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SURFACE VEHICLE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard

SAE J1939-71

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Vehicle Application Layer

Foreword—This document has also changed to comply with the SAE Technical Standards Boards format. Definitions have changed to Section 3 and Abbreviations to Section 4. All other section numbers have changed accordingly.

This series of SAE Recommended Practices has been developed by the SAE Truck and Bus Control and Communications Network Subcommittee of the SAE Truck and Bus Electrical and Electronics Committee. The objectives of the subcommittee are to develop information reports, recommended practices, and standards concerned with the requirements design and usage of devices which transmit electronic signals and control information among vehicle components. The usage of these documents is not limited to truck and bus applications; other applications may be accommodated with immediate support being provided for construction and agricultural equipment, and stationary power systems.

These documents are intended as a guide toward standard practice and are subject to change so as to keep pace with experience and technical advances.

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1. Scope—As described in the parent document, SAE J1939, there are a minimum of seven documents required to fully define a complete version of this network. This particular SAE Recommended Practice, SAE J1939-71, describes an Application Layer for vehicle use.

2. References

2.1 Applicable Documents—General information regarding this series of recommended practices is found in SAE J1939. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1349—Engine Power Test Code-Spark Ignition and Compression Ignition-Net Power Rating
SAE J1843—Accelerator Pedal Position Sensor for Use with Electronic Controls in Medium- and Heavy-Duty Diesel On-Highway Engines
SAE J1922—Powertrain Control Interface for Electronic Controls Used in Medium and Heavy-Duty Diesel on-Highway Vehicle Applications
SAE J1939 (Draft)—Recommended Practice for a Serial Control and Communication Vehicle Network
SAE J1939-21—Data Link Layer

2.1.2 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

3. Definitions—See SAE J1939 for terms and definitions that are not defined in this document.

4. Abbreviations

ATA	American Trucking Association
EBS	Electronic Braking System
Kp	Engine endspeed governor gain
VMRS	Vehicle Maintenance Reporting System

See SAE J1939 for additional abbreviations that may be used in this document.

5. Technical Requirements—The Application Layer provides a means for application processes to access the OSI environment. This layer contains management functions and generally useful mechanisms to support applications.

5.1 General Guidelines

(R) 5.1.1 SIGNAL CHARACTERIZATION—It is the intent of the SAE J1939 network to provide current data and signals from a source so that it may be used by other nodes. It is recommended that the time between physical data acquisition of a signal and the transmission of the data should not exceed two times the repetition rate defined for the data. Additional constraints may be defined for certain parameters (see also 5.1.7.2).

(R) 5.1.2 MESSAGE FORMAT—The message format of SAE J1939 uses the parameter group number as the label for a group of parameters. Each of the parameters within the group can be expressed in ASCII, as scaled data defined by the ranges described in 5.1.4, or as function states consisting of two or more bits. Alphanumeric data will be transmitted with the most significant byte first. Unless otherwise specified, alphanumeric characters will conform to the ISO Latin 1 ASCII character set as shown in 5.1.3. Other parameters consisting of 2 or more data bytes shall be transmitted least significant byte first.

(R) The type of data shall also be identified for each parameter. Data may be either status or measured. Status specifies the present state of a multi-state parameter or function as a result of action taken by the transmitting node. This action is the result of a calculation which uses local and/or network “measured” and/or “status” information. Note that specific confirmation of this action is not necessarily assured. For instance, the status may indicate that a solenoid has been activated, yet no measurement may have been taken to ensure the solenoid accomplished its function. Examples of status-type data are: engine brakes are enabled, PTO speed control is active, cruise control is active, the cruise control is in the “set” state of operation (as opposed to a measured indication that the “set” switch contacts are closed), fault codes, torque/speed control override modes, desired speed/speed limit, engine torque mode, engine's desired operating speed, engine's operating speed asymmetry adjustment, etc.

Measured data conveys the current value of a parameter as measured or observed by the transmitting node to determine the condition of the defined parameter. Examples of measured-type data are: boost pressure, ignition on/off, cruise set switch activated, maximum cruise speed, cruise set speed, engine speed, percent load at current speed, etc.

(R) 5.1.3 ISO LATIN 1 CHARACTER SET—Horizontal boldface characters are the single hexidecimal digit representing the lower nibble of the single byte code for the character. Vertical boldface characters are the single hexidecimal digit representing the upper nibble of the single byte code for the character. See Figure 1.

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**A**	**B**	**C**	**D**	**E**	**F**
0	**---------- should not be displayed ----------**															
1	**---------- should not be displayed ----------**															
2	space	!	"	#	$	%	&	’	(	)	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6	‘	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{	l	}	~	nil
8	**---------- should not be displayed ----------**															
9	**---------- should not be displayed ----------**															
A	nil	¡	¢	£	¤	¥	l	§	¨	©	ª	«	¬	□	®	—
B	°	±	2	3	´	µ	¶	·	¸	1	º	»	¼	½	¾	¿
C	À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î	Ï
D	Ð	Ñ	Ò	Ó	Ô	Õ	Ö	×	Ø	Ù	Ú	Û	Ü	Ý	Þ	ß
E	à	á	â	ã	ä	å	æ	ç	è	é	ê	ë	ì	í	î	ï
F	ð	ñ	ò	ó	ô	õ	ö	÷	ø	ù	ú	û	ü	ý	þ	ÿ

FIGURE 1—ISO LATIN I CHARACTER SET

5.1.4 PARAMETER RANGES—Table 1 defines the ranges used to determine the validity of a transmitted signal. Table 2 defines the ranges used to denote the state of a discrete parameter and Table 3 defines the ranges used to denote the state of a control mode command. The values in the range "error indicator" provide a means for a module to immediately indicate that valid parametric data is not currently available due to some type of error in the sensor, sub-system, or module.

The values in the range "not available" provide a means for a module to transmit a message which contains a parameter that is not available or not supported in that module. The values in the range "not requested" provide a means for a device to transmit a command message and identify those parameters where no response is expected from the receiving device.

TABLE 1—TRANSMITTED SIGNAL RANGES

Range Name	1 byte	2 bytes	4 bytes	ASCII
Valid Signal	0 to 250 00_{16} to FA_{16}	0 to 64 255 0000_{16} to $FAFF_{16}$	0 to 4 211 081 215 00000000_{16} to $FAFFFFFF_{16}$	1 to 254 01_{16} to FE_{16}
Parameter specific indicator	251 FB_{16}	64 256 to 64 511 $FB00_{16}$ to $FBFF_{16}$	4 211 081 216 to 4 227 858 431 $FBxxxxxx_{16}$	none
Reserved range for future indicator bits	252 to 253 FC_{16} to FD_{16}	64 512 to 65 023 $FC00_{16}$ to $FDFF_{16}$	4 227 858 432 to 4 261 412 863 $FC000000_{16}$ to $FDFFFFFF_{16}$	none
Error indicator	254 FE_{16}	65 024 to 65 279 $FExx_{16}$	4 261 412 864 to 4 278 190 079 $FExxxxxx_{16}$	0 00_{16}
Not available or not requested	255 FF_{16}	65 280 to 65 535 $FFxx_{16}$	4 278 190 080 to 4 294 967 294 $FFxxxxxx_{16}$	255 FF_{16}

TABLE 2—TRANSMITTED VALUES FOR DISCRETE PARAMETERS (MEASURED)

Range Name	Transmitted Value
Disabled (off, passive, etc.)	00
Enabled (on, active, etc.)	01
Error indicator	10
Not available or not installed	11

TABLE 3—TRANSMITTED VALUES FOR CONTROL COMMANDS (STATUS)

Range Name	Transmitted Value
Command to disable function (turn off, etc.)	00
Command to enable function (turn on, etc.)	01
Reserved	10
Don't care/take no action (leave function as is)	11

If a component failure prevents the transmission of valid data for a parameter, the error indicator as described in Tables 1 and 2 should be used in place of that parameter's data. However, if the measured or calculated data has yielded a value that is valid yet exceeds the defined parameter range, the error indicator should not be used. The data should be transmitted using the appropriate minimum or maximum parameter value.

5.1.5 ASSIGNMENT OF RANGES TO NEW PARAMETERS—This section is intended to define a set of recommended SLOTs (Scaling, Limit, Offset, and Transfer Function) which can be used when parameters are added to SAE J1939. This permits data consistency to be maintained as much as possible between parameters of a given type (temperature, pressure, speed, etc.). Each SLOT is intended to provide a range and resolution suitable for most parameters within a given type. When necessary, a different scaling factor or offset can be used. All SLOTs should be based on a power of 2 scaling from another SLOT. This will minimize the math required for any internal scaling and reduce the opportunity for misinterpreted values. Offsets should be selected preferably on the following basis:

a. Offset = 0, or
b. Offset = 50% (equal ± range)

Table 4 defines the recommended SLOTs to be used when ranges are assigned to new parameters.

TABLE 4—RECOMMENDED SLOT DEFINITIONS

	Parameter	Scaling (Resolution)	Limits (Range)	Offset	Parameter Size
	Angle/Direction	10^{-7} deg/bit	−210 to 211.108 122 deg	−210	32 bit
(R)		1/128 deg/bit	−200 to 301.992 deg	−200	16 bit
		1/128 deg/bit	0 to 502 deg	0	16 bit
(R)		1 deg/bit	–125 to 125 deg	–125	8 bit
		0.1 s/bit	–3276.8 to 3276.8 s	–3276.8	16 bit
(R)	Brake Applications	1 brake appl/bit	0 to 4 227 858 431 appl	0	32 bit
(R)	Count	1 Count/bit	0 to 64 255 counts	0	16 bit
(R)	Curvature	1/128 1/km/bit	–250 to 250.992 1/km	–250	16 bit
	Distance	0.125 km/bit	0 to 526 385 151.9 km	0	32 bit
(R)		0.125 m/bit	−2500 to 5531.875 m	−2500	16 bit
(R)		0.1 mm/bit	–3200 to 3200 mm	–3200	16 bit
(R)		0.1 mm/bit	0 to 6400 mm	0	16 bit
(R)		1 m/bit	0 to 250 m	0	8 bit
(R)		1 m/bit	–125 to 125 m	–125	8 bit
(R)		5 m/bit	0 to 21 055 406 km	0	32 bit
(R)		5 km/bit	–160 635 to 160 635 km	–160635	16 bit
(R)	Economy, liquid	1/512 km/L per bit	0 to 125.5 km/L	0	16 bit
(R)	Economy, gaseous	1/512 km/kg per bit	0 to 125.5 km/kg	0	16 bit
	Electrical Current	1 A/bit	−125 to 125 A	−125	8 bit
		1 A/bit	0 to 250 A	0	8 bit
	Electrical Potential	0.05 V/bit	0 to 3212.75 V	0	16 bit
(R)	Flow Rate, liquid	0.05 L/h per bit	0 to 3212.75 L/h	0	16 bit
(R)	Flow Rate, gaseous	0.05 kg/h per bit	0 to 3212.75 kg/h	0	16 bit
(R)	Flow Rate, Volumetric	0.1 m^3/h per bit	0 to 6425.5 m^3/h	0	16 bit

TABLE 4—RECOMMENDED SLOT DEFINITIONS (CONTINUED)

	Parameter	Scaling (Resolution)	Limits (Range)	Offset	Parameter Size
	Force	5 N/bit	0 to 321 275 N	0	16 bit
(R)	Fuel used, liquid	0.5 L/bit	0 to 2 105 540 607.5 L	0	32 bit
(R)	Fuel used, gaseous	0.5 kg/bit	0 to 2 105 540 607.5 kg	0	32 bit
	Governor gain	1/1280 %/rpm per bit	0 to 50.2 %/rpm	0	8 bit
(R)	Gear ratio	0.01/bit	0 to 642.55	0	16 bit
(R)	Gear value	1 gear value/bit	-125 to 125	-125	8 bit
(R)	ID (Component, Software)	1 ID/bit	0 to 250 ID	0	8 bit
(R)	Kinematic viscosity	1 mm^2/s per bit	0 to 250 mm^2/s	0	8 bit
	Mass (cargo)	0.5 kg/bit	0 to 32 127.5 kg	0	16 bit
		2 kg/bit	0 to 128 510 kg	0	16 bit
(R)		10 kg/bit	0 to 642 550 kg	0	16 bit
(R)	Percent	0.0025%/bit	0 to 160.6375%	0	16 bit
(R)	(Position/Level)	0.4%/bit	0 to 100%	0	8 bit
		1%/bit	−125 to 125%	−125	8 bit
(R)		1%/bit	0 to 250%	0	8 bit
	Power	0.5 kW/bit	0 to 32 127.5 kW	0	16 bit
	Pressure	4 kPa/bit	0 to 1000 kPa	0	8 bit
		0.05 kPa/bit	0 to 12.5 kPa	0	8 bit
(R)		5 kPa/bit	0 to 1250 kPa	0	8 bit
(R)		8 kPa/bit	0 to 2000 kPa	0	8 bit
(R)		0.1 kPa/bit	0 to 6425.5 kPa	0	16 bit
(R)		0.125 kPa/bit	0 to 8031.875 kPa	0	16 bit
		16 kPa/bit	0 to 4000 kPa	0	8 bit
		0.5 kPa/bit	0 to 32 127.5 kPa	0	16 bit
		1/256 MPa/bit	0 to 251 MPa	0	16 bit
		1/128 kPa/bit	−250 to 251.99 kPa	−250	16 bit
		2 kPa/bit	0 to 500 kPa	0	8 bit
		0.5 kPa/bit	0 to 125 kPa	0	8 bit
	Ratio	0.1/bit	0 to 25.0	0	8 bit
		0.001/bit	0 to 64.255	0	16 bit
		1/bit	0 to 250	0	8 bit
(R)	Record	1 record/bit	1 to 250 records	0	8 bit
	Revolutions	1000 r/bit	0 to 4 211 081 215 000 r	0	32 bit
(R)	Source address	1 source address/bit	0 to 253	0	8 bit
(R)	Specific gravity	0.001/bit	0 to 2	0	8 bit
(R)	Specific resistance	0.1 MΩm/bit	0 to 25 MΩm	0	8 bit
(R)	Step	1 step/bit	0 to 250 steps	0	8 bit
	Temperature	1 °C/bit	−40 to 210 °C	−40	8 bit
		0.03125 °C/bit	−273 to 1735 °C	−273	16 bit

TABLE 4—RECOMMENDED SLOT DEFINITIONS (CONTINUED)

	Parameter	Scaling (Resolution)	Limits (Range)	Offset	Parameter Size
(R)	Time	0.01 ms/bit	0 to 642.55 ms	0	16 bit
(R)		0.1 s/bit	0 to 25 s	0	8 bit
		0.25 s/bit	0 to 62.5 s	0	8 bit
		1 s/bit	0 to 64 255 s	0	16 bit
(R)		1 s/bit	0 to 4 294 967 296 s	0	32 bit
		1 min/bit	0 to 250 min	0	8 bit
(R)		1 min/bit	–125 to 125 min	–125	8 bit
		1 h/bit	0 to 250 hr	0	8 bit
(R)		1 h/bit	–125 to 125 hr	–125	8 bit
(R)		1 h/bit	–32 127 to 32 128 h	–32 127	16 bit
		0.05 h/bit	0 to 210 554 060.75 h	0	32 bit
		0.25 day/bit	0 to 62.5 days	0	8 bit
(R)		1 week/bit	–125 to 125 weeks	–125	8 bit
		1 month/bit	0 to 250 months	0	8 bit
		1 year/bit	1985 to 2235 years	+1985	8 bit
	Torque	1 Nm/bit	–32 000 to 32 255 Nm	–32 000	16 bit
		1 Nm/bit	0 to 64 255 Nm	0	16 bit
(R)		2 Nm/bit	0 to 128 510 Nm	0	16 bit
	Velocity, linear (speed)	1/256 km/h/bit	0 to 250.996 km/h (1 km/h/bit for upper byte)	0	16 bit
		1/128 km/h/bit	–250 to 251.992 km/h	–250	16 bit
(R)		1/16 km/h/bit	–7.8125 to 7.8125 km/h	–7.8125	8 bit
		1 km/h/bit	0 to 250 km/h	0	8 bit
	Velocity, rotational	0.125 rpm/bit	0 to 8031.875 rpm (32 rpm/bit for upper byte)	0	16 bit
		4 rpm/bit	0 to 257 020 rpm	0	16 bit
		0.5 rpm/bit	0 to 32 127.5 rpm	0	16 bit
		10 rpm/bit	0 to 2500 rpm	0	8 bit
(R)	Volume	0.5 L/bit	0 to 2 105 540 607.5 L	0	32 bit

5.1.6 ADDING PARAMETERS TO PARAMETER GROUPS—Several of the Parameter Groups contain bytes that are not defined and may be replaced with new parameters as appropriate. If existing parameter group definitions do not permit the inclusion of a new parameter, a new parameter group may be defined. Refer to SAE J1939 for additional definitions and abbreviations for instructions for adding new parameters to parameter groups and for requesting new parameter group numbers.

In general, parameters should be grouped into parameter groups as follows:

a. By function (Oil, Coolant, Fuel, etc.) and not by type (temperature, pressure, speed, etc.)
b. With similar update rates (to minimize unnecessary overhead)
c. By common subsystem (the device likely to measure and send data)

5.1.7 TRANSMISSION REPETITION RATES (UPDATE RATES)

5.1.7.1 Definition of Transmission Repetition Rate—All transmission repetition rates defined in SAE J1939-71 are nominal rates. The actual transmission repetition rate on the network should be at this rate plus/minus the "typical" jitter which occurs in microcontroller based systems. The average rate should be the nominal value.

5.1.7.2 Transmission Repetition Rate for Engine Speed and Directly Associated Data (Crank Angle or Time Based Update Rates)—Some parameters may be calculated and/or updated based on engine crank angle rather than at a specific time interval. When this is the case, the reference to a specific update rate is not accurate because this time will change based on the speed of the engine. The primary goal is to minimize the latency associated with sampling, calculating, and transmitting the data without overburdening the network. There are many approaches to sampling the data to be converted and sent over the network. The two preferred approaches are: (a) Time-based sampling, calculating, and transmission; and (b) A hybrid time-based and engine crank angle-based sampling, calculating, and transmission where the number of crank angle degrees between updates is modified based on the current operating speed in order to maintain an update rate within an acceptable range (see Figure 2). Because there are multiple ways to acquire and transmit data onto the network, the following guidelines have been defined for the engine speed and directly associated data.

1. At speeds above 500 rpm, the time from sampling to message transmission shall not exceed 12 ms. Systems that acquire engine speed information via period measurement inherently have less time delay at higher speeds. Above 1000 rpm, for instance, the time from sampling to message transmission shall range from 5 to 30 ms. Less time is required because the period measurement takes less time at higher speeds. How much time is saved depends on the number of crank angle degrees used to perform the period measurement.
2. "Normal" update rates:

    a. Time based updates will occur every 20 ms.
    b. Hybrid time based and engine crank angle based updates are shown in Figure 2.

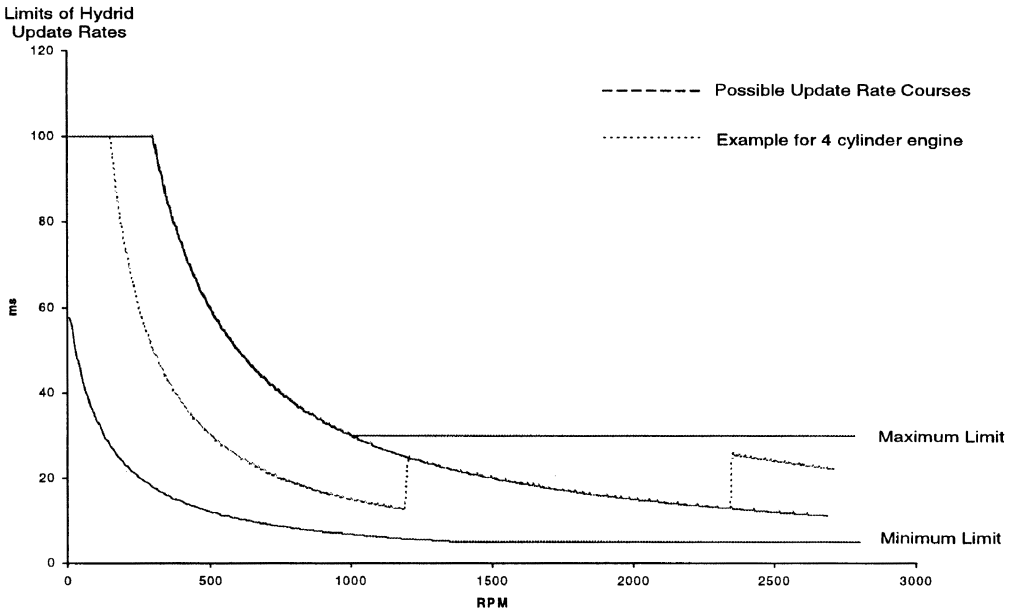


FIGURE 2—LIMITS OF HYBRID UPDATE RATES

(R) 5.1.8 NAMING CONVENTION FOR ENGINE PARAMETERS—When there are multiple instances of the same parameter on the same component (i.e., exhaust ports), the following naming convention will by used. While facing the engine from the flywheel housing, left bank (LB) parameters are assigned prior to the right bank (RB) parameters. Front parameters are assigned prior to the rear or back parameters (with the rear/back being the end containing the flywheel housing). For a six-cylinder in-line engine, the position furthest from the flywheel will be identified as 1. For a 12 cylinder "V" engine, the position furthest from the flywheel on the left bank will be identified as 1, followed by the position next closest to the flywheel on the left bank. When only one parameter is required or available, the parameter denoted as number 1 should be used. (i.e., an engine having only one turbocharger would use Turbocharger 1 Compressor Inlet Temperature when broadcasting the temperature).

5.2 Parameter Definitions—This section provides a description of each parameter used for in the SAE J1939 network. The description includes data length, data type, resolution, range, and a tag (label) for reference.

After power on, a node should internally set the "availability bits" of received parameters as not available and operate with default values until valid data is received. When transmitting, undefined bytes should be sent as 255 (FF_{16}) and undefined bits should be sent as 1.

5.2.1 CONTROL PARAMETERS

5.2.1.1 Net Brake Torque (Power)—The measured torque (or power output) of a "fully equipped" engine. A fully equipped engine is an engine equipped with accessories necessary to perform its intended service. This includes, but is not restricted to, the basic engine, including fuel, oil, and cooling pumps, plus intake air system, exhaust system, cooling system, alternator, starter, emissions, and noise control. Accessories which are not necessary for the operation of the engine, but may be engine mounted, are not considered part of a fully equipped engine. These items include, but are not restricted to, power steering pump systems, vacuum pumps, and compressor systems for air conditioning, brakes, and suspensions. When these accessories are integral with the engine, the torque/power absorbed in an unloaded condition may be determined and added to the net brake torque. (Refer to SAE J1349.)

Net brake torque is calculated by subtracting friction torque from indicated torque for the purposes of this document.

5.2.1.2 Friction Torque—The torque required to drive the engine alone as "fully equipped."

5.2.1.3 Indicated Torque—Indicated torque is the torque developed in the cylinders. It is defined as the sum of the net brake torque and friction torque.

(R) *5.2.1.4 Driver's Demand Engine - Percent Torque*—The requested torque output of the engine by the driver. It is based on input from the following requestors external to the powertrain: operator (via the accelerator pedal), cruise control and/or road speed limit governor. Dynamic commands from internal powertrain functions such as smoke control, low- and high-speed engine governing; ASR and shift control are excluded from this calculation. The data is transmitted in indicated torque as a percent of the reference engine torque. See 5.3.17 for the engine configuration message. Several status bits are defined separately to indicate the request which is currently being honored. This parameter may be used for shift scheduling.

Data Length:	1 byte
Resolution:	1%/bit gain, –125% offset (00 = –125%, 125 = 0%, 250 = +125%)
Data Range:	–125 to 125%
Operating Range:	0 to 125%
Type:	Measured
Suspect Parameter Number:	512
Reference:	5.3.7

Figures 3 and 4 show two typical torque calculations in an engine controller. On the left side of the figures there are single engine controller functions. The output torque signals of these functions are connected in the manner shown. The result is the actual engine percent torque which is realized by the engine.

On top of the figures, external torque commands (e.g., traction and transmission control) can control the engine. These commands can influence the engine torque by four control modes. Four engine internal signals are transmitted to the network:

a. Driver's demand engine - percent torque
b. Actual engine - percent torque
c. Nominal friction - percent torque
d. Engine's desired operating speed

The difference between Figure 3 and Figure 4 is the connection of the idle governor output to the torque calculation. In Figure 3 there is a maximum selection, while in Figure 4 a summation is used. The summation method needs a subtraction point for each external command input because the starting point of an ASR or a shift operation should be the present actual engine - percent torque value. As the actual engine - percent torque signal contains the idle governor output and the external commands are compared with the driver's demand engine - percent torque or the powertrain demand which does not contain the idle governor output, the external commands must be subtracted by the idle governor output to get the correct signals for comparison.

The advantage of the maximum selection (Figure 3) is that no other speed controller can work parallel to the idle governor. This allows for a better optimization of the different speed control loops. The advantage of the summation method (Figure 4) is that changes of the idle governor output influence the engine directly (no dead zones exist).

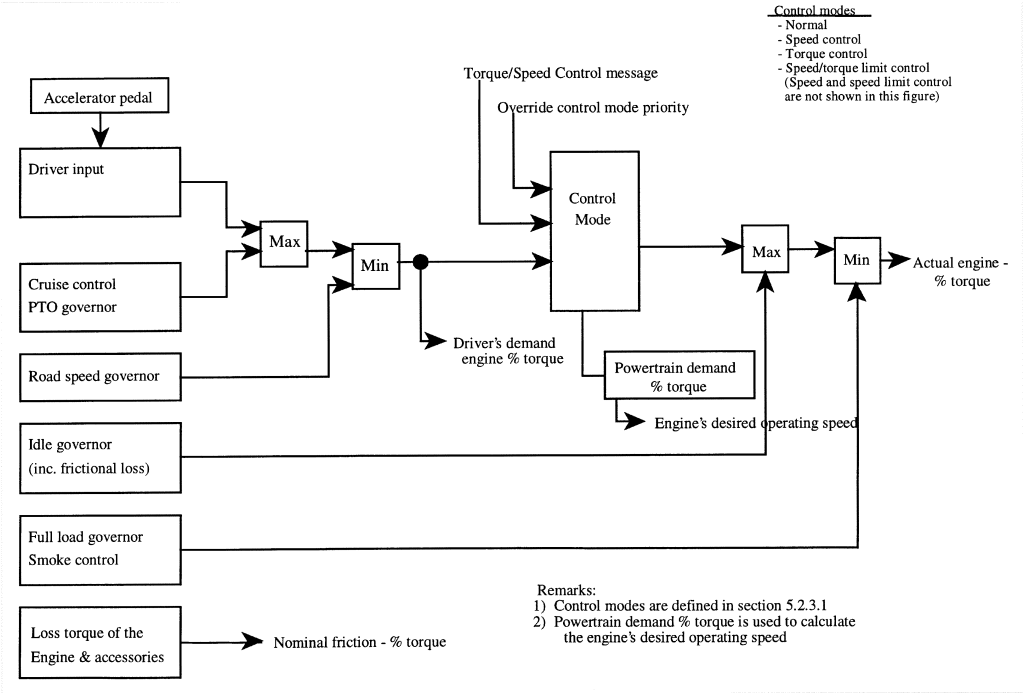


FIGURE 3—TORQUE COMMANDS AND CALCULATIONS WHEN A "MAXIMUM SELECTION FOR LOW IDLE" TECHNIQUE IS USED

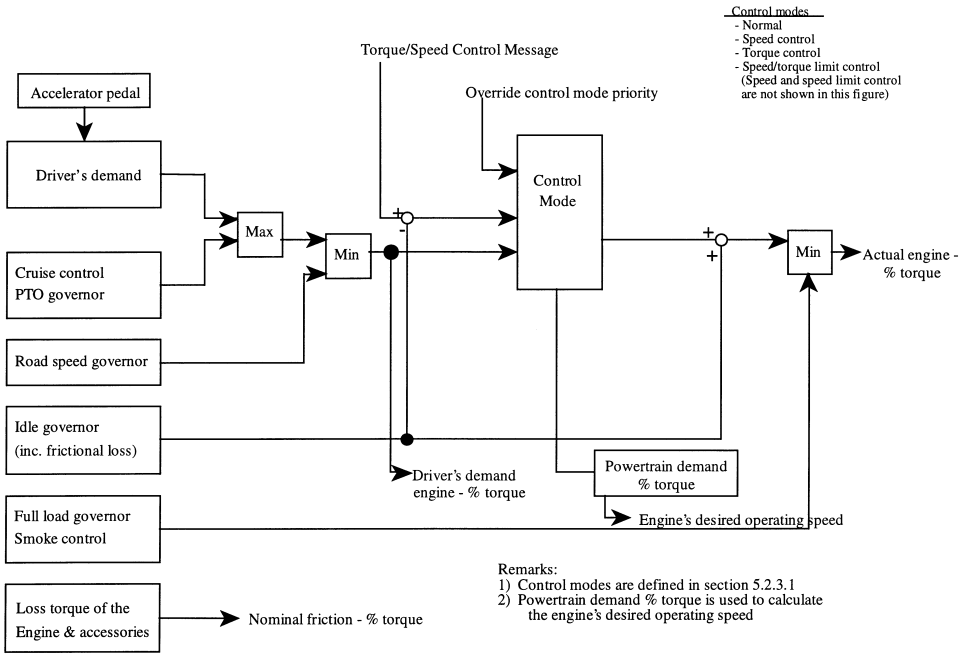


FIGURE 4—TORQUE COMMANDS AND CALCULATIONS WHEN A "SUMMATION WITH LOW IDLE" TECHNIQUE IS USED

(R) *5.2.1.5 Actual Engine - Percent Torque*—The calculated output torque of the engine. The data is transmitted in indicated torque as a percent of reference engine torque (see the engine configuration message, 5.3.17). The engine percent torque value will not be less than zero and it includes the torque developed in the cylinders required to overcome friction as described in 5.2.1.3.

Data Length:	1 byte
Resolution:	1%/bit gain, –125% offset
Data Range:	–125 to 125%
Operating Range:	0 to 125%
Type:	Measured
Suspect Parameter Number:	513
Reference:	5.3.7

(R) *5.2.1.6 Nominal Friction - Percent Torque*—The calculated torque that indicates the amount of torque required by the basic engine itself added by the loss torque of accessories. It contains the frictional and thermodynamic loss of the engine itself, and the losses of fuel, oil, and cooling pumps. The data is transmitted in indicated torque as a percent of reference engine torque (see the engine configuration message, 5.3.17).

The realization can be done by a map dependent on engine speed and engine temperature and an offset value for additional loss torques.

Data Length:	1 byte
Resolution:	1%/bit gain, –125% offset
Data Range:	–125 to 125%
Operating Range:	0 to 125%
Type:	Status
Suspect Parameter Number:	514
Reference:	5.3.13

5.2.1.7 Percent Load at Current Speed—The ratio of actual engine percent torque (indicated) to maximum indicated torque available at the current engine speed, clipped to zero torque during engine braking.

Data Length:	1 byte
Resolution:	1%/bit gain, 0% offset
Range:	0 to 125%
Type:	Status
Suspect Parameter Number:	92
Reference:	5.3.6

5.2.1.8 Accelerator Pedal Position—The ratio of actual accelerator pedal position to maximum pedal position. Although it is used as an input to determine powertrain demand, it also provides anticipatory information to transmission and ASR algorithms about driver actions.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to 100%
Type:	Measured
Suspect Parameter Number:	91
Reference:	5.3.6

5.2.1.9 Engine Speed—Actual engine speed which is calculated over a minimum crankshaft angle of 720 degrees divided by the number of cylinders.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit gain, 0 rpm offset (upper byte resolution = 32 rpm/bit)
Data Range:	0 to 8031.875 rpm
Type:	Measured
Suspect Parameter Number:	190
Reference:	5.3.7

5.2.1.10 Engine's Desired Operating Speed—An indication by the engine of the optimal operating speed of the engine for the current existing conditions. These conditions may include the torque generated to accommodate powertrain demands from the operator (via the accelerator pedal), cruise control, road speed limit governors, or ASR. Dynamic commands from functions such as smoke control or shift control are excluded from this calculation.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit gain, 0 rpm offset (upper byte resolution = 32 rpm/bit)
Data Range:	0 to 8031.875 rpm
Type:	Status
Suspect Parameter Number:	515
Reference:	5.3.13

5.2.1.11 Ground-based Vehicle Speed—Actual ground speed of the vehicle, measured by a device such as RADAR. (1 km/h = 0.621 mph)

Data Length:	2 bytes
Resolution:	1/256 km/h/bit gain, 0 km/h offset (1/412 mph/bit gain, 0 mph offset) upper byte resolution = 1.0 km/h/bit (0.62 mph/bit)
(R) Data Range:	0 to 250.996 km/h (0 to 155.87 mph)
Type:	Measured
Suspect Parameter Number:	516
Reference:	

5.2.1.12 Wheel-based Vehicle Speed—Speed of the vehicle as calculated from wheel or tailshaft speed.

Data Length:	2 bytes
Resolution:	1/256 km/h/bit gain, 0 km/h offset (1/412 mph/bit gain, 0 mph offset) upper byte resolution = 1.0 km/h/bit (0.62 mph/bit)
(R) Data Range:	0 to 250.996 km/h (0 to 155.87 mph)
Type:	Measured
Suspect Parameter Number:	84
Reference:	5.3.31

5.2.1.13 Navigation-based Vehicle Speed—Speed of the vehicle as calculated from a device such as a Global Positioning System (GPS).

Data Length:	2 bytes
Resolution:	1/256 km/h/bit gain, 0 km/h offset (1/412 mph/bit gain, 0 mph offset) upper byte resolution = 1.0 km/h/bit (0.62 mph/bit)
(R) Data Range:	0 to 250.996 km/h (0 to 155.87 mph)
Type:	Measured
Suspect Parameter Number:	517
Reference:	5.3.22

(R) *5.2.1.14 Output Shaft Speed*—Calculated speed of the transmission output shaft.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit gain, 0 rpm offset (upper byte resolution = 32 rpm/bit)
Data Range:	0 to 8031.875 rpm
Type:	Measured
Suspect Parameter Number:	191
Reference:	5.3.5

(R) *5.2.1.15 Requested Torque*—Parameter provided to the engine or retarder in the torque/speed control message for controlling or limiting the output torque.

Requested torque to the engine is measured in indicated torque as a percentage of reference engine torque (see the engine configuration message, 5.3.17). This is the engine torque at which the engine is expected to operate if the torque control mode is active or the engine torque which the engine is not expected to exceed if the torque limit mode is active.

Zero torque can be requested which implies zero fuel and, according to Figures 3 and 4, the engine will not be allowed to stall. The actual engine percent torque (5.2.1.5) should be zero and the engine should decelerate until the low idle governor kicks in, at which time the actual engine percent torque will be calculated as shown in Figures 3 and 4 and the engine torque mode bits (5.2.2.1) should be equal to 0000_2 - Low Idle Governor.

Requested torque to the retarder is measured in indicated torque as a percentage of reference retarder torque (see the retarder configuration message, 5.3.15). The logic used in enabling or disabling the retarder is based on the override control mode priority bits (5.2.3.3).

Data Length:	1 byte
Resolution:	1%/bit gain, –125% offset
Data Range:	–125 to 125%
Operating range:	0 to 125% for engine torque requests –125 to 0% for retarder torque requests
Type:	Status
Suspect Parameter Number:	518
Reference:	5.3.1

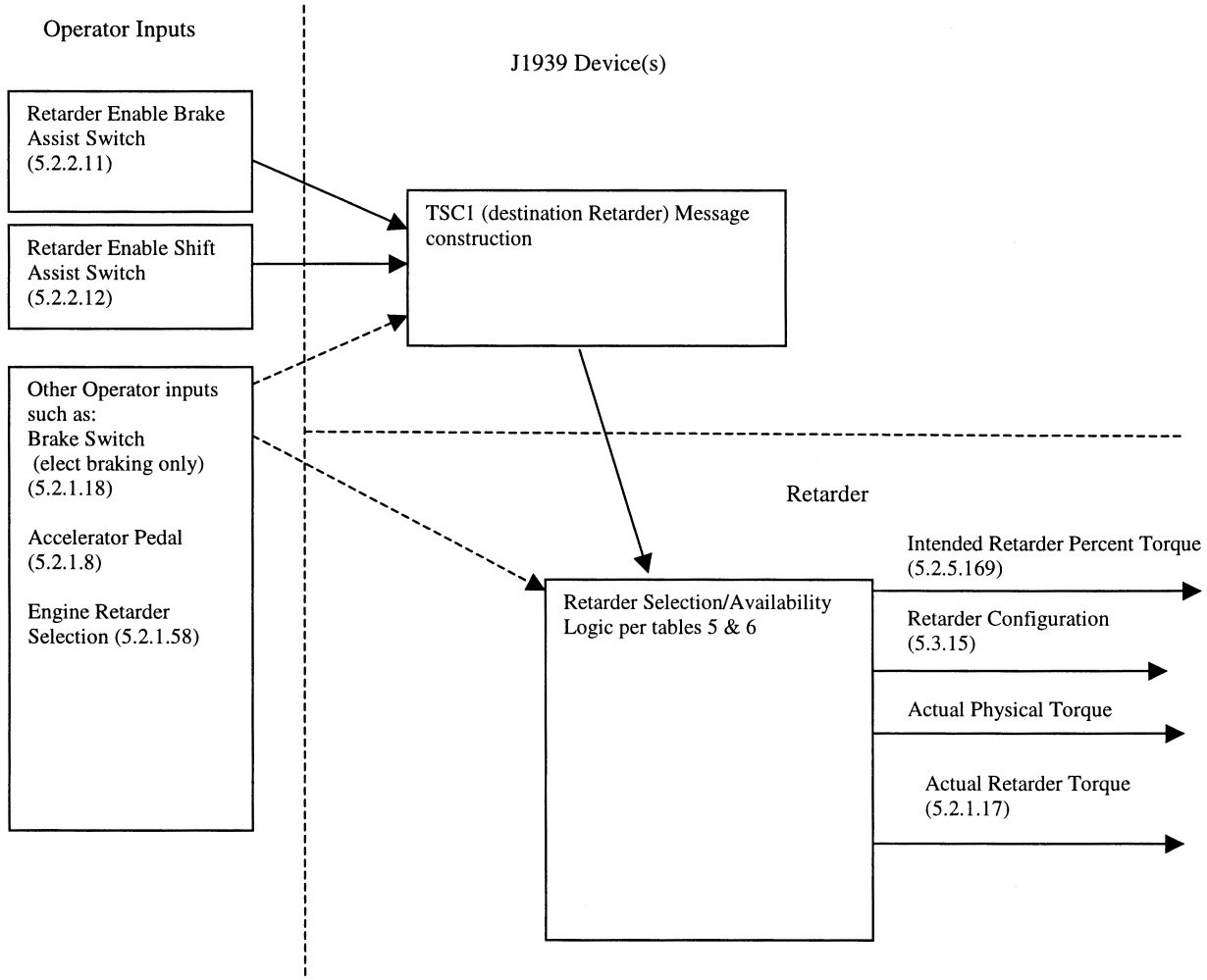
(R) Several elements affect the retarder besides the Requested Torque parameter in the TSC1 message. These elements are not looked at by the retarder itself, but are used by various other devices to determine if they may ask the retarder to be engaged. These are the Retarder Enable Shift Assist Switch, and the Retarder Enable Brake Assist Switch. The relationship between those switches and the retarder (as well as that between the operator and retarder) is described in Figure 5.

Tables 5 and 6 identify many use cases. Each row is the summary of one or more uses. One of the primary communications provided by these tables is that the retarder can be activated by the SAE J1939 TSC1 message, although the operator input is “off.”

Table 6 shows the relationship between various inputs and an after engine retarder.

The biggest difference between this type of retarder and an engine brake is that the exhaust brake may be engaged while the engine is still being fueled. Also, if cruise control is communicating with the retarder, it would do so using the TSC1 message.

Consequently, columns for accelerator pedal input and cruise control input would only serve to confuse the issue of retarder availability in Table 6.



(R) FIGURE 5—RELATIONSHIP BETWEEN OPERATOR/SWITCH INPUTS AND RETARDERS

(R) TABLE 5—PRIMARY RETARDER – BEFORE TRANSMISSION (ENGINE RETARDER)

Operator Inputs SAE J1939 Inputs[1] (TSC1)	Operator Inputs Cruise Control[2]	Operator Inputs Accel Pedal[3]	Operator Inputs Torque Request Via Engine Retarder Selection[4] (See 5.2.1.58)	Outputs May Retarder Provide Brake Torque?	Outputs Retarder Torque Mode (base 2)
T	Any	Any	Any	No	0000
R	Any	Any	Any	Yes	> 0001
NTR	Any	T	Any	No	0000
NTR	R	ZR	R	Yes	> 0001
NTR	R	ZR	ZR	Yes	0010
NTR	NTR	ZR	R[5]	Yes[5]	0001
NTR	NTR	ZR	ZR	No	0000
ZR	Any	Any	Any	No	0000

1. Note that the TSC1 inputs will override Operator Torque Selection. The SAE J1939 devices that generate the TSC1 messages will assure that the Retarder Enable Brake Assist Switch and Retarder Enable Shift Assist Switch are enabled as appropriate before commanding the Retarder to engage. See 5.2.2.11 and 5.2.2.12 for descriptions of these switches. Also, for the purposes of this table, it is assumed that if the TSC1, Destination Retarder message is requesting Retarder Torque, no other TSC1, Destination Engine messages are requesting engine fueling. That arbitration is beyond the scope of this section.
2. This refers to the torque requested by the cruise control, and does not refer to the cruise switches. Cruise control is defined to be on and engaged in this column. The cruise control should not request retarder torque unless the Retarder Enable - Brake Assist Switch is enabled.
3. The Accelerator Pedal is inherently incapable of requesting negative torque. It may have no particular torque demands, or it may request some engine fueling, which prevents the retarder from engaging. Consequently, the chart is complete even though no rows exist for the AP to request retarder torque.
4. The Operator Torque Request is incapable of requesting positive torque. The table is complete without the Operator Torque Request asking for positive Engine Torque
5. This description assumes no other switch (such as brake pedal depressed) is needed in order for the operator torque request to initiate retarder braking. Other implementation specific rules would apply if such a catalyst were needed.

Key:

T = request positive Torque

R = request Retarder torque

NTR = No Torque Request

ZR = Zero torque Requested by retarder

Any = This value has no bearing whether or not the Retarder is available. The retarder will NOT be available because some other entity is requesting positive torque.

(R) TABLE 6—PRIMARY RETARDER – AFTER ENGINE (EXHAUST BRAKE, HYDRAULIC RETARDER)

Operator Inputs SAE J1939 Inputs[1] (TSC1)	Operator Inputs Torque Request Via operator torque request[2]	Outputs May Retarder Provide Brake Torque?	Outputs Retarder Torque Mode (base 2)
R	R	Yes	> 0001
R	ZR	Yes	> 0001
NTR	R[3]	Yes[3]	0001
NTR	ZR	No	0000
ZR	Any	No	0000

1. Note that the TSC1 inputs will override Operator Torque Selection. The SAE J1939 devices that generate the TSC1 messages will assure that the Retarder Enable Brake Assist Switch and Retarder Shift Assist Switch are enabled before commanding the Retarder to engage. Also, for the purposes of this table, it is assumed that if the TSC1, Destination Retarder message is requesting Retarder Torque, no other TSC1, Destination Engine messages are requesting engine fueling. That arbitration is beyond the scope of this section.
2. The Operator Torque Request is incapable of requesting positive torque. The table is complete without the Operator Torque Request asking for positive Engine Torque.
3. This description assumes no other switch (such as brake pedal depressed) is needed in order for the operator torque request to initiate retarder braking. Other implementation specific rules would apply if such a requirement were needed.

Key:

R = request Retarder torque – some amount of braking torque is requested of the retarder.

ZR = Zero Retarder request – Zero percent torque is requested of the retarder.

NTR = No retarder Torque Request – No request is being made of the retarder one way or another.

Any = This value has no bearing whether or not the retarder is available. In fact, because of what some other entity is requesting, the retarder will NOT be available.

5.2.1.16 Engine's Desired Operating Speed Asymmetry Adjustment—This byte is utilized in transmission gear selection routines and indicates the engine's preference of lower versus higher engine speeds should its desired speed not be achievable. This is a scaled ratio such that 125 represents an equal preference for a speed lower or higher that the engine's indicated desired speed. The higher the asymmetry adjustment value is above 125, the more the engine prefers to be operated at or above its indicated desired speed. Conversely, the lower the asymmetry adjustment value is below 125, the more the engine prefers to operate at or below its indicated desired speed. Typically, the engine's asymmetry adjustment will be predicated on fuel consumption considerations, and under these conditions, the method for computing the asymmetry adjustment is indicated in Figure 6. The engine may include other factors into its asymmetry adjustment calculation such as temperatures, pressures, and other operating parameters.

Data Length:	1 byte
Resolution:	ratio
Range:	0 to 250
Type:	Status
Suspect Parameter Number:	519
Reference:	5.3.13

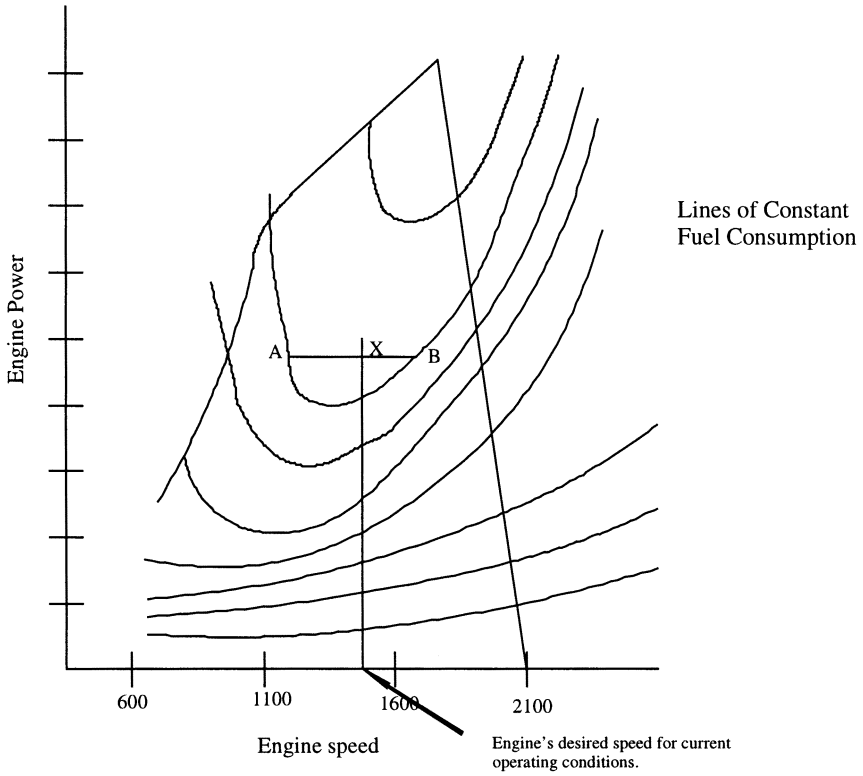


FIGURE 6—DESIRED OPERATING SPEED ASYMMETRY ADJUSTMENT

5.2.1.17 *Actual Retarder - Percent Torque*—Actual braking torque of the retarder as a percent of maximum available at that speed.

Data Length:	1 byte
Resolution:	1%/bit gain, –125% offset
Data Range:	–125 to 125%
Operating range:	–125 to 0%
(R) Type:	Measured
Suspect Parameter Number:	520
Reference:	5.3.3

5.2.1.18 Brake Pedal Position—Ratio of brake pedal position to maximum pedal position. Used for electric brake applications.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to 100%
Type:	Measured
Suspect Parameter Number:	521
Reference:	5.3.4

5.2.1.19 Requested Speed—Parameter provided to the engine from external sources in the torque/speed control message. This is the engine speed which the engine is expected to operate at if the speed control mode is active or the engine speed which the engine is not expected to exceed if the speed limit mode is active.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit gain, 0 rpm offset (upper byte resolution = 32 rpm/bit)
Data Range:	0 to 8031.875 rpm
Type:	Status
Suspect Parameter Number:	898
Reference:	5.3.1

5.2.1.20 Percent Clutch Slip—Parameter which represents the ratio of input shaft speed to current engine speed (in percent).

$$\text{Percent Clutch Slip} = \frac{\text{Engine rpm} - \text{Input shaft rpm}}{\text{Engine rpm}} \text{ x } 100 \qquad \text{(Eq.1)}$$

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to 100%
Type:	Measured
Suspect Parameter Number:	522
Reference:	5.3.5

(R) *5.2.1.21 Requested Percent Clutch Slip*—Parameter which represents the percent clutch slip requested by a device.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to 100%
Type:	Status
Suspect Parameter Number:	684
Reference:	5.3.2

5.2.1.22 Current Gear—The gear currently engaged in the transmission or the last gear engaged while the transmission is in the process of shifting to the new or selected gear. Transitions toward a destination gear will not be indicated. Once the selected gear has been engaged then Current Gear will reflect that gear.

Data Length:	1 byte
Resolution:	1 gear value/bit, –125 offset
Data Range:	–125 to +125, negative values are reverse gears, positive values are forward gears, zero is neutral
(R) Parameter Specific Indicator:	251 (FB_{16}) is park
Type:	Measured
Suspect Parameter Number:	523
Reference:	5.3.8

5.2.1.23 Selected Gear—The gear that the transmission will attempt to achieve during the current shift if a shift is in progress, or the next shift if one is pending (i.e., waiting for torque reduction to initiate the shift).

Data Length:	1 byte
Resolution:	1 gear value/bit, –125 offset
Data Range:	–125 to +125, negative values are reverse gears, positive values are forward gears, zero is neutral
(R) Parameter Specific Indicator:	251 (FB_{16}) is park
Type:	Status
Suspect Parameter Number:	524
Reference:	5.3.8

5.2.1.24 Requested Gear—Gear requested by the operator, ABS, or engine.

Data Length:	1 byte
Resolution:	1 gear value/bit, –125 offset
Data Range:	–125 to +125, negative values are reverse gears, positive values are forward gears, zero is neutral
Parameter Specific Indicator:	FB_{16} is park
Type:	Status
Suspect Parameter Number:	525
Reference:	5.3.2

5.2.1.25 Actual Gear Ratio—Actual ratio of input shaft speed to output shaft speed.

Data Length:	2 bytes
Resolution:	0.001/bit, 0 offset
Data Range:	0 to 64.255
Type:	Measured
Suspect Parameter Number:	526
Reference:	5.3.8

5.2.1.26 Engine Speed at Idle, Point 1 (Engine configuration)—Stationary low idle speed of engine which includes influences due to engine temperature (after power up) and other stationary changes (calibration offsets, sensor failures, etc). This parameter is point 1 of the engine configuration map (see 5.2.4.1).

Data Length:	2 bytes
Resolution:	0.125 rpm/bit, 0 rpm offset
Data Range:	0 to 8031.875 rpm
Type:	Measured
Suspect Parameter Number:	188
Reference:	5.3.17

5.2.1.27 Engine Speed at Point 2 (Engine configuration)—Engine speed of point 2 of the engine torque map (see 5.2.4.1). In engine configuration mode 1 and 3, point 2 is defined as the kick-in point from which torque is reduced to zero. In mode 2, there are no special requirements for the definition of this point.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit, 0 rpm offset
Data Range:	0 to 8031.875 rpm
Type:	Measured
Suspect Parameter Number:	528
Reference:	5.3.17

5.2.1.28 Engine Speed at Points 3, 4, and 5 (Engine configuration)—Engine speed of point 3, 4, and 5 of the engine torque map (see 5.2.4.1). It is recommended that one of these points indicate the peak torque point for the current engine torque map. Points 3, 4, and 5 are optional and lie between idle and point 2.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit, 0 rpm offset
Data Range:	0 to 8031.875 rpm
Type:	Measured
Suspect Parameter Number:	529 (Point 3) 530 (Point 4) 531 (Point 5)
Reference:	5.3.17

5.2.1.29 Engine Speed at High Idle, Point 6 (Engine configuration)—Engine speed of high idle (point 6) of the engine torque map (see 5.2.4.1). In engine configuration mode 3, point 6 is not defined by the engine torque map but by the governor characteristic and the zero torque line.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit, 0 rpm offset
Data Range:	0 to 8031.875 rpm
Type:	Measured
Suspect Parameter Number:	532
Reference:	5.3.17

5.2.1.30 Maximum Momentary Engine Override Speed, Point 7 (Engine configuration)—The maximum engine speed above high idle allowed by the engine control during a momentary high idle override. This duration of the override is limited by the maximum momentary override time limit.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit, 0 rpm offset
Data Range:	0 to 8031.875 rpm
Type:	Measured
Suspect Parameter Number:	533
Reference:	5.3.17

5.2.1.31 Maximum Momentary Override Time Limit—The maximum time limit allowed to override the engine's high idle speed.

Data Length:	1 byte
Resolution:	0.1 s/bit gain, 0 s offset
Data Range:	0 s to 25 s 0 = no override of high idle allowed 255 = not applicable (no time restriction)
Type:	Measured
Suspect Parameter Number:	534
Reference:	5.3.17

5.2.1.32 Requested Speed Control Range Lower Limit (Engine configuration)—The minimum engine speed that the engine will allow when operating in a speed control/limit mode.

Data Length:	1 byte
Resolution:	10 rpm/bit gain, 0 rpm offset
Data Range:	0 to 2500 rpm
Type:	Measured
Suspect Parameter Number:	535
Reference:	5.3.17

5.2.1.33 Requested Speed Control Range Upper Limit (Engine configuration)—The maximum engine speed that the engine will allow when operating in a speed control/limit mode, excluding any maximum momentary engine override speed, if supported.

Data Length:	1 byte
Resolution:	10 rpm/bit gain, 0 rpm offset
Data Range:	0 to 2500 rpm
Type:	Measured
Suspect Parameter Number:	536
Reference:	5.3.17

5.2.1.34 Requested Torque Control Range Lower Limit (Engine configuration)—The minimum engine torque that the engine will allow when operating in a torque control/limit mode.

Data Length:	1 byte
Resolution:	1%/bit gain, –125% offset
Data Range:	–125 to 125%
Operating Range:	0 to 125%
Type:	Measured
Suspect Parameter Number:	537
Reference:	5.3.17

5.2.1.35 Requested Torque Control Range Upper Limit (Engine configuration)—The maximum engine torque that the engine will allow when operating in a torque control/limit mode.

Data Length:	1 byte
Resolution:	1%/bit gain, –125% offset
Data Range:	–125 to 125%
Operating Range:	0 to 125%
Type:	Measured
Suspect Parameter Number:	538
Reference:	5.3.17

5.2.1.36 Percent Torque at Idle, Point 1 (Engine configuration)—The torque limit that indicates the available engine torque which can be provided by the engine at idle speed. This parameter may be influenced by engine temperature (after power up) and other stationary changes (calibration offsets, sensor failures, etc.) See also 5.2.1.26. The data is transmitted in indicated torque as a percent of the reference engine torque.

Data Length:	1 byte
Resolution:	1%/bit gain, –125% offset
Data Range:	–125 to 125%
Operating Range:	0 to 125%
Type:	Measured
Suspect Parameter Number:	539
Reference:	5.3.17

5.2.1.37 Percent Torque at Point 2 (Engine configuration)—The torque limit that indicates the available engine torque which can be provided by the engine at point 2 of the engine map (see 5.2.4.1). In engine configuration mode 1 and 3, point 2 is defined as the kick-in point from which torque is reduced to zero. In mode 2, there are no special requirements for the definition of this point. The data is transmitted in indicated torque as a percent of the reference engine torque.

Data Length:	1 byte
Resolution:	1%/bit gain, –125% offset
Data Range:	–125 to 125%
Operating Range:	0 to 125%
Type:	Measured
Suspect Parameter Number:	540
Reference:	5.3.17

(R) *5.2.1.38 Percent Torque at Points 3, 4, and 5 (Engine configuration)*—The torque limit that indicates the available engine torque which can be provided by the engine at point 3, 4, and 5 of the engine map (see 5.2.4.1). It is required that one of these points indicate the peak torque point for the current engine torque map. Points 3, 4, and 5 lie between idle and point 2. The data is transmitted in indicated torque as a percent of the reference engine torque.

Data Length:	1 byte
Resolution:	1%/bit gain, –125% offset
Data Range:	–125 to 125%
Operating Range:	0 to 125%
Type:	Measured
Suspect Parameter Number:	541 (Point 3) 542 (Point 4) 543 (Point 5)
Reference:	5.3.17

5.2.1.39 Reference Engine Torque (Engine configuration)—This parameter is the 100% reference value for all defined indicated engine torque parameters. It is only defined once and doesn't change if a different engine torque map becomes valid.

Data Length:	2 bytes
Resolution:	1 Nm/bit gain, 0 Nm offset
Data Range:	0 to 64 255 Nm
Type:	Measured
Suspect Parameter Number:	544
Reference:	5.3.17

5.2.1.40 Gain (KP) of the Endspeed Governor (Engine configuration)—The endspeed governor is defined as a linear line with the following equations (Capital letters mean physical values, small letters mean normalized values). Refer to 5.2.4.1.

The gain KP/kp is defined as a positive value. The factor 4096 is necessary for realizing flat curves with sufficient resolution as well as very steep curves.

KP = ΔTorque / ΔSpeed
kp (normalized) = KP * 250/100% * 8031 rpm/64255 * 4096 = KP * 1280 rpm/%

Data Length:	2 bytes
Resolution:	0.0007813% engine reference torque/rpm per bit gain (normalized), 0%/rpm per bit offset
Data Range:	0 to 50.2 %/rpm
Type:	Measured
Suspect Parameter Number:	545
Reference:	5.3.17

5.2.1.41 Retarder Speed at Idle, Point 1 (Retarder configuration)—See 5.2.4.3.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit, 0 rpm offset
Data Range:	0 to 8031.875 rpm
Type:	Measured
Suspect Parameter Number:	546
Reference:	5.3.15

5.2.1.42 Retarder Speed at Peak Torque, Point 5 (Retarder configuration)—See 5.2.4.3.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit, 0 rpm offset
Data Range:	0 to 8031.875 rpm
Type:	Measured
Suspect Parameter Number:	547
Reference:	5.3.15

5.2.1.43 Maximum Retarder Speed, Point 2 (Retarder configuration)—Maximum speed of retarder (see 5.2.4.3).

Data Length:	2 bytes
Resolution:	0.125 rpm/bit, 0 rpm offset
Data Range:	0 to 8031.875 rpm
Type:	Measured
Suspect Parameter Number:	548
Reference:	5.3.15

5.2.1.44 Retarder Speed at Points 3 and 4 (Retarder configuration)—Retarder speed of point 3 and 4 of the engine retarder torque map (see 5.2.4.3).

Data Length:	2 bytes
Resolution:	0.125 rpm/bit, 0 rpm offset
Data Range:	0 to 8031.875 rpm
Type:	Measured
Suspect Parameter Number:	549 (Point 3) 550 (Point 4)
Reference:	5.3.15

5.2.1.45 Percent Torque at Idle, Point 1 (Retarder configuration)—The torque limit that indicates the available retarder torque which can be provided by the retarder at idle speed. The data is transmitted in indicated torque as a percent of the reference retarder torque.

Data Length:	1 byte
Resolution:	1%/bit gain, –125% offset
Data Range:	–125 to 125%
Operating Range:	–125 to 0%
Type:	Measured
Suspect Parameter Number:	551
Reference:	5.3.15

5.2.1.46 Percent Torque at Maximum Speed, Point 2 (Retarder configuration)—The torque limit that indicates the available retarder torque which can be provided by the retarder at its maximum speed (see 5.2.4.3). The data is transmitted in indicated torque as a percent of the reference retarder torque.

Data Length:	1 byte
Resolution:	1%/bit gain, –125% offset
Data Range:	–125 to 125%
Operating Range:	–125 to 0%
Type:	Measured
Suspect Parameter Number:	552
Reference:	5.3.15

5.2.1.47 Percent Torque at Points 3 and 4 (Retarder configuration)—The torque limit that indicates the available retarder torque which can be provided by the retarder at points 3 and 4 of the retarder torque map (see 5.2.4.3). The data is transmitted in indicated torque as a percent of the reference retarder torque.

Data Length:	1 byte
Resolution:	1%/bit gain, –125% offset
Data Range:	–125 to 125%
Operating Range:	–125 to 0%
Type:	Measured
Suspect Parameter Number:	553 (Point 3) 554 (Point 4)
Reference:	5.3.15

5.2.1.48 Percent Torque at Peak Torque, Point 5 (Retarder configuration)—The torque limit that indicates the available retarder torque which can be provided by the retarder at point 5 of the retarder torque map (see 5.2.4.3). The data is transmitted in indicated torque as a percent of the reference retarder torque.

Data Length:	1 byte
Resolution:	1%/bit gain, –125% offset
Data Range:	–125 to 125%
Operating Range:	–125 to 0%
Type:	Measured
Suspect Parameter Number:	555
Reference:	5.3.15

(R) *5.2.1.49 Reference Retarder Torque (Retarder configuration)*—This parameter is the 100% reference value for all defined indicated retarder torque parameters. It is only defined once and doesn't change if a different retarder torque map becomes valid.

Data Length:	2 bytes
Resolution:	1 Nm/bit gain, 0 Nm offset
Data Range:	0 to 64 255 Nm
Type:	Measured
Suspect Parameter Number:	556
Reference:	5.3.15

(R) *5.2.1.50 Retarder Control Method (Retarder configuration)*—This parameter identifies the number of steps used by the retarder.

Data Length:	1 byte
Resolution:	1 step/bit, 0 offset
Data Range:	0 to 250
Operating Range:	0: continuous control 1: On/off control 2 to 250: Number of steps
Type:	Measured
Suspect Parameter Number:	557
Reference:	5.3.15

5.2.1.51 Front Axle Speed—The average speed of the two front wheels.

Data Length:	2 bytes
Resolution:	1/256 km/h/bit gain, 0 km/h offset (1/412 mph/bit gain, 0 mph offset) upper byte resolution = 1.0 km/h/bit (0.62 mph/bit)
(R) Data Range:	0 to 250.996 km/h (0 to 156 mph)
Type:	Measured
Suspect Parameter Number:	904
Reference:	5.3.56

5.2.1.52 Relative Speed; Front Axle, Left Wheel—The speed of the front axle, left wheel relative to the front axle (see 5.2.1.51).

Data Length:	1 byte
Resolution:	1/16 km/h/bit gain, 7.8125 km/h offset (1/26 mph/bit gain, 4.844 mph offset)
Data Range:	–7.8125 km/h to +7.8125 km/h (–4.844 mph to +4.844 mph)
Type:	Measured
Suspect Parameter Number:	905
Reference:	5.3.56

5.2.1.53 Relative Speed; Front Axle, Right Wheel—The speed of the front axle, right wheel relative to the front axle (see 5.2.1.51).

Data Length:	1 byte
Resolution:	1/16 km/h/bit gain, 7.8125 km/h offset (1/26 mph/bit gain, 4.844 mph offset)
Data Range:	–7.8125 km/h to +7.8125 km/h (–4.844 mph to +4.844 mph)
Type:	Measured
Suspect Parameter Number:	906
Reference:	5.3.56

5.2.1.54 Relative Speed; Rear Axle #1, Left Wheel—The speed of the rear axle #1, left wheel relative to the front axle (see 5.2.1.51).

Data Length:	1 byte
Resolution:	1/16 km/h/bit gain, 7.8125 km/h offset (1/26 mph/bit gain, 4.844 mph offset)
Data Range:	–7.8125 km/h to +7.8125 km/h (–4.844 mph to +4.844 mph)
Type:	Measured
Suspect Parameter Number:	907
Reference:	5.3.56

5.2.1.55 Relative Speed; Rear Axle #1, Right Wheel—The speed of the rear axle #1, right wheel relative to the front axle (see 5.2.1.51).

Data Length:	1 byte
Resolution:	1/16 km/h/bit gain, 7.8125 km/h offset (1/26 mph/bit gain, 4.844 mph offset)
Data Range:	–7.8125 km/h to +7.8125 km/h (–4.844 mph to +4.844 mph)
Type:	Measured
Suspect Parameter Number:	908
Reference:	5.3.56

5.2.1.56 Relative Speed; Rear Axle #2, Left Wheel—The speed of the rear axle #2, left wheel relative to the front axle (see 5.2.1.51).

Data Length:	1 byte
Resolution:	1/16 km/h/bit gain, 7.8125 km/h offset (1/26 mph/bit gain, 4.844 mph offset)
Data Range:	–7.8125 km/h to +7.8125 km/h (–4.844 mph to +4.844 mph)
Type:	Measured
Suspect Parameter Number:	909
Reference:	5.3.56

5.2.1.57 Relative Speed; Rear Axle #2, Right Wheel—The speed of the rear axle #2, right wheel relative to the front axle (see 5.2.1.51).

Data Length:	1 byte
Resolution:	1/16 km/h/bit gain, 7.8125 km/h offset (1/26 mph/bit gain, 4.844 mph offset)
Data Range:	–7.8125 km/h to +7.8125 km/h (–4.844 mph to +4.844 mph)
Type:	Measured
Suspect Parameter Number:	910
Reference:	5.3.56

(R) *5.2.1.58 Engine Retarder Selection*—The percent engine retarder torque requested by the operator as a percent of maximum braking torque at the current retarder speed. Retarder torque is expressed as 0% to 100%. 0% means no braking torque is requested by the operator while 100% retarder torque means maximum braking.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0% to 100%
Type:	Measured
Suspect Parameter Number:	973
Reference:	5.3.4

(R) *5.2.1.59 Remote accelerator*—Ratio of the actual remote accelerator position to the maximum remote accelerator position.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0% to 100%
Type:	Measured
Suspect Parameter Number:	974
Reference:	5.3.6

NOTE—The remote accelerator enable switch (see 5.2.6.53) must be active and the accelerator interlock switch (see 5.2.6.56) inactive before the remote accelerator can be enabled.

(R) *5.2.1.60 Estimated Percent Engine Fan Speed*—Estimated fan speed as a ratio of the fan drive (current speed) to the fully engaged fan drive (maximum fan speed). A two state fan (off/on) will use 0% and 100% respectively. A three state fan (off/intermediate/on) will use 0%, 50% and 100% respectively. A variable speed fan will use 0% to 100%. Multiple fan systems will use 0 to 100% to indicate the percent cooling capacity being provided.

Note that the intermediate fan speed of a three state fan will vary with different fan drives, therefore 50% is being used to indicate that the intermediate speed is required from the fan drive.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0% to 100%
Type:	Status
Suspect Parameter Number:	975
Reference:	5.3.58

(R) *5.2.1.61 Requested Percent Fan Speed*—Fan speed as a ratio of the actual fan drive (current speed) to the fully engaged fan drive (maximum fan speed). A two state fan (off/on) will use 0% and 100% respectively. A three state fan (off/intermediate/on) will use 0%, 50% and 100% respectively. A variable speed fan will use 0% to 100%. Multiple fan systems will use 0 to 100% to indicate the percent cooling capacity being provided. Feedback to this request is provided using the estimated fan speed (see 5.2.1.60).

Note that the intermediate fan speed of a three state fan will vary with different fan drives, therefore 50% is being used to indicate that the intermediate speed is required from the fan drive.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0% to 100%
Type:	Status
Suspect Parameter Number:	986
Reference:	5.3.59

5.2.2 DRIVETRAIN STATE PARAMETERS

5.2.2.1 Engine and Retarder Torque Mode (4 bits)—State signal which indicates which engine or retarder torque mode is currently generating, limiting, or controlling the torque. See Table 7. Note that the modes are not in prioritized order. Not all modes may be relevant for a given device. Some devices may not implement all functions. For typical priorities refer to Figures 3 and 4 for engine control and Tables 5 to 6 for retarder control. The data type of this parameter is measured. (Reference: 5.3.3, 5.3.7)

Mode 0000_2 means “No request”: engine torque may range from 0 to full load only due to low idle governor output; retarder torque = 0 (no braking).

Modes 0001_2 to 1110_2 indicate that there is either a torque request or the identified function is currently controlling the engine/retarder: engine/retarder torque may range from 0 (no fueling/no braking) to the upper limit.

(R) Suspect Parameter Number: Engine Mode: 899 (used in PGN 61,444, reference 5.3.7)
Retarder Mode: 900 (used in PGN 61,440, reference 5.3.3)

TABLE 7—ENGINE/RETARDER TORQUE MODES

	Bit States	Engine/Retarder Torque Mode
	0000	Low idle governor/no request (default mode)
	0001	Accelerator pedal/operator selection
	0010	Cruise control
	0011	PTO governor
	0100	Road speed governor
	0101	ASR control
	0110	Transmission control
	0111	ABS control
	1000	Torque limiting
	1001	High speed governor
	1010	Braking system
(R)	1011	Remote accelerator
	1100	not defined
	1101	not defined
	1110	Other
	1111	Not available

5.2.2.1.1 Low Idle Governor/No request (Default mode)—This mode is active if the accelerator pedal (not necessarily the torque output of the driver input, see Figure 3 and Figure 4) is zero. This is the default mode. At low speed, the low idle governor may be active while at higher speed, it is zero.

5.2.2.1.2 Accelerator Pedal—This mode is active if the accelerator pedal position is active (being followed). This mode is active for the retarder if it is turned on by the operator. Note that it may be disabled by the accelerator pedal or clutch switches (operator selection).

5.2.2.1.3 Cruise Control—This mode is active if cruise control is active and greater than the accelerator pedal request.

5.2.2.1.4 PTO Governor—This mode is active if the PTO governor is active.

5.2.2.1.5 Road Speed Governing—Indicates that road speed governing is active and limiting torque.

5.2.2.1.6 ASR Control—Indicates that the ASR command is active (Speed, Torque, or Speed/Torque Limit Control).

5.2.2.1.7 Transmission Control—Indicates that the transmission command is active (Speed, Torque, or Speed/Torque Limit Control).

5.2.2.1.8 ABS Control—Indicates that the ABS is controlling torque.

5.2.2.1.9 Torque Limiting—This mode is active if the demanded or commanded engine torque is limited by internal logic due to full load, smoke and/or emissions control, engine protection and/or other factors. A reduced torque limit may be necessary for engine protection if the engine temperature is too high or a sensor fails (speed, timing, or boost pressure), as examples.

5.2.2.1.10 High Speed Governor—This mode is active if the engine is controlled by the high speed governor due to normal operation.

5.2.2.1.11 Brake System (Electronic)—This indicates that the brake pedal is controlling the torque. Note that this may include enabling of the retarder when the brake pedal is depressed (touched).

Note that if there is a request to the retarder but operating conditions do not allow braking, this situation will be reflected by the Percent Retarder Torque = 0 when broadcast.

(R) 5.2.2.1.12 Remote Accelerator—This mode is active if the remote accelerator is controlling engine speed.

5.2.2.1.13 Other—Torque control by a type of device which is different than those defined in 5.2.2.1.1 through 5.2.2.1.11.

5.2.2.2 Retarder Type (4 bits)—A vehicle retarder is a supplementary device to the wheel brakes for the driver to better control the vehicle. The wheel brakes used in the vehicle are not designed for continuous retarding operation. In a prolonged period of braking, the brakes can be thermally over-stressed, causing the braking effect to be reduced or even lead to complete braking system failure. The vehicle retarder is designed for continuous operation for braking during downhill operation and is also used for braking the vehicle to comply with speed limits and traffic conditions. See Table 8.

This parameter provides some indication of the retarder dynamics. It is used in the retarder configuration message (See 5.3.15). The data type of this parameter is measured.

Suspect Parameter Number: 901

TABLE 8—RETARDER TYPES

Bit States	Retarder Type
0000	Electric/Magnetic
0001	Hydraulic
0010	Cooled Friction
0011	Compression Release (Engine retarder)
0100	Exhaust
0101-1101	Not defined
1110	Other
1111	Not available

5.2.2.2.1 Electric/Magnetic Retarder—The electric/magnetic retarder functions by creating eddy currents generated in a conductive armature when placed in a variable magnetic field. Currently, electric retarders have a stator on which field coils are mounted. The rotors, mounted on both sides of the drive shaft, are ribbed for heat dissipation. In order to brake the vehicle, voltage is applied to the field coils which generate a magnetic field inducing eddy currents in the rotors as they pass through the field. Magnetic retarders use a permanent magnet to generate the eddy currents. Braking-torque is dependent on stator excitation and on the air gap between the rotor and the stator.

5.2.2.2.2 Hydraulic Retarder—The hydraulic retarder is a hydrodynamic coupling device. Two impellers which face each other, a rotor and a stator, are filled with oil. When the rotor, which is connected to the vehicle drive shaft rotates, it drives the oil in the direction of rotation. The mechanical energy produced by the rotor is converted into kinetic energy in the operating fluid. Hydrodynamic coupling between the rotor and stator converts the kinetic energy into heat and the rotor is retarded. This retardation effect is transmitted to the drive shaft and the vehicle is retarded.

5.2.2.2.3 Cooled Friction Brake—The cooled friction brake uses air or hydraulic fluid to dissipate heat from the friction surface of the service brake. By controlling the friction surface temperature, retarding torque is improved, along with a reduced rate of wear.

5.2.2.2.4 Compression Release Engine Retarder—The compression release engine retarder converts a power-producing diesel engine into a power-absorbing retarding mechanism by opening the exhaust valve near the top dead center in the engine compression cycle. No positive power will be produced, since the compressed air mass is released. The vehicle is retarded as it must provide energy to compress the cylinder air charge and subsequently to return the piston to the bottom position.

5.2.2.2.5 Exhaust Brake—The exhaust brake restricts the escape of the exhaust gas from the exhaust manifold. Each succeeding exhaust stroke builds up a back pressure in the manifold which exerts a retarding effect to the pistons during the exhaust stroke. The engine turns against this back pressure creating a braking effect to the vehicle.

5.2.2.2.6 Auxiliary Retarder—Fans, air conditioners, or any power-absorbing device in the vehicle can also function as retarders as they impose parasitic loading on the engine or vehicle.

5.2.2.3 Retarder Location (4 bits)—This parameter defines whether the "torque/speed curve" defined by the retarder configuration message (see 5.3.15) is dependent on engine rpm, output shaft rpm, or other parameter. The data type of this parameter is measured. See Table 9.

Suspect Parameter Number: 902

TABLE 9—RETARDER LOCATION

Bit States	Retarder Location
0000 (Primary)	Engine Compression Release Brake (Engine rpm)
0001 (Primary)	Engine Exhaust Brake (Exhaust pressure)
0010 (Primary)	Transmission Input (Engine rpm)
0011 (Secondary)	Transmission Output (Output Shaft rpm)
0100 (Secondary)	Driveline (Output Shaft rpm)
0101	Trailer (Vehicle speed)
0110-1101	Not defined
1110	Other
1111	Not available

5.2.2.4 Accelerator Pedal Low Idle Switch—Switch signal which indicates whether the accelerator pedal low idle switch is opened or closed. The low idle switch is defined in SAE J1843.

00 - Accelerator pedal not in low idle condition
01 - Accelerator pedal in low idle condition
Type: Measured
Suspect Parameter Number: 558
Reference: 5.3.6

5.2.2.5 Accelerator Pedal Kickdown Switch—Switch signal which indicates whether the accelerator pedal kickdown switch is opened or closed. The kickdown switch is defined in SAE J1843.

00 - Kickdown passive
01 - Kickdown active
Type: Measured
Suspect Parameter Number: 559
Reference: 5.3.6

5.2.2.6 Driveline Engaged—Driveline engaged indicates the transmission controlled portion of the driveline is engaged sufficiently to allow a transfer of torque through the transmission. Driveline engaged is ACTIVE whenever the transmission is in gear and the clutch (if controlled by the transmission controller) is less than 100% clutch slip (clutch able to transfer torque). This parameter should be used in conjunction with the parameter "Shift in Process" (5.2.2.14). While a shift is in process, the receiver should not assume that the driveline is either fully engaged or disengaged (i.e., cruise control).

00 - Driveline disengaged
01 - Driveline engaged
Type: Measured
Suspect Parameter Number: 560
Reference: 5.3.5

5.2.2.7 ASR Engine Control Active—State signal which indicates that ASR engine control has been commanded to be active. Active means that ASR actually tries to control the engine. This state signal is independent of other control commands to the engine (e.g., from the transmission) which may have higher priority.

00 - ASR engine control passive but installed
01 - ASR engine control active
Type: Status
Suspect Parameter Number: 561
Reference: 5.3.4

5.2.2.8 ASR Brake Control Active—State signal which indicates that ASR brake control is active. Active means that ASR actually controls wheel brake pressure at one or more wheels of the driven axle(s).

00 - ASR brake control passive but installed
01 - ASR brake control active
Type: Status
Suspect Parameter Number: 562
Reference: 5.3.4

(R) *5.2.2.9 Anti-lock Braking (ABS) Active*—State signal which indicates that the ABS is active. The signal is set active when wheel brake pressure actually starts to be modulated by ABS and is reset to passive when all wheels are in a stable condition for a certain time. The signal can also be set active when driven wheels are in high slip (e.g., caused by retarder). Whenever the ABS system is not fully operational (due to a defect or during off-road ABS operation) , this signal is only valid for that part of the system that is still working. When ABS is switched off completely, the flag is set to passive regardless of the current wheel slip conditions.

00 - ABS passive but installed
01 - ABS active
Type: Status
Suspect Parameter Number: 563
Reference: 5.3.4

5.2.2.10 Differential Lock State—State used which indicates the condition of the various differential locks. The differential locks are located as defined in Figure 7.

00 - Differential lock disengaged
01 - Differential lock engaged
Type: Status
Suspect Parameter Number: 564 (Central)
565 (Central front)
566 (Central rear)
567 (Front axle 1)
568 (Front axle 2)
569 (Rear axle 1)
570 (Rear axle 2)
Reference: 5.3.9

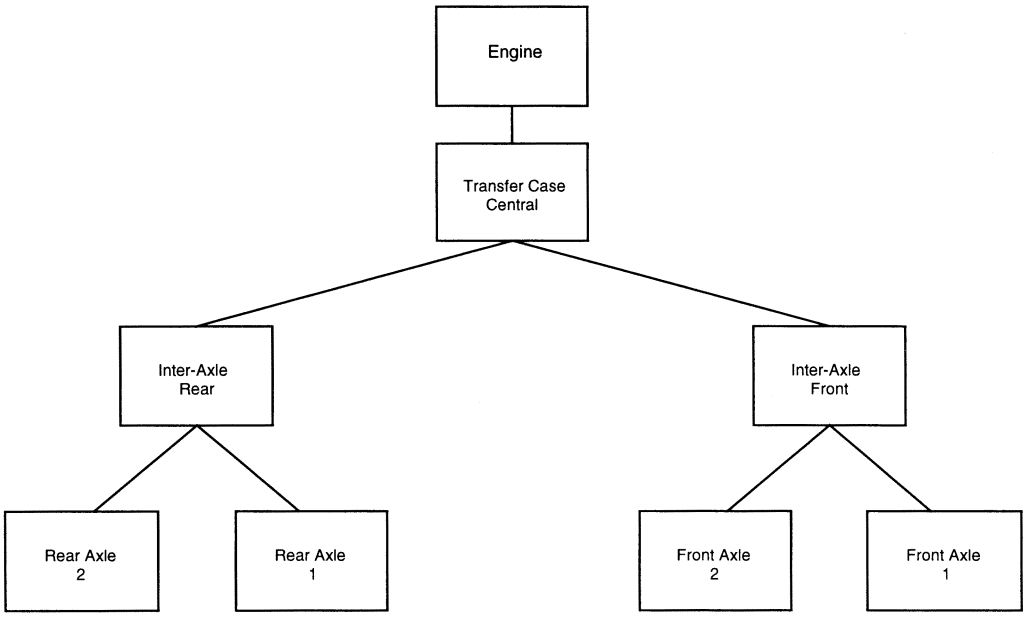


FIGURE 7—DIFFERENTIAL LOCK POSITIONS

(R) *5.2.2.11 Retarder Enable - Brake Assist Switch*—Switch signal which indicates whether the operator wishes the retarder to be enabled for vehicle braking assist. The retarder does not check this switch, nor does the enabling of this switch engage the retarder. When this switch is “enabled,” the devices constructing TSC1 – destination retarder messages may command retarder torque for braking. For example, the cruise control should not request retarder torque if this switch is not “enabled.” The switch exists to prevent the engine retarder from being asked to be engaged via TSC1 in a noise sensitive area. See also 5.2.2.12.

00 - Retarder - brake assist disabled
01 - Retarder - brake assist enabled
Type: Measured
Suspect Parameter Number: 571
Reference: 5.3.3

(R) *5.2.2.12 Retarder Enable - Shift Assist Switch*—Switch signal which indicates whether the operator wishes the retarder to be enabled for transmission shift assist. The retarder does not check this switch, nor does the enabling of this switch engage the retarder. When this switch is "enabled," the transmission may activate the retarder (via the TSC1 message) to increase the rate of engine deceleration to assist in shift control. The switch exists to prevent the engine retarder from being asked to be engaged via TSC1 in a noise sensitive area. See also 5.2.2.11.

00 - Retarder - shift assist disabled
01 - Retarder - shift assist enabled
Type: Measured
Suspect Parameter Number: 572
Reference: 5.3.3

5.2.2.13 Torque Converter Lockup Engaged—State signal which indicates whether the torque converter lockup is engaged.

00 - Torque converter lockup disengaged
01 - Torque converter lockup engaged
Type: Status
Suspect Parameter Number: 573
Reference: 5.3.5

5.2.2.14 Shift in Process—Indicates that the transmission is in process of shifting from the current gear to the selected gear. This state is generally ACTIVE during the entire time that the transmission controls the vehicle. This includes any transmission clutch control, all engine control sequences, pulling to transmission neutral, and engaging the destination gear (e.g., until it is no longer sending commands and/or limits to the engine). See also 5.2.2.6. (See Figure 8.)

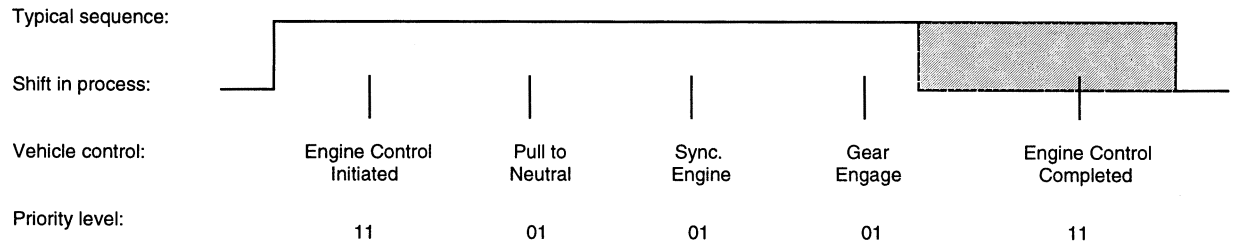


FIGURE 8—SHIFT IN PROCESS

00 - Shift is not in process
01 - Shift in process
Type: Measured
Suspect Parameter Number: 574
Reference: 5.3.5

5.2.2.15 ABS Off-Road Switch—Switch signal which indicates the position of the ABS off-road switch.

00 - ABS off-road switch passive
01 - ABS off-road switch active
Type: Measured
Suspect Parameter Number: 575
Reference: 5.3.4

5.2.2.16 ASR Off-Road Switch—Switch signal which indicates the position of the ASR off-road switch.

00 - ASR off-road switch passive
01 - ASR off-road switch active
Type: Measured
Suspect Parameter Number: 576
Reference: 5.3.4

5.2.2.17 ASR "Hill Holder" Switch—Switch signal which indicates the position of the ASR "hill holder" switch.

00 - ASR "hill holder" switch passive
01 - ASR "hill holder" switch active
Type: Measured
Suspect Parameter Number: 577
Reference: 5.3.4

5.2.2.18 Cruise Control States (3 bits)—This parameter is used to indicate the current state, or mode, of operation by the cruise control device. See Table 10. This is a status parameter. (Reference: 5.3.31)

Suspect Parameter Number: 527

TABLE 10—CRUISE CONTROL STATES

Bit States	Cruise Control State
000	Off/Disabled
001	Hold
010	Accelerate
011	Decelerate/Coast
100	Resume
101	Set
110	Accelerator override
111	Not available

5.2.2.18.1 Off/Disabled 000—Used to indicate that the cruise control device is off or on standby. Note that the cruise control system switch does not necessarily have to be off to be in this mode.

5.2.2.18.2 Hold 001—Used to indicate that the cruise control device is active and currently maintaining a captured operating speed.

5.2.2.18.3 Accelerate 010—Used to indicate that the cruise control device is in the process of ramping up the operating speed.

5.2.2.18.4 Decelerate 011—Used to indicate that the cruise control device is in the process of ramping down, or coasting, the operating speed.

5.2.2.18.5 Resume 100—Used to indicate that the cruise control device is in the process of resuming the operating speed to a previously captured value.

5.2.2.18.6 Set 101—Used to indicate that the cruise control device is establishing the current vehicle speed as the operating speed (captured value).

5.2.2.18.7 Accelerator Override 110—Used to indicate that the cruise control device is active but not currently maintaining the captured operating speed.

(R) 5.2.2.19 *PTO States (5 bits)*—This parameter is used to indicate the current state or mode of operation by the power takeoff (PTO) device. See Table 11. It needs to be ensured that each achieved state information be set up to be conveyed in at least one datalink message before a transition to another state is allowed. The Suspect Parameter Number for this parameter is 976.

(R) **TABLE 11—PTO STATES**

Bit States	PTO State
00000	Off/Disabled
00001	Hold
00010	Remote Hold
00011	Standby
00100	Remote Standby
00101	Set
00110	Decelerate/Coast
00111	Resume
01000	Accelerate
01001	Accelerator Override
01010	Preprogrammed set speed 1
01011	Preprogrammed set speed 2
01100	Preprogrammed set speed 3
01101	Preprogrammed set speed 4
01110	Preprogrammed set speed 5
01111	Preprogrammed set speed 6
10000	Preprogrammed set speed 7
10001	Preprogrammed set speed 8
10010-11110	Not defined
11111	Not available

(R) 5.2.2.19.1 Off/Disabled 00000—Used to indicate that the PTO enable switch is in the off position.

(R) 5.3.3.19.2 Hold 00001—Used to indicate that the PTO device is active and currently maintaining a captured operating speed.

(R) 5.2.2.19.3 Remote Hold 00010—Used to indicate that the remote PTO device is active and currently maintaining a captured operating speed.

(R) 5.2.2.19.4 Standby 00011—Used to indicate that the PTO device enable switch is in the ON position and it is possible to manage the PTO device.

(R) 5.2.2.19.5 Remote Standby 00100—Used to indicate that the remote PTO device enable switch is in the ON position and it is possible to manage the PTO device.

(R) 5.2.2.19.6 Set 00101—Used to indicate that the PTO device is establishing current speed as the operating speed (captured value).

(R) 5.2.2.19.7 Decelerate/Coast 00110—Used to indicate that the PTO device is in the process of ramping down, or coasting, from the current operating speed.

(R) 5.2.2.19.8 Resume 00111—Used to indicate that the PTO device is in the process of resuming the operating speed to a previously captured value.

(R) 5.2.2.19.9 Accelerate 01000—Used to indicate that the PTO device is in the process of ramping up the operating speed.

(R) 5.2.2.19.10 Accelerator Override 01001—Used to indicate that the PTO device is active but for the present time the engine is controlled by a large driver's demand.

(R) 5.2.2.19.11 Preprogrammed Set Speed 1 01010—Used to indicate that the PTO device is establishing a first preprogrammed set speed (user programmable) as the current operating speed.

(R) 5.2.2.19.12 Preprogrammed Set Speed 2 01011—Used to indicate that the PTO device is establishing a second preprogrammed set speed (user programmable) as the current operating speed.

(R) 5.2.2.19.13 Preprogrammed Set Speed 3 01100—Used to indicate that the remote PTO device is establishing a third preprogrammed set speed (user programmable) as the current operating speed.

(R) 5.2.2.19.14 Preprogrammed Set Speed 4 01101—Used to indicate that the remote PTO device is establishing a fourth preprogrammed set speed (user programmable) as the current operating speed.

(R) 5.2.2.19.15 Preprogrammed Set Speed 5 01110—Used to indicate that the remote PTO device is establishing a fifth preprogrammed set speed (user programmable) as the current operating speed.

(R) 5.2.2.19.16 Preprogrammed Set Speed 6 01111—Used to indicate that the remote PTO device is establishing a sixth preprogrammed set speed (user programmable) as the current operating speed.

(R) 5.2.2.19.17 Preprogrammed Set Speed 7 10000—Used to indicate that the remote PTO device is establishing a seventh preprogrammed set speed (user programmable) as the current operating speed.

(R) 5.2.2.19.18 Preprogrammed Set Speed 8 10001—Used to indicate that the remote PTO device is establishing a eighth preprogrammed set speed (user programmable) as the current operating speed.

(R) 5.2.2.20 *Fan Drive States (4 bits)*—This parameter is used to indicate the current state or mode of operation by the fan drive. See Table 12. The Suspect Parameter Number for this parameter is 977.

(R) **TABLE 12—FAN DRIVE STATES**

Bit States	Fan Drive State
0000	Fan off
0001	Engine system–General
0010	Excessive engine air temperature
0011	Excessive engine oil temperature
0100	Excessive engine coolant temperature
0101-1000	Not defined
1001	Manual control
1010	Transmission retarder
1011	A/C system
1100	Timer
1101	Engine brake
1110	Other
1111	Not available

(R) 5.2.2.20.1 Fan Off 0000—Used to indicate that the fan clutch is disengaged and the fan is inactive

(R) 5.2.2.20.2 Engine System–General 0001—Used to indicate that the fan is active due to an engine system not otherwise defined.

(R) 5.2.2.20.3 Excessive Engine Air Temperature 0010—Used to indicate that the fan is active due to high air temperature.

(R) 5.2.2.20.4 Excessive Engine Oil Temperature 0011—Used to indicate that the fan is active due to high oil temperature.

(R) 5.2.2.20.5 Excessive Engine Coolant Temperature 0100—Used to indicate that the fan is active due to high coolant temperature.

(R) 5.2.2.20.6 Manual Control 1001—Used to indicate that the fan is active as requested by the operator.

(R) 5.2.2.20.7 Transmission Retarder 1010—Used to indicate that the fan is active as required by the transmission retarder.

(R) 5.2.2.20.8 A/C System 1011—Used to indicate that the fan is active as required by the air conditioning system.

(R) 5.2.2.20.9 Timer 1100—Used to indicate that the fan is active as required by a timing function.

(R) 5.2.2.20.10 Engine Brake 1101—Used to indicate that the fan is active as required to assist engine braking.

(R) *5.2.2.21 Engine Coolant Load Increase*—Status of an event, external to the engine, that may increase the nominal temperature of the engine coolant liquid.

00 - No coolant load increase
01 - Coolant load increase possible
Type: Status
Suspect Parameter Number: 1082
Reference: 5.3.3

5.2.3 DRIVETRAIN CONTROL PARAMETERS

5.2.3.1 *Override Control Mode (2 bits)*—The override control mode defines which sort of command is used:

00 - Override disabled - Disable any existing control commanded by the source of this command.
01 - Speed control - Govern speed to the included “desired speed” value.
10 - Torque control - Control torque to the included “desired torque” value.
11 - Speed/torque limit control - Limit speed and/or torque based on the included limit values. The speed limit governor is a droop governor where the speed limit value defines the speed at the maximum torque available during this operation.
Type: Status
Suspect Parameter Number: 695
Reference: 5.3.1

If a device wants to know whether it has access to the engine, there are several possibilities:

a. Comparing its command with the actual engine broadcasts.
b. Looking at command modes from other devices.
c. Looking to the engine and retarder torque mode.

Remarks:

a. The realization of a torque limit (minimum selection) is possible by setting the speed limit to a high value ($FAFF_{16}$).
b. The realization of a speed limit (minimum selection) is possible by setting the torque limit to a high value (FA_{16}).

c. Limiting the retarder torque means to limit the magnitude of the torque request. As the brake torque is represented by negative torque values, the limitation must be done by a maximum selection of the requested torque and the retarder internal torque signals.
d. For torque increasing functions, time limits for the torque or speed value (command) and the direct modes are desirable.
e. The selection of which device has control of the engine's speed or torque depends on the override mode priority (see 5.2.3.3) with the highest priority device gaining control. In the case of two devices with identical priority, the engine responds to speed/torque control commands over speed/torque limit commands and will act on the speed or torque commands on a first come, first served basis. The torque limit will be a “lowest wins” selection (e.g., if one device commands 60% limit and another 80% limit, then the engine will limit torque to 60%). Figure 9 provides a flowchart of the torque/speed control priority selection logic.

5.2.3.2 Requested Speed Control Conditions (2 bits)—This mode tells the engine control system the governor characteristics that are desired during speed control. The four characteristics defined are:

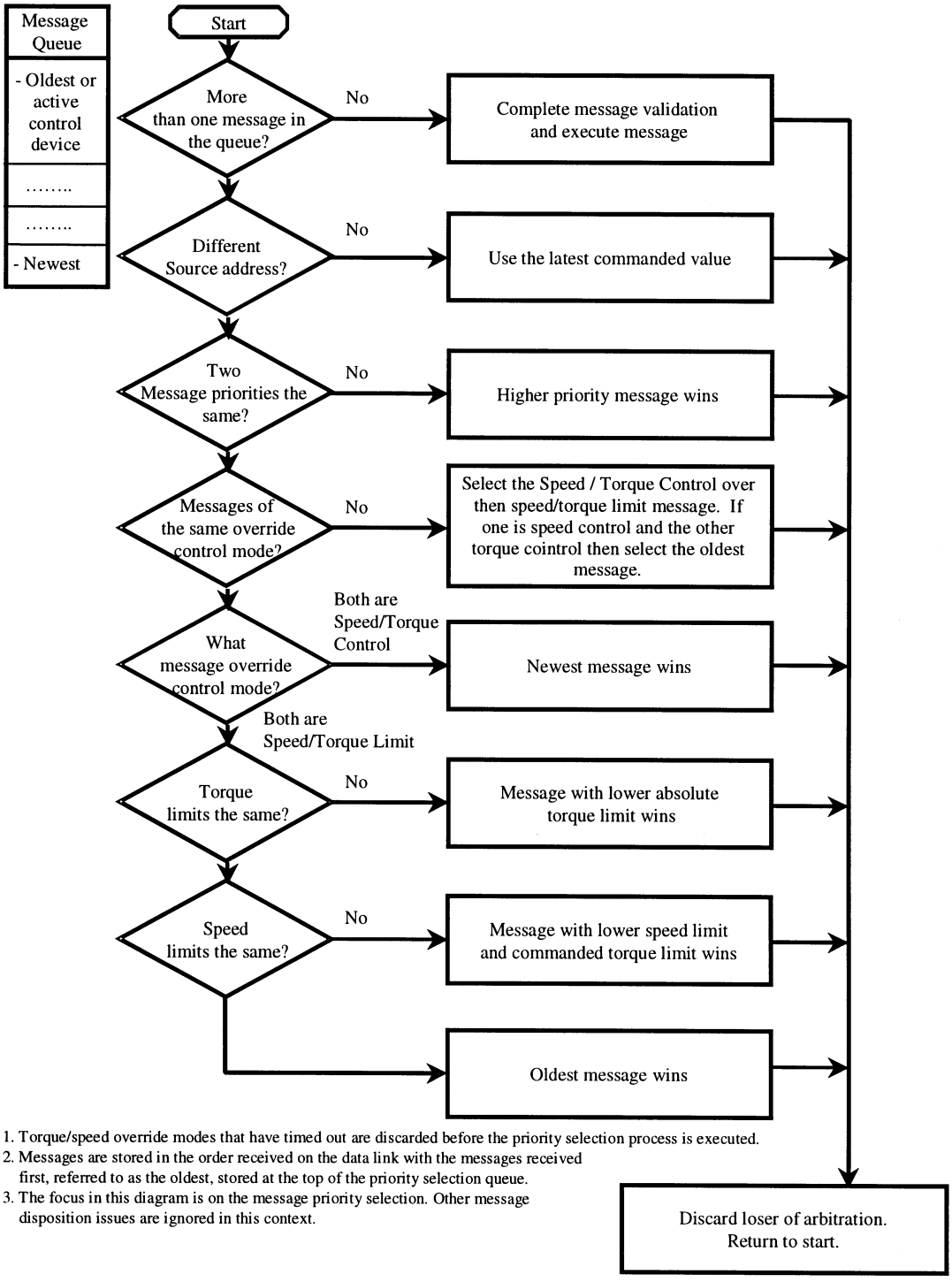
00 - Transient Optimized for driveline disengaged and non-lockup conditions
01 - Stability Optimized for driveline disengaged and non-lockup conditions
10 - Stability Optimized for driveline engaged and/or in lockup condition 1 (e.g., vehicle driveline)
11 - Stability Optimized for driveline engaged and/or in lockup condition 2 (e.g., PTO driveline)
Type: Status
Suspect Parameter Number: 696
Reference: 5.3.1

5.2.3.2.1 Speed Control Characteristic 00—This speed governor gain selection is adjusted to provide rapid transition between speed setpoints. RPM overshoot and undershoot may be greater than what is seen when the “speed control characteristic” is set to be stability optimized.

5.2.3.2.2 Speed Control Characteristic 01—This control condition has been optimized to minimize rpm overshoot and undershoot given an expected plant consisting of the engine and its accessory loads. This gain adjustment is not intended to compensate for driveline characteristics. This characteristic is most appropriate when no driveline is connected.

5.2.3.2.3 Speed Control Characteristic 10—This control condition has been optimized to minimize rpm overshoot and undershoot given a more complex plant. For instance, the more complex plant would contain the engine, its accessory loads and the driveline characteristics. As an example, the driveline characteristics might include the effective spring mass relationship of pumps, tires, clutches, axles, driveshafts, and multiple gear ratios. This characteristic is most appropriate when a driveline is engaged.

5.2.3.2.4 Speed Control Characteristic 11—This speed control characteristic is available for applications requiring compensation for more than one driveline characteristic. It has been optimized to minimize rpm overshoot and undershoot given a more complex plant of the second variety. This more complex plant would again contain the engine, its accessory loads and a second driveline characteristic unique from the one described in speed control characteristic 10.



1. Torque/speed override modes that have timed out are discarded before the priority selection process is executed.
2. Messages are stored in the order received on the data link with the messages received first, referred to as the oldest, stored at the top of the priority selection queue.
3. The focus in this diagram is on the message priority selection. Other message disposition issues are ignored in this context.

FIGURE 9—TORQUE/SPEED CONTROL PRIORITY SELECTION LOGIC

5.2.3.3 Override Control Mode Priority (2 bits)—This field is used as an input to the engine or retarder to determine the priority of the Override Control Mode received in the Torque/Speed Control message (see 5.3.1). The default is 11 (Low priority). It is not required to use the same priority during the entire override function. For example, the transmission can use priority 01 (High priority) during a shift, but can set the priority to 11 (Low priority) at the end of the shift to allow traction control to also interact with the torque limit of the engine.

The four priority levels defined are:

00 -	Highest priority
01 -	High priority
10 -	Medium priority
11 -	Low priority
Type:	Status
Suspect Parameter Number:	897
Reference:	5.3.1

5.2.3.3.1 Highest Priority 00—Used for situations that require immediate action by the receiving device in order to provide safe vehicle operation (i.e., braking systems). This level of priority should only be used in safety critical conditions.

5.2.3.3.2 High Priority 01—Used for control situations that require prompt action in order to provide safe vehicle operation. An example is when the transmission is performing a shift and requires control of the engine in order to control driveline reengagement.

5.2.3.3.3 Medium Priority 10—Used for powertrain control operations which are related to assuring that the vehicle is in a stable operating condition. An example is when the traction control system is commanding the engine in order to achieve traction stability.

5.2.3.3.4 Low Priority 11—Used to indicate that the associated command desires powertrain control but is needed for function which improves the driver comfort which may be overridden by other devices. An example is cruise control or the non-critical part of a transmission shift to a new gear.

5.2.3.4 Gear Shift Inhibit Request—Command signal to inhibit gear shifts.

00 -	Gear shifts are allowed (disable function)
01 -	Gear shifts are inhibited (enable function)
11 -	Take no action (leave function as is)
Type:	Status
Suspect Parameter Number:	681
Reference:	5.3.2

5.2.3.5 Torque Converter Lockup Disable Request—Command signal to prevent torque converter lockup, which may cause problems in certain circumstances for ASR.

00 -	Allow torque convertor lockup
01 -	Disable torque convertor lockup
11 -	Take no action
Type:	Status
Suspect Parameter Number:	682
Reference:	5.3.2

5.2.3.6 Disengage Driveline Request—Command signal used to simply disengage the driveline, e.g., to prevent engine drag torque from causing high wheel slip on slippery surfaces.

00 -	Allow driveline engagement
01 -	Disengage driveline
11 -	Take no action
Type:	Status
Suspect Parameter Number:	683
Reference:	5.3.2

5.2.3.7 Disengage Differential Lock Request—Command signal used to disengage the various differential locks, e.g., to allow an undistributed individual wheel control by ABS. The differential locks are located as defined in Figure 7.

00 -	Engage differential lock
01 -	Disengage differential lock
11 -	Take no action
Type:	Status
Suspect Parameter Number:	Front axle 1 - 685
	Front axle 2- 686
	Rear axle 1 - 687
	Rear axle 2 - 688
	Central - 689
	Central front - 690
	Central rear - 691
Reference:	5.3.2

5.2.3.8 ABS Off-Road Switch Request—Command signal used by the driver via a dashboard switch to choose the ABS off-road function.

00 -	Switch off ABS off-road function
01 -	Switch on ABS off-road function
11 -	Take no action
Type:	Status
Suspect Parameter Number:	692
Reference:	

5.2.3.9 ASR Off-Road Switch Request—Command signal used by the driver via a dashboard switch to choose the ASR off-road function.

00 -	Switch off ASR off-road function
01 -	Switch on ASR off-road function
11 -	Take no action
Type:	Status
Suspect Parameter Number:	693
Reference:	

5.2.3.10 ASR "Hill Holder" Switch Request—Command signal used by the driver via a dashboard switch to choose a special ASR function.

00 -	Switch off ASR special function
01 -	Switch on ASR special function
11 -	Take no action
Type:	Status
Suspect Parameter Number:	694
Reference:	

5.2.3.11 Progressive Shift Disable—Command signal used to indicate that progressive shifting by the engine should be disallowed.

00 -	Progressive shift is not disabled
01 -	Progressive shift is disabled
11 -	Take no action
Type:	Status
Suspect Parameter Number:	607
Reference:	5.3.5

5.2.3.12 Momentary Engine Overspeed Enable—Command signal used to indicate that the engine speed may be boosted up to the maximum engine overspeed value to accommodate transmission downshifts. The maximum time for overspeed is limited by the time defined in the engine configuration message (see 5.3.17). The transmission module must command a "override disabled" state at least once before the engine will accept a subsequent request for overspeed.

00 -	Momentary engine overspeed is disabled
01 -	Momentary engine overspeed is enabled
11 -	Take no action
Type:	Status
Suspect Parameter Number:	606
Reference:	5.3.5

(R) *5.2.3.13 Trip Group 1*—Command signal used to reset the PGNs and parameters as defined in Table 13.

00 -	Take no action
01 -	Reset
11 -	Not applicable
Type:	Status
Suspect Parameter Number:	988
Reference:	5.3.74

(R) **TABLE 13—TRIP GROUP 1**

Parameter	SPN
Trip distance	244
Trip fuel	182
High resolution trip distance	918
Trip compression brake distance	990
Trip service brake applications	993
Trip maximum engine speed	1013
Trip average engine speed	1014
Trip drive average load factor	1015
Trip average fuel rate	1029
Trip average fuel rate (Gaseous)	1031
Parameter Group	**SPN**
Trip time information #2	65,200
Trip time information #1	65,204
Trip shutdown information	65,205
Trip vehicle speed/cruise distance information	65,206
Trip fuel information (Gaseous)	65,208
Trip fuel information	65,209
Trip distance information	65,210
Trip fan information	65,211

(R) *5.2.3.14 Trip Group 2–Proprietary*—Command signal used to reset proprietary parameters associated with a trip but not defined within this document.

00 - Take no action
01 - Reset
11 - Not applicable
Type: Status
Suspect Parameter Number: 989
Reference: 5.3.74

5.2.4 DRIVETRAIN CONFIGURATION PARAMETERS—The configuration messages are sent to describe a controller's configuration to other controllers on the network. The configuration messages are sent in response to a configuration request message.

5.2.4.1 Engine Configuration—This map describes the stationary behavior of the engine and the speed dependent available indicated torque. This map should reflect the effect of changes due to barometric pressure, engine temperature, and any other stationary changes (sensor failures, etc.) which influence the engine torque curve more than 10%. This map is only valid for maximum boost pressure. At low boost pressures the torque limit may be much lower.

The engine configuration message must be sent at any time that the engine configuration map has changed by more than 10% of speed or torque (due to events other than boost pressure) since that last time the message was transmitted. As an alternative, it may be sent periodically, once every 5 s. It shall also be sent on response to a configuration request message.

The engine characteristic can be described in one of three modes. Mode 1 provides a complete curve of speed and torque points (see Figure 10). Modes 2 and 3 provide a partial curve of speed and torque points and a separate endspeed governor characteristic. In modes 2 and 3, the receiver of the engine configuration message has to calculate the minimum of the engine torque curve and the endspeed governor characteristic to get the final available engine torque.

Mode 2 provides a high idle point where torque equals zero (point 6) and the endspeed governor gain Kp (see Figure 11). Mode 3 provides the kick-in point of the endspeed governor (point 2) and the governor gain Kp (see Figure 12).

The selection of the three modes can be done by setting the parameters as shown in Table 14.

TABLE 14—ENGINE CONFIGURATION CHARACTERISTIC MODES

Mode	Torque/Speed Point 2	Governor Gain KP	High Idle Speed
1	Available	Not available	Available
2	Not Available	Available	Available
3	Available	Available	Not available

The following points are shown in Figures 10, 11, and 12.

Point 1 (required): Torque/speed point at idle

Point 2 (required): Mode 1 & 3: Torque/speed point at which the high-speed governor becomes active
Mode 2: Normal torque/speed point

Point 3,4,5 (required): Torque/speed points between points 1 and 2 to permit linear interpolation over the entire torque range. It is required that one of these points indicate the peak torque point for the current engine torque map.

Point 6 (mode dependent): Mode 1 & 2: High idle speed (torque = 0)
Mode 3: Not available (point is defined by the endspeed governor where torque = 0)

Point 7 (optional): Maximum momentary engine override speed (torque = 0)

Reference engine torque: Engine torque in Nm. This parameter is the reference value of 100% for all defined indicated engine torque parameters. It is only defined once and doesn't change if a different engine torque map becomes valid.

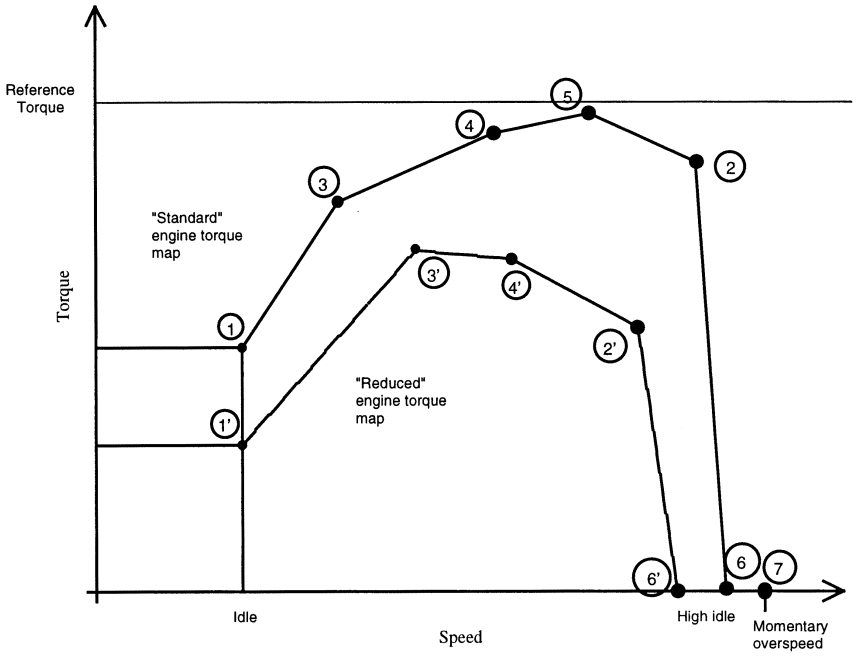


FIGURE 10—ENGINE CONFIGURATION MAP-MODE 1

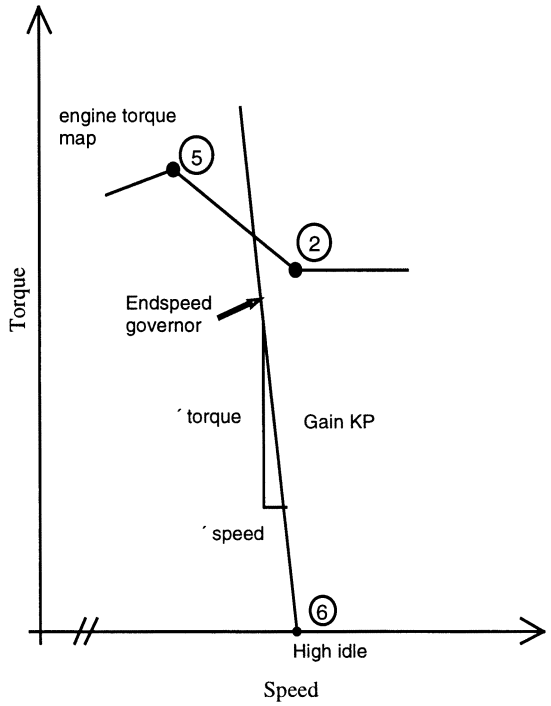


FIGURE 11—ENGINE CONFIGURATION MAP-MODE 2

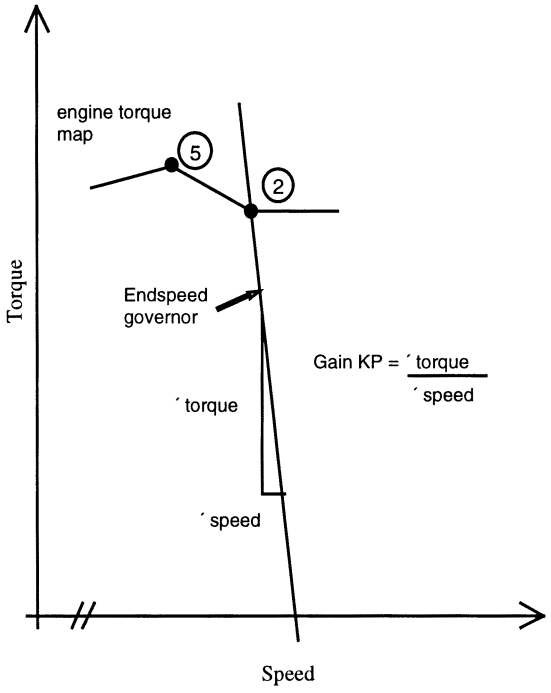


FIGURE 12—ENGINE CONFIGURATION MAP-MODE 3

5.2.4.2 Transmission Configuration—The transmission configuration describes the number of forward gears, the number of reverse gears, and the ratio of each gear with the following resolution:

Data Length:	2 bytes
Resolution:	0.001/bit, 0 offset
Data Range:	0 to 64.255
Type:	Measured
Suspect Parameter Number:	581
Reference:	5.3.16

5.2.4.3 Retarder Configuration—This map describes the stationary behavior of the retarder. See Figures 13 and 14.

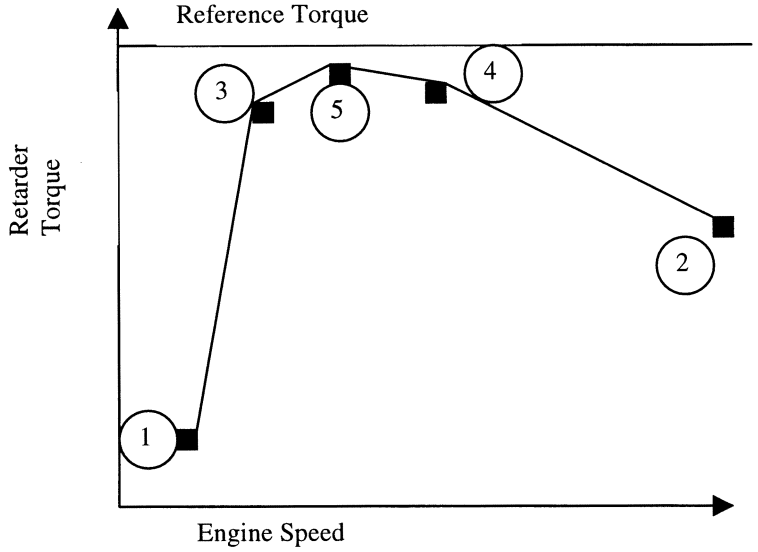


FIGURE 13—TYPICAL HYDRAULIC RETARDER TORQUE CURVE

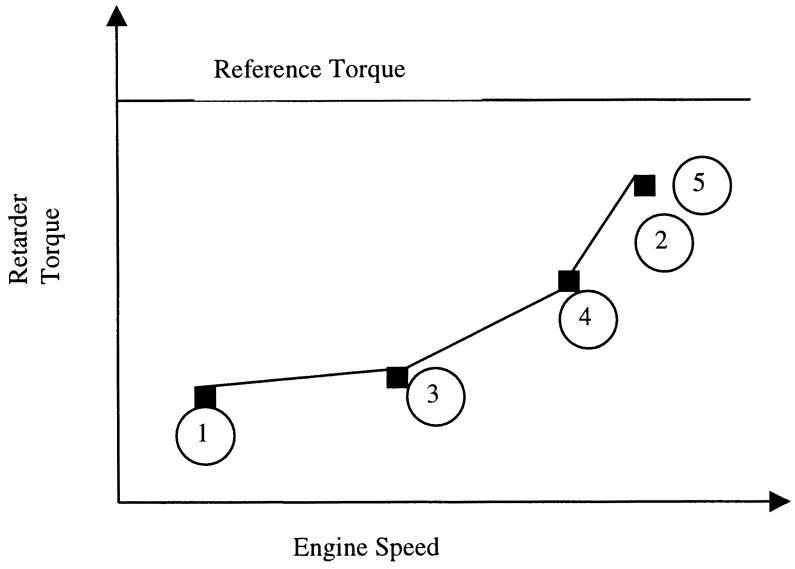


FIGURE 14—TYPICAL ENGINE COMPRESSION BRAKE TORQUE CURVE

5.2.4.4 Number of Forward Gear Ratios—Number of forward gear ratios in the transmission, provided as part of the configuration.

Data Length:	1 byte
Resolution:	1 gear ratios/bit, 0 offset
Operating Range:	0 to 125 gear ratios
Type:	Measured
Suspect Parameter Number:	957
Reference:	5.3.16

5.2.4.5 Number of Reverse Gear Ratios—Number of reverse gear ratios in the transmission, provided as part of the transmission configuration.

Data Length:	1 byte
Resolution:	1 gear ratios/bit, 0 offset
Operating Range:	0 to 125 gear ratios
Type:	Measured
Suspect Parameter Number:	958
Reference:	5.3.16

5.2.5 INFORMATIONAL PARAMETERS

5.2.5.1 Steering Axle Temperature—Temperature of lubricant in steering axle.

Data Length:	1 byte
Resolution:	1 °C/bit gain, –40 °C offset
Data Range:	–40 to +210 °C (–40 to 410 °F)
Type:	Measured
Suspect Parameter Number:	75
Reference:	5.3.39

5.2.5.2 Drive Axle Temperature—Temperature of axle lubricant in drive axle.

Data Length:	1 byte
Resolution:	1 °C/bit gain, –40 °C offset
Data Range:	–40 to +210 °C (–40 to 410 °F)
Type:	Measured
Suspect Parameter Number:	578
Reference:	5.3.39

5.2.5.3 Power Takeoff Oil Temperature—Temperature of lubricant in device used to transmit engine power to auxiliary equipment.

Data Length:	1 byte
Resolution:	1 °C/bit gain, –40 °C offset
Data Range:	–40 to +210 °C (–40 to 410 °F)
Type:	Measured
Suspect Parameter Number:	90
Reference:	5.3.30

5.2.5.4 Intake Manifold Temperature—Temperature of pre-combustion air found in intake manifold of engine air supply system.

Data Length:	1 byte
Resolution:	1 °C/bit gain, –40 °C offset
Data Range:	–40 to +210 °C (–40 to 410 °F)
Type:	Measured
(R) Suspect Parameter Number:	105 – Intake Manifold 1 Temperature
(R)	1131 – Intake Manifold 2 Temperature
(R)	1132 – Intake Manifold 3 Temperature
(R)	1133 – Intake Manifold 4 Temperature
(R) Reference:	5.3.36 – Intake Manifold 1 Temperature
(R)	5.3.84 – Intake Manifold 2 Temperature
(R)	5.3.84 – Intake Manifold 3 Temperature
(R)	5.3.84 – Intake Manifold 4 Temperature

5.2.5.5 Engine Coolant Temperature—Temperature of liquid found in engine cooling system.

Data Length:	1 byte
Resolution:	1 °C/bit gain, –40 °C offset
Data Range:	–40 to +210 °C (–40 to 410 °F)
Type:	Measured
Suspect Parameter Number:	110
Reference:	5.3.28

5.2.5.6 Engine Intercooler Temperature—Temperature of liquid found in the intercooler located after the turbocharger.

Data Length:	1 byte
Resolution:	1 °C/bit gain, –40 °C offset
Data Range:	–40 to +210 °C (–40 to 410 °F)
Type:	Measured
Suspect Parameter Number:	52
Reference:	5.3.28

5.2.5.7 Hydraulic Retarder Oil Temperature—Temperature of oil found in a hydraulic retarder.

Data Length:	1 byte
Resolution:	1 °C/bit gain, –40 °C offset
Data Range:	–40 to +210 °C (–40 to 410 °F)
Type:	Measured
Suspect Parameter Number:	120
Reference:	5.3.41

5.2.5.8 Exhaust Gas Temperature—Temperature of combustion byproducts leaving the engine.

Data Length:	2 bytes
Resolution:	0.03125 °C/bit gain, –273 °C offset
Data Range:	–273 to +1735.0 °C (–459.4 to 3155.0 °F)
Type:	Measured
Suspect Parameter Number:	173
Reference:	5.3.36

5.2.5.9 Road Surface Temperature—Indicated temperature of road surface over which vehicle is operating.

Data Length:	2 bytes
Resolution:	0.03125 °C/bit gain, –273 °C offset
Data Range:	–273 to +1735.0 °C (–459.4 to 3155.0 °F)
Type:	Measured
Suspect Parameter Number:	79
Reference:	5.3.35

5.2.5.10 Cargo Ambient Temperature—Temperature of air inside vehicle container used to accommodate cargo.

Data Length:	2 bytes
Resolution:	0.03125 °C/bit gain, –273 °C offset
Data Range:	–273 to +1735.0 °C (–459.4 to 3155.0 °F)
Type:	Measured
Suspect Parameter Number:	169
Reference:	5.3.42

5.2.5.11 Cab Interior Temperature—Temperature of air inside the part of the vehicle that encloses the driver and vehicle operating controls.

Data Length:	2 bytes
Resolution:	0.03125 °C/bit gain, –273 °C offset
Data Range:	–273 to +1735.0 °C (–459.4 to 3155.0 °F)
Type:	Measured
Suspect Parameter Number:	170
Reference:	5.3.35

5.2.5.12 Ambient Air Temperature—Temperature of air surrounding vehicle.

Data Length:	2 bytes
Resolution:	0.03125 °C/bit gain, –273 °C offset
Data Range:	–273 to +1735.0 °C (–459.4 to 3155.0 °F)
Type:	Measured
Suspect Parameter Number:	171
Reference:	5.3.35

5.2.5.13 Air Inlet Temperature—Temperature of air entering vehicle air induction system.

Data Length:	1 byte
Resolution:	1 °C/bit gain, –40 °C offset
Data Range:	–40 to +210 °C (–40 to 410 °F)
Type:	Measured
Suspect Parameter Number:	172
Reference:	5.3.35

5.2.5.14 Fuel Temperature—Temperature of fuel entering injectors.

Data Length:	1 byte
Resolution:	1 °C/bit gain, –40 °C offset
Data Range:	–40 to +210 °C (–40 to 410 °F)
Type:	Measured
Suspect Parameter Number:	174
Reference:	5.3.28

5.2.5.15 Engine Oil Temperature—Temperature of the engine lubricant.

	Data Length:	2 bytes
	Resolution:	0.03125 °C/bit gain, –273 °C offset
	Data Range:	–273 to +1735.0 °C (–459.4 to 3155.0 °F)
	Type:	Measured
(R)	Suspect Parameter Number:	175 – Engine Oil Temperature 1
(R)		1135 – Engine Oil Temperature 2
(R)	Reference:	5.3.28 – Engine Oil Temperature 1
(R)		5.3.85 – Engine Oil Temperature 2

5.2.5.16 Turbo Oil Temperature—Temperature of the turbocharger lubricant.

Data Length:	2 bytes
Resolution:	0.03125 °C/bit gain, –273 °C offset
Data Range:	–273 to +1735.0 °C (–459.4 to 3155.0 °F)
Type:	Measured
Suspect Parameter Number:	176
Reference:	5.3.28

5.2.5.17 Transmission Oil Temperature—Temperature of the transmission lubricant.

Data Length:	2 bytes
Resolution:	0.03125 °C/bit gain, –273 °C offset
Data Range:	–273 to +1735.0 °C (–459.4 to 3155.0 °F)
Type:	Measured
Suspect Parameter Number:	177
Reference:	5.3.38

5.2.5.18 Tire Temperature—Temperature at the surface of the tire sidewall.

Data Length:	2 bytes
Resolution:	0.03125 °C/bit gain, –273 °C offset
Data Range:	–273 to +1735.0 °C (–459.4 to 3155.0 °F)
Type:	Measured
Suspect Parameter Number:	242
Reference:	5.3.34

5.2.5.19 Gas Supply Pressure—Gage pressure of gas supply to fuel metering device.

Data Length:	2 bytes
Resolution:	0.5 kPa/bit gain, 0 kPa offset
Data Range:	0 to +32 127.5 kPa (0 to 4 659.7 psi)
Type:	Measured
Suspect Parameter Number:	159
Reference:	5.3.43

5.2.5.20 Injection Control Pressure—The gage pressure of the engine oil in the hydraulic accumulator that powers an intensifier used for fuel injection.

Data Length:	2 bytes
Resolution:	1/256 MPa/bit gain, 0 MPa offset
Data Range:	0 to +251 MPa (0 to 36 404 psi)
Type:	Measured
Suspect Parameter Number:	164
Reference:	5.3.46

(R) *5.2.5.21 Injector Metering Rail 1 Pressure*—The gage pressure of fuel in the primary, or first, metering rail as delivered from the supply pump to the injector metering inlet. See Figure 15.

Data Length:	2 bytes
Resolution:	1/256 MPa/bit gain, 0 MPa offset
Data Range:	0 to +251 MPa (0 to 36 404 psi)
Type:	Measured
Suspect Parameter Number:	157
Reference:	5.3.46

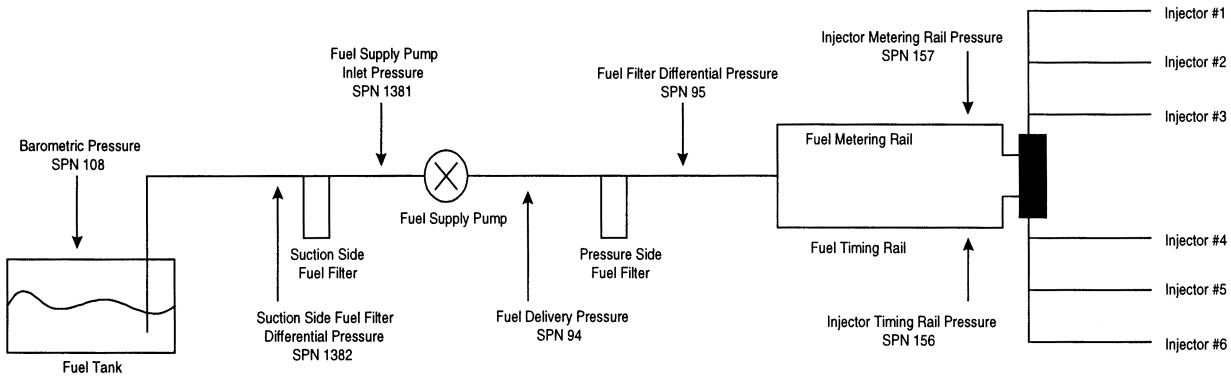


FIGURE 15—FUEL SYSTEM WITH RAILS

5.2.5.22 Auxiliary Pump Pressure—Gage pressure of auxiliary water pump driven as a PTO device.

Data Length:	1 byte
Resolution:	16 kPa/bit gain, 0 kPa offset
Data Range:	0 to +4000 kPa (0 to 580 psi)
Type:	Measured
Suspect Parameter Number:	73
Reference:	5.3.44

5.2.5.23 Clutch Pressure–Gage pressure of oil within a wet clutch.

Data Length:	1 byte
Resolution:	16 kPa/bit gain, 0 kPa offset
Data Range:	0 to +4000 kPa (0 to 580 psi)
Type:	Measured
Suspect Parameter Number:	123
Reference:	5.3.38

5.2.5.24 Transmission Oil Pressure—Gage pressure of lubrication fluid in transmission, measured after pump.

Data Length:	1 byte
Resolution:	16 kPa/bit gain, 0 kPa offset
Data Range:	0 to +4000 kPa (0 to 580 psi)
Type:	Measured
Suspect Parameter Number:	127
Reference:	5.3.38

5.2.5.25 Drive Axle Lift Air Pressure—Gage pressure of air in system that utilizes compressed air to provide force between axle and frame.

Data Length:	1 byte
Resolution:	4 kPa/bit gain, 0 kPa offset
Data Range:	0 to +1000 kPa (0 to 145 psi)
Type:	Measured
Suspect Parameter Number:	579
Reference:	5.3.39

5.2.5.26 Air Start Pressure—Gage pressure of air in an engine starting system that utilizes compressed air to provide the force required to rotate the crankshaft.

Data Length:	1 byte
Resolution:	4 kPa/bit gain, 0 kPa offset
Data Range:	0 to +1000 kPa (0 to 145 psi)
Type:	Measured
Suspect Parameter Number:	82
Reference:	5.3.12

(R) *5.2.5.27 Fuel Delivery Pressure*—Gage pressure of fuel in system as delivered from supply pump to the injection pump. See Figures 15 and 16.

Data Length:	1 byte
Resolution:	4 kPa/bit gain, 0 kPa offset
Data Range:	0 to +1000 kPa (0 to 145 psi)
Type:	Measured
Suspect Parameter Number:	94
Reference:	5.3.29

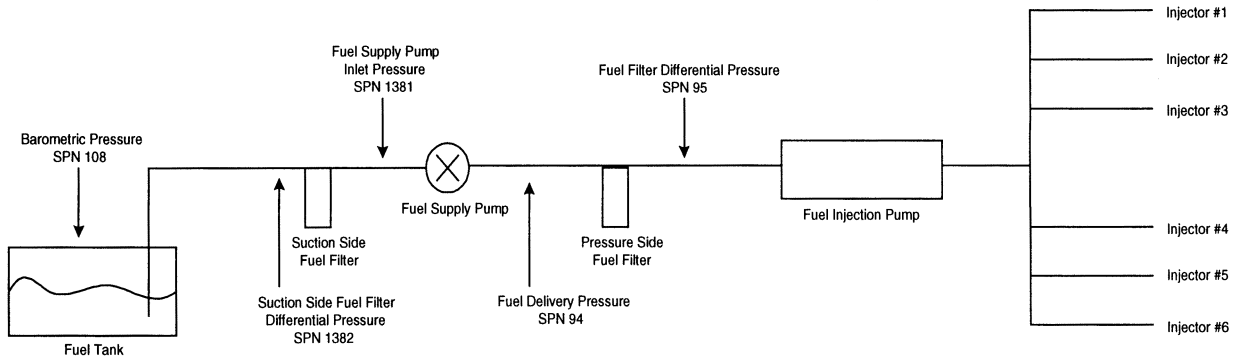


FIGURE 16—FUEL SYSTEM WITH PUMP

5.2.5.28 Engine Oil Pressure—Gage pressure of oil in engine lubrication system as provided by oil pump.

Data Length:	1 byte
Resolution:	4 kPa/bit gain, 0 kPa offset
Data Range:	0 to +1000 kPa (0 to 145 psi)
Type:	Measured
Suspect Parameter Number:	100
Reference:	5.3.29

(R) *5.2.5.29 Turbocharger Lube Oil Pressure* —Gage pressure of oil in turbocharger lubrication system.

	Data Length:	1 byte
	Resolution:	4 kPa/bit gain, 0 kPa offset
	Data Range:	0 to +1000 kPa (0 to 145 psi)
	Type:	Measured
(R)	Suspect Parameter Number:	104 - Turbocharger Lube Oil Pressure 1
(R)		1168 - Turbocharger Lube Oil Pressure 2
(R)	Reference:	5.3.11 – Turbocharger Lube Oil Pressure 1
(R)		5.3.94 – Turbocharger Lube Oil Pressure 2

5.2.5.30 Brake Application Pressure—Gage pressure of compressed air or fluid in vehicle braking system measured at the brake chamber when brake shoe (or pad) is placed against brake drum (or disc).

Data Length:	1 byte
Resolution:	4 kPa/bit gain, 0 kPa offset
Data Range:	0 to +1000 kPa (0 to 145 psi)
Type:	Measured
Suspect Parameter Number:	116
Reference:	5.3.40

5.2.5.31 Brake Primary Pressure—Gage pressure of air in the primary, or supply side, of the air brake system.

Data Length:	1 byte
Resolution:	4 kPa/bit gain, 0 kPa offset
Data Range:	0 to +1000 kPa (0 to 145 psi)
Type:	Measured
Suspect Parameter Number:	117
Reference:	5.3.40

5.2.5.32 Brake Secondary Pressure—Gage pressure of air in the secondary, or service side, of the air brake system.

Data Length:	1 byte
Resolution:	4 kPa/bit gain, 0 kPa offset
Data Range:	0 to +1000 kPa (0 to 145 psi)
Type:	Measured
Suspect Parameter Number:	118
Reference:	5.3.40

5.2.5.33 Hydraulic Retarder Pressure—Gage pressure of oil in hydraulic retarder system.

Data Length:	1 byte
Resolution:	16 kPa/bit gain, 0 kPa offset
Data Range:	0 to +4000 kPa (0 to 580 psi)
Type:	Measured
Suspect Parameter Number:	119
Reference:	5.3.41

5.2.5.34 Tire Pressure—Pressure at which air is contained in cavity formed by tire and rim.

Data Length:	1 byte
Resolution:	4 kPa/bit gain, 0 kPa offset
Data Range:	0 to +1000 kPa (0 to 145 psi)
Type:	Measured
Suspect Parameter Number:	241
Reference:	5.3.34

(R) *5.2.5.35 Fuel Filter Differential Pressure*—Change in fuel delivery pressure, measured across the filter, due to accumulation of solid or semisolid matter on the filter element. See Figures 15 and 16.

Data Length:	1 byte
Resolution:	2 kPa/bit gain, 0 kPa offset
Data Range:	0 to +500 kPa (0 to 72.5 psi)
Type:	Measured
Suspect Parameter Number:	95
Reference:	5.3.42

(R) *5.2.5.36 Boost Pressure*—Gage pressure of air measured downstream on the compressor discharge side of the turbocharger. See also 5.2.5.202 for alternate range and resolution. If there is one boost pressure to report and this range and resolution is adequate, this parameter should be used.

Data Length:	1 byte
Resolution:	2 kPa/bit gain, 0 kPa offset
Data Range:	0 to +500 kPa (0 to 72.5 psi)
Type:	Measured
Suspect Parameter Number:	102
Reference:	5.3.36

5.2.5.37 Air Inlet Pressure—Absolute air pressure at inlet to intake manifold or air box.

Data Length:	1 byte
Resolution:	2 kPa/bit gain, 0 kPa offset
Data Range:	0 to +500 kPa (0 to 72.5 psi)
Type:	Measured
Suspect Parameter Number:	106
Reference:	5.3.36

5.2.5.38 Coolant Pressure—Gage pressure of liquid found in engine cooling system.

Data Length:	1 byte
Resolution:	2 kPa/bit gain, 0 kPa offset
Data Range:	0 to +500 kPa (0 to 72.5 psi)
Type:	Measured
Suspect Parameter Number:	109
Reference:	5.3.29

5.2.5.39 Transmission Filter Differential Pressure—Change in transmission fluid pressure, measured after the filter, due to accumulation of solid or semisolid material on or in the filter.

Data Length:	1 byte
Resolution:	2 kPa/bit gain, 0 kPa offset
Data Range:	0 to +500 kPa (0 to 72.5 psi)
Type:	Measured
Suspect Parameter Number:	126
Reference:	5.3.38

5.2.5.40 Crankcase Pressure—Gage pressure inside engine crankcase.

Data Length:	2 bytes
Resolution:	7.8125×10^{-3} kPa/bit gain (1/128 kPa/bit), –250 kPa offset
Data Range:	–250 to +251.99 kPa (–36.259 to +36.548 lbf/in^2)
Type:	Measured
Suspect Parameter Number:	101
Reference:	5.3.29

5.2.5.41 Particulate Trap Inlet Pressure—Exhaust back pressure as a result of particle accumulation on filter media placed in the exhaust stream.

Data Length:	1 byte
Resolution:	0.5 kPa/bit gain, 0 kPa offset
Data Range:	0 to +125 kPa (0 to +18.1 psi)
Type:	Measured
Suspect Parameter Number:	81
Reference:	5.3.36

5.2.5.42 Engine Oil Filter Differential Pressure—Change in engine oil pressure, measured across the filter, due to the filter and any accumulation of solid or semisolid material on or in the filter.

Data Length:	1 byte
Resolution:	0.5 kPa/bit gain, 0 kPa offset
Data Range:	0 to +125 kPa (0 to +18.1 psi)
Type:	Measured
Suspect Parameter Number:	99
Reference:	5.3.42

5.2.5.43 Barometric Pressure—Absolute air pressure of the atmosphere. See Figures 15 and 16.

Data Length:	1 byte
Resolution:	0.5 kPa/bit gain, 0 kPa offset
Data Range:	0 to +125 kPa (0 to +18.1 psi)
Type:	Measured
Suspect Parameter Number:	108
Reference:	5.3.35

5.2.5.44 Coolant Filter Differential Pressure—Change in coolant pressure, measured across the filter, due to the filter and any accumulation of solid or semisolid matter on or in the filter.

Data Length:	1 byte
Resolution:	0.5 kPa/bit gain, 0 kPa offset
Data Range:	0 to +125 kPa (0 to +18.1 psi)
Type:	Measured
Suspect Parameter Number:	112
Reference:	5.3.36

5.2.5.45 Air Filter Differential Pressure—Change in engine air system pressure, measured across the filter, due to the filter and any accumulation of solid foreign matter on or in the filter.

Data Length:	1 byte
Resolution:	0.05 kPa/bit gain, 0 kPa offset
Data Range:	0 to +12.5 kPa (0 to +1.8 psi)
Type:	Measured
Suspect Parameter Number:	107
Reference:	5.3.36

5.2.5.46 Maximum Vehicle Speed Limit—Maximum vehicle velocity allowed.

Data Length:	1 byte
Resolution:	1 km/h/bit gain, 0 km/h offset
(R) Data Range:	0 to +250 km/h (0 to +155 mph)
Type:	Measured
Suspect Parameter Number:	74
Reference:	5.3.27

5.2.5.47 Cruise Control Set Speed—Value of set (chosen) velocity of velocity control system.

Data Length:	1 byte
Resolution:	1 km/h/bit gain, 0 km/h offset
(R) Data Range:	0 to +250 km/h (0 to +155 mph)
Type:	Measured
Suspect Parameter Number:	86
Reference:	5.3.31

5.2.5.48 Cruise Control High Set Limit Speed—Maximum vehicle velocity at which cruise can be set.

Data Length:	1 byte
Resolution:	1 km/h/bit gain, 0 km/h offset
(R) Data Range:	0 to +250 km/h (0 to +155 mph)
Type:	Measured
Suspect Parameter Number:	87
Reference:	5.3.27

(R) *5.2.5.49 Cruise Control Low Set Limit Speed*—Minimum vehicle velocity at which cruise can be set or minimum vehicle velocity for cruise operation before it will exit cruise control operation.

Data Length:	1 byte
Resolution:	1 km/h/bit gain, 0 km/h offset
(R) Data Range:	0 to +250 km/h (0 to +155 mph)
Type:	Measured
Suspect Parameter Number:	88
Reference:	5.3.27

5.2.5.50 Trip Distance—Distance traveled during all or part of a journey.

Data Length:	4 bytes
Resolution:	0.125 km/bit gain, 0 km offset
Data Range:	0 to +526 385 151.9 km (0 to +327 080 569.4 mi)
Type:	Measured
Suspect Parameter Number:	244
Reference:	5.3.14

NOTE—See 5.2.5.107 for alternate resolution.

5.2.5.51 Total Vehicle Distance—Accumulated distance traveled by vehicle during its operation.

Data Length:	4 bytes
Resolution:	0.125 km/bit gain, 0 km offset
Data Range:	0 to +526 385 151.9 km (0 to +327 080 569.4 mi)
Type:	Measured
Suspect Parameter Number:	245
Reference:	5.3.14

NOTE—See 5.2.5.106 for alternate resolution.

5.2.5.52 Altitude—Altitude of the vehicle referenced to sea level at standard atmospheric pressure and temperature.

Data Length:	2 bytes
Resolution:	0.125 m/bit gain, –2500 m offset
Data Range:	–2500 to +5531.875 m (–8202.1 to +15 896.193 ft)
Type:	Measured
Suspect Parameter Number:	580
Reference:	5.3.22

5.2.5.53 Turbocharger Speed—Rotational velocity of rotor in the turbocharger.

	Data Length:	2 bytes
	Resolution:	4 rpm/bit gain, 0 rpm offset
	Data Range:	0 to +257 020 rpm
	Type:	Measured
(R)	Suspect Parameter Number:	103 – Turbocharger 1 Speed
(R)		1169 – Turbocharger 2 Speed
(R)		1170 – Turbocharger 3 Speed
(R)		1171 – Turbocharger 4 Speed
(R)	Reference:	5.3.11 – Turbocharger 1 Speed
(R)		5.3.94 – Turbocharger 2 Speed
(R)		5.3.94 – Turbocharger 3 Speed
(R)		5.3.94 – Turbocharger 4 Speed

5.2.5.54 Main Shaft Speed—Rotational velocity of the first intermediate shaft of the transmission.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit gain, 0 rpm offset
Data Range:	0 to +8031.875 rpm
Type:	Measured
Suspect Parameter Number:	160
Reference:	

5.2.5.55 Input Shaft Speed—Rotational velocity of the primary shaft transferring power into the transmission. When a torque converter is present, it is the output of the torque converter.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit gain, 0 rpm offset
Data Range:	0 to +8031.875 rpm
Type:	Measured
Suspect Parameter Number:	161
Reference:	5.3.5

5.2.5.56 Power Takeoff Speed—Rotational velocity of device used to transmit engine power to auxiliary equipment.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit gain, 0 rpm offset
Data Range:	0 to +8031.875 rpm
Type:	Measured
Suspect Parameter Number:	186
Reference:	5.3.30

5.2.5.57 Power Takeoff Set Speed—Rotational velocity selected by operator for device used to transmit engine power to auxiliary equipment.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit gain, 0 rpm offset
Data Range:	0 to +8031.875 rpm
Type:	Measured
Suspect Parameter Number:	187
Reference:	5.3.30

5.2.5.58 Total Engine Revolutions—Accumulated number of revolutions of engine crankshaft during its operation.

Data Length:	4 bytes
Resolution:	1000 r/bit gain, 0 r offset
Data Range:	0 to +4 211 081 215 000 r
Type:	Measured
Suspect Parameter Number:	249
Reference:	5.3.19

5.2.5.59 Total Idle Hours—Accumulated time of operation of the engine while under idle conditions.

Data Length:	4 bytes
Resolution:	0.05 h/bit gain, 0 h offset
Data Range:	0 to +210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	235
Reference:	5.3.10

5.2.5.60 Total Vehicle Hours—Accumulated time of operation of vehicle.

Data Length:	4 bytes
Resolution:	0.05 h/bit gain, 0 h offset
Data Range:	0 to +210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	246
Reference:	5.3.21

5.2.5.61 Total Engine Hours—Accumulated time of operation of engine.

Data Length:	4 bytes
Resolution:	0.05 h/bit gain, 0 h offset
Data Range:	0 to +210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	247
Reference:	5.3.19

5.2.5.62 Total Power Takeoff Hours—Accumulated time of operation of power takeoff device.

Data Length:	4 bytes
Resolution:	0.05 h/bit gain, 0 h offset
Data Range:	0 to +210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	248
Reference:	5.3.21

5.2.5.63 Fuel Rate—Amount of fuel consumed by engine per unit of time.

Data Length:	2 bytes
Resolution:	0.05 L/h per bit gain, 0 L/h offset (13.9 x 10^{-6} L/s per bit)
Data Range:	0 to +3212.75 L/h
Type:	Measured
Suspect Parameter Number:	183
Reference:	5.3.32

5.2.5.64 Trip Fuel—Fuel consumed during all or part of a journey.

Data Length:	4 bytes
Resolution:	0.5 L/bit gain, 0 L offset
(R) Data Range:	0 to +2 105 540 607.5 L
Type:	Measured
Suspect Parameter Number:	182
Reference:	5.3.23

5.2.5.65 Total Idle Fuel Used—Accumulated amount of fuel used during vehicle operation while under idle conditions.

Data Length:	4 bytes
Resolution:	0.5 L/bit gain, 0 L offset
Data Range:	0 to +2 105 540 607.5 L
Type:	Measured
Suspect Parameter Number:	236
Reference:	5.3.10

5.2.5.66 Total Fuel Used—Accumulated amount of fuel used during vehicle operation.

Data Length:	4 bytes
Resolution:	0.5 L/bit gain, 0 L offset
Data Range:	0 to +2 105 540 607.5 L
Type:	Measured
Suspect Parameter Number:	250
Reference:	5.3.23

5.2.5.67 Instantaneous Fuel Economy—Current fuel economy at current vehicle velocity.

Data Length:	2 bytes
Resolution:	1/512 km/L per bit gain, 0 km/L offset
Data Range:	0 to +125.5 km/L
Type:	Measured
Suspect Parameter Number:	184
Reference:	5.3.32

5.2.5.68 Average Fuel Economy—Average of instantaneous fuel economy for that segment of vehicle operation of interest.

Data Length:	2 bytes
Resolution:	1/512 km/L per bit gain, 0 km/L offset
Data Range:	0 to +125.5 km/L
Type:	Measured
Suspect Parameter Number:	185
Reference:	5.3.32

5.2.5.69 Blower Bypass Valve Position—Relative position of the blower bypass valve.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to +100%
Type:	Measured
Suspect Parameter Number:	72
Reference:	5.3.43

5.2.5.70 Washer Fluid Level—Ratio of volume of liquid to total container volume of fluid reservoir in windshield wash system.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to +100%
Type:	Measured
Suspect Parameter Number:	80
Reference:	5.3.42

5.2.5.71 Fuel Level—Ratio of volume of fuel to the total volume of fuel storage container.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to +100%
Type:	Measured
Suspect Parameter Number:	96
Reference:	5.3.42

5.2.5.72 Engine Oil Level—Ratio of current volume of engine sump oil to maximum required volume.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to +100%
Type:	Measured
Suspect Parameter Number:	98
Reference:	5.3.29

5.2.5.73 Coolant Level—Ratio of volume of liquid found in engine cooling system to total cooling system volume.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to +100%
Type:	Measured
Suspect Parameter Number:	111
Reference:	5.3.29

5.2.5.74 Transmission Oil Level—Ratio of volume of transmission sump oil to recommended volume.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to +100%
Type:	Measured
Suspect Parameter Number:	124
Reference:	5.3.38

5.2.5.75 Battery Potential (Voltage), Switched—Electrical potential measured at the input of the electronic control unit supplied through a switching device.

Data Length:	2 bytes
Resolution:	0.05 V/bit gain, 0 V offset
Data Range:	0 to +3212.75 V
Type:	Measured
Suspect Parameter Number:	158
Reference:	5.3.37

5.2.5.76 Alternator Potential (Voltage)—Electrical potential measured at the alternator output.

Data Length:	2 bytes
Resolution:	0.05 V/bit gain, 0 V offset
Data Range:	0 to +3212.75 V
Type:	Measured
Suspect Parameter Number:	167
Reference:	5.3.37

5.2.5.77 Electrical Potential (Voltage)—Measured electrical potential of the battery.

Data Length:	2 bytes
Resolution:	0.05 V/bit gain, 0 V offset
Data Range:	0 to +3212.75 V
Type:	Measured
Suspect Parameter Number:	168
Reference:	5.3.37

5.2.5.78 Net Battery Current—Net flow of electrical current into/out of the battery or batteries.

Data Length:	1 byte
Resolution:	1.0 A/bit gain, –125 A offset
Data Range:	–125 to +125 A
Type:	Measured
Suspect Parameter Number:	114
Reference:	5.3.37

5.2.5.79 Alternator Current—Measure of electrical flow from the alternator.

Data Length:	1 byte
Resolution:	1.0 A/bit gain, 0 A offset
Data Range:	0 to +250 A
Type:	Measured
Suspect Parameter Number:	115
Reference:	5.3.37

(R) *5.2.5.80 Axle Weight*—Total mass imposed by the tires on the road surface at the specified axle.

Data Length:	2 bytes
Resolution:	0.5 kg/bit gain, 0 kg offset
Data Range:	0 to +32 127.5 kg (0 to 70 829 lb)
Type:	Measured
Suspect Parameter Number:	582
Reference:	5.3.24

(R) *5.2.5.81 Trailer Weight*—Total mass of freight-carrying vehicle designed to be pulled by truck, including the weight of the contents.

Data Length:	2 bytes
Resolution:	2.0 kg/bit gain, 0 kg offset
Data Range:	0 to +128 510 kg (0 to 283 316 lb)
Type:	Measured
Suspect Parameter Number:	180
Reference:	5.3.24

(R) *5.2.5.82 Cargo Weight*—The mass of freight carried.

Data Length:	2 bytes
Resolution:	2.0 kg/bit gain, 0 kg offset
Data Range:	0 to +128 510 kg (0 to 283 316 lb)
Type:	Measured
Suspect Parameter Number:	181
Reference:	5.3.24

5.2.5.83 Compass Bearing—Present compass bearing of vehicle.

Data Length:	2 bytes
Resolution:	1/128 degree/bit gain, 0 degree offset
Data Range:	0 to +502 degrees
Type:	Measured
Suspect Parameter Number:	165
Reference:	5.3.22

5.2.5.84 Pitch—Pitch of the vehicle as calculated by the navigation device(s).

Data Length:	2 bytes
Resolution:	1/128 degree/bit gain, –200 degrees offset
(R) Data Range:	–200 degrees (DESCENT) to +301.992 degrees (ASCENT)
Type:	Measured
Suspect Parameter Number:	583
Reference:	5.3.22

5.2.5.85 Latitude—Latitude position of the vehicle.

Data Length:	4 bytes
Resolution:	10^{-7} degree/bit gain, –210 degree offset
Data Range:	–210 degrees (SOUTH) to +211.108 122 degrees (NORTH)
Type:	Measured
Suspect Parameter Number:	584
Reference:	5.3.33

5.2.5.86 Longitude—Longitude position of the vehicle.

Data Length:	4 bytes
Resolution:	10^{-7} degree/bit gain, –210 degree offset
Data Range:	–210 degrees (WEST) to + 211.108 121 degrees (EAST)
Type:	Measured
Suspect Parameter Number:	585
Reference:	5.3.33

5.2.5.87 Vehicle Identification Number—Vehicle Identification Number (VIN) as assigned by the vehicle manufacturer.

Data Length:	variable - up to 200 characters
Resolution:	ASCII
Data Range:	ASCII
Type:	Measured
Suspect Parameter Number:	237
Reference:	5.3.26

NOTE—The ASCII character "*" is reserved as a delimiter.

5.2.5.88 Software Identification—Software identification of an electronic module. As an example, this parameter may be represented with ASCII characters MMDDYYaa where MM is the month, DD is the day, YY is the year, and aa is the revision number.

Data Length:	variable - up to 200 characters
Resolution:	ASCII
Data Range:	ASCII
Type:	Measured
Suspect Parameter Number:	234
Reference:	5.3.47

NOTE—The ASCII character "*" is reserved as a delimiter.

5.2.5.89 Unit Number (Power Unit)—Owner assigned unit number for the power unit of the vehicle.

Data Length:	variable - up to 200 characters
Resolution:	ASCII
Data Range:	ASCII
Type:	Measured
Suspect Parameter Number:	233
Reference:	5.3.25

NOTE—The ASCII character "*" is reserved as a delimiter.

5.2.5.90 Make—Make of the component corresponding to the codes defined in the American Trucking Association Vehicle Maintenance Reporting Standard (ATA/VMRS). It is suggested that spaces (ASCII 32) are used to fill the remaining characters if the ATA/VMRS make code is less than five characters in length.

Data Length:	5 bytes
Resolution:	ASCII
Data Range:	ASCII
Type:	Measured
Suspect Parameter Number:	586
Reference:	5.3.25

NOTE—The ASCII character "*" is reserved as a delimiter.

5.2.5.91 Model—Model of the component.

Data Length:	Variable - up to 200 characters
Resolution:	ASCII
Data Range:	ASCII
Type:	Measured
Suspect Parameter Number:	587
Reference:	5.3.25

NOTE—The ASCII character "*" is reserved as a delimiter.

5.2.5.92 Serial Number—Serial number of the component.

Data Length:	Variable
Resolution:	ASCII
Data Range:	ASCII
Type:	Measured
Suspect Parameter Number:	588
Reference:	5.3.25

NOTE—The ASCII character "*" is reserved as a delimiter.

5.2.5.93 Seconds—Part of a parameter used to represent time.

Data Length:	1 byte
Resolution:	0.25 s/bit gain, 0 s offset
Operating Range:	0 to 59.75 s
Type:	Measured
Suspect Parameter Number:	959
Reference:	5.3.20

5.2.5.94 Minutes—Part of a parameter used to represent time.

Data Length:	1 byte
Resolution:	1 min/bit gain, 0 min offset
Operating Range:	0 to 59 min
Type:	Measured
Suspect Parameter Number:	960
Reference:	5.3.20

5.2.5.95 Location—To identify to which of several similar devices (such as tires or fuel tanks) the information applies.

Data Length:	1 byte
Resolution:	Bit-mapped
Data Range:	N/A
Type:	Measured
(R) Suspect Parameter Number:	927 (used in PGN 61,446, reference 5.3.9) 928 (Axle location, used in PGN 65,258, reference 5.3.24) 929 (used in PGN 65,268, reference 5.3.34) 930 (Drive axle location, used in PGN 65,273, reference 5.3.39)

The low order 4 bits represent a position number, counting left to right when facing in the direction of normal vehicle travel (forward).

The high order 4 bits represent a position number, counting front to back on the vehicle.

The value FF_{16} indicates not available.

It is recommended that output devices add 1 to the position number (range 1 to 15, not 0 to 14) for use by drivers and service technicians.

Examples: Tire pressure for location 00_{16} would be left front tire.

Tire pressure for location 23_{16} would be right outside rear rear on a 3-axle tractor with dual axle per side (3rd axle, 4th tire).

5.2.5.96 Throttle Position—The position of the valve used to regulate the supply of a fluid, usually air or fuel/air mixture, to an engine. 0% represents no supply and 100% is full supply.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to 100%
Type:	Measured
Suspect Parameter Number:	51
(R) Reference:	5.3.32

5.2.5.97 Alternator Speed—Actual rotation speed of the alternator.

Data Length:	2 bytes
Resolution:	0.5 rpm gain, 0 rpm offset
Data Range:	0 to 32 127.5 rpm
Type:	Measured
Suspect Parameter Number:	589
Reference:	5.3.49

5.2.5.98 Shift Finger Rail Position—The current position of the shift finger in the rail direction.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to +100%
Type:	Measured
Suspect Parameter Number:	60
Reference:	5.3.50

5.2.5.99 Shift Finger Gear Position—The current position of the shift finger in the gear direction.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to +100%
Type:	Measured
Suspect Parameter Number:	59
Reference:	5.3.50

5.2.5.100 Transmission Synchronizer Clutch Value—The current modulated value for the air supply to the synchronizer clutch.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to +100%
Type:	Measured
Suspect Parameter Number:	53
Reference:	5.3.51

5.2.5.101 Transmission Synchronizer Brake Value—The current modulated value for the air supply to the synchronizer brake.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to +100%
Type:	Measured
Suspect Parameter Number:	54
Reference:	5.3.51

5.2.5.102 Service Component Identification—Identification of component needing service. See Table 15.

	Data Length:	1 byte
(R)	Resolution:	1 Component ID/bit
	Data Range:	0 to 250
	Type:	Measured
(R)	Suspect Parameter Number:	911 (Used in PGN 65,216, reference 5.3.55, byte 1) 912 (Used in PGN 65,216, reference 5.3.55, byte 4) 913 (Used in PGN 65,216, reference 5.3.55, byte 6) 1379 (Used in PGN 65,166, reference 5.3.109) 1584 (Used in PGN 56,832, reference 5.3.74)

5.2.5.103 Service Distance—The distance which can be traveled by the vehicle before the next service inspection is required. A negative distance is transmitted if the service inspection has been passed. The component that requires service is identified by the service component identification (see 5.2.5.102).

Data Length:	2 bytes
Resolution:	5 km/bit gain, –160 635 km offset (3.1 mi/bit gain, 99 593.7 mi offset)
Data Range:	–160 635 to +160 640 km (–99 593.7 to +99 596.8 mi)
Type:	Measured
Suspect Parameter Number:	914
Reference:	5.3.55

5.2.5.104 Service Delay/Calendar Time Based—The time in weeks until the next vehicle service inspection is required. A negative value is transmitted if the service inspection has been passed. The component that requires service is identified by the service component identification (see 5.2.5.102).

Data Length:	1 byte
Resolution:	1 week/bit gain, –125 weeks offset
Data Range:	–125 to +125 weeks
Type:	Measured
Suspect Parameter Number:	915
Reference:	5.3.55

TABLE 15—SERVICE COMPONENT IDENTIFICATION

	Identification	Component
	0	Service check for entire vehicle
	1	Brake lining; left front axle
	2	Brake lining; right front axle
	3	Brake lining; left rear axle
	4	Brake lining; right rear axle
	5	Clutch lining
	6-15	Not defined
	16	Regulated general check for entire vehicle
	17	Brake system special check
	18	In-between check
	19	Check trip recorder
	20	Check exhaust gas
	21	Check vehicle speed limiter
(R)	22-29	Not defined
(R)	30	Engine coolant change
(R)	31	Engine coolant filter change
	32	Engine oil—engine #1
	33	Engine oil—engine #2
	34	Not defined
	35	Steering oil
	36	Not defined
	37	Transmission oil—transmission #1
	38	Transmission oil—transmission #2
	39	Not defined
	40	Intermediate transmission oil
	41	Not defined
	42	Front axle oil
	43	Rear axle oil
	44-47	Not defined
	48	Tires
	49	Engine air filter
	50	Engine oil filter
(R)	51-60	Not defined
(R)	61	Tachograph
(R)	62	Driver card #1
(R)	63	Driver card #2
(R)	64-239	Not defined
	240-249	Manufacturer specific
(R)	250-251	Reserved
(R)	252	Reset all components
(R)	253	No action to be taken
	254	Error
	255	Component identification not available

(R) *5.2.5.105 Service Delay/Operational Time Based*—The time in vehicle operational time until the next vehicle service inspection is required. A negative value is transmitted if the service inspection has been passed. The component that requires service is identified by the service component identification (see 5.2.5.102).

Data Length:	2 bytes
Resolution:	1 h/bit gain, –32 127 h offset
Data Range:	–32 127 to 32 128 h
Type:	Measured
Suspect Parameter Number:	916
Reference:	5.3.55

(R) *5.2.5.106 High Resolution Total Vehicle Distance*—Accumulated distance traveled by the vehicle during its operation.

Data Length:	4 bytes
Resolution:	5 m/bit gain, 0 m offset (16.4 ft/bit gain, 0 ft offset)
Data Range:	0 to +21 055 406 km (0 to 13 054 351.8 mi)
Type:	Measured
Suspect Parameter Number:	917
Reference:	5.3.54

NOTE—See 5.2.5.51 for alternate resolution.

5.2.5.107 High Resolution Trip Distance—Distance traveled during all or part of a journey.

Data Length:	4 bytes
Resolution:	5 m/bit gain, 0 m offset (16.4 ft/bit gain, 0 ft offset)
Data Range:	0 to +21 055 406 km (0 to 13 054 351.8 mi)
Type:	Measured
Suspect Parameter Number:	918
Reference:	5.3.54

NOTE—See 5.2.5.50 for alternate resolution.

(R) *5.2.5.108 Transmission Requested Range*—Range selected by the operator. Characters may include P, Rx, Rx-1...R2, R1, R, Nx, Nx-1...N2, N1, N, D, D1, D2..., Dx, L, L1, L2..., Lx-1, 1, 2, 3,... If only one displayed character is required, the second character shall be used and the first character shall be a space (ASCII 32) or a control character (ASCII 0 to 31). If the first character is a control character, refer to the manufacturer's application document for definition.

Data Length:	2 bytes
Resolution:	ASCII
Data Range:	0 to 250 (each byte)
Type:	Status
Suspect Parameter Number:	162
Reference:	5.3.8

(R) *5.2.5.109 Transmission Current Range*—Range currently being commanded by the transmission control system. Characters may include P, Rx, Rx-1...R2, R1, R, Nx, Nx-1...N2, N1, N, D, D1, D2..., Dx, L, L1, L2..., Lx-1, 1, 2, 3,... If only one displayed character is required, the second character shall be used and the first character shall be a space (ASCII 32) or a control character (ASCII 0 to 31). If the first character is a control character, refer to the manufacturer's application document for definition.

Data Length:	2 bytes
Resolution:	ASCII
Data Range:	0 to 250 (each byte)
Type:	Status
Suspect Parameter Number:	163
Reference:	5.3.8

5.2.5.110 Hours—Part of a parameter used to represent time.

Data Length:	1 byte
Resolution:	1 h/bit gain, 0 h offset
Operating Range:	0 to 23 h
Type:	Measured
Suspect Parameter Number:	961
Reference:	5.3.20

5.2.5.111 Day—Part of a parameter used to represent a calendar date.

Data Length:	1 byte
Resolution:	0.25 day/bit gain, 0 day offset
Operating Range:	0.25 to 31.75 day
Type:	Measured
Suspect Parameter Number:	962
Reference:	5.3.20

NOTE—A value of 0 for the date is null. The values 1, 2, 3, and 4 are used to identify the first day of the month; 5, 6, 7, and 8 identify the second day of the month; etc.

5.2.5.112 Month—Part of a parameter used to represent a calendar date.

Data Length:	1 byte
Resolution:	1 month/bit gain, 0 month offset
Operating Range:	1 to 12 month
Type:	Measured
Suspect Parameter Number:	963
Reference:	5.3.20

NOTE—A value of 0 for the month is null. The value 1 identifies January; 2 identifies February; etc.

5.2.5.113 Year—Part of a parameter used to represent a calendar date.

Data Length:	1 byte
Resolution:	1 year/bit gain, +1985 year offset
Operating Range:	1985 to 2235 year
Type:	Measured
Suspect Parameter Number:	964
Reference:	5.3.20

NOTE—A value of 0 for the year identifies the year 1985; a value of 1 identifies 1986; etc.

5.2.5.114 Number of Software Identification Fields—Number of software identification designators represented in the software identification parameter group.

Data Length:	1 byte
Resolution:	1 software identifier/bit, 0 offset
Operating Range:	0 to 125
Type:	Measured
Suspect Parameter Number:	965
Reference:	5.3.47

5.2.5.115 Rated Engine Power—Net brake power that the engine will deliver continuously, specified for a given application at a rated speed.

(R) Data Length:	2 bytes
Resolution:	0.5 kW/bit, 0 kW offset (0.67 hp/bit, 0 hp offset)
Range:	0 to 32 127.5 kW (0 to 43 083.7 hp)
Type:	Measured
Suspect Parameter Number:	166
Reference:	5.3.57

5.2.5.116 Rated Engine Speed—The maximum governed rotational velocity of the engine crankshaft under full load conditions. Note that the engine speed at point 2 (5.2.1.27) is equal to rated engine speed only in the case when the engine has not been derated. See also 5.2.4.1.

(R) Data Length:	2 bytes
Resolution:	0.125 rpm/bit, 0 offset
Range:	0 to 8031.875 rpm
Type:	Measured
Suspect Parameter Number:	189
Reference:	5.3.57

(R) *5.2.5.117 Total Compression Brake Distance*—Total distance over which the compression brakes have been active for the life of the engine.

Data Length:	4 bytes
Resolution:	0.125 km/bit, 0 km offset
Data Range:	0 to 526 385 151.9 km
Type:	Measured
Suspect Parameter Number:	990
Reference:	5.3.60

(R) *5.2.5.118 Trip Compression Brake Distance*—Total distance over which the compression brakes have been active since the last trip reset.

Data Length:	4 bytes
Resolution:	0.125 km/bit, 0 km offset
Data Range:	0 to 526 385 151.9 km
Type:	Measured
Suspect Parameter Number:	991
Reference:	5.3.60

(R) *5.2.5.119 Trip Service Brake Distance*—Total distance over which the service brakes have been active since the last trip reset.

Data Length:	4 bytes
Resolution:	0.125 km/bit, 0 km offset
Data Range:	0 to 526 385 151.9 km
Type:	Measured
Suspect Parameter Number:	992
Reference:	5.3.60

(R) *5.2.5.120 Trip Service Brake Applications*—Total number of times the service brakes have been activated since the last trip reset. Brake applications of less than 0.5 s are not counted and lengthy brake applications (longer than 0.5 s) are counted as a single event.

Data Length:	4 bytes
Resolution:	1 brake application/bit, 0 offset
Data Range:	0 to 4 227 858 431 brake applications
Type:	Measured
Suspect Parameter Number:	993
Reference:	5.3.60

NOTE—Definition and resolution shall stay the same if brakes are applied by only the tractor, only the trailer or both.

(R) *5.2.5.121 Trip Fan On Time*—Total time the fan has been on (due to an automatic trigger or manual trigger) since the last trip reset. The fan could be requested to be on by the engine system, a manual switch, and/or the A/C system. Whichever system requests the fan activation first shall have the time accumulated against it. The sum total of these three values shall equal the trip fan on time.

Data Length:	4 bytes
Resolution:	0.05 h/bit, 0 h offset
Data Range:	0 to 210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	994
Reference:	5.3.61

NOTE—If the fan has been requested to be on by a component that is not one of the defined categories, this time shall be accumulated in the Engine System category by default.

(R) *5.2.5.122 Trip Fan On Time Due to the Engine System*—Total time the fan has been on due to engine triggers (i.e., excluding time on due to an operator manual switch or A/C system) since the last trip reset. For the time to be accumulated against the engine system, it is necessary that it be the first to request the fan activation or it be the only system requesting fan activation.

Data Length:	4 bytes
Resolution:	0.05 h/bit, 0 h offset
Data Range:	0 to 210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	995
Reference:	5.3.61

(R) *5.2.5.123 Trip Fan On Time Due to a Manual Switch*—Total time the fan has been on due to manual activation by the operator (i.e., excluding time on due to automatic triggers) since the last trip reset. For the time to be accumulated against the manual switch, it is necessary that it be the first to request the fan activation or it be the only system requesting fan activation.

Data Length:	4 bytes
Resolution:	0.05 h/bit, 0 h offset
Data Range:	0 to 210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	996
Reference:	5.3.61

(R) *5.2.5.124 Trip Fan On Time Due to the A/C System*—Total time the fan has been on due to the A/C system since the last trip reset. For the time to be accumulated against the A/C system, it is necessary that it be the first to request the fan activation or it be the only system requesting fan activation.

Data Length:	4 bytes
Resolution:	0.05 h/bit, 0 h offset
Data Range:	0 to 210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	997
Reference:	5.3.61

(R) *5.2.5.125 Trip Distance on Road Speed Governing*—Total distance accumulated while the engine torque mode is road speed governing since the last trip reset.

Data Length:	4 bytes
Resolution:	0.125 km/bit, 0 km offset
Data Range:	0 km to +526 385 151.9 km (0 mi to +327 080 569.4 mi)
Type:	Measured
Suspect Parameter Number:	998
Reference:	5.3.62

(R) *5.2.5.126 Trip Gear Down Distance*—Total distance accumulated while the vehicle has operated in the gear which is one gear down from top gear and exceeds a calibrated minimum time (typically the time to shift the transmission) since the last trip reset.

Data Length:	4 bytes
Resolution:	0.125 km/bit, 0 km offset
Data Range:	0 km to +526 385 151.9 km (0 mi to +327 080 569.4 mi)
Type:	Measured
Suspect Parameter Number:	999
Reference:	5.3.62

(R) *5.2.5.127 Trip Distance in Top Gear*—Total distance accumulated while the vehicle has operated in top gear for a calibrated minimum time since the last trip reset.

Data Length:	4 bytes
Resolution:	0.125 km/bit, 0 km offset
Data Range:	0 km to +526 385 151.9 km (0 mi to +327 080 569.4 mi)
Type:	Measured
Suspect Parameter Number:	1000
Reference:	5.3.62

(R) *5.2.5.128 Trip Drive Fuel Used*—Total fuel consumed while the engine speed is greater than zero, vehicle speed is greater than or equal to 2 km/h, and neither the PTO or the remote PTO is controlling the engine power output, since the last trip reset.

Data Length:	4 bytes
Resolution:	0.5 L/bit gain, 0 L offset
Data Range:	0 L to +2 105 540 607.5 L
Type:	Measured
Suspect Parameter Number:	1001
Reference:	5.3.63

NOTE—This parameter is intended for liquid fueled engines. See 5.2.5.134 for alternate resolution.

(R) *5.2.5.129 Trip PTO Moving Fuel Used*—Total fuel consumed while the PTO or remote PTO is in the hold state, the engine speed is greater than zero, and vehicle speed is greater than or equal to 2 km/h, since the last trip reset.

Data Length:	4 bytes
Resolution:	0.5 L/bit gain, 0 L offset
Data Range:	0 L to +2 105 540 607.5 L
Type:	Measured
Suspect Parameter Number:	1002
Reference:	5.3.63

NOTE—This parameter is intended for liquid fueled engines. See 5.2.5.135 for alternate resolution.

(R) *5.2.5.130 Trip PTO Non-moving Fuel Used*—Total fuel consumed while the PTO or remote PTO is in the hold state, the engine speed is greater than zero, and vehicle speed is less than 2 km/h, since the last trip reset.

Data Length:	4 bytes
Resolution:	0.5 L/bit gain, 0 L offset
Data Range:	0 L to +2 105 540 607.5 L
Type:	Measured
Suspect Parameter Number:	1003
Reference:	5.3.63

NOTE—This parameter is intended for liquid fueled engines. See 5.2.5.136 for alternate resolution.

(R) *5.2.5.131 Trip Vehicle Idle Fuel Used*—Total fuel consumed while neither the PTO or remote PTO is in the hold state, the engine speed is greater than zero, and vehicle speed is less than 2 km/h, since the last trip reset.

Data Length:	4 bytes
Resolution:	0.5 L/bit gain, 0 L offset
Data Range:	0 L to +2 105 540 607.5 L
Type:	Measured
Suspect Parameter Number:	1004
Reference:	5.3.63

NOTE—This parameter is intended for liquid fueled engines. See 5.2.5.137 for alternate resolution.

(R) *5.2.5.132 Trip Cruise Fuel Used*—Total fuel consumed while the engine is in the cruise hold state since the last trip reset. If both cruise control and VSL (vehicle speed limiter) are commanding the same amount of fuel, the cruise control is deemed the active torque mode and fuel will be accumulated in "trip cruise fuel used" parameter. If fuel commanded due to the accelerator pedal position is larger than fuel commanded by cruise control (e.g., accelerator override torque mode), the cruise control is not deemed the active torque mode and fuel will not be accumulated in the "trip cruise fuel used" parameter.

Data Length:	4 bytes
Resolution:	0.5 L/bit gain, 0 L offset
Data Range:	0 L to +2 105 540 607.5 L
Type:	Measured
Suspect Parameter Number:	1005
Reference:	5.3.63

NOTE—This parameter is intended for liquid fueled engines. See 5.2.5.138 for alternate resolution.

(R) *5.2.5.133 Trip Drive Fuel Economy*—Trip drive fuel economy is equal to the distance traveled by vehicle in the drive state (engine speed greater than zero, vehicle speed greater than or equal to 2 km/h, and neither the PTO or remote PTO is controlling engine power output) divided by trip drive fuel used (5.2.5.128), since the last trip reset.

Data Length:	2 bytes
Resolution:	1/512 km/L per bit gain, 0 L offset
Data Range:	0 km/L to +125.5 km/L
Type:	Measured
Suspect Parameter Number:	1006
Reference:	5.3.63

NOTE—This parameter is intended for liquid fueled engines. See 5.2.5.139 for alternate resolution.

(R) *5.2.5.134 Trip Drive Fuel Used (Gaseous)*—Total fuel consumed while the engine speed is greater than zero, vehicle speed is greater than or equal to 2 km/h, and neither the PTO or the remote PTO is controlling the engine power output, since the last trip reset.

Data Length:	4 bytes
Resolution:	0.5 kg/bit gain, 0 kg offset
Data Range:	0 kg to +2 105 540 607.5 kg
Type:	Measured
Suspect Parameter Number:	1007
Reference:	5.3.64

NOTE—This parameter is intended for gaseous fueled engines. See 5.2.5.128 for alternate resolution.

(R) *5.2.5.135 Trip PTO Moving Fuel Used (Gaseous)*—Total fuel consumed while the PTO or remote PTO is in the hold state, the engine speed is greater than zero, and vehicle speed is greater than or equal to 2 km/h, since the last trip reset.

Data Length:	4 bytes
Resolution:	0.5 kg/bit gain, 0 kg offset
Data Range:	0 kg to +2 105 540 607.5 kg
Type:	Measured
Suspect Parameter Number:	1008
Reference:	5.3.64

NOTE—This parameter is intended for gaseous fueled engines. See 5.2.5.129 for alternate resolution.

(R) *5.2.5.136 Trip PTO Non-moving Fuel Used (Gaseous)*—Total fuel consumed while the PTO or remote PTO is in the hold state, the engine speed is greater than zero, and vehicle speed is less than to 2 km/h, since the last trip reset.

Data Length:	4 bytes
Resolution:	0.5 kg/bit gain, 0 kg offset
Data Range:	0 kg to +2 105 540 607.5 kg
Type:	Measured
Suspect Parameter Number:	1009
Reference:	5.3.64

NOTE—This parameter is intended for gaseous fueled engines. See 5.2.5.130 for alternate resolution.

(R) *5.2.5.137 Trip Vehicle Idle Fuel Used (Gaseous)*—Total fuel consumed while neither the PTO or remote PTO is active, the engine speed is greater than zero, and vehicle speed is less than to 2 km/h, since the last trip reset.

Data Length:	4 bytes
Resolution:	0.5 kg/bit gain, 0 kg offset
Data Range:	0 kg to +2 105 540 607.5 kg
Type:	Measured
Suspect Parameter Number:	1010
Reference:	5.3.64

NOTE—This parameter is intended for gaseous fueled engines. See 5.2.5.131 for alternate resolution. Trip vehicle idle fuel while in fast idle (vehicle speed less than 2 km/h with engine speed greater than 700 rpm) shall be accumulated in the trip vehicle idle fuel category. All other fuel usage scenarios that do not fall directly in the categories defined shall be accumulated in trip drive fuel used.

(R) *5.2.5.138 Trip Cruise Fuel Used (Gaseous)*—Total fuel consumed while the engine is in the cruise hold state since the last trip reset. If both cruise control and VSL (vehicle speed limiter) are commanding the same amount of fuel, the cruise control is deemed the active torque mode and fuel will be accumulated in "trip cruise fuel used" parameter. If fuel commanded due to the accelerator pedal position is larger than fuel commanded by cruise control (e.g., accelerator override torque mode), the cruise control is not deemed the active torque mode and fuel will not be accumulated in the "trip cruise fuel used" parameter.

Data Length:	4 bytes
Resolution:	0.5 kg/bit gain, 0 kg offset
Data Range:	0 kg to +2 105 540 607.5 kg
Type:	Measured
Suspect Parameter Number:	1011
Reference:	5.3.64

NOTE—This parameter is intended for gaseous fueled engines. See 5.2.5.132 for alternate resolution.

(R) *5.2.5.139 Trip Drive Fuel Economy (Gaseous)*—Trip drive fuel economy is equal to the distance traveled by vehicle in the drive state (engine speed greater than zero, vehicle speed greater than or equal to 2 km/h, and neither the PTO or remote PTO is controlling engine power output) divided by trip drive fuel used (5.2.5.134), since the last trip reset.

Data Length:	2 bytes
Resolution:	1/512 km/kg per bit gain, 0 kg offset
Data Range:	0 km/kg to +125.5 km/kg
Type:	Measured
Suspect Parameter Number:	1012
Reference:	5.3.64

NOTE—This parameter is intended for gaseous fueled engines. See 5.2.5.133 for alternate resolution.

(R) *5.2.5.140 Trip Maximum Engine Speed*—Maximum engine speed achieved since the last trip reset.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit gain, 0 rpm offset
Data Range:	0 to 8031.875 rpm
Type:	Measured
Suspect Parameter Number:	1013
Reference:	5.3.65

(R) *5.2.5.141 Trip Average Engine Speed*—Average speed of the engine since the last trip reset.

The equation is as follows:

$$\text{Trip average engine speed} = \frac{\sum_{i=0}^{N} \text{RPM}(i)}{N} \qquad \text{(Eq.2)}$$

where:

RPM is the engine speed at sample i, N is the number of samples of engine speed and is proportional to the current trip elapsed time

Data Length: 2 bytes
Resolution: 0.125 rpm/bit gain, 0 rpm offset
Data Range: 0 to 8031.875 rpm
Type: Measured
Suspect Parameter Number: 1014
Reference: 5.3.65

NOTE—Excludes ignition-on time without the engine speed above zero. Includes idle, PTO (moving and non-moving), and drive operation.

(R) *5.2.5.142 Trip Drive Average Load Factor*—Average engine load factor while engine speed is greater than zero, vehicle speed is greater than or equal to 2 km/h, and both the PTO (moving/non-moving) and remote PTO are not in the hold state, since the last trip reset. Engine operation during cruise control operation is included.

Data Length: 1 byte
Resolution: 0.4%/bit gain, 0% offset
Data Range: 0 to 100%
Type: Measured
Suspect Parameter Number: 1015
Reference: 5.3.65

(R) *5.2.5.143 Total Drive Average Load Factor*—Average engine load factor while engine speed is greater than zero, vehicle speed is greater than or equal to 2 km/h, and both the PTO (moving/non-moving) and remote PTO are not in the hold state, over the life of the engine. Engine operation during cruise control operation is included.

Data Length: 1 byte
Resolution: 0.4%/bit gain, 0% offset
Data Range: 0 to 100%
Type: Measured
Suspect Parameter Number: 1016
Reference: 5.3.65

(R) *5.2.5.144 Total Engine Cruise Time*—Total time that the engine has operated in the cruise hold state, excluding time in accelerator override, over the life of the engine.

Data Length: 4 bytes
Resolution: 0.05 h/bit, 0 h offset
Data Range: 0 to 210 554 060.75 h
Type: Measured
Suspect Parameter Number: 1017
Reference: 5.3.65

(R) *5.2.5.145 Trip Maximum Vehicle Speed*—Maximum vehicle speed achieved while the engine speed is greater than zero and the accelerator pedal position (APS) is at a value greater than 0%, since the last trip reset.

Data Length: 2 bytes
Resolution: 1/256 km/h per bit, 0 km/h offset
Data Range: 0 to 250.996 km/h
Type: Measured
Suspect Parameter Number: 1018
Reference: 5.3.66

(R) *5.2.5.146 Trip Cruise Distance*—Total distance that the engine has operated in the cruise hold state, excluding time in accelerator override, since the last trip reset.

Data Length:	4 bytes
Resolution:	0.125 km/bit, 0 km offset
Data Range:	0 km to +526 385 151.9 km (0 mi to +327 080 569.4 mi)
Type:	Measured
Suspect Parameter Number:	1019
Reference:	5.3.66

(R) *5.2.5.147 Trip Number of Hot Shutdowns*—Total number of hot shutdowns since the last trip reset. A hot shutdown is based on operation at high load or high engine speed or for long operating periods without allowing the engine to cool sufficiently.

Data Length:	2 bytes
Resolution:	1 count/bit, 0 counts offset
Data Range:	0 to 64 255 counts
Type:	Measured
Suspect Parameter Number:	1020
Reference:	5.3.67

(R) *5.2.5.148 Trip Number of Idle Shutdowns*—Total number of times the engine has been shutdown due to idling too long (at normal idle or fast idle) since the last trip reset.

Data Length:	2 bytes
Resolution:	1 count/bit, 0 counts offset
Data Range:	0 to 64 255 counts
Type:	Measured
Suspect Parameter Number:	1021
Reference:	5.3.67

(R) *5.2.5.149 Trip Number of Idle Shutdown Overrides*—Total number of times an operator disables idle shutdown to prevent an engine shutdown, since the last trip reset.

Data Length:	2 bytes
Resolution:	1 count/bit, 0 counts offset
Data Range:	0 to 64 255 counts
Type:	Measured
Suspect Parameter Number:	1022
Reference:	5.3.67

(R) *5.2.5.150 Trip Sudden Decelerations*—Total number of decelerations whenever the vehicle deceleration is more than XYZ km/h/s (where XYZ is a calibratible threshold), since the last trip reset. A lengthy deceleration shall be counted as one sudden deceleration.

Data Length:	2 bytes
Resolution:	1 count/bit, 0 counts offset
Data Range:	0 to 64 255 counts
Type:	Measured
Suspect Parameter Number:	1023
Reference:	5.3.67

(R) *5.2.5.151 Trip Time in VSL*—Total time accumulated when the engine has operated on the vehicle speed limiter (VSL) while not in the cruise hold state, since the last trip reset. The engine torque mode is equal to road speed governor during this operation.

Data Length:	4 bytes
Resolution:	0.05 h/bit, 0 h offset
Data Range:	0 to 210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	1024
Reference:	5.3.68

(R) *5.2.5.152 Trip Time in Top Gear*—Total time accumulated when the vehicle has operated in top gear for a calibrated minimum time, since the last trip reset.

Data Length:	4 bytes
Resolution:	0.05 h/bit, 0 h offset
Data Range:	0 to 210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	1025
Reference:	5.3.68

(R) *5.2.5.153 Trip Time in Gear Down*—Total time accumulated when the vehicle has operated in one gear down from the top gear for a calibrated minimum time, since the last trip reset.

Data Length:	4 bytes
Resolution:	0.05 h/bit, 0 h offset
Data Range:	0 to 210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	1026
Reference:	5.3.68

(R) *5.2.5.154 Trip Time in Derate by Engine*—Total time accumulated when the engine final fueling has been derated due to an engine protection algorithm, since the last reset.

Data Length:	4 bytes
Resolution:	0.05 h/bit, 0 h offset
Data Range:	0 to 210 554 060.75h
Type:	Measured
Suspect Parameter Number:	1027
Reference:	5.3.68

(R) *5.2.5.155 Total Engine PTO Fuel Used*—Total fuel used while the PTO or remote PTO is in the hold state and engine speed is above zero, over the life of the engine.

Data Length:	4 bytes
Resolution:	0.5 L/bit gain, 0 L offset
Data Range:	0 L to +2 105 540 607.5 L
Type:	Measured
Suspect Parameter Number:	1028
Reference:	5.3.69

NOTE—This parameter is intended for liquid fueled engines. See 5.2.5.157 for alternate resolution.

(R) *5.2.5.156 Trip Average Fuel Rate*—Average fuel rate, equal to trip fuel divided by trip time while the engine speed is above zero, since the last trip reset. This includes idle, PTO (both moving and non-moving) and drive operation but excludes ignition-on time while the engine speed is at zero rpm.

Data Length:	2 bytes
Resolution:	0.05 L/h per bit gain, 0 L/h offset
Data Range:	0 L/h to 3212.75 L/h
Type:	Measured
Suspect Parameter Number:	1029
Reference:	5.3.69

NOTE—This parameter is intended for liquid fueled engines. See 5.2.5.158 for alternate resolution.

(R) *5.2.5.157 Total Engine PTO Fuel Used (Gaseous)*—Total fuel used while the PTO or remote PTO is in the hold state and engine speed is above zero, over the life of the engine.

Data Length:	4 bytes
Resolution:	0.5 kg/bit gain, 0 kg offset
Data Range:	0 kg to +2 105 540 607.5 kg
Type:	Measured
Suspect Parameter Number:	1030
Reference:	5.3.70

NOTE—This parameter is intended for gaseous fueled engines. See 5.2.5.155 for alternate resolution.

(R) *5.2.5.158 Trip Average Fuel Rate (Gaseous)*—Average fuel rate, equal to trip fuel divided by trip time while the engine speed is above zero, since the last trip reset. This includes idle, PTO (both moving and non-moving) and drive operation but excludes ignition-on time while the engine speed is at zero rpm.

Data Length:	2 bytes
Resolution:	0.05 kg/h per bit gain, 0 kg/h offset
Data Range:	0 kg/h to 3212.75 kg/h
Type:	Measured
Suspect Parameter Number:	1031
Reference:	5.3.70

NOTE—This parameter is intended for gaseous fueled engines. See 5.2.5.156 for alternate resolution.

(R) *5.2.5.159 Total ECU Distance*—Total distance accumulated over the life of the ECU. When the ECU is replaced this value shall be reset.

Data Length:	4 bytes
Resolution:	0.125 km/bit, 0 km offset
Data Range:	0 km to +526 385 151.9 km (0 mi to +327 080 569.4 mi)
Type:	Measured
Suspect Parameter Number:	1032
Reference:	5.3.71

(R) *5.2.5.160 Total ECU Run Time*—Total time accumulated over the life of the ECU, from ignition switch ON to ignition switch OFF. When the ECU is replaced this value shall be reset.

Data Length:	4 bytes
Resolution:	0.05 h/bit, 0 h offset
Data Range:	0 to 210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	1033
Reference:	5.3.71

(R) *5.2.5.161 Trip Cruise Time*—Total time accumulated while the engine is in the cruise hold state, excluding time in accelerator override, since the last trip reset.

Data Length:	4 bytes
Resolution:	0.05 h/bit, 0 h offset
Data Range:	0 to 210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	1034
Reference:	5.3.72

(R) *5.2.5.162 Trip PTO Time*—Total time accumulated while the engine is in the PTO or remote PTO hold state since the last trip reset.

Data Length:	4 bytes
Resolution:	0.05 h/bit, 0 h offset
Data Range:	0 to 210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	1035
Reference:	5.3.72

(R) *5.2.5.163 Trip Engine Running Time*—Total time accumulated while the engine speed is greater than zero since the last trip reset. Note that time with the ignition switch on but engine speed at zero is not included.

Data Length:	4 bytes
Resolution:	0.05 h/bit, 0 h offset
Data Range:	0 to 210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	1036
Reference:	5.3.72

(R) *5.2.5.164 Trip Idle Time*—Total time accumulated while the engine speed is greater than zero, both the PTO and remote PTO is inactive, and the vehicle speed is less than 2 km/h, since the last trip reset.

Data Length:	4 bytes
Resolution:	0.05 h/bit, 0 h offset
Data Range:	0 to 210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	1037
Reference:	5.3.72

(R) *5.2.5.165 Trip Air Compressor On Time*—Total time that the air compressor is on and compressing air since the last trip reset.

Data Length:	4 bytes
Resolution:	0.05 h/bit, 0 h offset
Data Range:	0 to 210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	1038
Reference:	5.3.72

(R) *5.2.5.166 Trip Fuel (Gaseous)*—Total fuel consumed (trip drive fuel + trip PTO moving fuel + trip PTO non-moving fuel + trip idle fuel) since the last trip reset.

Data Length:	4 bytes
Resolution:	0.5 kg/bit gain, 0 kg offset
Data Range:	0 kg to +2 105 540 607.5 kg
Type:	Measured
Suspect Parameter Number:	1039
Reference:	5.3.73

(R) *5.2.5.167 Total Fuel Used (Gaseous)*—Total fuel consumed (trip drive fuel + trip PTO moving fuel + trip PTO non-moving fuel + trip idle fuel) over the life of the engine.

Data Length:	4 bytes
Resolution:	0.5 kg/bit gain, 0 kg offset
Data Range:	0 kg to +2 105 540 607.5 kg
Type:	Measured
Suspect Parameter Number:	1040
Reference:	5.3.73

(R) *5.2.5.168 Auxiliary I/O Channel*—Auxiliary channel of data (16 bit) read by the ECU. This data is in A/D counts and is manufacturer specific. It may be configured uniquely per application.

Data Length:	2 bytes
Resolution:	1 count/bit, 0 counts offset
Data Range:	0 to 64 255 counts
Type:	Measured
Suspect Parameter Number:	1083 (Channel 1) 1084 (Channel 2)
Reference:	5.3.48

(R) *5.2.5.169 Intended Retarder Percent Torque*—Braking torque of retarder that the retarder is currently trying to achieve. This value takes into account all static limitations, but not the limitations due to the dynamic behavior of the retarder. This value, if unchanged over a certain time, can and will be reached by the actual retarder - percent torque. (See 5.2.1.17 and Figure 17.)

Data Length:	1 byte
Resolution:	1%/bit, 125% offset
Data Range:	–125% to 125%
Operating Range:	–125% to 0%
Type:	Status
Suspect Parameter Number:	1085
Reference:	5.3.3

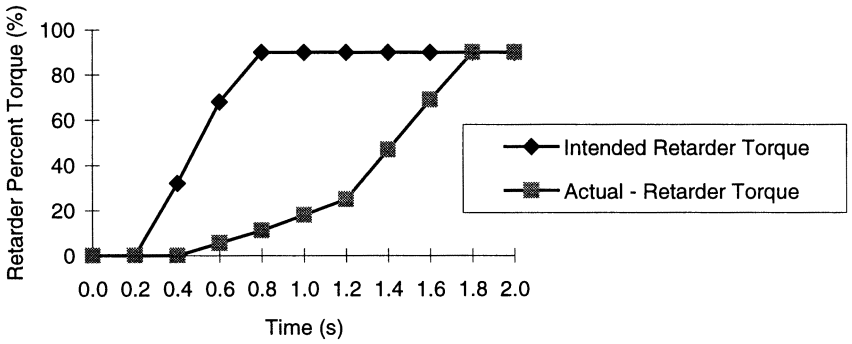


FIGURE 17—INTENDED RETARDER PERCENT TORQUE

(R) *5.2.5.170 Pneumatic Supply Pressure*— The pneumatic pressure in the main reservoir, sometimes referred to as the wet tank.

Data Length:	1 byte
Resolution:	8 kPa/bit gain, 0 kPa offset
Data Range:	0 kPa to +2000 kPa (0 to 290 psi)
Type:	Measured
Suspect Parameter Number:	46
Reference:	5.3.75

(R) *5.2.5.171 Parking and/or Trailer Air Pressure*—The pneumatic pressure in the circuit or reservoir for the parking brake and/or the trailer supply.

Data Length:	1 byte
Resolution:	8 kPa/bit gain, 0 kPa offset
Data Range:	0 kPa to +2000 kPa (0 to 290 psi)
Type:	Measured
Suspect Parameter Number:	1086
Reference:	5.3.75

(R) *5.2.5.172 Service Brake Air Pressure Circuit #1*—The pneumatic pressure in the service brake circuit or reservoir #1.

Data Length:	1 byte
Resolution:	8 kPa/bit gain, 0 kPa offset
Data Range:	0 kPa to +2000 kPa (0 to 290 psi)
Type:	Measured
Suspect Parameter Number:	1087
Reference:	5.3.75

(R) *5.2.5.173 Service Brake Air Pressure Circuit* #2—The pneumatic pressure in the service brake circuit or reservoir #2.

Data Length:	1 byte
Resolution:	8 kPa/bit gain, 0 kPa offset
Data Range:	0 kPa to +2000 kPa (0 to 290 psi)
Type:	Measured
Suspect Parameter Number:	1088
Reference:	5.3.75

(R) *5.2.5.174 Auxiliary Equipment Supply Pressure*—The pneumatic pressure in the auxiliary circuit.

Data Length:	1 byte
Resolution:	8 kPa/bit gain, 0 kPa offset
Data Range:	0 kPa to +2000 kPa (0 to 290 psi)
Type:	Measured
Suspect Parameter Number:	1089
Reference:	5.3.75

(R) *5.2.5.175 Air Suspension Supply Pressure*—The pneumatic pressure in the circuit for the electronically controlled air suspension system.

Data Length:	1 byte
Resolution:	8 kPa/bit gain, 0 kPa offset
Data Range:	0 kPa to +2000 kPa (0 to 290 psi)
Type:	Measured
Suspect Parameter Number:	1090
Reference:	5.3.75

(R) *5.2.5.176 Brake Application Pressure High Range, Front Axle, Left Wheel*—The brake application pressure for the left wheel on the front axle.

Data Length:	1 byte
Resolution:	5 kPa/bit gain, 0 kPa offset
Data Range:	0 kPa to +1250 kPa (0 to 181 psi)
Type:	Measured
Suspect Parameter Number:	1091
Reference:	5.3.76

(R) *5.2.5.177 Brake Application Pressure High Range, Front Axle, Right Wheel*—The brake application pressure for the right wheel on the front axle.

Data Length:	1 byte
Resolution:	5 kPa/bit gain, 0 kPa offset
Data Range:	0 kPa to +1250 kPa (0 to 181 psi)
Type:	Measured
Suspect Parameter Number:	1092
Reference:	5.3.76

(R) *5.2.5.178 Brake Application Pressure High Range, Rear Axle #1, Left Wheel*—The brake application pressure for the left wheel on the rear axle #1.

Data Length:	1 byte
Resolution:	5 kPa/bit gain, 0 kPa offset
Data Range:	0 kPa to +1250 kPa (0 to 181 psi)
Type:	Measured
Suspect Parameter Number:	1093
Reference:	5.3.76

(R) *5.2.5.179 Brake Application Pressure High Range, Rear Axle #1, Right Wheel*—The brake application pressure for the right wheel on the rear axle #1.

Data Length:	1 byte
Resolution:	5 kPa/bit gain, 0 kPa offset
Data Range:	0 kPa to +1250 kPa (0 to 181 psi)
Type:	Measured
Suspect Parameter Number:	1094
Reference:	5.3.76

(R) *5.2.5.180 Brake Application Pressure High Range, Rear Axle #2, Left Wheel*—The brake application pressure for the left wheel on the rear axle #2.

Data Length:	1 byte
Resolution:	5 kPa/bit gain, 0 kPa offset
Data Range:	0 kPa to +1250 kPa (0 to 181 psi)
Type:	Measured
Suspect Parameter Number:	1095
Reference:	5.3.76

(R) *5.2.5.181 Brake Application Pressure High Range, Rear Axle #2, Right Wheel*—The brake application pressure for the right wheel on the rear axle #2.

Data Length:	1 byte
Resolution:	5 kPa/bit gain, 0 kPa offset
Data Range:	0 kPa to +1250 kPa (0 to 181 psi)
Type:	Measured
Suspect Parameter Number:	1096
Reference:	5.3.76

(R) *5.2.5.182 Brake Application Pressure High Range, Rear Axle #3, Left Wheel*—The brake application pressure for the left wheel on the rear axle #3.

Data Length:	1 byte
Resolution:	5 kPa/bit gain, 0 kPa offset
Data Range:	0 kPa to +1250 kPa (0 to 181 psi)
Type:	Measured
Suspect Parameter Number:	1097
Reference:	5.3.76

(R) *5.2.5.183 Brake Application Pressure High Range, Rear Axle #3, Right Wheel*—The brake application pressure for the right wheel on the rear axle #3.

Data Length:	1 byte
Resolution:	5 kPa/bit gain, 0 kPa offset
Data Range:	0 kPa to +1250 kPa (0 to 181 psi)
Type:	Measured
Suspect Parameter Number:	1098
Reference:	5.3.76

(R) *5.2.5.184 Brake Lining Remaining, Front Axle, Left Wheel*—The percentage of brake lining which can still be measured for the left wheel on the front axle. 100% represents new brake linings, 0% represents totally worn brake linings.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0% to 100%
Type:	Measured
Suspect Parameter Number:	1099
Reference:	5.3.77

(R) *5.2.5.185 Brake Lining Remaining, Front Axle, Right Wheel*—The percentage of brake lining which can still be measured for the right wheel on the front axle. 100% represents new brake linings, 0% represents totally worn brake linings.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0% to 100%
Type:	Measured
Suspect Parameter Number:	1100
Reference:	5.3.77

(R) *5.2.5.186 Brake Lining Remaining, Rear Axle #1, Left Wheel*—The percentage of brake lining which can still be measured for the left wheel on the rear axle #1. 100% represents new brake linings, 0% represents totally worn brake linings.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0% to 100%
Type:	Measured
Suspect Parameter Number:	1101
Reference:	5.3.77

(R) *5.2.5.187 Brake Lining Remaining, Rear Axle #1, Right Wheel*—The percentage of brake lining which can still be measured for the right wheel on the rear axle #1. 100% represents new brake linings, 0% represents totally worn brake linings.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0% to 100%
Type:	Measured
Suspect Parameter Number:	1102
Reference:	5.3.77

(R) *5.2.5.188 Brake Lining Remaining, Rear Axle #2, Left Wheel*—The percentage of brake lining which can still be measured for the left wheel on the rear axle #2. 100% represents new brake linings, 0% represents totally worn brake linings.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0% to 100%
Type:	Measured
Suspect Parameter Number:	1103
Reference:	5.3.77

(R) *5.2.5.189 Brake Lining Remaining, Rear Axle #2, Right Wheel*—The percentage of brake lining which can still be measured for the right wheel on the rear axle #2. 100% represents new brake linings, 0% represents totally worn brake linings.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0% to 100%
Type:	Measured
Suspect Parameter Number:	1104
Reference:	5.3.77

(R) *5.2.5.190 Brake Lining Remaining, Rear Axle #3, Left Wheel*—The percentage of brake lining which can still be measured for the left wheel on the rear axle #3. 100% represents new brake linings, 0% represents totally worn brake linings.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0% to 100%
Type:	Measured
Suspect Parameter Number:	1105
Reference:	5.3.77

(R) *5.2.5.191 Brake Lining Remaining, Rear Axle #3, Right Wheel*—The percentage of brake lining which can still be measured for the right wheel on the rear axle #3. 100% represents new brake linings, 0% represents totally worn brake linings.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0% to 100%
Type:	Measured
Suspect Parameter Number:	1106
Reference:	5.3.77

(R) *5.2.5.192 Recommended Gear*—The transmission calculates this gear continuously. In dangerous situations, this gear may be selected to gain back vehicle control.

Data Length:	1 byte
Resolution:	1 gear value/bit, −125 offset
Data Range:	−125 to +125, negative values are reverse gears, positive values are forward gears, zero is neutral
Parameter Specific Indicator:	251 (FB_{16}) is park
Type:	Status
Suspect Parameter Number:	1113
Reference:	5.3.78

(R) *5.2.5.193 Lowest Possible Gear*—The transmission calculates this gear continuously. Together with the highest possible gear (see 5.2.5.194), it enables a management computer to know the exact range of available gears.

Data Length:	1 byte
Resolution:	1 gear value/bit, −125 offset
Data Range:	−125 to +125, negative values are reverse gears, positive values are forward gears, zero is neutral
Parameter Specific Indicator:	251 (FB_{16}) is park
Type:	Status
Suspect Parameter Number:	1114
Reference:	5.3.78

(R) *5.2.5.194 Highest Possible Gear*—The transmission calculates this gear continuously. Together with the lowest possible gear (see 5.2.5.193), it enables a management computer to know the exact range of available gears.

Data Length:	1 byte
Resolution:	1 gear value/bit, −125 offset
Data Range:	−125 to +125, negative values are reverse gears, positive values are forward gears, zero is neutral
Parameter Specific Indicator:	251 (FB_{16}) is park
Type:	Status
Suspect Parameter Number:	1115
Reference:	5.3.78

(R) *5.2.5.195 Gaseous Fuel Correction Factor*—A correction to a predefined gaseous fuel energy (expressed in energy per unit volume) represented as a percentage. The actual fuel energy used to control the engine is the product of the gaseous fuel correction factor and the energy of the gas.

Data Length:	1 byte
Resolution:	1%/bit gain, 0% offset
Data Range:	0% to 250%
Type:	Measured
Suspect Parameter Number:	1116
Reference:	5.3.79

(R) *5.2.5.196 Desired Rated Exhaust Oxygen*—The desired amount of oxygen in the exhaust at rated conditions represented as a percentage by volume with respect to the total volume of exhaust gases leaving the engine.

Data Length:	2 bytes
Resolution:	0.0025%/bit gain, 0% offset
Data Range:	0 to 160.6375%
Type:	Measured
Suspect Parameter Number:	1117
Reference:	5.3.80

(R) *5.2.5.197 Desired Exhaust Oxygen*—The desired amount of oxygen in the exhaust represented as a percentage by volume with respect to the total volume of exhaust gases leaving the engine.

Data Length:	2 bytes
Resolution:	0.0025%/bit gain, 0% offset
Data Range:	0 to 160.6375%
Type:	Measured
Suspect Parameter Number:	1118
Reference:	5.3.80

(R) *5.2.5.198 Actual Exhaust Oxygen*—The actual amount of oxygen in the exhaust represented as a percentage by volume with respect to the total volume of exhaust gases leaving the engine.

Data Length:	2 bytes
Resolution:	0.0025%/bit gain, 0% offset
Data Range:	0 to 160.6375%
Type:	Measured
Suspect Parameter Number:	1119
Reference:	5.3.80

(R) *5.2.5.199 Articulation Angle*—Angle of deflection of an articulated transit vehicle. A right turn is indicated with a positive angle and a left turn is indicated with a negative angle.

Data Length:	1 byte
Resolution:	1 deg/bit, –125 offset
Data Range:	–125 deg to +125 deg
Type:	Measured
Suspect Parameter Number:	1120
Reference:	5.3.81

(R) *5.2.5.200 Alternator Bearing Temperature*—Temperature of the bearing inside the alternator. Bearing 1 is the left or rear bearing. Bearing 2 is the right or front bearing.

Data Length:	1 byte
Resolution:	1 °C/bit gain, –40 °C offset
Data Range:	–40 to +210 °C (–40 to 410 °F)
Type:	Measured
Suspect Parameter Number:	1122 – Alternator Bearing 1 Temperature 1123 – Alternator Bearing 2 Temperature
Reference:	5.3.82

(R) *5.2.5.201 Alternator Winding Temperature*—Temperature of the windings inside the alternator.

Data Length:	1 byte
Resolution:	1 °C/bit gain, –40 °C offset
Data Range:	–40 to +210 °C (–40 to 410 °F)
Type:	Measured
Suspect Parameter Number:	1124 – Alternator Winding 1 Temperature 1125 – Alternator Winding 2 Temperature 1126 – Alternator Winding 3 Temperature
Reference:	5.3.82

(R) *5.2.5.202 Turbocharger Boost Pressure*—Gage pressure of air measured downstream on the compressor discharge side of the turbocharger. See also 5.2.5.36 for alternate range and resolution. If there is only one boost pressure to report and the range and resolution in 5.2.5.36 is adequate, that it should be used.

Data Length:	2 bytes
Resolution:	0.125 kPa/bit gain, 0 kPa offset
Data Range:	0 to +8031.875 kPa (0 to 1164.62 psi)
Type:	Measured
Suspect Parameter Number:	1127 – Turbocharger 1 Boost Pressure 1128 – Turbocharger 2 Boost Pressure 1129 – Turbocharger 3 Boost Pressure 1130 – Turbocharger 4 Boost Pressure
Reference:	5.3.83

(R) *5.2.5.203 Exhaust Gas Port Temperature*—Temperature at the cylinder exhaust port of the engine.

Data Length:	2 bytes
Resolution:	0.03125 °C/bit gain, –273 °C offset
Data Range:	–273 to +1735.0 °C (–459.4 to 3155.0 °F)
Type:	Measured
Suspect Parameter Number:	1137 – Exhaust Gas Port 1 Temperature 1138 – Exhaust Gas Port 2 Temperature 1139 – Exhaust Gas Port 3 Temperature 1140 – Exhaust Gas Port 4 Temperature 1141 – Exhaust Gas Port 5 Temperature 1142 – Exhaust Gas Port 6 Temperature 1143 – Exhaust Gas Port 7 Temperature 1144 – Exhaust Gas Port 8 Temperature 1145 – Exhaust Gas Port 9 Temperature 1146 – Exhaust Gas Port 10 Temperature 1147 – Exhaust Gas Port 11 Temperature 1148 – Exhaust Gas Port 12 Temperature 1149 – Exhaust Gas Port 13 Temperature 1150 – Exhaust Gas Port 14 Temperature 1151 – Exhaust Gas Port 15 Temperature 1152 – Exhaust Gas Port 16 Temperature 1153 – Exhaust Gas Port 17 Temperature 1154 – Exhaust Gas Port 18 Temperature 1155 – Exhaust Gas Port 19 Temperature 1156 – Exhaust Gas Port 20 Temperature
References:	5.3.86, 5.3.87, 5.3.88, 5.3.89, 5.3.90

(R) *5.2.5.204 Main Bearing Temperature*—Temperature of the main bearing which supports the crankshaft of the engine.

Data Length:	2 bytes
Resolution:	0.03125 °C/bit gain, –273 °C offset
Data Range:	–273 to +1735.0 °C (–459.4 to 3155.0 °F)
Type:	Measured
Suspect Parameter Number:	1157 – Main Bearing 1 Temperature 1158 – Main Bearing 2 Temperature 1159 – Main Bearing 3 Temperature 1160 – Main Bearing 4 Temperature 1161 – Main Bearing 5 Temperature 1162 – Main Bearing 6 Temperature 1163 – Main Bearing 7 Temperature 1164 – Main Bearing 8 Temperature 1165 – Main Bearing 9 Temperature 1166 – Main Bearing 10 Temperature 1167 – Main Bearing 11 Temperature
References:	5.3.91, 5.3.92, 5.3.93

(R) *5.2.5.205 Turbocharger Compressor Inlet Temperature*—Temperature of the air entering the compressor side of the turbocharger.

Data Length:	2 bytes
Resolution:	0.03125 °C/bit gain, –273 °C offset
Data Range:	–273 to +1735.0 °C (–459.4 to 3155.0 °F)
Type:	Measured
Suspect Parameter Number:	1172 – Turbocharger 1 Compressor Inlet Temperature 1173 – Turbocharger 2 Compressor Inlet Temperature 1174 – Turbocharger 3 Compressor Inlet Temperature 1175 – Turbocharger 4 Compressor Inlet Temperature
Reference:	5.3.95

(R) *5.2.5.206 Turbocharger Compressor Inlet Pressure*—Gage pressure of the air entering the compressor side of the turbocharger.

Data Length:	2 bytes
Resolution:	7.8125×10^{-3} kPa/bit gain (1/128 kPa/bit), –250 kPa offset
Data Range:	–250 to +251.99 kPa (–36.259 to +36.548 lbf/in^2)
Type:	Measured
Suspect Parameter Number:	1176 – Turbocharger 1 Compressor Inlet Pressure 1177 – Turbocharger 2 Compressor Inlet Pressure 1178 – Turbocharger 3 Compressor Inlet Pressure 1179 – Turbocharger 4 Compressor Inlet Pressure
Reference:	5.3.96

(R) *5.2.5.207 Turbocharger Turbine Inlet Temperature*—Temperature of the combustion by-products entering the turbine side of the turbocharger.

Data Length:	2 bytes
Resolution:	0.03125 °C/bit gain, –273 °C offset
Data Range:	–273 to +1735.0 °C (–459.4 to 3155.0 °F)
Type:	Measured
Suspect Parameter Number:	1180 – Turbocharger 1 Turbine Inlet Temperature
	1181 – Turbocharger 2 Turbine Inlet Temperature
	1182 – Turbocharger 3 Turbine Inlet Temperature
	1183 – Turbocharger 4 Turbine Inlet Temperature
Reference:	5.3.97

(R) *5.2.5.208 Turbocharger Turbine Outlet Temperature*—Temperature of the combustion by-products exiting the turbine side of the turbocharger.

Data Length:	2 bytes
Resolution:	0.03125 °C/bit gain, –273 °C offset
Data Range:	–273 to +1735.0 °C (–459.4 to 3155.0 °F)
Type:	Measured
Suspect Parameter Number:	1184 – Turbocharger 1 Turbine Outlet Temperature
	1185 – Turbocharger 2 Turbine Outlet Temperature
	1186 – Turbocharger 3 Turbine Outlet Temperature
	1187 – Turbocharger 4 Turbine Outlet Temperature
Reference:	5.3.98

(R) *5.2.5.209 Turbocharger Wastegate Drive*—Position of the wastegate drive. A value of 0% represents fully closed and a value of 100% represents fully open.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to +100%
Type:	Measured
Suspect Parameter Number:	1188 – Turbocharger 1 Wastegate Drive
	1189 – Turbocharger 2 Wastegate Drive
	1190 – Turbocharger 3 Wastegate Drive
	1191 – Turbocharger 4 Wastegate Drive
Reference:	5.3.99

(R) *5.2.5.210 Turbocharger Wastegate Actuator Control Air Pressure*—Gage pressure of the air used to control the actuator which opens and closes the wastegate valve.

Data Length:	1 byte
Resolution:	4 kPa/bit gain, 0 kPa offset
Data Range:	0 to 1000 kPa
Type:	Measured
Suspect Parameter Number:	1192
Reference:	5.3.99

(R) *5.2.5.211 Engine Operation Time Since Rebuild*—The time in engine operation since the last engine rebuild.

Data Length:	4 bytes
Resolution:	1 s/bit gain, 0 s offset
Data Range:	0 to 4 294 967 296 sec
Type:	Measured
Suspect Parameter Number:	1193
Reference:	5.3.100

(R) *5.2.5.212 Anti-Theft Random Number*—A 7-byte random numeric code provided by the component in response to an anti-theft request. This parameter is sent as a numeric value utilizing the full range of 0 to $FFFFFFFFFFFFFF_{16}$. The most significant byte is sent first, not following the rules of Table 1.

Data Length:	7 bytes
Resolution:	Binary
Data Range:	0 to 255 (each byte) 0 to $FFFFFFFFFFFFFF_{16}$
Type:	Status
Suspect Parameter Number:	1198
Reference:	5.3.102

(R) *5.2.5.213 Anti-Theft Password Representation*—This parameter is the 7-byte numeric code (i.e., 'encrypted password' or 'key') that is generated based on the encryption algorithm, the password supplied by the end user, and the random number seed given by the component. This parameter is sent as a numeric value utilizing the full range of 0 to $FFFFFFFFFFFFFF_{16}$. The most significant byte is sent first, not following the rules of Table 1.

Data Length:	7 bytes
Resolution:	Binary
Data Range:	0 to 255 (each byte) 0 to $FFFFFFFFFFFFFF_{16}$
Type:	Status
Suspect Parameter Number:	1202
Reference:	5.3.101

(R) *5.2.5.214 Engine Auxiliary Coolant Pressure*—Gage pressure of coolant found in the intercooler which is located after the turbocharger.

Data Length:	1 byte
Resolution:	4 kPa/bit gain, 0 kPa offset
Data Range:	0 to +1000 kPa (0 to 145 psi)
Type:	Measured
Suspect Parameter Number:	1203
Reference:	5.3.103

(R) *5.2.5.215 Electrical Load*—Electrical power delivered by the engine to the electrical system connected to the generator.

Data Length:	2 bytes
Resolution:	0.5 kW/bit, 0 kW offset
Data Range:	0 to 32127.5 kW
Type:	Measured
Suspect Parameter Number:	1204
Reference:	5.3.104

(R) *5.2.5.216 Engine ECU Temperature*—Temperature of the engine electronic control unit.

Data Length:	2 bytes
Resolution:	0.03125 °C/bit gain, –273 °C offset
Data Range:	–273 to +273 °C (–459 to 523 °F)
Type:	Measured
Suspect Parameter Number:	1136 (21, 1207 are not to be used - obsolete)
Reference:	5.3.85

(R) *5.2.5.217 Pre-filter Oil Pressure*—Gage pressure of the engine oil before the oil reaches the oil filter.

Data Length:	1 byte
Resolution:	4 kPa/bit gain, 0 kPa offset
Data Range:	0 to +1000 kPa (0 to 145 psi)
Type:	Measured
Suspect Parameter Number:	1208
Reference:	5.3.105

(R) *5.2.5.218 Exhaust Gas Pressure*—Gage pressure of the exhaust gasses as measured at the turbine inlet of the turbocharger.

Data Length:	2 bytes
Resolution:	7.8125×10^{-3} kPa/bit gain (1/128 kPa/bit), –250 kPa offset
Data Range:	–250 to +251.99 kPa (–36.259 to +36.548 lbf/in^2)
Type:	Measured
Suspect Parameter Number:	1209
Reference:	5.3.105

(R) *5.2.5.219 Rack Position*—Measured position of the engine rack. A value of 0% rack represents no fueling and a value of 100% rack represents maximum fueling.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to +100%
Type:	Measured
Suspect Parameter Number:	1210
Reference:	5.3.105

(R) *5.2.5.220 Engine Auxiliary Coolant Temperature*—Temperature of coolant found in the intercooler which is located after the turbocharger.

Data Length:	1 byte
Resolution:	1 °C/bit gain, –40 °C offset
Data Range:	–40 to +210 °C (–40 to 410 °F)
Type:	Measured
Suspect Parameter Number:	1212
Reference:	5.3.103

(R) *5.2.5.221 Natural Gas Mass Flow*—Mass flow of natural gas to the engine.

Data Length:	2 bytes
Resolution:	0.05 kg/h per bit gain, 0 kg/h offset
Data Range:	0 to 3212.75 kg/h
Type:	Measured
Suspect Parameter Number:	1241
Reference:	5.3.105

(R) *5.2.5.222 Instantaneous Estimated Brake Power*—Estimate of the power developed by the engine.

Data Length:	2 bytes
Resolution:	0.5 kW/bit gain, 0 kW offset
Data Range:	0 to 32127.5 kW
Type:	Measured
Suspect Parameter Number:	1242
Reference:	5.3.105

(R) *5.2.5.223 Number of Torque History Records*—Number of torque history records contained in the engine torque history PGN. A value of 0 is broadcast if no torque history records are stored in the ECU.

Data Length:	1 byte
Resolution:	1 record/bit gain, 0 record offset
Data Range:	0 to 250 records
Type:	Measured
Suspect Parameter Number:	1246
Reference:	5.3.107

(R) *5.2.5.224 Engine Power*—Advertised engine power capability. Advertised power is what a customer will find on a sales sheet for an engine with a certain calibration.

Data Length:	2 bytes
Resolution:	0.5 kW/bit gain, 0 kW offset
Data Range:	0 to 32127.5 kW
Type:	Measured
Suspect Parameter Number:	1247
Reference:	5.3.107

(R) *5.2.5.225 Peak Engine Torque 1*—Maximum torque output of the current ECU calibration when the engine operates on torque curve 1. For calibrations that support two torque curves, this parameter shall be assigned the value of the lower curve. For calibrations that support only one curve, this parameter should be used.

Data Length:	2 bytes
Resolution:	1 Nm/bit gain, 0 Nm offset
Data Range:	0 to 64255 Nm
Type:	Measured
Suspect Parameter Number:	1248
Reference:	5.3.107

(R) *5.2.5.226 Peak Engine Torque 2*—Maximum torque output of the current ECU calibration when the engine operates on torque curve 2. For calibrations that support two torque curves, this parameter shall be assigned the value of the higher curve. For calibrations that support only one curve, this parameter should to set to “not available”.

Data Length:	2 bytes
Resolution:	1 Nm/bit gain, 0 Nm offset
Data Range:	0 to 64255 Nm
Type:	Measured
Suspect Parameter Number:	1249
Reference:	5.3.107

(R) *5.2.5.227 Calibration Record Start Month*—Calendar month timestamp when an ECU record was established.

Data Length:	1 byte
Resolution:	1 month/bit gain, 0 month offset
Operating Range:	1 to 12 month
Type:	Measured
Suspect Parameter Number:	1250
Reference:	5.3.107

NOTE—A value of 0 for the month is null. The value 1 identifies January; 2 identifies February; etc.

(R) *5.2.5.228 Calibration Record Start Day*—Calendar day timestamp when an ECU record was established.

Data Length:	1 byte
Resolution:	0.25 day/bit gain, 0 day offset
Operating Range:	0.25 to 31.75 day
Type:	Measured
Suspect Parameter Number:	1251
Reference:	5.3.107

NOTE—A value of 0 for the date is null. The values 1, 2, 3, and 4 are used to identify the first day of the month; 5, 6, 7, and 8 identify the second day of the month; etc.

(R) *5.2.5.229 Calibration Record Start Year*—Calendar year timestamp when an ECU record was established.

Data Length:	1 byte
Resolution:	1 year/bit gain, +1985 year offset
Operating Range:	1985 to 2235 year
Type:	Measured
Suspect Parameter Number:	1252
Reference:	5.3.107

NOTE—A value of 0 for the year identifies the year 1985; a value of 1 identifies 1986; etc.

(R) *5.2.5.230 Calibration Record Duration Time*—Duration in hours for which the engine operated in the conditions captured in the current record.

Data Length:	4 bytes
Resolution:	0.05 h/bit gain, 0 h offset
Data Range:	0 to 210 554 060.75 h
Type:	Measured
Suspect Parameter Number:	1253
Reference:	5.3.107

(R) *5.2.5.231 Engine Oil Specific Resistance*—Engine oil specific resistance used to describe the engine oil quality.

Data Length:	1 byte
Resolution:	0.1 MΩm/bit gain, 0 MΩm offset
Data Range:	0 to 25.0 MΩm
Type:	Measured
Suspect Parameter Number:	1476
Reference:	

(R) *5.2.5.232 Transmission Gear Ratio 1*—Gear ratio value stored in the ECU that is used to define a range of transmission gears for which a limit is applied to the engine output torque. Transmission gear ratio 1 should be the numerically highest transmission gear ratio breakpoint that defines ratio ranges for torque limits.

Data Length:	2 bytes
Resolution:	0.01 gear ratio/bit gain, 0 gear ratio offset
Data Range:	0 to 642.55
Type:	Measured
Suspect Parameter Number:	1255
Reference:	5.3.107

(R) *5.2.5.233 Engine Torque Limit 1, Transmission*—Limit applied to the engine output torque during vehicle operation in transmission gear ratios numerically greater than transmission gear ratio 1 (see 5.2.5.232).

Data Length:	2 bytes
Resolution:	1 Nm/bit gain, 0 Nm offset
Data Range:	0 to 64255 Nm
Type:	Measured
Suspect Parameter Number:	1256
Reference:	5.3.107

(R) *5.2.5.234 Transmission Gear Ratio 2*—Gear ratio value stored in the ECU that is used to define a range of transmission gears for which a limit is applied to the engine output torque. Transmission gear ratio 2 should be the numerically highest transmission gear ratio breakpoint less than transmission gear ratio 1 (see 5.2.5.232) that defines ratio ranges for torque limits.

Data Length:	2 bytes
Resolution:	0.01 gear ratio/bit, 0 gear ratio offset
Data Range:	0 to 642.55
Type:	Measured
Suspect Parameter Number:	1257
Reference:	5.3.107

(R) *5.2.5.235 Engine Torque Limit 2, Transmission*—Limit applied to the engine output torque during vehicle operation in transmission gear ratios numerically less than or equal to transmission gear ratio 1 (see 5.2.5.232) and numerically greater than transmission gear ratio 2 (see 5.2.5.234). For example, with transmission gear ratio 1 equal to 12.0:1 and transmission gear ratio 2 equal to 5.0:1, vehicle operation in a transmission gear with a ratio of 6.0:1 will result in the application of engine torque limit 2, transmission.

Data Length:	2 bytes
Resolution:	1 Nm/bit gain, 0 Nm offset
Data Range:	0 to 64255 Nm
Type:	Measured
Suspect Parameter Number:	1258
Reference:	5.3.107

(R) *5.2.5.236 Transmission Gear Ratio 3*—Gear ratio value stored in the ECU that is used to define a range of transmission gears for which a limit is applied to the engine output torque. Transmission gear ratio 3 should be the numerically highest transmission gear ratio breakpoint less than transmission gear ratio 2 (see 5.2.5.234) that defines ratio ranges for torque limits.

Data Length:	2 bytes
Resolution:	0.01 gear ratio/bit, 0 gear ratio offset
Data Range:	0 to 642.55
Type:	Measured
Suspect Parameter Number:	1259
Reference:	5.3.107

(R) *5.2.5.237 Engine Torque Limit 3, Transmission*—Limit applied to the engine output torque during vehicle operation in transmission gear ratios numerically less than or equal to transmission gear ratio 2 (see 5.2.5.234) and numerically greater than transmission gear ratio 3 (see 5.2.5.236). For example, with transmission gear ratio 2 equal to 5.0:1 and transmission gear ratio 3 equal to 2.0:1, vehicle operation in a transmission gear with a ratio of 3.0:1 will result in the application of engine torque limit 3, transmission.

Data Length:	2 bytes
Resolution:	1 Nm/bit gain, 0 Nm offset
Data Range:	0 to 64255 Nm
Type:	Measured
Suspect Parameter Number:	1260
Reference:	5.3.107

(R) *5.2.5.238 Engine Torque Limit 4, Transmission*—Limit applied to the engine output torque during vehicle operation in transmission gear ratios numerically less than or equal to transmission gear ratio 3 (see 5.2.5.236).

Data Length:	2 bytes
Resolution:	1 Nm/bit gain, 0 Nm offset
Data Range:	0 to 64255 Nm
Type:	Measured
Suspect Parameter Number:	1261
Reference:	5.3.107

(R) *5.2.5.239 Engine Torque Limit 5, Switch*—Limit applied to the engine output torque based on activation of an ECU switch input.

Data Length:	2 bytes
Resolution:	1 Nm/bit gain, 0 Nm offset
Data Range:	0 to 64255 Nm
Type:	Measured
Suspect Parameter Number:	1262
Reference:	5.3.107

(R) *5.2.5.240 Engine Torque Limit 6, Axle Input*—Limit applied to the engine output torque based on the maximum allowable axle input torque. Axle input torque is calculated as the current engine torque output multiplied by the transmission gear ratio.

Data Length:	2 bytes
Resolution:	2 Nm/bit gain, 0 Nm offset
Data Range:	0 to 128510 Nm
Type:	Measured
Suspect Parameter Number:	1263
Reference:	5.3.107

(R) *5.2.5.241 Extended Crankcase Blow-by Pressure*—Differential crankcase blow-by pressure as measured through a tube with a venturi.

Data Length:	1 byte
Resolution:	0.05 kPa/bit gain, 0 kPa offset
Data Range:	0 to 12.5 kPa
Type:	Measured
Suspect Parameter Number:	22 (1264 not to be used – obsolete)
Reference:	5.3.29

(R) *5.2.5.242 Engine Intercooler Thermostat Opening*—The current position of the thermostat used to regulate the temperature of the engine intercooler. A value of 0% represents the thermostat being completely closed and 100% represents the thermostat being completely open.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0% to 100%
Type:	Measured
Suspect Parameter Number:	1134
Reference:	5.3.28

(R) *5.2.5.243 Injector Timing Rail 1 Pressure*—The gage pressure of fuel in the timing rail delivered from the supply pump to the injector timing inlet. See Figure 15.

Data Length:	2 bytes
Resolution:	1/256 MPa/bit gain, 0 MPa offset
Data Range:	0 to +251 MPa (0 to 36 404 psi)
Type:	Measured
Suspect Parameter Number:	156
Reference:	5.3.46

(R) *5.2.5.244 Injector Metering Rail 2 Pressure*—The gage pressure of fuel in the metering rail #2 as delivered from the supply pump to the injector metering inlet. See Figure 15 for fuel system related parameters. Although the figure does not show rail #2 it does show the relationship of rail pressure to other signals.

Data Length:	2 bytes
Resolution:	1/256 MPa/bit gain, 0 MPa offset
Data Range:	0 to +251 MPa (0 to 36 404 psi)
Type:	Measured
Suspect Parameter Number:	1349
Reference:	5.3.46

(R) *5.2.5.245 Fuel Specific Gravity*—This parameter conveys the specific gravity of the gaseous fuel being used by the engine. The specific gravity of the fuel can then be used to compute the density of the fuel.

Data Length:	2 bytes
Resolution:	0.0001/bit gain, 0.0000 offset
Operational Data Range:	0.0000 to 2.0000
Type:	Status
Suspect Parameter Number:	1389
Reference:	5.3.70

(R) *5.2.5.246 Time Since Last Service*—The vehicle operation time since the last service was performed. The type of service information is identified by the service component identification number.

Data Length:	2 bytes
Resolution:	1 h/bit gain, –32 127 h offset
Data Range:	–32 127 to 32 128 h
Type:	Measured
Suspect Parameter Number:	1350
Reference:	5.3.109

(R) *5.2.5.247 Externally Supplied Air Pressure*—Pressure of the air used to shut off the fuel supply to the engine.

Data Length:	2 bytes
Resolution:	0.5 kPa/bit gain, 0 kPa offset
Data Range:	0 to 32127.5 kPa
Type:	Measured
Suspect Parameter Number:	1320
Reference:	5.3.108

(R) *5.2.5.248 Auxiliary Pressure*—Pressure measured by auxiliary pressure sensor #1 or #2. Not to be used in place of existing SPNs.

Data Length:	1 byte
Resolution:	16 kPa/bit gain, 0 kPa offset
Data Range:	0 to 4000 kPa
Type:	Measured
Suspect Parameter Number:	1387 – Auxiliary Pressure 1 1388 – Auxiliary Pressure 2
Reference:	5.3.111

(R) *5.2.5.249 Auxiliary Temperature*—Temperature measured by auxiliary temperature sensor #1 or #2. Not to be used in place of existing SPNs.

Data Length:	1 byte
Resolution:	1 °C/bit gain, –40 °C offset
Data Range:	–40 to +210 °C (–40 to 410 °F)
Type:	Measured
Suspect Parameter Number:	441 – Auxiliary Temperature 1 442 – Auxiliary Temperature 2
Reference:	5.3.111

(R) *5.2.5.250 Absolute Fuel Valve Inlet Pressure*—The absolute pressure at the inlet of the gaseous fuel valve.

Data Length:	2 bytes
Resolution:	0.1 kPa/bit gain, 0 kPa offset
Data Range:	0 to 6425.5 kPa
Type:	Measured
Suspect Parameter Number:	1390
Reference:	5.3.113

(R) *5.2.5.251 Outlet to Inlet Fuel Valve Differential Pressure*—The differential pressure between the inlet and the outlet of a gaseous fuel valve.

Data Length:	2 bytes
Resolution:	0.1 kPa/bit gain, 0 kPa offset
Data Range:	0 to 6425.5 kPa
Type:	Measured
Suspect Parameter Number:	1391
Reference:	5.3.113

(R) *5.2.5.252 Air to Fuel Differential Pressure*—The differential pressure between the gaseous fuel and the air intake manifold.

Data Length:	2 bytes
Resolution:	0.1 kPa/bit gain, 0 kPa offset
Data Range:	0 to 6425.5 kPa
Type:	Measured
Suspect Parameter Number:	1392
Reference:	5.3.113

(R) *5.2.5.253 Cylinder Ignition Transformer Secondary Output*—This parameter indicates the relative intensity of the secondary output voltage of the ignition transformer.

Data Length:	1 byte
Resolution:	1%/bit gain, –125% offset
Data Range:	–125 to +125%
Type:	Measured
Suspect Parameter Number:	1393 – Cylinder 1 Ignition Transformer Secondary Output 1394 – Cylinder 2 Ignition Transformer Secondary Output 1395 – Cylinder 3 Ignition Transformer Secondary Output 1396 – Cylinder 4 Ignition Transformer Secondary Output 1397 – Cylinder 5 Ignition Transformer Secondary Output 1398 – Cylinder 6 Ignition Transformer Secondary Output 1399 – Cylinder 7 Ignition Transformer Secondary Output 1400 – Cylinder 8 Ignition Transformer Secondary Output 1401 – Cylinder 9 Ignition Transformer Secondary Output 1402 – Cylinder 10 Ignition Transformer Secondary Output 1403 – Cylinder 11 Ignition Transformer Secondary Output 1404 – Cylinder 12 Ignition Transformer Secondary Output 1405 – Cylinder 13 Ignition Transformer Secondary Output 1406 – Cylinder 14 Ignition Transformer Secondary Output 1407 – Cylinder 15 Ignition Transformer Secondary Output 1408 – Cylinder 16 Ignition Transformer Secondary Output 1409 – Cylinder 17 Ignition Transformer Secondary Output 1410 – Cylinder 18 Ignition Transformer Secondary Output 1411 – Cylinder 19 Ignition Transformer Secondary Output 1412 – Cylinder 20 Ignition Transformer Secondary Output
References:	5.3.114, 5.3.115, 5.3.116

(R) *5.2.5.254 Battery 2 Potential*—The voltage for isolated battery #2.

Data Length:	2 bytes
Resolution:	0.05 V/bit gain, 0 V offset
Data Range:	0 to +3212.75 V
Type:	Measured
Suspect Parameter Number:	444
Reference:	5.3.110

(R) *5.2.5.255 Actual Ignition Timing*—The actual ignition timing at the current engine conditions. This parameter may or may not be equal to one of the desired timing parameters (see 5.2.5.256), depending on the status of the engine.

Data Length:	2 bytes
Resolution:	1/128 deg per bit gain, –200 deg offset
Data Range:	–200 to 301.99 deg. 0 deg is TDC (top dead center), negative values are ATDC (after top dead center), positive values are BTDC (before top dead center.)
Type:	Status
Suspect Parameter Number:	1436
Reference:	5.3.122

(R) *5.2.5.256 Desired Ignition Timing*—A programmable timing value specific to the engine's application. Factors affecting this value include both fuel type and the nature of the load being driven.

Data Length:	2 bytes
Resolution:	1/128 deg per bit gain, –200 deg offset
Data Range:	–200 to 301.99 deg. 0 deg is TDC (top dead center), negative values are ATDC (after top dead center), positive values are BTDC (before top dead center.)
Type:	Status
Suspect Parameter Number:	1433 – Desired Ignition Timing 1 1434 – Desired Ignition Timing 2 1435 – Desired Ignition Timing 3
Reference:	5.3.122

(R) *5.2.5.257 Cylinder Ignition Timing*—The ignition timing of the cylinder.

Data Length:	2 bytes
Resolution:	1/128 deg per bit gain, –200 deg offset
Data Range:	–200 to 301.99 deg. 0 deg is TDC (top dead center), negative values are ATDC (after top dead center), positive values are BTDC (before top dead center.)
Type:	Status
Suspect Parameter Number:	1413 – Cylinder 1 Ignition Timing 1414 – Cylinder 2 Ignition Timing 1415 – Cylinder 3 Ignition Timing 1416 – Cylinder 4 Ignition Timing 1417 – Cylinder 5 Ignition Timing 1418 – Cylinder 6 Ignition Timing 1419 – Cylinder 7 Ignition Timing 1420 – Cylinder 8 Ignition Timing 1421 – Cylinder 9 Ignition Timing 1422 – Cylinder 10 Ignition Timing 1423 – Cylinder 11 Ignition Timing 1424 – Cylinder 12 Ignition Timing 1425 – Cylinder 13 Ignition Timing 1426 – Cylinder 14 Ignition Timing 1427 – Cylinder 15 Ignition Timing 1428 – Cylinder 16 Ignition Timing 1429 – Cylinder 17 Ignition Timing 1430 – Cylinder 18 Ignition Timing 1431 – Cylinder 19 Ignition Timing 1432 – Cylinder 20 Ignition Timing
References:	5.3.117, 5.3.118, 5.3.119, 5.3.120, 5.3.121

(R) *5.2.5.258 Desired Combustion Time*—The desired combustion time based upon engine load and speed lookup maps.

Data Length:	2 bytes
Resolution:	0.01 ms/bit gain, 0 ms offset
Data Range:	0 to 642.55 ms
Type:	Measured
Suspect Parameter Number:	1464
Reference:	5.3.129

(R) *5.2.5.259 Average Engine Combustion Time*—The average combustion time of all cylinders of an engine.

Data Length:	2 bytes
Resolution:	0.01 ms/bit gain, 0 ms offset
Data Range:	0 to 642.55 ms
Type:	Measured
Suspect Parameter Number:	1465
Reference:	5.3.129

(R) *5.2.5.260 Cylinder Combustion Time*—The amount of time from when the ignition of the fuel is initiated to when the fuel is completely ignited (i.e., the flame front has propagated across the cylinder).

Data Length:	2 bytes
Resolution:	0.01 ms/bit gain, 0 ms offset
Data Range:	0 to 642.55 ms
Type:	Measured
Suspect Parameter Number:	1444 – Cylinder 1 Combustion Time 1445 – Cylinder 2 Combustion Time 1446 – Cylinder 3 Combustion Time 1447 – Cylinder 4 Combustion Time 1448 – Cylinder 5 Combustion Time 1449 – Cylinder 6 Combustion Time 1450 – Cylinder 7 Combustion Time 1451 – Cylinder 8 Combustion Time 1452 – Cylinder 9 Combustion Time 1453 – Cylinder 10 Combustion Time 1454 – Cylinder 11 Combustion Time 1455 – Cylinder 12 Combustion Time 1456 – Cylinder 13 Combustion Time 1457 – Cylinder 14 Combustion Time 1458 – Cylinder 15 Combustion Time 1459 – Cylinder 16 Combustion Time 1460 – Cylinder 17 Combustion Time 1461 – Cylinder 18 Combustion Time 1462 – Cylinder 19 Combustion Time 1463 – Cylinder 20 Combustion Time
References:	5.3.124, 5.3.125, 5.3.126, 5.3.127, 5.3.128

(R) *5.2.5.261 Fuel Valve Position*—The position of a gaseous fuel valve that is metering the fuel flow to the engine. 0% indicates no fuel flow through valve and 100% means maximum fuel flow through valve.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to +100%
Type:	Measured
Suspect Parameter Number:	1442 – Fuel Valve 1 Position 1443 – Fuel Valve 2 Position
Reference:	5.3.123

(R) *5.2.5.262 Fuel Flow Rate*—The rate at which the fuel is flowing through a fuel valve.

Data Length:	2 bytes
Resolution:	0.1 m^3/h per bit gain, 0 m^3/h offset
Data Range:	0 to 6425.5 m^3/h
Type:	Measured
Suspect Parameter Number:	1440 – Fuel Flow Rate 1 1441 – Fuel Flow Rate 2
Reference:	5.3.123

(R) *5.2.5.263 Trailer, Tag or Push Channel Tire Pressure*—The latest gage pressure reading of the trailer, tag, or push group of tires, as opposed to the pressure in each tire.

Data Length:	2 bytes
Resolution:	0.5 kPa/bit gain, 0 kPa offset
Data Range:	0 to 32 127.5 kPa
Type:	Measured
Suspect Parameter Number:	144
Reference:	5.3.130

(R) *5.2.5.264 Drive Channel Tire Pressure*—The latest gage pressure reading of the drive group of tires, as opposed to the pressure in each tire.

Data Length:	2 bytes
Resolution:	0.5 kPa/bit gain, 0 kPa offset
Data Range:	0 to 32 127.5 kPa
Type:	Measured
Suspect Parameter Number:	145
Reference:	5.3.130

(R) *5.2.5.265 Steer Channel Tire Pressure*—The latest gage pressure reading of the steer group of tires, as opposed to the pressure in each tire.

Data Length:	2 bytes
Resolution:	0.5 kPa/bit gain, 0 kPa offset
Data Range:	0 to 32 127.5 kPa
Type:	Measured
Suspect Parameter Number:	146
Reference:	5.3.130

(R) *5.2.5.266 Trailer, Tag or Push Channel Tire Pressure Target*—The tire pressure control system's target gage pressure for the trailer, tag, or push group of tires.

Data Length:	2 bytes
Resolution:	0.5 kPa/bit gain, 0 kPa offset
Data Range:	0 to 32 127.5 kPa
Type:	Measured
Suspect Parameter Number:	141
Reference:	5.3.131

(R) *5.2.5.267 Drive Channel Tire Pressure Target*—The tire pressure control system's target gage pressure for the drive group of tires.

Data Length:	2 bytes
Resolution:	0.5 kPa/bit gain, 0 kPa offset
Data Range:	0 to 32 127.5 kPa
Type:	Measured
Suspect Parameter Number:	142
Reference:	5.3.131

(R) *5.2.5.268 Steer Channel Tire Pressure Target*—The tire pressure control system's target gage pressure for the steer group of tires.

Data Length:	2 bytes
Resolution:	0.5 kPa/bit gain, 0 kPa offset
Data Range:	0 to 32 127.5 kPa
Type:	Measured
Suspect Parameter Number:	143
Reference:	5.3.131

(R) *5.2.5.269 Tire Pressure Check Interval*—The interval at which the system will check the tire pressures (e.g., 5, 10, 15 min).

Data Length:	1 byte
Resolution:	1 min/bit gain, 0 min offset
Data Range:	0 to 250 min
Type:	Status
Suspect Parameter Number:	39
Reference:	5.3.132

NOTE—A value of 0 indicates continuous (real time) pressure readings.

(R) *5.2.5.270 Auxiliary Vacuum Pressure Reading*—Identifies the current vacuum pressure (relative to atmosphere) that is configured uniquely per application. Not to be used in place of defined parameters.

Data Length:	2 bytes
Resolution:	0.5 kPa/bit gain, 0 kPa offset
Data Range:	0 to 32 127.5 kPa
Type:	Measured
Suspect Parameter Number:	136
Reference:	5.3.133

(R) *5.2.5.271 Auxiliary Gage Pressure Reading*—Identifies the current gage pressure (relative to atmosphere) that is configured uniquely per application. Not to be used in place of defined parameters.

Data Length:	2 bytes
Resolution:	0.5 kPa/bit gain, 0 kPa offset
Data Range:	0 to 32 127.5 kPa
Type:	Measured
Suspect Parameter Number:	137
Reference:	5.3.133

(R) *5.2.5.272 Auxiliary Absolute Pressure Reading*—Identifies the current absolute pressure (relative to 0 pressure) that is configured uniquely per application. Not to be used in place of defined parameters.

Data Length:	2 bytes
Resolution:	0.5 kPa/bit gain, 0 kPa offset
Data Range:	0 to 32 127.5 kPa
Type:	Measured
Suspect Parameter Number:	138
Reference:	5.3.133

(R) *5.2.5.273 Powered Vehicle Weight*—Total mass imposed by the tires of the powered vehicle on the road surface. Does not include the trailer.

Data Length:	2 bytes
Resolution:	10 kg/bit gain, 0 kg offset
Data Range:	0 to 642 550 kg
Type:	Measured
Suspect Parameter Number:	1585
Reference:	5.3.140

(R) *5.2.5.274 Speed of Forward Vehicle*—Absolute velocity of the preceding vehicle situated within 250 m in the same lane and moving in the same direction.

Data Length:	1 byte
Resolution:	1 km/h/bit gain, 0 km/h offset
Data Range:	0 to 250 km/h, FF_{16} is no vehicle
Type:	Measured
Suspect Parameter Number:	1586
Reference:	5.3.141

(R) *5.2.5.275 Distance to Forward Vehicle*—Distance to the preceding vehicle situated within 250 m in the same lane and moving in the same direction.

Data Length:	1 byte
Resolution:	1 m/bit gain, 0 m offset
Data Range:	0 to 250 m, FF_{16} is no vehicle
Type:	Measured
Suspect Parameter Number:	1587
Reference:	5.3.141

(R) *5.2.5.276 Adaptive Cruise Control Set Speed*—Value of the desired (chosen) velocity of the adaptive cruise control system.

Data Length:	1 byte
Resolution:	1 km/h/bit gain, 0 km/h offset
Data Range:	0 to 250 km/h
Operating Range:	0 to 120 km/h
Type:	Status
Suspect Parameter Number:	1588
Reference:	5.3.141

(R) *5.2.5.277 Road Curvature*—Estimated value of the current road curvature for use by the adaptive cruise control system. Positive values are used for left curves. Curvature is the inverse of the radius and is zero for straight roads.

Data Length:	2 bytes
Resolution:	1/128 1/km/bit, -250 1/km/bit offset
Data Range:	–250 to 251.992 1/km
Type:	Status
Suspect Parameter Number:	1591
Reference:	5.3.141

(R) *5.2.5.278 Front Axle, Left Wheel Speed*—High resolution measurement of the speed of the left wheel on the front axle.

Data Length:	2 bytes
Resolution:	1/256 km/h/bit, 0 km/h/bit offset
Data Range:	0 to 250.996 km/h
Type:	Measured
Suspect Parameter Number:	1592
Reference:	5.3.142

(R) *5.2.5.279 Front Axle, Right Wheel Speed*—High resolution measurement of the speed of the right wheel on the front axle.

Data Length:	2 bytes
Resolution:	1/256 km/h/bit, 0 km/h/bit offset
Data Range:	0 to 250.996 km/h
Type:	Measured
Suspect Parameter Number:	1593
Reference:	5.3.142

(R) *5.2.5.280 Rear Axle, Left Wheel Speed*—High resolution measurement of the speed of the left wheel on the rear axle.

Data Length:	2 bytes
Resolution:	1/256 km/h/bit, 0 km/h/bit offset
Data Range:	0 to 250.996 km/h
Type:	Measured
Suspect Parameter Number:	1594
Reference:	5.3.142

(R) *5.2.5.281 Rear Axle, Right Wheel Speed*—High resolution measurement of the speed of the right wheel on the rear axle.

Data Length:	2 bytes
Resolution:	1/256 km/h/bit, 0 km/h/bit offset
Data Range:	0 to 250.996 km/h
Type:	Measured
Suspect Parameter Number:	1595
Reference:	5.3.142

(R) *5.2.5.282 Tachograph Output Shaft Speed*—Calculated speed of the transmission output shaft.

Data Length:	2 bytes
Resolution:	0.125 rpm/bit gain, 0 rpm offset (upper byte resolution = 32 rpm/bit)
Data Range:	0 to 8031.875 rpm
Type:	Measured
Suspect Parameter Number:	1623
Reference:	5.3.143

(R) *5.2.5.283 Tachograph Vehicle Speed*—Speed of the vehicle registered by the tachograph.

Data Length:	2 bytes
Resolution:	1/256 km/h/bit gain, 0 km/h offset (1/412 mph/bit gain, 0 mph offset) upper byte resolution = 1.0 km/h/bit (0.62 mph/bit)
Data Range:	0 to 250.996 km/h (0 to 155.87 mph)
Type:	Measured
Suspect Parameter Number:	1624
Reference:	5.3.143

(R) *5.2.5.284 Engine Oil Level Remote Reservoir*—Ratio of current volume of engine oil in a remote reservoir to the maximum required volume. If a single switch (on/off) is used, 20% and 100% respectively will be used where 100% means no oil needs to be added and 20% means oil needs to be added. If two switches are used, 20%, 50%, and 100% will be used where 20% indicates the oil is critically low, 50% indicates the oil level is low, and 100% means no oil needs to be added. For continuous sensors, the actual measured percent will be used.

Data Length:	1 byte
Resolution:	0.4%/bit gain, 0% offset
Data Range:	0 to 100%
Type:	Measured
Suspect Parameter Number:	1380
Reference:	5.3.112

(R) *5.2.5.285 Fuel Supply Pump Inlet Pressure*—Absolute pressure of fuel at the fuel supply pump inlet. See Figures 15 and 16.

Data Length:	1 byte
Resolution:	2 kPa/bit gain, 0 kPa offset
Data Range:	0 to +500 kPa (0 to 72.5 psi)
Type:	Measured
Suspect Parameter Number:	1381
Reference:	5.3.112

(R) *5.2.5.286 Fuel Filter (Suction Side) Differential Pressure*—Differential pressure measured across the fuel filter located between the fuel tank and the supply pump. See Figures 15 and 16.

Data Length:	1 byte
Resolution:	2 kPa/bit gain, 0 kPa offset
Data Range:	0 to +500 kPa (0 to 72.5 psi)
Type:	Measured
Suspect Parameter Number:	1382
Reference:	5.3.112

(R) *5.2.5.287 Driver Identification*—Used to obtain the driver identity.

Data Length:	Variable
Resolution:	ASCII
Data Range:	ASCII
Type:	Measured
Suspect Parameter Number:	1625 – Driver 1 Identification 1626 – Driver 2 Identification
Reference:	5.3.145

5.2.5.288 Adjust Seconds—Part of the parameter used to set the time.

Data Length:	1 byte
Resolution:	0.25 s/bit gain, 0 s offset
Operating Range:	0 to 59.75 s
Type:	Measured
Suspect Parameter Number:	1603
Reference:	5.3.144

5.2.5.289 Adjust Minutes—Part of the parameter used to set the time.

Data Length:	1 byte
Resolution:	1 min/bit gain, 0 min offset
Operating Range:	0 to 59 min
Type:	Measured
Suspect Parameter Number:	1604
Reference:	5.3.144

5.2.5.290 Adjust Hours—Part of the parameter used to set the time.

Data Length:	1 byte
Resolution:	1 h/bit gain, 0 h offset
Operating Range:	0 to 23 h
Type:	Measured
Suspect Parameter Number:	1605
Reference:	5.3.144

5.2.5.291 Adjust Month—Part of a parameter used to set a calendar date.

Data Length:	1 byte
Resolution:	1 month/bit gain, 0 month offset
Operating Range:	1 to 12 month
Type:	Measured
Suspect Parameter Number:	1606
Reference:	5.3.144

NOTE—A value of 0 for the month is null. The value 1 identifies January; 2 identifies February; etc.

5.2.5.292 Adjust Day—Part of a parameter used to set a calendar date.

Data Length:	1 byte
Resolution:	0.25 day/bit gain, 0 day offset
Operating Range:	0.25 to 31.75 day
Type:	Measured
Suspect Parameter Number:	1607
Reference:	5.3.144

NOTE—A value of 0 for the date is null. The values 1, 2, 3, and 4 are used to identify the first day of the month; 5, 6, 7, and 8 identify the second day of the month; etc.

5.2.5.293 Adjust Year—Part of a parameter used to set a calendar date.

Data Length:	1 byte
Resolution:	1 year/bit gain, +1985 year offset
Operating Range:	1985 to 2235 year
Type:	Measured
Suspect Parameter Number:	1608
Reference:	5.3.144

NOTE—A value of 0 for the year identifies the year 1985; a value of 1 identifies 1986; etc.

(R) *5.2.5.294 Adjust Local Minute Offset*—Used to set the local offset in minutes from a reference time.

Data Length:	1 byte
Resolution:	1 min/bit gain, –125 min offset
Operating Range:	–59 to +59 min
Type:	Measured
Suspect Parameter Number:	1609
Reference:	5.3.144

(R) *5.2.5.295 Adjust Local Hour Offset* —Used to set the local offset in hours from a reference time

Data Length:	1 byte
Resolution:	1 h/bit gain, -125 h offset
Operating Range:	-23 to +23 h
Type:	Measured
Suspect Parameter Number:	1610
Reference:	5.3.144

(R) *5.2.5.296 Local Minute Offset* —Local offset in minutes from a reference time.

Data Length:	1 byte
Resolution:	1 min/bit gain, 0 min offset
Operating Range:	0 to 59 min
Type:	Measured
Suspect Parameter Number:	1601
Reference:	5.3.20

(R) *5.2.5.297 Local Hour Offset*—Local offset in hours from a reference time

Data Length:	1 byte
Resolution:	1 h/bit gain, –125 h offset
Operating Range:	–24 to +23 h
Type:	Measured
Suspect Parameter Number:	1602
Reference:	5.3.20

(R) *5.2.5.298 Source Address of Controlling Device for Engine Control*—The source address of the SAE J1939 device currently controlling the engine. It is used to expand the torque mode parameter (see 5.2.2.1) in cases where control is in response to an ECU that is not listed in Table 7. Its value may be the source address of the ECU transmitting the message (which means that no external SAE J1939 message is providing the active command) or the source address of the SAE J1939 ECU that is currently providing the active command in a TSC1 (see 5.3.1) or similar message. Note that if this parameter value is the same as the source address of the device transmitting it, the control may be due to a message on a non-J1939 data link such as SAE J1922 or a proprietary link.

Data Length:	1 byte
Resolution:	1/bit gain, 0 offset
Data Range:	0 to 253
Type:	Status
Suspect Parameter Number:	1483
Reference:	5.3.7

(R) *5.2.5.299 Source Address of Controlling Device for Brake Control*—The source address of the SAE J1939 device currently controlling the brake system. Its value may be the source address of the ECU transmitting the message (which means that no external SAE J1939 message is providing the active command) or the source address of the SAE J1939 ECU that is currently providing the active command in a TSC1 (see 5.3.1) or similar message. Note that if this parameter value is the same as the source address of the device transmitting it, the control may be due to a message on a non-SAE J1939 data link such as SAE J1922 or a proprietary link.

Data Length:	1 byte
Resolution:	1/bit gain, 0 offset
Data Range:	0 to 253
Type:	Status
Suspect Parameter Number:	1481
Reference:	5.3.4

(R) *5.2.5.300 Source Address of Controlling Device for Retarder Control*—The source address of the SAE J1939 device currently controlling the retarder. It is used to expand the torque mode parameter (see 5.2.2.1) in cases where control is in response to an ECU that is not listed in Table 7. Its value may be the source address of the ECU transmitting the message (which means that no external SAE J1939 message is providing the active command) or the source address of the SAE J1939 ECU that is currently providing the active command in a TSC1 (see 5.3.1) or similar message. Note that if this parameter value is the same as the source address of the device transmitting it, the control may be due to a message on a non-SAE J1939 data link such as SAE J1922 or a proprietary link.

Data Length:	1 byte
Resolution:	1/bit gain, 0 offset
Data Range:	0 to 253
Type:	Status
Suspect Parameter Number:	1480
Reference:	5.3.3

(R) *5.2.5.301 Source Address of Controlling Device for Transmission Control*—The source address of the SAE J1939 device currently controlling the transmission. Its value may be the source address of the ECU transmitting the message (which means that no external SAE J1939 message is providing the active command) or the source address of the SAE J1939 ECU that is currently providing the active command in a TSC1 (see 5.3.1) or similar message. Note that if this parameter value is the same as the source address of the device transmitting it, the control may be due to a message on a non-SAE J1939 data link such as SAE J1922 or a proprietary link.

Data Length:	1 byte
Resolution:	1/bit gain, 0 offset
Data Range:	0 to 253
Type:	Status
Suspect Parameter Number:	1482
Reference:	5.3.5

(R) *5.2.5.302 Engine Oil Kinematic Viscosity*—Engine oil kinematic viscosity used to describe the engine oil quality.

Data Length:	1 byte
Resolution:	1 mm^2/s per bit gain, 0 mm^2/s offset
Data Range:	0 to 250 mm^2/s
Type:	Measured
Suspect Parameter Number:	1477
Reference:	

(R) *5.2.5.303 Engine Oil Relative Dielectricity*—Engine oil relative dielectricity used to describe the engine oil quality.

Data Length:	1 byte
Resolution:	0.1/bit, 0 offset
Data Range:	0 to 25.0
Type:	Measured
Suspect Parameter Number:	1478
Reference:	

(R) *5.2.5.304 Reserved—To be assigned*

(R) *5.2.5.305 Laser Strike Vertical Deviation*—The calculated distance from the laser strike position to the current land leveling system reference point.

Data Length:	2 bytes
Resolution:	0.1 mm/bit, –3200 mm offset
Operating Range:	–3200 to +3200 mm, negative values are below grade, positive values are above grade, zero is on grade.
Parameter specific parameter:	$FE03_{16}$ indicates that the sensor can not sense the laser
Type:	measured
Suspect Parameter Number:	1574
Reference:	5.3.135

(R) *5.2.5.306 Modify Set Point*—Used to control and coordinate the set point for the leveling system.

Data Length:	2 bytes
Resolution:	0.1 mm/bit, –3200 mm offset
Operating Range:	–3200 to +3200 mm, negative values are below current position, positive values are above current position, zero is no change.
Parameter specific parameter:	$FE01_{16}$ indicates Stop modifying the set point $FE03_{16}$ indicates Raise the current set point by 5 mm $FE11_{16}$ indicates Lower the current set point by 5 mm $FE13_{16}$ indicates Search for laser or target $FE15_{16}$ indicates go to the Park position $FE17_{16}$ indicates go to the Bench position
Type:	measured
Suspect Parameter Number:	1575
Reference:	5.3.136

(R) *5.2.5.307 Mast Position*—Used to monitor the position of the sensor attached to the land leveling mast.

Data Length:	2 bytes
Resolution:	0.1 mm/bit, –3200 mm offset
Operating Range:	–3200 to +3200 mm, negative values are below current position, positive values are above current position, zero is no change.
Type:	measured
Suspect Parameter Number:	1576
Reference:	5.3.137

(R) *5.2.5.308 Blade Duration and Direction*—Used to indicate the duration and direction that the land leveling system blade moves.

Data Length:	2 bytes
Resolution:	0.1 sec/bit, -3276.8 sec/bit offset
Data Range:	-3276.8 to 3276.8 sec, negative values indicate move the blade up, positive values indicate move the blade down, zero indicates no change
Type:	Status
Suspect Parameter Number:	1577
Reference:	5.3.138

(R) *5.2.5.309 Reserved—To be assigned*

(R) *5.2.5.310 Laser Tracer Target Deviation*—The calculated distance for the laser target to the current laser tracer reference point.

Data Length:	2 bytes
Resolution:	0.1 mm/bit, –3200 mm/bit offset
Operating Range:	–3200 to +3200 mm, negative values are below setpoint, positive values are above setpoint, zero is on grade.
Parameter specific parameter:	$FE03_{16}$ indicates that the sensor can not sense the laser
Type:	measured
Suspect Parameter Number:	1579
Reference:	5.3.139

(R) *5.2.5.311 Laser Tracer Vertical Distance*—The elevation of the laser tracer sensor in a laser leveling system.

Data Length:	2 bytes
Resolution:	0.1 mm/bit, 0 mm/bit offset
Operating Range:	0 to 6400 mm
Type:	measured
Suspect Parameter Number:	1580
Reference:	5.3.139

(R) *5.2.5.312 Laser Tracer Horizontal Deviation*—The calculated percent deviation between the target distance and the center of the laser tracer.

Data Length:	1 byte
Resolution:	1%/bit, 0% offset
Operating Range:	0 to 200%, 0 to 99% indicates target is left of center, 101 to 200% indicates target is right of center, 100% indicates target is centered, FF_{16} indicates previous pass mode and thus no horizontal deviation.
Type:	measured
Suspect Parameter Number:	1581
Reference:	5.3.139

5.2.6 INFORMATIONAL STATUS PARAMETERS

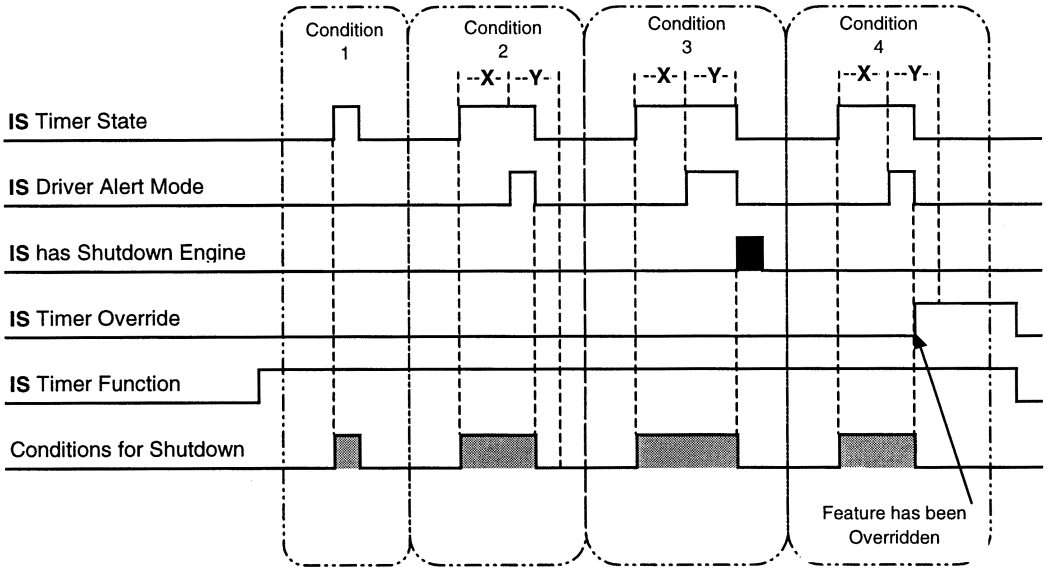
5.2.6.1 Two Speed Axle Switch—Switch signal which indicates the current axle range.

00 -	Low speed range
01 -	High speed range
Type:	Measured
Suspect Parameter Number:	69
Reference:	5.3.31

(R) *5.2.6.2 Idle Shutdown Timer State*—Status signal which indicates the current mode of operation of the idle shutdown timer system. See Figure 18.

00 -	Inactive
01 -	Active
Type:	Status
Suspect Parameter Number:	590
Reference:	5.3.18

Idle Shutdown (IS)



Condition 1 - When the IS Timer Override is inactive, the IS Timer State will become inactive if the conditions for shutdown no longer exist before the “X” time interval has expired or IS Driver Alert Mode is activated.

Condition 2 - When the IS Timer Override is inactive, the IS Timer State will become inactive if the conditions for shutdown no longer exist before the IS Driver Alert Mode “Y” time interval has expired.

Condition 3 - When the IS Timer Override is inactive, then the IS has Shutdown Engine will be active after the “Y” time interval has expired.

Condition 4 - When the IS Timer Override is active during the “Y” time interval, then the IS feature shall be overridden and will no longer be available until the system has been re-initated.

NOTE —0 State – Inactive, disabled in calibration, or conditions for idle shutdown do not exist.
1 State – Active, enabled in calibration, or conditions for idle shutdown do exist.

(R) FIGURE 18—IDLE SHUTDOWN (IS)

5.2.6.3 Idle Shutdown Timer Function—Parameter which indicates the configuration of the idle shutdown timer system.

00 -	Disabled in calibration
01 -	Enabled in calibration
Type:	Measured
Suspect Parameter Number:	591
Reference:	5.3.18

(R) *5.2.6.4 Idle Shutdown Timer Override*—Status signal which indicates the status of the override feature of the idle shutdown timer system. See Figure 18.

00 -	Inactive
01 -	Active
Type:	Status
Suspect Parameter Number:	592
Reference:	5.3.18

(R) *5.2.6.5 Idle Shutdown has Shutdown Engine*—Status signal which identifies whether or not the engine has been shutdown by the idle shutdown timer system. See Figure 18.

00 -	No
01 -	Yes
Type:	Status
Suspect Parameter Number:	593
Reference:	5.3.18

(R) *5.2.6.6 Idle Shutdown Driver Alert Mode*—Status signal which indicates the status of the driver alert mode of the idle shutdown timer system. While the driver alert mode is active, the idle shutdown timer may be overridden. See Figure 18.

00 -	Inactive
01 -	Active
Type:	Status
Suspect Parameter Number:	594
Reference:	5.3.18

5.2.6.7 Water In Fuel Indicator—Signal which indicates the presence of water in the fuel.

00 -	No
01 -	Yes
Type:	Measured
Suspect Parameter Number:	97
Reference:	5.3.45

5.2.6.8 Parking Brake Switch—Switch signal which indicates when the parking brake is set. (See also 5.2.6.13.)

00 -	Parking brake not set
01 -	Parking brake set
Type:	Measured
Suspect Parameter Number:	70
Reference:	5.3.31

5.2.6.9 Cruise Control Active—Cruise control is switched on. It is not ensured that the engine is controlled by cruise control, as in the case of a large driver's demand, the engine is controlled by the driver while cruise control is active (maximum selection of cruise control and driver's demand). The cruise control is set to 0 if a switch off condition occurs.

00 -	Cruise control switched off
01 -	Cruise control switched on
Type:	Measured
Suspect Parameter Number:	595
Reference:	5.3.31

5.2.6.10 Cruise Control Enable Switch—Switch signal which indicates that it is possible to manage the cruise control function.

00 -	Cruise control disabled
01 -	Cruise control enabled
Type:	Measured
Suspect Parameter Number:	596
Reference:	5.3.31

5.2.6.11 Brake Switch—Switch signal which indicates that the brake pedal is being pressed. It is necessary for a safe drivetrain behavior that the brake switch is set before the brakes are active (cruise control function).

00 -	Brake pedal released
01 -	Brake pedal depressed
Type:	Measured
Suspect Parameter Number:	597
Reference:	5.3.31

5.2.6.12 Clutch Switch—Switch signal which indicates that the clutch pedal is being pressed. It is necessary for a safe drivetrain behavior that the clutch switch is set before the clutch is opened (cruise control function).

00 -	Clutch pedal released
01 -	Clutch pedal depressed
Type:	Measured
Suspect Parameter Number:	598
Reference:	5.3.31

5.2.6.13 Parking Brake Actuator—Signal which indicates the current state of the actuator(s) that control the parking brake (see also 5.2.6.8).

00 -	Parking brake actuator inactive
01 -	Parking brake actuator active
Type:	Measured
Suspect Parameter Number:	619
Reference:	5.3.40

5.2.6.14 Cruise Control Set Switch—Switch signal of the cruise control activator which indicates that the activator is in the position “set.”

00 -	Cruise control activator not in the position “set”
01 -	Cruise control activator in position “set”
Type:	Measured
Suspect Parameter Number:	599
Reference:	5.3.31

5.2.6.15 Cruise Control Coast (Decelerate) Switch—Switch signal of the cruise control activator which indicates that the activator is in the position “coast (decelerate).”

00 -	Cruise control activator not in the position “coast”
01 -	Cruise control activator in position “coast”
Type:	Measured
Suspect Parameter Number:	600
Reference:	5.3.31

5.2.6.16 Cruise Control Resume Switch—Switch signal of the cruise control activator which indicates that the activator is in the position “resume.”

00 -	Cruise control activator not in the position “resume”
01 -	Cruise control activator in position “resume”
Type:	Measured
Suspect Parameter Number:	601
Reference:	5.3.31

5.2.6.17 Cruise Control Accelerate Switch—Switch signal of the cruise control activator which indicates that the activator is in the position “accelerate.”

00 -	Cruise control activator not in the position “accelerate”
01 -	Cruise control activator in position “accelerate”
Type:	Measured
Suspect Parameter Number:	602
Reference:	5.3.31

5.2.6.18 Auxiliary Discrete I/O Channel Status—Identifies the current status of auxiliary input/output functions that are configured uniquely per application.

00 -	Auxiliary channel off
01 -	Auxiliary channel on
Type:	Dependent on application
Suspect Parameter Number:	701-716
Reference:	5.3.48

5.2.6.19 Shift Finger Neutral Indicator—Indicates the status of the shift finger in the neutral position.

00 -	off
01 -	on
Type:	Status
Suspect Parameter Number:	780
Reference:	5.3.50

5.2.6.20 Shift Finger Engagement Indicator—Identifies the status of the shift finger in the engagement position.

00 - off
01 - on
Type: Status
Suspect Parameter Number: 781
Reference: 5.3.50

5.2.6.21 Shift Finger Center Rail Indicator—Identifies the status of the shift finger in the center rail position.

00 - off
01 - on
Type: Status
Suspect Parameter Number: 782
Reference: 5.3.50

(R) *5.2.6.22 Shift Finger Gear Actuator 1*—Identifies the status of the actuator that moves the shift finger identified as gear actuator #1.

00 - off
01 - on
Type: Status
Suspect Parameter Number: 773
Reference: 5.3.50

(R) *5.2.6.23 Shift Finger Gear Actuator 2*—Identifies the status of the actuator that moves the shift finger identified as gear actuator #2.

00 - off
01 - on
Type: Status
Suspect Parameter Number: 784
Reference: 5.3.50

(R) *5.2.6.24 Shift Finger Rail Actuator 1*—Identifies the status of the actuator that moves the shift finger identified as rail actuator #1.

00 - off
01 - on
Type: Status
Suspect Parameter Number: 772
Reference: 5.3.50

(R) *5.2.6.25 Shift Finger Rail Actuator 2*—Identifies the status of the actuator that moves the shift finger identified as rail actuator #2.

00 - off
01 - on
Type: Status
Suspect Parameter Number: 783
Reference: 5.3.50

5.2.6.26 Splitter Indirect Actuator—Identifies the status of the splitter indirect actuator in the auxiliary unit.

00 -	off
01 -	on
Type:	Status
Suspect Parameter Number:	771
Reference:	5.3.50

5.2.6.27 Splitter Direct Actuator—Identifies the status of the splitter direct actuator in the auxiliary unit.

00 -	off
01 -	on
Type:	Status
Suspect Parameter Number:	770
Reference:	5.3.50

5.2.6.28 Range Low Actuator—Identifies the status of the range low actuator in the auxiliary unit.

00 -	off
01 -	on
Type:	Status
Suspect Parameter Number:	769
Reference:	5.3.50

5.2.6.29 Range High Actuator—Identifies the status of the range high actuator in the auxiliary unit.

00 -	off
01 -	on
Type:	Status
Suspect Parameter Number:	768
Reference:	5.3.50

5.2.6.30 Inertia Brake Actuator—Identifies the status of the actuator that controls the inertia brake.

00 -	off
01 -	on
Type:	Status
Suspect Parameter Number:	787
Reference:	5.3.50

5.2.6.31 Defuel Actuator—Identifies the status of the actuator that controls the engine defuel mechanism.

00 -	off
01 -	on
Type:	Status
Suspect Parameter Number:	786
Reference:	5.3.50

5.2.6.32 Lockup Clutch Actuator—Identifies the status of the actuator that controls the lockup clutch.

00 -	off
01 -	on
Type:	Status
Suspect Parameter Number:	740
Reference:	5.3.50

5.2.6.33 Clutch Actuator—Identifies the status of the actuator that controls the clutch.

00 -	off
01 -	on
Type:	Status
Suspect Parameter Number:	788
Reference:	5.3.50

5.2.6.34 Transmission Low Range Sense Switch—Identifies the status of the switch that represents low range.

00 -	off
01 -	on
Type:	Status
Suspect Parameter Number:	779
Reference:	5.3.52

5.2.6.35 Transmission High Range Sense Switch—Identifies the status of the switch that represents high range.

00 -	off
01 -	on
Type:	Status
Suspect Parameter Number:	778
Reference:	5.3.52

5.2.6.36 Transmission Forward Direction Switch—Identifies the status of the switch that indicates forward direction.

00 -	off
01 -	on
Type:	Status
Suspect Parameter Number:	903
Reference:	5.3.52

(R) *5.2.6.37 Transmission Neutral Switch*—Identifies the status of the switch that indicates neutral.

00 -	off
01 -	on
Type:	Status
Suspect Parameter Number:	604
Reference:	5.3.52

5.2.6.38 Transmission Reverse Direction Switch—Identifies the status of the switch that indicates reverse direction.

00 - off
01 - on
Type: Status
Suspect Parameter Number: 767
Reference: 5.3.52

5.2.6.39 Transmission Output Retarder—Identifies the status of the transmission output retarder.

00 - off
01 - on
Type: Status
Suspect Parameter Number: 748
Reference: 5.3.53

5.2.6.40 Engine Test Mode Switch—Switch signal which indicates the position of the engine test mode switch.

00 - off
01 - on
Type: Measured
Suspect Parameter Number: 966
Reference: 5.3.31

5.2.6.41 Idle Decrement Switch—Switch signal which indicates the position of the idle decrement switch.

00 - off
01 - on
Type: Measured
Suspect Parameter Number: 967
Reference: 5.3.31

5.2.6.42 Idle Increment Switch—Switch signal which indicates the position of the idle increment switch.

00 - off
01 - on
Type: Measured
Suspect Parameter Number: 968
Reference: 5.3.31

(R) *5.2.6.43 Remote PTO Variable Speed Control Switch*—Switch signal which indicates that the remote PTO toggle switch is in the enabled (ON) position. If the toggle switch is enabled and other conditions are satisfied then the remote PTO control feature is activated and the PTO will control at a variable speed.

00 - off
01 - on
Type: measured
Suspect Parameter Number: 978
Reference: 5.3.30

(R) *5.2.6.44 Remote PTO Preprogrammed Speed Control Switch*—Switch signal which indicates that the remote PTO toggle switch is in the enabled (ON) position. If the toggle switch is enabled and other conditions are satisfied then the remote PTO control feature is activated and the PTO will control at the preprogrammed speed.

00 -	Off
01 -	On
Type:	Measured
Suspect Parameter Number:	979
Reference:	5.3.30

(R) *5.2.6.45 PTO Enable Switch*—Switch signal which indicates that the PTO toggle switch is in the enabled (ON) position and therefore it is possible to manage the PTO control function.

00 -	Off
01 -	On
Type:	Measured
Suspect Parameter Number:	980
Reference:	5.3.30

(R) *5.2.6.46 PTO Accelerate Switch*—Switch signal of the PTO control activator which indicates that the activator is in the position “accelerate.”

00 -	Off
01 -	On
Type:	Measured
Suspect Parameter Number:	981
Reference:	5.3.30

(R) *5.2.6.47 PTO Resume Switch*—Switch signal of the PTO control activator which indicates that the activator is in the position “resume.”

00 -	Off
01 -	On
Type:	Measured
Suspect Parameter Number:	982
Reference:	5.3.30

(R) *5.2.6.48 PTO Coast/Decelerate Switch*—Switch signal of the PTO control activator which indicates that the activator is in the position “coast/decelerate.”

00 -	Off
01 -	On
Type:	Measured
Suspect Parameter Number:	983
Reference:	5.3.30

(R) *5.2.6.49 PTO Set Switch*—Switch signal of the PTO control activator which indicates that the activator is in the position "set."

00 -	Off
01 -	On
Type:	Measured
Suspect Parameter Number:	984
Reference:	5.3.30

(R) *5.2.6.50 Refrigerant High Pressure Switch*—Switch signal which indicates the position of the high pressure switch in the coolant circuit of an air-conditioning system. When the switch is enabled, the pressure inside the circuit is too high and the compressor clutch may be disengaged.

00 -	Pressure normal
01 -	Pressure too high, compressor clutch may be disengaged
Type:	Measured
Suspect Parameter Number:	605
Reference:	5.3.18

(R) *5.2.6.51 Refrigerant Low Pressure Switch*—Switch signal which indicates the position of the low pressure switch in the coolant circuit of an air-conditioning system. When the switch is enabled, the pressure inside the circuit is too low and the compressor clutch may be disengaged.

00 -	Pressure normal
01 -	Pressure too low, compressor clutch may be disengaged
Type:	Measured
Suspect Parameter Number:	875
Reference:	5.3.18

(R) *5.2.6.52 A/C High Pressure Fan Switch*—Switch signal which indicates that the pressure in the coolant circuit of an air-conditioning system is high and the fan may be engaged.

00 -	Pressure normal
01 -	Pressure high, fan may be engaged
Type:	Measured
Suspect Parameter Number:	985
Reference:	5.3.18

(R) *5.2.6.53 Remote Accelerator Enable Switch*—Switch signal which indicates that the remote accelerator has been enabled and controls the engine.

00 -	Off
01 -	On
Type:	Measured
Suspect Parameter Number:	969
Reference:	5.3.4

NOTE—The accelerator interlock switch (see 5.2.6.56) must be disabled in order for the remote accelerator to perform engine control.

(R) *5.2.6.54 Auxiliary Engine Shutdown Switch*—Switch signal which requests that all engine fueling stop.

00 - Off
01 - On
Type: Measured
Suspect Parameter Number: 970
Reference: 5.3.4

(R) *5.2.6.55 Engine Derate Switch*—Switch signal used to activate the torque limiting feature of the engine. The specific nature of torque limiting should be verified with the manufacturer.

00 - Off
01 - On
Type: Measured
Suspect Parameter Number: 971
Reference: 5.3.4

(R) *5.2.6.56 Accelerator Interlock Switch*—Switch signal used to disable the accelerator and remote accelerator inputs, causing the engine to return to idle.

00 - Off
01 - On
Type: Measured
Suspect Parameter Number: 972
Reference: 5.3.4

(R) *5.2.6.57 Wait to Start Lamp*—Lamp signal which indicates that the engine is too cold to start and the operator should wait until the signal becomes inactive (turns off).

00 - Off
01 - On
Type: Status
Suspect Parameter Number: 1081
Reference: 5.3.18

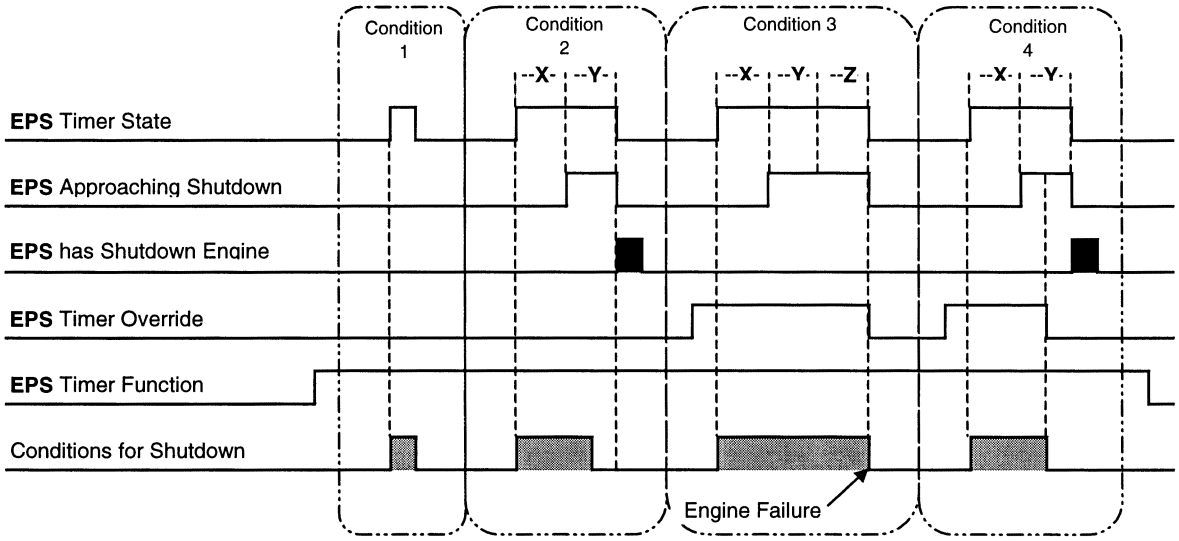
(R) *5.2.6.58 Engine Protection System Timer State*—Status signal which indicates the current mode of the engine protection system timer system. See Figure 19.

00 - Inactive
01 - Active
Type: Status
Suspect Parameter Number: 1107
Reference: 5.3.18

(R) *5.2.6.59 Engine Protection System Timer Override*—Status signal which indicates the status of the override feature of the engine protection system timer. See Figure 19.

00 - Inactive
01 - Active
Type: Status
Suspect Parameter Number: 1108
Reference: 5.3.18

Engine Protection System (EPS)



Condition 1 – When the EPS Timer Override is inactive, the EPS Timer State will become inactive if the conditions for shutdown no longer exist before the "X" time interval has expired or EPS Approaching Shutdown is activated.

Condition 2 – When the EPS Timer Override is inactive and conditions for shutdown exist during the "Y" time interval, then the Engine will shutdown, even though shutdown conditions subside before the "Y" time interval has expired.

Condition 3 – When the EPS Timer Override is active, then the EPS feature shall be overridden allowing for an engine failure when the "Z" time interval has expired.

Condition 4 – When the EPS Timer Override is active and then allowed to go inactive during the "Y" time interval, the response by the EPS shall be the same as condition 2. The time intervals for "X" and "Y" shall always start when conditions for shutdown first commence regardless whether the EPS Timer Override is enabled or not.

NOTE —0 State – Inactive, disabled in calibration, or conditions for Engine Protection do not exist.
1 State – Active, enabled in calibration, or conditions for Engine Protection do exist.

FIGURE 19—ENGINE PROTECTION SYSTEM (EPS)

(R) *5.2.6.60 Engine Protection System Approaching Shutdown*—Status signal which indicates that engine shutdown is imminent. This engine protection signal can be a result of different systems failing, i.e., engine overheating. See Figure 19.

00 -	Not approaching
01 -	Approaching
Type:	Status
Suspect Parameter Number:	1109
Reference:	5.3.18

(R) *5.2.6.61 Engine Protection System has Shutdown Engine*—Status signal which indicates whether or not the engine protection system has shutdown the engine. See Figure 19.

00 - No
01 - Yes
Type: Status
Suspect Parameter Number: 1110
Reference: 5.3.18

(R) *5.2.6.62 Engine Protection System Configuration*—Parameter which indicates the configuration of the engine shutdown system.

00 - Disabled in calibration
01 - Enabled in calibration
Type: Status
Suspect Parameter Number: 1111
Reference: 5.3.18

(R) *5.2.6.63 Anti-theft Encryption Seed Present Indicator*—Indicates the presence of the encryption seed random number.

00 - Random number is not present
01 - Random number is present
Type: Status
Suspect Parameter Number: 1194
Reference: 5.3.102

(R) *5.2.6.64 Anti-theft Password Valid Indicator*—Indicates the presence of a validated password.

00 - Password is not a validated password
01 - Password is a validated password
Type: Status
Suspect Parameter Number: 1195
Reference: 5.3.102

(R) *5.2.6.65 Anti-theft Component Status States (2 bits)*—Indicates whether or not the component can be started. See Table 16.

Type: Status
Suspect Parameter Number: 1196
Reference: 5.3.102

TABLE 16—COMPONENT STATUS STATES

Bit States	State
00	Unlocked
01	Locked
10	Blocked
11	Not defined

(R) 5.2.6.65.1 Unlocked—This state indicates that the component can be started without the end user being required to enter a password.

(R) 5.2.6.65.2 Locked—This state indicates that the component can NOT be started (i.e., Unlocked) without the end user being required to enter a password.

(R) 5.2.6.65.3 Blocked—This state indicates that a Lock or Unlock command cannot be executed because some other algorithm or command of higher priority is commanding differently.

(R) *5.2.6.66 Anti-theft Modify Password States (2 bits)*—This parameter is used to indicate whether a password request was successfully performed, or if the request could not be perform due to system constraints or if the request was not a valid request. See Table 17.

Type: Status
Suspect Parameter Number: 1197
Reference: 5.3.102

TABLE 17—MODIFY PASSWORD STATES

Bit States	State
00	Ok
01	Full_of_Passwords
10	Empty_of_Passwords
11	Not_valid

(R) 5.2.6.66.1 Ok—This state indicates that the request was successfully performed.

(R) 5.2.6.66.2 Full_Of_Passwords—This state indicates that the component can NOT store any additional passwords in its memory.

(R) 5.2.6.66.3 Empty_Of_Passwords—This state indicates that the component would be empty of passwords (an unacceptable condition) if the password under which the end user is logged in, is deleted. Thus the delete password command is not successfully executed.

Note that if the Delete_Password command is sent to a component that does not currently have a password the Empty_Of_Passwords state indicator shall be used.

(R) 5.2.6.66.4 Not_Valid—This state indicates that the request is not a valid one.

(R) *5.2.6.67 Anti-theft Encryption Indicator States (2 bits)*—This parameter is used to indicate if a random number seed is being requested, or if an encrypted password is being provided to the component. See Table 18.

Type: Status
Suspect Parameter Number: 1199
Reference: 5.3.101

TABLE 18—ENCRYPTION INDICATOR STATES

Bit States	State
00	Encryption_Seed_Request
01	Encrypted_Code_Present
10	Not defined
11	Not_Available

(R) 5.2.6.67.1 Encryption_Seed_Request—This state represents a request to the component to provide a random number seed.

(R) 5.2.6.67.2 Encrypted_Code_Present—This state is used to indicate that an encrypted password is being provided to the component.

(R) 5.2.6.67.3 Not_Available—This state is used to indicate that a random number is NOT being requested nor is an encrypted password being provided to the component.

(R) *5.2.6.68 Anti-theft Desired Exit Mode States (2 bits)*—This parameter is used to specify the desired triggers that are to be used by the component in deciding when to transition to the Locked state. See Table 19.

Type: Status
Suspect Parameter Number: 1200
Reference: 5.3.101

TABLE 19—DESIRED EXIT MODE STATES

Bit States	State
00	Lock_Upon_Operator_Request
01	Lock_When_Key_Off
10	Not defined
11	Not_Available

(R) 5.2.6.68.1 Lock_Upon_Operator_Request—This state is used to indicate that the end user would have to manually enter a password to Lock the engine.

(R) 5.2.6.68.2 Lock_When_Keyoff—This state is used to indicate that the component would automatically transition to the Locked state when the end user turns off the engine (i.e. without the end user being required to manually enter the password).

(R) 5.2.6.68.3 Not_Available—This state is indicates that the option is not selectable or changeable by the operator via using current tool.

(R) *5.2.6.69 Anti-theft Command States (3 bits)*—This parameter is used to identify the specific requests being sent to the component. See Table 20.

Type: Status
Suspect Parameter Number: 1201
Reference: 5.3.101

TABLE 20—COMMAND STATES

Bit States	State
000	Add_Password
001	Delete_Password
010	Change_Password
011	Lock_or_Unlock
100	Check_Status
101	Login
110-111	Not defined

(R) 5.2.6.69.1 Add_Password—This state represents a request to the component to add a password to the list of passwords that the component has stored as valid codes. This command will not be performed if the component has already stored, the maximum number of passwords that it is capable of storing. The Login command must precede this command.

(R) 5.2.6.69.2 Delete_Password—This state represents a request to the component to delete the password (the same one used when the end-user logged in). See 5.2.6.66.3 for limitations.

(R) 5.2.6.69.3 Change_Password—This state represents a request to the component to change the password (the same one that the end-user logged in with) to a different password, which is to be specified by the end user. The Login command must precede this command.

(R) 5.2.6.69.4 Lock_Or_Unlock—This state represents a request to the component to change from the Locked state to the Unlocked state or from the Unlocked state to the Locked state.

(R) 5.2.6.69.5 Check_Status—This state represents a request to check to see if the component is in the Locked or Unlocked state.

(R) 5.2.6.69.6 Login—This state represents a request to validate the end user, before performing commands such as Add_Password and Change_Password.

(R) *5.2.6.70 Engine Build Hours Reset*—Command signal used to reset the engine rebuild hours.

00 - Do not reset
01 - Reset
11 - Take no action
Type: Status
Suspect Parameter Number: 1211
Reference: 5.3.74

(R) *5.2.6.71 EBS Brake Switch*—Switch signal which indicates that the brake pedal is being pressed. The EBS brake switch is independent of the brake light switch and has no provisions for external connections.

00 - Brake pedal is not being pressed
01 - Brake pedal is being pressed
Type: Measured
Suspect Parameter Number: 1121
Reference: 5.3.4

(R) *5.2.6.72 Traction Control Override Switch*—Switch signal which indicates the position of the traction control override switch. The traction control override signal disables the automatic traction control function allowing the wheels to spin.

00 -	off
01 -	on
Type:	Measured
Suspect Parameter Number:	1238
Reference:	5.3.4

(R) *5.2.6.73 ABS/EBS Amber Warning State*—The ABS/EBS amber warning state is set as non-critical faults are detected in the ABS/EBS system. The vehicle can be driven to the next service station.

00 -	off
01 -	on
Type:	Measured
Suspect Parameter Number:	1438
Reference:	5.3.4

(R) *5.2.6.74 EBS Red Warning State*—The EBS red warning state is set if critical EBS faults are detected and the vehicle has to stop.

00 -	off
01 -	on
Type:	Measured
Suspect Parameter Number:	1439
Reference:	5.3.4

(R) *5.2.6.75 ABS Fully Operational*—Signal which indicates whether an ABS system is fully operational or whether its functionality is reduced by a defect or by an intended action (e.g., by activation of an ABS-off-road switch or during special diagnostic procedures). There are cases where the signal is necessary to fulfill legal regulations for special applications (e.g., switching off integrated retarders).

00 -	not fully operational
01 -	fully operational
Type:	Status
Suspect Parameter Number:	1243
Reference:	5.3.4

(R) *5.2.6.76 Road Speed Limit Status*—Status (active or not active) of the system used to limit maximum vehicle velocity.

00 -	active
01 -	not active
Type:	Status
Suspect Parameter Number:	1437
Reference:	5.3.6

(R) *5.2.6.77 Driver Working State (3 bits)*—State of work of the driver. See Table 21.

Type: Status
Suspect Parameter Number: 1612 – Driver 1 Working State
1613 – Driver 2 Working State
Reference: 5.3.143

TABLE 21—DRIVER WORKING STATES

Bit States	State
000	Rest - sleeping
001	Driver available – short break
010	Work – loading, unloading, working in an office
011	Drive – behind wheel
100-101	Reserved
110	Error
111	Not available

(R) *5.2.6.78 Drive Recognize*—Indicates whether motion of the vehicle is detected or not.

00 - Vehicle motion not detected
01 - Vehicle motion detected
Type: Measured
Suspect Parameter Number: 1611
Reference: 5.3.143

(R) *5.2.6.79 Driver Time Related State (4 bits)*—Indicates if the driver approaches or exceeds working time limits (or other limits). See Table 22.

Type: Measured
Suspect Parameter Number: 1617 – Driver 1 Time Related State
1618 – Driver 2 Time Related State
Reference: 5.3.143

TABLE 22—DRIVER TIME RELATED STATES

Bit States	State
0000	Normal/No limits reached
0001	Limit #1 – 15 min before 4-1/2 h
0010	Limit #2 – 4–1/2 h reached
0011	Limit #3 – 15 min before 9 h
0100	Limit #4 – 9 h reached
0101	Limit #5 – 15 min before 16 h (not having 8h rest during the last 24h)
0110	Limit #6 – 16 h reached
0111-1100	Reserved
1101	Other
1110	Error
1111	Not available

(R) *5.2.6.80 Driver Card*—Indicates the presence of a driver card

00 -	Driver card not present
01 -	Driver card present
Type:	Measured
Suspect Parameter Number:	1615 – Driver 1 Card
	1616 – Driver 2 Card
Reference:	5.3.143

(R) *5.2.6.81 Overspeed*—Indicates whether the vehicle is exceeding the legal speed limit set in the tachograph.

00 -	No overspeed
01 -	Overspeed
Type:	Measured
Suspect Parameter Number:	1614
Reference:	5.3.143

(R) *5.2.6.82 System Event*—Indicates that a tachograph event has occurred. This may include power supply interruption, interruption of the speed sensor, incorrect data on the driver card, driving without a driver card, illegal removal of a driver card, insertion of a driver card during driving, and time adjustment.

00 -	No tachograph event
01 -	Tachograph event
Type:	Status
Suspect Parameter Number:	1622
Reference:	5.3.143

(R) *5.2.6.83 Handling Information*—Indicates that handling information is present. Information could include “no printer paper”, “no driver card”, etc.

00 -	No handling information
01 -	Handling information
Type:	Status
Suspect Parameter Number:	1621
Reference:	5.3.143

(R) *5.2.6.84 Tachograph Performance*—Indicates the tachograph performance; including electronic or mechanical analysis, instrument analysis, speed sensor analysis, mass storage analysis, and printer analysis.

00 -	Normal performance
01 -	Performance analysis
Type:	Status
Suspect Parameter Number:	1620
Reference:	5.3.143

(R) *5.2.6.85 Direction Indicator*—Indicates the direction of the vehicle.

00 -	Forward
01 -	Reverse
Type:	Measured
Suspect Parameter Number:	1619
Reference:	5.3.143

(R) *5.2.6.86 Adaptive Cruise Control Set Distance Mode (3 bits)*—Selected distance mode for adaptive cruise control. See Table 23.

Type: Status
Suspect Parameter Number: 1589
Reference: 5.3.141

TABLE 23—ADAPTIVE CRUISE CONTROL SET DISTANCE MODE

Bit States	ACC Set Distance Mode
000	ACC Distance mode #1 (largest distance)
001	ACC Distance mode #2
010	ACC Distance mode #3
011	ACC Distance mode #4
100	ACC Distance mode #5 (shortest distance)
101	Conventional cruise control mode
110	Error condition
111	Not available/not valid

(R) *5.2.6.87 Adaptive Cruise Control Mode*—This parameter is used to indicate the current state, or mode, of operation by the Adaptive Cruise Control (ACC) device. The states characterize independent system states (e.g., it is not possible to express distance control active and overtake mode simultaneously). See Table 24.

ACC must not switch itself off while active because the driver expects it to work. So if an error occurs, the ACC must signal that to the driver so that the driver knows that he has to switch off the ACC.

Type: Status
Suspect Parameter Number: 1590
Reference: 5.3.141

TABLE 24—ADAPTIVE CRUISE CONTROL MODE

Bit States	ACC Mode
000	Off (Standby, enabled, ready for activation)
001	Speed control active
010	Distance control active
011	Overtake mode
100	Not defined
101	Finish mode
110	Disabled or error condition
111	Not available/not valid

(R) 5.2.6.87.1 Off 000—Used to indicate the ACC is enabled in calibration or configuration and there are no faults that would prevent the system from operating.

(R) 5.2.6.87.2 Speed Control Active 001—Used to indicate that ACC is on but not currently sending control messages. In other words, there is no target ahead and regular vehicle cruise control is controlling the vehicle speed to the driver's set speed.

(R) 5.2.6.87.3 Distance Control Active 010—Used to indicate that ACC is on and actively sending control messages to maintain the appropriate following interval.

(R) 5.2.6.87.4 Overtake Mode 011—Used to indicate that ACC is on but temporarily disabled because the driver is manually overriding cruise control by using either the accelerator pedal or the cruise control "accel" switch.

(R) 5.2.6.87.5 Finish Mode 101—Used to indicate that ACC is on with no target ahead, and ACC is currently sending control messages to return to the driver's set speed. This occurs when the target the ACC system was tracking moves out of the way so ACC returns the vehicle to the driver's set speed.

(R) 5.2.6.87.6 Disabled or Error Condition 110—Used to indicate that ACC is in an error state and can not operate.

(R) *5.2.6.88 Steer Channel Mode (4 bits)*—Indicates the functional mode of steer channel of the tire pressure control system. See Table 25.

Type: Status
Suspect Parameter Number: 1466
Reference: 5.3.132

(R) *5.2.6.89 Trailer/Tag Channel Mode (4 bits)*—Indicates the functional mode of trailer/tag channel of the tire pressure control system. See Table 25.

Type: Status
Suspect Parameter Number: 1467
Reference: 5.3.132

(R) *5.2.6.90 Drive Channel Mode (4 bits)*—Indicates the functional mode of trailer/tag channel of the tire pressure control system. See Table 25.

Type: Status
Suspect Parameter Number: 1468
Reference: 5.3.132

TABLE 25—TIRE PRESSURE CONTROL SYSTEM FUNCTIONAL MODES

Bit States	Functional Mode
0000	Maintain
0001	Inflate
0010	Deflate
0011	Confirm
0100	Inflate Wait – System will inflate when conditions allow
0101	Deflate Wait – System will deflate when conditions allow
0110	Pressure Check
0111-1101	Reserved
1110	Error Condition
1111	Not available

(R) *5.2.6.91 PCU Drive Solenoid Status*—Current state of the drive solenoid used to implement a tire pressure control system in its pneumatic control unit (PCU).

00 - Off
01 - On
Type: Status
Suspect Parameter Number: 1469
Reference: 5.3.132

(R) *5.2.6.92 PCU Steer Solenoid Status*—Current state of the steer solenoid used to implement a tire pressure control system in its pneumatic control unit (PCU).

00 - Off
01 - On
Type: Status
Suspect Parameter Number: 1470
Reference: 5.3.132

(R) *5.2.6.93 Tire Pressure Supply Switch Status*—Current state of an open/closed type switch used to determine if adequate pressure exists for system implementation.

00 - Off
01 - On
Type: Status
Suspect Parameter Number: 1471
Reference: 5.3.132

(R) *5.2.6.94 PCU Deflate Solenoid Status*—Current state of the deflate solenoid used to implement a tire pressure control system in its pneumatic control unit (PCU).

00 - Off
01 - On
Type: Status
Suspect Parameter Number: 1472
Reference: 5.3.132

(R) *5.2.6.95 PCU Control Solenoid Status*—Current state of the control solenoid used to implement a tire pressure control system in its pneumatic control unit (PCU).

00 - Off
01 - On
Type: Status
Suspect Parameter Number: 1473
Reference: 5.3.132

(R) *5.2.6.96 PCU Supply Solenoid Status*—Current state of the supply solenoid used to implement a tire pressure control system in its pneumatic control unit (PCU).

00 - Off
01 - On
Type: Status
Suspect Parameter Number: 1474
Reference: 5.3.132

(R) *5.2.6.97 PCU Trailer, Tag or Push Solenoid Status*—Current state of the trailer, tag, or push solenoid used to implement a tire pressure control system in its pneumatic control unit (PCU).

00 -	Off
01 -	On
Type:	Status
Suspect Parameter Number:	1475
Reference:	5.3.132

(R) *5.2.6.98 Fuel Leakage*—Status signal which indicates fuel leakage in the fuel rail of the engine. The location can be either before or after the fuel pump.

00 -	no leakage detected
01 -	leakage detected
Type:	Status
Suspect Parameter Number:	1239 – Fuel Leakage 1
	1240 – Fuel Leakage 2
Reference:	5.3.106

(R) *5.2.6.99 Safety Wire Status*—Status signal which indicates that the safety wire has been activated. When the safety wire is activated, the engine will not operate. This is used for maintenance purposes.

00 -	Safety wire has not been activated
01 -	Safety wire has been activated
Type:	Status
Suspect Parameter Number:	1205
Reference:	5.3.104

(R) *5.2.6.100 Turning Gear Engaged*—Status signal which indicates that the turning gear is engaged. The turning gear is used to turn the flywheel/crankshaft, for maintenance purposes, while the engine is not running.

00 -	Turning gear is not engaged
01 -	Turning gear is engaged
Type:	Status
Suspect Parameter Number:	1206
Reference:	5.3.104

(R) *5.2.6.101 Reserved—To be assigned*

(R) *5.2.6.102 Engine Shutdown Override Switch*—Switch signal which indicates the position of the engine shutdown override switch. This switch function allows the operator to override an impending engine shutdown.

00 -	off
01 -	on
Type:	Measured
Suspect Parameter Number:	1237
Reference:	5.3.31

(R) *5.2.6.103 Torque Limiting Feature Status*—Status of an ECU feature which limits the torque output of the engine.

00 - Disabled
01 - Enabled
Type: Status
Suspect Parameter Number: 1254
Reference: 5.3.107

(R) *5.2.6.104 Torque Limit Feature (3 bits)*—Torque limit rating described in the current record. See Table 26.

Suspect Parameter Number: 1632
Reference: 5.3.107

TABLE 26—TORQUE LIMIT FEATURE

Bit States	Torque Limit
000	Reserved
001	Highest torque rating
010	First torque rating
011	Previous torque rating (rating prior to the current rating)
100	Current torque rating
101-110	Reserved
111	Not available

(R) *5.2.6.105 LED Display Data #1 (8 bits)*—Informs display devices how to display the current vertical position. See Table 27.

Type: Status
Suspect Parameter Number: 1573
Reference: 5.3.134

TABLE 27—LED DISPLAY DATA #1

Bit States	LED Display Data #1
00000010	High Coarse LED on
00000100	High Fine LED on
00001000	On-grade LED on
00010000	Low Fine LED on
00100000	Low Coarse LED on
All other values	Reserved

(R) *5.2.6.106 LED Display Data #2 (8 bits)*—Informs display devices how to display the current position of the laser tracer. See Table 28.

Type: Status
Suspect Parameter Number: 1582
Reference: 5.3.139

TABLE 28—LED DISPLAY DATA #2

Bit States	LED Display Data #2
00000001	On-grade “A” LED on
00000010	On-grade “B” LED on
00000100	On-grade “C” LED on
00001000	Up LED on
00010000	Down LED on
00100000	Left LED on
01000000	Right LED on
All other values	Reserved

(R) *5.2.6.107 Blade Control Mode (8 bits)*—Allows the user to select the type of blade control for the land leveling system. See Table 29.

Type: Status
Suspect Parameter Number: 1578
Reference: 5.3.138

TABLE 29—BLADE CONTROL MODE

Bit States	Blade Control Mode
00000000	Manual mode
00000001	Automatic mode
00000010	Inactive automatic mode
All other values	Reserved

(R) *5.2.6.108 Laser Tracer Information (8 bits)*—Provides the status of the laser tracer to the operator. See Table 30.

Type: Status
Suspect Parameter Number: 1583
Reference: 5.3.139

TABLE 30—LASER TRACER INFORMATION

Bit States	Laser Tracer Information
00000001	Laser power is on
00000010	Laser is ready
00000100	Valid target (1 = yes)
00001000	Previous pass (1 = yes)
00010000	Stringline (1 = yes)
00100000	Curb (1 = yes)
All other values	Reserved

5.3 Parameter Group Definitions—This section defines the parameter groups for use on the SAE J1939 network. All undefined bits are to be transmitted with a value of "1." All undefined bits should be received as "don't care" (either masked out or ignored). This permits them to be defined and used in the future without causing any incompatibilities.

(R) Messages that are requesting control over the receiving device (TSC1, TC1) are transmitted at high rate only during the time when the control is active, but may be optionally sent at a slow rate as a "heartbeat." For TSC1, it is expected that the transmitting device indicate to the receiving device that it no longer requests control by sending at least one broadcast with the override control modes set to 00. In the absence of continued broadcasts from a requesting module, the receiving device shall default to its normal mode after two update periods.

The size of the CAN data field is 8 bytes. Parameter groups that are 0-8 data bytes in length use the services of the Data Link layer (Refer to SAE J1939-21). Parameter groups that exceed 8 data bytes or parameter group definitions that are variable in length and may exceed 8 data bytes shall utilize the services of the Transport Protocol. (Refer to 5.10 of SAE J1939-21.)

5.3.1 TORQUE/SPEED CONTROL #1: TSC1

Transmission repetition rate:	when active; 10 ms to the engine - 50 ms to the retarder
Data length:	8 bytes
Data page:	0
PDU format:	0
PDU specific:	Destination address
Default priority:	3
Parameter group number:	0 (000000_{16})

Byte:			Bit:			
	1	Control bits		8-7	Not defined	
				6,5	Override control mode priority	5.2.3.3
				4,3	Requested speed control conditions	5.2.3.2
				2,1	Override control modes	5.2.3.1
	2,3	Requested speed/Speed limit				5.2.1.19
	4	Requested torque/Torque limit				5.2.1.15
	5-8	Not defined				

(R) NOTE—Retarder may be disabled by commanding a torque limit of 0%. Use of the limit mode allows the use of the retarder only up to the limit specified in the request. This can be used to permit retarding of up to 50%, for example, if that limit is required by some device such as an EBS, or it can disable the use of the retarder by others, as when an ABS controller detects wheel slip.

5.3.2 TRANSMISSION CONTROL #1: TC1

Transmission repetition rate:	when active; 50 ms to the transmission and axles
Data length:	8 bytes
Data page:	0
PDU format:	1
PDU specific:	Destination address
Default priority:	3
Parameter group number:	256 (000100_{16})

Byte:	1	Control bits	Bit:	8-7	Not defined	
				6,5	Disengage driveline request	5.2.3.6
				4,3	Torque converter lockup disable request	5.2.3.5
				2,1	Gear shift inhibit request	5.2.3.4
	2	Requested percent clutch slip				5.2.1.21
	3	Requested gear				5.2.1.24
	4	Disengage diff. lock 1	Bit:	8,7	Rear axle 2	5.2.3.7
				6,5	Rear axle 1	5.2.3.7
				4,3	Front axle 2	5.2.3.7
				2,1	Front axle 1	5.2.3.7
	5	Disengage diff. lock 2	Bit:	8-7	Not defined	
				6,5	Central rear	5.2.3.7
				4,3	Central front	5.2.3.7
				2,1	Central	5.2.3.7
	6-8	Not defined				

5.3.3 ELECTRONIC RETARDER CONTROLLER #1: ERC1

Transmission repetition rate:	100 ms
Data length:	8 bytes
Data page:	0
PDU format:	240
PDU specific:	0
Default priority:	6
Parameter group number:	61 440 ($00F000_{16}$)

(R) NOTE—This message will be transmitted by several types of retarding devices such as engine compression release brakes, exhaust system restriction brakes, and driveline retarders using hydraulic, electric, or mechanical friction to slow the vehicle. The source address of the message will indicate which one, and the type and location of the retarder are available in the Retarder Configuration Message (see 5.3.15) if that detail is important to the receiver.

Users should also be aware that the Shift Assist and Brake Assist switch status in the first byte of this message are to be used by other ECUs that might request retarding force from the retarder to know when such assistance is available. The state of the "switches" will NOT prevent the retarder from activating if requested, but should be honored by the requester (by not sending a request when the appropriate "switch" is not enabled) to prevent unwarranted noise.

Byte:	1	Status_ERC1	Bit:	8,7	Retarder enable - shift assist switch	5.2.2.12
				6,5	Retarder enable - brake assist switch	5.2.2.11
				4-1	Engine/retarder torque mode	5.2.2.1
	2	Actual retarder - percent torque				5.2.1.17
(R)	3	Intended retarder percent torque				5.2.5.169
(R)	4	Coolant load increase	Bit:	8-3	Not defined	
				2,1	Engine coolant load increase	5.2.2.21
(R)	5	Source address of controlling device for retarder control				5.2.5.300
(R)	6-8	Not defined				

5.3.4 ELECTRONIC BRAKE CONTROLLER #1: EBC1—Used for brake control information.

Transmission repetition rate: 100 ms
Data length: 8 bytes
Data page: 0
PDU format: 240
PDU specific: 1
Default priority: 6
Parameter group number: 61 441 ($00F001_{16}$)

(R)	Byte:	1	Status_EBC1	Bit:	8,7	EBS brake switch	5.2.6.71
					6,5	ABS active	5.2.2.9
					4,3	ASR brake control active	5.2.2.8
					2,1	ASR engine control active	5.2.2.7
		2	Brake pedal position				5.2.1.18
(R)		3	Status_EBC2	Bit:	8,7	Traction control override switch	5.2.6.72
					6,5	ASR “hill holder” switch	5.2.2.17
					4,3	ASR off-road switch	5.2.2.16
					2,1	ABS off-road switch	5.2.2.15
(R)		4	Measured_Aux_1	Bit:	8,7	Remote accelerator enable switch	5.2.6.53
(R)					6,5	Auxiliary engine shutdown switch	5.2.6.54
(R)					4,3	Engine derate switch	5.2.6.55
(R)					2,1	Accelerator interlock switch	5.2.6.56
(R)		5	Engine retarder selection				5.2.1.58
		6		Bit:	8-7	Not defined	
(R)					6,5	ABS/EBS amber warning state	5.2.6.73
(R)					4,3	EBS red warning state	5.2.6.74
(R)					2,1	ABS fully operational	5.2.6.75
(R)		7	Source address of controlling device for brake control				5.2.5.299
		8	Not defined				

5.3.5 ELECTRONIC TRANSMISSION CONTROLLER #1: ETC1

Transmission repetition rate: 10 ms
Data length: 8 bytes
Data page: 0
PDU format: 240
PDU specific: 2
Default priority: 3
Parameter group number: 61 442 ($00F002_{16}$)

	Byte:	1	Status_ETC1	Bit:	8-7	Not defined	
					6,5	Shift in process	5.2.2.14
					4,3	Torque converter lockup engaged	5.2.2.13
					2,1	Driveline engaged	5.2.2.6
		2,3	Output shaft speed				5.2.1.14
		4	Percent clutch slip				5.2.1.20
		5	Command_ETC1	Bit:	8-5	Not defined	
					4,3	Progressive shift disable	5.2.3.11
					2,1	Momentary engine overspeed enable	5.2.3.12
		6,7	Input shaft speed				5.2.5.55
(R)		8	Source address of controlling device for transmission control				5.2.5.301

5.3.6 ELECTRONIC ENGINE CONTROLLER #2: EEC2

Transmission repetition rate: 50 ms
Data length: 8 bytes
Data page: 0
PDU format: 240
PDU specific: 3
Default priority: 3
Parameter group number: 61 443 ($00F003_{16}$)

(R)	Byte: 1	Status_EEC2	Bit:	8-7	Not defined	
(R)				6,5	Road speed limit status	5.2.6.76
				4,3	AP kickdown switch	5.2.2.5
				2,1	AP low idle switch	5.2.2.4
	2	Accelerator pedal (AP) position				5.2.1.8
	3	Percent load at current speed				5.2.1.7
(R)	4	Remote accelerator				5.2.1.59
(R)	5-8	Not defined				

5.3.7 ELECTRONIC ENGINE CONTROLLER #1: EEC1

Transmission repetition rate: engine speed dependent (see 5.1.7.2)
Data length: 8 bytes
Data page: 0
PDU format: 240
PDU specific: 4
Default priority: 3
Parameter group number: 61 444 ($00F004_{16}$)

Byte:	1	Status_EEC1	Bit:	8-5	Not defined	
				4-1	Engine/retarder torque mode	5.2.2.1
	2	Driver's demand engine - percent torque				5.2.1.4
	3	Actual engine - percent torque				5.2.1.5
	4,5	Engine speed				5.2.1.9
(R)	6	Source address of controlling device for engine control				5.2.5.298
(R)	7-8	Not defined				

5.3.8 ELECTRONIC TRANSMISSION CONTROLLER #2: ETC2

Transmission repetition rate: 100 ms
Data length: 8 bytes
Data page: 0
PDU format: 240
PDU specific: 5
Default priority: 6
Parameter group number: 61 445 ($00F005_{16}$)

Byte:	1	Selected gear	5.2.1.23
	2,3	Actual gear ratio	5.2.1.25
	4	Current gear	5.2.1.22
	5,6	Transmission requested range	5.2.5.108
	7,8	Transmission current range	5.2.5.109

5.3.9 ELECTRONIC AXLE CONTROLLER #1: EAC1

Transmission repetition rate: 500 ms
Data length: 8 bytes
Data page: 0
PDU format: 240
PDU specific: 6
Default priority: 6
Parameter group number: 61 446 ($00F006_{16}$)

Byte:						
	1	Location				5.2.5.95
	2	Differential lock status 1	Bit:	8,7	Rear axle 2	5.2.2.10
				6,5	Rear axle 1	5.2.2.10
				4,3	Front axle 2	5.2.2.10
				2,1	Front axle 1	5.2.2.10
	3	Differential lock status 2	Bit:	8-7	Not defined	
				6,5	Central rear	5.2.2.10
				4,3	Central front	5.2.2.10
				2,1	Central	5.2.2.10
	4-8	Not defined				

(R) NOTE–Request has to be responded to with as many messages as necessary to transmit all available information.

5.3.10 IDLE OPERATION

Transmission repetition rate: on request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 220
Default priority: 6
Parameter group number: 65 244 ($00FEDC_{16}$)

Byte:			
	1-4	Total idle fuel used	5.2.5.65
	5-8	Total idle hours	5.2.5.59

5.3.11 TURBOCHARGER

Transmission repetition rate: 1 sec
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 221
Default priority: 6
Parameter group number: 65 245 ($00FEDD_{16}$)

Byte:			
(R)	1	Turbocharger lube oil pressure 1	5.2.5.29
(R)	2,3	Turbocharger 1 speed	5.2.5.53
	4-8	Not defined	

5.3.12 AIR START PRESSURE

Transmission repetition rate: on request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 222
Default priority: 6
Parameter group number: 65 246 ($00FEDE_{16}$)

Byte:	1	Air start pressure	5.2.5.26
	2-8	Not defined	

5.3.13 ELECTRONIC ENGINE CONTROLLER #3: EEC3

Transmission repetition rate: 250 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 223
Default priority: 6
Parameter group number: 65 247 ($00FEDF_{16}$)

Byte:	1	Nominal friction - percent torque	5.2.1.6
	2,3	Engine's desired operating speed	5.2.1.10
	4	Engine's operating speed asymmetry adjustment	5.2.1.16
	5-8	Not defined	

5.3.14 VEHICLE DISTANCE

Transmission repetition rate: on request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 224
Default priority: 6
Parameter group number: 65 248 ($00FEE0_{16}$)

Byte:	1-4	Trip distance	5.2.5.50
	5-8	Total vehicle distance	5.2.5.51

(R) 5.3.15 RETARDER CONFIGURATION

Transmission repetition rate: On change of torque/speed points of more than 10% since last transmission, or every 5 s.
Data length: 19 bytes
Data page: 0
PDU format: 254
PDU specific: 225
Default priority: 6
Parameter group number: 65 249 ($00FEE1_{16}$)

Byte:			Bit:			
	1	Type and location	8-5	Retarder location		5.2.2.3
			4-1	Retarder type		5.2.2.2
	2	Retarder control method				5.2.1.50
	3,4	Retarder speed at idle, point 1				5.2.1.41
	5	Percent torque at idle, point 1				5.2.1.45
	6,7	Maximum retarder speed, point 2				5.2.1.43
	8	Percent torque at maximum speed, point 2				5.2.1.46
	9,10	Retarder speed at point 3				5.2.1.44
	11	Percent torque at point 3				5.2.1.47
	12,13	Retarder speed at point 4				5.2.1.44
	14	Percent torque at point 4				5.2.1.47
	15,16	Retarder speed at peak torque, point 5				5.2.1.42
	17,18	Reference retarder torque				5.2.1.49
	19	Percent torque at peak torque, point 5				5.2.1.48

5.3.16 TRANSMISSION CONFIGURATION

Transmission repetition rate: On request
Data length: Depends on total number of forward and reverse gear ratios
Data page: 0
PDU format: 254
PDU specific: 226
Default priority: 6
Parameter group number: 65 250 ($00FEE2_{16}$)

Byte:			
(R)	1	Number of reverse gear ratios	5.2.4.5
(R)	2	Number of forward gear ratios	5.2.4.4
	3,4	Highest reverse gear ratio	5.2.4.2
	.		
	.		
	a,b	Lowest reverse gear ratio	
	c,d	Lowest forward gear ratio	
	.		
	.		
	e,f	Highest forward gear ratio	

5.3.17 ENGINE CONFIGURATION—(reference 5.2.4.1)

Transmission repetition rate:	On change of torque/speed points of more than 10% since last transmission, or every 5 s.
Data length:	28 bytes
Data page:	0
PDU format:	254
PDU specific:	227
Default priority:	6
Parameter group number:	65 251 ($00FEE3_{16}$)

Byte:			
	1,2	Engine speed at idle, point 1	5.2.1.26
	3	Percent torque at idle, point 1	5.2.1.36
	4,5	Engine speed at point 2	5.2.1.27
	6	Percent torque at point 2	5.2.1.37
	7,8	Engine speed at point 3	5.2.1.28
	9	Percent torque at point 3	5.2.1.38
	10,11	Engine speed at point 4	5.2.1.28
	12	Percent torque at point 4	5.2.1.38
	13,14	Engine speed at point 5	5.2.1.28
	15	Percent torque at point 5	5.2.1.38
	16,17	Engine speed at high idle, point 6	5.2.1.29
	18,19	Gain (KP) of endspeed governor	5.2.1.40
	20,21	Reference engine torque	5.2.1.39
	22,23	Maximum momentary engine override speed, point 7	5.2.1.30
	24	Maximum momentary engine override time limit	5.2.1.31
	25	Requested speed control range lower limit	5.2.1.32
	26	Requested speed control range upper limit	5.2.1.33
	27	Requested torque control range lower limit	5.2.1.34
	28	Requested torque control range upper limit	5.2.1.35

(R) 5.3.18 SHUTDOWN

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 228
Default priority: 6
Parameter group number: 65 252 ($00FEE4_{16}$)

Byte:	1	Idle shutdown_1	Bit	8,7	Idle shutdown timer state	5.2.6.2
				6,5	Idle shutdown timer override	5.2.6.4
(R)				4,3	Idle shutdown driver alert mode	5.2.6.6
(R)				2,1	Idle shutdown has shutdown engine	5.2.6.5
	2	Idle shutdown_2	Bit	8,7	Idle shutdown timer function	5.2.6.3
				6-1	Not defined	
(R)	3	Refrigerant_press_1	Bit	8,7	Not defined	
				6,5	Refrigerant high pressure switch	5.2.6.50
				4,3	Refrigerant low pressure switch	5.2.6.51
				2,1	A/C high pressure fan switch	5.2.6.52
(R)	4	Lamp_commands	Bit	8-3	Not defined	
				2,1	Wait to start lamp	5.2.6.57
(R)	5	Engine shutdown_1	Bit	8,7	Engine protection system timer state	5.2.6.58
				6,5	Engine protection system timer override	5.2.6.59
				4,3	Engine protection system approaching shutdown	5.2.6.60
				2,1	Engine protection system has shutdown engine	5.2.6.61
(R)	6	Engine shutdown_2	Bit	8,7	Engine protection system configuration	5.2.6.62
				6-1	Not defined	
(R)	7-8	Not defined				

5.3.19 ENGINE HOURS, REVOLUTIONS

Transmission repetition rate: on request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 229
Default priority: 6
Parameter group number: 65 253 ($00FEE5_{16}$)

Byte:	1-4	Total engine hours	5.2.5.61
	5-8	Total engine revolutions	5.2.5.58

5.3.20 TIME/DATE

Transmission repetition rate: on request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 230
Default priority: 6
Parameter group number: 65 254 ($00FEE6_{16}$)

	Byte:			
		1	Seconds	5.2.5.93
		2	Minutes	5.2.5.94
		3	Hours	5.2.5.110
		4	Month	5.2.5.112
		5	Day	5.2.5.111
		6	Year	5.2.5.113
(R)		7	Local Minute Offset	5.2.5.296
(R)		8	Local Hour Offset	5.2.5.297

5.3.21 VEHICLE HOURS

Transmission repetition rate: on request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 231
Default priority: 6
Parameter group number: 65 255 ($00FEE7_{16}$)

Byte:			
	1-4	Total vehicle hours	5.2.5.60
	5-8	Total power takeoff hours	5.2.5.62

5.3.22 VEHICLE DIRECTION/SPEED

Transmission repetition rate: on request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 232
Default priority: 6
Parameter group number: 65 256 ($00FEE8_{16}$)

Byte:			
	1,2	Compass bearing	5.2.5.83
	3,4	Navigation-based vehicle speed	5.2.1.13
	5,6	Pitch	5.2.5.84
	7,8	Altitude	5.2.5.52

5.3.23 FUEL CONSUMPTION

Transmission repetition rate:	on request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	233
Default priority:	6
Parameter group number:	65 257 ($00FEE9_{16}$)

Byte:	1-4	Trip fuel	5.2.5.64
	5-8	Total fuel used	5.2.5.66

5.3.24 VEHICLE WEIGHT

Transmission repetition rate:	on request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	234
Default priority:	6
Parameter group number:	65 258 ($00FEEA_{16}$)

Byte:	1	Axle location	5.2.5.95
	2,3	Axle weight	5.2.5.80
	4,5	Trailer weight	5.2.5.81
	6,7	Cargo weight	5.2.5.82
	8	Not defined	

(R) NOTE–Request has to be responded to with as many messages as necessary to transmit all available information.

5.3.25 COMPONENT IDENTIFICATION

Transmission repetition rate:	on request
Data length:	Variable
Data page:	0
PDU format:	254
PDU specific:	235
Default priority:	6
Parameter group number:	65 259 ($00FEEB_{16}$)

Field:	a	Make	5.2.5.90
		Delimiter (ASCII “*”)	
	b	Model	5.2.5.91
		Delimiter (ASCII “*”)	
	c	Serial number	5.2.5.92
		Delimiter (ASCII “*”)	
	d	Unit number (Power unit)	5.2.5.89
		Delimiter (ASCII “*”)	

NOTE—The make, model, serial number and unit number fields in this message are optional and separated by an ASCII “*”. It is not necessary to include all fields; however, the delimiter (“*”) is always required.

5.3.26 VEHICLE IDENTIFICATION

Transmission repetition rate: on request
Data length: Variable
Data page: 0
PDU format: 254
PDU specific: 236
Default priority: 6
Parameter group number: 65 260 ($00FEEC_{16}$)

Byte:	1-n	Vehicle Identification Number Delimiter (ASCII "*")	5.2.5.87

5.3.27 CRUISE CONTROL/VEHICLE SPEED SETUP

Transmission repetition rate: on request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 237
Default priority: 6
Parameter group number: 65 261 ($00FEED_{16}$)

Byte:	1	Maximum vehicle speed limit	5.2.5.46
	2	Cruise control high set limit speed	5.2.5.48
	3	Cruise control low set limit speed	5.2.5.49
	4-8	Not defined	

5.3.28 ENGINE TEMPERATURE

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 238
Default priority: 6
Parameter group number: 65 262 ($00FEEE_{16}$)

	Byte:	1	Engine coolant temperature	5.2.5.5
		2	Fuel temperature	5.2.5.14
(R)		3,4	Engine oil temperature 1	5.2.5.15
		5,6	Turbo oil temperature	5.2.5.16
		7	Engine intercooler temperature	5.2.5.6
(R)		8	Engine intercooler thermostat opening	5.2.5.242

5.3.29 ENGINE FLUID LEVEL/PRESSURE

Transmission repetition rate: 0.5 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 239
Default priority: 6
Parameter group number: 65 263 ($00FEEF_{16}$)

	Byte:			
	1	Fuel delivery pressure		5.2.5.27
(R)	2	Extended crankcase blow-by pressure		5.2.5.241
	3	Engine oil level		5.2.5.72
	4	Engine oil pressure		5.2.5.28
	5,6	Crankcase pressure		5.2.5.40
	7	Coolant pressure		5.2.5.38
	8	Coolant level		5.2.5.73

5.3.30 POWER TAKEOFF INFORMATION

Transmission repetition rate: 100 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 240
Default priority: 6
Parameter group number: 65 264 ($00FEF0_{16}$)

	Byte:					
	1	Power takeoff oil temperature				5.2.5.3
	2,3	Power takeoff speed				5.2.5.56
	4,5	Power takeoff set speed				5.2.5.57
(R)	6	Measured_PTO_1	Bit:	8,7	Not defined	
				6,5	Remote PTO variable speed control switch	5.2.6.43
				4,3	Remote PTO preprogrammed speed control switch	5.2.6.44
				2,1	PTO enable switch	5.2.6.45
(R)	7	Measured_PTO_2	Bit:	8,7	PTO accelerate switch	5.2.6.46
				6,5	PTO resume switch	5.2.6.47
				4,3	PTO coast/decelerate switch	5.2.6.48
				2,1	PTO set switch	5.2.6.49
(R)	8	Not defined				

5.3.31 CRUISE CONTROL/VEHICLE SPEED

Transmission repetition rate: 100 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 241
Default priority: 6
Parameter group number: 65 265 ($00FEF1_{16}$)

	Byte:			Bit:		
	1	Measured_SW1		8-5	Not defined	
				4,3	Parking brake switch	5.2.6.8
				2,1	Two speed axle switch	5.2.6.1
	2,3	Wheel-based vehicle speed				5.2.1.12
	4	Measured_CC_SW1	Bit:	8,7	Clutch switch	5.2.6.12
				6,5	Brake switch	5.2.6.11
				4,3	Cruise control enable switch	5.2.6.10
				2,1	Cruise control active	5.2.6.9
	5	Measured_CC_SW2	Bit:	8,7	Cruise control accelerate switch	5.2.6.17
				6,5	Cruise control resume switch	5.2.6.16
				4,3	Cruise control coast switch	5.2.6.15
				2,1	Cruise control set switch	5.2.6.14
	6	Cruise control set speed				5.2.5.47
	7	State_CC	Bit:	8-6	Cruise control state	5.2.2.18
(R)				5-1	PTO state	5.2.2.19
(R)	8	Measured_Idle_SW1	Bit:	8,7	Engine shutdown override switch	5.2.6.102
				6,5	Engine test mode switch	5.2.6.40
				4,3	Idle decrement switch	5.2.6.41
				2,1	Idle increment switch	5.2.6.42

5.3.32 FUEL ECONOMY

Transmission repetition rate: 100 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 242
Default priority: 6
Parameter group number: 65 266 ($00FEF2_{16}$)

	Byte:		
	1,2	Fuel rate	5.2.5.63
	3,4	Instantaneous fuel economy	5.2.5.67
	5,6	Average fuel economy	5.2.5.68
(R)	7	Throttle position	5.2.5.96
(R)	8	Not defined	

5.3.33 VEHICLE POSITION

Transmission repetition rate: 5 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 243
Default priority: 6
Parameter group number: 65 267 ($00FEF3_{16}$)

Byte:			
	1-4	Latitude	5.2.5.85
	5-8	Longitude	5.2.5.86

5.3.34 TIRE CONDITION

Transmission repetition rate: 10 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 244
Default priority: 6
Parameter group number: 65 268 ($00FEF4_{16}$)

Byte:			
	1	Location	5.2.5.95
	2	Tire pressure	5.2.5.34
	3,4	Tire temperature	5.2.5.18
	5-8	Not defined	

(R) NOTE–Request has to be responded to with as many messages as necessary to transmit all available information.

5.3.35 AMBIENT CONDITIONS

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 245
Default priority: 6
Parameter group number: 65 269 ($00FEF5_{16}$)

Byte:			
	1	Barometric pressure	5.2.5.43
	2,3	Cab interior temperature	5.2.5.11
	4,5	Ambient air temperature	5.2.5.12
	6	Air inlet temperature	5.2.5.13
	7,8	Road surface temperature	5.2.5.9

5.3.36 INLET/EXHAUST CONDITIONS

Transmission repetition rate: 0.5 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 246
Default priority: 6
Parameter group number: 65 270 ($00FEF6_{16}$)

Byte:	1	Particulate trap inlet pressure	5.2.5.41
	2	Boost pressure	5.2.5.36
(R)	3	Intake manifold 1 temperature	5.2.5.4
	4	Air inlet pressure	5.2.5.37
	5	Air filter differential pressure	5.2.5.45
	6,7	Exhaust gas temperature	5.2.5.8
	8	Coolant filter differential pressure	5.2.5.44

5.3.37 VEHICLE ELECTRICAL POWER

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 247
Default priority: 6
Parameter group number: 65 271 ($00FEF7_{16}$)

Byte:	1	Net battery current	5.2.5.78
	2	Alternator current	5.2.5.79
	3,4	Alternator potential (voltage)	5.2.5.76
	5,6	Electrical potential (voltage)	5.2.5.77
	7,8	Battery potential (voltage), switched	5.2.5.75

5.3.38 TRANSMISSION FLUIDS

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 248
Default priority: 6
Parameter group number: 65 272 ($00FEF8_{16}$)

Byte:	1	Clutch pressure	5.2.5.23
	2	Transmission oil level	5.2.5.74
	3	Transmission filter differential pressure	5.2.5.39
	4	Transmission oil pressure	5.2.5.24
	5,6	Transmission oil temperature	5.2.5.17
	7,8	Not defined	

5.3.39 AXLE INFORMATION

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 249
Default priority: 6
Parameter group number: 65 273 ($00FEF9_{16}$)

Byte:	1	Steering axle temperature	5.2.5.1
	2	Drive axle location	5.2.5.95
	3	Drive axle lift air pressure	5.2.5.25
	4	Drive axle temperature	5.2.5.2
	5-8	Not defined	

(R) NOTE–Request has to be responded to with as many messages as necessary to transmit all available information.

5.3.40 BRAKES

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 250
Default priority: 6
Parameter group number: 65 274 ($00FEFA_{16}$)

Byte:	1	Brake application pressure				5.2.5.30
	2	Brake primary pressure				5.2.5.31
	3	Brake secondary pressure				5.2.5.32
	4	Brake_status	Bit:	8-3	Not defined	
				2,1	Parking brake actuator	5.2.6.13
	5-8	Not defined				

5.3.41 RETARDER FLUIDS

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 251
Default priority: 6
Parameter group number: 65 275 ($00FEFB_{16}$)

Byte:	1	Hydraulic retarder pressure	5.2.5.33
	2	Hydraulic retarder oil temperature	5.2.5.7
	3-8	Not defined	

5.3.42 DASH DISPLAY

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 252
Default priority: 6
Parameter group number: 65 276 ($00FEFC_{16}$)

Byte:	1	Washer fluid level	5.2.5.70
	2	Fuel level	5.2.5.71
	3	Fuel filter differential pressure	5.2.5.35
	4	Engine oil filter differential pressure	5.2.5.42
	5,6	Cargo ambient temperature	5.2.5.10
	7-8	Not defined	

5.3.43 ALTERNATE FUEL #1

Transmission repetition rate: 500 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 253
Default priority: 6
Parameter group number: 65 277 ($00FEFD_{16}$)

Byte:	1	Blower bypass valve position	5.2.5.69
	2,3	Gas supply pressure	5.2.5.19
	4-8	Not defined	

5.3.44 AUXILIARY WATER PUMP PRESSURE

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 254
Default priority: 6
Parameter group number: 65 278 ($00FEFE_{16}$)

Byte:	1	Auxiliary pump pressure	5.2.5.22
	2-8	Not defined	

5.3.45 WATER IN FUEL INDICATOR

Transmission repetition rate: 10 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 255
Default priority: 6
Parameter group number: 65 279 ($00FEFF_{16}$)

(R)	Byte:	1	Water in fuel indicator Bit:	8-3	Not defined	
				2,1	Water in fuel indicator	5.2.6.7
		2-8	Not defined			

5.3.46 ENGINE FLUID LEVEL/PRESSURE #2

Transmission repetition rate: 0.5 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 219
Default priority: 6
Parameter group number: 65 243 ($00FEDB_{16}$)

	Byte:	1,2	Injection control pressure	5.2.5.20
(R)		3,4	Injector metering rail 1 pressure	5.2.5.21
(R)		5,6	Injector timing rail 1 pressure	5.2.5.243
(R)		7,8	Injector metering rail 2 pressure	5.2.5.244

5.3.47 SOFTWARE IDENTIFICATION

Transmission repetition rate: on request
Data length: Variable
Data page: 0
PDU format: 254
PDU specific: 218
Default priority: 6
Parameter group number: 65 242 ($00FEDA_{16}$)

(R)	Byte:	1	Number of software identification fields	5.2.5.114
		2-n	Software identification(s) Delimiter (ASCII "*")	5.2.5.88

NOTE—The software identification field is variable in length and may contain up to 125 software identification designators. An ASCII "*" is used as a delimiter to separate multiple software identifications. Additional software identification fields may be added at the end, each separated by an ASCII "*" as a delimiter. An ASCII "*" is required at the end of the last software identification field, even if there is only one software identification designator.

5.3.48 AUXILIARY DISCRETE INPUT/OUTPUT STATUS

(R) Transmission repetition rate: manufacturer defined, not faster than 100 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 217
Default priority: 6
Parameter group number: 65 241 ($00FED9_{16}$)

Byte:	1	I/O_Status1	Bit:	8,7	I/O channel #1	5.2.6.18
				6,5	I/O channel #2	5.2.6.18
				4,3	I/O channel #3	5.2.6.18
				2,1	I/O channel #4	5.2.6.18
	2	I/O_Status2	Bit:	8,7	I/O channel #5	5.2.6.18
				6,5	I/O channel #6	5.2.6.18
				4,3	I/O channel #7	5.2.6.18
				2,1	I/O channel #8	5.2.6.18
	3	I/O_Status3	Bit:	8,7	I/O channel #9	5.2.6.18
				6,5	I/O channel #10	5.2.6.18
				4,3	I/O channel #11	5.2.6.18
				2,1	I/O channel #12	5.2.6.18
	4	I/O_Status4	Bit:	8,7	I/O channel #13	5.2.6.18
				6,5	I/O channel #14	5.2.6.18
				4,3	I/O channel #15	5.2.6.18
				2,1	I/O channel #16	5.2.6.18
(R)	5,6	Auxiliary I/O channel #1				5.2.5.168
(R)	7,8	Auxiliary I/O channel #2				5.2.5.168

(R) NOTE—SPN 701 is used for I/O channel #1. The remaining I/O channels are numbered sequentially ending with SPN 716 for I/O channel #16.

5.3.49 ALTERNATOR SPEED

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 213
Default priority: 6
Parameter group number: 65 237 ($00FED5_{16}$)

Byte:	1,2	Alternator speed	5.2.5.97
	3-8	Not defined	

5.3.50 ELECTRONIC TRANSMISSION CONTROLLER #3: ETC3

Transmission repetition rate: on request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 199
Default priority: 7
Parameter group number: 65 223 ($00FEC7_{16}$)

Byte:						
1	Shift finger gear position					5.2.5.99
2	Shift finger rail position					5.2.5.98
3	Shift_finger_status_1	Bit:	8-7	Not defined		
			6,5	Center rail indicator		5.2.6.21
			4,3	Engagement indicator		5.2.6.20
			2,1	Neutral indicator		5.2.6.19
4	Shift_finger_status_2	Bit:	8,7	Gear actuator 2		5.2.6.23
			6,5	Rail actuator 2		5.2.6.25
			4,3	Gear actuator 1		5.2.6.22
			2,1	Rail actuator 1		5.2.6.24
5	Transmission_actuator_1	Bit:	8,7	Splitter indirect actuator		5.2.6.26
			6,5	Splitter direct actuator		5.2.6.27
			4,3	Range low actuator		5.2.6.28
			2,1	Range high actuator		5.2.6.29
6	Transmission_actuator_2	Bit:	8,7	Inertia brake actuator		5.2.6.30
			6,5	Defuel actuator		5.2.6.31
			4,3	Lockup clutch actuator		5.2.6.32
			2,1	Clutch actuator		5.2.6.33
7-8	Not defined					

5.3.51 ELECTRONIC TRANSMISSION CONTROLLER #4: ETC4

Transmission repetition rate: on request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 197
Default priority: 7
Parameter group number: 65 221 ($00FEC5_{16}$)

Byte:			
1	Transmission synchronizer clutch value		5.2.5.100
2	Transmission synchronizer brake value		5.2.5.101
3-8	Not defined		

5.3.52 ELECTRONIC TRANSMISSION CONTROLLER #5: ETC5

Transmission repetition rate: on request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 195
Default priority: 7
Parameter group number: 65 219 ($00FEC3_{16}$)

(R)	Byte: 1	Range	Bit:	8-5	Not defined	
				4,3	Low range sense switch	5.2.6.34
				2,1	High range sense switch	5.2.6.35
(R)	2	Direction	Bit:	8-7	Not defined	
				6,5	Forward direction switch	5.2.6.36
				4,3	Neutral direction switch	5.2.6.37
				2,1	Reverse direction switch	5.2.6.38
	3-8	Not defined				

5.3.53 ELECTRONIC RETARDER CONTROLLER #2: ERC2

Transmission repetition rate: 1 s when active; or on change of state
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 194
Default priority: 7
Parameter group number: 65 218 ($00FEC2_{16}$)

Byte: 1	Retarder_status	Bit:	8-3	Not defined	
			2,1	Transmission output retarder	5.2.6.39
2-8	Not defined				

5.3.54 HIGH RESOLUTION VEHICLE DISTANCE

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 193
Default priority: 6
Parameter group number: 65 217 ($00FEC1_{16}$)

Byte: 1-4	High resolution total vehicle distance	5.2.5.106
5-8	High resolution trip distance	5.2.5.107

5.3.55 SERVICE—Transmitted with the service component identification that has the shortest distance or nearest time until the next service inspection.

Transmission repetition rate:	On request
(R) Data length:	8 bytes or variable
Data page:	0
PDU format:	254
PDU specific:	192
Default priority:	6
Parameter group number:	65 216 ($00FEC0_{16}$)

Byte:	1	Service component identification	5.2.5.102
	2,3	Service distance	5.2.5.103
	4	Service component identification	5.2.5.102
	5	Service delay/calendar time based	5.2.5.104
	6	Service component identification	5.2.5.102
	7,8	Service delay/operational time based	5.2.5.105

(R) NOTE—There are two acceptable formats for the Service PGN. Format 1 has only 8 bytes of data and reports the component most in need of service for each of the three categories. Format 2, however, uses the transport layer as necessary in order to repeat these 8 bytes of service component information until all supported service components in each category have been transmitted.

5.3.56 WHEEL SPEED INFORMATION

Transmission repetition rate:	100 ms
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	191
Default priority:	6
Parameter group number:	65 215 ($00FEBF_{16}$)

Byte:	1,2	Front axle speed	5.2.1.51
	3	Relative speed; front axle, left wheel	5.2.1.52
	4	Relative speed; front axle, right wheel	5.2.1.53
	5	Relative speed; rear axle #1, left wheel	5.2.1.54
	6	Relative speed; rear axle #1, right wheel	5.2.1.55
	7	Relative speed; rear axle #2, left wheel	5.2.1.56
	8	Relative speed; rear axle #2, right wheel	5.2.1.57

5.3.57 ELECTRONIC ENGINE CONTROLLER #4: EEC4

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 190
Default priority: 7
Parameter group number: 65 214 ($00FEBE_{16}$)

Byte:			
1,2	Rated engine power		5.2.5.115
3,4	Rated engine speed		5.2.5.116
5-8	Not defined		

(R) 5.3.58 FAN DRIVE

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 189
Default priority: 6
Parameter group number: 65 213 ($00FEBD_{16}$)

Byte:					
1	Estimated percent fan speed				5.2.1.60
2	State_Fan_Drive	Bit:	8-5	Not defined	
			4-1	Fan drive state	5.2.2.20
3-8	Not defined				

(R) 5.3.59 CAB MESSAGE #1: CM1

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 224
PDU specific: Destination address
Default priority: 6
Parameter group number: 57 344 ($00E000_{16}$)

Byte:			
1	Requested percent fan speed		5.2.1.61
2-8	Not defined		

(R) 5.3.60 COMPRESSION/SERVICE BRAKE INFORMATION

Transmission repetition rate:	On request
Data length:	16 bytes
Data page:	0
PDU format:	254
PDU specific:	188
Default priority:	7
Parameter group number:	65 212 ($00FEBC_{16}$)

Byte:	1-4	Total compression brake distance	5.2.5.117
	5-8	Trip compression brake distance	5.2.5.118
	9-12	Trip service brake distance	5.2.5.119
	13-16	Trip service brake applications	5.2.5.120

(R) 5.3.61 TRIP FAN INFORMATION

Transmission repetition rate:	On request
Data length:	16 bytes
Data page:	0
PDU format:	254
PDU specific:	187
Default priority:	7
Parameter group number:	65 211 ($00FEBB_{16}$)

Byte:	1-4	Trip fan on time	5.2.5.121
	5-8	Trip fan on time due to the engine system	5.2.5.122
	9-12	Trip fan on time due to a manual switch	5.2.5.123
	13-16	Trip fan on time due to the A/C system	5.2.5.124

(R) 5.3.62 TRIP DISTANCE INFORMATION

Transmission repetition rate:	On request
Data length:	12 bytes
Data page:	0
PDU format:	254
PDU specific:	186
Default priority:	7
Parameter group number:	65 210 ($00FEBA_{16}$)

Byte:	1-4	Trip distance on VSL	5.2.5.125
	5-8	Trip gear down distance	5.2.5.126
	9-12	Trip distance in top gear	5.2.5.127

(R) 5.3.63 TRIP FUEL INFORMATION

Transmission repetition rate: On request
Data length: 22 bytes
Data page: 0
PDU format: 254
PDU specific: 185
Default priority: 7
Parameter group number: 65 209 ($00FEB9_{16}$)

Byte:			
	1-4	Trip drive fuel used	5.2.5.128
	5-8	Trip PTO moving fuel used	5.2.5.129
	9-12	Trip PTO non-moving fuel used	5.2.5.130
	13-16	Trip vehicle idle fuel used	5.2.5.131
	17-20	Trip cruise fuel used	5.2.5.132
	21-22	Trip drive fuel economy	5.2.5.133

(R) 5.3.64 TRIP FUEL INFORMATION (GASEOUS)

Transmission repetition rate: On request
Data length: 22 bytes
Data page: 0
PDU format: 254
PDU specific: 184
Default priority: 7
Parameter group number: 65 208 ($00FEB8_{16}$)

Byte:			
	1-4	Trip drive fuel used (natural gas)	5.2.5.134
	5-8	Trip PTO moving fuel used (natural gas)	5.2.5.135
	9-12	Trip PTO non-moving fuel used (natural gas)	5.2.5.136
	13-16	Trip vehicle idle fuel used (natural gas)	5.2.5.137
	17-20	Trip cruise fuel used (natural gas)	5.2.5.138
	21-22	Trip drive fuel economy (natural gas)	5.2.5.139

(R) 5.3.65 ENGINE SPEED/LOAD FACTOR INFORMATION

Transmission repetition rate: On request
Data length: 10 bytes
Data page: 0
PDU format: 254
PDU specific: 183
Default priority: 7
Parameter group number: 65 207 ($00FEB7_{16}$)

Byte:			
	1-2	Trip maximum engine speed	5.2.5.140
	3-4	Trip average engine speed	5.2.5.141
	5	Trip drive average load factor	5.2.5.142
	6	Total drive average load factor	5.2.5.143
	7-10	Total engine cruise time	5.2.5.144

(R) 5.3.66 TRIP VEHICLE SPEED/CRUISE DISTANCE INFORMATION

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	82
Default priority:	7
Parameter group number:	65 206 ($00FEB6_{16}$)

Byte: 1-2	Trip maximum vehicle speed	5.2.5.145
3-6	Trip cruise distance	5.2.5.146
7-8	Not defined	

(R) 5.3.67 TRIP SHUTDOWN INFORMATION

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	181
Default priority:	7
Parameter group number:	65 205 ($00FEB5_{16}$)

Byte: 1-2	Trip number of hot shutdowns	5.2.5.147
3-4	Trip number of idle shutdowns	5.2.5.148
5-6	Trip number of idle shutdown overrides	5.2.5.149
7-8	Trip number of sudden decelerations	5.2.5.150

(R) 5.3.68 TRIP TIME INFORMATION #1

Transmission repetition rate:	On request
Data length:	16 bytes
Data page:	0
PDU format:	254
PDU specific:	180
Default priority:	7
Parameter group number:	65 204 ($00FEB4_{16}$)

Byte: 1-4	Trip time in VSL	5.2.5.151
5-8	Trip time in top gear	5.2.5.152
9-12	Trip time in gear down	5.2.5.153
13-16	Trip time in derate by engine	5.2.5.154

(R) 5.3.69 FUEL INFORMATION

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	179
Default priority:	7
Parameter group number:	65 203 ($00FEB3_{16}$)

Byte:	1-4	Total engine PTO fuel used	5.2.5.155
	5-6	Trip average fuel rate	5.2.5.156
	7-8	Not defined	

(R) 5.3.70 FUEL INFORMATION (GASEOUS)

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	178
Default priority:	7
Parameter group number:	65 202 ($00FEB2_{16}$)

Byte:	1-4	Total engine PTO fuel used (natural gas)	5.2.5.157
	5,6	Trip average fuel rate (natural gas)	5.2.5.158
	7,8	Fuel specific gravity	5.2.5.245

(R) 5.3.71 ECU HISTORY

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	177
Default priority:	7
Parameter group number:	65 201 ($00FEB1_{16}$)

Byte:	1-4	Total ECU distance	5.2.5.159
	5-8	Total ECU run time	5.2.5.160

(R) 5.3.72 TRIP TIME INFORMATION #2

Transmission repetition rate: On request
Data length: 20 bytes
Data page: 0
PDU format: 254
PDU specific: 176
Default priority: 7
Parameter group number: 65 200 ($00FEB0_{16}$)

Byte:			
1-4	Trip cruise time		5.2.5.161
5-8	Trip PTO time		5.2.5.162
9-12	Trip engine running time		5.2.5.163
13-16	Trip idle time		5.2.5.164
17-20	Trip air compressor on time		5.2.5.165

(R) 5.3.73 FUEL CONSUMPTION (GASEOUS)

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 175
Default priority: 7
Parameter group number: 65 199 ($00FEAF_{16}$)

Byte:			
1-4	Trip fuel (natural gas)		5.2.5.166
5-8	Total fuel used (natural gas)		5.2.5.167

(R) 5.3.74 RESET

Transmission repetition rate: When needed
Data length: 8 bytes
Data page: 0
PDU format: 222
PDU specific: Destination address
Default priority: 7
Parameter group number: 56 832 ($00DE00_{16}$)

Byte:					
1	Trip reset	Bit:	8-5	Not defined	
			4,3	Trip group 2 - Proprietary	5.2.3.14
			2,1	Trip group 1	5.2.3.13
2	Service component to reset				5.2.5.102
3	General reset	Bit:	8-3	Not defined	
			2,1	Engine build hours reset	5.2.6.70
4-8	Not defined				

NOTE—This message requires an Acknowledgement response (See SAE J1939-21, 5.4.4) from the receiving node. The use of individual proprietary protocols can still be used instead of the “trip reset” PGN to maintain security.

(R) 5.3.75 SUPPLY PRESSURE

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 174
Default priority: 6
Parameter group number: 65 198 ($00FEAE_{16}$)

Byte:	1	Pneumatic supply pressure	5.2.5.170
	2	Parking and/or trailer air pressure	5.2.5.171
	3	Service brake air pressure, circuit #1	5.2.5.172
	4	Service brake air pressure, circuit #2	5.2.5.173
	5	Auxiliary equipment supply pressure	5.2.5.174
	6	Air suspension supply pressure	5.2.5.175
	7-8	Not defined	

(R) 5.3.76 WHEEL APPLICATION PRESSURE HIGH RANGE INFORMATION: EBC3

Transmission repetition rate: 100 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 173
Default priority: 6
Parameter group number: 65 197 ($00FEAD_{16}$)

Byte:	1	Brake application pressure high range, front axle, left wheel	5.2.5.176
	2	Brake application pressure high range, front axle, right wheel	5.2.5.177
	3	Brake application pressure high range, rear axle #1, left wheel	5.2.5.178
	4	Brake application pressure high range, rear axle #1, right wheel	5.2.5.179
	5	Brake application pressure high range, rear axle #2, left wheel	5.2.5.180
	6	Brake application pressure high range, rear axle #2, right wheel	5.2.5.181
	7	Brake application pressure high range, rear axle #3, left wheel	5.2.5.182
	8	Brake application pressure high range, rear axle #3, right wheel	5.2.5.183

(R) 5.3.77 WHEEL BRAKE LINING REMAINING INFORMATION: EBC4

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	172
Default priority:	7
Parameter group number:	65 196 ($00FEAC_{16}$)

Byte:	1	Brake lining remaining, front axle, left wheel	5.2.5.184
	2	Brake lining remaining, front axle, right wheel	5.2.5.185
	3	Brake lining remaining, rear axle #1, left wheel	5.2.5.186
	4	Brake lining remaining, rear axle #1, right wheel	5.2.5.187
	5	Brake lining remaining, rear axle #2, left wheel	5.2.5.188
	6	Brake lining remaining, rear axle #2, right wheel	5.2.5.189
	7	Brake lining remaining, rear axle #3, left wheel	5.2.5.190
	8	Brake lining remaining, rear axle #3, right wheel	5.2.5.191

(R) 5.3.78 ELECTRONIC TRANSMISSION CONTROLLER #6: ETC6

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	171
Default priority:	7
Parameter group number:	65 195 ($00FEAB_{16}$)

Byte:	1	Recommended Gear	5.2.5.192
	2	Highest Possible Gear	5.2.5.193
	3	Lowest Possible Gear	5.2.5.194
	4-8	Not Defined	

(R) 5.3.79 ALTERNATE FUEL #2

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	170
Default priority:	7
Parameter group number:	65 194 ($00FEAA_{16}$)

Byte:	1	Gaseous fuel correction factor	5.2.5.195
	2-8	Not defined	

(R) 5.3.80 EXHAUST OXYGEN #1

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 169
Default priority: 7
Parameter group number: 65 193 ($00FEA9_{16}$)

Byte:			
	1,2	Desired rated exhaust oxygen	5.2.5.196
	3,4	Desired exhaust oxygen	5.2.5.197
	5,6	Actual exhaust oxygen	5.2.5.198
	7-8	Not defined	

(R) 5.3.81 ARTICULATION CONTROL

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 162
Default priority: 7
Parameter group number: 65 192 ($00FEA8_{16}$)

Byte:			
	1	Articulation angle	5.2.5.199
	2-8	Not defined	

(R) 5.3.82 ALTERNATOR TEMPERATURE

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 167
Default priority: 7
Parameter group number: 65 191 ($00FEA7_{16}$)

Byte:			
	1	Alternator bearing 1 temperature	5.2.5.200
	2	Alternator bearing 2 temperature	5.2.5.200
	3	Alternator winding 1 temperature	5.2.5.201
	4	Alternator winding 2 temperature	5.2.5.201
	5	Alternator winding 3 temperature	5.2.5.201
	6-8	Not defined	

(R) 5.3.83 INTAKE MANIFOLD INFORMATION #1

Transmission repetition rate: 0.5 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 166
Default priority: 6
Parameter group number: 65 190 ($00FEA6_{16}$)

Byte:	1,2	Turbocharger 1 boost pressure	5.2.5.202
	3,4	Turbocharger 2 boost pressure	5.2.5.202
	5,6	Turbocharger 3 boost pressure	5.2.5.202
	7,8	Turbocharger 4 boost pressure	5.2.5.202

(R) 5.3.84 INTAKE MANIFOLD INFORMATION #2

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 165
Default priority: 7
Parameter group number: 65 189 ($00FEA5_{16}$)

Byte:	1	Intake manifold 2 temperature	5.2.5.4
	2	Intake manifold 3 temperature	5.2.5.4
	3	Intake manifold 4 temperature	5.2.5.4
	4-8	Not defined	

(R) 5.3.85 ENGINE TEMPERATURE #2

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 164
Default priority: 6
Parameter group number: 65 188 ($00FEA4_{16}$)

Byte:	1,2	Engine oil temperature 2	5.2.5.15
	3,4	Engine ECU temperature	5.2.5.216
	5-8	Not defined	

(R) 5.3.86 EXHAUST PORT TEMPERATURE #1

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 163
Default priority: 7
Parameter group number: 65 187 ($00FEA3_{16}$)

Byte:	1,2	Exhaust gas port 1 temperature	5.2.5.203
	3,4	Exhaust gas port 2 temperature	5.2.5.203
	5,6	Exhaust gas port 3 temperature	5.2.5.203
	7,8	Exhaust gas port 4 temperature	5.2.5.203

(R) 5.3.87 EXHAUST PORT TEMPERATURE #2

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 162
Default priority: 7
Parameter group number: 65 186 ($00FEA2_{16}$)

Byte:	1,2	Exhaust gas port 5 temperature	5.2.5.203
	3,4	Exhaust gas port 6 temperature	5.2.5.203
	5,6	Exhaust gas port 7 temperature	5.2.5.203
	7,8	Exhaust gas port 8 temperature	5.2.5.203

(R) 5.3.88 EXHAUST PORT TEMPERATURE #3

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 161
Default priority: 7
Parameter group number: 65 185 ($00FEA1_{16}$)

Byte:	1,2	Exhaust gas port 9 temperature	5.2.5.203
	3,4	Exhaust gas port 10 temperature	5.2.5.203
	5,6	Exhaust gas port 11 temperature	5.2.5.203
	7,8	Exhaust gas port 12 temperature	5.2.5.203

(R) 5.3.89 EXHAUST PORT TEMPERATURE #4

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 160
Default priority: 7
Parameter group number: 65 184 ($00FEA0_{16}$)

Byte:	1,2	Exhaust gas port 13 temperature	5.2.5.203
	3,4	Exhaust gas port 14 temperature	5.2.5.203
	5,6	Exhaust gas port 15 temperature	5.2.5.203
	7,8	Exhaust gas port 16 temperature	5.2.5.203

(R) 5.3.90 EXHAUST PORT TEMPERATURE #5

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 159
Default priority: 7
Parameter group number: 65 183 ($00FE9F_{16}$)

Byte:	1,2	Exhaust gas port 17 temperature	5.2.5.203
	3,4	Exhaust gas port 18 temperature	5.2.5.203
	5,6	Exhaust gas port 19 temperature	5.2.5.203
	7,8	Exhaust gas port 20 temperature	5.2.5.203

(R) 5.3.91 MAIN BEARING TEMPERATURE #1

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 158
Default priority: 6
Parameter group number: 65 182 ($00FE9E_{16}$)

Byte:	1,2	Main bearing 1 temperature	5.2.5.204
	3,4	Main bearing 2 temperature	5.2.5.204
	5,6	Main bearing 3 temperature	5.2.5.204
	7,8	Main bearing 4 temperature	5.2.5.204

(R) 5.3.92 MAIN BEARING TEMPERATURE #2

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 157
Default priority: 6
Parameter group number: 65 181 ($00FE9D_{16}$)

Byte:	1,2	Main bearing 5 temperature	5.2.5.204
	3,4	Main bearing 6 temperature	5.2.5.204
	5,6	Main bearing 7 temperature	5.2.5.204
	7,8	Main bearing 8 temperature	5.2.5.204

(R) 5.3.93 MAIN BEARING TEMPERATURE #3

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 156
Default priority: 6
Parameter group number: 65 180 ($00FE9C_{16}$)

Byte:	1,2	Main bearing 9 temperature	5.2.5.204
	3,4	Main bearing 10 temperature	5.2.5.204
	5,6	Main bearing 11 temperature	5.2.5.204
	7,8	Not defined	

(R) 5.3.94 TURBOCHARGER INFORMATION #1

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 155
Default priority: 7
Parameter group number: 65 179 ($00FE9B_{16}$)

Byte:	1	Turbocharger lube oil pressure 2	5.2.5.29
	2,3	Turbocharger 2 speed	5.2.5.53
	4,5	Turbocharger 3 speed	5.2.5.53
	6,7	Turbocharger 4 speed	5.2.5.53
	8	Not defined	

(R) 5.3.95 TURBOCHARGER INFORMATION #2

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 154
Default priority: 6
Parameter group number: 65 178 ($00FE9A_{16}$)

Byte:	1	Turbocharger 1 compressor inlet temperature	5.2.5.205
	2	Turbocharger 2 compressor inlet temperature	5.2.5.205
	3	Turbocharger 3 compressor inlet temperature	5.2.5.205
	4	Turbocharger 4 compressor inlet temperature	5.2.5.205
	5-8	Not defined	

(R) 5.3.96 TURBOCHARGER INFORMATION #3

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 153
Default priority: 6
Parameter group number: 65 177 ($00FE99_{16}$)

Byte:	1,2	Turbocharger 1 compressor inlet pressure	5.2.5.206
	3,4	Turbocharger 2 compressor inlet pressure	5.2.5.206
	5,6	Turbocharger 3 compressor inlet pressure	5.2.5.206
	7,8	Turbocharger 4 compressor inlet pressure	5.2.5.206

(R) 5.3.97 TURBOCHARGER INFORMATION #4

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 152
Default priority: 6
Parameter group number: 65 176 ($00FE98_{16}$)

Byte:	1,2	Turbocharger 1 turbine inlet temperature	5.2.5.207
	3,4	Turbocharger 2 turbine inlet temperature	5.2.5.207
	5,6	Turbocharger 3 turbine inlet temperature	5.2.5.207
	7,8	Turbocharger 4 turbine inlet temperature	5.2.5.207

(R) 5.3.98 TURBOCHARGER INFORMATION #5

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 151
Default priority: 6
Parameter group number: 65 175 ($00FE97_{16}$)

Byte:	1,2	Turbocharger 1 turbine outlet temperature	5.2.5.208
	3,4	Turbocharger 2 turbine outlet temperature	5.2.5.208
	5,6	Turbocharger 3 turbine outlet temperature	5.2.5.208
	7,8	Turbocharger 4 turbine outlet temperature	5.2.5.208

(R) 5.3.99 TURBOCHARGER WASTEGATE

Transmission repetition rate: 100 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 150
Default priority: 6
Parameter group number: 65 174 ($00FE96_{16}$)

Byte:	1	Turbocharger 1 wastegate drive	5.2.5.209
	2	Turbocharger 2 wastegate drive	5.2.5.209
	3	Turbocharger 3 wastegate drive	5.2.5.209
	4	Turbocharger 4 wastegate drive	5.2.5.209
	5	Turbocharger wastegate actuator control air pressure	5.2.5.210
	6-8	Not defined	

(R) 5.3.100 REBUILD INFORMATION

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 149
Default priority: 7
Parameter group number: 65 173 ($00FE95_{16}$)

Byte:	1-4	Engine operation time since rebuild	5.2.5.211
	5-8	Not defined	

(R) 5.3.101 ANTI-THEFT REQUEST

Transmission repetition rate: Transmission of this message is interrupt driven. This message is also transmitted upon power-up of the interfacing device sending this message.
Data length: 8 bytes
Data page: 0
PDU format: 221
PDU specific: Destination Specific
Default priority: 7
Parameter group number: 56 576 ($00DD00_{16}$)

Byte: 1	Status_1	Bit:	8-6	Anti-theft command states	5.2.6.69
			5,4	Anti-theft desired exit mode states	5.2.6.68
			3,2	Anti-theft encryption indicator states	5.2.6.67
			1	Not defined	
2-8	Anti-theft password representation				5.2.5.213

NOTE–See Figures 20 to 25 for examples of Anti-theft message transfers. Bit 1 is the right most bit in each byte.

(R) 5.3.102 ANTI-THEFT STATUS

Transmission repetition rate: This message is transmitted in response to an Anti-Theft Request message. This message is also sent when the component has an abnormal power interruption. In this situation the Anti-Theft Status Report is sent without the Anti-Theft Request.
Data length: 8 bytes
Data page: 0
PDU format: 220
PDU specific: Destination Specific
Default priority: 7
Parameter group number: 56 320 ($00DC00_{16}$)

Byte: 1	Status_1	Bit:	8,7	Anti-theft modify password states	5.2.6.66
			6,5	Anti-theft component status states	5.2.6.65
			4,3	Anti-theft password valid indicator	5.2.6.64
			2,1	Anti-theft encryption seed present indicator	5.2.6.63
2-8	Anti-theft random number				5.2.5.212

NOTE–See Figures 20 to 25 for examples of Anti-theft message transfers. Bit 1 is the right most bit in each byte.

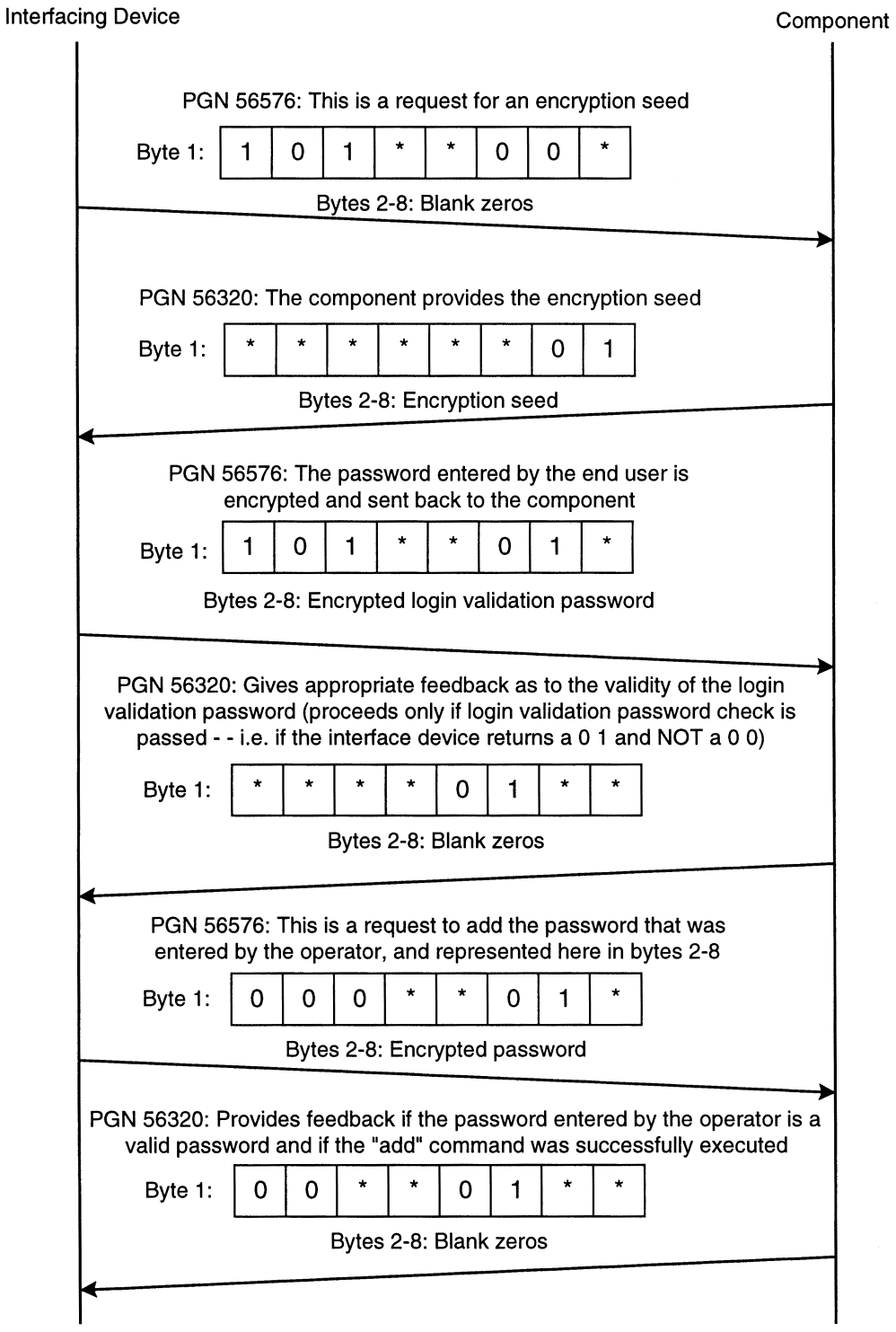


FIGURE 20—OPERATOR DESIRES TO ADD A PASSWORD TO THE COMPONENT'S PASSWORD STRUCTURE

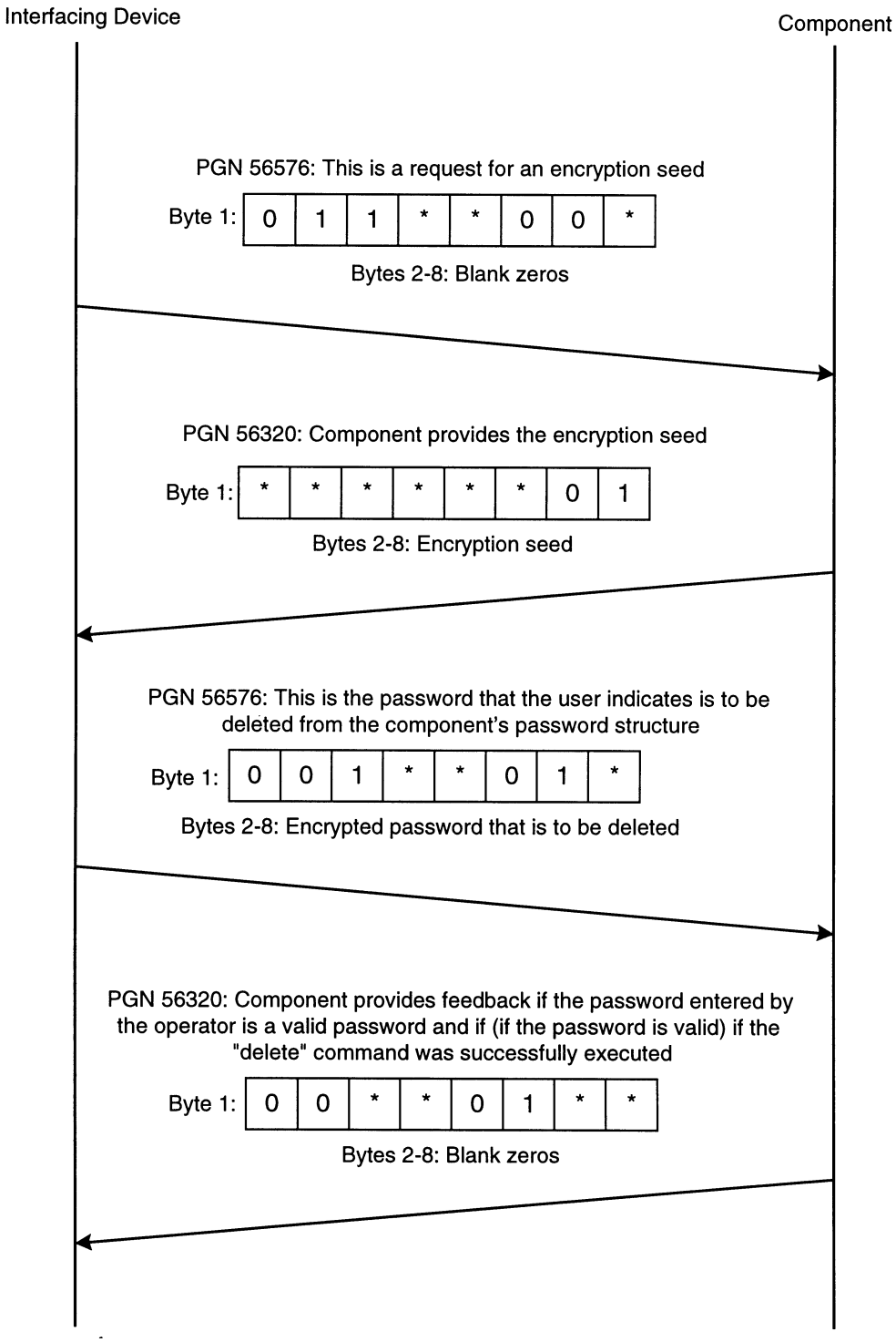


FIGURE 21—OPERATOR DESIRES TO DELETE A PASSWORD FROM THE COMPONENT'S PASSWORD STRUCTURE

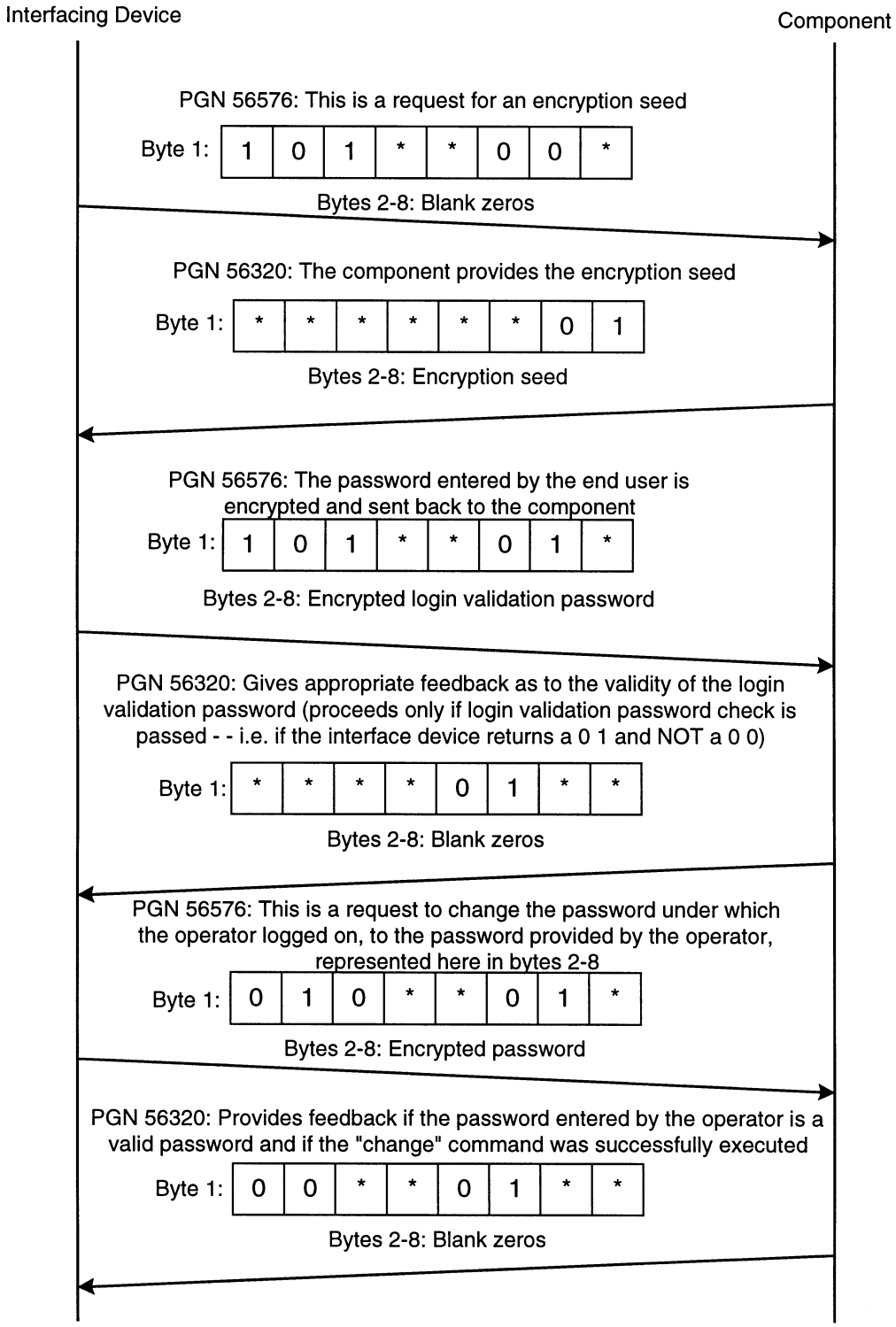


FIGURE 22—OPERATOR DESIRES TO CHANGE A PASSWORD WITHIN THE COMPONENT'S PASSWORD STRUCTURE

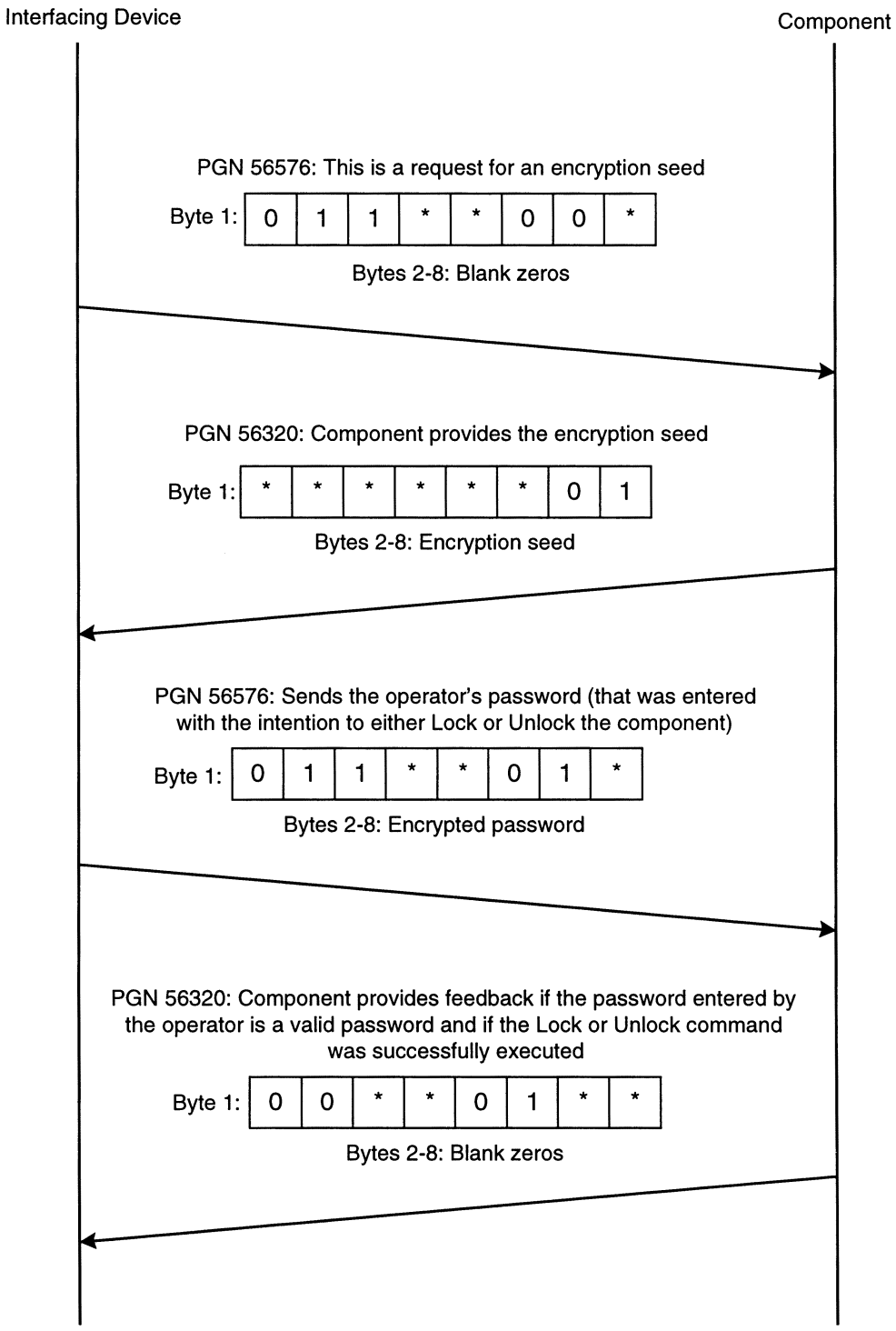


FIGURE 23—OPERATOR DESIRES TO LOCK OR UNLOCK THE COMPONENT

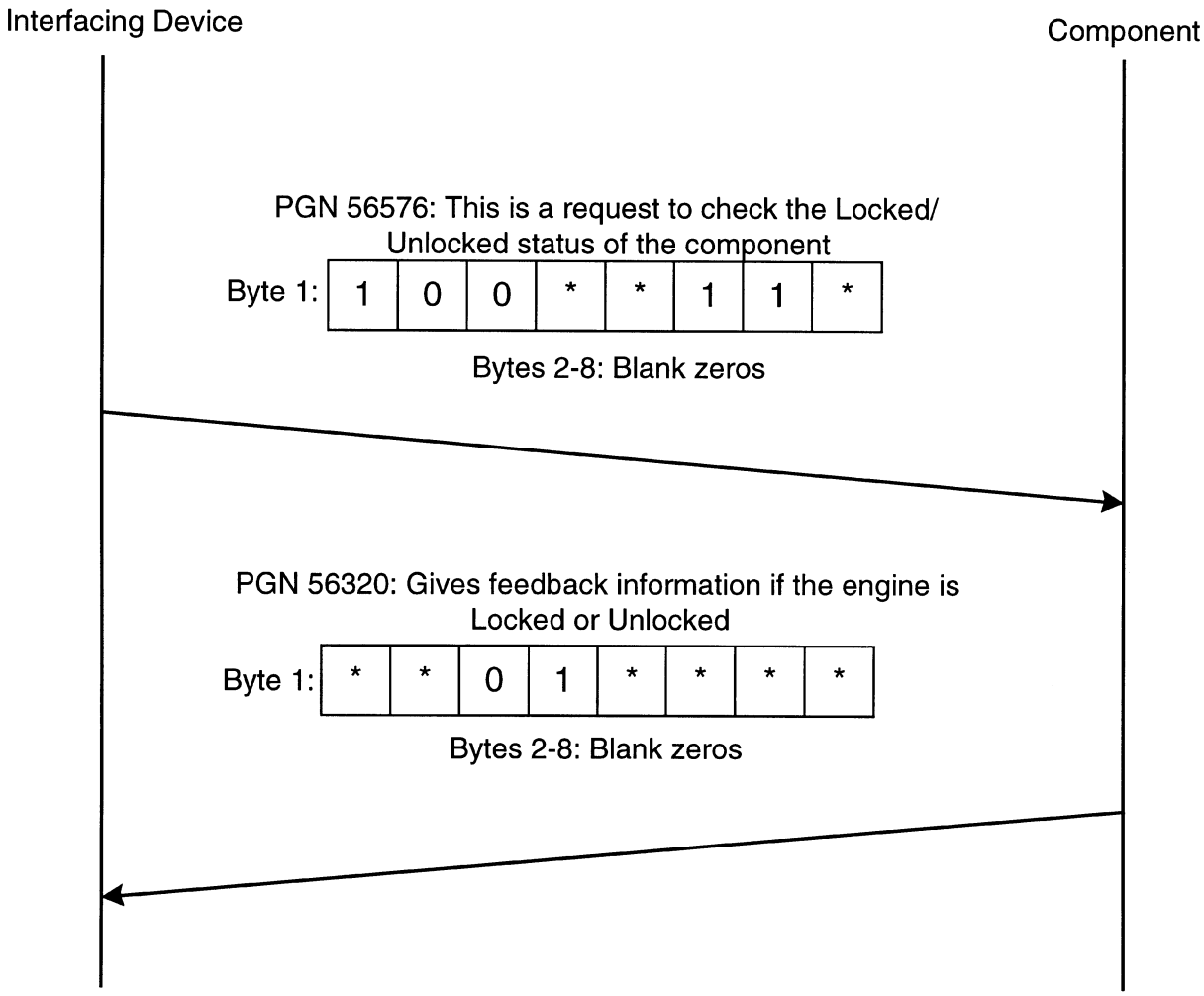


FIGURE 24—CHECKING STATUS OF THE COMPONENT

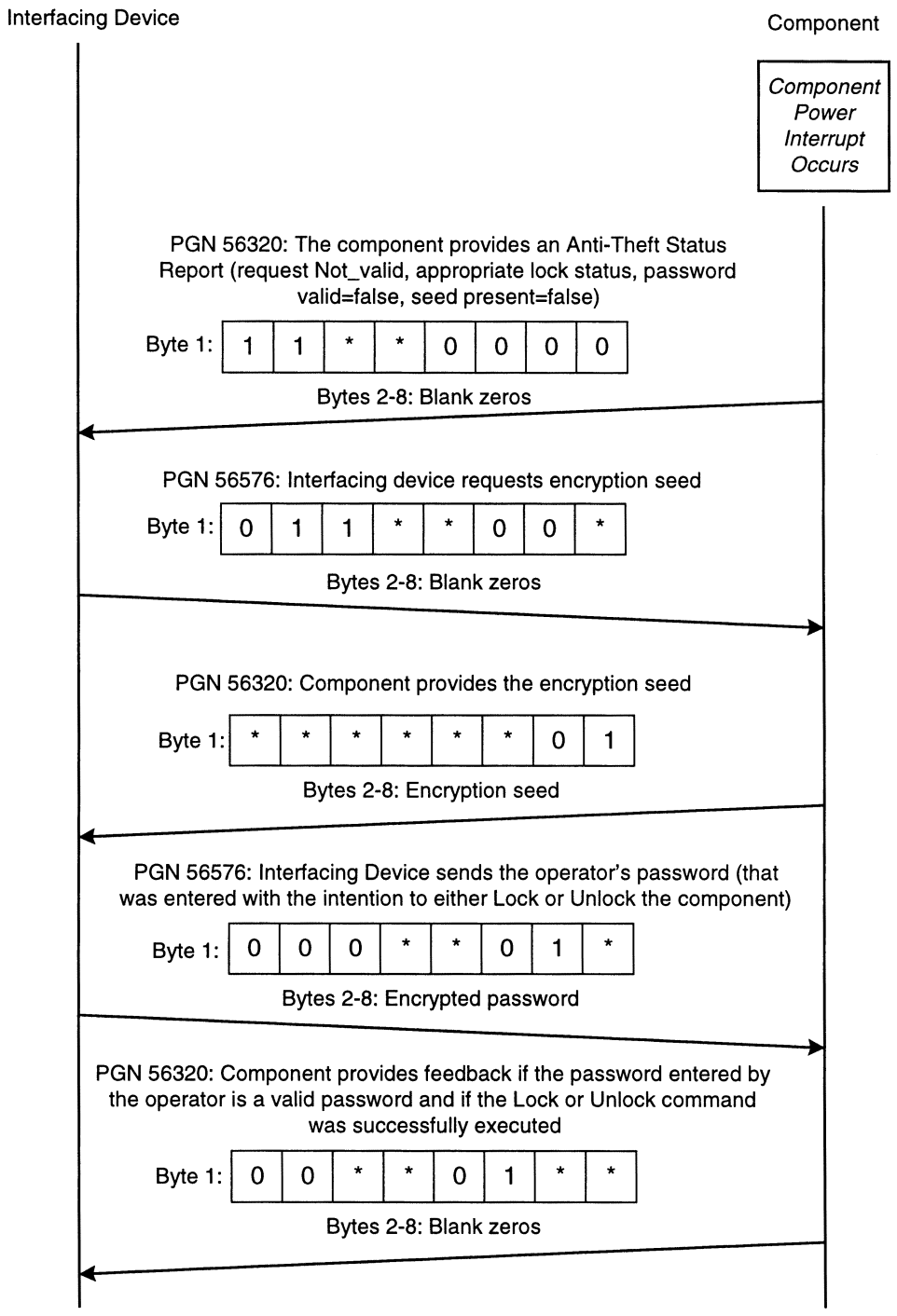


FIGURE 25—ABNORMAL COMPONENT POWER INTERRUPTION (INTERFACING DEVICE POWER IS NOT INTERRUPTED)

(R) 5.3.103 ENGINE AUXILIARY COOLANT

Transmission repetition rate: 0.5 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 148
Default priority: 6
Parameter group number: 65 172 ($00FE94_{16}$)

Byte:			
1	Engine auxiliary coolant pressure		5.2.5.214
2	Engine auxiliary coolant temperature		5.2.5.220
3-8	Not defined		

(R) 5.3.104 ENGINE ELECTRICAL SYSTEM/MODULE INFORMATION

Transmission repetition rate: 100 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 147
Default priority: 7
Parameter group number: 65 171 ($00FE93_{16}$)

Byte:					
1,2	Electrical load				5.2.5.215
3	Safety wire status	Bit:	8-5	Not defined	
			4,3	Turning gear engaged	5.2.6.100
			2,1	Safety wire status	5.2.6.99
4-8	Not defined				

(R) 5.3.105 ENGINE INFORMATION

Transmission repetition rate: 100 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 146
Default priority: 7
Parameter group number: 65 170 ($00FE92_{16}$)

Byte:		
1	Pre-filter oil pressure	5.2.5.217
2,3	Exhaust gas pressure	5.2.5.218
4	Rack position	5.2.5.219
5,6	Natural gas mass flow	5.2.5.221
7,8	Instantaneous estimated brake power	5.2.5.222

(R) 5.3.106 FUEL LEAKAGE

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 15
Default priority: 7
Parameter group number: 65 169 ($00FE91_{16}$)

Byte:						
1	Fuel leakage	bits:	8-5	Not defined		
			4,3	Fuel leakage 2		5.2.6.98
			2,1	Fuel leakage 1		5.2.6.98
2-8	Not defined					

(R) 5.3.107 ENGINE TORQUE HISTORY

Transmission repetition rate: On request
Data length: Variable
Data page: 0
PDU format: 254
PDU specific: 144
Default priority: 6
Parameter group number: 65 168 ($00FE90_{16}$)

Byte:					
1	Number of torque history records				5.2.5.223
2,3	Engine power				5.2.5.224
4,5	Peak power torque 1				5.2.5.225
6,7	Peak power torque 2				5.2.5.226
8	Calibration record start month				5.2.5.227
9	Calibration record start day				5.2.5.228
10	Calibration record start year				5.2.5.229
11-14	Calibration record start duration time				5.2.5.230
15	Torque limiting feature status	bits:	8-6	Not defined	
			5-3	Torque limit feature	5.2.6.104
			2,1	Torque limit feature status	5.2.6.103
16,17	Transmission gear ratio 1				5.2.5.232
18,19	Engine torque limit 1, transmission				5.2.5.233
20,21	Transmission gear ratio 2				5.2.5.234
22,23	Engine torque limit 2, transmission				5.2.5.235
24,25	Transmission gear ratio 3				5.2.5.236
26,27	Engine torque limit 3, transmission				5.2.5.237
28,29	Engine torque limit 4, transmission				5.2.5.238
30,31	Engine torque limit 5, switch				5.2.5.239
32,33	Engine torque limit 6, axle input				5.2.5.240
34-39	Not defined				

NOTE—The torque history PGN is variable in length and may contain up to 125 torque history records. Each torque history record is 38 bytes in length.

(R) 5.3.108 SUPPLY PRESSURE #2

Transmission repetition rate: 1 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 13
Default priority: 6
Parameter group number: 65 167 ($00FE8F_{16}$)

Byte: 1,2 Externally supplied air pressure 5.2.5.247
3-8 Not defined

(R) 5.3.109 SERVICE #2

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 142
Default priority: 7
Parameter group number: 65 166 ($00FE8E_{16}$)

Byte: 1 Service component identification 5.2.5.102
2-3 Time since last service 5.2.5.246
4-8 Not defined

NOTE—There are two acceptable formats for the Service PGN. Format 1 has only 8 bytes of data and reports the component most in need of service for each of the three categories. Format 2, however, uses the transport layer as necessary in order to repeat these 8 bytes of service component information until all supported service components in each category have been transmitted.

(R) 5.3.110 VEHICLE ELECTRICAL POWER #2

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 141
Default priority: 7
Parameter group number: 65 165 ($00FE8D_{16}$)

Byte: 1,2 Battery 2 potential (voltage) 5.2.5.254
3-8 Not defined

(R) 5.3.111 AUXILIARY ANALOG INFORMATION

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 140
Default priority: 7
Parameter group number: 65 164 ($00FE8C_{16}$)

Byte:	1	Auxiliary temperature 1	5.2.5.249
	2	Auxiliary temperature 2	5.2.5.249
	3	Auxiliary pressure 1	5.2.5.248
	4	Auxiliary pressure 2	5.2.5.248

(R) 5.3.112 ENGINE FUEL/LUBE SYSTEMS

Transmission repetition rate: 0.5 s
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 106
Default priority: 6
Parameter group number: 65 130 ($00FE6A_{16}$)

Byte:	1	Engine oil level remote reservoir	5.2.5.284
	2	Fuel supply pump inlet pressure	5.2.5.285
	3	Fuel filter (suction side) differential pressure	5.2.5.286
	4-8	Not defined	

(R) 5.3.113 GASEOUS FUEL PRESSURE

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 139
Default priority: 7
Parameter group number: 65 163 ($00FE8B_{16}$)

Byte:	1,2	Absolute fuel valve inlet pressure	5.2.5.250
	3,4	Outlet to inlet fuel valve differential pressure	5.2.5.251
	5,6	Air to fuel differential pressure	5.2.5.252
	7-8	Not defined	

(R) 5.3.114 IGNITION TRANSFORMER SECONDARY OUTPUT #1

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 136
Default priority: 7
Parameter group number: 65 160 ($00FE88_{16}$)

Byte: 1	Cylinder 1 ignition transformer secondary output		5.2.5.253
2	Cylinder 2 ignition transformer secondary output		5.2.5.253
3	Cylinder 3 ignition transformer secondary output		5.2.5.253
4	Cylinder 4 ignition transformer secondary output		5.2.5.253
5	Cylinder 5 ignition transformer secondary output		5.2.5.253
6	Cylinder 6 ignition transformer secondary output		5.2.5.253
7	Cylinder 7 ignition transformer secondary output		5.2.5.253
8	Cylinder 8 ignition transformer secondary output		5.2.5.253

(R) 5.3.115 IGNITION TRANSFORMER SECONDARY OUTPUT #2

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 137
Default priority: 7
Parameter group number: 65 161 ($00FE89E_{16}$)

Byte: 1	Cylinder 9 ignition transformer secondary output		5.2.5.253
2	Cylinder 10 ignition transformer secondary output		5.2.5.253
3	Cylinder 11 ignition transformer secondary output		5.2.5.253
4	Cylinder 12 ignition transformer secondary output		5.2.5.253
5	Cylinder 13 ignition transformer secondary output		5.2.5.253
6	Cylinder 14 ignition transformer secondary output		5.2.5.253
7	Cylinder 15 ignition transformer secondary output		5.2.5.253
8	Cylinder 16 ignition transformer secondary output		5.2.5.253

(R) 5.3.116 IGNITION TRANSFORMER SECONDARY OUTPUT #3

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 138
Default priority: 7
Parameter group number: 65 162 ($00FE8A_{16}$)

Byte: 1	Cylinder 17 ignition transformer secondary output		5.2.5.253
2	Cylinder 18 ignition transformer secondary output		5.2.5.253
3	Cylinder 19 ignition transformer secondary output		5.2.5.253
4	Cylinder 20 ignition transformer secondary output		5.2.5.253
5-8	Not defined		

(R) 5.3.117 IGNITION TIMING #1

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	130
Default priority:	7
Parameter group number:	65 154 ($00FE82_{16}$)

Byte:	1,2	Cylinder 1 ignition timing	5.2.5.257
	3,4	Cylinder 2 ignition timing	5.2.5.257
	5,6	Cylinder 3 ignition timing	5.2.5.257
	7,8	Cylinder 4 ignition timing	5.2.5.257

(R) 5.3.118 IGNITION TIMING #2

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	131
Default priority:	7
Parameter group number:	65 155 ($00FE83_{16}$)

Byte:	1,2	Cylinder 5 ignition timing	5.2.5.257
	3,4	Cylinder 6 ignition timing	5.2.5.257
	5,6	Cylinder 7 ignition timing	5.2.5.257
	7,8	Cylinder 8 ignition timing	5.2.5.257

(R) 5.3.119 IGNITION TIMING #3

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	132
Default priority:	7
Parameter group number:	65 156 ($00FE84_{16}$)

Byte:	1,2	Cylinder 9 ignition timing	5.2.5.257
	3,4	Cylinder 10 ignition timing	5.2.5.257
	5,6	Cylinder 11 ignition timing	5.2.5.257
	7,8	Cylinder 12 ignition timing	5.2.5.257

(R) 5.3.120 IGNITION TIMING #4

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	133
Default priority:	7
Parameter group number:	65 157 ($00FE85_{16}$)

Byte:	1,2	Cylinder 13 ignition timing	5.2.5.257
	3,4	Cylinder 14 ignition timing	5.2.5.257
	5,6	Cylinder 15 ignition timing	5.2.5.257
	7,8	Cylinder 16 ignition timing	5.2.5.257

(R) 5.3.121 IGNITION TIMING #5

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	134
Default priority:	7
Parameter group number:	65 158 ($00FE86_{16}$)

Byte:	1,2	Cylinder 17 ignition timing	5.2.5.257
	3,4	Cylinder 18 ignition timing	5.2.5.257
	5,6	Cylinder 19 ignition timing	5.2.5.257
	7,8	Cylinder 20 ignition timing	5.2.5.257

(R) 5.3.122 IGNITION TIMING #6

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	135
Default priority:	7
Parameter group number:	65 159 ($00FE87_{16}$)

Byte:	1,2	Desired ignition timing 1	5.2.5.256
	3,4	Desired ignition timing 2	5.2.5.256
	5,6	Desired ignition timing 3	5.2.5.256
	7,8	Actual ignition timing	5.2.5.255

(R) 5.3.123 FUEL INFORMATION #2 (GASEOUS)

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	129
Default priority:	7
Parameter group number:	65 153 ($00FE81_{16}$)

Byte:	1,2	Fuel flow rate 1	5.2.5.262
	3,4	Fuel flow rate 2	5.2.5.262
	5	Fuel valve 1 position	5.2.5.261
	6	Fuel valve 2 position	5.2.5.261
	7,8	Not defined	

(R) 5.3.124 COMBUSTION TIME #1

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	123
Default priority:	7
Parameter group number:	65 147 ($00FE7B_{16}$)

Byte:	1,2	Cylinder 1 combustion time	5.2.5.260
	3,4	Cylinder 2 combustion time	5.2.5.260
	5,6	Cylinder 3 combustion time	5.2.5.260
	7,8	Cylinder 4 combustion time	5.2.5.260

(R) 5.3.125 COMBUSTION TIME #2

Transmission repetition rate:	On request
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	124
Default priority:	7
Parameter group number:	65 148 ($00FE7C_{16}$)

Byte:	1,2	Cylinder 5 combustion time	5.2.5.260
	3,4	Cylinder 6 combustion time	5.2.5.260
	5,6	Cylinder 7 combustion time	5.2.5.260
	7,8	Cylinder 8 combustion time	5.2.5.260

(R) 5.3.126 COMBUSTION TIME #3

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 125
Default priority: 7
Parameter group number: 65 149 ($00FE7D_{16}$)

Byte:			
	1,2	Cylinder 9 combustion time	5.2.5.260
	3,4	Cylinder 10 combustion time	5.2.5.260
	5,6	Cylinder 11 combustion time	5.2.5.260
	7,8	Cylinder 12 combustion time	5.2.5.260

(R) 5.3.127 COMBUSTION TIME #4

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 126
Default priority: 7
Parameter group number: 65 150 ($00FE7E_{16}$)

Byte:			
	1,2	Cylinder 13 combustion time	5.2.5.260
	3,4	Cylinder 14 combustion time	5.2.5.260
	5,6	Cylinder 15 combustion time	5.2.5.260
	7,8	Cylinder 16 combustion time	5.2.5.260

(R) 5.3.128 COMBUSTION TIME #5

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 127
Default priority: 7
Parameter group number: 65 150 ($00FE7F_{16}$)

Byte:			
	1,2	Cylinder 17 combustion time	5.2.5.260
	3,4	Cylinder 18 combustion time	5.2.5.260
	5,6	Cylinder 19 combustion time	5.2.5.260
	7,8	Cylinder 20 combustion time	5.2.5.260

(R) 5.3.129 COMBUSTION TIME #6

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 128
Default priority: 7
Parameter group number: 65 151 ($00FE80_{16}$)

Byte: 1,2	Desired combustion time	5.2.5.258
3,4	Average engine combustion time	5.2.5.259
5-8	Not defined	

(R) 5.3.130 TIRE PRESSURE CONTROL UNIT CURRENT PRESSURES

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 122
Default priority: 7
Parameter group number: 65 146 ($00FE7A_{16}$)

Byte: 1,2	Trailer, tag or push channel tire pressure	5.2.5.263
3,4	Drive channel tire pressure	5.2.5.264
5,6	Steer channel tire pressure	5.2.5.265
7-8	Not defined	

(R) 5.3.131 TIRE PRESSURE CONTROL UNIT TARGET PRESSURES

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 121
Default priority: 7
Parameter group number: 65 145 ($00FE79_{16}$)

Byte: 1,2	Trailer, tag or push channel tire pressure target	5.2.5.266
3,4	Drive channel tire pressure target	5.2.5.267
5,6	Steer channel tire pressure target	5.2.5.268
7-8	Not defined	

(R) 5.3.132 TIRE PRESSURE CONTROL UNIT MODE AND STATUS

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 120
Default priority: 7
Parameter group number: 65 144 ($00FE78_{16}$)

Byte:						
	1	Tire pressure check interval				5.2.5.269
	2	PCU channel mode 1	bits:	8-5	Not defined	
				4-1	Steer channel mode	5.2.6.88
	3	PCU channel mode 2	bits:	8-5	Drive channel mode	5.2.6.90
				4-1	Trailer/tag channel mode	5.2.6.89
	4	PCU status 1	bits:	8-7	Not defined	
				6,5	Tire pressure supply switch	5.2.6.93
				4,3	PCU steer solenoid status	5.2.6.92
				2,1	PCU drive solenoid status	5.2.6.91
	5	PCU status 2	bits:	8,7	PCU trailer, tag or push solenoid status	5.2.6.97
				6,5	PCU supply solenoid status	5.2.6.96
				4,3	PCU control solenoid status	5.2.6.95
				2,1	PCU deflate solenoid status	5.2.6.94
	6-8	Not defined				

(R) 5.3.133 AUXILIARY PRESSURES

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 119
Default priority: 7
Parameter group number: 65 143 ($00FE77_{16}$)

Byte:			
	1,2	Auxiliary vacuum pressure reading	5.2.5.270
	3,4	Auxiliary gage pressure reading #1	5.2.5.271
	5,6	Auxiliary absolute pressure reading	5.2.5.272
	7-8	Not defined	

(R) 5.3.134 LASER LEVELING SYSTEM VERTICAL POSITION DISPLAY DATA

Transmission repetition rate: 100 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 118
Default priority: 4
Parameter group number: 65 142 ($00FE76_{16}$)

Byte:			
	1	LED display data #1	5.2.6.105
	2-8	Not defined	

(R) 5.3.135 LASER LEVELING SYSTEM VERTICAL DEVIATION

Transmission repetition rate: 50 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 117
Default priority: 3
Parameter group number: 65 141 ($00FE75_{16}$)

Byte:	1,2	Laser strike vertical deviation	5.2.5.305
	3-8	Not defined	

(R) 5.3.136 MODIFY LEVELING SYSTEM CONTROL SET POINT

Transmission repetition rate: 50 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 116
Default priority: 3
Parameter group number: 65 140 ($00FE74_{16}$)

Byte:	1,2	Modify set point	5.2.5.306
	3-8	Not defined	

(R) 5.3.137 LASER RECEIVER MAST POSITION

Transmission repetition rate: 50 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 115
Default priority: 3
Parameter group number: 65 139 ($00FE73_{16}$)

Byte:	1,2	Mast position	5.2.5.307
	3-8	Not defined	

(R) 5.3.138 LASER LEVELING SYSTEM BLADE CONTROL

Transmission repetition rate: 50 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 114
Default priority: 3
Parameter group number: 65 138 ($00FE72_{16}$)

Byte:	1,2	Blade duration and direction	5.2.5.308
	3	Blade control mode	5.2.6.107
	4-8	Not defined	

(R) 5.3.139 LASER TRACER POSITION

Transmission repetition rate: 50 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 113
Default priority: 3
Parameter group number: 65 137 ($00FE71_{16}$)

Byte:			
1,2	Laser tracer target deviation		5.2.5.310
3,4	Laser tracer vertical distance		5.2.5.311
5	Laser tracer horizontal deviation		5.2.5.312
6	LED display data #2		5.2.6.106
7	Laser tracer information		5.2.6.108
8	Not defined		

(R) 5.3.140 COMBINATION VEHICLE WEIGHT

Transmission repetition rate: On request
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 112
Default priority: 6
Parameter group number: 65 136 ($00FE70_{16}$)

Byte:			
1,2	Powered vehicle weight		5.2.5.273
3-8	Not defined		

(R) 5.3.141 ADAPTIVE CRUISE CONTROL (ACC1)

Transmission repetition rate: 100 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 111
Default priority: 4
Parameter group number: 65 135 ($00FE6F_{16}$)

Byte:					
1	Speed of forward vehicle				5.2.5.274
2	Distance to forward vehicle				5.2.5.275
3	Adaptive cruise control set speed				5.2.5.276
4	ACC status 1	bits:	8-7	Not defined	
			6-4	Adaptive cruise control set distance mode	5.2.6.86
			3-1	Adaptive cruise control state	5.2.6.87
5-6	Road curvature				5.2.5.277
7-8	Not defined				

NOTE—The ACC1 message is required whenever the engine is running and ACC is powered on and not faulted. The timeout for ACC1 message will be between 2.5 times to 5 times the update rate.

The ACC1 message is intended primarily for engines and driver display units. The receiving device should identify the ACC device based on ACC function value of 32 (headway controller) or source address of 42 (headway controller).

In the event that the engine is running, the ACC is installed and the ACC1 message is not present, the engine will disable cruise control and return to non-cruise mode; also, the driver display unit will notify the driver that ACC operation is no longer available. In addition to the ACC1 timeout, engine cruise control will also be disabled if parameter "Adaptive Cruise Control State" in ACC1 is 110_2 (ACC disabled or in error). In some cases, it may be possible for the driver to restart cruise control (without ACC capability) during ACC/J1939 fault by performing a reset function. See Figure 26.

It is possible that engines and driver display units may require calibration settings in order to know if the present vehicle configuration includes an ACC system or not. A calibration setting may also be needed for defining the driver reset function.

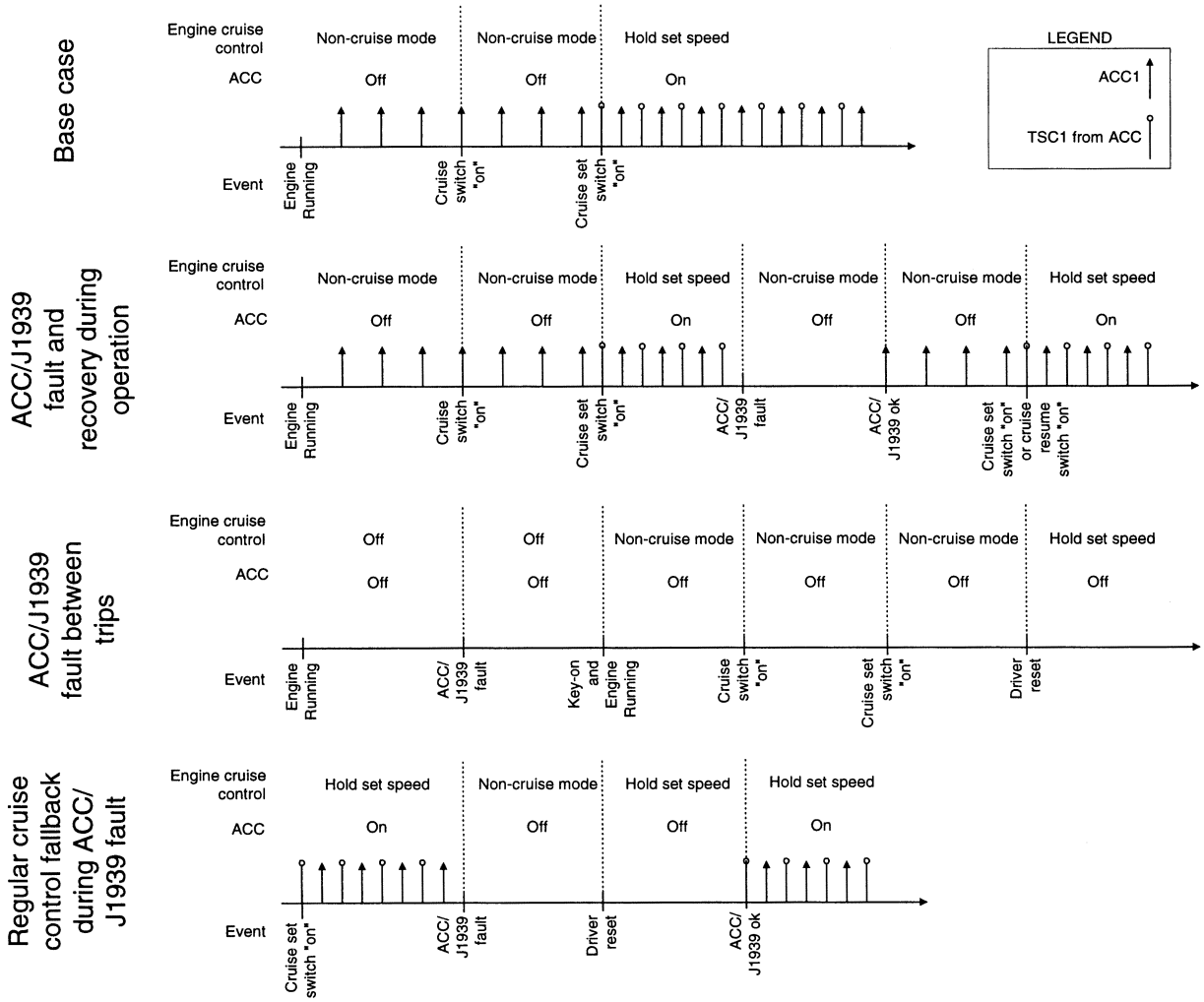


FIGURE 26—ADAPTIVE CRUISE CONTROL TIMING DIAGRAM

(R) 5.3.142 HIGH RESOLUTION WHEEL SPEED

Transmission repetition rate: 20 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 110
Default priority: 2
Parameter group number: 65 134 ($00FE6E_{16}$)

Byte:	1,2	Front axle, left wheel speed	5.2.5.278
	3,4	Front axle, right wheel speed	5.2.5.279
	5,6	Rear axle, left wheel speed	5.2.5.280
	7,8	Rear axle, right wheel speed	5.2.5.281

(R) 5.3.143 TACHOGRAPH: TCO1

Transmission repetition rate: 50 ms
Data length: 8 bytes
Data page: 0
PDU format: 254
PDU specific: 108
Default priority: 3
Parameter group number: 65 132 ($00FE6C_{16}$)

Byte:	1	TCO status 1	bits:	8,7	Drive recognize	5.2.6.78
				6-4	Driver 2 working state	5.2.6.77
				3-1	Driver 1 working state	5.2.6.77
	2	TCO status 2	bits:	8,7	Overspeed	5.2.6.81
				6,5	Driver 1 card	5.2.6.80
				4-1	Driver 1 time related states	5.2.6.79
	3	TCO status 3	bits:	8,7	Not defined	
				6,5	Driver 2 card	5.2.6.80
				4-1	Driver 2 time related states	5.2.6.79
	4	TCO status 4	bits:	8,7	Direction indicator	5.2.6.85
				6,5	Tachograph performance	5.2.6.84
				4,3	Handling information	5.2.6.83
				2,1	System event	5.2.6.82
	5,6	Tachograph output shaft speed				5.2.5.282
	7,8	Tachograph vehicle speed				5.2.5.283

(R) 5.3.144 TIME/DATE ADJUST

Transmission repetition rate:	As needed
Data length:	8 bytes
Data page:	0
PDU format:	213
PDU specific:	Destination Address
Default priority:	6
Parameter group number:	54 528 ($00D500_{16}$)

Byte:	1	Adjust seconds	5.2.5.288
	2	Adjust minutes	5.2.5.289
	3	Adjust hours	5.2.5.290
	4	Adjust month	5.2.5.291
	5	Adjust day	5.2.5.292
	6	Adjust year	5.2.5.293
	7	Adjust local minute offset	5.2.5.294
	8	Adjust local hour offset	5.2.5.295

(R) 5.3.145 DRIVER IDENTIFICATION

Transmission repetition rate:	On request
Data length:	Variable
Data page:	0
PDU format:	254
PDU specific:	107
Default priority:	6
Parameter group number:	65 131 ($00FE6B_{16}$)

Field:	a	Driver 1 Identification Delimiter (ASCII "*")	5.2.5.287
	b	Driver 2 Identification Delimiter (ASCII "*")	5.2.5.287

NOTE—If only driver card 1 is present, only the parameter driver 1 identification and two delimiters shall be transmitted. If only driver card 2 is present, a delimiter followed by parameter driver 2 identification and the second delimiter shall be transmitted. If no driver cards are present, only the two delimiters shall be sent.

5.4 Application Notes

5.4.1 PARAMETERS WITH MULTIPLE SOURCES—Each parameter received by a node for control purposes shall be configurable by the system integrator to identify the primary source of the data, as well as the secondary source, if applicable. It is to be expected that the system integrator configure each receiving device on a network identically.

6. Notes

6.1 Marginal Indicia—The (R) symbol located in the left margin is for the convenience of the user in locating area where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE SAE TRUCK AND BUS CONTROL AND COMMUNICATIONS NETWORK SUBCOMMITTEE OF THE SAE TRUCK AND BUS ELECTRICAL AND ELECTRONICS COMMITTEE

Rationale—Not applicable

Relationship of SAE Standard to ISO Standard—Not applicable

Application—As described in the parent document, SAE J1939, there are a minimum of seven documents required to fully define a complete version of this network. This particular document, SAE J1939-71, describes an Application Layer for vehicle use.

Reference Section

SAE J1349—Engine Power Test Code-Spark Ignition and Compression Ignition-Net Power Rating

SAE J1843—Accelerator Pedal Position Sensor for Use with Electronic Control in Medium- and Heavy-Duty Diesel On-Highway Engines

SAE J1922—Powertrain Control Interface for Electronic Controls Used in Medium and Heavy-Duty Diesel on-Highway Vehicle Applications

SAE J1939 (Draft)—Recommended Practice for a Serial Control and Communication Vehicle Network

SAE J1939-21—Data Link Layer

Developed by the SAE Truck and Bus Control and Communications Network Subcommittee

Sponsored by the SAE Truck and Bus Electrical and Electronics Committee