GENERATOR_DEMAND_STATUS with Demand 01b (Demanded), Manual Override 00b (Normal),	1. The product attempts to start the genset.

		Demand = 01b (Demanded) and Manual Override 00b (Normal).	Network Demand 01b (Demanded). GENERIC_ALARM_STATUS, Instance 7 (Network Demand) is sent. GENERIC_ALARM_STATUS, Instance 1 (AGS Start) is sent.	
		2. GENERATOR_DEMAND_COMMAND is sent with Demand = 01b (Demanded) and Manual Override 01b (Manual).	2. GENERATOR_DEMAND_STATUS with Demand 01b (Demanded), Manual Override 01b (Normal), Network Demand 01b (Demanded).GENERIC_ALARM_STATUS, Instance 3 (Manual Demand) is sent.	2. No change in genset activity.
		3. GENERATOR_DEMAND_COMMAND is sent with Demand = 00b (No Demand) and Manual Override 00b (Normal).	3. Code 8 (User override has priority) A Global Request for GENERATOR_DEMAND_COMMAND is broadcast. After 250ms, GENERATOR_DEMAND_STATUS with Demand 01b (Demanded), Manual Override 01b (Manual), Network Demand 00b (Demanded). After 250ms, GENERIC_ALARM_STATUS, Instance 8 (No Network Demand) is sent.	3. No change in genset activity.
		4. GENERATOR_DEMAND_COMMAND is sent with Demand = 00b (No Demand) and Manual Override 01b (Manual).	4. GENERATOR_DEMAND_STATUS with Demand 00b (Demanded), Manual Override 00b (Manual), Network Demand 00b (Demanded). GENERIC_ALARM_STATUS, Instance 4 (Manual Demand ends) is sent. GENERIC_ALARM_STATUS, Instance 2 (AGS Stop) is sent.	4. The product attempts to stop the genset.
65N-C-06	Manual Override	With the genset off and no flags set.		
		1. GENERATOR_DEMAND_COMMAND is sent with Demand = 01b (Demanded) and Manual Override 01b (Manual).	1. GENERATOR_DEMAND_STATUS with Demand 01b (Demanded), Manual Override 01b (Manual), Network Demand 00b (No Demand). GENERIC_ALARM_STATUS, Instance 3 (Manual Demand) is sent. GENERIC_ALARM_STATUS, Instance 1 (AGS Start) is sent.	1. The product attempts to start the genset.
		2. GENERATOR_DEMAND_COMMAND is sent with Demand = 01b (Demanded) and Manual Override 00b	2. GENERATOR_DEMAND_STATUS with Demand 01b (Demanded), Manual Override 01b (Normal), Network Demand 01b (Demanded). GENERIC_ALARM_STATUS,	2. No change in genset activity.

		(Normal).	Instance 7 (Network Demand) is sent.	
		3. GENERATOR_DEMAND_COMMAND is sent with Demand = 00b (No Demand) and Manual Override 01b (Manual). Within 250ms, GENERATOR_DEMAND_COMMAND is sent with Demand = 01b (Demand) and Manual Override 00b (Normal).	3. GENERATOR_DEMAND_STATUS with Demand 00b (Demanded), Manual Override 01b (Manual), Network Demand 01b (Demanded). GENERIC_ALARM_STATUS, Instance 4 (Manual Demand End) is sent. A Global Request for GENERATOR_DEMAND_COMMAND is broadcast. After 250ms, GENERATOR_DEMAND_STATUS with Demand 01b (Demanded), Manual Override 01b (Manual), Network Demand 01b (Demanded). GENERIC_ALARM_STATUS, Instance 7 (Network Demand) is sent. GENERIC_ALARM_STATUS, Instance 2 (AGS Stop) is sent.	3. The product attempts to stop the genset.
		4. GENERATOR_DEMAND_COMMAND is sent with Demand = 00b (No Demand) and Manual Override 00b (Normal).	4. A Global Request for GENERATOR_DEMAND_COMMAND is broadcast. After 250ms, GENERATOR_DEMAND_STATUS with Demand 00b (No Demand), Manual Override 01b (Manual), Network Demand 00b (No Demand). GENERIC_ALARM_STATUS, Instance 8 (No Network Demand) is sent.	4. No change in genset activity.

6.35.11.4 Profile 65S: AGS – Network Demand Source

This profile applies to sources of generator demand on the network other than the AGS product itself. For example, a thermostat may implement this profile to trigger a genstart when air conditioning is required and no AC power is available. This profile is complementary to the 65N-S-01 - AGS - Network Demand Support Profile.

A network demand source must support the AGS_CRITERION_COMMAND and _STATUS messages in the same manner as an integrated AGS controller. All sources of AGS demand must be controlled through these messages. At a minimum, all criteria must support the base demand criterion profile, ensuring that all criteria can be enabled and disabled and their type and demand status determined. It is not necessary for all criteria to satisfy a specific criterion profile, and proprietary profiles are acceptable. At least one criterion must be supported.

Reporting

ID	Datum	Test	Required Response
65S-S-01	Request for GENERATOR_DEMAND_COMMAND	A Global Request for GENERATOR_DEMAND_COMMAND is sent.	GENERATOR_DEMAND_COMMAND is broadcast with the Generator Demand field set per current conditions. Manual Override is 00b (Normal), External Activity

			Reset is 00b or 11b (No Reset).
65S-S-02	AGS_CRITERION_STATUS/ COMMAND	1. All conditions for triggering AGS demand are accessible as AGS Criteria.	
		2. All AGS Criteria supported by the product meet the base AGS Criterion profile as noted above.	

6.35.11.5 Profile 65Q: AGS Quiet Time

If a product supports more than one Quiet Time criterion (i.e. time window), each criterion must be tested.
The number of quiet time criteria (time windows) must be included in the test documentation. If any internal criteria may be configured to override quiet time, this also must be listed in the test documentation and available for public review.
Reporting:

ID	Datum	Test	Required Response
65Q-S-01	Quiet Time Begin/End	AGS_CRITERION_COMMAND is sent, with the instance as configured, Criterion Type 5 (Quiet Time), and Begin Hour, Begin Minute, End Hour, End Minute set to valid values.	AGS_CRITERION_STATUS is sent, with the instance as configured, Criterion Type 5 (Quiet Time), and Begin Hour, Begin Minute, End Hour, End Minute set to valid values.
65Q-S-02	Quiet Time Enable/Disable. If more than one criterion (time window) is supported, each must be tested independently.	1. AGS_CRITERION_COMMAND is sent, with the instance as configured, Active Status 01b (Activate)	1. AGS_CRITERION_STATUS is sent, with the instance as configured, Criterion Type 5 (Quiet Time), and Active Status 01b (Active). GENERIC_ALARM_STATUS with Instance 165 (Quiet Time Enabled) is sent.
		2. AGS_CRITERION_COMMAND is sent, with the instance as configured, Active Status 00b (Deactivate)	2. AGS_CRITERION_STATUS is sent, with the instance as configured, Criterion Type 5 (Quiet Time), and Active Status 00b (Inactive), GENERIC_ALARM_STATUS with Instance 197 (Quiet Time Disabled) is sent.
65Q-S-03	Quiet Time Status	With all Quiet Time criteria configured with time windows which do not overlap:	
		1. The product enters any time window.	1. GENERATOR_DEMAND_STATUS is sent, with Quiet Time 01b (In

			Quiet Time). GENERIC_ALARM_STATUS with Instance 69 (Quiet Time Start) is sent.
		2. The product exits the time window.	2. GENERATOR_DEMAND_STATUS is sent, with Quiet Time 00b (Not In Quiet Time). GENERIC_ALARM_STATUS with Instance 101 (Quiet Time End) is sent.

Command Response:

ID	Datum	Test	Required Response	Required Behavior
65Q-C-01	Quiet Time Begin/End - Manual	With no flags set,		
		1. GENERATOR_DEMAND_COMMAND is sent with Demand 01b (Demanded), Manual Override 01b (Manual), Quiet Time Override 00b (No Override).	1. GENERATOR_DEMAND_STATUS is broadcast with Demand 01b (Demanded), Manual Override 01b (Manual), Quiet Time Override 00b (No Override).	1. The product attempts to start the genset.
		2. The product is allowed to enter quiet time, per any quiet time criterion.	2. GENERATOR_DEMAND_STATUS is broadcast with Demand 00b (No Demand), Manual Override 00b (No Override), Quiet Time Override 00b (No Override).	2. The product attempts to stop the genset.
		3. Step 1 is repeated.	3. NAK is sent, with code 3 (Conditions do not allow.) GENERATOR_DEMAND_STATUS is sent as per Step 2. GENERIC_ALARM_STATUS with Instance 9 (Demand Ignored) is sent.	3. The genset remains stopped.
		4. The product is allowed to exit quiet time.	4. Same as Step 2.	4. The genset remains stopped.
65Q-C-02	Quiet Time Begin/End - Manual, with Override	With no flags set,		
		1. GENERATOR_DEMAND_COMMAND is sent with Demand 01b (Demanded), Manual Override 01b (Manual), Quiet Time	1. GENERATOR_DEMAND_STATUS is broadcast with Demand 01b (Demanded), Manual Override 01b (Manual), Quiet Time	1. The product attempts to start the genset.

		Override 01b (Override).	Override 01b (Override).	
		2. The product is allowed to enter quiet time, per any quiet time criterion.	2. Same as Step 1.	2. The genset continues to run.
		3. The generator is stopped and all other flags cleared. Then Step 1 is repeated.	3. Same as Step 1.	3. The product attempts to start the genset.
65Q-C-03	Midnight Rollover	AGS_CRITERION_COMMAND is sent with Begin Hour/Minute greater than the End Hour/Minute. Test 65Q-C-02 above is then applied by manipulating the time such that:		
		1. The time is between midnight and the End Time,		1. The unit enters Quiet Time. Response is as per Test 65Q-C-02.
		2. The time is between the two times.		2. The unit does not enter Quiet Time.
		3. The time is after the Begin Time		3. The unit enters Quiet Time. Response is as per Test 65Q-C-02.
65Q-C-04	Quiet Time Begin/End - Automatic	With no flags set,		
		1. Any AGS Criterion is allowed to trigger.	1. GENERATOR_DEMAND_STATUS is broadcast with Demand 01b (Demanded), Quiet Time Override 00b (No Override).	1. The product attempts to start the genset.
		2. The product is allowed to enter quiet time, per any quiet time criterion.	2. GENERATOR_DEMAND_STATUS is broadcast with Demand 00b (No Demand), Quiet Time Override 00b (No Override).	2. The product attempts to stop the genset.
		3. The AGS Criterion is triggered again. This test must be conducted for at least one internal AGS criterion (if any are supported), and Network Demand, if Network Demand is supported.	3. Same as Step 2. If the criterion is a Network Demand, a NAK is also sent, with Code 3 (Conditions do not allow …). GENERIC_ALARM_STATUS with Instance 9 (Demand Ignored) is sent.	3. The genset remains stopped.
65Q-C-05	Quiet Time Override	With no flags set and no		

	- Automatic, Network Demand. (Req'd if Network Demand Support profile is supported.)	other AGS demand sources active,		
		1. GENERATOR_DEMAND_COMMAND is sent with Demand 01b (Demanded), Manual Override 00b (No Override), Quiet Time Override 01b (Override).	1. GENERATOR_DEMAND_STATUS is broadcast with Demand 01b (Demanded), Manual Override 00b (No Override), Quiet Time Override 01b (Override).	1. The product attempts to start the genset.
		2. The product is allowed to enter quiet time, per any quiet time criterion.	2. GENERATOR_DEMAND_STATUS is broadcast with no changes.	2. The genset continues to run.
		3. GENERATOR_DEMAND_COMMAND is sent with Demand 00b (No Demand), Manual Override 00b (No Override)	3. GENERATOR_DEMAND_STATUS is broadcast with Demand 00b (No Demand), Manual Override 00b (No Override), Quiet Time Override 00b (No Override).	3. The product attempts to stop the genset.
65Q-C-06	Quiet Time Override - Automatic, Internal Demand. (Req'd if any criterion can be configured to override quiet time.)	With no flags set and no other AGS demand sources active,		
		1. The internal demand criterion is allowed to trigger.	1. GENERATOR_DEMAND_STATUS is broadcast with Demand 01b (Demanded), Manual Override 00b (No Override), Quiet Time Override 01b (Override).	1. The product attempts to start the genset.
		2. The product is allowed to enter quiet time, per any quiet time criterion.	2. GENERATOR_DEMAND_STATUS is broadcast with no changes.	2. The genset continues to run.
		3. The criterion demand is satisfied.	3. GENERATOR_DEMAND_STATUS is broadcast with Demand 00b (No Demand), Manual Override 00b (No Override), Quiet Time Override 00b (No Override).	3. The product attempts to stop the genset.
		4. While still in quiet time and no other demand sources are active, Step 1 is repeated.	4. Same as Step 1.	4. Same as Step 1.

6.35.11.6 AGS Criterion Profiles

Each AGS Criterion must satisfy both a set of base tests which are common to all criterion types, and a set of tests which are specific to the criterion type. There are two forms for the common tests, one for implementations in which the criterion feature is integrated into the primary AGS controller, and one in which the criterion feature is contained in a separate device and communicates demand as a Network Source. The specific tests are unique for each type. Thus, the full AGS Criterion profile consists of the type-specific tests, plus the base tests for either an integrated implementation or an independent implementation. For clarity in test reporting, the first term in the common tests is left blank here. When reporting test results, this term shall be replaced by the first term in the AGS Criterion profile.
65B - AGS Base Profile or 65S - Network Demand Source is a prerequisite for all AGS Criterion profiles. 65B is required for integrated implementations, 65S is required for independent AGS demand sources.

6.35.11.7 Common Tests, AGS – Demand Criterion - Integrated Implementation

An AGS Criterion may be implemented either as part of an integrated AGS controller, which reports GENERATOR_DEMAND_STATUS, or as a separate device which communicates to the primary controller using the GENERATOR_DEMAND_COMMAND with the Network Demand field. This profile applies to the first case.
As the criteria are integrated into the same device that reports GENERATOR_DEMAND_STATUS, the profile tests only whether the criterion correctly reports its own status. The AGS Base Profile includes tests to ensure that the genset is actually started and/or stopped accordingly.
The profile does not place any requirements on the method for configuring the instance and type, and it assumes that the instance and type of all criteria have been configured previous to the tests.
Reporting

ID	Datum	Test	Required Response
*-U-01	AGS_CRITERION_STATUS, Active Status	1. AGS_CRITERION_COMMAND is sent with the given instance, Active Status 01b (Activate)	1. AGS_CRITERION_STATUS is broadcast with Active Status 01b (Active), and Criterion Type set appropriately. GENERIC_ALARM_STATUS with Instance 160-191, per Criterion Type, is sent.
		2. AGS_CRITERION_COMMAND is sent with the given instance, Active Status 00b (Deactivate)	2. AGS_CRITERION_STATUS is broadcast with Active Status 00b (Inactive), and Criterion Type set appropriately. GENERIC_ALARM_STATUS with Instance 192-223, per Criterion Type, is sent.
*-U-02	AGS_CRITERION_STATUS, Demand Status	With the criterion activated,	
		1. Conditions for the AGS criterion are satisfied.	1. AGS_CRITERION_STATUS is broadcast with Current Demand Status 01b (Demand On), GENERIC_ALARM_STATUS with Instance 64-95 per the Criterion Type is sent.
		2. Conditions for ending AGS demand are satisfied.	2. AGS_CRITERION_STATUS is broadcast with Current Demand Status 00b (No Current Demand). GENERIC_ALARM_STATUS with

			Instance 96-127 per the Criterion Type is sent.
*-U-03	AGS_CRITERION_STATUS,Criterion Type	A Request for AGS_CRITERION_STATUS is sent.	AGS_CRITERION_STATUS, with Criterion Type appropriate per the criterion type. A proprietary type (128-250) is allowed only if no appropriate type has been defined in the protocol.
*-U-04	AGS_CRITERION_COMMAND as request for status.	AGS_CRITERION_COMMAND is sent with corresponding criterion instance, all other fields N/D.	AGS_CRITERION_STATUS is broadcast with valid values for all fields supported.

Command Response

ID	Datum	Test	Required Response	Required Behavior
*-D-01	Manual Override	With the Manual Override Flag 01b (Manual) and Demand 00b (Off), the criterion is allowed to trigger.	AGS_CRITERION_STATUS is sent with Demand 01b GENERATOR_DEMAND_STATUS is sent with Demand 00b (Off) and Manual Override Flag 01b (Manual)	The genset remains stopped.
*-D-02	External Activity Override	With the External Activity Flag 01b (Activity Detected), and Demand 00b (Off), the criterion is allowed to trigger.	AGS_CRITERION_STATUS is sent with Demand 01b GENERATOR_DEMAND_STATUS is sent with Demand 00b (Off) and External Activity 01b (Activity Detected).	The genset remains stopped.
*-D-03	Manual Override - Continue	With genset off and no flags active.		
		1. The AGS is triggered by the criterion	1. GENERATOR_DEMAND_STATUS is sent with Demand 01b (On) and Manual Override 00b (Normal). AGS_CRITERION_STATUS is sent with Demand 01b.	1. The product attempts to start the genset.
		2. A GENERATOR_DEMAND_COMMAND is sent with the Manual Override flag 01b (Manual) and Demand 01b (On).	2. GENERATOR_DEMAND_STATUS is sent with Demand 01b (On) and Manual Override 01b (Manual).	2. The genset continues to run.
		3. The trigger is allowed to end.	3. AGS_CRITERION_STATUS is sent with Demand 00b.	3. The genset continues to run.
*-D-04	Manual Override - Stop	With genset off and no status		

		flags set.		
		1. The AGS is triggered by the criterion	1. GENERATOR_DEMAND_STATUS is sent with Demand 01b (On) and Manual Override 00b (Normal). AGS_CRITERION_STATUS is sent with Demand 01b.	1. The product attempts to start the genset.
		2. A GENERATOR_DEMAND_COMMAND is sent with the Manual Override flag 01b (Manual) and Demand 00b (Off).	2. GENERATOR_DEMAND_STATUS with Demand 00b (Off) and Manual Override 01b (Manual)	2. The product attempts to stop the genset.
		3. The criterion demand is allowed to end.	3. GENERATOR_DEMAND_STATUS with Demand 00b and Manual Override 01b (Manual) AGS_CRITERION_STATUS is sent with Demand 00b.	3. The genset remains stopped.
		4. The criterion is triggered again.	4. GENERATOR_DEMAND_STATUS with Demand 00b and Manual Override 01b (Manual) AGS_CRITERION_STATUS is sent with Demand 01b.	4. The genset remains stopped.

6.35.11.8 Common Tests, AGS – Demand Criterion – Independent Implementation

An AGS Criterion may be implemented either as part of an integrated AGS controller, which reports GENERATOR_DEMAND_STATUS, or as a separate device which communicates to the primary controller using the GENERATOR_DEMAND_COMMAND with the Network Demand field. This profile applies to the second case. Note that the tests do not include tests for interaction with the External Activity, Manual Override, or Quiet Time conditions, as these tests are part of the Network Demand Support profile.

As the device implementing such a criterion communicates demand to the primary AGS controller via GENERATOR_DEMAND_COMMAND, support for Network Demand Source is required.

The profile does not place any requirements on the method for configuring the instance and type, and it assumes that the instance and type of all criteria have been configured previous to the tests.

Each criterion type differs in the conditions which trigger and satisfy AGS demand. For standard types, these conditions are given in the specific criterion profile.

Reporting

ID	Datum	Test	Required Response
*-T-01	AGS_CRITERION_STATUS, Active Status	1. AGS_CRITERION_COMMAND is sent with the given instance, Active Status 01b (Activate)	1. AGS_CRITERION_STATUS is broadcast with Active Status 01b (Active), and Criterion Type set appropriately.

			GENERIC_ALARM_STATUS with Instance 160-191 per the Criterion Type is sent.
		2. AGS_CRITERION_COMMAND is sent with the given instance, Active Status 00b (Deactivate)	2. AGS_CRITERION_STATUS is broadcast with Active Status 00b (Inactive), and Criterion Type set appropriately. GENERIC_ALARM_STATUS with Instance 191-223 per the Criterion Type is sent.
*-T-02	AGS_CRITERION_STATUS, Demand Status, GENERATOR_DEMAND_COMMAND	With only this criterion activated,	
		1. Conditions for the AGS criterion are satisfied.	1. AGS_CRITERION_STATUS is broadcast with Current Demand Status 01b (Demand On). GENERIC_ALARM_STATUS with Instance 64-95 per the Criterion Type is sent. GENERATOR_DEMAND_COMMAND is broadcast per values in Network Demand Source profile.
		2. Conditions for ending AGS demand are satisfied. See the specific criterion profiles for a description of how the criterion is satisfied. See above.	2. AGS_CRITERION_STATUS is broadcast with Current Demand Status 00b (No Current Demand). GENERIC_ALARM_STATUS with Instance 96-127 per the Criterion Type is sent. GENERATOR_DEMAND_COMMAND is broadcast per values in Network Demand Source profile.
*-T-03	AGS_CRITERION_STATUS,Criterion Type	A Request for AGS_CRITERION_STATUS is sent.	AGS_CRITERION_STATUS, with Criterion Type appropriate per the criterion type. A proprietary type (128-250) is allowed only if no appropriate type has been defined in the protocol.
*-T-04	AGS_CRITERION_COMMAND as request for status.	AGS_CRITERION_COMMAND is sent with corresponding criterion instance, all other fields N/D.	AGS_CRITERION_STATUS is broadcast with valid values for all fields supported.

6.35.11.9 Multiple Criteria (Independent Implementation)

The following test *-T-05 applies only to products which implement more than one AGS criteria. A complete test for the support for multiple demand criteria could require a prohibitively time-consuming and complex process, and it may not be possible to test all sequences in which AGS criteria can begin and end demand. To enable a reasonably comprehensive test, the product vendor must provide a suitable test sequence. The sequence must be such that all criteria supported by the product appear in at least one test step in which the criterion starts demand when at least one other criterion has demand and subsequently all other demand sources end (thus demonstrating that the criterion can maintain overall demand), and at least one test step in which the

criterion ends demand when at least one other criterion has demand (thus demonstrating that the criterion can relinquish control properly.)
Reporting

ID	Datum	Test	Required Response
*-T-05	Multiple Demand Sources	See Notes above. With no flags set and the genset off.	AGS_CRITERION_STATUS broadcast with each status change.
		1. One AGS Criterion is triggered	1.GENERATOR_DEMAND_COMMAND is sent with Demand 01b (Demand) and other values per Network Demand Source profile.
		2. Criteria (including, if applicable, Network Demand) are triggered and satisfied in rotation, with at least one criterion actively demanding the genset at all times.	2. No additional requirement.
		3. Demand from all criteria is ended.	3. GENERATOR_DEMAND_COMMAND is sent with Demand 00b (Demand) and other values per Network Demand Source profile.

6.35.11.10 Profile 65C0: AGS DC voltage Criterion

This profile also requires either set of Common Tests, as indicated above.
Note that the Time Under Threshold and DC Instance are not required to be configurable, but are required to be reported.
For purposes of tests 65C0-S-02 and 65C0-S-03, demand shall be triggered when the voltage at the indicated DC source is less than DC Voltage Threshold for a continuous span of time of at least the Time-Under-Threshold. The conditions for satisfying demand may be specified by the applicant, the specification to be included in the product's public compliance documentation.
Reporting

ID	Datum	Test	Required Response
65C0-S-01	DC Voltage Threshold, Time-Under-Threshold, DC Instance	AGS_CRITERION_COMMAND is sent with a valid value for DC Voltage Threshold.	AGS_CRITERION_STATUS is sent with the same value for DC Voltage Threshold, a valid value for Time Under Threshold, and a valid value for DC Instance. GENERIC_ALARM_STATUS with Instance 128 (Configuration Change) is sent.
65C0-S-02	Time-Under Counter	The voltage of the DC Instance is held below the DC Voltage Threshold.	AGS_CRITERION_STATUS_2 is broadcast with Time-Under Counter incrementing each second. The broadcast is repeated each second.
65C0-S-03	Time-Under Counter	1. The previous test 65C0-S-02 is allowed to continue until the Time-Under-Threshold is reached.	1. AGS_CRITERION_STATUS_2 is sent with Time-Under Counter equal to the threshold. The DGN is no longer repeated each second.

		2. The previous test 65C0-S-02 is interrupted by bringing the DC Voltage above the threshold before the time-under threshold is reached.	2. AGS_CRITERION_STATUS_2 is sent with Time-Under Counter 0 (Value above threshold). The DGN is no longer repeated each second.

6.35.11.11 Profile 65C1: AGS DC State of Charge Criterion

This profile also requires either set of Common Tests, as indicated above.
Note that the Time Under Threshold and DC Instance are not required to be configurable, but are required to be reported.
For purposes of tests 65C1-S-02 and 65C1-S-03, demand shall be triggered when the State of Charge at the indicated DC source is less than State of Charge Start Threshold for a continuous span of time of at least the Time-Under-Threshold. Demand is satisfied when the State of Charge equals the State of Charge Stop Threshold.
Reporting

ID	Datum	Test	Required Response
65C1-S-01	DC State-of-Charge Start Threshold, State-of-Charge Stop Threshold, Time-Under-Threshold, DC Instance	1. AGS_CRITERION_COMMAND is sent with a valid value for DC State-of-Charge Start Threshold.	1. AGS_CRITERION_STATUS is sent with the same value for DC State-of-Charge Start Threshold, and valid values for Stop Threshold, Time Under Threshold, and DC Instance. GENERIC_ALARM_STATUS with Instance 129 (Configuration Change) is sent.
		2. AGS_CRITERION_COMMAND is sent with a valid value for DC State-of-Charge Stop Threshold.	2. As above, with the new value for State-of-Charge Stop Threshold.
65C1-S-02	Time-Under Counter	The State-of-Charge of the DC Instance is held below the DC Voltage Threshold, with no other source of charging available.	AGS_CRITERION_STATUS_2 is broadcast with Time-Under Counter incrementing each second. The broadcast is repeated each second.
65C1-S-03	Time-Under Counter	1. The previous test 65C1-S-02 is allowed to continue until the Time-Under-Threshold is reached.	1. AGS_CRITERION_STATUS_2 is sent with Time-Under Counter equal to the threshold. The DGN is no longer repeated each second.
		2. The previous test 65C1-S-02 is interrupted by bringing the State-of-Charge above the threshold before the time-under threshold is reached.	2. AGS_CRITERION_STATUS_2 is sent with Time-Under Counter 0 (Value above threshold). The DGN is no longer repeated each second.

6.35.11.12 Profile 65C4: AGS Transfer Switch AC Point Voltage Criterion

This profile also requires either set of Common Tests, as indicated above.
Note that the Voltage Threshold, Time Under Threshold and ATS AC Point Instance are not required to be configurable, but are required to be reported.
For purposes of tests 65C4-S-02 and 65C4-S-04, demand shall be triggered when the RMS Voltage at the ATS AC Point Instance indicated is below the AC Voltage Threshold for a continuous span of time of at least the Time-Under-Threshold. As not all ATS products report their status when no AC power is available, no ATS AC Point RMS Voltage report is to be considered the same as 0 Vac being present. The conditions for satisfying demand may be specified by the applicant, the specification to be included in the product's public compliance documentation. It is acceptable to indicate that demand is only satisfied after user intervention.

Reporting

ID	Datum	Test	Required Response
65C4-S-01	AC VoltageThreshold, Time-Under-Threshold, ATS AC Point Instance	AGS_CRITERION_COMMAND is sent with the AGS Criterion Instance.	AGS_CRITERION_STATUS is sent with valid values for AC Voltage Threshold, a valid value for Time Under Threshold, and a valid value for ATS AC Point Instance. GENERIC_ALARM_STATUS with Instance 132 (Configuration Change) is sent.
65C4-S-02	Time-Under Counter	The RMS voltage for the ATS AC Point is held below the AC Voltage Threshold.	AGS_CRITERION_STATUS_2 is broadcast with Time-Under Counter incrementing each second. The broadcast is repeated each second.
65C4-S-03	ATS AC Point Timeout	Broadcast of the ATS AC Point voltage is suspended.	After no more than 3 seconds, AGS_CRITERION_STATUS_2 is broadcast per the previous test 65C4-S-02.
65C4-S-04	Time-Under Counter	1. The previous test 65C4-S-02 is allowed to continue until the Time-Under-Threshold is reached.	1. AGS_CRITERION_STATUS_2 is sent with Time-Under Counter equal to the threshold. The DGN is no longer repeated each second.
		2. The previous test 65C4-S-02 is interrupted by bringing the ATS AC Point voltage above the threshold before the time-under threshold is reached.	2. AGS_CRITERION_STATUS_2 is sent with Time-Under Counter 0 (Value above threshold). The DGN is no longer repeated each second.

6.35.11.13 Profile 65C6: AGS Timed Start Criterion

This profile also requires either set of Common Tests, as indicated above.
For purposes of tests 65C6-S-01 and 65C6-S-02, demand shall be triggered when RV-C Time reaches the configured start time, and demand is satisfied after the run time has passed. The applicant may specify the behavior when the criterion is activated or the product boots up in the time window after the start time but within the run time. This specification is to be included in the product's public compliance documentation.
Reporting

ID	Datum	Test	Required Response
65C6-S-01	Time Begin Hour	AGS_CRITERION_COMMAND is sent with a valid value for Time Begin Hour.	AGS_CRITERION_STATUS is sent with the same value for Time Begin Hour. GENERIC_ALARM_STATUS with Instance 134 (Configuration Change) is sent.
65C6-S-02	Time Begin Minute	AGS_CRITERION_COMMAND is sent with a valid value for Time Begin Minute.	AGS_CRITERION_STATUS is sent with the same value for Time Begin Minute. GENERIC_ALARM_STATUS with Instance 134 (Configuration

			Change) is sent.
65C6-S-03	Run Time	AGS_CRITERION_COMMAND is sent with a valid value for Run Time.	AGS_CRITERION_STATUS is sent with the same value for Run Time. GENERIC_ALARM_STATUS with Instance 134 (Configuration Change) is sent.

6.35.11.14 Profile 65C7: AGS Air Conditioning Criterion

This profile also requires either set of Common Tests, as indicated above..
Note that the Air Conditioner Instance is not required to be configurable, but is required to be reported.
For purposes of test 65C7-S-01, the applicant must specify when demand is to be triggered and when it is satisfied. This specification is to be included in the product's public compliance documentation.
Reporting

ID	Datum	Test	Required Response
65C7-S-01	Air Conditioner Instance	AGS_CRITERION_COMMAND is sent with the instance of the criterion.	AGS_CRITERION_STATUS is sent with a valid value for Air Conditioner Instance

6.35.11.15 Profile 65CX: AGS Non-Standard Criterion

This profile consists entirely of either set of Common Tests, as indicated above. All tests shall be reported with the 65CX prefix. Note that profile 65B includes test 65B-S-04, which requires all AGS Criteria to satisfy an AGS Criterion profile. This profile is a catch-all to allow the certification of AGS controllers which support any number of criteria for which profiles have not been defined or are proprietary..

6.36 Floor Heat

6.36.1 Introduction

Although Floor Heat is conceptually similar to an ordinary furnace, it differs in that the temperature sensor is almost always internal to the floor heat system. Each floor heat unit operates independently from the conventional thermostats and their zones. There may be multiple floor heat units.
These DGNs may also be used for other specialized heating products that operate in isolation from the conventional zones. The following formats apply (see Table 6.36.1).

Table 6.36.1 — Floor heat definition

Device attribute	Value
Category	Comfort systems
Default Source Address	97 to 99
Dynamic Address Range	192 to 207
Instance	Multiple

Multiple source addresses are available, but these products are identified by the Instance field in each DGN.

6.36.2 Floor Heat Status

This DGN allows products to determine the status of a floor heat unit. Table 6.36.2a defines the DG attributes and Table 6.36.2b defines the signal and parameter attributes.

Table 6.36.2a — DG definition

DG attribute	Value
Name	FLOOR_HEAT_STATUS
DGN	1FEFCh
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.36.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	see Table 5.3 Does not correspond to Thermostat Instances (“Zones”)
1	0 to 1	Operating mode	uint2	-	00b — Automatic 01b — Manual
	2 to 3	Operating status	uint2	-	00b — Off 01b — On
	4 to 5	Heat element status	uint2	-	00b — Off 01b — On
	6 to 7	Schedule Mode	uint2	-	00b – Disabled 01b – Enabled. If enabled, the set point will change according to a programmed schedule
2 to 3	-	Measured temperature	uint16	°C	see Table 5.3
4 to 5	-	Set point	uint16	°C	see Table 5.3
6	-	Dead band	uint8	°C	Precision = 0.1 °C Value range = 0.0 to 25.0 °C

6.36.3 Floor Heat Command

This DGN allows products to control the status of a floor heat unit. Table 6.36.3a defines the DG attributes and Table 6.36.3b defines the signal and parameter attributes.

Table 6.36.3a — DG definition

DG attribute	Value
Name	FLOOR_HEAT_COMMAND
DGN	1FEFBh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1

ACK requirements	NAK, FLOOR_HEAT_STATUS

Table 6.36.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	see Table 5.3 Does not correspond to Thermostat Instances (“Zones”)
1	0 to 1	Desired operating mode	uint2	-	00b — Automatic 01b — Manual
	2 to 3	Desired operating status	uint2	-	00b — Off 01b — On
	4 to 5	Heat element status	uint2	-	00b — Off 01b — On
	6 to 7	Schedule Mode	uint2	-	00b – Disabled 01b – Enabled. If enabled, the set point will change according to a programmed schedule
2 to 3	-	Set point	uint16	°C	see Table 5.3
4	-	Dead band	uint8	°C	Precision = 0.1 °C Value range = 0.0 to 25.0 °C

6.36.4 Service Points

As with most multiple instance devices, if the Most Significant Byte is non-zero the Intermediate Byte provides the Instance associated with the failure. Table 6.36.5 lists the Service Points.

Table 6.36.5 — Service Points

MSB	ISB	LSb	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	Temperature Sensor
1	Instance	1	Power Source
1	Instance	2	Heat Element

6.36.5 Test Profile

6.36.5.1 Floor Heat Base Profile

(FLOOR_HEAT_COMMAND/FLOOR_HEAT_STATUS)

ID	Datum	Test	Required Response	Required Behavior
97A-C-01	Automatic Operating mode	On FLOOR_HEAT_COMMAND, send Set Point	FLOOR_HEAT_STATUS reports Set point	NA
		On FLOOR_HEAT_COMMAND, send Dead Band	FLOOR_HEAT_STATUS reports Dead Band	NA
		On FLOOR_HEAT_COMMAND, send Operating mode = 00b (automatic)	FLOOR_HEAT_STATUS reports Operating modes = 00b (automatic)	Floor heat turns on and off when set point is reached and turns off when set point and deadband is

				reached
	Manual Operating mode	On FLOOR_HEAT_COMMAND, send Operating mode = 01b (manual)	FLOOR_HEAT_STATUS reports Operating modes = 01b (manual)	Floor heat turns to manual mode
		On FLOOR_HEAT_COMMAND, send Operating status = 01b (on)	FLOOR_HEAT_STATUS reports Operating status = 01b (on)	Floor heat turns on and stays on
		On FLOOR_HEAT_COMMAND, send Operating status = 00b (off)	FLOOR_HEAT_STATUS reports Operating status = 00b (off)	Floor heat turns off

6.37 Tire Monitoring

6.37.1 Introduction

These DGs replace the J1939 DGNs for Tire Pressure reporting (J1939 protocol does not fully support all the features of current TPM systems.) These DGs assume a system in which some type of sensor is installed at each tire, including possibly those in a trailer or towed vehicle. The sensor reports pressure and/or temperature information along with some sort of identifier.
The following formats apply (see Table 6.37.1).

Table 6.37.1 — Tire monitoring definition

Device attribute	Value
Category	Sensors
Default Source Address	133
Dynamic Address Range	160 to 175
Instance	Multi-instance

The receiver may simply report raw sensor data using the TIRE_RAW_STATUS DGN, or with the data indexed to the tire location using the TIRE_STATUS DGs.
The RV-C protocol makes no statements about the appropriate frequency of transmissions from the sensors. The TIRE_STATUS and TIRE_RAW_STATUS DGs are transmitted immediately whenever sensor data is received. This may mean gaps of several minutes, or even much longer if the vehicle is stationary.

6.37.2 Raw Tire Status

If tire data cannot be correlated with a specific location, then the data should be broadcast with this DGN. Table 6.37.2a defines the DG attributes and Table 6.37.2b defines the signal and parameter attributes. This DG is broadcast only on the reception of sensor data. It is not available on request.

Table 6.37.2a — DG definition

DG attribute	Value
Name	TIRE_RAW_STATUS
DGN	1FEF1h
Default priority	6
Maximum broadcast gap	N/A

Normal broadcast gap	on sensor transmission
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	None

Table 6.37.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0 to 3	-	Sensor ID	uint32	-	Manufacturer-specific sensor identifier..
4 to 5	-	Tire pressure	uint16	kPa	Precision = 1 kPa Value range = 0 to 65 530 kPa Actual Gauge pressure. This value should not be temperature corrected.
6 to 7	-	Tire temperature	uint16	°C	see Table 5.3

6.37.3 Tire Status

If sensor data can be identified with a specific tire location, then the data should be sent using this DG. Table 6.37.3a defines the DG attributes and Table 6.37.3b defines the signal and parameter attributes.
If this DGN is requested, the most recent data for each identified tire should be sent. This should be sent through repeated transmissions of this DGN, not a Long Message. If no data has yet been received from a specific tire, the DGN should still be sent, but with FFb values in all data items except Tire Location.

Table 6.37.3a — DG definition

DG attribute	Value
Name	TIRE_STATUS
DGN	1FEF0h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on transmission or on TIRE_LOW_PRESSURE_CONFIGURATION_COMMAND / TIRE_HIGH_PRESSURE_CONFIGURATION_COMMAND / TIRE_TEMPERATURE_CONFIGURATION_COMMAND change
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	None

Table 6.37.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 3	Tire location – Position	uint4	-	0 - Outside left tire 1 - Inside left tire 2 - Inside right tire 3 - Outside right tire If only two tires are mounted on an axle, they should be numbered 0 and 3. If more than four

					tires are on an axle, they should be numbered sequentially from left to right.
	4 to 7	Tire location - Axle	uint4	-	0 - Steer axle 1 - Drive axle 2 - Tag axle 3 to 13 - Trailer / Tow axle If the sensors are mounted only on a trailer, then Zero indicates the most forward axle, and other axles are numbered sequentially from front to rear.
1 to 2	-	Tire pressure	uint16	kPa	Precision = 1 kPa Value range = 0 to 65530 kPa
3 to 4	-	Tire temperature	uint16	°C	see Table 5.3
5	-	Battery level	uint8	V	Precision = 0.02 V Value range = 0.00 to 5.00 V Note that this does NOT match Table 5.3
6	-	Signal level	uint8	%	see Table 5.3
7	0 to 2	Pressure status	uint3	-	000b – Ok 001b - Extremely low 010b - Low 011b - High 100b - Extremely high
	3 to 5	Temperature status	uint3	-	000b - Ok 001b - Extremely high 010b - High
	6 to 7	Battery status	uint2	-	00b - Ok 01b - Low battery warning

6.37.4 Slow Leak Alarm

If a slow leak is detected, this alarm shall be sent for the appropriate sensor. This alarm can only be provided for sensors identified with a specific location. If the Slow Leak Threshold defined in TIRE_PRESSURE_CONFIGURATION_STATUS is set to zero, this alarm will not be sent.
Table 6.37.4a defines the DG attributes and Table 6.37.4b defines the signal and parameter attributes. If this DGN is requested, the unit should respond with values for every tire. When an alarm occurs, only the data for the leaking tire should be transmitted.

Table 6.37.4a — DG definition

DG attribute	Value
Name	TIRE_SLOW_LEAK_ALARM
DGN	1FEEFh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	Upon detection of leak. Repeated every 5000 ms while leak active
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	None

Table 6.37.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 3	Tire location - Position	uint4	-	0 - Outside left tire 1 - Inside left tire 2 - Inside right tire 3 - Outside right tire If only two tires are mounted on an axle, they should be numbered 0 and 3. If more than four tires are on an axle, they should be numbered sequentially from left to right.
	4 to 7	Tire location - Axle	uint4	-	0 - Steer axle 1 - Drive axle 2 - Tag axle 3 to 13 - Trailer / Tow axle If the sensors are mounted only on a trailer, then Zero indicates the most forward axle, and other axles are numbered sequentially from front to rear.
1	0 to 1	Alarm status	uint2	-	00b - No alarm 01b - Slow leak detected
2 to 3	-	Leak rate	uint16	kPa/h	Precision = 1 kPa/h Value range = 0 to 65 530 kPa/h 0 - No leak detected

6.37.5 Tire Alarm Configuration (Introduction)

The Pressure, Temperature, and Battery Status items in the TIRE_STATUS DG are determined by configuration values set for each axle. The protocol assumes that all tires on a given axle are of the same type and have the same target levels.

6.37.6 Tire Temperature Configuration Status

Table 6.37.6a defines the DG attributes and Table 6.37.6b defines the signal and parameter attributes. If this DGN is requested, the device should respond with data for every axle.

Table 6.37.6a — DG definition

DG attribute	Value
Name	TIRE_TEMPERATURE_CONFIGURATION_STATUS
DGN	1FEEEh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on request
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	None

Table 6.37.6b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 3	Reserved	-	-	Tire parameters are assumed to be consistent

					across all tires on a specific axle.
0	4 to 7	Tire location - Axle	uint4	-	0 - Steer axle 1 - Drive axle 2 - Tag axle 3 to 13 - Trailer / Tow / Spare Tire axle If the sensors are mounted only on a trailer, then 0 indicates the most forward axle, and other axles are numbered sequentially from front to rear.
1 to 2	-	Extremely high tire temperature	uint16	°C	see Table 5.3
3 to 4	-	High tire temperature	uint16	°C	see Table 5.3
5	-	Low battery level	uint8	V	Precision = 0.02 V Value range = 0.00 to 5.00 V Note that this does NOT match Table 5.3

6.37.7 Tire Pressure Configuration Status

Table 6.37.7a defines the DG attributes and Table 6.37.7b defines the signal and parameter attributes. If this DGN is requested, the device should respond with data for every axle.

Table 6.37.7a — DG definition

DG attribute	Value
Name	TIRE_PRESSURE_CONFIGURATION_STATUS
DGN	1FEEDh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on request
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	None

Table 6.37.7b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 3	Reserved	-	-	Tire parameters are assumed to be consistent across all tires on a specific axle.
0	4 to 7	Tire location - Axle	uint4	-	0 - Steer axle 1 - Drive axle 2 - Tag axle 3 to 13 - Trailer / Tow / Spare Tire axle If the sensors are mounted only on a trailer, then 0 indicates the most forward axle, and other axles are numbered sequentially from front to rear.
1 to 2	-	Extremely low tire pressure	uint16	kPa	Precision = 1 kPa/hr Value range = 0 to 65 530 kPa/hr
3 to 4	-	Low tire pressure	uint16	kPa	Precision = 1 kPa/hr

					Value range = 0 to 65 530 kPa/hr
5 to 6	-	Slow leak threshold	uint16	kPa/hr	Precision = kPa/hr range = 0 to 65 530 kPa/hr 0 = No slow leak alarms

6.37.8 Tire High Pressure Configuration Status

Table 6.37.8a defines the DG attributes and Table 6.37.8b defines the signal and parameter attributes. If this DGN is requested, the device should respond with data for every axle.

Table 6.37.8a — DG definition

DG attribute	Value
Name	TIRE_HIGH_PRESSURE_CONFIGURATION_STATUS
DGN	1FDEDh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on request
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	None

Table 6.37.8b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 3	Reserved	-	-	Tire parameters are assumed to be consistent across all tires on a specific axle.
0	4 to 7	Tire location - Axle	uint4	-	0 - Steer axle 1 - Drive axle 2 - Tag axle 3 to 13 - Trailer / Tow / Spare Tire axle If the sensors are mounted only on a trailer, then 0 indicates the most forward axle, and other axles are numbered sequentially from front to rear.
1 to 2	-	Extremely high tire pressure	uint16	kPa	Precision = 1 kPa Value range = 0 to 65 530 kPa/hr
3 to 4	-	High tire pressure	uint16	kPa	Precision = 1 kPa/hr Value range = 0 to 65 530 kPa/hr

6.37.9 Tire Pressure/Temperature Configuration Command

Table 6.37.9a describes the DG definitions. The signal and parameter attributes have the same format as their corresponding STATUS DGNs.

Table 6.37.9 — DG definition

DG attribute	Value
Name	TIRE_PRESSURE_CONFIGURATION_COMMAND TIRE_TEMPERATURE_CONFIGURATION_COMMAND TIRE_HIGH_PRESSURE_CONFIGURATION_COMMAND

DGN	1FEECh 1FEEBh 1FDECh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	as needed
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	ACK, NAK, TIRE_PRESSURE_CONFIGURATION_STATUS / TIRE_TEMPERATURE_CONFIGURATION_STATUS / TIRE_HIGH_PRESSURE_CONFIGURATION_STATUS / TIRE_STATUS

6.37.10 Tire Sensor Configuration (Introduction)

These DGs allow the assignment of sensor ID numbers to specific locations. When a sensor transmission is received, the device should check to see whether that sensor has been assigned a position, and if so, report the data using TIRE_STATUS. If the sensor has not been assigned a location, the data should be sent using TIRE_RAW_STATUS.

6.37.11 Tire ID Status

Table 6.37.11a defines the DG attributes and Table 6.37.11b defines the signal and parameter attributes. If this DGN is requested, the device should respond with data for every assigned tire location.

Table 6.37.11a — DG definition

DG attribute	Value
Name	TIRE_ID_STATUS
DGN	1FEEAh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on request
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	None

Table 6.37.11b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 3	Tire location - Position	uint4	-	0 - Outside left tire 1 - Inside left tire 2 - Inside right tire 3 - Outside right tire If only two tires are mounted on an axle, they should be numbered 0 and 3. If more than four tires are on an axle, they should be numbered sequentially from left to right.

	4 to 7	Tire location - Axle	uint4	-	0 - Steer axle 1 - Drive axle 2 - Tag axle 3 to 13 - Trailer / Tow axle / Spare Tire If the sensors are mounted only on a trailer, then 0 indicates the most forward axle, and other axles are numbered sequentially from front to rear.
1 to 4		Sensor identification number	uint32	-	see Table 5.3

6.37.12 Tire ID Command

Table 6.37.12 describes the DG definitions. The signal and parameter attributes format is identical to TIRE_ID_STATUS. If the Sensor Identification Number is FFFFFFFFh, the device should respond by removing the tire currently assigned to that location from the assignment table.

Table 6.37.12 — DG definition

DG attribute	Value
Name	TIRE_ID_COMMAND
DGN	1FEE9h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	1 s
Number of frames	1
ACK requirements	ACK, NAK, TIRE_ID_STATUS

6.37.13 Service Points

As with other multi-instance items, SPNs that are particular to a tire instance are coded with a non-zero value in the MSB and the Instance in the ISB. The Instance is a combination of axle and wheel location, with the four MSBs being the Axle, and the four LSBs being the Tire Position.
If a sensor has not been assigned a location, the Instance should be set to 0xFF. There is no method provided for specific identification of a failure on an unassigned sensor.
Note that all diagnostic messages apply to the sensors and the receiver, not to the tires themselves. Tire failures shall be reported using the TIRE_STATUS DGN. Table 6.37.15 lists the Service Points.

Table 6.37.15 — Service Points

MSB	ISB	LSb	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	Pressure Sensor
1	Instance	1	Temperature Sensor
1	Instance	2	Battery Level
1	Instance	3	Internal Failure
1	Instance	4	Loss of Signal

6.37.14 Alarms

Alarm Instance	Description
1	Slow Leak
2	Low Tire Pressure
3	Extremely Low Tire Pressure
4	High Tire Pressure
5	Extremely High Tire Pressure
6	High Tire Temperature
7	Extremely High Tire Temperature

6.37.15 Test Profiles

6.37.15.1 Profile 133B: Tire Monitoring Pressure Base

ID	Datum	Test	Required Response
133B-C-01	Configuration Command	Set pressure configuration for an Axle	Tire Location, Extreme Low Pressure, Extreme High Pressure, Low Tire Pressure, High Tire Pressure, Slow Leak Threshold

6.37.15.2 Profile 133T: Tire Monitoring Temperature Base

ID	Datum	Test	Required Response
133T-C-01	Configuration Command	Set configuration for an Axle	Tire Location, Extreme High Temperature, Low Tire Temperature, Battery Level

6.38 Awning

6.38.1 Introduction

This DGN contains control information for the awnings. The following formats apply (see Table 6.38.1).

Table 6.38.1 — Awning definition

Device attribute	Value
Category	Mechanical components
Default Source Address	130
Dynamic Address Range	176 to 191
Instance	Multiple

6.38.2 Awning Status

Table 6.38.2a defines the DG attributes and Table 6.38.2b defines the signal and parameter attributes.

Table 6.38.2a — DG definition

DG attribute	Value

Name	AWNING_STATUS
DGN	1FEF3h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change 100 ms when awning is in motion
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

Table 6.38.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 - Awning 1 (main patio awning) 2 to 253 - Awning 2 to 253
1	-	Motion	uint8	-	0 - No motion 1 - Extending 2 - Retracting
2	-	Position	uint8	%	see Table 5.3 0 - Retracted 200 - 100% Extended If the device can only detect whether it is fully retracted, it shall only report using values of 0% (fully retracted) and 100% (not fully retracted). IF it can detect full extension as well, but not intermediate values, it shall report using 0%, 100% (fully extended), and 50% (partially extended).
3	0 to 1	Travel Lock status	uint2	-	00b - Awning is secured 01b - Awning is not secured The status of a physical lock, typically used to prevent motion due to vibration or wind. This may be checked to determine whether it is safe to move the vehicle as well as whether commands will be accepted.
	2 to 3	Unlock status	uint2	-	00b - Awning is unlocked and ready to move 01b - Awning is not unlocked and should not be moved The status of a physical lock, typically used to prevent motion due to vibration or wind. This may be checked to determine whether it is safe to move the vehicle as well as whether commands will be accepted.
	4 to 5	User lock status	uint2	-	00b - User lock is not activated. Awning is OK to move

					01b - User lock is activated. Awning will not move The status of a software lock, preventing motion.
	6 to 7	Brake status	uint2	-	00b - All motor brakes are not locked 01b - One or more motor brakes are locked. A motor brake prevents motion due to vibration or wind, but does not prevent motion from commands. This may be checked to determine whether the vehicle is safe to move.
4	0 to 1	Parked status	uint2	-	00b - Awning may move 01b - Awning will not move because of Parked status. This is typically from a park brake input, but may be derived from other sources. The status of the park brake lock, typically derived from the Chassis Mobility Status DGN but possibly from another source.
	2 to 3	Ignition key	uint2	-	00b - Awning may move 01b - Awning will not move because of Ignition status The status of ignition status lock, typically derived from the Chassis Mobility Status DGN but possibly from another source.
	4 to 5	Low voltage	uint2	-	00b - Awning may move 01b - Awning will not move because of Low Voltage status
	6 to 7	Generic lock	uint2		00b - Awning may move 01b - Awning will not move because of generic lockout signal status. The lockout signal is typically a wind or vibration sensor, but may be a key switch or similar protection.
5	0 to 1	Awning light	uint2	-	00b – Integrated awning light off, if present 01b – Integrated awning light on
	2 to 3	Secondary light	uint2	-	00b – Secondary awning light off, if present 01b – Secondary awning light on
	4 to 5	Auto Retraction on Park Brake Release	uint2	-	00b - No auto retraction based on park brake 01b - Awning set to automatically retract with park brake released
	6 to 7	Auto Retraction on Ignition	uint2	-	00b - No auto retraction based on park brake 01b - Awning set to automatically retract with park brake released

6	-	Awning Light	uint8	%	See Table 5.3 It is possible that the device also implements DC Dimmer DGNs. If so, this field should echo the dimmer status.
7	-	Secondary Light	uint8	%	See Table 5.3 It is possible that the device also implements DC Dimmer DGNs. If so, this field should echo the dimmer status.

6.38.3 Awning Command

Table 6.38.3a defines the DG attributes and Table 6.38.3b defines the signal and parameter attributes. This DGN triggers awning actions. If the Direction of Motion is Extend or Retract, the command must be repeated every 100ms to keep the awning in motion. If a longer gap occurs, the awning should stop automatically for safety. The Direction of Motion command for Stop does not need to be repeated, but it should certainly be sent to stop the motion.

Table 6.38.3a — DG definition

DG attribute	Value
Name	AWNING_COMMAND
DGN	1FEF2h
Default priority	3
Maximum broadcast gap	N/A
Normal broadcast gap	on change 100 ms when awning is in motion
Minimum broadcast gap	50 ms
Number of frames	1
ACK requirements	NAK, AWNING_STATUS

Table 6.38.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 - All, for Retraction and Lock Engagement/Disengagement only. 1 - Awning 1 (main patio awning) 2 to 253 - Awning 2 to 253
1	0 to 1	User lock	uint2	-	00b - Release user lock 01b - Set user lock
	2 to 3	Mechanical lock	uint2	-	00b - Disengage lock 01b - Engage lock
	4 to 5	Awning light	uint2	-	00b – Set integrated awning light off, if present 01b – Set integrated awning light on
	6 to 7	Secondary light	uint2	-	00b – Set secondary awning light off, if present 01b – Set secondary awning light on
2	-	Direction of movement	uint8	-	0 - Stop 1 - Extend 2 - Retract
3	-	Move to Position	uint8	%	Desired Amount of Extension see Table 5.3 0 – Full Retraction

					200 – Full Extention
4	-	Motion Sensitivity	uint8	-	See AWNING_STATUS 6.38.2
5	0 to3	Reserved	-	-	-
	4 to 5	Auto Retraction on Park Brake Release	uint2	-	00b - No auto retraction based on park brake 01b - Set awning to automatically retract with park brake release
	6 to 7	Auto Retraction on Ignition	uint2	-	00b - No auto retraction based on park brake 01b - Set awning to automatically retract with ignition.
6	-	Awning Light	uint8	%	See Table 5.3
7	-	Secondary light	uint8	%	See Table 5.3

6.38.4 Awning Status 2

Table 6.38.4a defines the DG attributes and Table 6.38.4b defines the signal and parameter attributes.

Table 6.38.4a — DG definition

DG attribute	Value
Name	AWNING_STATUS_2
DGN	1FDCD
Default priority	6
Maximum broadcast gap	5 sec
Normal broadcast gap	On Change
Minimum broadcast gap	50 ms
Number of frames	1
ACK requirements	None

Table 6.38.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 - 250
1	-	Motion Sensitivity	uint8	-	Determines the sensitivity to vibration for automatic retraction. 0 = 0% = Least Sensitive 200 = 100% = Most Sensitive
2	0 to 1	Calibration	bit	-	00b – Uncalibrated 01b – Calibrated
3	-	Extension lockout based on Chassis Mobility Status	uint8	-	Chassis mobility extension lockout bitmask: b0 - Must be set to 0 b1 - Park brake (Extension lockout when park brake off) b2 - Transmission lock (Extension lockout when engine free to start)

					b3 - Engine lock status (Extension lockout when engine free to start) b4 - Ignition switch status (Extension lockout when ignition switch On) b5 - Accessory switch status (Extension lockout when accessory switch On) b6 - Transmission current gear (Extension lockout when not in Park or Neutral) b7 - Transmission gear selected (Extension lockout when not in Park or Neutral)
4	-	Retract and extension lockout based on Chassis Mobility Status	uint8	-	Chassis mobility retract then lockout (RTL) bitmask: b0 - Must be set to 0 b1 - Park brake (RTL when park brake off) b2 - Transmission lock (RTL when transmission not locked) b3 - Engine lock status (RTL when engine free to start) b4 - Ignition switch status (RTL when ignition switch On) b5 - Accessory switch status (RTL when accessory switch On) b6 - Transmission current gear (RTL when not in Park or Neutral) b7 - Transmission gear selected (RTL when not in Park or Neutral)
5	0 to 3	Extension lockout input signal active states	uint4	-	0000b - Input Disabled 0001b - Active when input Low 0010b - Active when input High 0011b - Active when input either Low or High 0100b - Active when input Floating 0101b - Active when input Floating and Low 0110b - Active when input Floating and High
	4 to 7	Auto retract with extension lockout input signal active states	uint4	-	0000b - Input Disabled 0001b - Active when input Low 0010b - Active when input High 0011b - Active when input either Low or High 0100b - Active when input Floating 0101b - Active when input Floating and Low 0110b - Active when input Floating and High

6.38.5 Awning Command 2

Table 6.38.5a defines the DG attributes and Table 6.38.5b defines the signal and parameter attributes.

Table 6.38.5a — DG definition

DG attribute	Value
Name	AWNING_COMMAND_2
DGN	1FDCC
Default priority	6

Maximum broadcast gap	N/A
Normal broadcast gap	As Needed
Minimum broadcast gap	50 ms
Number of frames	1
ACK requirements	NAK, AWNING_COMMAND_2

Table 6.38.5b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 - 250
1	-	Motion Sensitivity	uint8	-	Determines the sensitivity to vibration for automatic retraction. 0 = 0% = Least Sensitive 200 = 100% = Most Sensitive
2	0 to 1	Calibration	bit	-	00b – Initiate calibration routine
3	-	Extension lockout based on Chassis Mobility Status	uint8	-	Chassis mobility extension lockout bitmask: b0 - Must be set to 0 b1 - Park brake (Extension lockout when park brake off) b2 - Transmission lock (Extension lockout when engine free to start) b3 - Engine lock status (Extension lockout when engine free to start) b4 - Ignition switch status (Extension lockout when ignition switch On) b5 - Accessory switch status (Extension lockout when accessory switch On) b6 - Transmission current gear (Extension lockout when not in Park or Neutral) b7 - Transmission gear selected (Extension lockout when not in Park or Neutral)
4	-	Retract and extension lockout based on Chassis Mobility Status	uint8	-	Chassis mobility retract then lockout (RTL) bitmask: b0 - Must be set to 0 b1 - Park brake (RTL when park brake off) b2 - Transmission lock (RTL when transmission not locked) b3 - Engine lock status (RTL when engine free to start) b4 - Ignition switch status (RTL when ignition switch On) b5 - Accessory switch status (RTL when accessory switch On) b6 - Transmission current gear (RTL when not in Park or Neutral) b7 - Transmission gear selected (RTL when not in Park or Neutral)
5	0 to 3	Extension lockout input	uint4	-	0000b - Input Disabled

		signal active states			0001b - Active when input Low 0010b - Active when input High 0011b - Active when input either Low or High 0100b - Active when input Floating 0101b - Active when input Floating and Low 0110b - Active when input Floating and High
	4 to 7	Auto retract with extension lockout input signal active states	uint4	-	0000b - Input Disabled 0001b - Active when input Low 0010b - Active when input High 0011b - Active when input either Low or High 0100b - Active when input Floating 0101b - Active when input Floating and Low 0110b - Active when input Floating and High

6.38.6 Service Points

SPN's

1	instance	0	Awning Motor
1	instance	1	Motor Driver
1	instance	2	Main light driver
1	instance	3	Secondary light driver
1	instance	4	Main light bulb
1	instance	5	Secondary light bulb
1	instance	6	Travel lock
1	instance	7	Extension lock
2	instance	0	Motor brake

6.38.7 Alarms

Alarms

Alarm Instance		Description
1	Info	Retraction triggered by wind.
2	Info	Retraction triggered by lockout signal status change.
3	Stat	User-Initiated Extension. *Only broadcast once upon initial motion, unless a subsequent command changes direction or a period of time elapses with no activity. Not broadcast if a more specific alarm is available.*
4	Stat	User-initiated Retraction. *See previous alarm*.
5	Stat	User-initiated full Retraction.
6	Info	Locks Engaged
7	Info	Locks Disengaged
8	User	RV motion detected when lock is not engaged.
9	Info	Retraction triggered by Park Brake release.
10	Info	Retraction triggered by Ignition status.

6.38.8 Test Profile

6.38.8.1 Awning Base Profile:

ID	Datum	Test	Required Response	Required Behavior
	AWNING_COMMAND	Send 0x01h on byte 2 to desired awning instance	AWNING_STATUS response with 0x01h on byte 1	Awning stops within 50ms of receiving command
	AWNING_COMMAND	Send 0x02h on byte 2 to desired awning instance	AWNING_STATUS responds with 0x02h on byte 1	Awning extends unless a stop command is received, more than 100ms is detected between commands, or the awning is fully extended
	AWNING_COMMAND	Send 0x03h on byte 2 to desired awning instance	AWNING_STATUS response with 0x03h on byte 1	Awning retracts unless a stop command is received, more than 100ms is detected between commands, or the awning is fully retracted

6.39 Window Shade Control

6.39.1 Introduction

This group of DGNs applies to devices that drive and control DC powered motorized window shades. The following formats apply (see Table 6.39.1). Static addressing is discouraged in this product.

Table 6.39.1 – Window Shade Control Definition

Device attribute	Value
Category	Power components
Default Source Address	134
Dynamic Address Range	128-143
Instance	Multiple

6.39.2 Window Shade Control Status

The following table (Table 6.39.2a) defines the DG attributes and Table 6.39.2b defines the signal and parameter attributes.

Table 6.39.2a – DG Definition

DG attribute	Value
Name	WINDOW_SHADE_CONTROL_STATUS
DGN	1FEDEh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change

Minimum broadcast gap	250ms
Number of frames	1
ACK requirements	None

Table 6.39.2b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	Valid = 1 to 250.
1	-	Group	uint8	bitmap	Indicates group membership. One bit is assigned to each of seven groups. Highest bit is not used to indicate a group. If 0, the other bits refer to the groups. 0 in any other position indicates the load is a member of the corresponding group. 01111110 – Group 1 01111101 – Group 2 00000000 - All groups 11111111 – No Data
2	-	Operating Status (Motor Duty)	uint8	Percent	See Table 5.3
3	0 to 1	Lock Status	uint2	-	00b – Load is unlocked 01b – Load is locked 11b – Lock command is not supported When locked, the instance will ignore certain commands (device specific) until an unlock command is received.
	2 to 3	Motor Status	uint2	-	00b — Neither 'Forward' nor 'Reverse' output is on. 01b — either 'Forward' or 'Reverse' output is on (Motor active in either direction)
	4 to 5	Forward Status	uint2	-	00b — 'Forward' output not on. 01b — 'Forward' output is on. Shade is raising/opening.
	6 to 7	Reverse Status	uint2	-	00b — 'Reverse' output not on 01b — 'Reverse' output is on. Shade is lowering/closing.
4	-	Duration	uint8	Sec	Number of seconds remaining in Duration command. Max = 240 seconds 0 = delay/duration expired 1 – 239 = seconds remaining 240 = 240 or more seconds remaining 255 = no delay/duration active
5	-	Last Command	uint8		Indicates last command (function) executed by this instance. This is the last command executed by the WINDOW_SHADE_CONTROL_COMMAND (DGN 1FEDF). See Table 6.39.3c below for a list of possible commands.
6	0 to 1	Overcurrent Status	uint2	-	00b — load output not in overcurrent 01b — load output has drawn overcurrent 11b – Overcurrent status is unavailable or not supported
	2 to 3	Override Status	uint2	-	00b – External override is inactive 01b – External override is active 11b – Override status is unavailable or not supported

					When the override is active, the output has been physically changed by a user outside of the device.
	4 to 5	Disable1 Status	uint2	-	00b — Disable 1 is not active 01b — Disable 1 is active 11b – Disable 1 is not supported When disable 1 is active, it has been set through an external signal input.
	6 to 7	Disable2 Status	uint2	-	00b — Disable 2 is not active 01b — Disable 2 is active 11b – Disable 2 is not supported When disable 2 is active, it has been set through an external signal input.
7	-	Reserved			

6.39.3 Window Shade Control Command

The following table (Table 6.39.3a) defines the DG attributes and Table 6.39.3b defines the signal and parameter attributes.

Table 6.39.3a – DG Definition

DG attribute	Value
Name	WINDOW_SHADE_CONTROL_COMMAND
DGN	1FEDFh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	as needed
Minimum broadcast gap	100ms
Number of frames	1
ACK requirements	NAK, WINDOW_SHADE_CONTROL_STATUS

Table 6.39.3b – Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	Valid = 1 to 250. 0xFF for group commands.
1	-	Group	uint8	Bitmap	see Table 6.39.2b If bit 7 = 1 and bit 6 = 0, it is a node group. Node groups support more than seven groups where multiple groups cannot be selected in one command. This is required to handle the physical grouping of multiple control instances within one node. 10000001 – Node Group 1 10011111 – Node Group 31 (max for this mode) 11111111 – For non-group commands
2	-	Motor Duty	uint8	%	See Table 5.3
3	-	Command	uint8	Bitmap	See table 6.39.3c for a list of possible commands and explanations..
4	-	Duration	uint8	Sec	Number of seconds to enable motor for before stopping. Range: 1 to 240 seconds

					Additional minute increment values: 241 = 5 min 242 = 6 min … 250 = 14 min 255 = Continuous command 0 = momentary command. This command will only turn on the channel for 2 seconds. However, if the message is repeated with a period less than 2 seconds, the channel will stay on indefinitely. Duration is ignored if not supported by specified command
5	-	Interlock	uint8	Bitmap	Bit 0 – Interlock A Bit 1 – Interlock B A command message with either interlock bit set to ‘1’ will not be activated until an identical message is received from a different source with the opposing interlock bit set to ‘1’. Bit 2-7 – Reserved
6-7	-	Reserved			

Table 6.39.3c - Supported Command Descriptions

Command	Description
0x04 – Stop	If motor is active in either direction, immediately stop it.
0x81 – Forward	Turn motor on in the “Forward” (open shade) direction for specified duration (Controller may enforce a dead time for direction reversal)
0x41 – Reverse	Turn motor on in the “Reverse” (close shade) direction for specified duration (Controller may enforce a dead time for direction reversal)
0x85 – Toggle Forward	If motor is off, turn on in the forward direction for specified duration. If motor is on in forward direction, stop it. If motor is on in reverse direction, stop it and turn on in forward direction (Controller may enforce a dead time for direction reversal).
0x45 – Toggle Reverse	If motor is off, turn on in the reverse direction for specified duration. If motor is on in reverse direction, stop it. If motor is on in forward direction, stop it and turn on in reverse direction (Controller may enforce a dead time for direction reversal).
0x10 – Tilt	Tilts louvers type shades in the upward direction.
0x21 – Lock	Lock instance preventing certain commands from affecting it until an “Unlock” command is received.
0x22 – Unlock	Unlock an instance that is currently locked.

6.39.4 Test Profile

6.39.4.1 Window Shade Base Profile

(WINDOW_SHADE_CONTROL_COMMAND/WINDOW_SHADE_CONTROL_STATUS)

ID	Datum	Test	Required Response	Required Behavior
134A-C-01	Command	While shade is up, on WINDOW_SHADE_CONTROL_COMMAND, send Command=0x81 (Forward/Raise)	WINDOW_SHADE_CONTROL_STATUS reports Motor Status = 01b and Forward Status = 01b	Shade runs forward (Raises)
		While shade is up, on WINDOW_SHADE_CONTROL_CO	WINDOW_SHADE_CONTROL_STATUS reports Motor Status = 01b	Shade runs reverse (Lowers)

		MMAND, send Command=0x41 (Reverse/Lower)	and Reverse Status = 01b	
		While shade is active, on WINDOW_SHADE_CONTROL_COMMAND, send Command=0x04 (Stop)	WINDOW_SHADE_CONTROL_STATUS reports Motor Status = 00b, and Reverse Status = 00b	Shade immediately stops

6.40 Door and Window Controller

6.40.1 Introduction

A door/window controller provides the ability to lock and unlock one or more door/window, and/or open and close power windows/doors. Although typically these functions are found in cab doors and windows, they may also refer to storage bay doors or any network controlled door or window.

Door and window placement varies considerably with the make and model of RV. Therefore no instancing scheme can apply unambiguously to all situations. However, if appropriate the following guidelines shall be used to assign instances to physical locations in the RV.

In a motorized RV with a driver door:
- The driver door/window shall be assigned Instance 1.
- The passenger door/window shall be assigned Instance 2.
- Additional Instances shall be assigned in a clockwise order, starting at the passenger door/window, and incrementing by one.

Thus, in a four-door RV, the driver door is Instance 1, the front passenger door in Instance 2, the right rear door is Instance 3, and the left rear door is Instance 4.

In a non-motorized RV, or a motorized RV without a driver door:
- The main entry door/window shall be assigned Instance 1. If there are two entry doors, the door further forward shall be Instance 1.
- Additional Instances shall be assigned in clockwise order, as above.

Commands broadcast with Instance 0 shall be accepted and carried out by all instances. In this case, only locks and windows that fail to carry out the command are required to send a NAK DGN. All locks shall respond with their status after the command. Note that sending a command with Instance zero but no data in the Lock field has the same result as requesting the LOCK_STATUS DGN.

Table 6.40.1 – Door Lock Control Definition

Device Attribute	Value
Category	Mechanical Components
Default Source Address	135 – Door Controller 145 – Window Controller
Dynamic Address Range	176-191
Instance	Multiple

The main DGNs associated with a Door Controller are sent only on request. Moreover, these devices are often powered from the chassis accessory or ignition circuits, and are therefore often off-line. Therefore it is particularly important that the controller send a regular status message when on-line to ensure that network devices are aware of its presence.

6.40.2 Door Status

The following table (Table 6.40.2a) defines the DG attributes and Table 6.40.2b defines the signal and parameter attributes.

Table 6.40.2a – DG Definition

DG Attribute	Value
Name	DOOR_STATUS
DGN	1FEE5h
Default Priority	6
Maximum Broadcast gap	5000 ms
Normal Broadcast gap	On Change and periodically
Minimum Broadcast gap	500 ms
Number of Frames	1
ACK Requirements	None

Table 6.40.2b – Signal and Parameter Definition

Byte	Bit	Name	Data Type	Unit-	Definition
0	-	Instance	uint8	-	1 - 250. See section 6.40.1
1	0 to 1	Lock Status	uint2	-	0 = Unlocked 1 = Locked
2	-	Motion	uint8	-	0 = No Motion 1 = Opening 2 = Closing
3	-	Position	uint8	%	See Table 5.3 100% = Fully Open
4 to 5	-	Voltage	unit16	V	See Table 5.3

6.40.3 Door Command

The following table (Table 6.40.3a) defines the DG attributes and Table 6.40.3b defines the signal parameter attributes.

Table 6.40.3a – DG Definition

DG Attribute	Value
Name	DOOR_COMMAND
DGN	1FEE4h
Default Priority	6
Maximum Broadcast gap	N/A
Normal Broadcast gap	As Needed
Minimum Broadcast gap	50 ms
Number of Frames	1
ACK Requirements	NAK, DOOR_STATUS

Table 6.40.3b – Signal and Parameter Definition

Byte	Bit	Name	Data Type	Definition
0		Instance	uint8	0 = All Locks

				1 - 250. See section 6.40.1.
1	0 to 1	Lock Command	uint2	0 = Unlocked 1 = Locked
2		Command	uint8	0 = No Additional Action (same as FFh) 1 = Open/Extend Door 2 = Close/Retract Door 3 = Stop Note: The manual door close command will timeout after 250 ms and therefore should be transmitted every 100 ms during operation.

6.40.4 Window Status

The following table (Table 6.40.4a) defines the DG attributes and Table 6.40.4b defines the signal and parameter attributes.

Table 6.40.4a – DG Definition

DG Attribute	Value
Name	WINDOW_STATUS
DGN	1FEE3h
Default Priority	6
Maximum Broadcast gap	5000 ms
Normal Broadcast gap	On change and periodically (250ms when window is in motion)
Minimum Broadcast gap	100 ms
Number of Frames	1
ACK Requirements	None

Table 6.40.4b – Signal and Parameter Definition

Byte	Bit	Name	Data Type	Unit	Definition
0		Instance	uint8		1 - 250. See section 6.40.1
1		Motion	uint8		0 = No Motion 1 = Opening 2 = Closing
2		Position	uint8	%	See Table 5.3 100% = Fully Open
3	0 to 1	User Lock Status	uint2		0 = Window is not locked and free to move. 1 = Window is locked to prevent movement.

This DGN should be sent whenever the window is in motion, or on any change in status. After motion has stopped, it should be sent again to indicate the change in motion status.

6.40.5 Window Command

The following table (Table 6.40.5a) defines the DG attributes and Table 6.40.5b defines the signal and parameter attributes.

Table 6.40.5a – DG Definition

DG Attribute	Value
Name	WINDOW_COMMAND
DGN	1FEE2h
Default Priority	6
Maximum Broadcast gap	N/A
Normal Broadcast gap	As Needed. 100 ms during manual operation.
Minimum Broadcast gap	50 ms
Number of Frames	1
ACK Requirements	None

During manual operation, if this message is not repeated in the indicated time frame the target window should stop moving.

Table 6.40.5b – Signal and Parameter Definition

Byte	Bit	Name	Data Type	Unit	Definition
0		Instance	uint8		0 = All Instances 1 - 250 = Target Instance. See section 6.40.1
1	0 to 1	Lock Command	uint2		0 = Unlock Window 1 = Lock Window
2		Manual Operation	uint8		0 = Stop 1 = Open Window 2 = Close Window Note: The manual window close command will timeout after 250 ms and therefore should be transmitted every 100 ms during operation.
3		Automatic Operation	uint8	%	See Table 5.3 Desired window position. 0 = Fully closed. 200 = 100% Open

The Lock parameter supports a common safety feature intended to prevent children from operating the windows in a distracting or hazardous manner.

6.40.6 Alarms

Instance	Alarm
1	Door/window started opening
2	Door/window started closing
3	Door/window stopped
4	Door/window stopped due to timeout
5	Door/window stopped due to obstruction (overcurrent)
6	Door/window locked
7	Door/window unlocked

6.40.7 Test profiles

6.40.7.1 Door Lock Base Profile

(DOOR_COMMAND)

ID	Datum	Test	Required Response	Required Behavior
135A-C-01	Lock Command	On DOOR_COMMMAND, send Lock Command=0 (Unlock)	N/A	Door unlocks
		On DOOR_COMMMAND, send Lock Command=1 (Lock)	N/A	Door Locks

6.40.7.2 Door Motion Base Profile

(DOOR_COMMAND)

ID	Datum	Test	Required Response	Required Behavior
135A-C-01	Command	On DOOR_COMMMAND, send Command=1 (Open/Extend)	N/A	Door opens/extends
		On DOOR_COMMMAND, send Command=2 (Close/Retract)	N/A	Door closes/retracts
		On DOOR_COMMMAND, send Command=3 (Stop) while door is in motion	N/A	Door stops immediately

6.40.7.3 Window Lock Base Profile

(WINDOW_COMMAND)

ID	Datum	Test	Required Response	Required Behavior
145A-C-01	Lock Command	On WINDOW_COMMMAND, send Lock Command=0 (Unlock)	N/A	Window unlocks
		On WINDOW_COMMMAND, send Lock Command=1 (Lock)	N/A	Window Locks

6.40.7.4 Window Motion Base Profile

(WINDOW_COMMAND)

ID	Datum	Test	Required Response	Required Behavior
145A-C-01	Manual Operation	On WINDOW_COMMMAND, send Manual Operation=1 (Open)	N/A	Window opens

		On WINDOW_COMMMAND, send Manual Operation=2 (Close)	N/A	Window closes
		On WINDOW_COMMMAND, send Manual Operation=0 (Stop) while window is in motion	N/A	Window stops immediately

6.41 Vehicle Seat

6.41.1 Introduction

The following formats apply to a vehicle seat, which may be equipped with positioning motors, heat, massage devices, fans, and more. The following formats apply.(see Table 6.41).

Table 6.41 — Vehicle Seat DSA

Device attribute	Value
Category	Mechanical components
Default Source Address	150
Dynamic Address Range	176 - 191
Instance	Multi-Instance

6.41.2 Vehicle Seat Command

Table 6.41.2a defines the DG attributes and Table 6.41.2b defines the signal and parameter attributes.

Table 6.41.2a — DG definition

DG attribute	Value
Name	VEHICLE_SEAT_COMMAND
DGN	1FDC8h
Default priority	6
Maximum broadcast gap	100 ms
Normal broadcast gap	On change
Minimum broadcast gap	As Needed
Number of frames	1
ACK requirements	NAK, VEHICLE_SEAT_STATUS

Table 6.41.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0		Seat Instance	uint8	-	1 to 250. 1 = Driver Seat.

1	0-3	Seat Position	uint4	-	0 = Stop, 1 = Move forward, 2 = Move backward
	4-7	Seat Back	uint4	-	0 = Stop 1 = Stand up 2 = Fall back
2	0-3	Seat Head Rest	uint4	-	0 = Stop 1 = Move up 2 = Move down
	4-7	Seat Leg Rest	uint4	-	0 = Stop 1 = Move up 2 = Move down
3	0-3	Seat Back Adjustment	uint4	-	0 = Stop, 1 = Adjust upper part 2 = Adjust lower part 3 = Push out 4 = Flat down
4	0-3	Seat Heat	uint4	-	0 = Off, 1 to 13 = Heat -on level (Low to High)
	4-7	Seat Fan	uint4	-	0 = Off, 1 to 13 = Fan-on level (Low to High)
5	0-3	Seat Massage Mode	uint4	-	0 = Wave, 1 = Cat, 2 = Stretch, 3 = Snake, 4 = Butterfly
	4-7	Seat Massage Level	uint4	-	0 = Off 1-13 = Massage Level
6	0-1	Aux. Switch1	uint2	-	0 = Off 1 = On
	2-3	Aux. Switch2	uint2	-	0 = Off 1 = On

6.41.3 Vehicle Seat Status

Table 6.41.3a defines the DG attributes and Table 6.41.3b defines the signal and parameter attributes.

Table 6.41.3a — DG definition

DG attribute	Value
Name	VEHICLE_SEAT_STATUS
DGN	1FDC7h
Default priority	6
Maximum broadcast gap	500 ms
Normal broadcast gap	On change
Minimum broadcast gap	5 s

Number of frames	1
ACK requirements	None

Table 6.41.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0		Seat Instance	uint8	-	1 to 250. 1 = Driver Seat.
1	0-3	Seat Position	uint4	-	0 = Stop, 1 = Move forward, 2 = Move backward
	4-7	Seat Back	uint4	-	0 = Stop 1 = Stand up 2 = Fall back
2	0-3	Seat Head Rest	uint4	-	0 = Stop 1 = Move up 2 = Move down
	4-7	Seat Leg Rest	uint4	-	0 = Stop 1 = Move up 2 = Move down
3	0-3	Seat Back Adjustment	uint4	-	0 = Stop, 1 = Adjust upper part 2 = Adjust lower part 3 = Push out 4 = Flat down
4	0-3	Seat Heat	uint4	-	0 = Off, 1 to 13 = Heat -on level (Low to High)
	4-7	Seat Fan	uint4	-	0 = Off, 1 to 13 = Fan-on level (Low to High)
5	0-3	Seat Massage Mode	uint4	-	0 = Wave, 1 = Cat, 2 = Stretch, 3 = Snake, 4 = Butterfly
	4-7	Seat Massage Level	uint4	-	0 = Off 1-13 = Massage Level
6	0-1	Aux. Switch1	bits	-	0 = Off 1 = On
	2-3	Aux. Switch2	bits	-	0 = Off 1 = On
	4-7	Max Seat Heat	uint4	-	0 = No Seat Heat 1-13 = Max Heat Level
7	0-3	Max Fan Level	uint4		0 = No Seat Fan 1-13 = Max Heat Level
	4-7	Max Massage Level	uint4		0 = No Massage 1-13 = Max Massage Level

6.41.4 Vehicle Seat Lighting Command

Table 6.41.4a defines the DG attributes and Table 6.41.4b defines the signal and parameter attributes.

Table 6.41.4a — DG definition

DG attribute	Value
Name	VEHICLE_SEAT_LIGHTING_COMMAND
DGN	1FDC6h
Default priority	6
Maximum broadcast gap	100 ms
Normal broadcast gap	On change
Minimum broadcast gap	As Needed
Number of frames	1
ACK requirements	NAK, VEHICLE_SEAT_LIGHTING_STATUS

Table 6.41.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Seat Instance	uint8	-	1 to 250. 1 = Driver Seat.
1	-	Master brightness	uint8	%	See Table 5.3
2	-	Red brightness	uint8	%	See Table 5.3
3	-	Green brightness	uint8	%	See Table 5.3
4	-	Blue brightness	uint8	%	See Table 5.3
5	0-3	On duration	uint4	s	Precision - 1s Value range - 0 to 14 s 0 - Always on
	4-7	Off duration	uint4	s	Precision - 1s Value range - 0 to 14 s 0 - “One Shot” - Switch shall activate once, then stay off. Note: In case of conflicts between the Off duration and the On duration, the On duration takes priority.
6	-	White brightness	uint8	%	See Table 5.3

6.41.5 Vehicle Seat Lighting Status

Table 6.41.5a defines the DG attributes and Table 6.41.5b defines the signal and parameter attributes.

Table 6.41.5a — DG definition

DG attribute	Value
Name	VEHICLE_SEAT_LIGHTING_STATUS

DGN	1FDC5h
Default priority	6
Maximum broadcast gap	500 ms
Normal broadcast gap	On change
Minimum broadcast gap	5 s
Number of frames	1
ACK requirements	None

Table 6.41.5b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Seat Instance	uint8	-	1 to 250. 1 = Driver Seat.
1	-	Master brightness	uint8	%	See Table 5.3
2	-	Red brightness	uint8	%	See Table 5.3
3	-	Green brightness	uint8	%	See Table 5.3
4	-	Blue brightness	uint8	%	See Table 5.3
5	0-3	On duration	uint4	s	Precision - 1s Value range - 0 to 14 s 0 - Always on
	4-7	Off duration	uint4	s	Precision - 1s Value range - 0 to 14 s 0 - “One Shot” - Switch shall activate once, then stay off. Note: In case of conflicts between the Off duration and the On duration, the On duration takes priority.
6	-	White brightness	uint8	%	See Table 5.3

6.42 DC System Disconnect and Bridge

6.42.1 Introduction

These DGNs are for a DC System Disconnect. This is typically a solenoid or similar cut-off switch that control the DC power to a substantial portion of the RV. It may also bridge two or more DC systems, such as the chassis and house batteries. The precise function of the device is not explicit in the DGN - there is generally no way to identify the purpose of a circuit in RV-C. The following formats apply (see Table 6.42).

Table 6.42 — DC Disconnect/Bridge

Device attribute	Value
Category	Power components
Default Source Address	143
Dynamic Address Range	128 to 143
Instance	Multiple

Each circuit is identified with an Instance from 1 to 250. In practice multiple instances are likely to be contained in a single controller.

6.42.2 DC Disconnect Status

This should not be used with the Multi-Packet protocol. If multiple devices are to be reported, each should be reported in its own packet. Table 6.42.2a defines the DG attributes and Table 6.42.2b defines the signal and parameter attributes.

Table 6.42.2a — DG definition

DG attribute	Value
Name	DC_DISCONNECT_STATUS
DGN	1FED0h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	On change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	NAK, DC_DISCONNECT_STATUS

Table 6.42.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 – Invalid 1 – Main House Battery Disconnect 2 – Chassis Battery Disconnect 3 – House/Chassis Bridge 4 — Secondary House Battery 5 – Generator Starter Battery 6 - 250 – Other There may be other instances in the RV. The numbering of other instances is arbitrary, not determined by this document.
1	0 to 1	Circuit Status	uint2	-	00b – Circuit is disconnected. 01b – Circuit is connected.
	2 to 3	Last Command	uint2	-	00b – Disconnect circuit. 01b – Connect circuit.
	4 to 5	Bypass Detect	uint2	-	00b – Circuit is under system control. 01b – Circuit has been bypassed.
2 to 3	-	DC switched voltage	uint16	V	See Table 5.3
4 to 7	-	DC switched current	uint32	A	See Table 5.3 A positive value indicates positive current flowing out of the switched terminal

The Bypass Detect flag is set when the physical status of the circuit does not match the expected status – typically due to the use of a physical override that is independent of the RV-C controller.

6.42.3 DC Disconnect Command

Table 6.42.3a defines the DG attributes and Table 6.42.3b defines the signal and parameter attributes.

Table 6.42.3a — DG definition

DG attribute	Value
Name	DC_DISCONNECT_COMMAND
DGN	1FECFh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On change
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	DC_DISCONNECT_STATUS

Table 6.42.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 – Invalid 1 – Main House Battery Disconnect 2 – Chassis Battery Disconnect 3 – House/Chassis Bridge 4-250 - Other
1	0 to 1	Command	uint2	-	00b – Disconnect circuit. 01b – Connect circuit.

6.42.4 Service Points

Table 6.42.4 lists the Service Points.

Table 6.42.4 — Service Points

MSB	ISB	LSb	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSB to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	Solenoid
1	Instance	1	Solenoid Coil Current
1	Instance	2	Solenoid Voltage
1	Instance	3	Solenoid Temperature
1	Instance	4	Contact Current
1	Instance	5	Contact Voltage

6.42.5 Test Profiles

6.42.5.1 Profile 143B-3A: DC Disconnect (Base)

Reporting

ID	Datum	Test	Required Response	Required Behavior
143B-S-01	DC_DISCONNECT_STATUS	Instance Circuit Status	The DC Disconnect shall broadcast this DGN at least once every 5000ms.	N/A
143B-S-02	Circuit Status	Manual Switch to *disconnected*	Reports DC_DISCONNECT_STATUS Circuit Status with 00b immediately.	Opens contacts, and reports disconnect status.
143B-S-03	Circuit Status	Manual Switch to *connected*	Reports DC_DISCONNECT_STATUS Circuit Status with 01b immediately.	Closes contacts, and reports connected status.

Command Response

ID	Datum	Test	Required Response	Required Behavior
143B-C-01	DC_DISCONNECT_COMMAND	Disconnect: Instance = Device Instance Command = 01b	Reports DC_DISCONNECT_STATUS Circuit Status with 00b if connected, otherwise report with NAK.	If contacts closed, open contacts, and reports disconnect status.
143B-C-02	DC_DISCONNECT_COMMAND	Connect: Instance = Device Instance Command = 00b	Reports DC_DISCONNECT_STATUS Circuit Status with 01b if disconnected. Otherwise report with NAK.	If contacts open, close contacts, and reports connected status.
143B-C-03	DC_DISCONNECT_COMMAND	Send non-executable command: Instance = Device Instance Command = 11b	Reports with NAK, then device shall not change status and report status immediately.	N/A
143B-C-04	DC_DISCONNECT_COMMAND	Send non-applicable command: Instance = Non-Device Instance Command = 11b	N/A	N/A

6.42.5.2 Profile 143C-3A: DC Disconnect (DC Source Connection Support)

The following profile requirements are in addition to 143B – DC Disconnect (Base) Profile.

Command Response

ID	Datum	Test	Required Response	Required Behavior
143C-C-01	DC_SOURCE_CONNECTION_STATUS	request for DC_SOURCE_CONNECTION_STATUS	Reports: DC_SOURCE_CONNECTION_STATUS immediately.	N/A

6.43 Network Bridge

This DSA includes bridges to a high-speed network such as Ethernet, where raw RV-C data is translated across the bridge in its entirety, and also bridges to other low-and-medium speed networks such as SAE J1939 (or even a second RV-C network), in which only a portion of the data is bridged across media. The following formats apply (see Table 6.43).

Table 6.43 — Network Bridge

Device attribute	Value
Category	Appliances and Bridges
Default Source Address	253
Dynamic Address Range	208-223
Instance	Single

6.43.1 Bridged CAN Network Status

A vehicle may contain multiple CAN networks (not all of which are necessarily using the RV-C communication protocol), with a bridge device connecting them. This DGN provides a method of checking the CAN Hi / Lo dominate voltages, the CAN Bus Impedance, the communication protocol being used on the network, and Bus Termination / Network Statuses for each network. A bridge device may also implement other protocols other than CAN, but only CAN networks have their status reported by this message.

Each CAN network is identified with an Instance ranging from 1 to 250. Note that the bridge itself is a non-instanced device.

The Remote / Local Network bits in Byte 6 of the message are used as a flag indicating whether or not the CAN Bus Monitoring packet is being sent on the same (local) network as the measurements were taken. If needed, this local network flag could be used by other CAN devices as a means of determining the network instance number for the network in which they are connected.

Table 6.43.1a defines the DG attributes and Table 6.43.1b defines the signal and parameter attributes.

Table 6.43.1a — DG definition

DG attribute	Value
Name	CAN_BUS_STATUS
DGN	1FDE6h
Default priority	6
Maximum broadcast gap	None
Normal broadcast gap	On Request / On Change / 5000ms if an error active
Minimum broadcast gap	100 ms
Number of frames	1

ACK requirements	None

Table 6.43.1b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value description
0	-	Instance	uint8	-	1 to 250 - Network Instance number
1	-	CAN Hi Dominate Voltage	uint8	V	CAN Hi Dominate Voltage Precision = 0.1 Vdc, Range = 0.0-25.0 Vdc
2	-	CAN Lo Dominate Voltage	uint8	V	CAN Lo Dominate Voltage Precision = 0.1 Vdc, Range = 0.0-25.0 Vdc
3 to 4	-	CAN Bus Impedance	uint16	Ohms	CAN Bus Impedance (ZBUS) Precision = 0.1 Ω, Range = 0-65530 Ω
5	0 to 3	Protocol Employed	uint4	-	0 = RV-C 1 = J1939 2 = NMEA2000
	4 to 7	Bit Rate Employed	uint4	-	0 = 125 kbps 1 = 250 kbps 2 = 500 kbps 3 = 1 Mbps
6	0 to 1	Network Status	uint2	-	00b = Normal 01b = Bus-off 10b = Abnormal
	2 to 3	Remote / Local Network	uint2		00b = Remote Bus. This packet is describing a bus other than the one the packet is being transmitted on. 01b = Local Bus. This packet is describing the same bus that the packet is being transmitted on.
	4 to 7	Bus Termination	uint4	-	0 = No termination (ZBUS > 200Ω) 1 = Insufficient termination, most likely a single termination (70 < ZBUS < 200Ω) 2 = Valid termination, two 120 Ω terminations (50 < ZBUS < 70Ω) 3 = Excess termination (10 < ZBUS < 50 Ω) 4 = Bus short, CAN Hi/Lo lines likely shorted together (ZBUS < 10Ω) 5 = Not available, such as if CAN Hi or Lo shorted to 12V or ground.

6.44 External Interface

This is typically a connection to a non-RV-C device or devices that are low-speed or high-latency, such as Cellular SMS. Only a small amount of data is typically transmitted across the bridge, providing a limited interface to the external device or network. The following formats apply (see Table 6.44).

Table 6.44 — External Interface

Device attribute	Value
Category	Appliances and Bridges
Default Source Address	139
Dynamic Address Range	208-223
Instance	Single

No DGNs or SPNs are defined for this device type.

6.45 Solar Charge Controller

6.45.1 Introduction

Solar Charge Controller(s) are associated with Solar Panels to provide features such as multi-stage battery charging. There may be more than It one charge controller associated with a single DC source (battery) to increase capacity. The following formats apply (see Table 6.45.1).

Table 6.45.1 — Solar definition

Device attribute	Value
Category	Power components
Default Source Address	141
Dynamic Address Range	128 to 143
Instance	Multiple

6.45.2 Solar Controller Status

The controller status DGN describes the general operating status of the Solar Controller on a particular DC Source (Battery Bank). Table 6.45.2a defines the DG attributes and Table b defines the signal and parameter attributes.

Table 6.45.2a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_STATUS
DGN	1FEB3h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	5000 ms or on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.45.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	
1 to 2	-	Charge voltage	uint16	V	see Table 5.3

					Control voltage: The voltage desired to be delivered to the battery.
3 to 4	-	Charge current	uint16	A	see Table 5.3 Control current: The current desired to be delivered to the battery.
5	-	Charge current percent of maximum	uint8	%	see Table 5.3 Control current as a percent of the maximum.
6	-	Operating state	uint8	-	Specifies the current operating state of the controller. see table 6.5.5b
7	0 to 1	Power-up state	uint2	-	00b - controller disabled 01b - controller enabled
	2 to 3	Clear history	uint2	-	00b - History not clear 01b - History cleared
	4 to 7	Force Charge	uint4	-	0 - Charging is NOT forced 1 - Force charge to bulk 2 - Force charge to float

6.45.3 Solar Controller Status 2

The controller status DGN describes the general operating status of the Solar Controller on a particular DC Source (Battery Bank). Table 6.45.3a defines the DG attributes and Table 6.45.3b defines the signal and parameter attributes.

Table 6.45.3a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_STATUS_2
DGN	1FE85h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	5000 ms or on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.45.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	
1 to 2	-	Rated battery voltage	uint16	V	Maximum battery voltage the solar charge controller can handle on its battery terminals
3 to 4	-	Rated charging current	uint16	A	Maximum current that the solar charge controller is capable of outputting to the battery.

6.45.4 Solar Controller Status 3

The controller status DGN describes the general operating status of the Solar Controller on a particular DC Source (Battery Bank). Table 6.45.4a defines the DG attributes and Table 6.45.4b defines the signal and parameter attributes.

Table 6.45.4a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_STATUS_3
DGN	1FE84h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	5000 ms or on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.45.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	
1 to 2	-	Rated solar input voltage	uint16	V	Maximum voltage the solar charge controller can accept on the solar input terminals.
3 to 4	-	Rated solar input current	uint16	V	Maximum current the solar charge controller can accept into the solar input.
5 to 6		Rated solar over-power	uint16	W	How much the solar array can be oversized without causing damage to the solar charge controller

6.45.5 Solar Controller Status 4

The controller status DGN describes the general operating status of the Solar Controller on a particular DC Source (Battery Bank). Table 6.45.5a defines the DG attributes and Table 6.45.5b defines the signal and parameter attributes.

Table 6.45.5a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_STATUS_4
DGN	1FE83h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	5000 ms or on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.45.5b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	

1 to 2	-	Today's amp-hours to battery	uint16	Ah	Total number of Ah that have gone out to the battery today.
3 to 4	-	Yesterday's amp-hours to battery	uint16	Ah	Total number of Ah that have gone out to the battery yesterday.
5 to 6	-	Day before yesterday's amp-hours to battery	uint16	Ah	Total number of Ah that have gone out to the battery the day before yesterday.

6.45.6 Solar Controller Status 5

The controller status DGN describes the general operating status of the Solar Controller on a particular DC Source (Battery Bank). Table 6.45.6a defines the DG attributes and Table 6.45.6b defines the signal and parameter attributes.

Table 6.45.6a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_STATUS_5
DGN	1FE82h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	5000 ms or on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.45.6b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	
1 to 2		Last 7 days amp-hours to battery	uint16	Ah	Total number of Ah that have gone out to the battery in the last 7 days.
3 to 6	-	Cumulative power generation	uint32	kWh	Total amount of kWh generated by the solar charge controller since the last time the history was cleared.

6.45.7 Solar Controller Status 6

The controller status DGN describes the general operating status of the Solar Controller on a particular DC Source (Battery Bank). Table 6.45.7a defines the DG attributes and Table 6.45.7b defines the signal and parameter attributes.

Table 6.45.7a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_STATUS_6
DGN	1FE81h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	5000 ms or on change
Minimum broadcast gap	500 ms

Number of frames	1
ACK requirements	None

Table 6.45.7b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	
1 to 2	-	Total number of operating days	uint16	days	Total number of days the solar charge controller has been operating since the last time the history was cleared.
3 to 4	-	Solar charge controller measured temperature	uint16	°C	Internal temperature of the solar charge controller

6.45.8 Solar Charge Controller Battery Status

The controller status DGN describes the general operating status of the Solar Controller on a particular DC Source (Battery Bank). Table 6.45.8a defines the DG attributes and Table 6.45.8b defines the signal and parameter attributes.

Table 6.45.8a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_BATTERY_STATUS
DGN	1FE80h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	5000 ms or on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.45.8b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	
1	-	DC Source Instance DEPRECATED	uint8	-	DC Source solar charge controller is associated with. See table 6.20.9b Deprecated in favor of generic methods in DC source
2	-	Charger Priority DEPRECATED	uint8	-	Priority of charger See table 6.20.9b
3 to 4	-	Measured voltage	uint16	V	Measured voltage at the solar charge controller's battery output.
5 to 6	-	Measured current	uint16	A	Measured current currently going out the solar charge controller's battery output.
7	-	Measured temperature	Uint8	°C	see Table 5.3

6.45.9 Solar Charge Controller Solar Array Status

The controller status DGN describes the general operating status of the Solar Controller on a particular DC Source (Battery Bank). Table 6.45.9a defines the DG attributes and Table 6.45.9b defines the signal and parameter attributes.

Table 6.45.9a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_SOLAR_ARRAY_STATUS
DGN	1FDFFh
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	5000 ms or on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.45.9b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	
1 to 2	-	Solar array measured voltage	uint16	V	Measured voltage on the solar array input.
3 to 4	-	Solar array measured input current	uint16	A	Measured current coming in from the solar array.

6.45.10 Solar Controller Configuration Status

This DG provides configuration information for the Solar Controller(s). Table 6.45.10a defines the DG attributes and Table 6.45.10b defines the signal and parameter attributes.

Table 6.45.10a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_CONFIGURATION_STATUS
DGN	1FEB2h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on charge
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.45.10b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	
1	-	Charging algorithm	uint8	-	The algorithm being applied to the battery. see table 6.20.11b

2	-	Controller mode	uint8	-	see table 6.20.11b
3	0 to 1	Battery sensor present	uint2	-	00b - No Battery Temperature sensor in use. 01b - Sensor is present and active.
	2 to 3	Linkage mode	uint2	-	00b – Independent 01b – Linked to DC Source Indicates that operation is linked to a DC source which reports through the DC_SOURCE_STATUS DGNs.
	4 to 7	Battery type	uint4	-	see Table 6.5.5b
4 to 5	-	Battery bank size	uint16	A•h	see Table 5.3
7	-	Maximum charging current	uint8	A	see Table 5.3

6.45.11 Solar Controller Command

This command starts or stops the charger. Note that Enabling the charger does not necessarily start the unit to converting power. Table 6.45.11a defines the DG attributes and Table 6.45.11b defines the signal and parameter attributes.

Table 6.45.11a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_COMMAND
DGN	1FEB1h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on charge
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, SOLAR_CONTROLLER_STATUS

Table 6.45.11b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	
1	-	Solar Charge Controller Status	uint8	-	0 — Disable 1 — Enable controller 2 — Start equalization 3 — Top up battery
2	0 to 1	Default state on power- up	uint2	-	00b — Controller disabled on power-up 01b — Controller enabled on power-up
	2 to 3	Clear History	uint2	-	00b — Do nothing 01b — Clear history
	4 to 7	Force Charge	uint4	-	0 - Charging is NOT forced 1 - Force charge to bulk 2 - Force charge to float

6.45.12 Solar Controller Configuration Command

This DGN provides changes in the Solar Controller configuration. Table 6.45.12a defines the DG attributes and Table 6.45.12b defines the signal and parameter attributes.

Placing a No Data (255, 65 535) in a field will cause that setting to be ignored. Thus it is possible to adjust any single setting without changing any others.

Table 6.45.12a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_CONFIGURATION_COMMAND
DGN	1FEB0h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, SOLAR_CONTROLLER_CONFIGURATION_STATUS

Table 6.45.12b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	
1	-	Charging algorithm	uint8	-	The algorithm to apply to the battery. see table 6.20.11b
2	-	Charger mode	uint8	-	see 6.20.11b
3	0 to 1	Battery sensor present	uint2	-	00b — No battery temperature sensor in use 01b — Sensor is present and active
3	2 to 3	Linkage mode	uint2	-	00b – Independent 01b – Linked to DC Source Indicates that operation is linked to a DC source which reports through the DC_SOURCE_STATUS DGNs.
3	4 to 7	Battery type	uint4	-	see table 6.5.5b
4 to 5	-	Battery bank size	uint16	A•h	see Table 5.3
7	-	Maximum charging current	uint8	A	see Table 5.3

6.45.13 Solar Controller Configuration Status 2

This DG provides configuration information for the Solar Controller(s). Table 6.45.13a defines the DG attributes and Table 6.45.13b defines the signal and parameter attributes.

Table 6.45.13a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_CONFIGURATION_STATUS_2
DGN	1FDFEh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on charge
Minimum broadcast gap	50 ms, see 3.2.4.2

Number of frames	1
ACK requirements	None

Table 6.45.13b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0		Instance	uint8	-	
1 to 2		Bulk-absorption voltage	uint16	V	The battery voltage at which the solar charge controller transitions from the bulk to absorption stage
3 to 4		Float voltage	uint16	V	The voltage to apply to the battery during the float stage.
5 to 6		Charge return voltage	uint16	V	When the battery voltage drops below this voltage the solar charge controller will start a new charge cycle to prevent self-discharge of the battery.

6.45.14 Solar Controller Configuration Command 2

This DGN provides changes in the Solar Controller configuration. Table 6.45.14a defines the DG attributes. The signal and parameter attributes are identical to SOLAR_CONTROLLER_CONFIGURATION_STATUS_2 (see Table 6.45.13b). An Instance of Zero indicates that the settings should be applied to all instances.

Table 6.45.14a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_CONFIGURATION_COMMAND_2
DGN	1FDFDh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, SOLAR_CONTROLLER_CONFIGURATION_STATUS_2

6.45.15 Solar Controller Configuration Status 3

This DG provides configuration information for the Solar Controller(s). Table 6.45.15a defines the DG attributes and Table 6.45.15b defines the signal and parameter attributes.

Table 6.45.15a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_CONFIGURATION_STATUS_3
DGN	1FDFCh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on charge

Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.45.15b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0		Instance	uint8	-	
1 to 2		Under-voltage warning voltage	uint16	V	The voltage at which the solar charge controller will trigger the low voltage warning fault.
3 to 4		Battery high voltage limit voltage	uint16	V	The voltage at which the solar charge controller considers the battery over-charged and triggers the high voltage limit fault
5 to 6		Battery low voltage limit voltage	uint16	V	The voltage at which the solar charge controller considers the battery over-discharged and triggers the low voltage limit fault

6.45.16 Solar Controller Configuration Command 3

This DGN provides changes in the Solar Controller configuration. Table 6.45.16a defines the DG attributes. The signal and parameter attributes are identical to SOLAR_CONTROLLER_CONFIGURATION_STATUS_3 (see Table 6.45.15b). An Instance of Zero indicates that the settings should be applied to all instances.

Table 6.45.16a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_CONFIGURATION_COMMAND_3
DGN	1FDFBh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, SOLAR_CONTROLLER_CONFIGURATION_STATUS_3

6.45.17 Solar Controller Configuration Status 4

This DG provides configuration information for the Solar Controller(s). Table 6.45.17a defines the DG attributes and Table 6.45.17b defines the signal and parameter attributes.

Table 6.45.17a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_CONFIGURATION_STATUS_4
DGN	1FDFAh
Default priority	6
Maximum broadcast gap	N/A

Normal broadcast gap	on charge
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.45.17b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0		Instance	uint8	-	
1 to 2		Battery high voltage limit return voltage	uint16	V	The voltage below which the solar charge controller will clear the battery high voltage limit fault
3 to 4		Battery low voltage limit return voltage	uint16	V	The voltage over which the solar charge controller will clear the battery low voltage limit fault
5		Battery low voltage limit time delay	uint8	sec	The amount of time the solar charge controller will wait when the battery voltage is below the low voltage limit voltage before triggering the battery low voltage limit fault. Precision = 1s Value range = 0 to 255s
6		Absorption duration	uint8	min	The amount of time that the bulk-absoption voltage is applied to the battery before moving to the float stage. Precision = 1 min Value range = 0 to 255 min
7		Temperature compensation factor	uint8	mV/°C	Used to adjust the charge voltage according to the measured temperature of the battery to ensure there is no damage to the battery.

6.45.18 Solar Controller Configuration Command 4

This DGN provides changes in the Solar Controller configuration. Table 6.45.18a defines the DG attributes. The signal and parameter attributes are identical to SOLAR_CONTROLLER_CONFIGURATION_STATUS_4 (see Table 6.45.17b). An Instance of Zero indicates that the settings should be applied to all instances.

Table 6.45.18a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_CONFIGURATION_COMMAND_4
DGN	1FDF9h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, SOLAR_CONTROLLER_CONFIGURATION_STATUS_4

6.45.19 Solar Controller Configuration Status 5

This DG provides configuration information for the Solar Controller(s). Table 6.45.19a defines the DG attributes and Table 6.45.19b defines the signal and parameter attributes.

Table 6.45.19a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_CONFIGURATION_STATUS_5
DGN	1FDCFh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on charge
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	none

Table 6.45.19b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	
1	-	Charger Priority	uint8	-	Priority of charger see table 6.20.9b
2	-	External temperature sensor high temperature limit	uint8	°C	see Table 5.3
3	-	External temperature sensor low temperature limit	uint8	°C	see Table 5.3

6.45.20 Solar Controller Configuration Command 5

This DGN provides changes in the Solar Controller configuration. Table 6.45.20a defines the DG attributes. The signal and parameter attributes are identical to SOLAR_CONTROLLER_CONFIGURATION_STATUS_5 (see Table 6.45.20b). An Instance of Zero indicates that the settings should be applied to all instances.

Table 6.45.20a — DG definition

DG attribute	Value
Name	SOLAR_CONTROLLER_CONFIGURATION_COMMAND_5
DGN	1FDCEh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, SOLAR_CONTROLLER_CONFIGURATION_STATUS_5

6.45.21 Solar Equalization Status

This describes the status of the Equalization process. Table 6.45.21a defines the DG attributes and Table 6.45.21b defines the signal and parameter attributes. This DGN is normally broadcast only during the equalization process.

Table 6.45.21a — DG definition

DG attribute	Value
Name	SOLAR_EQUALIZATION_STATUS
DGN	1FEAFh
Default priority	6
Maximum broadcast gap	5000 ms if active
Normal broadcast gap	1000 if active
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.45.21b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	
1 to 2	-	Time remaining	uint16	min	Precision = 1 min Value range = 0 to 65 530 min
3	0 to 1	Pre-charging status	uint2	-	00b — Pre-charging is not in process 01b — Charger is charging the batteries to prepare for equalization
4	-	Time since last equalization	uint8	days	The number of days since the last equalization cycled was applied to the battery. Precision = 1 day Value range = 0 to 252 days 253 = More than 252 days, or never.

6.45.22 Solar Equalization Configuration Status

This describes configuration information for the Equalization mode of the Charger. Table 6.45.22a defines the DG attributes and Table 6.45.22b defines the signal and parameter attributes.

Table 6.45.22a — DG definition

DG attribute	Value
Name	SOLAR_EQUALIZATION_CONFIGURATION_STATUS
DGN	1FEAEh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.45.22b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	
1 to 2	-	Equalization voltage	uint16	V	The voltage used during an equalization maintenance cycle. see Table 5.3
3 to 4	-	Equalization time	uint16	min	The amount of time the equalization voltage will be applied to the battery. Precision = 1 min Value range = 0 to 65 530 min
5	-	Equalization Interval	uint8	days	The frequency at which an equalizing charge will be applied to maintain the battery. Precision = 1 day Value range = 0 to 253 days

6.45.23 Solar Equalization Configuration Command

This changes the configuration information for the Equalization mode of the Charger. Table 6.45.23 defines the DG attributes. The signal and parameter attributes have the same format as SOLAR_EQUALIZATION_CONFIGURATION_STATUS (see Table 6.45.22b).

Table 6.45.23 — DG definition

DG attribute	Value
Name	SOLAR_EQUALIZATION_CONFIGURATION_COMMAND
DGN	1FEADh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, SOLAR_EQUALIZATION_CONFIGURATION_STATUS

6.45.24 Service Points

The SPNs defined in Table 6.45.24a shall apply to the Solar Charge Controller.

Table 6.45.24a — Service Points

MSB	ISB	LSb	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	DC Voltage
1	Instance	1	DC Current
1	Instance	2	Battery Temperature
1	Instance	3	DC Source State of Charge

1	Instance	4	DC Source State of Health
1	Instance	5	DC Source Capacity
1	Instance	6	DC Source AC Ripple
1	Instance	7	DC Source Reverse Polarity. Deprecated - not for new products.
2	Instance	0	Ambient Temperature
2	Instance	1	Battery Equalization
2	Instance	2	Solar Array Voltage
2	Instance	3	Solar Array Current

6.45.25 Alarms

Table 6.32.7 — Alarms

Instance	Description
1	History cleared
2	High solar voltage limit
100	Solar charge controller enabled
101	Solar charge controller disabled
102	Solar charge controller over temperature
103	Solar controller configuration changed
104	Solar controller configuration 2 changed
105	Solar controller configuration 3 changed
106	Solar controller configuration 4 changed
107	Solar controller configuration 5 changed
108	Solar controller equalization configuration changed
110	Transition to bulk stage
111	Transition to absorption stage
112	Transition to Overcharge State
113	Transition to Equalize State
114	Transition to float stage
115	Transition to CC/CV Stage
116	Charging Complete
119	Low battery warning
120	Low battery voltage limit
121	High battery voltage limit
122	Battery over temperature
123	Battery under temperature
124	Battery Disconnected

6.45.26 Test Profiles

The following test profiles shall be used to test adherence with the RV-C specification as it was intended to be implemented for various use cases. They outline specific tests that can be performed and indicate the required response the device is expected to produce under the test conditions.

6.45.26.1 Profile 141A: Solar Charge Controller Base

The base profile for solar controllers tests the basic functionality every solar controller must have in order to be used on an RV-C network.

Prerequisites: None
DC_SOURCE_CONNECTION_STATUS (6.5.20) (if SOLAR_CONTROLLER_BATTERY_STATUS is supported)

Reporting

ID	Datum	Test	Required Response	Required Behavior
141A-S-01	Controller Status	Operating status of DM_RV has a value of 0101b	The solar controller shall broadcast the following DGNs at least once in a 5000ms period. SOLAR_CONTROLLER_STATUS SOLAR_CONTROLLER_STATUS_2 SOLAR_CONTROLLER_STATUS_3 SOLAR_CONTROLLER_STATUS_6 (byte 1-2 can be FFh) SOLAR_CONTROLLER_BATTERY_STATUS SOLAR_CONTROLLER_SOLAR_ARRAY_STATUS SOLAR_CONTROLLER_STATUS Operating state set to anything but 0.	N/A
141A-S-02	Controller Status	Operating status of DM_RV has a value of 0101b AND Battery voltage measured by the solar charge controller is less than the bulk-absorption voltage in SOLAR_CONTROLLER_CONFIGURATION_STATUS_2	Reports SOLAR_CONTROLLER_STATUS with operating status of 2 – Bulk AND Reports GENERIC_ALARM_STATUS with instance 110 (Transition to bulk stage)	Solar Charge Controller enters bulk charging
141A-S-03	Controller Status	Operating status of DM_RV has a value of 0101b AND Battery voltage measured	Reports SOLAR_CONTROLLER_STATUS with operating status of 3 – Absorption AND	Solar Charge Controller enters absorption charging

		by the solar charge controller is greater than or equal to the bulk-absorption voltage in SOLAR_CONTROLLER_CONFIGURATION_STATUS_2	Reports GENERIC_ALARM_STATUS with instance 111 (Transition to absorption stage)	
141A-S-04	Controller Status	Operating status of DM_RV has a value of 0101b AND Solar charge controller has just completed absorption or equalize charging	Reports SOLAR_CONTROLLER_STATUS with operating status of 6 – Float AND Reports GENERIC_ALARM_STATUS with instance 114 (Transition to float stage)	Solar Charge Controller enters float charging
141A-S-05	Controller Status	Operating status of DM_RV has a value of 0101b AND Solar charge controller has just completed float charging	Reports SOLAR_CONTROL LER_STATUS with operating status of 1- Not charging AND Reports GENERIC_ALARM_STATUS with instance 117 (Charging complete)	Solar Charge Controller has completed charging the battery
141A-S-06	Controller Status	Solar charge controller measured temperature in SOLAR_CONTROLLER_STATUS_6 has exceeded the controllers maximum internal operating temperature	Reports SOLAR_CONTROLLER_STATUS with operating status of 1- Not charging AND Reports GENERIC_ALARM_STATUS with instance 102 (Solar charge controller over temperature)	Solar charge controller will stop charging
141A-S-07	Controller Status	Solar voltage has exceeded rated solar input voltage of solar charge controller	Reports SOLAR_CONTROL LER_STATUS with operating status of 1- Not charging AND Reports GENERIC_ALARM_STATUS with instance 2 (High solar input voltage limit)	Solar charge controller will stop charging
141A-S-08	Controller Status	Battery voltage is less than Under-voltage warning voltage in SOLAR_CONTROLLER_CONFIGURATION_STATUS	Reports GENERIC_ALARM_STATUS with instance 119 (Low battery warning)	N/A

		_3		
141A-S-09	Controller Status	Battery voltage is less than Battery low voltage limit voltage in SOLAR_CONTROLLER_CONFIGURATION_STATUS_3	Reports GENERIC_ALARM_STATUS with instance 120 (Low battery voltage limit)	If the solar controller has a load output it will be disconnected
141A-S-10	Controller Status	Battery voltage is greater than Battery high voltage limit voltage in SOLAR_CONTROLLER_CONFIGURATION_STATUS_3	Reports SOLAR_CONTROLLER_STATUS with operating status of 1- Not charging AND Reports GENERIC_ALARM_STATUS with instance 121 (High battery voltage limit)	Solar charge controller will stop charging
141A-S-11	Controller Status	Measured temperature in SOLAR_CONTROLLER_BATTERY_STATUS is above External temperature sensor high temperature limit in SOLAR_CONTROLLER_CONFIGURATION_STATUS_5	Reports SOLAR_CONTROLLER_STATUS with operating status of 1- Not charging AND Reports GENERIC_ALARM_STATUS with instance 122 (Battery over temperature)	Solar charge controller will stop charging
141A-S-12	Controller Status	Measured temperature in SOLAR_CONTROLLER_BATTERY_STATUS is below External temperature sensor low temperature limit in SOLAR_CONTROLLER_CONFIGURATION_STATUS_5	Reports SOLAR_CONTROLLER_STATUS with operating status of 1- Not charging AND Reports GENERIC_ALARM_STATUS with instance 123 (Battery under temperature)	Solar charge controller will stop charging
141A-S-13	Controller Status	Measured voltage in SOLAR_CONTROLLER_BATTERY_STATUS is less than 1V	Reports SOLAR_CONTROLLER_STATUS with operating status of 1- Not charging AND Reports GENERIC_ALARM_STATUS with instance 124 (Battery disconnected)	

Command Response

ID	Datum	Test	Required Response	Required Behavior
141A-C-01	Command	*Send command* SOLAR_CONTROLLER_BATTERY_COMMAND with DC Source Instance set to 01h and Charger Priority set to 01h	Reports SOLAR_CONTROLLER_BATTERY_STATUS immediately with DC Source Instance set to 01h and Charger Priority set to 01h	N/A
141A-C-02	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Charging algorithm set to 00h	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Charging algorithm set to 00h AND Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller configuration changed)	The solar charge controller will now charge with a single stage algorithm controlling the voltage using the bulk-absorption voltage in SOLAR_CONTROLLER_CONFIGURATION_STATUS_2 as the setpoint. Current will be limited to the maximum charging current value in SOLAR_CONTROLLER_CONFIGURATION_STATUS.
141A-C-03	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Charging algorithm set to 01h	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Charging algorithm set to 01h AND Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller configuration changed)	The solar charge controller will now charge with a single stage algorithm controlling the current using the maximum charging current value in SOLAR_CONTROLLER_CONFIGURATION_STATUS as the setpoint.
141A-C-04	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Charging algorithm set to 02h	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Charging algorithm set to 02h AND Reports GENERIC_ALARM_STATUS with instance 103	The solar charge controller will now charge with a 3-stage algorithm that includes: (1) Bulk (constant current) using the maximum charging current value in SOLAR_CONTROLLER_CONFIGURATION_STATUS as the setpoint (2) Absorption (constant voltage) using the bulk-absorption voltage in

			(Solar controller configuration changed)	SOLAR_CONTROLLER_CONFIGURATION_STATUS_2 as the setpoint (3) Float (constant voltage) using the float voltage in SOLAR_CONTROLLER_CONFIGURATION_STATUS_2 as the setpoint.
141A-C-05	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Charging algorithm set to 03h	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Charging algorithm set to 03h AND Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller configuration changed)	The solar charge controller will now charge with a 2-stage algorithm that includes: (1) Constant current using the maximum charging current value in SOLAR_CONTROLLER_CONFIGURATION_STATUS as the setpoint (2) Constant voltage charging using the bulk-absorption voltage in SOLAR_CONTROLLER_CONFIGURATION_STATUS_2 as the setpoint.
141A-C-06	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Charging algorithm set to 04h	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Charging algorithm set to 04h AND Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller configuration changed)	The solar charge controller will now “trickle charge” using a single stage algorithm to control the current to the battery. The actual value of the current can be proprietary and vary from one solar charge controller to the other.
141A-C-07	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Charging algorithm set to F9h	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Charging algorithm set to F9h AND Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller	The solar charge controller will now charge with a custom algorithm. The actual value of the current and or voltage and the number of charge stages can be proprietary and vary from one solar charge controller to the other.

			configuration changed)	
141A-C-08	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Charging algorithm set to FAh	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Charging algorithm set to FAh AND Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller configuration changed)	The solar charge controller will now charge with a custom algorithm. The actual value of the current and or voltage and the number of charge stages can be proprietary and vary from one solar charge controller to the other.
141A-C-09	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Battery sensor present set to 00b	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Battery sensor present set to 00b AND Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller configuration changed)	The solar charge controller will assume there is no external temperature sensor present. When SOLAR_CONTROLLER_BATTERY_STATUS is broadcast, Measured temperature will always be FFh to indicate there is no measured temperature available.
141A-C-10	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Battery sensor present set to 01b	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Battery sensor present set to 01b AND Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller configuration changed)	The solar charge controller will assume there is a temperature sensor present. When SOLAR_CONTROLLER_BATTERY_STATUS is broadcast, Measured temperature will contain the measured value.

141A-C-11	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Battery type set to 0000b	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Battery type set to 0000b AND Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller configuration changed)	The solar charge controller will use the stored profile for flooded batteries. SOLAR_CONTROLLER_CONFIGURATION_STATUS_2, SOLAR_CONTROLLER_CONFIGURATION_STATUS_3, SOLAR_CONTROLLER_CONFIGURATION_STATUS_4, SOLAR_CONTROLLER_CONFIGURATION_STATUS_5 and SOLAR_EQUALIZATION_CONFIGURATION_STATUS will automatically start broadcasting the values associated with this battery type.
141A-C-12	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Battery type set to 0001b	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Battery type set to 0001b AND Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller configuration changed)	The solar charge controller will use the stored profile for gel batteries. SOLAR_CONTROLLER_CONFIGURATION_STATUS_2, SOLAR_CONTROLLER_CONFIGURATION_STATUS_3, SOLAR_CONTROLLER_CONFIGURATION_STATUS_4, SOLAR_CONTROLLER_CONFIGURATION_STATUS_5 and SOLAR_EQUALIZATION_CONFIGURATION_STATUS will automatically start broadcasting the values associated with this battery type.
141A-C-13	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Battery type set to 0010b	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Battery type set to 0010b AND Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller configuration changed)	The solar charge controller will use the stored profile for AGM batteries. SOLAR_CONTROLLER_CONFIGURATION_STATUS_2, SOLAR_CONTROLLER_CONFIGURATION_STATUS_3, SOLAR_CONTROLLER_CONFIGURATION_STATUS_4, SOLAR_CONTROLLER_CONFIGURATION_STATUS_5 and SOLAR_EQUALIZATION_CONFIGURATION_STATUS will automatically start broadcasting the values associated with this battery type.
141A-C-14	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Battery type set to 0011b	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Battery type set to 0011b AND	The solar charge controller will use the stored profile for LiFePO4 batteries. SOLAR_CONTROLLER_CONFIGURATION_STATUS_2, SOLAR_CONTROLLER_CONFIGURATION_STATUS_3, SOLAR_CONTROLLER_CONFIGURA

			Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller configuration changed)	TION_STATUS_4, SOLAR_CONTROLLER_CONFIGURATION_STATUS_5 and SOLAR_EQUALIZATION_CONFIGURATION_STATUS will automatically start broadcasting the values associated with this battery type.
141A-C-15	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Battery type set to 1100b	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Battery type set to 1100b AND Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller configuration changed)	The solar charge controller will use the stored vendor defined battery profile. SOLAR_CONTROLLER_CONFIGURATION_STATUS_2, SOLAR_CONTROLLER_CONFIGURATION_STATUS_3, SOLAR_CONTROLLER_CONFIGURATION_STATUS_4, SOLAR_CONTROLLER_CONFIGURATION_STATUS_5 and SOLAR_EQUALIZATION_CONFIGURATION_STATUS will continue to broadcast the values associated with the previously set battery type until the values are changed using SOLAR_CONTROLLER_CONFIGURATION_COMMAND_2, SOLAR_CONTROLLER_CONFIGURATION_COMMAND_3, SOLAR_CONTROLLER_CONFIGURATION_COMMAND_4, SOLAR_CONTROLLER_CONFIGURATION_COMMAND_5 and SOLAR_EQUALIZATION_CONFIGURATION_COMMAND respectively.
141A-C-16	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Battery type set to 1101b	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Battery type set to 1101b AND Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller configuration changed)	The solar charge controller will use the stored vendor defined battery profile. SOLAR_CONTROLLER_CONFIGURATION_STATUS_2, SOLAR_CONTROLLER_CONFIGURATION_STATUS_3, SOLAR_CONTROLLER_CONFIGURATION_STATUS_4, SOLAR_CONTROLLER_CONFIGURATION_STATUS_5 and SOLAR_EQUALIZATION_CONFIGURATION_STATUS will continue to broadcast the values associated with the previously set battery type until the values are changed using SOLAR_CONTROLLER_CONFIGURATION_COMMAND_2,

				SOLAR_CONTROLLER_CONFIGURATION_COMMAND_3, SOLAR_CONTROLLER_CONFIGURATION_COMMAND_4, SOLAR_CONTROLLER_CONFIGURATION_COMMAND_5 and SOLAR_EQUALIZATION_CONFIGURATION_COMMAND respectively.
141A-C-17	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Battery bank size set to 0064h	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Battery bank size set to 0064h AND Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller configuration changed)	N/A
141A-C-18	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND with Maximum charging current set to 0Ah	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS immediately with Maximum charging current set to 0Ah AND Reports GENERIC_ALARM_STATUS with instance 103 (Solar controller configuration changed)	The solar charge controller will charge the battery with a maximum of 10A.
141A-C-19	Command	*Send command* SOLAR_CONTROLLER_COMMAND with Solar Charge Controller Status set to 00h	Reports SOLAR_CONTROLLER_STATUS immediately with operating state set to 00h AND Reports DM_RV immediately with operating status set to 0100b AND	The solar charge controller will change its operating status to be ON but in standby mode by setting Operating status of DM-RV to 0100b. When in this mode it will respond to commands and broadcast required DGNs but will not charge the battery.

			Reports GENERIC_ALARM_STATUS with instance 101 (Solar charge controller disabled)	
141A-C-20	Command	*Send command* SOLAR_CONTROLLER_COMMAND with Solar Charge Controller Status set to 01h	Reports SOLAR_CONTROLLER_STATUS immediately with operating state set to anything but 00h AND Reports DM_RV immediately with Operating status set to 0101b AND Reports GENERIC_ALARM_STATUS with instance 100 (Solar charge controller enabled)	The solar charge controller will change its operating status to be ON and active by setting Operating status of DM-RV to 0101b. When in this mode it will respond to commands, broadcast required DGNs and actively try to charge the battery.
141A-C-21	Command	*Send command* SOLAR_CONTROLLER_COMMAND with default state on power-up set to 00b	Reports SOLAR_CONTROLLER_STATUS immediately with default state on power-up set to 00b	When the solar charge controller is power cycled it will start up with its operating status set to ON but in standby mode with Operating status of DM-RV set to 0100b and operating state in SOLAR_CONTROLLER_STATUS will be 0 - Disable. When in this mode it will respond to commands and broadcast required DGNs but will not charge the battery.
141A-C-22	Command	*Send command* SOLAR_CONTROLLER_COMMAND with Default state on power- up set to 00b	Reports SOLAR_CONTROLLER_STATUS immediately with Default state on power-up set to 01b.	When the solar charge controller is power cycled it will start up with its operating status set to ON but in standby mode with Operating status of DM-RV set to 0100b and operating state in SOLAR_CONTROLLER_STATUS will be between 1 and 7 but not 0. When in this mode it will respond to commands and broadcast required DGNs but will not charge the battery.

141A-C-23	Command	Send command SOLAR_CONTROLLER_COMMAND with Force charge set to 1 AND Battery voltage measured by the solar charge controller is less than the bulk-absorption voltage in SOLAR_CONTROLLER_CONFIGURATION_STATUS_2	Reports SOLAR_CONTROLLER_STATUS immediately with Force charge set to 1 AND Reports GENERIC_ALARM_STATUS with instance 110 (Transition to bulk stage)	The solar charge controller will transition to bulk charging regardless of what stage the charger was in prior to receiving this command. If the solar charge controller has more than one battery output any prioritization of batteries will be ignored until the battery voltage measured by the solar charge controller for this battery is equal to the bulk-absorption voltage in SOLAR_CONTROLLER_CONFIGURATION_STATUS_2.
141A-C-24	Command	Send command SOLAR_CONTROLLER_COMMAND with Force charge set to 2 AND Battery voltage measured by the solar charge controller is greater than or equal to the bulk-absorption voltage in SOLAR_CONTROLLER_CONFIGURATION_STATUS_2	Reports SOLAR_CONTROLLER_STATUS immediately with Force charge set to 1 AND Reports GENERIC_ALARM_STATUS with instance 114 (Transition to float stage)	The solar charge controller will transition to float charging regardless of what stage the charger was in prior to receiving this command. If the solar charge controller has more than one battery output any prioritization of batteries will be ignored until the solar charge controller has completed float charging for this battery.
141A-C-25	Command	Send command SOLAR_CONTROLLER_CONFIGURATION_COMMAND_2	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS_2 immediately with all bytes matching those from the command that were not 0xFF. AND Reports GENERIC_ALARM_STATUS with instance 104 (Solar controller configuration 2 changed)	Sending this command will manually edit the bulk- absorption voltage and/or the float voltage and/or the charger return voltage, which will cause the battery type broadcast in Battery type parameter of SOLAR_CONTROLLER_CONFIGURATION_STATUS to automatically change to 12 or 13 indicating a custom battery type. The solar charge controller will immediately restart a new charging cycle and use these voltages to charge the battery.

141A-C-26	Command	Send command SOLAR_CONTROLLER_CONFIGURATION_COMMAND_3	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS_3 immediately with all bytes matching those from the command that were not 0xFF. AND Reports GENERIC_ALARM_STATUS with instance 105 (Solar controller configuration 3 changed)	Sending this command will manually edit under-voltage warning voltage and/or battery high voltage limit voltage and/or battery low voltage limit voltage, which will cause the battery type broadcast in Battery type parameter of SOLAR_CONTROLLER_CONFIGURATION_STATUS to automatically change to 12 or 13 indicating a custom battery type. The solar charge controller will immediately restart a new charging cycle and use these voltages to charge the battery.
141A-C-27	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND_4	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS_4 immediately with all bytes matching those from the command that were not 0xFF. AND Reports GENERIC_ALARM_STATUS with instance 106 (Solar controller configuration 4 changed)	Sending this command will manually edit the battery high voltage limit return voltage and/or battery low voltage limit return voltage and/or battery low voltage limit time delay and/or absorption duration and/or the temperature compensation factor, which will cause the battery type broadcast in Battery type parameter of SOLAR_CONTROLLER_CONFIGURATION_STATUS to automatically change to 12 or 13 indicating a custom battery type. The solar charge controller will immediately restart a new charging cycle and use these parameters to charge the battery.
141A-C-28	Command	Send command SOLAR_CONTROLLER_CONFIGURATION_COMMAND_5	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS_5 immediately with all bytes matching those from the command that were not 0xFF. AND Reports GENERIC_ALARM_STATUS with instance 107 (Solar controller configuration 5 changed)	Sending this command will manually edit the battery high voltage limit return voltage and/or battery low voltage limit return voltage and/or battery low voltage limit time delay and/or absorption duration and/or the temperature compensation factor, which will cause the battery type broadcast in Battery type parameter of SOLAR_CONTROLLER_CONFIGURATION_STATUS to automatically change to 12 or 13 indicating a custom battery type. The solar charge controller will immediately restart a new charging cycle and use these parameters to charge the battery.

6.45.26.2 Profile 141B: Solar Charge Controller History

The history profile tests the reporting and control of optional historical parameters used to provide performance details for display to the user.

Prerequisites: Base (6.45.26.1)

Reporting

ID	Datum	Test	Required Response	Required Behavior
141B-S-01	Controller Status	Operating status of DM_RV has a value of 0101h and SOLAR_CONTROLLER_STATUS Operating state set to anything but 0.	The solar controller shall broadcast the following DGNs at least once in a 5000ms period. SOLAR_CONTROLLER_STATUS_4 SOLAR_CONTROLLER_STATUS_5 SOLAR_CONTROLLER_STATUS_6	N/A

Command Response

ID	Datum	Test	Required Response	Required Behavior
141B-C-01	Command	*Send command* SOLAR_CONTROLLER_COMMAND with Clear History set to 01b	Reports SOLAR_CONTROLLER_STATUS immediately with Clear History set to 01b	The solar charge controller will clear the history data broadcast in Total number of operating days parameter of SOLAR_CONTROLLER_STATUS_6 as well as all parameters in SOLAR_CONTROLLER_STATUS_5 and SOLAR_CONTROLLER_STATUS_4 by setting the values to zero.

6.45.26.3 Profile 141C: Solar Charge Controller Equalization/Balancing

The equalization/balancing profile tests reporting and control of optional flooded battery equalization or lithium battery balancing.

Prerequisites: Base (6.45.26.1)

Reporting

ID	Datum	Test	Required Response	Required Behavior
141C-S-01	Controller Status	Operating status of DM_RV has a value of 0101h	The solar controller shall broadcast the following DGNs at least once in a 5000ms period if there is an equalization currently in progress. SOLAR_EQUALIZATION_STATUS	N/A
141C-S-02	Controller Status	Time since last equalization in SOLAR_EQUALIZATION_STATUS has exceeded Equalization Interval in SOLAR_EQUALIZATION_CONFIGURATION_STATUS AND	Reports SOLAR_CONTROLLER_STATUS with operating status of 5-Equalize AND Reports GENERIC_ALARM_STATUS with instance 113 (Transition to	Solar Charge Controller enters equalize charging

		Battery voltage measured by the solar charge controller is greater than the bulk-absorption voltage in SOLAR_CONTROLLER_CONFIGURATION_STATUS_2	equalize state)	

Command Response

ID	Datum	Test	Required Response	Required Behavior
141C-C-01	Command	*Send command* SOLAR_EQUALIZATION_CONFIGURATION_COMMAND	Reports SOLAR_EQUALIZATION_CONFIGURATION_STATUS immediately with bytes 0-7 matching those from the command that were not 0xFF AND Reports GENERIC_ALARM_STATUS with instance 108 (Solar controller equalization configuration changed)	Sending this command will edit the equalization voltage and/or equalization time and/or equalization interval. If there is currently an equalization maintenance cycle in progress when these parameters are changed these parameters will take effect immediately, but the cycle will not be restarted.
141C-C-02	Command	*Send command* SOLAR_CONTROLLER_COMMAND with Solar Charge Controller Status set to 02h	Reports SOLAR_CONTROLLER_STATUS immediately with operating state set to 05h AND Reports DM_RV immediately with Operating status set to 0101b AND Reports GENERIC_ALARM_STATUS with instance 113 (Transition to Equalize State)	The solar charge controller will immediately initiate a maintenance cycle and change its operating status to be ON and active by setting Operating status of DM-RV to 0101b. When in this mode it will respond to commands and broadcast required DGNs.

6.45.26.4 Profile 141D: Solar Charge Controller Static Custom Battery

The static custom battery profile tests the behavior of the solar charge controller when the battery type is set to 12 or 13 (which are designated for "vendor defined") and one or both of these battery types are statically set to support a custom battery type.

Prerequisites: Base (6.45.26.1)

Command Response

ID	Datum	Test	Required Response	Required Behavior
141D-C-01	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND_2 with all parameters set to FFh	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS_2 immediately with the hard-coded values AND Reports GENERIC_ALARM_STATUS with instance 104 (Solar controller configuration 2 changed)	N/A
141D-C-02	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND_2 with all parameters set to something other than FFh	Reports with NAK and then SOLAR_CONTROLLER_CONFIGURATION_STATUS_2 immediately with hard-coded values. AND Reports GENERIC_ALARM_STATUS with instance 104 (Solar controller configuration 2 changed) Note: The NAK indicates that the solar charge controller does not support user customizable charge parameters. The reporting of SOLAR_CONTROLLER_CONFIGURATION_STATUS_2 is intended to provide a way to read the hard-coded values.	N/A
141D-C-03	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND_3 with all parameters set to FFh	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS_3 immediately with the hard-coded values AND Reports GENERIC_ALARM_STATUS with instance 105 (Solar controller configuration 3 changed)	N/A
141D-C-04	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND_3 with all parameters set to something other than FFh	Reports with NAK and then SOLAR_CONTROLLER_CONFIGURATION_STATUS_3 immediately with hard-coded values AND Reports GENERIC_ALARM_STATUS	N/A

			with instance 105 (Solar controller configuration 3 changed) Note:The NAK indicates that the solar charge controller does not support user customizable charge parameters. The reporting of SOLAR_CONTROLLER_CONFIGURATION_STATUS_2 is intended to provide a way to read the hard-coded values.	
141D-C-05	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND_4 with all parameters set to FFh	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS_4 immediately with the hard-coded values AND Reports GENERIC_ALARM_STATUS with instance 106 (Solar controller configuration 4 changed)	N/A
141D-C-06	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND_4 with all parameters set to something other than FFh	Reports with NAK and then SOLAR_CONTROLLER_CONFIGURATION_STATUS_4 immediately with hard-coded values AND Reports GENERIC_ALARM_ STATUS with instance 106 (Solar controller configuration 4 changed) Note: The NAK indicates that the solar charge controller does not support user customizable charge parameters. The reporting of SOLAR_CONTROLLER_CONFIGURATION_STATUS_2 is intended to provide a way to read the hard-coded values.	N/A

6.45.26.5 Profile 141E: Solar Charge Controller Configurable Custom Battery

The configurable custom battery profile tests the behavior of the solar charge controller when the battery type is set to 12 or 13 (which are designated for “vendor defined”) and one or both of these battery types are used to provide user configurable charge parameters.

Prerequisites: Base (6.45.26.1)

Command Response

ID	Datum	Test	Required Response	Required Behavior

141E-C-01	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND_2 with all parameters set to something other than FFh	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS_2 immediately with all parameters matching those from the command AND Reports GENERIC_ALARM_STATUS with instance 104 (Solar controller configuration 2 changed)	Sending this command will manually edit the bulk-absorption voltage and/or the float voltage and/or the charger return voltage, which will cause the battery type broadcast in Battery type parameter in SOLAR_CONTROLLER_CONFIGURATION_STATUS to automatically change to 12 or 13 indicating a custom battery type. The solar charge controller will immediately restart a new charging cycle and use these voltages to charge the battery.
141E-C-02	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND_3 with all parameters set to something other than FFh	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS_3 immediately with all parameters matching those from the command AND Reports GENERIC_ALARM_STATUS with instance 105 (Solar controller configuration 3 changed)	Sending this command will manually edit under-voltage warning voltage and/or battery high voltage limit voltage and/or battery low voltage limit voltage, which will cause the battery type broadcast in Battery type parameter in SOLAR_CONTROLLER_CONFIGURATION_STATUS to automatically change to 12 or 13 indicating a custom battery type. The solar charge controller will immediately restart a new charging cycle and use these voltages to charge the battery.
141E-C-03	Command	*Send command* SOLAR_CONTROLLER_CONFIGURATION_COMMAND_4 with all parameters set to something other than FFh	Reports SOLAR_CONTROLLER_CONFIGURATION_STATUS_4 immediately with all parameters matching those from the command AND Reports GENERIC_ALARM_STATUS with instance 106 (Solar controller configuration 4 changed)	Sending this command will manually edit the battery high voltage limit return voltage and/or battery low voltage limit return voltage and/or battery low voltage limit time delay and/or absorption duration and/or the temperature compensation factor, which will cause the battery type broadcast in Battery type parameter in SOLAR_CONTROLLER_CONFIGURATION_STATUS to automatically change to 12 or 13 indicating a custom battery type. The solar charge controller will immediately restart a new charging cycle and use these parameters to charge the battery.

6.45.26.6 Profile 141F: Directed Charger

A Directed Charger is one which has the ability to take guidance from an external device for the real-time setting of charging state and goals. Often this is a BMS (Battery Management System) or SOC (State of Charge) device, but it could also be another charging device associated with the same DC Instance or DC Bus. Such a device is known as a Remote Battery Master

(RBM).

A RBM must at minimum broadcast DC_STATUS_4 indicating its Instance, Priority, as well as desired Charge State to provided direction to chargers. An RBM must also broadcast DC_STATUS_1, and DC_STATUS_2 to provide a periodic heart-beat indicating the RBM is still present and active. (Refer to DC_STATUS for additional details on additional minimum requirements, including required fields, for an RBM as well as the presence of multiple potential RMBs and the handling of such).

- Directed Chargers shall respond to the highest priority RBM associated with its Battery or DC Bus Instance.
- Directed Chargers may (optionally) act as an RBM, providing it has sufficient capability and is configures to act as an RBM.
- Directed Charges may (optionally) utilize information supplied from an RBM to augment instrumentation (Remote Instrumentation).
- Only one RBM shall be followed at any given time: Even if that RBM is unable to supply full battery status information (e.g., does not supply a battery temperature value)
- In the absence of no RBM, Directed Chargers shall behave according to the 141A: Solar Charge Controller Base Profile.

Prerequisites: Base (6.45.26.1), RBM associated with same DC Instance / Bus ID.
DC_SOURCE_CONNECTION_STATUS (6.5.20)

Reporting

ID	Datum	Test	Required Response	Required Behavior
141F-R-01	Application of energy – No RBM present.	a. Charging starts with no RBM indicated.	a. Unit behaves per Basic Charger Profile above.	When no validated direction has been received from an external RBM, the charger shall proceed based on its existing configuration in a stand-alone fashion. Care needs to be taken by the evaluator, as some chargers may have an option to enter a standby or even faulted mode in the lack of a validated RBM.
141F-R-02	Introduction of RBM with different DC Instance / bus.	a. Validated RBM begins broadcasting direction using a DC Instance/bus not matching the DC Instance/bus the charger is configured for.	a. Charger ignores RBM and continues to behave per the Base Profile.	The arrival of any directional messages not associated with the configured DC Instance should be ignored. Only messages which match the same DC Instance (indicating the charger and the battery are on the same DC bus) should be processed.
141F-R-03	Introduction of RBM with matching DC Instance / bus.	a. Validated RBM begins broadcasting direction of DC Instance using a matching Charger's configured DC Instance	a. Charger will begin following requested charging state.	When a validated charging direction message is received, the charger should begin following those directions. Directions may be as simple as 'Start/stop charging', in which case the charger will follow its configure charging profile. Or the

		b. Validated RBM supplies DC Voltage and/or current goals or targets.	b. Charger shall utilize those as its targets. Limiting its energy output to meet the most restrictive voltage or current goal supplied.	directions may include specific goals / limits for battery voltage and/or current, in which case those goals should override any internal charger configuration.
		c. Validated RBM ceases broadcasting of DC_STATUS_x messages	c. Charger shall revert to Base Profile behavior above. It may restart a new charging cycle, or continue on the present charging cycle and mode, A charger may also be able to take other actions depending on its configuration and capability.	
141F-R-04	Charger requested to stop charging via external wire signal (Optional: If capable)	a. Activation of external Charger Enable/Disable signal wire to disable charger.	a. Unit shall cease deliver of energy (Current <= 1A) within 500mS of application of signal. – overriding any RBM directions. SOLAR_CONTROLLER_STATUS message shall set Operating State field = Not Charging, Float, or Disabled (Device and / or configuration dependent)	Even in the presence of validated charging direction messages via RV-C, if the charger is equipped with a physical charger/do not charge wire, that capability should override any CAN based directions. This allows for a kind of belts-and-suspenders installation with the hardware signal being a safety backstop.

Command Response

ID	Datum	Test	Required Response	Required Behavior
141F-C-01	High Voltage Condition	Send DC_SOURCE_STATUS_6 with matching DC-Instance and “High Voltage Limit Status” set = Limit Reached	Unit shall terminate charging. SOLAR_CONTROLLER_STATUS "Operating State" shall change to 'Disabled' or 'No Charging'	A Directed Charger must monitor for relevant commands outside the Charger section and respond accordingly. Limit conditions shall be respected even if other Directions are received, example if a DC_SORUCE_STATUS_4 is still asking for Charging, but a High Limit is received, charging shall stop.
141F-C-02	High Voltage Disconnect	Send DC_SOURCE_STATUS_6 with matching DC-Instance and “High Voltage Disconnect Status” set = Limit Reached	Unit shall terminate charging and prepare for disconnect status. SOLAR_CONTROLLER_STATUS "Operating State" shall change to 'Disabled' or 'No Charging'	Some chargers may chose to enter a Faulted state when a Disconnect command is received.

141F-C-03	High Temperature Condition	Send DC_SOURCE_STATUS_6 with matching DC-Instance and "High DC source temperature limit status" set = Limit Reached	Unit shall terminate charging. SOLAR_CONTROLLER_STATUS "Operating State" shall change to 'Disabled' or 'No Charging'	
141F-C-04	High Temperature Disconnect	Send DC_SOURCE_STATUS_6 with matching DC-Instance and "High DC source temperature disconnect status" set = Limit Reached	Unit shall terminate charging and prepare for disconnect status. SOLAR_CONTROLLER_STATUS "Operating State" shall change to 'Disabled' or 'No Charging'	Some chargers may chose to enter a Faulted state when a Disconnect command is received.
141F-C-05	Global Battery Off	Send DC_SOURCE_COMMAND with matching DC-Instance and "Desired Power On/Off Status" = off	Unit shall terminate charging. SOLAR_CONTROLLER_STATUS "Operating State" shall change to 'Disabled' or 'No Charging'	Reception of global DC_SOURCE off commands shall cause all associated charging sources to terminate charging. Upon receiving On command, the charger may resume its prior mode of operation.
141F-C-06	Global Charger Off	Send DC_SOURCE_COMMAND with matching DC-Instance and "Desired Charge On/Off Status" = off	Unit shall terminate charging. SOLAR_CONTROLLER_STATUS "Operating State" shall change to 'Disabled' or 'No Charging'	

6.45.26.7 Profile 141G: Prioritizing Charger

A Prioritizing Charger is one which has the ability to follow guidance from an RBM, and also monitor other charging sources adjusting its output as needed to assure the charging devices with higher priority are fully utilized (90% or above) by adjusting its own output as needed to meet the total energy goals supplied by the RBM. In order for a Prioritizing Charger to operate, the RBM must supply a Goal Current value as part of DC_STATUS_4 and chargers must supply their utilization as part of SOLAR_CONTROLLER_STATUS.

Prerequisites: Base (6.45.26.1), 141F: Directed Charger (6.45.26.6), RBM associated with same DC Instance / Bus ID supplying charging current goals.
DC_SOURCE_CONNECTION_STATUS (6.5.20)

Command Response

ID	Datum	Test	Required Response	Required Behavior

141G-R-01	Communication	a. Broadcast Charger Utilization	a. Solar Charge Controller broadcasts SOLAR_CONTROLLER_ STATUS Required fields: Charger current as percent of maximum (% utilization of charger)	To allow for prioritization of chargers, it is important to send out an accurate representation of charger utilization. But this must be relative to the real-time capabilities of the charger, not the idealized capabilities. Example, if a given charger is able to operate from either a 220v / 50A source and able to provide upwards of 100A, or a 120v/15A source and is limited to 25A in this case, it must adjust its utilization accurately. In this case, if it si being powered by a 120v/15A source and delivering 20A, its utilization is 80%, not 20%
		b. Broadcast Charger DC Bus and priority.	b. Solar Charge Controller broadcasts SOLAR_CONTROLLER_ BATTERY_STATUS Required fields: DC Source Instance, Charger Priority	
141G-R-02	RBM Goal Current Exceeded	a. Lower Priority charging devices present on same DC Instance/bus with indicated utilization above 10%	a. No change in unit's behaviors – lower priority chargers to adjust their output down.	During prioritization, when the current is over goal, the charger should ascertain of it is the lowers priority active charging source, taking into account charges, Solar, DC Generators –all charging sources and their priority. If indeed it is one of the lowest priority sources, it should reduce its output to lower total system current delivery.
		b. Charging device is lowest priority device associated with DC Instance/bus	b. Unit reduces energy output until its output is 0A, or total charging current is at or below RBM goal.	
141G-R-03	RBM Goal Current not met	a. Higher Priority charging devices present on same DC Instance/bus with indicated utilization under 90%.	a. No change in units behaviors – higher priority chargers to adjust their output up.	Likewise, if current deliver is under goal the charging source should assess if it is the lower priority source and increase its output. During this time it is also important that a charging source assures higher priority sources are operating at a high level of utilization.
		b. Higher Priority charging devices present on same DC Instance/bus with indicated utilization at or above 90%	b. Unit increases energy output until it reaches 90+ % or the total charging current is at the RBM goal.	

6.46 Roof Fan

6.46.1 Introduction

This DGN contains control information for the rooftop fan vents. The following formats apply (see Table 6.46.1).

Table 6.46.1 — Roof Fan definition

Device attribute	Value
Category	Comfort Systems
Default Source Address	142
Dynamic Address Range	192-207
Instance	Multiple

6.46.2 Roof Fan Status 1

This DG communicates the roof fan status. Table 6.46.2a defines the DG attributes and Table 6.46.2b defines the signal and parameter attributes.

Table 6.46.2a — DG definition

DG attribute	Value
Name	ROOF_FAN_STATUS_1
DGN	1FEA7h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	5000 ms or on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.46.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1-250
1	0 to 1	System Status	uint2	-	00b – Off 01b – On
	2 to 3	Fan Mode	uint2	-	00b – Auto 01b – Forced On
	4 to 5	Speed Mode	uint2	-	00b – Auto (Variable) 01b – Manual
	6 to 7	Light	uint2	-	00b – Off 01b – On
2	-	Fan Speed Setting	uint8	%	see Table 5.3
3	0 to 1	Wind Direction Switch	uint2	-	00b – Air Out 01b – Air In
	2 to 5	Dome Position	uint4	-	0000b – Closed 0001b – ¼ Open 0010b – ½ Open

					0011b – ¾ Open 0100b – Open
	6 to 7	Deprecated	uint2	-	Deprecated and replaced under ROOF_FAN_STATUS_2
4 to 5	-	Ambient Temperature	uint16	°C	see Table 5.3
6 to 7	-	Set Point	uint16	°C	see Table 5.3

6.46.3 Roof Fan Status 2

This DGN communicates the Roof Fan status. Table 6.46.3a defines the DG attributes and Table 6.46.3b defines the signal and parameter attributes.

6.46.3a — DG definition

DG attribute	Value
Name	ROOF_FAN_STATUS_2
DGN	1FDE3h
Default priority	6
Maximum broadcast gap	5000 ms
Normal broadcast gap	5000 ms or on change
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.46.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1-250
1		Dome Mode	uint8	-	0 - Stopped 1 - Opening (Raising) 2 - Closing (Lowering)
2		Dome Position	uint8	%	see Table 5.3
3	0 to 1	Rain Sensor	uint2	-	00b – No Rain Detected 01b – Rain Detected 10b – Sensor Error 11b – Rain Sensor Not Installed
	2 to 3	Rain Sensor Override	uint2	-	00b – Rain Sensor Used (dome will

					automatically close when rain is detected) 01b – Rain Sensor Overridden (dome will not automatically close due to rain or can be raised despite the rain)
	4 to 5	Setpoint Controlled Dome State	uint2	-	00b - Dome is not automatically controlled 01b - Dome is automatically controlled (Dome will automatically open/close as needed by controller to maintain setpoint)
	6 to 7	Auto Close Dome on Fan Off	uint2	-	0 - Dome will stay open when fan shuts off 1 - Dome will automatically close when fan shuts off
4	0 to 1	Auto Fan Off on Dome Close	uint2	-	0 - Fan will not automatically shut off when dome closes 1 - Fan will automatically shut off when dome closes
	2 to 7	Fan Steps (Speeds) Supported	uint6	-	0 - 200 step resolution (0.5%) 1 - 1 step resolution (0%/100% only) 2-50 - Number of steps/speeds supported by fan 63 - Fan Speed Increment/Decrement not supported Note: Fans supporting the Fan Speed Increment/Decrement command must populate this field with data as it indicates how many steps/speeds are supported by the fan.
5 to 7		Reserved	uint24	-	Reserved

6.46.4 Roof Fan Command 1

This DGN allows external control of the Roof Fan. Table 6.46.4a defines the DG attributes and Table 6.46.4b defines the signal and parameter attributes.

Table 6.46.4a — DG definition

DG attribute	Value
Name	ROOF_FAN_COMMAND_1
DGN	1FEA6h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed

Number of frames	1
ACK requirements	NAK, ROOF_FAN_STATUS

Table 6.46.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1-250
1	0 to 1	System Status	uint2	-	00b – Off 01b – On
	2 to 3	Fan Mode	uint2	-	00b – Auto 01b – Force On
	4 to 5	Speed Mode	uint2	-	00b – Auto (Variable) 01b – Manual
	6 to 7	Light	uint2	-	00b – Off 01b – On
2	-	Fan Speed Setting	uint8	%	see Table 5.3
3	0 to 1	Wind Direction Switch	uint2	-	00b – Air Out 01b – Air In
	2 to 5	Dome Position [Deprecated]	uint4	-	0000b – Close 0001b – ¼ Open 0010b – ½ Open 0011b – ¾ Open 0100b – Open 0101b – Stop Recommend to use Desired Dome Position under ROOF_FAN_COMMAND_2 for new development.
	6 to 7	Rain Sensor [Deprecated]	uint2	-	Deprecated and replaced under ROOF_FAN_COMMAND_2
4 to 5	-	Ambient Temperature	uint16	°C	see Table 5.3
6 to 7	-	Set Point	uint16	°C	see Table 5.3

6.46.5 Roof Fan Command 2

This DGN allows external control of the Roof Fan. Table 6.46.5a defines the DG attributes and Table 6.46.5b defines the signal and parameter attributes.

Table 6.46.5a — DG Definition

DG attribute	Value
Name	ROOF_FAN_COMMAND_2
DGN	1FDE2h

Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, ROOF_FAN_STATUS_2

Table 6.46.5b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1-250
1	-	Dome Command	uint8	-	0 – Stop 1 - Open (Raise) 2 - Close (Lower)
2	-	Desired Dome Position	uint8	%	0-200 - See Table 5.3 250 - Momentary operation - When received, run in the requested direction for one second. As long as this is received once per second the dome will continue to run.
3	0 to 1	Rain Sensor Override	uint2	-	0 - Use Rain Sensor (dome will automatically close when rain is detected) 1 - Override Rain Sensor (dome will not automatically close due to rain or can be raised despite the rain)
	2 to 3	Desired Setpoint Controlled Dome	uint2	-	0 - Dome will not be automatically controlled 1 - Dome will be automatically controlled (Lid will automatically open/close as needed to maintain setpoint)
	4 to 5	Auto Close Dome on Fan Off	uint2	-	0 - Leave dome open when fan shuts off 1 - Automatically close dome when fan shuts off
	6 to 7	Auto Fan Off on Dome Close	uint2	-	0 - Leave fan on when dome is closed 1 - Automatically shut fan off when dome is closed
4	0 to 1	Fan Speed Increment/Decrement	uint2	-	0 - Decrement fan speed 1 - Increment fan speed Note: Step size is defined by Increment/Decrement Step or the fan itself where speeds are fixed (For example a 3 speed fan)
	2 to 7	Fan Speed Increment/Decrement Step	uint6	-	0 - Directly to 0%/100% 1 - One step 2-50 - Number of steps for increment/decrement command 63 - One step Note: This would typically be used on fans that

					support a broad range of possible speeds. When adjusting fixed speed fans this value would typically be set to 63 (111111b)
5 to 7	-	Reserved	uint24	-	Reserved

6.46.6 Test Profiles

6.46.6.1 Roof Fan Control Base Profile

(ROOF_FAN_COMMAND_1/ROOF_FAN_STATUS_1)

ID	Datum	Test	Required Response	Required Behavior
142A-C-01	Enable Fan	Send ROOF_FAN_COMMAND_1 with Fan Mode = 01b (Force On)	ROOF_FAN_STATUS_1 reports the System Status = 01b (On)	Fan turns on
		Send ROOF_FAN_COMMAND_1 with Fan Mode = 00b (Off)	ROOF_FAN_STATUS_1 reports the System Status = 00b (Off)	Fan turns off

6.46.6.2 Roof Fan Speed Control Base Profile

(ROOF_FAN_COMMAND_1/ROOF_FAN_STATUS_1)

ID	Datum	Test	Required Response	Required Behavior
142A-C-01	Fan Speed Setting	With ROOF_FAN_COMMAND_1 System Status = 01b (On) and Fan Mode = 01b (Force On) and, if supported, Speed Mode = 01b (Manual) send ROOF_FAN_COMMAND_1 with Fan Speed Setting = 200 (100%)	ROOF_FAN_STATUS_1 reports the Fan Speed Setting = 200 (100%)	Fan goes to 100%
		With ROOF_FAN_COMMAND_1 System Status = 01b (On) and Fan Mode = 01b (Force On) and, if supported, Speed Mode = 01b (Manual) send ROOF_FAN_COMMAND_1 with Fan Speed Setting = user selected speed supported by fan	ROOF_FAN_STATUS_1 reports the Fan Speed Setting = requested fan speed	Fan goes to requested speed

6.46.6.3 Roof Fan Dome Control Base Profile

(ROOF_FAN_COMMAND_2/ROOF_FAN_STATUS_2)

ID	Datum	Test	Required Response	Required Behavior
142A-C-01	Dome Command ROOF_FAN_COMMAND_2	With dome closed, send ROOF_FAN_COMMAND_2 Dome Command = 1 (Open) and Desired Dome Position = 200 (100%)	ROOF_FAN_STATUS_2 reports the Dome Mode = 1 (Opening) and Dome Position = 200 (100%)	Dome fully raises

		With dome open, send ROOF_FAN_COMMAND_2 Dome Command = 2 (Close) and Desired Dome Position = 0 (0%)	ROOF_FAN_STATUS_2 reports the Dome Mode = 2 (Closing) and Dome Position = 0 (0%)	Dome fully closes
		With dome in motion, send ROOF_FAN_COMMAND_2 with Dome Command = 0 (Stop)	ROOF_FAN_STATUS_2 reports the Dome Mode = 0 (Stopped) and Dome Position = approximate percent where stopped	Dome stops immediately

6.47 Generic Alarm

This device definition provides a generalized method for handling alarms such as a burglar alarm or a hazard detector not otherwise specified in this protocol. Such alarms are often integrated into other devices, such as a door-lock control or appliance. Note that such multi-function devices should report a DM-RV as an alarm device in addition to the DM-RV for their major function. To avoid excess network traffic, the Full-Time Monitoring feature should be reserved for alarms whose absence from the network requires immediate user notification, for example, to satisfy regulations.

Table 6.47 — Alarm

Device attribute	Value
Category	Sensors
Default Source Address	144
Dynamic Address Range	160 to 175
Instance	Multiple

6.47.1 Alarm Status

Table 6.47.1a defines the DG attributes, and Table 6.47.1b defines the identifies the signal and parameter attributes.

Table 6.47.1a — DG definition

DG attribute	Value
Name	GENERIC_ALARM_STATUS
DGN	1FE9Fh
Default priority	6
Maximum broadcast gap	If Full-Time Monitoring Required: 5000 ms
Normal broadcast gap	on change and periodically if Full-Time Monitoring Required
Minimum broadcast gap	500ms
Number of frames	1
ACK requirements	None

6.47.1b— Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Definition
0	-	Instance	uint8	-	1 – 253
1		DSA	uint8	-	0-63 – Generic. 64-253 – DSA of the device function.
2	0 to 1	Alarm Triggered	uint2	-	00b – Alarm is not Triggered. Either the condition is “Ok” or it is not Ready. 01b – Alarm is Triggered
	2 to 3	Alarm Ready	uint2	-	00b – Alarm condition is not being monitored. 01b – Alarm condition is being monitored.
	4 to 5	Alarm is Acknowledged	uint2	-	00b – Alarm has not been acknowledged 01b – Alarm has been triggered and acknowledged.
	6 to 7	Automatic Reset Enabled	uint2	-	00b – Alarm will not automatically return to the Ready State. 01b – Alarm will automatically return to the Ready State once an “Ok” condition is observed.
3-4		Elapsed Time	uint16	min	Time elapsed while triggered. This should not be reset to zero until the alarm is triggered again.
5		Device Instance	uint8		Instance of the specific device generating the Alarm, if necessary. If the device type is multi-instances, FFh = All Instances. If the device is single-instanced, this should always be FFh.
6	0 to 1	Full-Time Monitoring Required	uint2	-	00b - Full-Time monitoring of alarm is not required. 01b - Full-Time monitoring of alarm is required. Devices monitoring this alarm shall treat the lack its transmission as an alarm.
	2 to 3	Alarm for Logging	uint2	-	00b - Do not log alarm now. 01b - Alarm should be logged for statistical or forensic purposes. In general, this flag should be set only on the initial triggering of the alarm. In subsequent reports of the same alarm, this should be set to 00b, until such time as the alarm has reset and triggered again.
	4 to 5	Alarm for User Notification	uint2	-	00b - Do not notify user. 01b - User notification required. In general, at least one of these two flags - Alarm for Logging and/or Alarm for User Notification, should be set.
	6 to 7	Reserved	uint2	-	

Note that the instances are arbitrary. The DSA field is intended to reduce potential conflicts in the field by providing a second means of distinguishing alarms. If an alarm is tied to a specific device such as an appliance or mechanical device, this field should be filled in with the DSA of that device. Thus, a slide room controller (DSA 84) may use alarm instance 1 to indicate a safety problem on the same network as a refrigerator (DSA 107) is using instance 1 to indicate that its door is open. Since RV-C does not implement DSAs lower than 64, these values are available for generic devices.

To prevent conflicts between products from independent vendors, it is recommended that any device implementing this DGN with arbitrary values have a method for assigning the instance if there is any chance of conflict. Section 6.47.3 (Instance Assignment) provides a common method for this purpose.

6.47.2 Alarm Command

Table 6.47.2a defines the DG attributes, and Table 6.47.2b defines the identifies the signal and parameter attributes .

Table 6.47.2a — DG definition

DG attribute	Value
Name	GENERIC_ALARM_COMMAND
DGN	1FE9Eh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	None

Table 6.47.2b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Definition
0	-	Instance	uint8	-	1 – 253
1		DSA	uint8	-	0-63 – Generic. 64-253 – DSA of the target device function.
2	0 to 1	Reserved	uint2		Always 11b – No Data (Reserved)
	2 to 3	Ready Alarm	uint2	-	00b – Stop Monitoring Alarm condition. 01b – Start Monitoring Alarm condition.
	4 to 5	Acknowledge Alarm	uint2	-	00b – No Action 01b – Acknowledge Alarm.
	6 to 7	Automatic Reset Enabled	uint2	-	00b – Disable automatic return to the Ready State. 01b – Enable automatic return to the Ready State.
5		Device Instance	uint8		Instance of the specific device generating the Alarm, if necessary. If the device type is multi-instances, FFh = All Instances. If the device is single-instanced, this should always be FFh.

The “Automatic Reset” state determines how an alarm should respond to being Acknowledged. If the Automatic Reset is enabled, the typical sequence is as follows:

ALARM_COMMAND Ready Alarm 01b *This arms the alarm.*
ALARM_STATUS Triggered 00b, Ready 01b, Acknowledged 00b, Auto Reset 01b

An alarm condition occurs.
ALARM_STATUS Triggered 01b, Ready 01b, Acknowledged 00b, Auto Reset 01b
The user acknowledges the alarm
ALARM_COMMAND Acknowledge Alarm 01b
ALARM_STATUS Triggered 00b, Ready 00b, Acknowledged 01b, Auto Reset 01b
The alarm condition eventually clears and the alarm is reset.
ALARM_STATUS Triggered 00b, Ready 01b, Acknowledged 00b, Auto Reset 01b

If the Automatic Reset is not enabled, the typical sequence is as follows:

ALARM_COMMAND Ready Alarm 01b
This arms the alarm.
ALARM_STATUS Triggered 00b, Ready 01b, Acknowledged 00b, Auto Reset 00b
An alarm condition occurs.
ALARM_STATUS Triggered 01b, Ready 01b, Acknowledged 00b, Auto Reset 00b
The user acknowledges the alarm
ALARM_COMMAND Acknowledge Alarm 01b
ALARM_STATUS Triggered 00b, Ready 00b, Acknowledged 01b, Auto Reset 00b
The user performs some action to clear the alarm condition and decides to re-arm the alarm.
ALARM_COMMAND Ready Alarm 01b
ALARM_STATUS Triggered 00b, Ready 01b, Acknowledged 00b, Auto Reset 00b
Note that in many cases, the Automatic Reset feature is permanently enabled or disabled due to the nature of the alarm and the amount of user intervention required to ensure safety or proper functionality.

6.47.3 Standard Alarm Instances

Many alarm functions are general to the type of device. In such cases, the instance used for the alarm shall be drawn from the list of standardized alarm instances provided here. It is acceptable to use non-standard instances for alarms that are specific to the proprietary design of a device. The instance numbers for such proprietary alarms should be selected from the range 128-253 (80h - 0xFDh).

Note that alarms may duplicate conditions reported by other means. For example, there is a Low Voltage Limit Status defined in DC_SOURCE_STATUS_6 (Byte 2, Bits 4-5). In general, alarms should not be defined if they exactly duplicate the previously defined condition. However, there are applications in which it is salutary to inform the user of an impending condition, in which case the use of the alarm is appropriate as it does not precisely duplicate the defined condition.

Alarms should not duplicate DM-RV SPNs. SPNs indicate that the device is not working properly, and some technical intervention is likely required. Generally, alarms indicate devices that are working properly but are in a state that the user should be informed of. Note that, in general, users should have the ability to arm or disarm individual alarms, but they cannot do the same for SPNs.

Section 7.6 provides a list of standard Alarms.

6.47.4 Test Profiles

6.47.4.1 Generic Alarm Base Profile

(GENERIC_ALARM_STATUS)

ID	Datum	Test	Required Response	Required Behavior

144A-S-01	Alarm Triggered	Activate Alarm Trigger	GENERIC_ALARM_STATUS reports Alarm Triggered = 01b (Triggered)	N/A
		Deactivate Alarm Trigger	GENERIC_ALARM_STATUS reports Alarm Triggered = 00b (Not Triggered)	N/A

6.47.4.2 Generic Alarm Acknowledgement Profile
(GENERIC_ALARM_COMMAND/GENERIC_ALARM_STATUS)

ID	Datum	Test	Required Response	Required Behavior
144A-C-01	Acknowledge Alarm	While GENERIC_ALARM_STATUS Alarm Triggered = 01b (Triggered), send GENERIC_ALARM_COMMAND Acknowledge Alarm = 01b.	GENERIC_ALARM_STATUS reports Alarm is Acknowledged = 01b (Acknowledged)	N/A

6.47.4.3 Generic Alarm Full-Time Monitoring Required Profile
(GENERIC_ALARM_STATUS)

ID	Datum	Test	Required Response	Required Behavior
144A-S-01	Full-Time Monitoring Required	While GENERIC_ALARM_STATUS Full-Time Monitoring Required = 01b (Required), disconnect the required device from the network or otherwise silence the GENERIC_ALARM_STATUS message.	N/A	Monitoring device notifies the user of the absence of GENERIC_ALARM_STATUS as an alarm

6.48 Step

This device encapsulates the function of a powered entry step.

Table 6.48 — Step

Device attribute	Value
Category	Mechanical Components
Default Source Address	147
Dynamic Address Range	176-191
Instance	Multiple Using Instance 1 for the main entry step is preferred.

6.48.1 Step Status

Table 6.48.1a defines the DG attributes, and Table 6.48.1b defines the signal and parameter attributes.

Table 6.48.1a — DG definition

DG attribute	Value
Name	STEP_STATUS
DGN	1FE89h
Default priority	3
Maximum broadcast gap	500ms
Normal broadcast gap	on change or 50ms when active
Minimum broadcast gap	50ms
Number of frames	1
ACK requirements	None

6.48.1b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0		Instance	uint8	-	1 – 253
1		Step operation mode	uint8	-	0 - Step extends/retracts with user operated switch. 1 - Step will extend/retract with the door switch. 2 - Step will stay extended regardless of door position.
2		Motion	uint8	-	1 - No motion 2 - Extending 3 - Retracting
3		Position	uint8	%	see Table 5.3 0 - Retracted 200 - 100% Extended Products that only know that the step is neither in nor out shall report 50%.
4	0 to 1	Obstruction sensor bottom	uint2	-	00b - No obstruction detected at underside of step 01b - Obstruction detected at underside of switch
	2 to 3	Obstruction sensor front face	uint2	-	00b - No obstruction detected at front face of step 01b Obstruction detected at front face of step

6.48.2 Step Command

Table 6.48.2a defines the DG attributes, and Table 6.48.2b defines the identifies the signal and parameter attributes.

Table 6.48.2a — DG definition

DG attribute	Value
Name	STEP_COMMAND
DGN	1FE88h
Default priority	6
Maximum broadcast rate	As needed
Normal broadcast rate	as needed
Minimum broadcast gap	50ms
Number of frames	1
ACK requirements	STEP_STATUS

Table 6.48.2b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Definition
0	-	Instance	uint8	-	1 – 253
1		Step operation mode	uint8	-	0 - Step extends/retracts with user operated switch. 1 - Step will extend/retract with the door switch. 2 - Step will stay extended regardless of door position.
2		Direction of movement	uint8	-	1 - Stop 2 - Extend 3 - Retract

6.48.3 SPN's

SPN MSB	SPN ISB	SPN LSB	Description
0	Instance	0	Motion
0	Instance	1	Position
0	Instance	2	Obstruction sensor bottom
0	Instance	3	Obstruction sensor front face

6.48.4 Alarms

Alarm Instance	Description
1	Step In Motion
2	Step Stowed
3	Step Not Stowed
4	Obstruction Sensor Blocked

6.48.5 Test Profile

Basic step control using manual input

ID	Datum	Test	Required Response	Required Behavior
	STEP_COMMAND	With byte 1 set to 0x00h: Send 0x01h on byte 2 to desired instance	SLIDE_STATUS responds with identical instance, 0x00h on byte 1, and 0x01h on byte 2	Step stops moving within 50ms of receiving command
	STEP_COMMAND	With byte 1 set to 0x00h: Send 0x02h on byte 2 to desired instance	SLIDE_STATUS responds with identical instance, 0x00h on byte 1, and 0x02h on byte 2	Step extends until a stop command is received, more than 100ms is detected between commands, or the step is fully extended
	STEP_COMMAND	With byte 1 set to 0x00h: send 0x03h on byte 2 to desired instance	SLIDE_STATUS responds with identical instance, 0x00h on byte 1, and 0x03h on byte 2	Step retracts until a stop command is received, more than 100ms is detected between commands, or the step is fully retracted

6.49 Battery

Traditionally DC_SOURCE DGs were sufficient to manage the typical “dumb” battery being monitored by a metering device, inverter/charger, or a voltmeter, or even a single “smart” battery. However, as capabilities of Batteries evolved, and in the case that multiple batteries are installed, a distinction between the bank of batteries and each individual battery is required as well as insight into an individual Cell level in many cases.

Within RV-C a Battery is defined as one or more Cells combined with a monitoring / control device. An example of a Battery is a Lithium based device with its associated BMS, an AGM device combined with a SOC meter also meets the criteria of a `Battery’ in the definition of RV-C.

BATTERY DGs are intended to augment DC_SOURCE providing additional insight into more complex installations – including cell level details, series/parallel connections of Batteries to support the associated DC_SOURCE instance, and even details to support aggregation of multiple batteries/DC_SOURCEs for use as a virtual device. Unlike DC_SOURCE, BATTERY DGs do not have the concept of ‘Priority’, and as such unless the monitoring device is dedicated to a given grouping of cells, it should transmit BATTERY messages.

A battery consists of one or more modules connected in parallel, with each module containing a number of cells. (For the purpose of RV-C, a Cell will be defined either as a single physical electro-chemical cell, or a number of such electro-chemical cells connected in parallel.). Cells are numbered within a module beginning with 1 at the lowest voltage point of the module (Ground). Each Module within a battery contains the exact same number of Cells. Often a Module consists of a single physical container, but if may also consist of a number of series-connected physical containers. In this case cell number will continue across the physical container bearer – just as if all cells were contained in a common physical container.

In the case where the Battery nominal voltage matches that of the associated DC_SOURCE instance nominal voltage (aka, the series string consists of only one battery instance), the Battery management device will directly broadcast relevant DC_SOURCE messages to represent the entire battery. In the case of more than one battery is connected in series (two or more Battery Instances associated with a common Series String instance), the individual batteries will coordinate to allow for a single summary view to be presented via DC_SOURCE messages. It is up to the battery manufactures to develop this series coordination mechanism outside of RV-C.

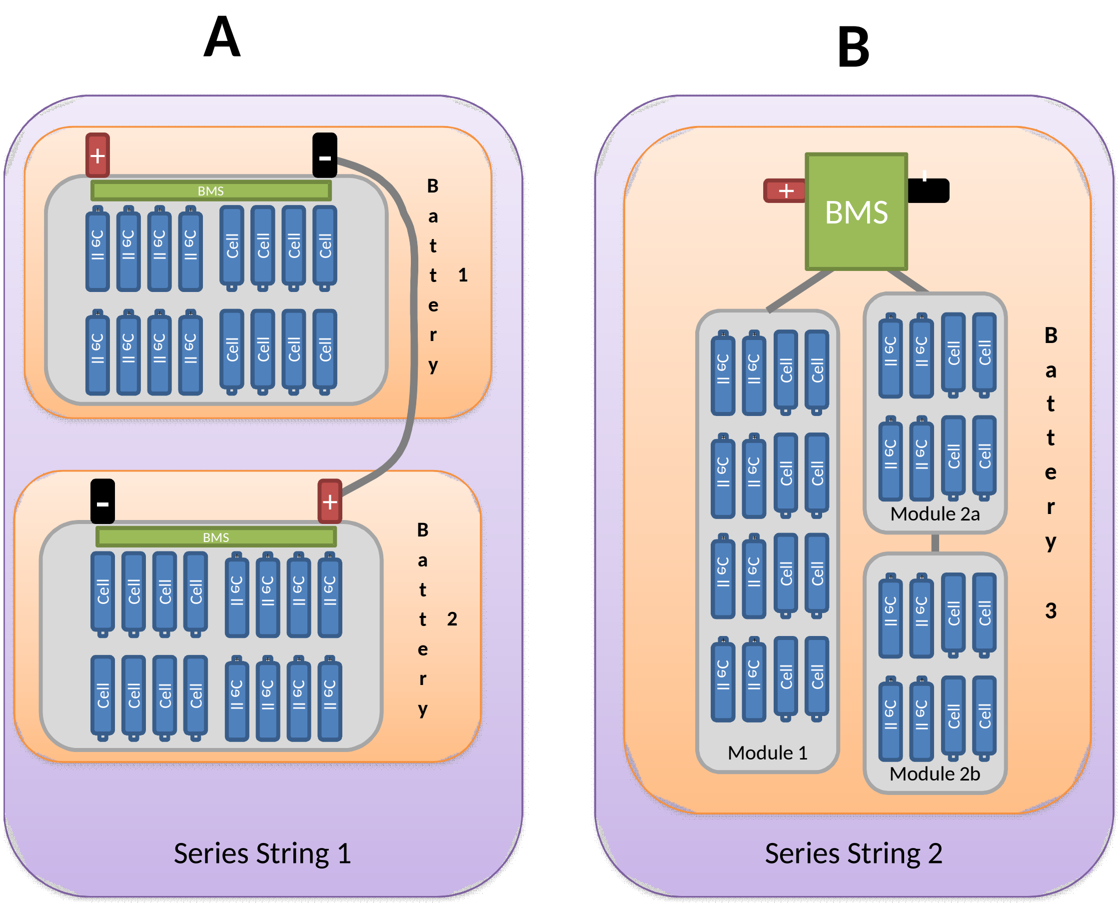
BATTERY DGNs are largely not broadcasted, but instead sent on request – though some may be push at a status change, mostly those related with warning and alarm conditions. A Global Request for Battery Summary may be used to survey the entire system and build a map of batteries, their relationship to each other and their relationships to DC Source Instances.

Cell DGNs are not broadcast in normal operation, and if a device or service tool desires data for individual cells, it shall trigger a report using the BATTERY_COMMAND message; the status of individual cells should be sent only on request. When returning cell status, nodes should maintain at least a 25 ms gap between packets to avoid clogging the data bus. This is a slightly smaller gap than the standard 50ms gap required for general operation, and assumes that requests for cell data are not part of the normal operation of the system but are reserved for diagnostic testing and monitoring, with the quicker response rate allowing for a more responsive HUI experience.

Table 6.49 — DC source definition

Device attribute	Value
Category	Multi-source DG format
Default Source Address	70
Dynamic Address Range	128 to 143
Instance	Multi-instance

The following graphic illustrates the relative relationship between Battery Instance, Module Instance, Series String Instance, and Cell instance.



Note that within a battery, each Module contains the same number of cells while within a module, the Cell closest to GROUND is referenced as Cell Instance 1
For each of the Battery DGNs, reference the related DC_SOURCE DGN for additional notes and comments.

6.49.1 Battery Status 1

Table 6.49.1a defines the DG attributes, and Table 6.49.1b defines the signal and parameter attributes.

Table 6.49.1a — DG definition

DG attribute	Value
Name	BATTERY_STATUS_1
DGN	1FE95h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.49.1b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Battery Instance	uint8	-	1-250
1	-	DC Instance	uint8	-	DC SOURCE Instance this Battery is associated with.
2 to 3	-	DC voltage	uint16	V	see Table 5.3
4 to 7	-	DC current	uint32	A	see Table 5.3 A positive value indicates current flowing from the battery (discharge), while a negative value would be indicative of the battery being recharged.

6.49.2 Battery Status 2

Table 6.49.2a defines the DG attributes, and Table 6.49.2b defines the signal and parameter attributes.

Table 6.49.2a — DG definition

DG attribute	Value
Name	BATTERY_STATUS_2
DGN	1FE94h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request

Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.49.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Battery Instance	uint8	-	1-250
1	-	DC Instance	uint8	-	DC Instance this Battery is associated with
2 to 3	-	Source temperature	uint16	°C	see Table 5.3
4	-	State of charge	uint8	%	see Table 5.3 The approximate amount of energy remaining in the battery bank, relative to its current full capacity.
5 to 6	-	Time remaining	uint16	min	Depending on the value in the Time Remaining Interpretation, the expected amount of time before the state of charge reaches 0 or 100%.
7	0 to 1	Time remaining Interpretation	uint2	-	00b = Time to Empty. 01b = Time to Full. If no value (11b) provided, the value in the Time Remaining field shall be interpreted as Time to Empty.

6.49.3 Battery Status 3

Table 6.49.3a defines the DG attributes, and Table 6.49.3b defines the signal and parameter attributes.

Table 6.49.3a — DG definition

DG attribute	Value
Name	BATTERY_STATUS_3
DGN	1FE93h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.49.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Battery Instance	uint8	-	1-250
1	-	DC Instance	uint8	-	DC Instance this battery is associated with.1-250 - Index of cell within a multiple-cell battery. 0 – Entire battery.
2	-	State of health	uint8	%	see Table 5.3

					The expected remaining lifetime of the battery, relative to the total expected lifetime.
3 to 4	-	Capacity remaining	uint16	A•h	see Table 5.3 The remaining capacity of the source relative to its present capacity when fully charged (which may have been reduced due to age, etc) Typically applied to batteries.
5	-	Relative capacity	uint8	%	see Table 5.3 The capacity remaining, relative to total capacity when fully charged.
6 to 7	-	AC RMS ripple	uint16	mV	Precision = 1 mV Value range = 0 to 65530 mV The total measured AC Ripple detected on the DC bus.

6.49.4 Battery Status 4

Table 6.49.4a defines the DG attributes, and Table 6.49.4b defines the signal and parameter attributes.
See DC_SOURCE_STATUS_4 for additional notes regarding this message.

Table 6.49.4a — DG definition

DG attribute	Value
Name	BATTERY_STATUS_4
DGN	1FE92h
Default priority	6
Maximum broadcast gap	100ms
Normal broadcast gap	On Change, On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.49.4b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Battery Instance	uint8	-	1-250
1	-	DC Instance	uint8	-	DC Instance this Battery is associated with.
2	-	Desired charge state	uint8	-	See DC_SOURCE_STATUS_4
3 to 4	-	Desired DC voltage	uint16	V	see Table 5.3 The desired voltage the battery is targeting during charging.
5 to 6	-	Desired DC current	uinit16	A	see Table 5.3 The desired maximum acceptance current the battery is targeting from all charging sources during charging.
7	0 to 3	Battery Type	uint4	-	See Table 6.5.5b 0 – Flooded 1 – Gel 2 – AGM

					3 – Lithium-Iron-Phosphate 12-13 – Reserved for Vendor-defined proprietary types.

6.49.5 (NOT USED)

6.49.6 Battery Status 6

See DC_SOURCE_STATUS_6 for additional notes. Table 6.49.6a defines the DG attributes, and Table 6.49.6b defines the signal and parameter attributes.

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Table 6.49.6a — DG definition

DG attribute	Value
Name	BATTERY_STATUS_6
DGN	1FE90h
Default priority	6
Maximum broadcast gap	100ms
Normal broadcast gap	On Change, On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.49.6b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Battery Instance	uint8	-	1-250
1	-	DC Instance	uint8	-	DC Instance this Battery is associated with.
2	0 to 1	High Voltage Limit Status	uint2	-	00b - Not reached 01b - Limit reached Indicates whether Battery has reached its upper operation voltage limit and charging sources should terminate.
	2 to 3	High Voltage Disconnect Status	uint2	-	00b - Connected 01b - Charge bus disconnected. Indicates whether the Battery has been disconnected due to reaching its upper operation voltage limit.
	4 to 5	Low Voltage Limit Status	uint2	-	00b - Not reached 01b - Limit reached Indicates whether Battery has reached its lower operation voltage limit and charging sources should terminate.
	6 to 7	Low Voltage Disconnect Status	uint2	-	00b - Connected 01b - Charge bus disconnected Indicates whether the Battery has been disconnected due to reaching its lower operation voltage limit.
3	0 to 1	Low state of charge limit	uint2	-	00b - Not reached

		status			01b - Limit reached Indicates whether DC Source (e.g. battery) has reached its lower state of charge limit and loads should be disconnected.
	2 to 3	Low state of charge disconnect status	uint2	-	00b - Connected 01b - Battery main power switch disconnected Indicates whether the DC Source (e.g. battery) has been disconnected from the load due to reaching the lower state of charge limit.
	4 to 5	Low DC source temperature limit status	uint2	-	00b - Not reached 01b - Limit reached Indicates whether DC Source (e.g. battery) has reached its lower temperature limit and charging sources should terminate.
	6 to 7	Low DC source temperature disconnect status	uint2	-	00b - Connected 01b - Charge bus disconnected Indicates whether the DC Source has been disconnected due to reaching its lower temperature limit.
4	0 to 1	High DC source temperature limit status	uint2	-	00b - Not reached 01b - Limit reached Indicates whether DC Source (e.g. battery) has reached its upper temperature limit and loads should be disconnected
	2 to 3	High DC source temperature disconnect status	uint2	-	00b - Connected 01b - Battery main power switch disconnected Indicates whether the DC Source (e.g. battery) has been disconnected from the load due to reaching the upper temperature limit.
	4 to 5	High Current DC Source Limit	uint2	-	00b - Not reached 01b - Limit reached Indicates whether DC Source (e.g. battery) has reached its upper current limit and loads should be disconnected
	6 to 7	High Current DC Source Disconnect	uint2	-	00b - Connected 01b - Load bus disconnected Indicates whether DC Source (e.g. battery) has been disconnected from the load bus due to reaching the upper temperature limit.

6.49.7 Battery Status 7

Table 6.49.7a defines the DG attributes, and Table 6.49.7b defines the signal and parameter attributes.

Table 6.49.7a — DG definition

DG attribute	Value
Name	BATTERY_STATUS_7
DGN	1FE8Fh

Default priority	6
Maximum broadcast gap	100ms
Normal broadcast gap	On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.49.7b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Instance	uint8	-	1-250
1	-	DC Instance	uint8	-	DC Instance this Battery is associated with.
2 to 3	-	Today's Input Amp-Hours	uint16	A•h	see Table 5.3
4 to 5	-	Today's Output Amp-Hours	uint16	A•h	see Table 5.3

6.49.8 Battery Status 8

Table 6.49.8a defines the DG attributes, and Table 6.49.8b defines the signal and parameter attributes.

Table 6.49.8a — DG definition

DG attribute	Value
Name	BATTERY_STATUS_8
DGN	1FE8Eh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.49.8b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Battery Instance	uint8	-	1 - 250
1	-	DC Instance	uint8	-	DC Instance this Battery is associated with.
2 to 3	-	Yesterday's Input Amp-Hours	uint16	A•h	see Table 5.3
4 to 5	-	Yesterday's Output Amp-Hours	uint16	A•h	see Table 5.3

6.49.9 Battery Status 9

Table 6.49.9a defines the DG attributes, and Table 6.49.9b defines the signal and parameter attributes.

Table 6.49.9a — DG definition

DG attribute	Value
Name	BATTERY_STATUS_9
DGN	1FE8Dh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.49.9b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Battery Instance	uint8	-	1-250
1	-	DC Instance	uint8	-	DC Instance this Battery is associated with.
2 to 3	-	Day Before Yesterday's Input Amp-Hours	uint16	A•h	see Table 5.3
4 to 5	-	Day Before Yesterday's Output Amp-Hours	uint16	A•h	see Table 5.3

6.49.10 Battery Status 10

Table 6.49.10a defines the DG attributes, and Table 6.49.10b defines the signal and parameter attributes.

Table 6.49.10a — DG definition

DG attribute	Value
Name	BATTERY_STATUS_10
DGN	1FE8Ch
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.49.10b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Battery Instance	uint8	-	1-250
1	-	DC Instance	uint8	-	DC Instance this Battery is associated with.
2 to 3	-	Last 7 Days Input Amp-Hours	uint16	A•h	see Table 5.3
4 to 5	-	Last 7 Days Output Amp-	uint16	A•h	see Table 5.3

		Hours			

6.49.11 Battery Status 11

Table 6.49.11a defines the DG attributes, and Table 6.49.11b defines the signal and parameter attributes.
On-Change broadcast is to be initiated only from a change in the Discharge and Charge on/off status. (Byte 2, Bits 0..3). Any event (Internal, or external) which causes an opening of the Discharge (load) or charge bus contactors MUST have at minimum a 2 seconds delay between the transmission of Battery Status 11 and the actual physical opening of the contactor/disconnect. If a device does not support separate discharge/charge contactors (sharing a common contactor), the change in the status of one contactor status must be reflected in both Charge and Discharge status.

Table6.49.11a — DG definition

DG attribute	Value
Name	BATTERY_STATUS_11
DGN	1FE8Bh
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Change, On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.49.11b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	-	Battery Instance	uint8	-	1-250
1	-	DC Instance	uint8	-	DC Instance this Battery is associated with.
2	0 to 1	Discharge On/Off Status	uint2	-	State of Battery main Discharge Bus switch / contactor. 00 = Battery Discharge Bus disconnected. 01 = Battery Discharge Bus connected.
	2 to 3	Charge On/Off Status	uint2	-	State of Charge Bus switch / contactor. 00 = Charge Bus disconnected 01 = Charge Bus connected.
	4 to 5	Charge Detected	uint2	-	State of Charge source. Usually valid only when Power off. 00 = No charge detected. 01 = Charge detected.
	6 to 7	Reserve Status	uint2	-	Reserve level status. 00 = Battery charge is above the reserve level. 01 = Battery charge is at or below reserve level.
3 to 4	-	Full Capacity	uint16	Ah	Nominal capacity of a fully charged battery. Precision = 1 Ah Value range = 0 to 65530 Ah

5 to 6	-	DC Power	uint16	W	Current DC Power input or output. Consult the amperage value in BATTERY_STATUS_1 to determine whether this is input or output. Precision = 1 W Value range = 0 to 65530 W

See DC_SOURCE_STATUS_11 for an explanation of the relationships between State of Charge, State of Health, Capacity Remaining, Relative Capacity, and Full Capacity.
Note that "battery bank size" is defined for several other device types (e.g. charger). This is typically the Full Capacity of the Battery.

6.49.12 Battery Status 12

Table 6.49.12a defines the DG attributes, and Table 6.49.12b defines the signal and parameter attributes.

Table 6.49.12a — DG definition

DG attribute	Value
Name	BATTERY_STATUS_12
DGN	1FDF3h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.49.12b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Battery Instance	uint8	-	1-250
1	-	DC Instance	uint8	-	DC Instance this Battery is associated with.
2 to 3	-	Cycles	uint16	-	The number of charge cycles since the last time the history was cleared
4 to 5	-	Deepest discharge depth	uint16	-	The deepest discharge in Ah since the last time the history was cleared.
6 to 7	-	Average discharge depth	uint16	-	Average discharge depth since the last time the history was cleared.

6.49.13 Battery Status 13

Table 6.49.13a defines the DG attributes, and Table 6.49.13b defines the signal and parameter attributes.

Table 6.49.13a — DG definition

DG attribute	Value
Name	BATTERY_STATUS_13
DGN	1FDF2h

Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	On Request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	None

Table 6.49.13b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	-	Battery Instance	uint8	-	1-250
1	-	DC Instance	uint8	-	DC Instance this Battery is associated with.
2 to 3	-	Lowest Battery voltage	uint16	-	see Table 5.3 The lowest voltage of the battery since the last time the history was cleared.
4 to 5	-	Highest Battery voltage	uint16	-	see Table 5.3 The highest voltage of the battery since the last time the history was cleared

6.49.14 Battery Command

Battery Command allows for the management and of an individual battery within the associated DC_SOURCE.

Table 6.49.14a defines the DG attributes, and Table 6.49.14b defines the signal and parameter attributes.

Table 6.49.14a — DG definition

DG attribute	Value
Name	BATTERY_COMMAND
DGN	1FE8Ah
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	ACK always

Table 6.49.14b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	-	Battery Instance	uint8	-	1-250
1	0-1	Desired Load On/Off Status	uint2	-	00b = Disconnect Battery main power switch / contactor. 01b = Connect Battery main power switch / contactor. 11b = Do not change status
	2-3	Desired Charge On/Off Status	uint2	-	00b = Disconnect Charge Bus switch / contactor. 01b = Connect Charge Bus switch / contactor. 11b = Do not change status

	4-5	Clear History	uint2	-	00b = No action 01b = Clear history
	6-7	Reserved	uint2	-	
2	-	Return module's Cell details	uint8	-	Module instance to report via Cell Details DGN. 0 = report all modules within battery 1-250 Report individual module
3	-	DC Instance	uint8	-	Set DC Instance this battery is associated with. 0 = unclaimed 1-250 DC_SOURCE_INSTANCE 255 = Do not modify associated DC_Instance

Upon reception of a Battery Command, the battery shall take the appropriate steps and also cause the updating of any relevant DC_SOURCE status / message. If a Battery/BMS does not support separate Load/Charge buses/disconnects, then the reception of either desired Load/Charge command will alter the status of BOTH load and charge bus / contactors.

6.49.15 Battery Summary

The Battery Summary DG communicates details about a given battery and its relationship to an associated DC_SOURCE instance (if assigned). Other details include number of Modules within a battery and (optionally) series connections of individual Batteries to support the associated higher DC_SOURCE bus voltages.

Battery Summary may also be used to communicate the available batteries in a system. A global request for the BATTERY_SUMMARY DG shall cause all batteries to reply.

Table 6.49.15a defines the DG attributes, and Table 6.49.15b defines the signal and parameter attributes.

Table 6.49.15a — DG definition

DG attribute	Value
Name	BATTERY_SUMMARY
DGN	1FDF1h
Default priority	6
Maximum broadcast gap	100ms
Normal broadcast gap	On Change, On request
Minimum broadcast gap	50 ms, see 3.2.4.2
Number of frames	1
ACK requirements	BATTERY_SUMMARY, NAK

Table 6.49.15b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Battery Instance	uint8	-	see table b 0 = Invalid 1..250 Battery Instance to report out.
1	-	DC Source Instance	uint8	-	see table b 0 = not assigned to a DC Instance at this time. 1-250 = DC Source Instance this battery is associated with.

					251..254 - Reserved 255 – Unspecified
2	-	Series String	uint8	-	0 - Invalid 1..250 - Series connected String this battery associated with 251..254 - Reserved 255 – Unspecified
3		Module Count	uint8	-	0 – Cell is not being balanced. 1 – Balancing process is active for this cell.
4		Cells per Module	uint8	-	1..250 cells within a Module in this Battery.
5-6	-	Reserved	-	-	-
7	0-2	Voltage Status	uint4	-	0 – Normal 1 – Extreme Under Voltage 2 – Under Voltage 3 – Over Voltage 4 – Extreme Over Voltage
	3-5	Temperature Status	Uint4	-	0 – Normal 1 – Extreme Under Temperature 2 – Under Temperature 3 – Over Temperature 4 – Extreme Over Temperature

6.49.16 Cell Detail

A battery may receive the BATTERY_COMMAND DGN asking for cell level details for one (or all) of its banks. When making a request, 'Battery Instance' and 'Module Instance' are filled in with the requested details. Upon reception of this message, the associated battery will respond with a series of Cell Detail messages, one for each cell until all cells within the requested module is communicated. After all cells within a module are communicated, transmission will stop.

If this message is received with an invalid module index, NAK is sent back. NAK is also sent back if the requested node does not support Cell Level messaging, or if the requested battery index is incorrect.

Table 6.49.16a defines the DG attributes, and Table 6.49.16b defines the signal and parameter attributes.

Table 6.49.16a — DG definition

DG attribute	Value
Name	CELL_DETAIL
DGN	1FDDDh
Default priority	7
Maximum broadcast gap	N/A
Normal broadcast gap	On Request
Minimum broadcast gap	25ms
Number of frames	1
ACK requirements	NAK, BATTERY_CELL_DETAIL

Table 6.49.16b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value definition
0	-	Battery Instance	uint8	-	1-250
1	-	Module Instance	uint8	-	Module within the battery 1-250
2	-	Cell Instance	uint8	-	Cell Instance within the module. 0 – Invalid 1- Cell closest to GROUND terminal of module. 2..250 – Subsequent Cells 251..254 - Reserved 255 – Unspecified
3	0-1	Voltage Status	uint2	-	0 – Invalid 1 – Normal 2 – Over Voltage 3 – Under Voltage
	2-3	Temperature Status	uint2	-	0 – Invalid 1 – Normal 2 – Over Temperature 3 – Under Temperature
	4-5	Balancing	uint2	-	Is the Cell being balanced at the moment?
	6-7	Reserved	uint2	-	-
4-5	-	Voltage	uint16	mV	mV resolution
6	-	Temperature	uint8	°C	See Table 5.3
7	-	Reserved	-	-	-

6.49.17 Alarms

Table lists the alarms.

Table 6.49.17 Profile 143C-3A: DC Disconnect (DC Source Connection Support) — Alarms

Alarm Instance	Description
1	History cleared
100	High Voltage Limit Warning
101	High Voltage Disconnect
102	Low Voltage Limit Warning
110	Low Voltage Disconnect
111	Low SOC Warning
112	Low SOC Disconnect
113	High SOC Warning
114	High SOC Disconnect
115	Low Temperature Warning
116	Low Temperature Disconnect
120	High Temperature Warning
121	High Temperature Disconnect

122	High Current Warning
123	High Current Disconnect

6.49.18 Test Profile

BATTERY messages are unique on RV-C in that they extend and support DC_SOURCE messages as opposed to stand alone. The primary purpose of BATTERY is to allow for deeper insight and granularity into a battery based DC_SOURCE. As such, the use of BATTERY DGs are not requires, and some vendors may choose to support their system using only DC_SOURCE messages (Which are required at some level, reference DC_SOURCE profiles). The following Profile is only for those devices which choose to support the BATTERY messages.
When evaluating a given system, both DC_SOURCE and (optional) BATTERY profiles must be assessed

6.49.18.1 Profile 70: Battery

In the simplest form no BATTERY messages are required, only DC_SOURCE messages. If a message is requested and the battery replies with NAK, that is an acceptance response. In each case, if a BATTERY message is returned, assure the associated DC_SOURCE message is also adjusted to reflect appropriate details.

Prerequisites: DC_SOURCE (One of the levels)

Reporting

ID	Datum	Test	Required Response	Required Behavior
70-R-01	Status	Minimum reporting status	None	No BATTERY DGs are required, however to be qualified in RV-C a battery must supports one of the DC_SOURCE profiles
70-R-02	Status (optional)	Force transmission of all BATTERY_STATUS_x messages via Request.	If message contained Battery Instance and DC Instance values, verify they are correct for the current configuration.	NAK is an acceptable response when a message is requested.
70-R-03	Status (optional)	Change in requested Charge State	Transmission of BATTERY_STATUS_4 with 'Desired Charge State' updated to new value.	Battery initiated changes in requested mode or goals should force an automatic transmission of BATTERY_STATUS_4. If Battery does not explicitly send out Voltage or Current Goals, 0xFFFF is allowable.
70-R-04	Status (optional)	Change in Desired DC Voltage	Transmission of BATTERY_STATUS_4 with 'Desired DC Voltage State' updated to new value.	
70-R-05	Status (optional)	Change in Desired DC Current	Transmission of BATTERY_STATUS_4 with 'Desired DC current State' updated to new value.	
70-R-06	Status (optional)	Verify Battery Type	Send request for BATTERY_STATUS_4, if reply	Device replying with NAK is also acceptable.

			is transmitted verify Battery Type matches that of actual battery	
70-R-07	Status (optional)	Setting of Warning item	For each Warning level item, force Battery into Warning condition, very transmission of BATTERY_STATUS_6 message with appropriate flag set.	Verify appropriate Alarms are also set for each Warning / Alarm condition that has an alarm associated with it.
70-R-08	Status (optional)	Clearing of Warning item	After setting Warning status for item, restore item to normal status and verify transmission of BATTERY_STATUS_6 message with appropriate flag cleared.	
70-R-09	Status (optional)	Setting of Alarm item	For each Alarm level item, force Battery into Alarm condition, very transmission of BATTERY_STATUS_6 message with appropriate flag set.	
70-R-010	Status (optional)	Clearing of Alarm item	After setting Alarm status for item, restore item to normal status and verify transmission of BATTERY_STATUS_6 message with appropriate flag cleared.	
70-R-011	Status (optional)	Force Disconnect condition	Upon forcing of a disconnect condition (Alarm, power off, or any other methodology) BATTERY_STATUS_11 shall be transmitted with the appropriate Discharge / Charge status (Byte 2 bit 0/1 & 2/3) cleared.	BATTERY_STATUS_11 message must be transmitted 2 seconds or more before the actual disconnect / contactor is opened.
70-R-12	Status (optional)	Clear Disconnect Condition	BATTERY_STATUS_11 shall be transmitted with the appropriate Discharge / Charge status (Byte 2 bit 0/1 & 2/3) set.	Assure contactor / disconnect is reconnected BEFORE the transmission of a reconnected BATTERY+STATUS_11 message.
70-R-13	Status (optional)	SOC, and other tracking values	Force transmission of the following messages and verify the reported values represent the actual condition of the battery: BATTERY_STATUS_7 BATTERY_STATUS_8 BATTERY_STATUS_9 BATTERY_STATUS_10 BATTERY_STATUS_11	Not all messages/fields will be supported by every Battery. NAK and/or ‘FF’ (Not provided) markers are acceptable results.

			BATTERY_STATUS_12 BATTERY_STATUS_13	
70-R-14	Status (optional)	BATTER_SUMMARY	Request Battery Summary DG, verify all filed contain correct values.	

Command Response

ID	Datum	Test	Required Response	Required Behavior
70-C-01	Status (optional)	Send BATTERY_COMMAND toggling 'Desired Load' status on/off.	Verify BATTERY_STATUS_11 message with appropriate DISCHARGE-BUS status	If Battery/BMS uses a common load/charge disconnect, note that toggling of either the Load and/or Charge bus status will result in change in BOTH the Load & Charge Status bits in BATTERY_STATUS_11 Validate a minimum 2 seconds delay occurs between the issuing of any disconnect request with its reply of BATTERY_STATUS_11 message and the actual physical disconnect.
70-C-02	Status (optional)	Send BATTERY_COMMAND toggling 'Desired Charge' status on/off.	Verify BATTERY_STATUS_11 message with appropriate CHARGE-BUS status	
70-C-03	Status (optional)	Clear History (via BATTERY_COMMAND) with Desired Charge & Load status set = 11 (Do Not Change)	Verify all clearable History message have been reset. Verify no change in either Load or Charge bus status.	
70-C-04	Status (optional)	Set DC SOURCE Instance via BATTERY_COMMAND	Change Battery DC Instance value, verify (via returning BATTERY_STATUS_11 message) associated DC Instance is reflected.	Validate that not only is one able to set an associated DC Source Instance, but also is able to set the Battery for 'Unclaimed' by using DC Instance = 0
70-C-05	Status (optional)	Request Cell Detail via BATTERY_COMMAND	Send request for Cell Details for individual strings – verify subsequent CELL_DEAIL message contained correct information. Send request for All Cells (request Module = 0) Very all battery cell detail is returned. Send request for invalid module number, verify NAK is returned.	

6.50 DC Drivers

Many products use "smart" FETs or DC current drivers which can be programmed in various ways and are capable of providing a variety of measurements. The following DGs provide a consistent method of reporting data from these components and

configuring them, regardless of the sort of device that they are contained in.
These DGs are intended primarily for diagnostics and are transmitted only on request. The sole exception is DRIVER_STATUS_1, which is also sent on a change in status of the Shutdown Status value. Devices shall maintain a 25ms minimum gap between all status messages, rather than the usual 50ms gap.
In many cases, the DC driver will correspond with a specific instance of a device such as a Dimmer or DC Load. In other cases each instance of a device may have multiple DC drivers. For example, an Awning may have two drivers which form an H-bridge, while a complicated device such as a Furnace may have several DC drivers with a variety of functions. To accommodate this latter case, each DC driver may have a secondary index. The index is assigned by the device manufacturer, and the protocol does not attempt to identify the function of each index.
Devices are allowed to report the same driver under multiple device/instance/index designations. For example, a node may report a driver as both a GENERIC_DC_LOAD, Instance 5, Index 1 and as a AWNING, Instance 1, Index 3. This is appropriate for products that can be configured to have multiple functions (in this example, an awning light) or to make identification easier for a technician. No standard mechanism is provided for identifying these cross-defined drivers.
The DGN for each message is structured per table DC Drivers.

Table 6.50 — DC Driver DGN Structure

Field	Function
DGN MSB	Message type.
DGN LSB	DSA of the RV-C device containing the driver.
Data Byte 0	Instance of the device (per the DSA). For non-instanced devices, always FFh.
Data Byte 1	Index. 1-250 0 is reserved for certain commands to indicate “All Drivers” FFh is acceptable for devices with single driver - e.g. DC Load, DC Dimmer.

For example, a generator (DSA 40h) shall report the status of its internal drivers using DGN 16F40h, 16E40h, etc.. Devices shall respond only to requests for DGNs of the same DSA as the device. For example, a generator shall only respond to requests for DGNs 16F40h, 16E40h, etc..
It is acceptable for devices to implement a “diagnostic mode” in which status messages are temporarily transmitted on a schedule. Devices shall automatically exit the diagnostic mode after a set period of time.

6.50.1 DC Component Driver Status 1

Table 6.50.1a defines the DG attributes, and Table 6.50.1b defines the signal and parameter attributes.

Table 6.50.1a — DG definition

DG attribute	Value
Name	DC_COMPONENT_DRIVER_STATUS_1
DGN	16F00h-16FFFh
Default priority	6
Normal broadcast gap	On Request, and on change of Shutdown Status
Diagnostic broadcast gap	500ms
Number of frames	1
ACK requirements	None

Table 6.50.1b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	-	Device Instance	uint8	-	1-250, FFh for non-instanced devices.
1	-	Driver Index	uint8	-	1-250, FFh is acceptable for devices with a single driver.

2 to 3	-	Voltage	uint16	V	see Table 5.3
4 to 5	-	Current	uint16	A	see Table 5.3
6	0 to 1	Output Status	uint2	-	00b - Off 01b - On
	2 to 3	Desired Status	uint2	-	00b - Off 01b - On
	4 to 5	Shutdown Status	uint2	-	00b - Ok 01b - Output Disabled (see Byte 7)
	6 to 7	Reset Type	uint2	-	00b - Manual 01b - Automatic
7	-	Reason for Shutdown	uint8	-	0 = Output Not Disabled 1 = Over Current 2 = Short Circuit 3 = Over Voltage 4 = Under Voltage 5 = Under Current 6 = Over Temperature 7 = Hardware Disabled 8 = Driver Fault

6.50.2 DC Component Driver Status 2

Table 6.50.2a defines the DG attributes, and Table 6.50.2b defines the signal and parameter attributes.

Table 6.50.2a — DG definition

DG attribute	Value
Name	DC_COMPONENT_DRIVER_STATUS_2
DGN	16E00h-16EFFh
Default priority	6
Normal broadcast gap	On Request
Diagnostic broadcast gap	5000ms, or on change of Temperature Warning Status
Number of frames	1
ACK requirements	None

Table 6.50.2b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	-	Device Instance	uint8	-	1-250, FFh for non-instanced devices.
1	-	Driver Index	uint8	-	1-250 0 - Applies to all drivers (for instance if over temperature on device shuts down all driver channels) FFh is acceptable for devices with a single driver.
2 to 3	-	Temperature	uint16	Deg C	see Table 5.3
4	0 to 3	Temperature Warning	uint4	-	0 - Temp Normal

					1 - Temp Warning 2 - Temp Failure (Shutdown)
	4 to 7	Driver Type	uint4	-	0 - High-Side 1 - Low-Side 2 - H-Bridge 3 - Half Bridge 4 - Breaker
5	0 to 1	Undercurrent	uint2	-	0 - Normal current draw 1 - Undercurrent condition Note: Undercurrent does not imply the load is on as undercurrent detection is possible even when the output is shut off.
	2 to 7	Reserved	uint6	-	Reserved
6 to 7	-	Peak Temperature at Last Shutdown	uint16	Deg C	see Table 5.3

6.50.3 DC Component Driver Status 3

Table 6.50.3a defines the DG attributes, and Table 6.50.3b defines the signal and parameter attributes.

Table 6.50.3a — DG definition

DG attribute	Value
Name	DC_COMPONENT_DRIVER_STATUS_3
DGN	16D00h-16DFFh
Default priority	6
Normal broadcast gap	On Request and on change of shutdown count
Diagnostic broadcast gap	On Change
Number of frames	1
ACK requirements	None

Table 6.50.3b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	-	Device Instance	uint8	-	1-250, FFh for non-instanced devices.
1	-	Driver Index	uint8	-	1-250, FFh is acceptable for devices with a single driver.
2 to 3	-	Shutdown Count	uint16	-	Value Range - 0 to 65,534 0xFFFF if unused
4 to 5	-	Peak Current at Last Shutdown	uint16	A	see Table 5.3
6 to 7	-	Voltage at Last Shutdown	uint16	V	see Table 5.3

6.50.4 DC Component Driver Status 4

Table 6.50.4a defines the DG attributes, and Table 6.50.4b defines the signal and parameter attributes.

Table 6.50.4a — DG definition

DG attribute	Value
Name	DC_COMPONENT_DRIVER_STATUS_4
DGN	16C00h-16CFFh
Default priority	6
Normal broadcast gap	On Request
Diagnostic broadcast gap	On Request, and on change of On Cycle Count
Number of frames	1
ACK requirements	None

Table 6.50.4b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	-	Device Instance	uint8	-	1-250, FFh for non-instanced devices.
1	-	Driver Index	uint8	-	1-250, FFh is acceptable for devices with a single driver.
2 to 3	-	On Cycle Count	uint16	-	Value Range - 0 to 65,534 0xFFFF if unused
4 to 7	-	Channel On Time	uint32	min	Value Range - 0 to 4,294,967,294 min 0xFFFFFFFF if unused

6.50.5 DC Component Driver Status 5

Table 6.50.5a defines the DG attributes, and 6.50.5b defines the signal and parameter attributes.

Table 6.50.5a — DG definition

DG attribute	Value
Name	DC_COMPONENT_DRIVER_STATUS_5
DGN	16B00h-16BFFh
Default priority	6
Normal broadcast gap	On Request
Diagnostic broadcast gap	On Request
Number of frames	1
ACK requirements	None

Table 6.50.5b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	-	Device Instance	uint8	-	1-250, FFh for non-instanced devices.
1	-	Driver Index	uint8	-	1-250, FFh is acceptable for devices with a single driver.
2	-	Last Shutdown - Year	uint8	year	Offset - 2000 AD Value Range - 2000 to 2250
3	-	Last Shutdown - Month	uint8	month	1 - January, 2 - February ….

					12 - December
4	-	Last Shutdown - Day	uint8	day	Value Range - 1 to 31
5	-	Last Shutdown - Hour	uint8	h	Value Range - 0 to 23 0 - 12:00 AM 12 - 12:00 Noon 23: - 11:00 PM
6	-	Last Shutdown - Minute	uint8	min	Value Range - 0 to 59
7	-	Last Shutdown - Second	uint8	s	Value Range - 0 to 59

6.50.6 DC Component Driver Settings 1

Table 6.50.6a defines the DG attributes, and Table 6.50.6b defines the signal and parameter attributes.

Table 6.50.6a — DG definition

DG attribute	Value
Name	DC_COMPONENT_DRIVER_SETTINGS_1
DGN	16A00h-16AFFh
Default priority	6
Broadcast gap	On Request
Number of frames	1
ACK requirements	None

Table 6.50.6b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	-	Device Instance	uint8	-	1-250, FFh for non-instanced devices.
1	-	Driver Index	uint8	-	1-250, FFh is acceptable for devices with a single driver.
2 to 3	-	Overcurrent Shutdown Threshold	uint16	A	see Table 5.3
4 to 5	-	Overcurrent Time Threshold - Instantaneous (us)	uint16	us	Resolution – 10 ns Value Range - 0 to 655,340 ns (655 us)
6 to 7	-	Overcurrent Time Threshold - Filtered (ms)	uint16	ms	Resolution - 0.1ms Value Range - 0 to 6,553.4 ms (655 us)

6.50.7 DC Component Driver Settings 2

Table 6.50.7a defines the DG attributes, and 6.50.7b defines the signal and parameter attributes.

Table 6.50.7a — DG definition

DG attribute	Value
Name	DC_COMPONENT_DRIVER_SETTINGS_2
DGN	16900h-169FFh

Default priority	6
Broadcast gap	On Request
Number of frames	1
ACK requirements	None

Table 6.50.7b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	-	Device Instance	uint8	-	1-250, FFh for non-instanced devices.
1	-	Driver Index	uint8	-	1-250, FFh is acceptable for devices with a single driver.
2 to 3	-	Temperature Shutdown Threshold	uint16	Deg C	see Table 5.3
4 to 5	-	Over Voltage Shutdown Threshold	uint16	V	see Table 5.3
6 to 7	-	Low Voltage Shutdown Threshold	uint16	V	see Table 5.3

6.50.8 DC Component Driver Settings Command 1

Table 6.50.8a defines the DG attributes.

6.50.8a — DG definition

DG attribute	Value
Name	DC_COMPONENT_DRIVER_SETTINGS_COMMAND_1
DGN	16100h-161FFh
Default priority	6
Broadcast gap	As needed.
Number of frames	1
ACK requirements	NAK, DC_COMPONENT_DRIVER_SETTINGS_1

The parameter attributes are identical to DC_COMPONENT_DRIVER_SETTINGS_1, table 6.50.6b. An Instance of zero indicates that the command shall apply to all instances. A driver index of zero indicates that the command shall apply to all drivers for the particular device.

6.50.9 DC Component Driver Settings Command 2

Table 6.50.9a defines the DG attributes.

Table 6.50.9a — DG definition

DG attribute	Value
Name	DC_COMPONENT_DRIVER_SETTINGS_COMMAND_2
DGN	16200h-162FFh
Default priority	6
Broadcast gap	As needed.
Number of frames	1
ACK requirements	NAK, DC_COMPONENT_DRIVER_SETTINGS_2

The parameter attributes are identical to DC_COMPONENT_DRIVER_SETTINGS_2, table 6.50.7b. An Instance of zero indicates that the command shall apply to all instances. A driver index of zero indicates that the command shall apply to all drivers for the particular device.

6.50.10 DC Component Driver Command

Table 6.50.10a defines the DG attributes, and Table 6.50.10b defines the signal and parameter attributes.

Table 6.50.10a — DG definition

DG attribute	Value
Name	DC_COMPONENT_DRIVER_COMMAND
DGN	16000h-160FFh
Default priority	6
Broadcast gap	As Needed
Number of frames	1
ACK requirements	NAK, DC_COMPONENT_DRIVER_STATUS

Table 6.50.10b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	-	Device Instance	uint8	-	1-250, 0 - Apply to all instances. FFh for non-instanced devices.
1	-	Driver Index	uint8	-	1-250 0 - Apply to all drivers. FFh is acceptable for devices with a single driver.
2	-	Command	uint8	-	1 - Reset Driver 2 - Force Driver Off (For testing purposes only) 3 - Force Driver On (For testing purposes only) 4 - Enter Diagnostic Reporting Mode (Initiates reporting of status values) 5 - Exit Diagnostic Reporting Mode (Ends reporting of status values) 6 - Reset DRIVER_STATUS_3 statistics 7 - Reset DRIVER_STATUS_4 statistics 8 - Reset DRIVER_STATUS_5 statistics 9 – Reset Driver Overcurrent 10 – Reset Driver Overtemperature 11 – Reset Driver Undervoltage/Overvoltage

6.50.11 DC Component Driver Status 6

Table 6.50.11a defines the DG attributes, and 6.50.11b defines the signal and parameter attributes.

Table 6.50.11a — DG definition

DG attribute	Value

Name	DC_COMPONENT_DRIVER_STATUS_6
DGN	16300h-163FFh (16300h + DSA)
Default priority	6
Normal broadcast gap	On request, on change, or optionally every 1000 to 5000 ms
Diagnostic broadcast gap	On Request
Number of frames	1
ACK requirements	N/A

Table 6.50.11b — Signal and parameter definition

Byte	Bit	Name	Data Type	Unit	Value Definition
0	-	Device Instance	uint8	-	1-250, FFh for non-instanced devices.
1	-	Driver Index	uint8	-	1-250 0 - Applies to all drivers (on device instance) FFh is acceptable for devices with a single driver.
2	0-1	Driver Direction	uint2	-	00b = reverse/down/driving low 01b = forward/up/driving high 11b = driver not active
	2-3	Driver Pulsing	uint2	-	00b = driver not pulsing 01b = driver pulsing 11b = driver does not support pulsing
	4-5	Lock Status	uint2	-	00b = driver not locked 01b = driver locked 11b = driver does not support locking
	6-7	Command Timeout	uint2	-	Indicates if this driver has a command timeout, such that any commands that activate the driver must be sent repeatedly to keep the driver active, and if a command timeout has occurred. 00b = Driver has a command timeout, no timeout active 01b = Driver has a command timeout, timeout occurred 11b = Driver does not have a command timeout Timeout status cleared when a new command received that either explicitly turns off driver, or reactivates driver.
3	-	PWM Duty	uint8	%	Indicates the current, or target in case of a ramp, PWM duty cycle for the driver. If driver does not support PWM, must be set to FFh to indicate that. Range 0-200 = 0-100%

4	-	Delay Remaining	uint8	sec	Indicates the number of seconds remaining in a delayed command. 1-240 = remaining delay in seconds before state change 241-250 = 5-14 minutes remaining delay 0 = delay expired, driver state has been updated 255 = no delayed command active Delay status will be cleared/updated when a new command is received that affects the driver output state.
5	-	Duration Remaining	uint8	sec	Indicates the number of seconds remaining in a duration command. 1-240 = remaining duration in seconds before driver turns off 241-250 = 5-14 minutes remaining duration 0 = duration expired, driver has been turned off 255 = no duration command active
6	0-1	Override Input	uint2	-	00b = Override inactive 01b = Override active
	-	Unused	uint6		
7	-	Unused			

6.50.12 Test Profile

As DC Driver is entirely optional there is no minimum level test profile that is applied. Advanced test profiles will be added as required by the industry.

6.51 Generic Plumbing Valve

6.51.1 Introduction

The RV-C protocol has specific provisions for controlling the tank dump valves and freshwater fill valve, but RV plumbing systems may contain addition valves for draining, winterizing, and other purposes. These DGN allow the control and monitoring of such valves, without specifying the specific function of the valves. It also includes provisions for monitoring water pressure. This is not intended to replace the Current System Pressure field in the WATER_PUMP_STATUS DGN, but for other purposes such as measuring the pressure drop across a filter or to detect the opening of a faucet or fixture.

The following formats apply (see Table 6.52.1).

Table 6.51.1a — Generic Plumbing Valve definition

Device attribute	Value
Category	Mechanical components
Default Source Address	148
Dynamic Address Range	176 to 191
Instance	Multiple

6.51.2 Valve Status

Table 6.51.2a defines the DG attributes and Table 6.51.2b defines the signal and parameter attributes.

Table 6.51.2a — DG definition

DG attribute	Value
Name	VALVE_STATUS
DGN	1FDE5h
Default priority	6
Maximum broadcast gap	5 sec, if Pressure is included. Otherwise, no maximum gap.
Normal broadcast gap	On change of Motion, or a change of Pressure greater than 5% since last broadcast.
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

Table 6.51.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 - 250
1	-	Motion	uint8	-	0 - No motion 1 - Opening 2 - Closing
2	-	Position	uint8	%	see Table 5.3 0 - Closed 200 - 100% Open
3 to 4	-	Pressure	uint16	Pa	Precision = 100 Pa = 0.0145 PSI Value range = 0 to 6 553 200 Pa (0 to 950.214 PSI)

6.51.3 Valve Command

Table 6.51.3a defines the DG attributes and Table 6.51.3b defines the signal and parameter attributes. This DGN triggers valve actions. The command need only be sent once, even if the amount of time required for the valve to open or close is significant.

Table 6.51.3a — DG definition

DG attribute	Value
Name	VALVE_COMMAND
DGN	1FDE4h
Default priority	3
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, VALVE_STATUS

Table 6.51.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	1 - Awning 1 (main patio awning) 2 to 13 - Awning 2 to 13
1	-	Move to Position	uint8	%	Desired Amount of Extension see Table 5.3

					0 – Fully Closed 200 – Fully Open

6.51.4 Service Points

Table 6.51.4a lists the allowable Service Points.

Table 6.51.4a — Service Points

MSB	ISB	LSb	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	Valve Actuator
1	Instance	1	Pressure Sensor

6.51.5 Alarms

Alarm Instance	Description
1	Valve Opened
2	Valve Closed

6.51.6 Test Profile

6.51.6.1 Profile 130B: Basic Valve

This profile describes a valve that is limited to being either completely open or completely closed.

ID	Datum	Test	Desired Response
130B-S-01	VALVE_STATUS	VALVE_COMMAND is sent with arbitrary or empty values.	VALVE_STATUS is broadcast with the Motion and Position fields reflecting their current value. If the valve always requires less than 250ms to open/close, the Motion field is not required (i.e. FFh is acceptable).
130B-C-01	VALVE_COMMAND	1. With the valve completely closed, VALVE_COMMAND is sent with Move To Position 200 (Open).	1. VALVE_STATUS is broadcast immediately, with Motion 1 (Opening) and Position 0 (Closed). After the operation is complete, VALVE_STATUS is broadcast with Motion 0 (No Motion) and Position 200 (Open). GENERIC_ALARM_STATUS is broadcast with Alarm Instance 1 (Valve Opened). If the operation requires less than 250ms, only the second VALVE_STATUS is required.
		2. After 1 is complete, VALVE_COMMAND is sent with Move To Position 200 (Open).	2. VALVE_STATUS is broadcast with Motion 0 (No Motion) and Position 200 (100%). No other message is sent.
		3. After 2 is complete, VALVE_COMMAND is sent with Move To Position 0 (Closed). Desired Response:	3. VALVE_STATUS is broadcast immediately, with Motion 2 (Closing) and Position 200 (Open). After the operation is complete, VALVE_STATUS is broadcast with Motion 0 (No Motion) and Position 0 (Closed). GENERIC_ALARM_STATUS is broadcast with

			Alarm Instance 2 (Valve Closed). If the operation requires less than 250ms, only the second VALVE_STATUS is required.

6.52 Refrigerator

6.52.1 Introduction

This DGN contains control information for the refrigerator. The following formats apply (see Table 6.52.1).

Table 6.52.1 — Refrigerator definition

Device attribute	Value
Category	Appliances and Bridges
Default Source Address	107
Dynamic Address Range	208 to 223
Instance	Multiple

6.52.2 Refrigerator Status

Table 6.52.2a defines the DG attributes and Table 6.52.2b defines the signal and parameter attributes.

Table 6.52.2a — DG definition

DG attribute	Value
Name	REFRIGERATOR_STATUS
DGN	1FDD3h
Default priority	6
Maximum broadcast gap	5000
Normal broadcast gap	As needed
Minimum broadcast gap	500 ms
Number of frames	1
ACK requirements	None

Table 6.52.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 5	Instance	uint6	-	1 to 60
	6 to 7	Cavity	uint2	-	00b - fridge 01b - freezer
1	0 to 1	Light	uint2	-	00b – all off 01b – all on
	2 to 3	Door Switch	uint2	-	00b – closed 01b - open
2 to 3	-	Current Temperature	uint16	°C	See Table 5.3
4 to 5	-	Set Temperature	uint16	°C	See Table 5.3

6	0 to 3	Fuel Source	uint4	-	000b – Gas 001b – DC Voltage 010b – AC Voltage
	4 to 7	Refrigerator Mode	uint4	-	0000b – off 0001b – on 0010b - night
7	-	Compressor Speed	uint8	%	See Table 5.3

6.52.3 Refrigerator Command

Table 6.52.3a defines the DG attributes and Table 6.52.3b defines the signal and parameter attributes. This DGN triggers refrigerator actions.

Table 6.52.3a — DG definition

DG attribute	Value
Name	REFRIGERATOR_COMMAND
DGN	1FDD2h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	As needed
Minimum broadcast gap	As needed
Number of frames	1
ACK requirements	NAK, REFRIGERATOR_STATUS

Table 6.52.3b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	0 to 5	Instance	uint6	-	See Table 5.3
	6 to 7	Cavity	uint2	-	See Table 5.3
1	0 to 1	Light	uint2	-	00b – turn all off 01b – turn all on
4 to 5	-	Set Temperature	uint16	°C	See Table 5.3
6	0 to 3	Fuel Source	uint4	-	0000b – Gas 0001b – DC Voltage 0010b – AC voltage
	4 to 7	Refrigerator Mode	uint4	-	0000b – off 0001b – on

6.52.4 Service Points

Table 6.52.4 lists the Service Points.

Table 6.52.4 — Service Points

MSB	ISB	LSb	Description
0	0-FFh	0-7	Node-Global Service Points. Combine the ISB and LSb to calculate. Values from 0-FFh are Standard SPNs – see Table 7.3
1	Instance	0	Set Point Temperature

	Instance	1	Main Control
	Instance	2	Thermostat
	Instance	3	Burner
	Instance	4	AC Element
	Instance	5	DC Power
	Instance	6	Igniter
	Instance	7	AC Power
2	Instance	0	Temp Limit Switch
	Instance	1 to 7	Temp Sensor
3	Instance	0	User Interface
	Instance	1	Burner start failure
	Instance	2	Flame Failure
	Instance	3	Burner voltage
	Instance	4	Burner premature flame recognition
	Instance	5	Flame monitor
	Instance	6	Compressor
	Instance	7	Cooling System Pressure Low
4	Instance	0 to 3	Fan
	Instance	4	Cooling System Pressure High
	Instance	5	Burner assembly overheating
	Instance	6	Door Switch
	Instance	7	Power supply
5	Instance	0	DC Element
	Instance	1	Overheating protection system
	Instance	2	Refrigerator over temperature
	Instance	3	Exhaust gas temperature
	Instance	4	Exhaust gas temperature sensor
	Instance	5	Burner control unit

6.52.5 Test Profiles

6.52.5.1 Refrigerator base profile

(REFRIGERATOR_STATUS)

ID	Datum	Test	Required Response	Behavior
107A-C-01	Current Temperature	Plug in Refrigerator	REFRIGERATOR_STATUS reports the Current Temperature REFRIGERATOR_STATUS reports the Fuel Source	N/A

			REFRIGERATOR_STATUS reports the Door Switch REFRIGERATOR_STATUS reports the Refrigerator mode	

6.52.5.2 Refrigerator with settable temperature

(REFRIGERATOR_COMMAND/REFRIGERATOR_STATUS)

ID	Datum	Test	Required Response	Behavior
107A-C-01	Set Temperature	Send REFRIGERATOR_COMMAND with Set Temperature	REFRIGERATOR_STATUS reports the Set Temperature confirmed	Refrigerator changes to new set temperature
107A-C-01	Refrigerator mode	Send REFRIGERATOR_COMMAND with Refrigerator on mode = 0001b	REFRIGERATOR_COMMAND with Refrigerator on mode =00 01b	Refrigerator is on
		Send REFRIGERATOR_COMMAND with Refrigerator off mode = 0000b	REFRIGERATOR_COMMAND with Refrigerator off mode = 0000b	Refrigerator is off

6.52.5.3 Refrigerator Profile with Gas fuel source

(REFRIGERATOR_COMMAND/REFRIGERATOR_STATUS)

ID	Datum	Test	Required Response	Behavior
107A-C-01	Fuel Source	Send REFRIGERATOR_COMMAND with Fuel Source = 0000b (GAS)	REFRIGERATOR_STATUS reports the Fuel Source = 0000b (GAS)	Refrigerator Runs on Gas

6.52.5.4 Refrigerator Profile with DC fuel source

(REFRIGERATOR_COMMAND/REFRIGERATOR_STATUS)

ID	Datum	Test	Required Response	Behavior
107A-C-01	Fuel Source	Send REFRIGERATOR_COMMAND with Fuel Source = 0001b (DC)	REFRIGERATOR_STATUS reports the Fuel Source = 0001b (DC)	Refrigerator Runs on DC Voltage

6.52.5.5 Refrigerator Profile with AC fuel source

(REFRIGERATOR_COMMAND/REFRIGERATOR_STATUS)

ID	Datum	Test	Required Response	Behavior
107A-C-01	Fuel Source	Send REFRIGERATOR_COMMAND with Fuel Source = 0010b (AC)	REFRIGERATOR_STATUS reports the Fuel Source = 0010b (AC)	Refrigerator Runs on AC Power

6.53 TV Lift

6.53.1 Introduction

This DGN contains control information for the TV Lift. The following formats apply (see Table 6.53.1a).

Table 6.53.1a — DG definition

Device attribute	Value
Category	Entertainment Systems
Default Source Address	118, 119
Dynamic Address	234-239
Instance	Multiple

6.53.2 TV Lift Status

Table 6.53.2a defines the DG attributes and Table 6.53.2b defines the signal and parameter attributes.

Table 6.53.2a — DG definition

DG attribute	Value
Name	TV_LIFT_STATUS
DGN	1FDC4h
Default priority	6
Maximum broadcast gap	N/A
Normal broadcast gap	on change 100 ms when lift is in motion
Minimum broadcast gap	100 ms
Number of frames	1
ACK requirements	None

Table 6.53.2b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	Uint8	-	1-250
1	-	Motion	Uint8	-	0 - No motion

					1 - Deploying 2 - Storing
2	-	Position	Uint8	%	See Table 5.3 0 - Stored 200 - 100% Deployed If the device can only detect whether it is fully stored, it shall only report using values of 0% (fully stored) and 100% (not fully stored). IF it can detect fully deployed as well, but not intermediate values, it shall report using 0%,100% (fully deployed), and 50% (partially deployed).
3	0 to 1	Mechanical Lock status	Uint2	-	00b - Lift is unlocked 01b - Lift is locked The status of a physical lock that secures the lift so that it cannot move.
	4 to 5	User lock status	Uint2	-	00b - User lock is not activated. Lift is OK to move 01b - User lock is activated. Lift will not move The status of a software lock, preventing motion.
	6 to 7	Brake status	Uint2	-	00b - All motor brakes are not locked 01b - One or more motor brake is locked. A motor brake prevents motion while idle, but does not prevent motion from commands.
4	0 to 1	Parked status	Uint2	-	00b - Lift may move 01b - Lift will not move because of Parked status. This is typically from a park brake input, but may be derived from other sources.
	2 to 3	Ignition key	Uint2	-	00b - Lift may move 01b - Lift will not move because of Ignition status The status of ignition status lock, typically derived from the Chassis Mobility Status DGN but possibly from another source.
	4 to 5	Low voltage	Uint2	-	00b - Lift may move 01b - Lift will not move because of Low Voltage status
	6 to 7	Generic Lock	Uint2	-	00b - Lift may move 01b - Lift will not move because of generic lockout signal status. The lockout signal is typically a switch.
5	0 to 1	Auto Retraction on Park Brake Release	Uint2	-	00b – No auto retraction based on park brake 01b – Lift automatically stores when park brake releases
	2 to 3	Auto Retraction on Ignition	Uint2	-	00b – No auto retraction based on ignition 01b – Lift automatically stores when ignition releases

	4 to 5	Overcurrent Status	Uint2	-	00b – Motor output not in overcurrent 01b – Motor output has drawn overcurrent
	6 to 7	Override Status	Uint2	-	00b – External override is inactive 01b – External override is active Override status may be used when lift is being operated from an external switch.
6	0 to 1	Lift deployment limit switch	Uint2	-	00b – Lift is not fully deployed 01b – Lift is fully deployed
	2 to 3	Lift storage limit switch	Uint2	-	00b – Lift is not fully stored 01b – Lift is fully stored

6.53.3 TV Lift Command

Table a defines the DG attributes and Table b defines the signal and parameter attributes. This DGN triggers lift actions. If the Direction of Motion is Deploy or Store, the command must be repeated every 100ms to keep the lift in motion. If a longer gap occurs, the lift should stop automatically for safety. The Direction of Motion command for Stop does not need to be repeated, but it should certainly be sent to stop the motion.

Table a — DG definition

DG attribute	Value
Name	TV_LIFT_COMMAND
DGN	1FDC3h
Default priority	3
Maximum broadcast gap	N/A
Normal broadcast gap	on change 100 ms when lift is in motion
Minimum broadcast gap	N/A
Number of frames	1
ACK requirements	NAK, TV_LIFT_STATUS

Table b — Signal and parameter definition

Byte	Bit	Name	Data type	Unit	Value description
0	-	Instance	uint8	-	0 - All, for Storing and Lock Engagement/Disengagement only. 1 - 250
1	0 to 1	User lock	uint2	-	00b - Release user lock 01b - Set user lock
	2 to 3	Mechanical lock	uint2	-	00b - Disengage lock 01b - Engage lock
2	-	Direction of movement	Uint8	-	0 - Stop 1 - Deploy 2 - Store
3	-	Move to Position	uint8	%	Desired Position See Table 5.3 0 – Fully Stored 200 – Fully Deployed
4	0 to 1	Auto Retraction on Park	uint2	-	00b – No auto retraction based on park brake

		Brake Release			01b – Set lift to automatically store with park brake release
	2 to 3	Auto Retraction on Ignition	Uint2	-	00b – No auto retraction based on ignition 01b – Set lift to automatically store with ignition

6.53.4 Service Points

Table 6.53.4 lists the Service Points.

Table 6.53.4— Service Points

MSB	ISB	LSb	Description
1	Instance	0	Lift Motor
1	Instance	1	Motor Driver
1	Instance	2	Motor Brake
1	Instance	3	Mechanical Lock
1	Instance	4	Lift Deployment Limit Switch
1	Instance	5	Lift Storage Limit Switch

6.53.5 Alarms

Table 6.53.5— Alarms

Instance	Description
1	Lift started deploying
2	Lift started storing
3	Lift stopped (user-initiated)
4	Lift stopped (limit switch)
5	Lift stopped (overcurrent)
6	Lift locked
7	Lift unlocked
8	Storing triggered by Park Brake release
9	Storing triggered by Ignition status

7 Informational Tables

7.1 Manufacturer codes

The manufacturer codes shown in Table 7.1 are defined and used by the corresponding companies before any agreement was made with SAE in regards of assigning manufacturer codes. Any manufacturer shall apply for a code from SAE and it is highly recommended to use SAE assigned manufacturer codes.

Table 7.1 — Manufacturer codes

Code	Manufacturer
101	Atwood Mobile Products
102	Carefree of Colorado
103	Dometic Corporation
104	Freightliner Custom Chassis Corp.
105	General Dynamics - Intellitec Products
106	Girard Systems
107	Hopkins Manufacturing Corp.
108	HWH Corporation
109	Integrated Power Systems
110	Onan / Cummins Power Generation
111	Progressive Dynamics, Inc.
112	SilverLeaf Electronics, Inc.
113	Spartan Motors Chassis, Inc.
114	Technology Research Corporation
115	Transportation Systems Design, Inc.
116	Vehicle Systems, Inc.
117	Wire Design, Inc.
118	Workhorse Custom Chassis
119	Xantrex Technology, Inc.
120	Power Gear
121	RV Products
122	Suburban
123	Borg-Warner
124	Garnet Instruments
125	American Technology
126	Automated Engineering Corp.

7.2 Default source addresses (DSA)

The following table provides a list of products, the static address it should be assigned, and the dynamic address where it should start the claiming process. Nodes using dynamic source addresses should start with the highest address in the preferred range and work down.

If a node has multiple functions, it uses the same source address for all messages. If statically addressed, it may use the DSA for any one function which is unlikely to be duplicated in a network. If dynamically addressed, it should start the claiming process in the Multifunction group (112-127).

Table 7.2 Default Source Addresses

Product	DSA	Preferred Dynamic Address Range	Notes Dynamic Address Group	Section
Multifunction	See Above	112-127	Multifunction	
Generator	64	128-143	Power Components	6.18
Genstart Controller	65	128-143	Power Components	6.35
Inverter #1-2	66, 67	128-143	Power Components	6.19
Control Panel*	68	144-159	Controls and Displays	
Battery State of Charge Monitor	69	160-175	Sensors	6.49
Battery	70	128-143	Power Components	6.49
Chassis Battery S.O.C.	71	160-175	Sensors	6.5
Water/Waste Tank System	72	160-175	Sensors	6.28
LPG Tank System	73	160-175	Sensors	6.28
Converter #1	74	128-143	Power Components	6.20
Converter #2	75	128-143	Power Components	6.20
Charge Controller	76	128-143	Power Components	6.20
AC Load Monitor / Controller	77	128-143	Power Components	6.22
AC Fault Protection System	78	128-143	Power Components	6.32
Transfer Switch	79	128-143	Power Components	6.32
Weather Station	80	160-175	Sensors	6.33
Hydraulic/Electric Leveling System Controller	81	176-191	Mechanical Components	6.13
Hydraulic/Electric Leveling System	82	176-191	Mechanical Components	6.13
Air Leveling System	83	176-191	Mechanical Components	6.13
Slide Room #1-4	84-87	176-191	Mechanical Components	6.14
Main Thermostat	88	192-207	Comfort Systems	6.16
Bedroom Thermostat	89	192-207	Comfort Systems	6.16
Thermostat #3-6	90-93	192-207	Comfort Systems	6.16
Main Furnace (Conventional)	94	192-207	Comfort Systems	6.15
Conventional Furnace #2-3	95, 96	192-207	Comfort Systems	6.15
Aux. Heat (e.g Tile Heat), #1-3	97-99	192-207	Comfort Systems	6.36
Furnace (Hydronic)	100	192-207	Comfort Systems	6.15
Water Heater #1-2	101, 102	208-223	Appliances and Bridges	6.9
Air Conditioners #1-4	103-106	192-207	Comfort Systems	6.17
Refrigerator	107	208-223	Appliances and Bridges	
Aux. Refrigerator(Wine Cooler)	108	208-223	Appliances and Bridges	
Aux. Freezer	109	208-223	Appliances and Bridges	
Ice Maker	110	208-223	Appliances and Bridges	
Stove	111	208-223	Appliances and Bridges	
Audio Entertainment #1-3	112-114	224-239	Entertainment Systems	
Video Entertainment #1-3	115-117	224-239	Entertainment Systems	
TV Lift (Living, Bedroom)	118, 119	224-239	Entertainment Systems	
Gas Detectors	120-125	208-223	Appliances and Bridges	6.10

Active Air Suspension	126	144-159	Chassis	6.12
Water Pump	127	208-223	Appliances and Bridges	6.29
Tank Autofill	128	208-223	Appliances and Bridges	6.30
Waste Dump	129	208-223	Appliances and Bridges	6.31
Awning	130	176-191	Mechanical Components	6.38
DC Dimmer	131	128-143	Power Components	6.23, 6.24
DC Input, Keypad	132	144-159	Controls and Displays	6.25
Tire Monitor	133	160-175	Sensors	6.37
Window Shade Control	134	128-143	Power Components	6.39
Door Control	135	176-191	Mechanical Components	6.40
GPS	136	160-175	Sensors	6.34, Error: Reference source not found
AC Load	137	128-143	Power Components	6.22
DC Motor Controller	138	128-143	Power Components	6.27
DC Disconnect	139	144-159	Appliances and Bridges	6.44
Generic AC Source	140	128-143	Power Components	6.21
Solar Charge Controller	141	128-143	Power Components	6.45
Roof Fan	142	192-207	Comfort Systems	6.46
External Interface	143	128-143	Power Components	6.42
Generic Alarm	144	160-175	Sensors	6.47
Window Control	145	176-191	Mechanical Components	6.40
DC Load	146	128-143	Power Components	6.23
Step Control	147	176-191	Mechanical Components	6.48
Generic Plumbing Valve	148	176-191	Mechanical Components	
Breaker Panel	149	128-143	Power Components	6.50
Vehicle Seat	150	176-191	Mechanical Components	6.41
Service Tool	249	-		
System Clock	250	-		6.4
Data Logger	251	-		
Chassis Bridge	252	144-159	Chassis	6.11
Network Bridge	253	144-159	Appliances and Bridges	6.43

7.3 Standard SPNs

These SPNs apply to devices of all types. The range of 0 to 255 is reserved for this purpose. Node-specific SPNs shall be 256 or greater. Standard SPNs must be encoded as non-instanced failures, per section 3.2.5.6. In each case, the MSB is zero, and the ISB and LSB contain the SPN value (see Table 3.2.5.5).

Table 7.3 — Standard SPNs

Value	Description
0	Specific Point Unknown
1	Node Microprocessor (or ECM)
2	Node Analog-Digital Converter
3	Node Settings or Configuration
4	Node RAM
5	Node Power Supply
6	Node Temperature
7	Node Clock / Timer
8	Node Date / Time. Usually indicates a product that requires a clock DGN from another source.

9	Node RV-C Connection. Usually indicates a product that requires a specific DGN from another source.
10	Node Serial/ID Number
11	Node Processor Supervisor (Watchdog)
12	Node Firmware
13	Node Internal Subnetwork Communications.

7.4 Failure Mode Identifier

Table 7.4 - Failure Mode Identifiers
Duplicates Table 3.2.5.8

7.5 Standard acknowledgments

Table 7.5 — Standard acknowledgments

Value	Description
0	ACK. Command will be executed.
1	NAK. Command will not be executed.
2	Command is not acceptable from the source.
3	Conditions do not allow command to be executed.
4	Command is not formatted properly.
5	Command parameters are out of range.
6	Command requires a security password.
7	Command requires more time to execute. This should be followed by an ACK when complete.
8	Command overridden by user.
9 to 127	Reserved
128 to 254	Command-specific responses.

These are the valid values for the Acknowledgment field in the Acknowledgment DGN (59392).
NAK 7 is used for operations in which an immediate positive or negative response is not possible. For example, if the node must check the status of other devices before it knows whether the command is possible, and those devices do not respond within the 1250 ms time window allowed for commands, it should send an immediate NAK 7 then send a second message when the outcome is fully known.

7.6 Standard Alarm Instances

Alarm Instance	Description
1	Impending Low Voltage Cutoff
DSA 72 - Water/Waste System DSA 73 - LPG System	
1	Tank nearly empty (e.g. Fresh, LPG)
2	Tank nearly full (e.g. Waste)
DSA 79 - Transfer Switch	

1	Unexpected loss of AC power
DSA 107 - Refrigerator DSA 108 - Aux Refrigerator DSA 109 - Aux Freezer DSA 110 - Ice Maker	
1	Refrigerator compartment too warm.
2	Freezer compartment too warm
DSA 130 - Awning	
1	Retraction triggered by wind.
2	Retraction triggered by lockout signal status change.
DSA 135 - Door Control	
1	Intrusion detected.
DSA 139 - DC Disconnect	
1	Impending low voltage cutoff.

7.7 DGN designations

The following table provides the values for the DGNs defined by RV-C. The scheme is intended to reduce the probability of intersecting NMEA 2000 DGNs. New DGNs should be added in sequence, counting down to 1FF80h, then resuming again at 1FEFFh. At 1FE80h the sequence should again be interrupted and resumed at 1FDFFh. NMEA numbers their DGNs in groups, with each group starting at 1F#00h. Thus unless any NMEA group exceeds 128 DGNs, there is no chance of collision.

Table 7.7 — DGN designations

DGN	Hex	Decimal	Section
DATE_TIME_STATUS	1FFFF	131071	6.4.2
SET_DATE_TIME_COMMAND	1FFFE	131070	6.4.3
DC_SOURCE_STATUS_1	1FFFD	131069	6.5.2
DC_SOURCE_STATUS_2	1FFFC	131068	6.5.3
DC_SOURCE_STATUS_3	1FFFB	131067	6.5.4
COMMUNICATION_STATUS_1	1FFFA	131066	6.6.2
COMMUNICATION_STATUS_2	1FFF9	131065	6.6.3
COMMUNICATION_STATUS_3	1FFF8	131064	6.6.4
WATERHEATER_STATUS	1FFF7	131063	6.9.2
WATERHEATER_COMMAND	1FFF6	131062	6.9.3
GAS_SENSOR_STATUS	1FFF5	131061	6.10.2
CHASSIS_MOBILITY_STATUS	1FFF4	131060	6.11.2
CHASSIS_MOBILITY_COMMAND	1FFF3	131059	6.11.4
AAS_STATUS	1FFF0	131056	6.12.3
AAS_COMMAND	1FFF1	131057	6.12.2
reserved	1FFF0	131056	
AAS_SENSOR_STATUS	1FFEF	131055	6.12.4
LEVELING_CONTROL_COMMAND	1FFEE	131054	6.13.3
LEVELING_CONTROL_STATUS	1FFED	131053	6.13.2
LEVELING_JACK_STATUS	1FFEC	131052	6.13.4
LEVELING_SENSOR_STATUS	1FFEB	131051	6.13.5
HYDRAULIC_PUMP_STATUS	1FFEA	131050	6.13.6
LEVELING_AIR_STATUS	1FFE9	131049	6.13.11
SLIDE_STATUS	1FFE8	131048	6.14.1
SLIDE_COMMAND	1FFE7	131047	6.14.2
SLIDE_SENSOR_STATUS	1FFE6	131046	6.14.3

DGN	Hex	Decimal	Section
SLIDE_MOTOR_STATUS	1FFE5	131045	6.14.4
FURNACE_STATUS	1FFE4	131044	6.15.2
FURNACE_COMMAND	1FFE3	131043	6.15.3
THERMOSTAT_STATUS_1	1FFE2	131042	6.16.2
AIR_CONDITIONER_STATUS	1FFE1	131041	6.17.6
AIR_CONDITIONER_COMMAND	1FFE0	131040	6.17.4
GENERATOR_AC_STATUS_1	1FFDF	131039	6.18.3
GENERATOR_AC_STATUS_2	1FFDE	131038	6.18.4
GENERATOR_AC_STATUS_3	1FFDD	131037	6.18.5
GENERATOR_STATUS_1	1FFDC	131036	6.18.23
GENERATOR_STATUS_2	1FFDB	131035	6.18.24
GENERATOR_COMMAND	1FFDA	131034	6.18.25
GENERATOR_START_CONFIG_STATUS	1 FFD9	131033	6.18.26
GENERATOR_START_CONFIG_COMMAND	1 FFD8	131032	6.18.27
INVERTER_AC_STATUS_1	1FFD7	131031	6.19.3
INVERTER_AC_STATUS_2	1FFD6	131030	6.19.4
INVERTER_AC_STATUS_3	1FFD5	131029	6.19.5
INVERTER_STATUS	1FFD4	131028	6.19.6
INVERTER_COMMAND	1FFD3	131027	6.19.9
INVERTER_CONFIGURATION_STATUS_1	1FFD2	131026	6.19.10
INVERTER_CONFIGURATION_STATUS_2	1FFD1	131025	6.19.11
INVERTER_CONFIGURATION_COMMAND_1	1FFD0	131024	6.19.14
INVERTER_CONFIGURATION_COMMAND_2	1FFCF	131023	6.19.15
INVERTER_STATISTICS_STATUS	1FFCE	131022	6.19.18
INVERTER_APS_STATUS	1FFCD	131021	6.19.19
INVERTER_DCBUS_STATUS	1FFCC	131020	6.19.20
INVERTER_OPS_STATUS	1FFCB	131019	6.19.21
CHARGER_AC_STATUS_1	1FFCA	131018	6.20.3
CHARGER_AC_STATUS_2	1FFC9	131017	6.20.4
CHARGER_AC_STATUS_3	1FFC8	131016	6.20.5
CHARGER_STATUS	1FFC7	131015	6.20.6
CHARGER_CONFIGURATION_STATUS	1FFC6	131014	6.20.11
CHARGER_COMMAND	1FFC5	131013	6.20.12
CHARGER_CONFIGURATION_COMMAND	1FFC4	131012	6.20.13
reserved	1FFC3	131011	
CHARGER_APS_STATUS	1FFC2	131010	6.20.24
CHARGER_DCBUS_STATUS	1FFC1	131009	6.20.25
CHARGER_OPS_STATUS	1FFC0	131008	6.20.26
AC_LOAD_STATUS	1FFBF	131007	6.22.2
AC_LOAD_COMMAND	1FFBE	131006	6.22.4
DC_LOAD_STATUS	1FFBD	131005	6.23.2
DC_LOAD_COMMAND	1FFBC	131004	6.23.4
DC_DIMMER_STATUS_1	1FFBB	131003	6.24.2
DC_DIMMER_STATUS_2	1FFBA	131002	6.24.3
DC_DIMMER_COMMAND	1FFB9	131001	6.24.5
DIGITAL_INPUT_STATUS	1FFB8	131000	6.25.2
TANK_STATUS	1FFB7	130999	6.28.2
TANK_CALIBRATION_COMMAND	1FFB6	130998	6.28.3
TANK_GEOMETRY_STATUS	1FFB5	130997	6.28.4

DGN	Hex	Decimal	Section
TANK_GEOMETRY_COMMAND	1FFB4	130996	6.28.5
WATER_PUMP_STATUS	1FFB3	130995	6.29.2
WATER_PUMP_COMMAND	1FFB2	130994	6.29.3
AUTOFILL_STATUS	1FFB1	130993	6.30.2
AUTOFILL_COMMAND	1FFB0	130992	6.30.3
WASTEDUMP_STATUS	1FFAF	130991	6.31.2
WASTEDUMP_COMMAND	1FFAE	130990	6.31.3
ATS_AC_STATUS_1	1FFAD	130989	6.32.2
ATS_AC_STATUS_2	1FFAC	130988	6.32.2
ATS_AC_STATUS_3	1FFAB	130987	6.32.2
ATS_STATUS	1FFAA	130986	6.32.4
ATS_COMMAND	1FFA9	130985	6.32.5
reserved	1FFA8	130984	
reserved	1FFA7	130983	
reserved	1FFA6	130982	
WEATHER_STATUS_1	1FFA5	130981	6.33.4
WEATHER_STATUS_2	1FFA4	130980	6.33.5
ALTIMETER_STATUS	1FFA3	130979	6.33.6
ALTIMETER_COMMAND	1FFA2	130978	6.33.7
WEATHER_CALIBRATE_COMMAND	1FFA1	130977	6.33.8
COMPASS_BEARING_STATUS	1FFA0	130976	6.34.2
COMPASS_CALIBRATE_COMMAND	1FF9F	130975	6.34.3
reserved (formerly BRIDGE_COMMAND)	1FF9E	130974	
reserved (formerly BRIDGE_DGN_LIST)	1FF9D	130973	
THERMOSTAT_AMBIENT_STATUS	1FF9C	130972	6.16.11
HEAT_PUMP_STATUS	1FF9B	130971	6.17.5
HEAT_PUMP_COMMAND	1FF9A	130970	6.17.6
CHARGER_EQUALIZATION_STATUS	1FF99	130969	6.20.21
CHARGER_EQUALIZATION_CONFIGURATION_STATUS	1FF98	130968	6.20.22
CHARGER_EQUALIZATION_CONFIGURATION_COMMAND	1FF97	130967	6.20.23
CHARGER_CONFIGURATION_STATUS_2	1FF96	130966	6.20.14
CHARGER_CONFIGURATION_COMMAND_2	1FF95	130965	6.20.15
GENERATOR_AC_STATUS_4	1FF94	130964	6.18.6
GENERATOR_ACFAULT_CONFIGURATION_STATUS_1	1FF93	130963	6.18.7
GENERATOR_ACFAULT_CONFIGURATION_STATUS_2	1FF92	130962	6.18.7
GENERATOR_ACFAULT_CONFIGURATION_COMMAND_1	1FF91	130961	6.18.7
GENERATOR_ACFAULT_CONFIGURATION_COMMAND_2	1FF90	130960	6.18.7
INVERTER_AC_STATUS_4	1FF8F	130959	6.19.6
INVERTER_ACFAULT_CONFIGURATION_STATUS_1	1FF8E	130958	6.19.7
INVERTER_ACFAULT_CONFIGURATION_STATUS_2	1FF8D	130957	6.19.7
INVERTER_ACFAULT_CONFIGURATION_COMMAND_1	1FF8C	130956	6.19.7
INVERTER_ACFAULT_CONFIGURATION_COMMAND_2	1FF8B	130955	6.19.7
CHARGER_AC_STATUS_4	1FF8A	130954	6.20.6
CHARGER_ACFAULT_CONFIGURATION_STATUS_1	1FF89	130953	6.20.7
CHARGER_ACFAULT_CONFIGURATION_STATUS_2	1FF88	130952	6.20.7
CHARGER_ACFAULT_CONFIGURATION_COMMAND_1	1FF87	130951	6.20.7
CHARGER_ACFAULT_CONFIGURATION_COMMAND_2	1FF86	130950	6.20.7
ATS_AC_STATUS_4	1FF85	130949	6.32.2
ATS_ACFAULT_CONFIGURATION_STATUS_1	1FF84	130948	6.32.3

DGN	Hex	Decimal	Section
ATS_ACFAULT_CONFIGURATION_STATUS_2	1FF83	130947	6.32.3
ATS_ACFAULT_CONFIGURATION_COMMAND_1	1FF82	130946	6.32.3
ATS_ACFAULT_CONFIGURATION_COMMAND_2	1FF81	130945	6.32.3
GENERATOR_DEMAND_STATUS	1FF80	130944	6.35.2
GENERATOR_DEMAND_COMMAND	1FEFF	130815	6.35.3
AGS_CRITERION_STATUS	1FEFE	130814	6.35.4
AGS_CRITERION_COMMAND	1FEFD	130813	6.35.6
FLOOR_HEAT_STATUS	1FEFC	130812	6.36.2
FLOOR_HEAT_COMMAND	1FEFB	130811	6.36.3
THERMOSTAT_STATUS_2	1FEFA	130810	6.16.3
THERMOSTAT_COMMAND_1	1FEF9	130809	6.16.4
THERMOSTAT_COMMAND_2	1FEF8	130808	6.16.5
THERMOSTAT_SCHEDULE_STATUS_1	1FEF7	130807	6.16.7
THERMOSTAT_SCHEDULE_STATUS_2	1FEF6	130806	6.16.8
THERMOSTAT_SCHEDULE_COMMAND_1	1FEF5	130805	6.16.9
THERMOSTAT_SCHEDULE_COMMAND_2	1FEF4	130804	6.16.10
INVERTER_DC_STATUS	1FEE8	130792	6.19.22
AWNING_STATUS	1FEF3	130803	6.38.2
AWNING_COMMAND	1FEF2	130802	6.38.8
TIRE_RAW_STATUS	1FEF1	130801	6.37.2
TIRE_STATUS	1FEF0	130800	6.37.3
TIRE_SLOW_LEAK_ALARM	1FEEF	130799	6.37.4
TIRE_TEMPERATURE_CONFIGURATION_STATUS	1FEEE	130798	6.37.6
TIRE_PRESSURE_CONFIGURATION_STATUS	1FEED	130797	6.37.7
TIRE_PRESSURE_CONFIGURATION_COMMAND	1FEEC	130796	6.37.9
TIRE_TEMPERATURE_CONFIGURATION_COMMAND	1FEEB	130795	6.37.9
TIRE_ID_STATUS	1FEEA	130794	6.37.11
TIRE_ID_COMMAND	1FEE9	130793	6.37.12
INVERTER_DC_STATUS	1FEE8	130792	6.19.22
GENERATOR_DEMAND_CONFIGURATION_STATUS (deprecated)	1FEE7	130791	6.35.7
GENERATOR_DEMAND_CONFIGURATION_COMMAND (deprecated)	1FEE6	130790	6.35.8
LOCK_STATUS	1FEE5	130789	6.40.2
LOCK_COMMAND	1FEE4	130788	6.40.3
WINDOW_STATUS	1FEE3	130787	6.40.4
WINDOW_COMMAND	1FEE2	130786	6.40.7.4
DC_MOTOR_CONTROL_COMMAND	1FEE1	130785	6.27.5
DC_MOTOR_CONTROL_STATUS	1FEE0	130784	6.27.2
WINDOW_SHADE_CONTROL_COMMAND	1FEDF	130783	6.39.4
WINDOW_SHADE_CONTROL_STATUS	1FEDE	130782	6.39.2
AC_LOAD_STATUS_2	1FEDD	130781	6.22.3
DC_LOAD_STATUS_2	1FEDC	130780	6.23.3
DC_DIMMER_COMMAND_2	1FEDB	130779	6.24.6
DC_DIMMER_STATUS_3	1FEDA	130778	6.24.4
GENERIC_INDICATOR_COMMAND	1FED9	130777	6.26.3
GENERIC_CONFIGURATION_STATUS	1FED8	130776	6.3.2
GENERIC_INDICATOR_STATUS	1FED7	130775	6.26.1.1
MFG_SPECIFIC_CLAIM_REQUEST	1FED6	130774	3.2.4
AGS_DEMAND_CONFIGURATION_STATUS	1FED5	130773	6.35.7
AGS_DEMAND_CONFIGURATION_COMMAND	1FED4	130772	6.35.8

DGN	Hex	Decimal	Section
DEPRECATED (Prior to 10/31/21, was GPS_STATUS)	1FED3	130771	
AGS_CRITERION_STATUS_2	1FED2	130770	6.35.5
SUSPENSION_AIR_PRESSURE_STATUS	1FED1	130769	6.12.5
DC_DISCONNECT_STATUS	1FED0	130768	6.42.2
DC_DISCONNECT_COMMAND	1FECF	130767	6.42.3
INVERTER_CONFIGURATION_STATUS_3	1FECE	130766	6.19.12
INVERTER_CONFIGURATION_COMMAND_3	1FECD	130765	6.19.16
CHARGER_CONFIGURATION_STATUS_3	1FECC	130764	6.20.16
CHARGER_CONFIGURATION_COMMAND_3	1FECB	130763	6.20.17
DM-RV	1FECA	130762	3.2.5
DC_SOURCE_STATUS_4	1FEC9	130761	6.5.5
DC_SOURCE_STATUS_5	1FEC8	130760	6.5.6
DC_SOURCE_STATUS_6	1FEC7	130759	6.5.7
GENERATOR_DC_STATUS_1	1FEC6	130758	6.18.9
GENERATOR_DC_CONFIGURATION_STATUS	1FEC5	130757	6.18.11
GENERATOR_DC_COMMAND	1FEC4	130756	6.18.12
GENERATOR_DC_CONFIGURATION_COMMAND	1FEC3	130755	6.18.13
GENERATOR_DC_EQUALIZATION_STATUS	1FEC2	130754	6.18.20
GENERATOR_DC_EQUALIZATION_CONFIGURATION_STATUS	1FEC1	130753	6.18.21
GENERATOR_DC_EQUALIZATION_CONFIGURATION_COMMAND	1FEC0	130752	6.18.22
CHARGER_CONFIGURATION_STATUS_4	1FEBF	130751	6.20.18
CHARGER_CONFIGURATION_COMMAND_4	1FEBE	130750	6.20.19
INVERTER_TEMPERATURE_STATUS	1FEBD	130749	6.19.26
HYDRAULIC_PUMP_COMMAND	1FEBC	130748	6.13.10
GENERIC_AC_STATUS_1	1FEBB	130747	6.21.2
GENERIC_AC_STATUS_2	1FEBA	130746	6.21.3
GENERIC_AC_STATUS_3	1FEB9	130745	6.21.4
GENERIC_AC_STATUS_4	1FEB8	130744	6.21.5
GENERIC_ACFAULT_CONFIGURATION_STATUS_1	1FEB7	130743	6.21.8.3
GENERIC_ACFAULT_CONFIGURATION_STATUS_2	1FEB6	130742	6.21.8.3
GENERIC_ACFAULT_CONFIGURATION_COMMAND_1	1FEB5	130741	6.21.8.3
GENERIC_ACFAULT_CONFIGURATION_COMMAND_2	1FEB4	130740	6.21.8.3
SOLAR_CONTROLLER_STATUS_1	1FEB3	130739	6.45.2
SOLAR_CONTROLLER_CONFIGURATION_STATUS	1FEB2	130738	6.45.10
SOLAR_CONTROLLER_COMMAND	1FEB1	130737	6.45.11
SOLAR_CONTROLLER_CONFIGURATION_COMMAND	1FEB0	130736	6.45.12
SOLAR_EQUALIZATION_STATUS	1FEAF	130735	6.45.21
SOLAR_EQUALIZATION_CONFIGURATION_STATUS	1FEAE	130734	6.45.22
SOLAR_EQUALIZATION_CONFIGURATION_COMMAND	1FEAD	130733	6.45.23
DC_SOURCE_STATUS_7	1FEAC	130732	6.5.8
DC_SOURCE_STATUS_8	1FEAB	130731	6.5.9
DC_SOURCE_STATUS_9	1FEAA	130730	6.5.10
DC_SOURCE_STATUS_10	1FEA9	130729	6.5.11
CHASSIS_MOBILITY_STATUS_2	1FEA8	130728	6.11.3
ROOF_FAN_STATUS_1	1FEA7	130727	6.46.2
ROOF_FAN_COMMAND_1	1FEA6	130726	6.46.4
DC_SOURCE_STATUS_11	1FEA5	130725	6.5.12
DC_SOURCE_COMMAND	1FEA4	130724	6.5.15
CHARGER_STATUS_2	1FEA3	130723	6.20.9

DGN	Hex	Decimal	Section
CHARGER_CONFIGURATION_COMMAND_5	1FEA2	130722	6.20.21
CHARGER_CONFIGURATION_STATUS_5	1FEA1	130721	6.20.20
GPS_DATE_TIME_STATUS	1FEA0	130720	6.4.4
GENERIC_ALARM_STATUS	1FE9F	130719	6.47.1
GENERIC_ALARM_COMMAND	1FE9E	130718	6.47.2
reserved for deprecation	1FE9D	130717	
reserved for deprecation	1FE9C	130716	
INVERTER_CONFIGURATION_STATUS_4	1FE9B	130715	6.19.13
INVERTER_CONFIGURATION_COMMAND_4	1FE9A	130714	6.19.17
WATERHEATER_STATUS_2	1FE99	130713	6.9.4
WATERHEATER_COMMAND_2	1FE98	130712	6.9.5
CIRCULATION_PUMP_STATUS	1FE97	130711	6.9.6
CIRCULATION_PUMP_COMMAND	1FE96	130710	6.9.7
BATTERY_STATUS_1	1FE95	130709	6.49.1
BATTERY_STATUS_2	1FE94	130708	6.49.2
BATTERY_STATUS_3	1FE93	130707	6.49.3
BATTERY_STATUS_4	1FE92	130706	6.49.4
BATTERY_STATUS_5	1FE91	130705	6.49.5
BATTERY_STATUS_6	1FE90	130704	6.49.6
BATTERY_STATUS_7	1FE8F	130703	6.49.7
BATTERY_STATUS_8	1FE8E	130702	6.49.8
BATTERY_STATUS_9	1FE8D	130701	6.49.9
BATTERY_STATUS_10	1FE8C	130700	6.49.10
BATTERY_STATUS_11	1FE8B	130699	6.49.11
BATTERY_COMMAND	1FE8A	130698	6.49.14
STEP_STATUS	1FE89	130697	6.48.1
STEP_COMMAND	1FE88	130696	6.48.2
VEHICLE_ENVIRONMENT_STATUS	1FE87	130695	6.11.5
VEHICLE_ENVIRONMENT_COMMAND	1FE86	130694	6.11.6
SOLAR_CONTROLLER_STATUS_2	1FE85	130693	6.45.3
SOLAR_CONTROLLER_STATUS_3	1FE84	130692	6.45.4
SOLAR_CONTROLLER_STATUS_4	1FE83	130691	6.45.5
SOLAR_CONTROLLER_STATUS_5	1FE82	130690	6.45.6
SOLAR_CONTROLLER_STATUS_6	1FE81	130689	6.45.7
SOLAR_CONTROLLER_BATTERY_STATUS	1FE80	130688	6.45.8
SOLAR_CONTROLLER_SOLAR_ARRAY_STATUS	1FDFF	130559	6.45.9
SOLAR_CONTROLLER_CONFIGURATION_STATUS_2	1FDFE	130558	6.45.13
SOLAR_CONTROLLER_CONFIGURATION_COMMAND_2	1FDFD	130557	6.45.14
SOLAR_CONTROLLER_CONFIGURATION_STATUS_3	1FDFC	130556	6.45.15
SOLAR_CONTROLLER_CONFIGURATION_COMMAND_3	1FDFB	130555	6.45.16
SOLAR_CONTROLLER_CONFIGURATION_STATUS_4	1FDFA	130554	6.45.17
SOLAR_CONTROLLER_CONFIGURATION_COMMAND_4	1FDF9	130553	6.45.18
DC_SOURCE_STATUS_12	1FDF8	130552	6.5.13
DC_SOURCE_CONFIGURATION_STATUS_1	1FDF7	130551	6.5.16
DC_SOURCE_CONFIGURATION_COMMAND_1	1FDF6	130550	6.5.17
DC_SOURCE_CONFIGURATION_STATUS_2	1FDF5	130549	6.5.18
DC_SOURCE_CONFIGURATION_COMMAND_2	1FDF4	130548	6.5.19
BATTERY_STATUS_12	1FDF3	130547	6.49.12
BATTERY_STATUS_13	1FDF2	130546	6.49.13

DGN	Hex	Decimal	Section
BATTERY_SUMMARY	1FDF1	130545	6.49.15
DEPRECATED (Prior to 103121, was BATTERY_CONFIGURATION_COMMAND_1)	1FDF0	130544	
DEPRECATED (Prior to 103121, was BATTERY_CONFIGURATION_STATUS_2)	1FDEF	130543	
DEPRECATED (Prior to 103121, was BATTERY_CONFIGURATION_COMMAND_2)	1FDEE	130542	
TIRE_HIGH_PRESSURE_CONFIGURATION_STATUS	1FDED	130541	6.37.8
TIRE_HIGH_PRESSURE_CONFIGURATION_COMMAND	1FDEC	130540	6.37.9
LEVELING_SENSOR_ROLL_CONFIG_STATUS	1FDEB	130539	6.13.7
LEVELING_SENSOR_ROLL_CONFIG_COMMAND	1FDEA	130538	6.13.8
LEVELING_SENSOR_PITCH_CONFIG_STATUS	1FDE9	130537	6.13.6
LEVELING_SENSOR_PITCH_CONFIG_COMMAND	1FDE8	130536	6.13.8
DC_SOURCE_STATUS_13	1FDE7	130535	6.5.14
CAN_BUS_STATUS	1FDE6	130534	6.43.1
VALVE_STATUS	1FDE5	130533	6.51.2
VALVE_COMMAND	1FDE4	130532	6.51.3
ROOF_FAN_STATUS_2	1FDE3	130531	6.46.3
ROOF_FAN_COMMAND_2	1FDE2	130530	6.46.5
WEATHER_ALARM_STATUS	1FDE1	130529	6.33.3
WEATHER_ALARM_COMMAND	1FDE0	130528	6.33.2
GPS_TIME_STATUS	1FDDF	130527	6.34.6
DC_SOURCE_CONFIGURATION_COMMAND_3	1FDDE	130526	6.5.21
CELL_DETAIL	1FDDD	130525	6.49.16
GENERATOR_DC_STATUS_2	1FDDC	130524	6.18.10
GENERATOR_DC_CONFIGURATION_STATUS_2	1FDDB	130523	6.18.14
GENERATOR_DC_CONFIGURATION_COMMAND_2	1FDDA	130522	6.18.15
GENERATOR_DC_CONFIGURATION_STATUS_3	1FDD9	130521	6.18.16
GENERATOR_DC_CONFIGURATION_COMMAND_3	1FDD8	130520	6.18.17
GENERATOR_DC_CONFIGURATION_STATUS_4	1FDD7	130519	6.18.18
GENERATOR_DC_CONFIGURATION_COMMAND_4	1FDD6	130518	6.18.19
DEPRECATED (Prior to 103121, was GENERATOR_DC_CONFIGURATION_STATUS_5)	1FDD5	130517	
DEPRECATED (Prior to 103121, was GENERATOR_DC_CONFIGURATION_COMMAND_5)	1FDD4	130516	
REFRIGERATOR_STATUS	1FDD3	130515	6.52.2
REFRIGERATOR_COMMAND	1FDD2	130514	6.52.3
DEVICE_STATE_SYNCHRONIZATION	1FDD1	130513	6.2.5
DC_SOURCE_CONNECTION_STATUS	1FDD0	130512	6.5.20
SOLAR_CONTROLLER_CONFIGURATION_STATUS_5	1FDCF	130511	6.45.19
SOLAR_CONTROLLER_CONFIGURATION_COMMAND_5	1FDCE	130510	6.45.20
AWNING_STATUS_2	1FDCD	130509	6.38.4

DGN	Hex	Decimal	Section
AWNING_COMMAND_2	1FDCC	130508	6.38.5
INVERTER_TEMPERATURE_STATUS_2	1FDCB	130507	6.19.24
CHARGER_STATUS_3	1FDCA	130506	6.20.10
AIR_CONDITIONING_STATUS_2	1FDC9	130505	6.17.3
VEHICLE_SEAT_COMMAND	1FDC8	130504	6.41.2
VEHICLE_SEAT_STATUS	1FDC7	130503	6.41.3
VEHICLE_SEAT_LIGHTING_COMMAND	1FDC6	130502	6.41.4
VEHICLE_SEAT_LIGHTING_STATUS	1FDC5	130501	6.41.5
TV_LIFT_STATUS	1FDC4	130500	6.53
TV_LIFT_COMMAND	1FDC3	130499	6.53
DC_LIGHTING_CONTROLLER_STATUS_1	1FDC2	130498	6.24.9
DC_LIGHTING_CONTROLLER_STATUS_2	1FDC1	130497	6.24.10
DC_LIGHTING_CONTROLLER_STATUS_3	1FDC0	130496	6.24.11
DC_LIGHTING_CONTROLLER_STATUS_4	1FDBF	130495	6.24.12
DC_LIGHTING_CONTROLLER_STATUS_5	1FDBE	130494	6.24.13
DC_LIGHTING_CONTROLLER_STATUS_6	1FDBD	130493	6.24.14
DC_LIGHTING_CONTROLLER_COMMAND_1	1FDBC	130492	6.24.15
DC_LIGHTING_CONTROLLER_COMMAND_2	1FDBB	130491	6.24.16
DC_LIGHTING_CONTROLLER_COMMAND_3	1FDBA	130490	6.24.17
DC_LIGHTING_CONTROLLER_COMMAND_4	1FDB9	130489	6.24.18
DC_LIGHTING_CONTROLLER_COMMAND_5	1FDB8	130488	6.24.19
DC_LIGHTING_CONTROLLER_COMMAND_6	1FDB7	130487	6.24.20
Reserved – External Interface	1FDB6	130486	6.44
Reserved – External Interface	1FDB5	130485	6.44
Reserved – External Interface	1FDB4	130484	6.44
Reserved – External Interface	1FDB3	130483	6.44
Reserved – External Interface	1FDB2	130482	6.44
Reserved – External Interface	1FDB1	130481	6.44
Reserved – External Interface	1FDB0	130480	6.44
Reserved – External Interface	1FDAF	130479	6.44
Reserved – External Interface	1FDAE	130478	6.44
GENERAL_RESET	17F##	98048 + address	6.2.1
TERMINAL	17E##	97792 + address	6.2.3
DOWNLOAD	17D##	97536 + address	6.2.2
INSTANCE_ASSIGNMENT	17C##	97280 + address	6.2.4
INSTANCE_STATUS	17B##	97024 + address	6.2.4
DC_COMPONENT_DRIVER_STATUS_1	16F##	93952 + DSA	6.50.1
DC_COMPONENT_DRIVER_STATUS_2	16E##	93696 + DSA	6.50.2

DGN	Hex	Decimal	Section
DC_COMPONENT_DRIVER_STATUS_3	16D##	93440 + DSA	6.50.3
DC_COMPONENT_DRIVER_STATUS_4	16C##	93184 + DSA	6.50.4
DC_COMPONENT_DRIVER_STATUS_5	16B##	92928 + DSA	6.50.5
DC_COMPONENT_DRIVER_SETTINGS_1	16A##	92672 + DSA	6.50.6
DC_COMPONENT_DRIVER_SETTINGS_2	169##	92416 + DSA	6.50.7
DC_COMPONENT_DRIVER_COMMAND	160##	90112 + DSA	6.50.10
DC_COMPONENT_DRIVER_SETTINGS_COMMAND_1	161##	90368 + DSA	6.50.8
DC_COMPONENT_DRIVER_SETTINGS_COMMAND_2	162##	90624 + DSA	6.50.9
DC_COMPONENT_DRIVER_STATUS_6	163##	90880 + DSA	6.50.11
DEPRECATED (Prior to 103121, was GPS_POSITION)	FEF3	65267	