Approaching Vehicle Audible System Module

(AVAS)

FUNCTIONAL SPECIFICATION

FS_ML3T-14G113-AB

Version: 2.0 RELEASE

Date Revised: 07/30/2019

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Functional Specification Approaching Vehicle Audible System Module

PART NAME	PART NUMBER
Functional Specification – Module Assembly – Approaching Vehicle Audible System	FS-ML3T-14G113-AB

	LET	FR	REVISIONS	DR	CK	REFERENCE
08/08/2018	REL	All	FS-ML3T-14G113-AA released			
07/30/2019	REL	All	FS-ML3T-14G113-AB Released			PREPARED BY: Peter Sripinyo
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						Quality Control
						Purchasing
						Supplier Quality Assistance

FRAME 1 OF 131	REV REL	

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1. DOCUMENT OVERVIEW

1.1 DOCUMENT OVERVIEW

Approaching Vehicle Audible System Module Author Team

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1.2 PURPOSE AND SCOPE

This document provides detailed requirement descriptions of Approaching Vehicle Audible System (AVAS) Module subsystem.
Although the Hatley-Pirbhai System Specification method was used to generate the contents herein, it has been tailored substantially for conformance to the generic systems engineering process and specification formats. This format is intended to provide the reader a well-organized structure to ease the understanding of the functionality allocated to this subsystem and at the same time provide a modular set of specification elements for reuse and/or re-allocation.

The requirements detailed in this functional specification meet the applicable MPLELC SDS requirements as stated in the SOW. See section 7 for compliance traceability for the feature description and MPLELC SDS.

1.2.1 Conflict of Documentation

This specification shall follow all government regulations. In case of conflict between specifications the government requirements should take precedence.

If any conflict of documentation, the released Part Drawing shall take precedence over the Component Specification, which shall take precedence over this Functional Specification, which shall take precedence over the System Specification.

1.3 DOCUMENT ROAD MAP

Section 1.0: This section provides the scope and purpose of the features in the AVAS control module. It also contains general requirements for the features in the AVAS Module and references to related documents.

Section 2.0 This section provides the detailed specification of all the features for the AVAS control module. The subsections in Section 2.0 detail an overview of the AVAS module as well as the specific requirements on how AVAS determines whether or not to play a sound and whether or not the AVAS module is an operational or faulted state. This section also covers VRM and diagnostics.

1.4 DOCUMENT CONVENTIONS

1.4.1 Methodology & Data Flow Diagrams

The requirements in this specification are partitioned into processes with data flowing between them. This partitioning is represented in the data flow diagrams. A bubble represents each process. Arrows represent data flows with the direction indicating the direction of the flow of information.

The context diagram shown below is presented here to illustrate the methodology and conventions used in the requirements modeling.

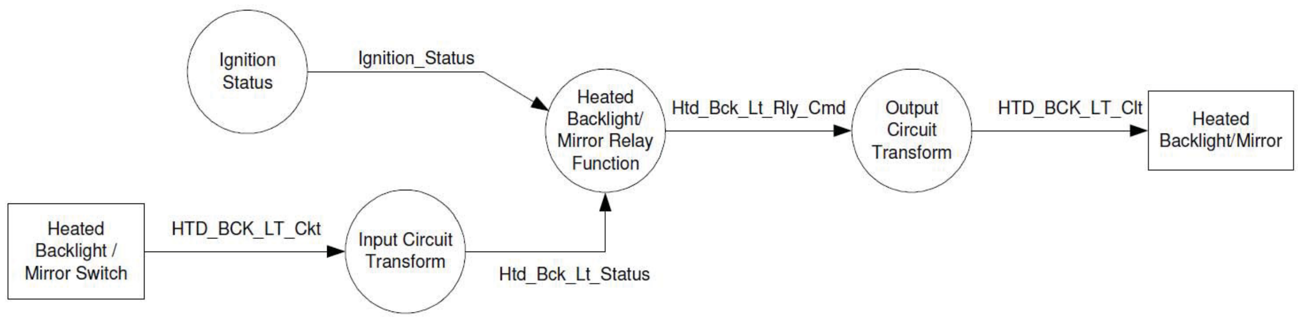


Figure 1.4-1 Context Diagram Illustration

The Hatley-Pirbhai method is used exclusively. Control flows, CFDs, and CSPECS are NOT used. All modeling is done via data flows and DFDs. *unless otherwise specified, it is assumed that all processes are activated when the module awakes and are deactivated when the module goes to sleep.*

When the use of an event would be highly desirable, the ”Ev” suffix is appended to a data flow.
All context diagrams in ***2 APPROACHING VEHICLE AUDIBLE SYSTEM (AVAS)*** include terminators for all data flows. Terminators can be processes or physical devices connected to the module. If the terminator is a process, such as *IGNITION STATUS,* this means that the reader must go to *the subsection for the process* to actually see the requirements for the Ignition Status Process.

1.4.2 Requirements Representations

Within each process, the required functionality is described in the form of text, decision tables, state transition diagrams, and/or state transition tables.

Decision tables show combinational logic where Inputs are on the left side of the table and Outputs are on the right side of the table. A double vertical line separates inputs and Outputs. Each row has a unique number to allow reference to that particular requirement.

State transition diagrams and state transition tables contain four key elements: states, transitions, events, and actions. States represent a known condition with the model. Transitions represent the interaction of the states. Events represent the conditions, which must be true for a transition to be taken. Actions represent the operations that must be accomplished when a transition is taken.

State transition diagrams use the following conventions: States are represented by rectangles. Arrows represent transitions. The symbols_, –>, and => mean "transitions to" and represent an event occurring at a specific point in time. For example, Ignition_Status _ RUN means that the ignition switch has transitioned to the RUN position. This is different than Ignition_Status = RUN, which means that the ignition switch is in the RUN position. The events and actions for a transition are in text with the events listed before a "/" and the actions following the "/". Timers in one State Transition Diagram are independent of timers in other State Transition Diagrams.

State transition tables have the Current State, Events, Actions, Next State column format with one transition per row. Each row has a unique number to allow reference to that particular requirement. Processing order shall be such that all inputs have been processed prior to evaluation of a given p-spec.

Requirements that are in purple bolded italics and highlighted in blue are "protect for" requirements. Requirements marked as such identify features that are 1) implemented in the FS, but not coded, 2) are not testable or 3) mark summary type information that needs to be searched easily. An example of such markings is ***R:2.4.2.12.2***

1.4.3 State Transition Table/Diagram Notation

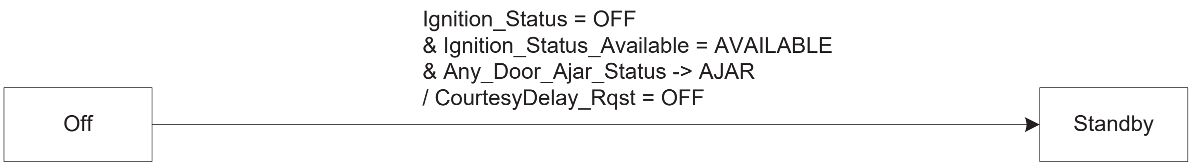
In state machines, some special symbols are used. All symbols used in state machines are listed below. The equality symbol (=) is explained because it is used both for comparisons and assignments.

Symbol	**Event or Action**	**Definition**
<n>	Event	Requirement number <n>: uniquely identifies requirement #1 when transitioning between state A and state B. is assigned a unique requirement number. Example: <1>
=	Event	Equality:
<>	Event	Inequality:
>=	Event	Greater than or equal:
<=	Event	Less than or equal:
>	Event	Greater than:
<	Event	Less than:
-> →	Event	Transitions to: activates only on the transition from one value to the target value. Unless specified otherwise in the Finite State Machine, the state machine must look for the data transition to occur while it is in the state (or super state) that has the -> as an exit condition. In modeling terms, this means that the transition flag is cleared upon entry to the state (or super state). Special care must be taken when the -> event must be evaluated as part of a logical AND operation. .
&	Event	Boolean “AND”:
|	Event	Boolean “OR”:
=	Action	Assignment:
no event	Event	No event trigger
no action	Action	No action taken:
Mark event xyzzy	Action	Event in time: conceptual timing requirement – this action marks the event “xyzzy” on an imaginary timeline. Later referenced by Time since event

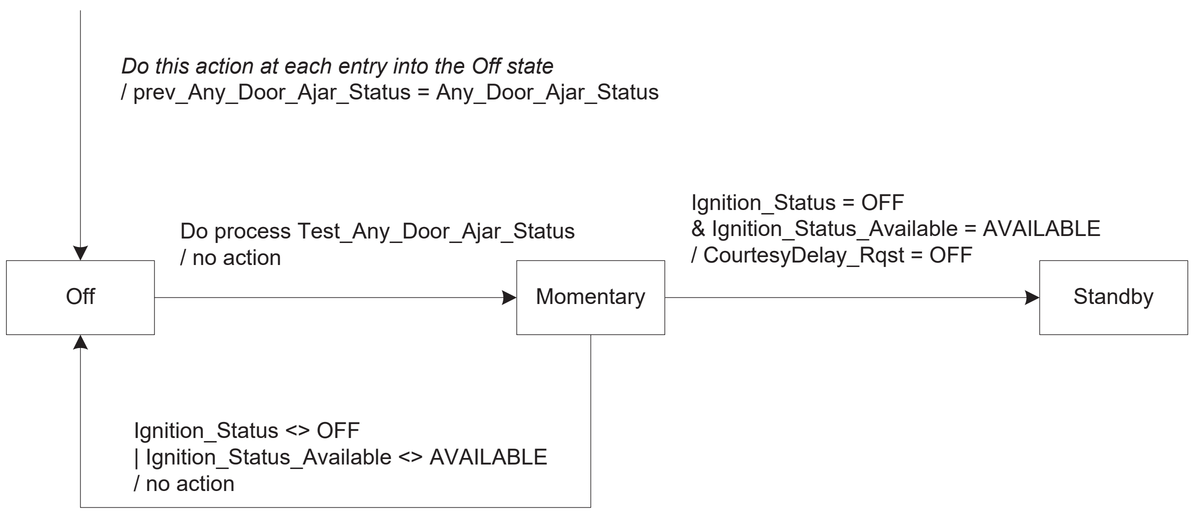
Time since event xyzzy	Event	Elapsed time: determines the amount of time that has elapsed since the last occurrence of the Mark event xyzzy

Table 1.4-1 Special Symbols used in Finite State Machines

This is an example of a state transition requirement using the “transitions to” notation (->) from the Courtesy Lighting Delay feature within Interior Lighting.



This is an example of one possible method to implement the above requirement without using the -> notation. The Momentary state is included to guarantee that prev_Any_Door_Ajar_Status is updated every time the exit conditions of the Off state are evaluated regardless of Ignition_Status or Ignition_Status_Available.



Definition of process Test_Any_Door_Ajar_Status

```
If  ( prev_Any_Door_Ajar_Status <> Any_Door_Ajar_Status
      & Any_Door_Ajar_Status = AJAR )
then
    prev_Any_Door_Ajar_Status = Any_Door_Ajar_Status
    return TRUE
else
    prev_Any_Door_Ajar_Status = Any_Door_Ajar_Status
    return FALSE
```

Figure 1.4-2 Example of Detecting a Transition

Feature Behavior Summary

To show by representation the difference between volatile memory and non-volatile memory data storage symbols. The non-volatile memory data storage symbol representation is 2 horizontal lines, one line above and one line below the non-volatile dataflow name. The volatile memory data storage is represented by 2 horizontal bars with solid / filled boxes at the end of each line, one line above and one line below the volatile dataflow name.

Feature Behavior Detail

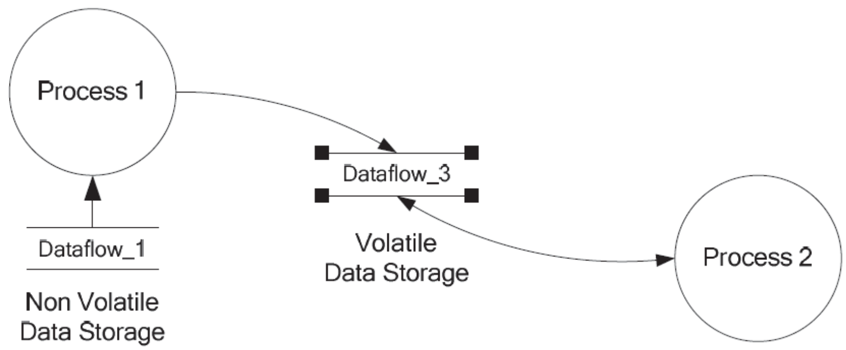


Figure 1.4-3 Convention Context Diagram

1.4.3.1 Feature Functional Requirements

The following state transition diagram defines the core processing for the feature.

R: 1.4.3.1.1	At Reset, Dataflow_3 must be set to the initial value specified in the Data Dictionary.

Rqmt. No.	Dataflow_1	Dataflow_2		Dataflow_3
R: 1.4.3.1.2	INACTIVE	INACTIVE		No Change
R: 1.4.3.1.3	INACTIVE	ACTIVE		No Change
R: 1.4.3.1.4	ACTIVE	INACTIVE		No Change
R: 1.4.3.1.5	ACTIVE	ACTIVE		ACTIVE

Table 1.4-2 Process 1 Determine Dataflow Status

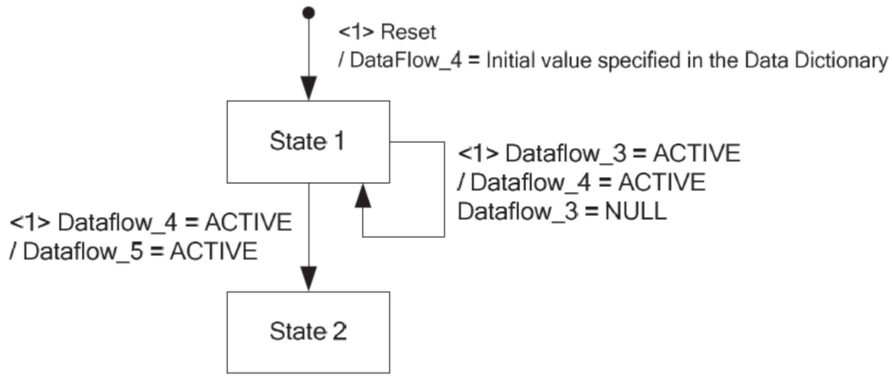


Figure 1.4-4 Process 2 Convention State Machine

1.4.4 Glossary of Terms

Acronyms and terms used in this document that may not be commonplace in the engineering world.

Table 1.4-3 Glossary of Terms

Term	**Definition as used and applied in this functional specification**
Active	ON or Enable
A/D	Analog to Digital convertor
ANI	Agree not to implement Functions with this flag are not included in the program. No planning/status entry is expected in any column further to the right of it in the FIP template.
Awake	All individual state machines are evaluating their operating conditions. (Reference sections 1.4.1 – 1.4.10)
AVAS	Approaching Vehicle Audible System
BCM	Body Control Module
Cfg	Configure, Configuration, Configurable
Cmd	Command
Constant	In Program Memory, Only Suppler can change this value (Flash/Re-Flash/ROM or EEPROM)
Disable	OFF
DTC	Diagnostic Trouble Code
EEPROM	Electrically Erasable Programmable Read Only Memory
EESE	Electrical / Electronic Systems Engineering
EESS	Electrical / Electronic System Specification
Enable	ON
Ev	Event
ICE	Internal Combustion Engine

Acronyms and terms used in this document that may not be commonplace in the engineering world.

Table 1.4-3 Glossary of Terms

Term	Definition as used and applied in this functional specification
Inactive	OFF or Disable
INDEF	Indefinitely
Initial State	Upon reset this is the value that the data flow is to take until a new value can be obtained.
Initial Value	Upon reset this is the value that the data flow is to take until a new value can be obtained.
NM	Network Manager
Network Receive Default	This is the timed out value that the data flow is to take until a new value is received over the network.
Non-Volatile Customer SET	Customer uses feature to change this value. Diagnostics can change this value. (EEPROM)
Non-Volatile Factory SET	Diagnostics can change this value. (EEPROM)
N/A	Not Applicable
OFF	Off / Disable
ON	On / Enable
Out	Output
PNI	Plan not to implement Functions with this flag are included in the program but are not implemented at the relevant integration point. This flag is only applicable to "Planned" column. No entry is expected in the "Actual" column in the FIP template.
Received Default	This is the timed out value that the data flow is to take until a new value is received over the network.
Req or Rqst	Request
Rqmt. No.	Requirement Number <n>, **R: 1.4.1**
R: 1.4.1	For example, **R: 1.4.1** is requirement number 1 in Section 1.4 of this document. Requirements are text denoted as "Caption, the font is Times New Roman 8pt, **BOLD"** to identify a requirement. All Requirements are Level 4 Captions. Requirements are sequenced based upon the "Heading 2" numbering sequence
Reset	To force the state machine to a known condition. Each state machine may have an independent reset condition not defined in the software requirements. This independent condition shall not conflict with the body module software requirements. Reference the software requirements document for conditions that may or may not cause a reset.
Sleep	All of the sleep criteria for the module have been met. All individual state machines must retain their current states prior to sleep. Retained states to be used as defined in the Wake Up definition. (Reference software requirement 62, and sections 1.4.1)
Toggle	To change state for example from On to OFF, or Disable to Enable

Acronyms and terms used in this document that may not be commonplace in the engineering world.

Table 1.4-3 Glossary of Terms

Term	**Definition as used and applied in this functional specification**
Volatile	Changes during run-time, program execution (RAM)
Wake Up	An input event that results in a transition from the module SLEEP state to the AWAKE state. All individual state machines resume at their previously retained states as defined in the Sleep definition. (Reference sections 1.4.1)

1.4.5 Assumed Interface to NVRAM Manager

Note: This document assumes the following interface with an EEPROM manager. The supplier does not need to support this exact interface.

NVRAM_Rqst
- **NULL** = do nothing
- **UPDATE** = post all changes to NVRAM (going to reboot)
- **STOP** = Let any current write finish – don't start another

NVRAM_Status
- **BUSY** = NVRAM is busy, write is occurring
- **NULL** = NVRAM is not busy
- **DONE** = request for UPDATE or STOP has been completed

This interface is used in the Sleep/Awake feature and in the Diagnostics feature.

1.4.6 Timer Mark Event / Time Since Event

Mark event xyzzy	Action	Event in time. This action marks the event “xyzzy” on an imaginary timeline. Later referenced by Time since event”
Time since event xyzzy > = TimeValue_Cfg	Condition	Elapsed time: determines the amount of time that has elapsed since the last occurrence of the "Mark event xyzzy"

Timers in the Behavior and Implementation models

a) The Behavior models shall implement the following timer resolutions (selection based on Data Dictionary criteria):

b) Note: all timers are 32-bit unsigned integers (U32).

c) Following API shall be used to mark and check timers:

Mark_Timer_msec(TIMER_NAME)

Check_Timer_msec(TIMER_NAME)

This timer runs only while the module is awake. While the resolution is in millisecond, it may be actually incremented by 5 every 5 msec, for example. This timer will retain its value across module sleep status, and be reset to 0 if the CPU is reset.

Mark_Timer_sec(TIMER_NAME)

Check_Timer_sec(TIMER_NAME)

This timer runs only while the module is awake. This timer will retain its value across module sleep status, and be reset to 0 if the CPU is reset.

Mark_GRTimer(TIMER_NAME)

Check_GRTimer(TIMER_NAME)

This global real timer runs while the module is supplied with power, even while the module is asleep. Its resolution is 100 milliseconds. The value is committed to EEPROM on a schedule, so that a "recent" value will be retained across a power loss. The value is also (normally) retained across short CPU resets.

Note that this means that across a power loss, the timer could "go backwards". Practically, this means that after a power loss, you must Mark a GRTimer before checking it.

Note also that this clock is not necessarily synchronized with the other 2 timers. i.e., it may run at a slightly different rate, because it must be very accurate over long time periods to be used for time of day clock on the radio.

Note that even though GRT timer resolution is 100milliseconds **Check_GRTimer()** reports in seconds. This is to have consistent usage of timers in milliseconds or seconds.

d) The supplier may develop a timer behavior library which simulates the timer implementation.
Test harness shall use this library to test the timers that are used in behavior library model.

All Data Dictionary time entries should use milliseconds or seconds as their units.

Note: The GRT is not allowed to use 0xFFFFFFFF (which indicates "unknown" in the vehicle CAN network). So every 13.6 years, we will have a 100msec error in GRT (which we will ignore). The GRT timer actually uses 100msec resolution. However, all uses of GRT use seconds as the unit. This means the calculation performed by the subroutine must be (ActualGRTime - BaseGRTime)/10 to convert to seconds.

Example Timer Implementation

Timer is 32-bit unsigned integer (U32).

Mark Event	Timer Base Unit	Time Since Event	Eng. Unit
Mark_Timer_msec	Milliseconds	Actual - Base >= Target	milliseconds
Mark_Timer_sec	second	Actual - Base >= Target	second
Mark_GRTTimer	100 milliseconds	$\frac{\text{Actual – Base}}{10}$ >= Target	second

			Time Value Hexadecimal (U32)	Decimal
			0000 0000	0
Mark event	Base	→	0000 0001	1
			0000 0002	2
			0000 0003	3
			0000 0004	4
			0000 0005	5
Time since event	Actual	→	0000 0006	6
			0000 0007	7
			0000 0008	8

Example computer computation:

Actual - Base

Actual + Two's Compliment of (Base)

Actual	6		0000 0006		0000 0006	Time Since Event
- Base	-1		0000 0001		+ FFFF FFFF	Mark Event 2's Compliment of Base
	5		0000 0005		0000 0005	

Compare Result of **Actual + Two's Compliment of (Base)** to **Target** (Note: Target is typically a method 3 **TimeValue_Cfg**)

Now compare **0000 0005** to the **Target** (TimeValue_Cfg)

1.5 RELATED DOCUMENTS

Related documents, referenced elsewhere in this document, are listed below for quick reference.

Table 1.5-1 – Related Documents

Item	Title	Control Number
1	Engineering Specification	ES-HG9T-14G113-AA
2	Minimum Noise Target Summary	V2
SDS Requirements		
3	SDS, ELCOMP Generic Body Module SDS	Rev.: 21
4	SDS, MPLELC Generic Body E/E Feature Function SDS	Rev.: 29

Table 1.5-1 – Related Documents

Item	Title	Control Number
	Requirements for PARSED	
4a	DVM-0055-EY EconoCentralConfigTest Spec	Latest Version at time of Work Agreement
4b	Economized Central Configuration Specification	Latest Version at time of Work Agreement
4c	On Vehicle Telematics Protocol Specification	Latest Version at time of Work Agreement
4d	Central Software PARSED Minimum Requirements	Latest Version at time of Work Agreement
	Body Modules Software Requirements	
5	ECU SW Design Rules - Body	EESE-SMD-CSE-PG-033 Version 2017.1
6	ECU SW Testing Requirements	EESE-SMD-CSE-PG-034 Version 2017.1
7	Global eSOW Software Attachment	EESE-SMD-CSE-PG-070 Version 2018.0
8	Global eSOW SW Attachment – Read me first	N/A
9	Non-Volatile Memory Requirements	EESE-SMD-CSE-PG-070 v2017.1
10	Outputs Fault Management	EESE-SMD-CSE-PG-032 Version 2017.1
11	Software Release Notes	EESE-SMD-CSE-PG-044 ver 2009.0
12	SWQA_Common TDR Checklist	Version: 2018_0
13	Voltage Range Monitor	EESE-SMD-CSE-PG-035 Version 2018.0

	Multiplex Communications & Diagnostic Specifications	
14	EESE Network Communications Diagnostic Statement of Work	Version 2018._1
15	EESE Network Communications Diagnostic Statement of Work Appendix A	Version 2018_1
16	EESE Network Communications Multiplex Technology Statement of Work (NetCom MUX SOW GPDS)	2018.1
17	EESE Network Communications Multiplex Technology Statement of Work Appendix A (SOW_AppendixA)	2018.1
	Note: This is not an exhaustive list of Netcom requirements documents. A full list including correct version number should be obtainable from the program's Netcom Application Engineer. All versioning information should come from the aforementioned source.	
	Diagnostic Specifications	

29	Generic Global Diagnostics Specification (Part I) – GGDS-00.06.15.001-004.pdf	Issue Index 004, Volume No 01 (2013-05-02)
30	GGDS-004_Errata_15AUG17.pdf	15 AUG 2017
31	Software Download Specification	00.06.15.002-006
32	SWDL Errata (SWDL-006_Errata_06DEC17.pdf)	06 DEC 2017
33	Software Download Functional Test Specification 006	00.06.15.223-003
34	Versatile Binary Format Specification 3.1	00.06.15.004-008
35	VBF 3.1 Test Specification	00.06.15.245_01
36	FS-ML3T-14G113-AA Data Dictionary V 1.0	21 AUG 2018
	Note: This is not an exhaustive list of Netcom requirements documents. A full list including correct version number should be obtainable from the program's Netcom Application Engineer. All versioning information should come from the aforementioned source.	
	Cybersecurity Specifications	
37	ReqSTD-2018-02-23-09-16 (Cybersecurity general requirements)	Latest revision in FEDE at time of signing statement of work, at time of this release 2018-02-23-09-16 is current
38	B.10 Ford_CyberAssurance-SOW_Release	Latest Revision at time of signing statement of work.
39	App Signing Requirements	Latest Revision at time of signing statement of work.
40	Cybersecurity DV Test Plan (DV test plan requirements from CyberSecurity Team)	Latest Revision at time of signing statement of work.

1.5.1 PARSED

PARSED functionality and requirements are defined by FORD CENTRAL SOFTWARE and the PARSED development team. Requirements cascaded for implementation of PARSED is captured by reference items [1] through [4] and were current at the writing of this functional spec. The most up-to-date version of these requirements should be requested from the PARSED team and included in the Statement of Work. Additionally, the PARSED team provides a test environment that is available to suppliers on request.

Note that these are minimum requirements. AVAS/PACM suppliers should work with the AVAS/PACM team to support any additional information that should be passed via PARSED. These items should be tracked in this FS or documented and made freely available in the AVAS Sharepoint with a reference to the document added here.

1.5.2 Cybersecurity

Cybersecurity requirements and statement of work are written and maintained by the Ford Security Team. For the ease of tracking, we have listed basic Cybersecurity documents in the Cybersecurity Specifications section but these are not meant to include all required documentation for Cybersecurity. The full list of documents can be found in the CyberAssurance Statement of work [38]. Actual requirements for Cybersecurity are listed in FEDE. The latest revision of these documents at the time of signing the statement of work should be used.

1.6 GENERAL REQUIREMENTS

1.6.1 Module - Memory / Power Up / Microcontroller Reset

1.6.1.1 Microcontroller memory Storage Classification Requirements:

The data dictionary specifies a "Storage Class" for every data flow used in this functional specification. The following five (5) requirements further specify / define the memory storage classes:

Table 1.6-1 Memory Storage Classification Requirements

Rqmt. No.	Memory Storage Classification	Definition
R: 1.6.1.1.1	Constant	Re-Program the program memory to change it. (FLASH / ROM or EEPROM, Named Complier Constants)
R: 1.6.1.1.2	Non-Volatile – Customer Set	Customer uses feature to change it. Diagnostics can change it. (EEPROM)
R: 1.6.1.1.3	Non-Volatile -- Factory Set Method 2	Diagnostics can change it. (EEPROM)
R: 1.6.1.1.4	Non-Volatile -- Factory Set Method 3	Diagnostics can change it. (EEPROM)
R: 1.6.1.1.5	Non-Volatile – Functional Requirement	Changes during program run – time. (EEPROM)
R: 1.6.1.1.6	Volatile	Changes during program run – time. (RAM)

1.6.1.2 Non-volatile Memory Requirements:

Table 1.6-2 Non-Volatile Memory Generic Requirements

Rqmt. No.	Requirement
R: 1.6.1.2.1	NVRAM Management According to the requirements & expectations for development (RED) nonvolatile memory (NVM) document #EESE-SMD-CSE-PG-032 v2016.1
R: 1.6.1.2.2	ECU SW Design Rules – Body version 2016.2

1.6.1.3 Module Power Up / Microcontroller Reset Requirements:

Table 1.6-3 Power Up / Reset Requirements

Rqmt. No.	Memory storage Class	Description
R: 1.6.1.3.1	Volatile	Upon module power-up and / or upon module reset the body feature initial values specified in the Data dictionary shall be used.
R: 1.6.1.3.2	ALL Non-Volatile	Shall be set to the initial values specified in the Data Dictionary prior to delivery to FORD.
R: 1.6.1.3.3	Constant	Shall be set to the initial value specified in the Data dictionary
R: 1.6.1.3.4	Upon module power-up and / or upon module reset all of the decision tables defined within this functional specification must have all of the output data flows set to the initial value as specified in the Data Dictionary	

1.6.2 Software Classification Level

The functional importance classifications are defined in RQT-191001-009906/18.

FUNCTIONAL IMPORTANCE CLASS C: Any function that is essential to the operation or control of the vehicle (e.g., braking, engine management) or is essential for safe vehicle operation.

FUNCTIONAL IMPORTANCE CLASS B: Any function that enhances the operation or control of the vehicle, but that is not essential to the operation or control of the vehicle.

FUNCTIONAL IMPORTANCE CLASS A: All other functions (e.g., comfort, entertainment).

Functional classifications are used when considering design failure modes and associated design mitigations both at the vehicle/subsystem level and at component level. Functional classifications are also used to describe acceptance criteria associated with particular tests (e.g. EMC Radiated Immunity).

Table 1.6-4 AVAS Software Classification Level Requirement

Requirement Number	Description
R: 1.6.1	AVAS is defined as a FUNCTIONAL IMPORTANCE CLASS C system
NOTE: AVAS has been reviewed by the EESE Functional Safety team. A determination was made that the AVAS module had an overall Automotive Safety Integrity Level (ASIL) of QM.	

1.6.3 Timing Requirements

1.6.3.1 Timing / Response Requirements

R: 1.6.3.1.1	T-1: Unless stated otherwise in the individual feature specification, activation / deactivation of an output response shall occur within the maximum delay time of the corresponding input(s) change as defined in *Table* 1.6-4 below. The maximum delay time is pin-to-pin, including debounce time and multiplex messaging.
R: 1.6.3.1.2	T1.1 Since ignition input debounce is longer than 100 milliseconds and is an exception to requirement T1.0, 55 milliseconds is the maximum delay time for output device activation after an ignition change is debounced.
R: 1.6.3.1.3	T-2: The time tolerances of all timing requirements are +/- 10% unless otherwise stated.

1.6.4 Order of Execution

Order of execution is important to prevent momentary output glitches and to ensure consistent sets of related outputs.

Software implementation shall comply with the requirements in Tables 1.6.5-1 and 1.6.5-2.

1.6.4.1 Order of Execution Requirements

Table 1.6-5 Overall Order of Execution

Rqmt. No.	Requirement
R: 1.6.5.1.1	The flow of data within this FS is generally organized from process to process in this order: input, feature, arbitrator, output. Within each feature category (e.g. Exterior Lighting) all inputs shall be executed before a feature is executed.
R: 1.6.5.1.2	All features that feed an arbitrator shall be executed together as a group. This will ensure that the features operate on a single set of input values and provide a single consistent set of output values to downstream processes.
R: 1.6.5.1.3	The arbitrator(s) that feed an output shall be executed before the output is executed.

Table 1.6.5-1.6-6 Internal Process Order of Execution

Rqmt. No.	Requirement
R: 1.6.5.1.5	Each (input, feature, arbitrator, and output) process shall be executed completely in a single time-slice.
R: 1.6.5.1.6	Each (input, feature, arbitrator, and output) process shall be executed atomically.
R: 1.6.5.1.7	Within every (input, feature, arbitrator, and output) process, data generally flows in the order in which decision tables and state transition diagrams are presented in this FS. For example, a decision table may feed a state transition diagram which may feed another decision table. The elements within a process shall be executed in the order of this internal data flow.

2 APPROACHING VEHICLE AUDIBLE SYSTEM (AVAS)

2.1 FEATURE BEHAVIOR SUMMARY

This functional specification defines system functionality for the Approaching Vehicle Audible System intended for electric vehicles.

Due to quiet operation on Electric Vehicles (EV), Hybrid Electric Vehicles (HEV) and Plug-in Hybrid Electric Vehicle (PHEV) at low vehicle speeds, there exists a higher risk of vehicle/pedestrians collisions. The purpose of the AVAS is to have the function of a ‘vehicle sounder’ to create pleasing noise to alert pedestrians of the presence of vehicles when they are nearby. AVAS should provide alerting information at least equivalent to the cues provided by internal combustion engine (ICE).

The sounder will operate as the applicable government regulation states.

The system should do FADE in/out for some pressure level and frequencies when vehicle is transitioning among all normal operation scenarios listed below.

Normal operations are:

Stationary:
In the case of a vehicle with an automatic transmission, the vehicle’s gear selector is in <u>Neutral</u> or <u>any gear position other than Park</u> that provides forward vehicle propulsion sound must be enabled.

Park:
When the vehicle is in park AVAS should be INACTIVE and sound must be disabled.

Reverse:
Whenever the vehicle’s gear selector is in the Reverse position sound must be enabled.

Drive:
Whenever the vehicle’s gear selector is in Drive/Low/Sport position sound must be enabled.

Acceleration and Deceleration:

Pitch Shifting is a characteristic sound where pedestrian associate a vehicle with the acceleration/decelerations based on the sound emitted by ICE vehicles. The sound produced on this scenario should be the same as the sound produced by the ICE vehicles when speed increases or decreases.

Constant Speed:

In this scenario the vehicle should produce a sound at certain speed, especially at low speed levels for example: 10 km/hr, 20 km/hr or 30 km/hr. On this scenario the vehicle should produce a minimum sound level in case vehicle is in this constant speed.

The sound levels of this module should follow any regional regulations. Sound levels or tones should be defined by NVH team.

2.2 SUBSYSTEM OVERVIEW

The context diagram for the AVAS module is illustrated in **Figure 2.2-1 AVAS Subsystem Overview**.

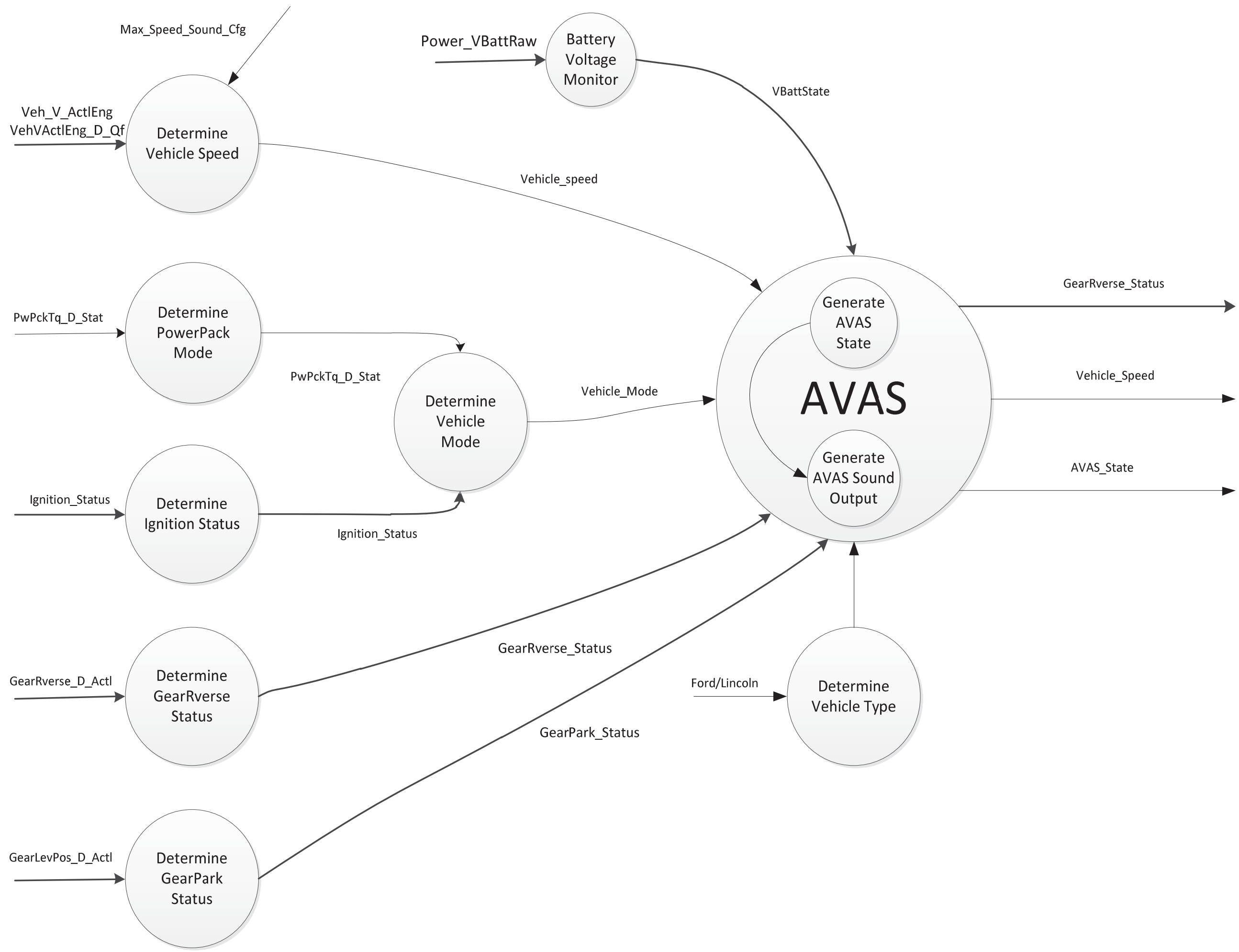


Figure 2.2-1 AVAS Subsystem Overview

2.3 FEATURE BEHAVIOR DETAIL

The AVAS module is a component of electric vehicles EV, PHEV or HEV. When the vehicle's powertrain pack (see **Table 2.5-2 Translation of PwPckTq_D_Stat Status Signal** PwPckOn_TqAvailable) is in a state where it is enabled and capable of producing motive torque on demand by the driver while stationary or moving in Reverse or Forward direction (see **Table 2.4-1 Translation of GearRverse_D_Actl** signal, Active_Confirmed), and below the top speed defined for the system (e.g. 30KPH in first release of FMVSS 141), the module should generate a sound that alerts pedestrians of vehicle presence. The module should not generate a sound in park. The module also does not make sound when the ignition status is off. (**Table 2.5-4 Determining Vehicle Mode** and

Table 2.8-1 Determine AVAS state)

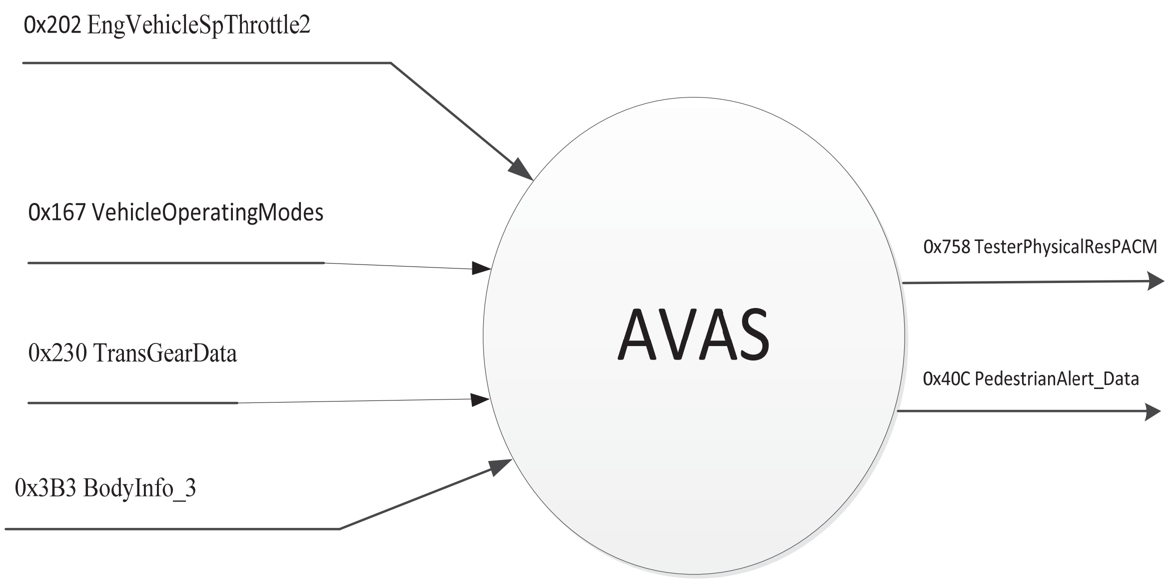


Figure 2.3-1 Context Diagram

2.4 DETERMINE TRANSMISSION STATUS

To determine vehicle direction, the module needs the message 0x202 EngVehicleSpThrottle2. Signal GearRvrse_D_Actl determines if reverse gear is in use or not, ACTIVE state is set when vehicle is going in reverse direction, and INACTIVE is set when direction is going forward.

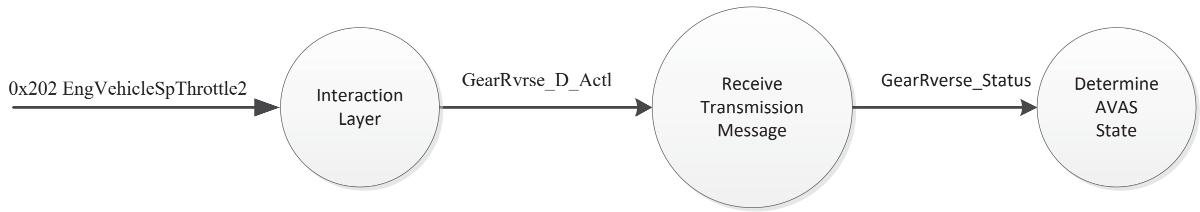


Figure 2.4-1 Vehicle Gear Reverse Status Data Flow

Table 2.4-1 Translation of GearRverse_D_Actl signal

Rqmt. No.	GearRverse_Status_Available	GearRvrse_D_Actl	Values	GearRverse_Status
R: 2.4.0	WAITING	Don't Care	N/A	INACTIVE
R: 2.4.1	LOST	Don't Care	N/A	LOST
R: 2.4.2	AVAILABLE	Active_Confirmed	0x3	ACTIVE
R: 2.4.3	All Other Valid Combination of Values			INACTIVE

Gear Reverse Signal Status Transition Diagram shows the logic to transition between the states of the GearRvese_Signal_Status including timing. When status equals LOST and GearRevrse_D_Actl_Signal_Received_Flag = NULL, the module should set a DTC, please see Diagnostics section below.

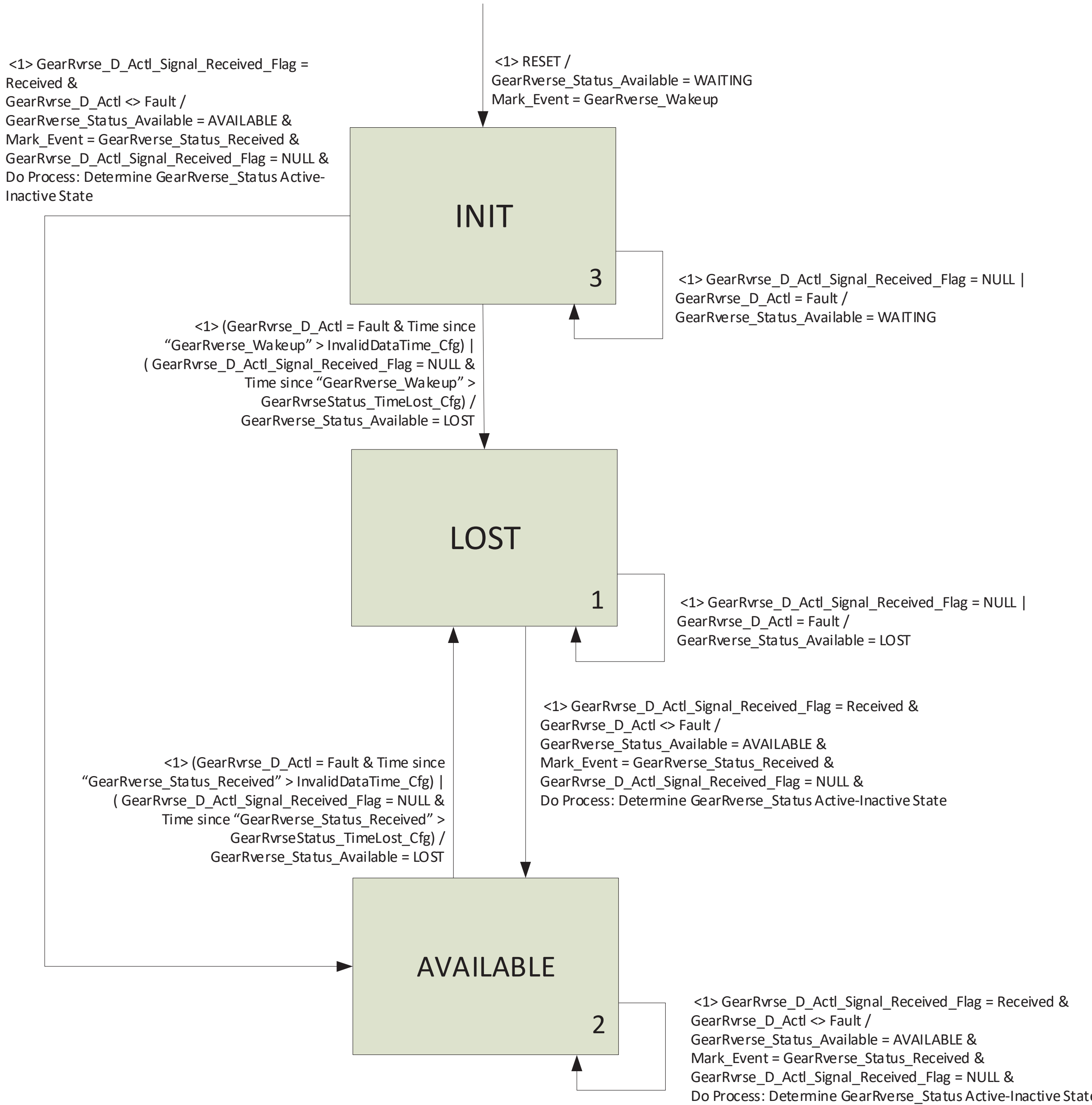


Figure 2.4-2 Gear Reverse Signal Status Transition Diagram

In order to prevent an audible delay in sound output when the driver moves the gear lever position through the Reverse gear position, AVAS shall delay for TransitionDelayCfg before transitioning GearRverse_Status from an Active to Inactive state and vice versa. **Figure 2.4-3 Determine GearRverse_Status Active-Inactive State** runs while GearRverse_Status_Available = Available and ensures that there is no audible pause in the sound when the driver shifts through but does not remain in park.

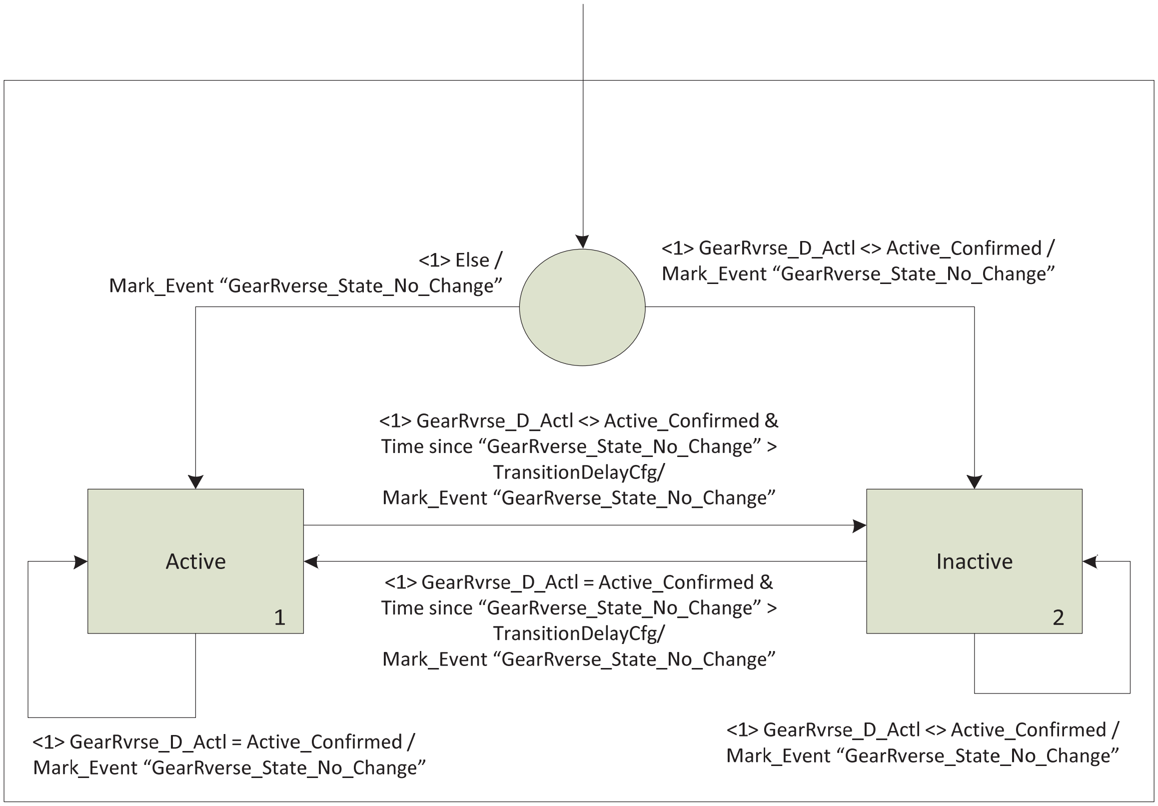


Figure 2.4-3 Determine GearRverse_Status Active-Inactive State

When the gear lever position is in park the AVAS system should be INACTIVE. To determine if the vehicle gear position is park, the module receives the signal GearLvrPos_D_Actl (in HEV vehicles before Gen IV). If the gear is in a park position, GearPark_Status is set to ACTIVE. If the vehicle's gear position is not park, GearPark_Status is set as INACTIVE. If the signal GearLvrPos_D_Actl is lost, determined by the value GearLrvPosAvailable, then GearPark_Status is set to LOST. **Figure 2.4-4 Vehicle Gear Park Status Data Flow** details how to determine if the GearPark_Available state is Lost or Available.

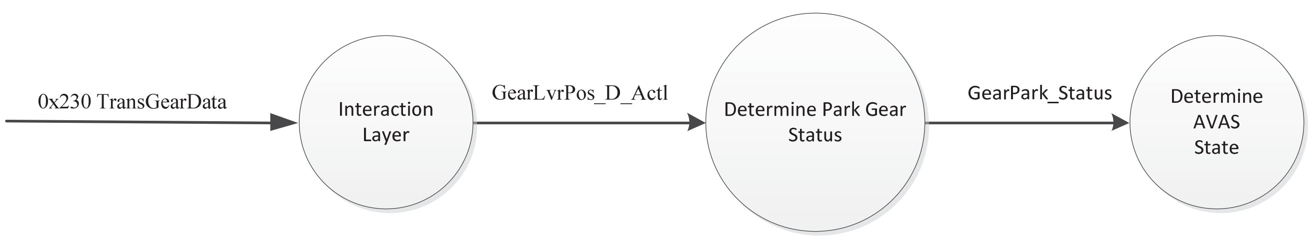


Figure 2.4-4 Vehicle Gear Park Status Data Flow

Table 2.4-2 Translation of GearLvrPos_D_Actl signal and GearPark_Status

Rqmt. No.	GearLvrPos_Available	GearLvrPos_D_Actl	Values	GearPark_Status
R: 2.4.3a	WAITING	Don't Care	Don't Care	INACTIVE
R: 2.4.4	LOST	Don't Care	Don't Care	LOST
R: 2.4.5	AVAILABLE	Park	0x0	ACTIVE
R: 2.4.6	All Other Valid Combination of Values			INACTIVE

Determine Park Status Transition Diagram shows the logic to transition to the different states of GearPark_Status. When GearLvrPos_Available equals LOST and GearLvrPos_D_Actl_Signal_Received_Flag = NULL, the module should set a DTC, please see Diagnostics section below.

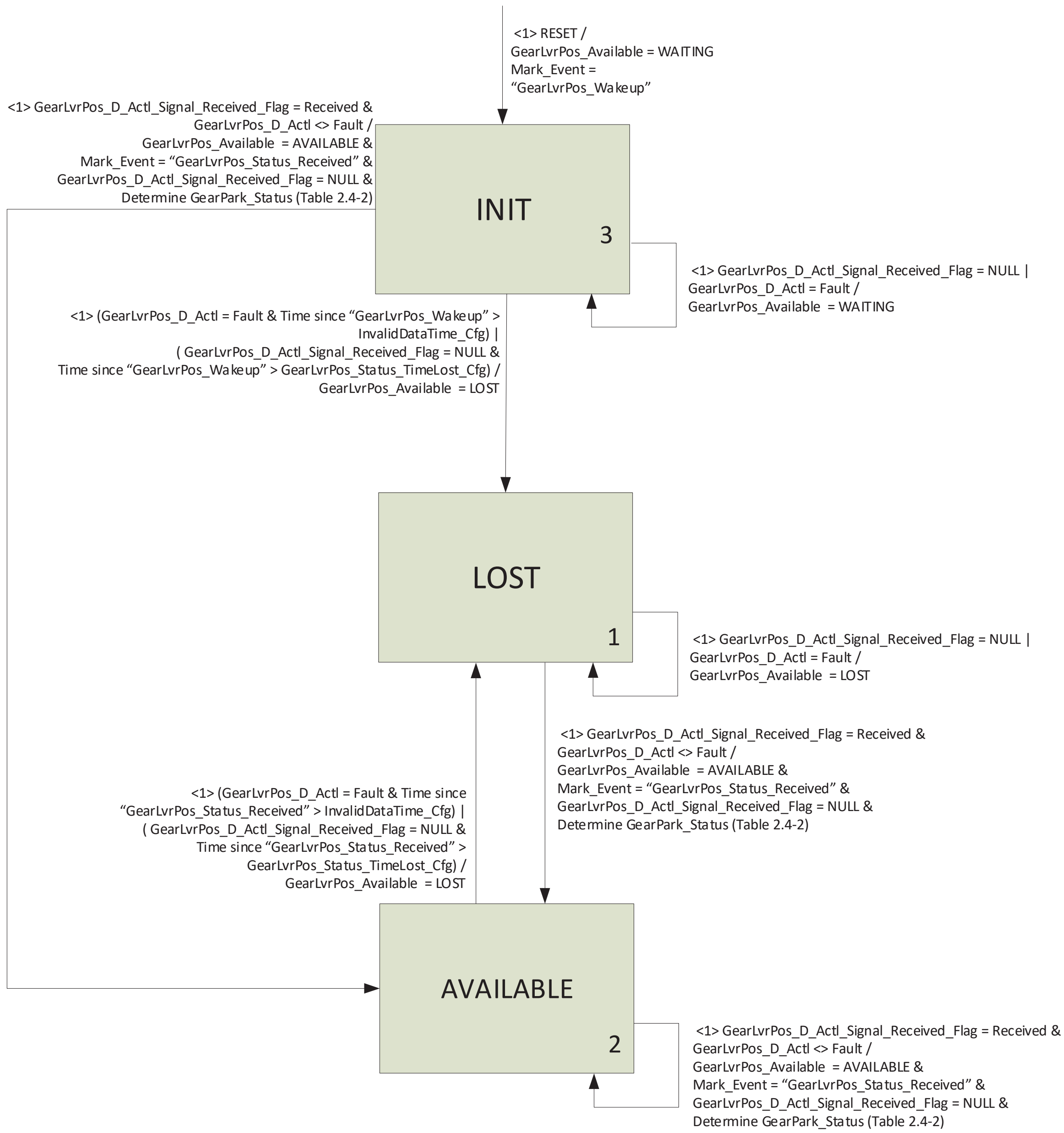


Figure 2.4-5 Determine Park Status Transition Diagram

In order to determine the AVAS state, the GearPark_Status and the GearRverse_Status_Available are combined into the Trans_Signal_Status whose value is used to determine the AVAS state in

Table 2.8-1 Determine AVAS state.

Table 2.4-3 Determination of Trans_Signal_Status

Rqmt. No.	GearRverse_Status	GearPark_Status	Trans_Signal_Status
R: 2.4.7	LOST	Don't Care	LOST
R: 2.4.8	Don't Care	LOST	LOST
R: 2.4.9	ACTIVE	Don't Care	ACTIVE
R: 2.4.10	All Other Valid Combination of Values		INACTIVE

2.5 DETERMINE VEHICLE MODE STATUS

To determine Vehicle mode, the module should receive messages 0x167 VehicleOperatingModes and 0x3B3 BodyInfo_3. Signals PwPackTq_D_Stat and Ignition Status helps to determine mode status of the vehicle. The results of the evaluation represent valid modes of the vehicle.

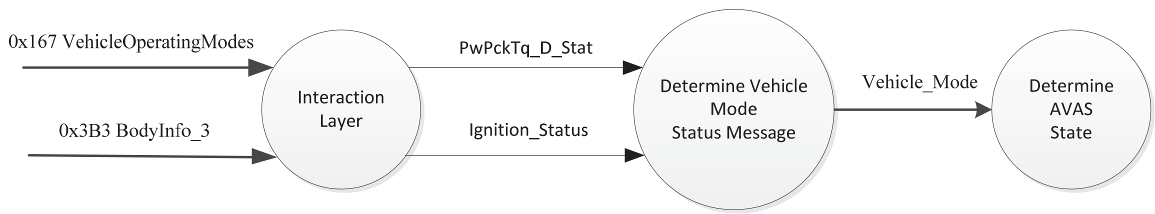


Figure 2.5-1 Determine Vehicle Mode Status Data Flow 1

Before using the values of PwPckTq_D_Stat and Ignition_Status, the AVAS module must check to see if the signals are available or lost. If the signal is lost, we have no valid values to use. **Determine PwPckTq Status Transition Diagram** shows the state machine that determines whether the PwPckTq_D_Stat signal is available or lost.

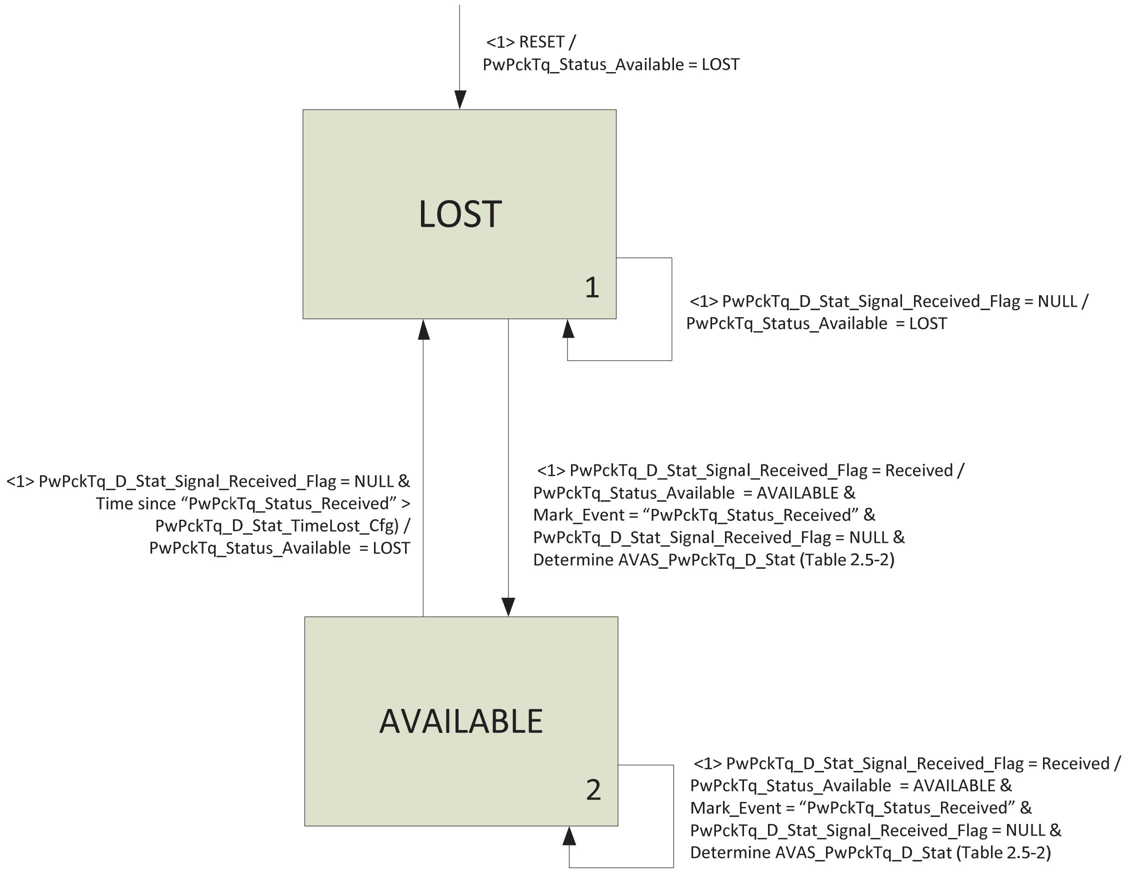


Figure 2.5-2 Determine PwPckTq Status Transition Diagram

When the status of PwPckTq_Status_Available = LOST and PwPckTq_D_Stat_Signal_Received_Flag = NULL, an appropriate DTC should be set. Please see the Diagnostics section below.

Determine Ignition_Status Signal Status Transition Diagram shows the state machine that determines whether the Ignition_Status signal is available or lost.

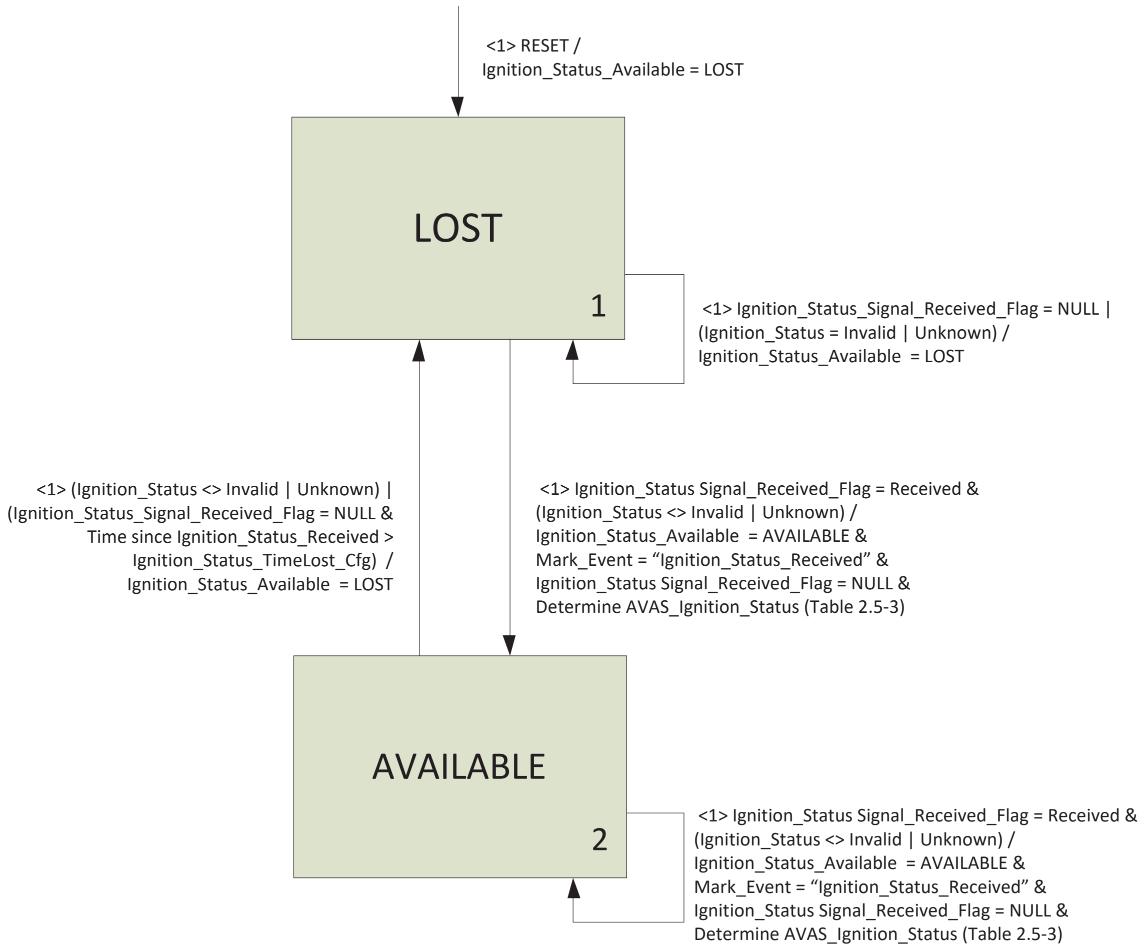


Figure 2.5-3 Determine Ignition_Status Signal Status Transition Diagram

When the Ignition_Status_Available = LOST and the Ignition_Status_Received_Flag = NULL, a LOST DTC must be set. Please see the Diagnostics section below.

The values of Ignition_Status_Available and PwPckTq_Status_Available will be combined into one value, PwPck&IgnStat_Signal_Status as shown in the table below.

Table 2.5-1 Determination of PwPck&IgnStat_Signal_Status

Rqmt. No.	PwPckTq_Status_Available	Ignition_Status_Available	PwPck&IgnStat_Signal_Status
R: 2.5.1	Lost	Don't Care	Lost
R: 2.5.2	Don't Care	Lost	Lost

R: 2.5.3	Available	Available	Available

Provided the signals are available and not lost, the value of the signals are translated to internal values used by AVAS as specified in **Table 2.5-2 Translation of PwPckTq_D_Stat Status Signal** and **Table 2.5-3 Translation of Ignitions Status** below.

Table 2.5-2 Translation of PwPckTq_D_Stat Status Signal

CAN ID	CAN Message	Signal	Detailed Meaning	State Encoded	AVAS_PwPckTq_D_Stat
0x167	VehicleOperatingModes	PwPckTq_D_Stat	PwPckOff_TqNotAvailable	0x0	OFF_NO_TQ
			PwPckOn_TqNotAvailable	0x1	ON_NO_TQ
			PwPckStrtInProg_TqNotAvail	0x2	START_IN_PROGRESS
			PwPckOn_TqAvailable	0x3	ON_TQ_AVAILABLE

Table 2.5-3 Translation of Ignitions Status

CAN ID	CAN Message	Signal	Detailed Meaning	State Encoded	AVAS_Ignition_Status
0x3B3	BodyInfo_3	Ignition_Status	Accessory	0x2	ACCESORY
			Run	0x4	RUN
			Start	0x8	START
			Invalid	0xF	INVALID
			Off	0x1	OFF
			Unknown	0x0	UNKNOWN

The availability of the PwPckTq_D_Stat and Ignition_Status signal, the GearPark_Status and the internal signal values AVAS_Ignition_Status and AVAS_PwPckTq_D_Stat are used to evaluate the current vehicle mode. This value is stored as Vehicle_Mode.

Table 2.5-4 Determining Vehicle Mode

Rqmt. No.	PwPck& IgnStat_Signal_Status	GearPark_Status	AVAS_Ignition_Status	AVAS_PwPckTq_D_Stat	Vehicle_Mode
R: 2.5.4	AVAILABLE	Don't Care	Accessory	Don´t Care	ACCESORY
R: 2.5.5	AVAILABLE	ACTIVE	RUN	Don't Care	GEAR_PARK

R: 2.5.6	AVAILABLE	< > ACTIVE	RUN	ON_NO_TQ | OFF_NO_TQ	GEAR_PARK
R: 2.5.7	AVAILABLE	Don't Care	Off	OFF_NO_TQ	IGNITION_OFF
R: 2.5.8	AVAILABLE	Don't Care	Don´t Care	START_IN_PROGRESS	CRANKING || DIAGNOSTIC_MODE
R: 2.5.9	AVAILABLE	< > ACTIVE	RUN	ON_TQ_AVAILABLE	POWERPACK_ON
R: 2.5.10	LOST	Don't Care	Don't Care	Don't Care	LOST
R: 2.5.11	AVAILABLE	Don't Care	START	Don't Care	CRANKING

2.6 DETERMINE VEHICLE SPEED STATUS

To determine vehicle speed, the module needs to receive the message 0x202 EngVehicleSpThrottle2. Signal Veh_V_ActlEng determine the current speed for electric vehicles. The signal VehVActlEng_D_Qf reports the quality of the value in Veh_V_ActlEng. This value may be faulty and invalid.

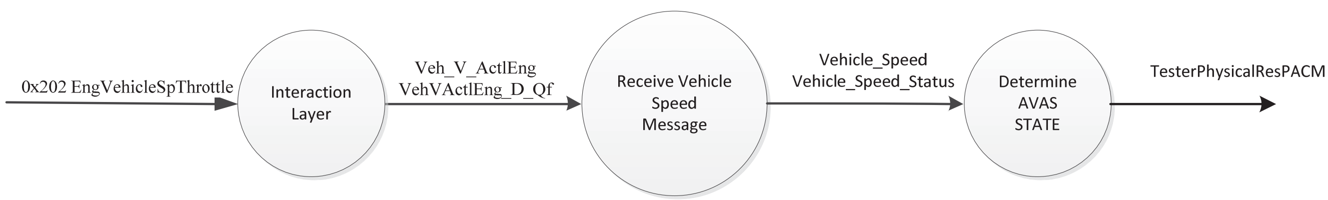


Figure 2.6-1 Determine Vehicle Speed and Vehicle Speed Status

Figure 2.6-2 Determine Vehicle Speed Status Transition Diagram shows how Vehicle_Speed_Available is determined. When the Vehicle_Speed_Available equals LOST and Veh_V_Actl_Eng_Signal_Received_Flag = NULL, the module should set a DTC as per the Diagnostics section below.

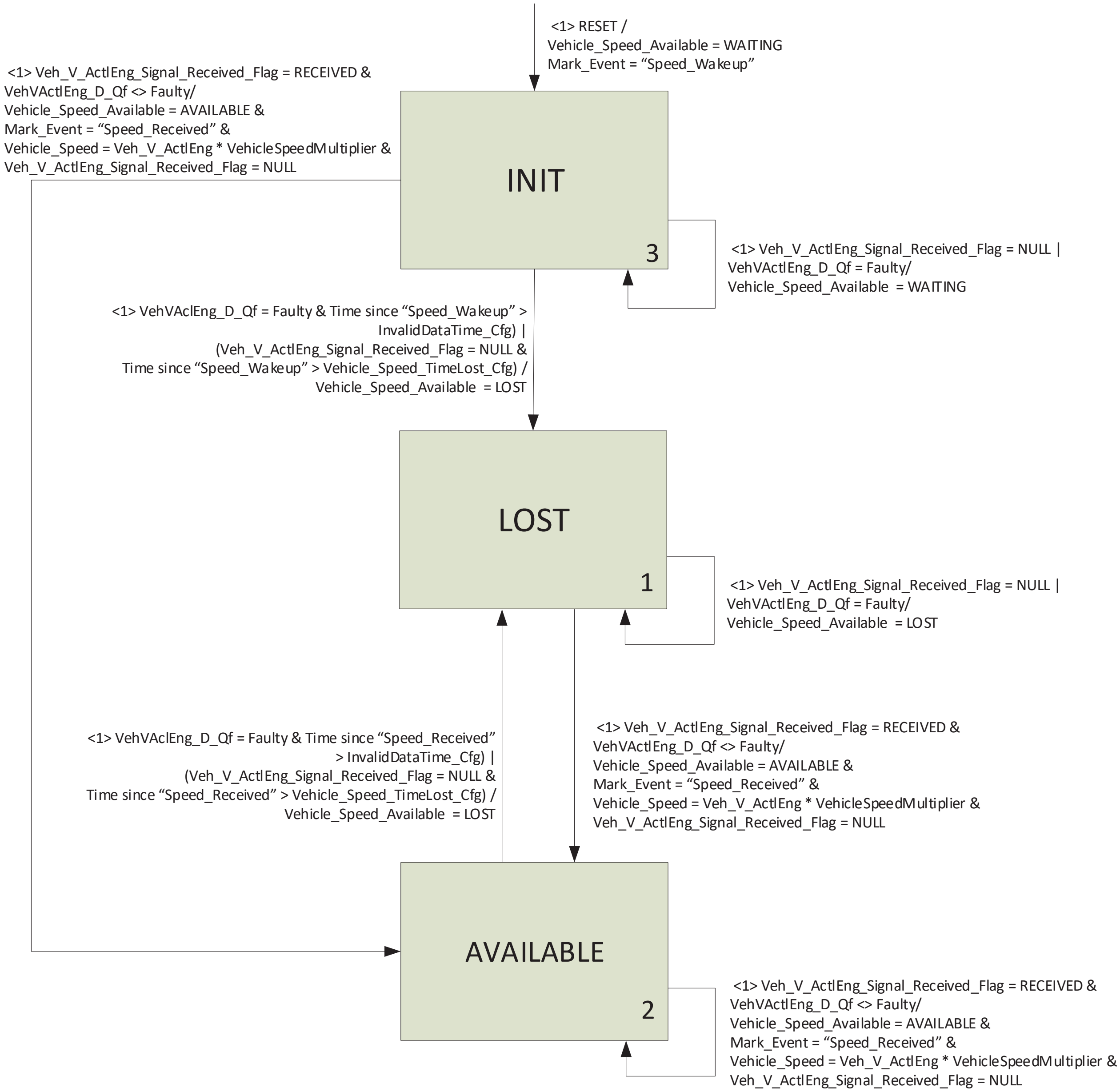


Figure 2.6-2 Determine Vehicle Speed Status Transition Diagram

Rqmt. No.	Vehicle_Mode	Trans_Signal_Status	Vehicle_Speed_Available	Vehicle_Speed	AVAS_State
R: 2.7.1	LOST	Don´t Care	Don’t Care	Don´t Care	FAULT
R: 2.7.2	Don´t Care	LOST	Don’t Care	Don´t Care	FAULT
R: 2.7.3	Don´t Care	Don´t Care	LOST	Don’t Care	FAULT
R: 2.7.3a	< > LOST	< > LOST	WAITING	Don’t Care	INACTIVE
R: 2.7.4	Don´t Care	Don´t Care	AVAILABLE	> Max_Speed_Sound_Cfg	INACTIVE
R: 2.7.5	ACCESORY	Don´t Care	AVAILABLE	<= Max_Speed_Sound_Cfg	INACTIVE
R: 2.7.6	CRANKING	Don´t Care	AVAILABLE	<= Max_Speed_Sound_Cfg	INACTIVE
R: 2.7.7	IGNITION_OFF	Don´t Care	AVAILABLE	<= Max_Speed_Sound_Cfg	INACTIVE
R: 2.7.8	POWERPACK_ON	Don´t Care	AVAILABLE	<= Max_Speed_Sound_Cfg	ACTIVE
R: 2.7.9	GEAR_PARK	Don’t Care	Don’t Care	Don’t Care	INACTIVE
R: 2.7.10	Check Diagnostics Section for Fault conditions				FAULT

2.8 DETERMINE AVAS STATE

The state of the AVAS ECU provides information when the module is ACTIVE, INACTIVE or FAULT. The module should be capable of informing when the module is producing sound, meaning; the state should be set to ACTIVE when the module is producing sound; INACTIVE when the module is not producing sound, and if there is something wrong with some of the input signals or due to some internal failures, then the module should set the state to FAULT.

The module should produce sound if all the elements such as the inputs necessary to determine the state of the system, or the internal variables and components of the AVAS system are correct. The module should check for a specific speed limit defined internally in the CONFIGURATION file and after exceeding it, it should not produce any sound. This maximum speed depends on the value of Max_Speed_Sound_Cfg.

The module should be capable to detect failures that compromise correct operation, these failures are:

- Speaker#1 Failure (Generally the Front Speaker or only speaker in a one speaker system)
- Speaker#2 Failure (Generally the rear speaker if it exists on the hardware)
- Amplifier failure
- Unknown state
- Lost communication or signal reported as faulted
- Internal failures

For more detailed information on specific failures refer to **2.11 Diagnostics**. When the failures above are present, the module should set AVAS_State to FAULT.

The next table represents the internal status of the AVAS module represented with the dataflow AVAS_State.

Table 2.8-1 Determine AVAS state

2.8.1 AVAS Fault State Signal

The module should transmit a CAN message PedestrianAlert_Data with ID 0x40C, signal name is PdstrnAlrt_B_Falt. This signal should indicate current condition of the module. This signal should be transmitted when vehicle mode is in ACCESORY, DIAGNOSTICS_MODE, CRANKING, GEAR_NUETRAL, and POWERPACK_ON as defined in **Table 2.5-4 Determining Vehicle Mode.**

- YES state indicates module is not working and a failure is present.
- NO state indicates module is working OK.

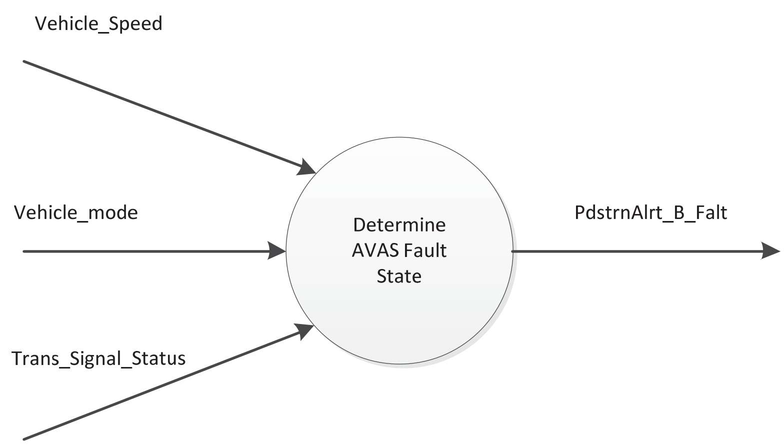


Figure 2.8-1 AVAS Fault State Flow Diagram

Table 2.8-2 PdstrnAlrt_B_Falt signal status

CAN ID	CAN Message	Signal	Detailed Meaning	State Encoded
0x40C	PedestrianAlert_Data	PdstrnAlrt_B_Falt	PACM_Fault_NO	0x0
			PACM_Fault_YES	0x1

The module should set PdstrnAlrt_B_Falt according to AVAS_State:

Table 2.8-3 PdsTrnAlrt_B_Falt set conditions

Requirement Number	AVAS_State	PdstrnAlrt_B_Falt
R: 2.8.1	ACTIVE || INACTIVE	PACM_Fault_NO

R: 2.8.2	FAULT	PACM_Fault_YES

2.9 GENERATE AVAS OUTPUT

2.9.1 General AVAS Output Requirements

The following requirements apply to generating the AVAS output:

Table 2.8.1.1 General AVAS Output Requirements

Rqmt. No.	Description
R: 2.9.1	AVAS system must be able to produce Broadband sound(s); adjustable for all 1/3 octave bands between 315 Hz and 5 KHz.
R: 2.9.2	The software sound strategy must include a time domain signal generation and frequency domain filter blocks.
R: 2.9.3	The signal generation block must use either a wave or grain based signal generation. For wave designs, the input files should be a minimum of 5 seconds at 16 kHz and 16 bit. The design must accommodate a minimum of two WAV files. For grain designs, the design must accommodate five grains of one second each. Design must be approved by NVH prior to implementation.
R: 2.9.4	The supplier must deliver a tuning tool to allow Ford to modify both the signal generation and the filter blocks.
R: 2.9.5	The system must also be capable of adjusting an overall gain vs speed within a 100 dB range.
R: 2.9.6	AVAS must have the capability to statically equalize the sound with respect to the vehicle transfer function using either a 1025 tap FIR filter or a bank of 8 IIR filters which include parametric peaking/notch, high pass, low pass, parametric bass shelf and parametric treble shelf.
R: 2.9.7	The calibration files must separate the time history components from the tuning parameters to enable end of line flash parameters.
R: 2.9.8	NVH will determine whether the supplier sound generation capability and GUI is capable of producing the desired sound characteristics per vehicle line and per requirement.
Note: The way of communicating this information should be agreed between the Ford vehicle NVH engineer, the Ford AVAS application D&R engineer and the supplier.	

2.9.2 AVAS Required Signal Flow

The figure below details the AVAS Digital Signal Processing flow and the required processing of sounds. Configuration for these processes should be through a GUI tool that allows a technician to set configuration values through a graphical user interface (GUI) and creates a configuration file for use with the AVAS ECU.

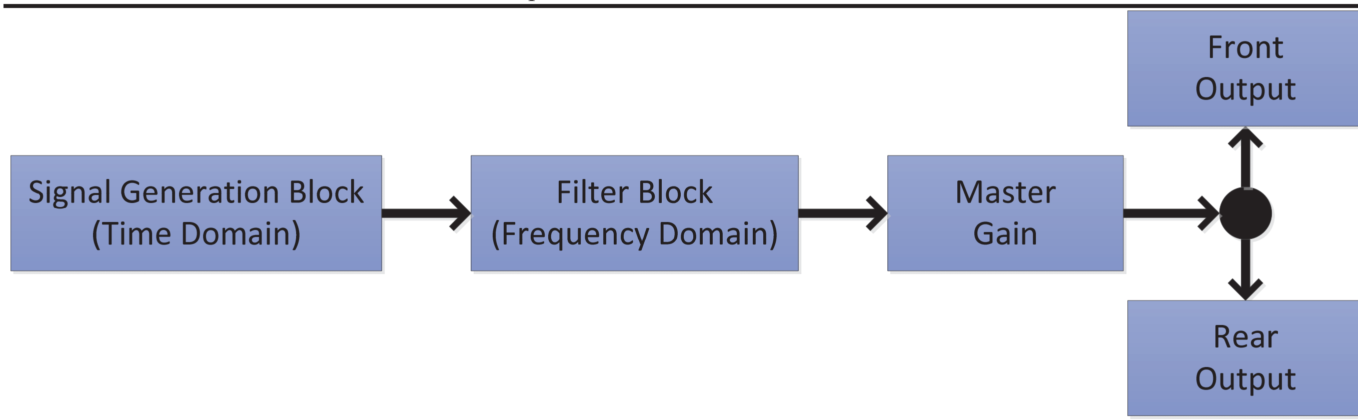


Figure 2.9-1 AVAS Digital Signal Processing Flow

2.9.3 Signal Generation Block Requirements

Ford Motor Company prefers for suppliers to implement an optimized signal generation strategy. A signal generation strategy should be designed by the supplier and approved by Ford Motor Company before final implementation. The concepts for Signal Generation presented in this section are example implementations but may be used as the basis for a supplier's signal generation design.

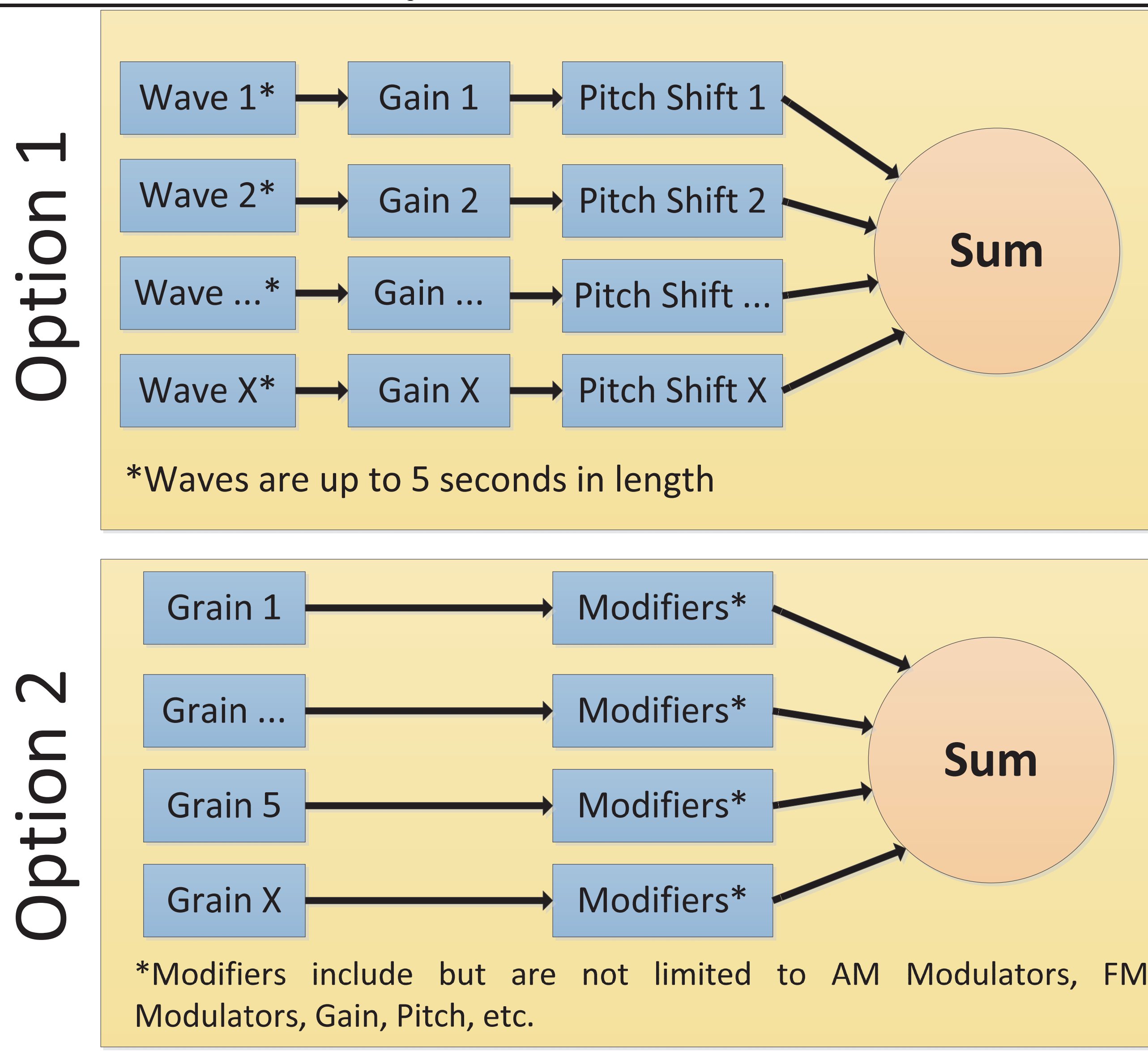


Figure 2.9-2 AVAS Signal Generation Block Concepts

Table 2.9-1 Requirements for the AVAS Signal Generation Block

Requirement Number	Description
R: 2.9.9	The supplier shall present and implement a strategy for signal generation that is approved by Ford Motor Company.
R: 2.9.10	The Signal Generation Block shall create sound using time domain techniques such as wave or grain synthesis.

2.9.4 Filter Block Requirements

Ford Motor Company prefers for suppliers to implement an optimized filtering strategy. A filtering strategy should be designed by the supplier and approved by Ford Motor Company before final implementation. The concepts for filtering presented in this section are example implementations but may be used as the basis for a supplier's signal generation design.

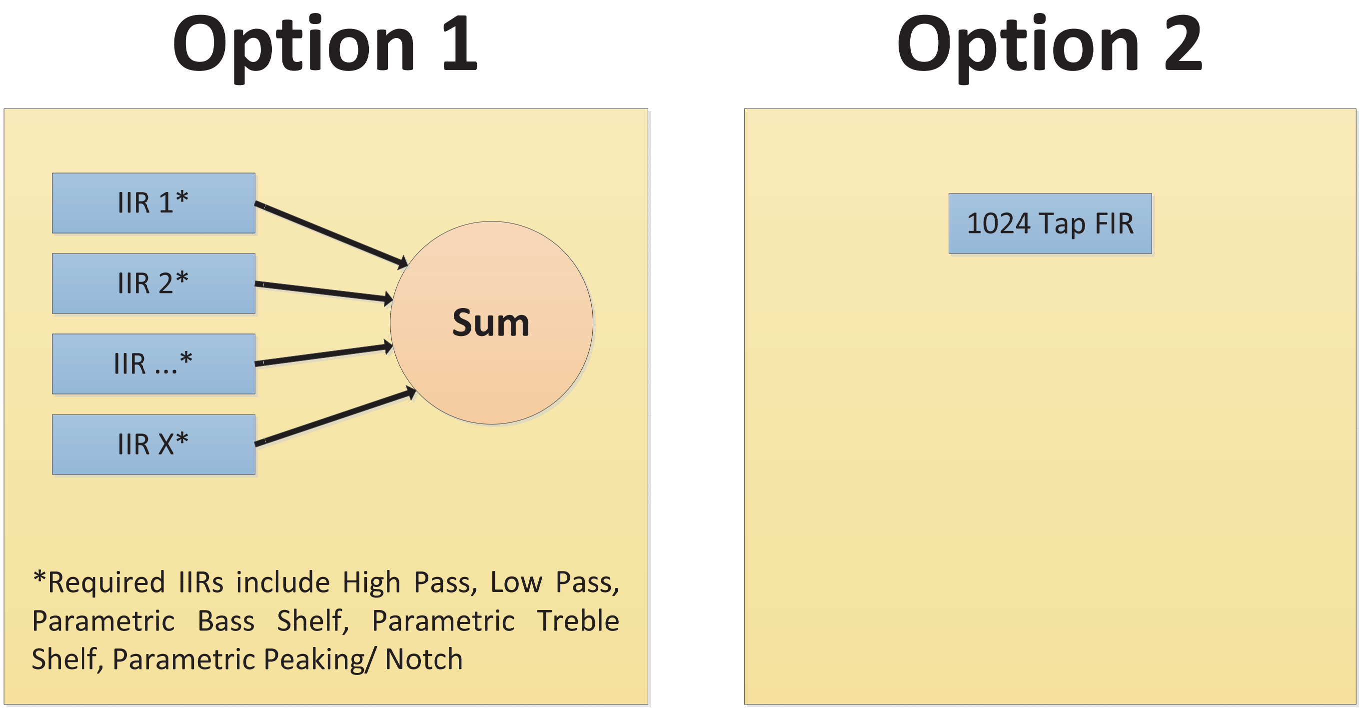


Figure 2.9-3 AVAS Filter Block Concepts

Table 2.9-2 Requirements for the AVAS Filter Block

Requirement Number	Description
R: 2.9.11	The supplier shall present and implement a strategy for signal filtering that is approved by Ford Motor Company.
R: 2.9.12	A static frequency filter block shall be used to enable faster tuning time and reduced vehicle usage.

2.9.5 One Speaker Systems versus Multi-Speaker Systems

The following requirements apply to configuration and functionality of a one-speaker system versus a multi-speaker system.

Table 2.9-3 Requirements for One Speaker and Multi-Speaker Systems

Requirement Number	Description

R: 2.9.13	AVAS_Spkr_Cfg shall be used to configure AVAS to be a one-speaker system or a multi-speaker system.
R: 2.9.14	In a one speaker system, all sound will be played from the single speaker (ACTIVE_SPKR1)
R: 2.9.15	In a two speaker system, the reverse sound will be played from the rear speaker (ACTIVE_SPKR2) and any other sounds will be played through the front speaker (ACTIVE_SPKR1)

Figure 2.9-4 Determination of Which Speaker is Playing Audio: Two Speaker System demonstrates how to determine which speaker is being used for playback.

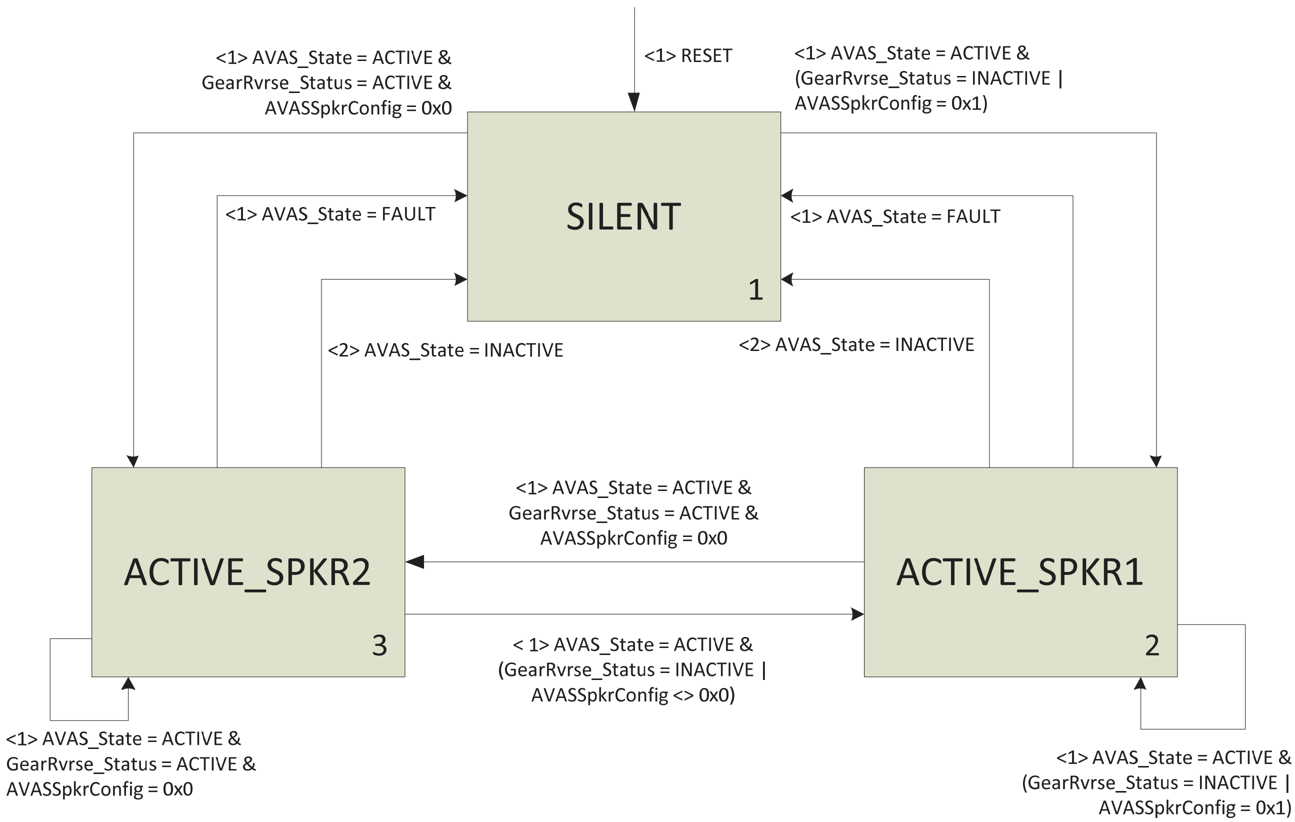


Figure 2.9-4 Determination of Which Speaker is Playing Audio: Two Speaker System

2.9.6 AVAS Output Timing Requirements

Table 2.9-4 AVAS Specific Timing Requirements

Rqm't Num.	Input Action	Output Response	Maximum Delay Time With Module In Awake State	Maximum Delay Time With Module In Sleep State
R: 2.9.16	Voltage: CAN: Vehicle Speed or Gear Position Ignition Status	Sound emitted by AVAS	500 ms (see note 10)	No Sleep state
R: 2.9.17	During a transition from forward sound/audio to reverse sound/audio or vice versa, the current sound shall continue to play until the new sound is loaded and ready to play unless AVAS enters into a state where no sound should be played.			

Notes	Maximum Delay Time With Module In Awake State	Maximum Delay Time With Module In Sleep State
1	1a – Calculation 50 ms to debounce the input. 20 ms to process the input. 3 ms to turn on the output.	1b – Calculation 50 ms to detect the switch has changed state 1 ms to wake up. 40 ms to debounce the input. 20 ms to process the input. 3 ms to turn on the output.
2	2a – Calculation 90 ms to debounce the input. 20 ms to process the input. 3 ms to turn on the output.	
8	ALL MAXIMUM DELAY TIMES ARE IN MILLISECONDS	
9	The input / output task schedule is every 20 milliseconds	
10	From the reception of the first CAN frames of Vehicle Speed, Reverse Status, Power Pack Torque, Gear Lever Position Actual and when voltage is in the nominal operating range. In the case where time is needed to determine a valid signal (debounce) such as with reverse status then a debounce time may be added to the maximum delay. Maximum delay time with the module in the awake state with debounce time added cannot exceed 750 ms	

2.10 VOLTAGE RANGE MONITOR

2.10.1 Voltage Range Monitor Feature Behavior Summary

This feature provides monitoring of battery and relay power voltages for proper operation of the features and outputs of the AVAS module. Different loads and features require different voltages to operate correctly. This feature maintains the state of the battery for each load/feature viz. NORMAL, LOW, HIGH, UNDER, OVER.

The voltage range monitor (VRM) will monitor the battery current according to the configuration constants defined below to determine whether or not the power to the AVAS and CAN transceiver are within normal operating range and not in danger of behaving abnormally. The feature behavior is detailed below.

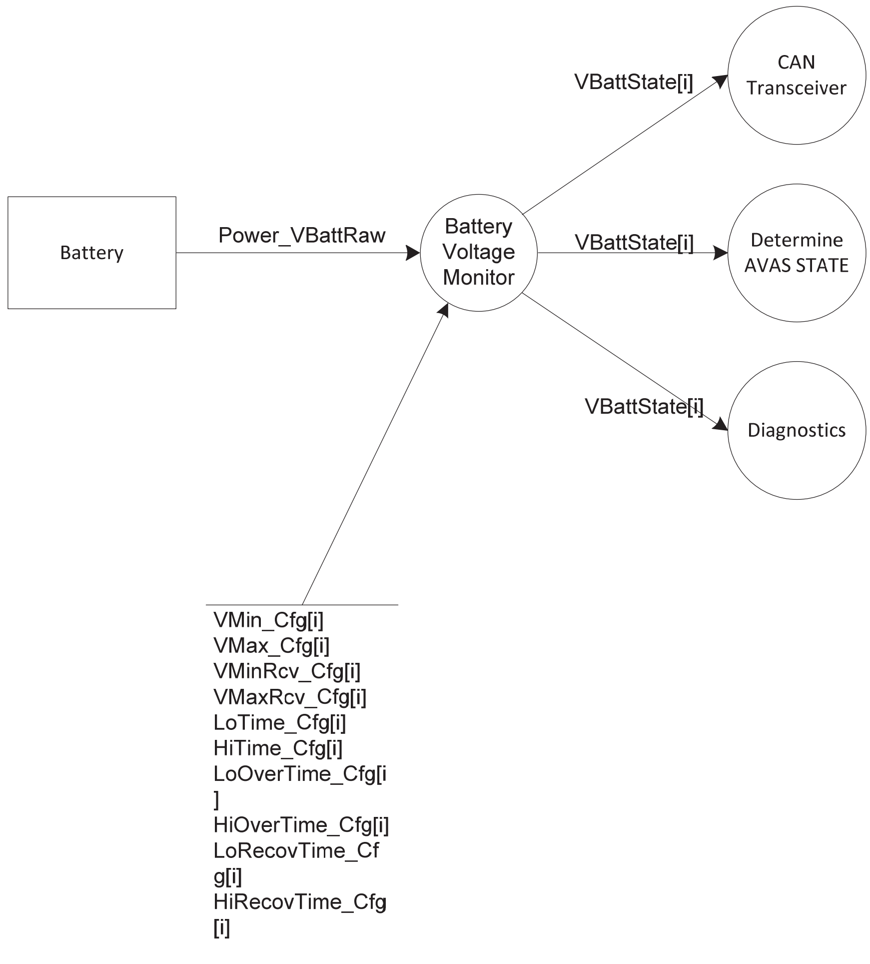


Figure 2.10-1 Battery Voltage Monitor Data Flow Diagram

A voltage range is defined to be in one of five different states. **Table 2.10-1 VBattState[i]** Definitions lists all of these states along with the associated voltage definition and what is expected of the typical feature. Each voltage range is mapped to an entry in the VBattState[i] array.

Table 2.10-1 VBattState[i] Definitions

VBattState[i]	Voltage	Typical Feature Behavior
NORM_V	Normal	Normal feature behavior
LO_V	Temporary Low	Most features should operate normally (there may be exceptions)
HI_V	Temporary High	Most features should operate normally (there may be exceptions)
UNDER_V	Too low too long, Under Voltage	Most features should shed loads (there may be exceptions)
OVER_V	Too high too long, Over Voltage	Most features should shed loads (there may be exceptions)

The following dataflows are defined for each voltage range. Note that whenever VBatt is outside the normal range (NORM_V) VBattState[i] immediately changes to LO_V or HIGH_V.

Table 2.10-2 Voltage Range Dataflows

Dataflow Name	Description
VMin_Cfg[i]	Defines minimum voltage for a *Voltage Range*
VMax_Cfg[i]	Defines maximum voltage for a *Voltage Range*
VMinRcv_Cfg[i]	Voltage hysteresis for recovering from an UNDER_V condition
VMaxRcv_Cfg[i]	Voltage hysteresis for recovering from an OVER_V condition
	Note: The data dictionary contains the default values of VMin_Cfg, VMax_Cfg, VMinRcv_Cfg and VMaxRcv_Cfg. The supplier will perform a worst case analysis of the circuits. The supplier will supply the updated values for the data dictionary to be included in subsequent builds and verification and validation testing.
LoTime_Cfg[i]	After VBatt dips low, this is the minimum amount of time normal voltage must be present before allowing inputs to be read again (return to NORM_V). This value must be set based on worst-case analysis of the slowest circuit that uses this *Voltage Range*.
HiTime_Cfg[i]	After VBatt pops high, this is the minimum amount of time normal voltage must be present before allowing inputs to be read again (return to NORM_V). This value must be set based on worst-case analysis of the slowest circuit that uses this *Voltage Range*.
LoOvrTime_Cfg[i]	Defines the amount of time to wait in a low voltage (LO_V) condition before declaring an UNDER_V condition.
HiOvrTime_Cfg[i]	Defines the amount of time to wait in a high voltage (HI_V) condition before declaring an OVER_V condition.
LoRecovTime_Cfg[i]	Defines the amount of time that the voltage must be above VMin_Cfg[i] before recovering from an UNDER_V condition and allowing input sampling again.
HiRecovTime_Cfg[i]	Defines the amount of time that the voltage must be below VMax_Cfg[i] before recovering from an OVER_V condition and allowing input sampling again.
VBattState[VR_xxx]	Current State of a specific *Voltage Range*.

2.10.2 Basic Voltage Range Requirements

The following voltage range requirements apply to each voltage range supported by the AVAS Voltage RangeMonitor:

Table 2.10-3 Basic Voltage Range Requirements

Rqmt. No.	Requirement
R: 2.10.1	Each feature is mapped to a *Voltage Range* (each *Voltage Range* can support multiple features and input circuits)
R: 2.10.2	VBattRaw shall always be readable (whenever the micro is running).
R: 2.10.3	If a feature is implemented without using a microprocessor, then the design must guarantee the fundamental concept in this document of not responding to input values when VBattRaw voltage makes the input circuit unreliable. The design must be approved in a Design Review.
R: 2.10.4	VBattRaw must be sampled every 5 milliseconds or faster.

2.10.3 Voltage Range State Machine

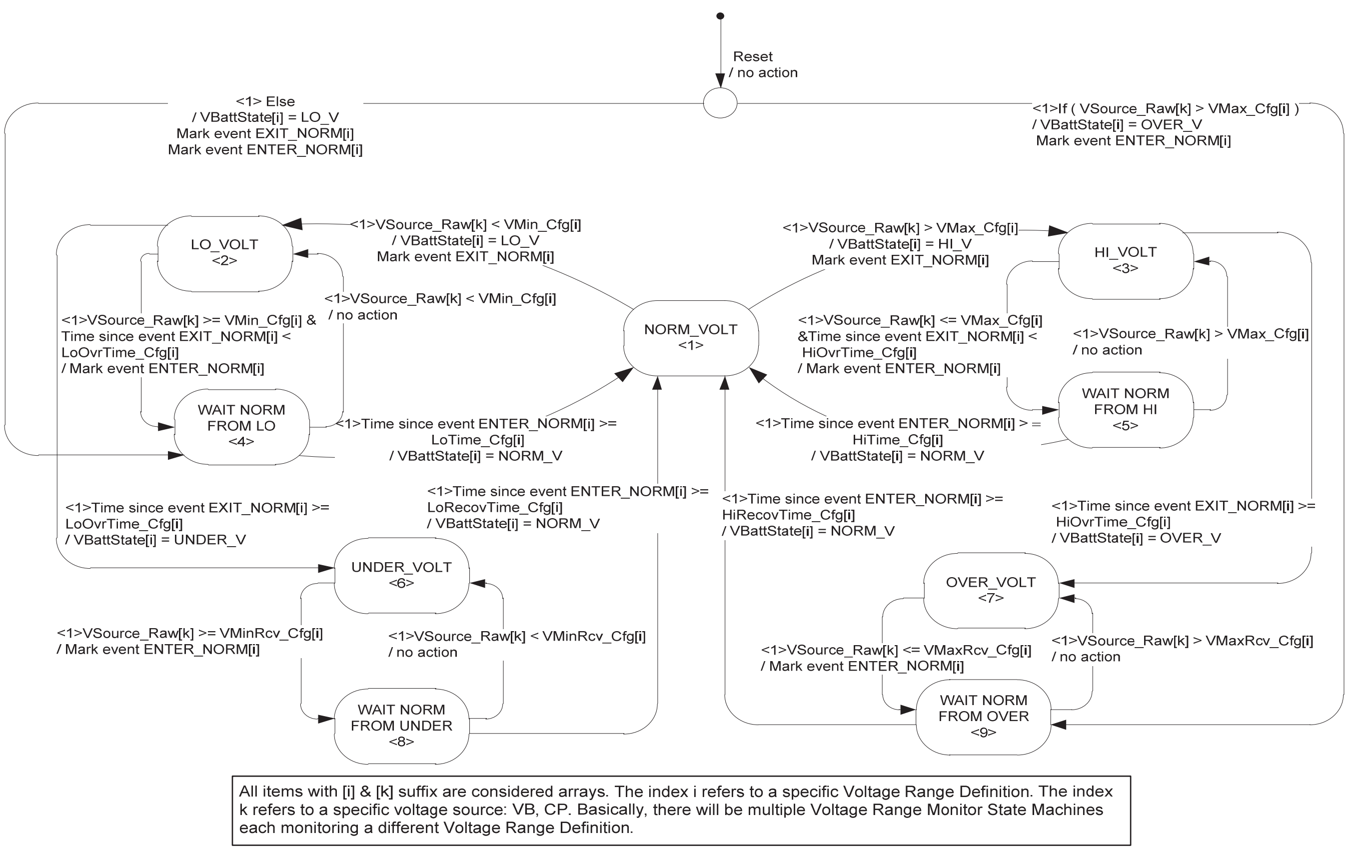


Figure 2.10-2 Voltage Range Monitoring Finite State Machine

R: 2.10.5	Each of the defined *Voltage Ranges* in **Table 2.10-3 Basic Voltage Range Requirements** must be evaluated using an instance of this state machine.

Table 2.10-4 Voltage Range Monitoring State Transition Diagram Requirements describes the transitional requirements of the Voltage Range Monitoring Finite State Machine.

Table 2.10-4 Voltage Range Monitoring State Transition Diagram Requirements

Rqmt. No.	Source State -> Destination State. Rqmt. No	Description
R: 2.10.6	0 -> 4.1	Wait normal from low on reset
R: 2.10.7	0 ->9.1	Wait normal from over on reset to detect jump start from reset
R: 2.10.8	1->3.1	Voltage rises to HIGH from Normal
R: 2.10.9	1->2.1	Voltage drops to LOW from Normal
R: 2.10.10	3->5.1	Voltage drops back to Normal range
R: 2.10.11	3->7.1	Voltage remains HIGH for more than HiOvrTime
R: 2.10.12	5->3.1	Voltage goes back to HIGH within HiTimeCfg
R: 2.10.13	5->1.1	Voltage stays in NORMAL range for HiTimeCfg or more
R: 2.10.14	2->4.1	Voltage rises back to Normal range
R: 2.10.15	2->6.1	Voltage remains LOW for more than LoOvrTime
R: 2.10.16	4->2.1	Voltage goes back to LOW within LoTimeCfg

Rqmt. No.	Source State -> Destination State. Rqmt. No	Description
R: 2.10.17	4->1.1	Voltage stays in NORMAL range for LoTimeCfg or more
R: 2.10.18	7->9.1	Voltage returns to NORMAL
R: 2.10.19	9->7.1	Voltage goes back above threshold
R: 2.10.20	9->1.1	Voltage stays in NORMAL for more than HiRecovTime_Cfg
R: 2.10.21	6->8.1	Voltage returns to NORMAL
R: 2.10.22	8->6.1	Voltage goes back below threshold
R: 2.10.23	8->1.1	Voltage stays in NORMAL for more than LoRecovTime_Cfg
R: 2.10.24	The conditions to transition from state 4 shall be evaluated in the following order (from highest to lowest priority). <1> 4->2 <2> 4->1	
R: 2.10.25	The conditions to transition from state 5 shall be evaluated in the following order (from highest to lowest priority). <1> 5->3 <2> 5->1	
R: 2.10.26	The conditions to transition from state 8 shall be evaluated in the following order (from highest to lowest priority). <1> 8->6 <2> 8->1	

Rqmt. No.	Source State -> Destination State. Rqmt. No	Description
R: 2.10.27	The conditions to transition from state 9 shall be evaluated in the following order (from highest to lowest priority). <1> 9->7 <2> 9->1	

2.10.4 Voltage Range Monitor Defined Voltage Ranges

2.10.4.1 Voltage Range Configuration (VR_080_160_VB)

Table 2.10-5 Voltage Range Configuration for VB 8.0 -16V

R: 2.10.28	• Shown in the table below are the operating voltages that have been specified as critical for the AVAS module in this range. These are to be monitored in dataflow VBattState[VR_080_160_VB]. • Reference **Figure 2.10-2 Voltage Range Monitoring Finite State Machine** and • This voltage range may be merged into another, wider voltage range given the condition that hardware supports this

Rqmt. No.	Dataflow/Other	Value	Description	Index 'i'
R: 2.10.29	VMin_Cfg[VR_080_160_VB], VMinRcv_Cfg[VR_080_160_VB]	8.0 volts (typical but may be less)	Minimum voltage to operate the AVAS ECU below which the module should report as a faulted because of under voltage.	I:0
R: 2.10.30	VMax_Cfg[VR_080_160_VB], VMaxRcv_Cfg[VR_080_160_VB]	16.0 volts (typical but may be more)		
R: 2.10.31	LoTime_Cfg[VR_080_160_VB]	15 *m*sec	Recovery time to NORM_V from LO_V	
R: 2.10.32	HiTime_Cfg[VR_080_160_VB]	15 *m*sec	Recovery time to NORM_V from HI_V	
R: 2.10.33	LoOvrTime_Cfg[VR_080_160_VB]	20 *m*sec	LO_V too long, enter UNDER_V	
R: 2.10.34	HiOvrTime_Cfg[VR_080_160_VB]	160 *msec*	HI_V too long, enter OVER_V	
R: 2.10.35	LoRecovTime_Cfg[VR_080_160_VB]	200 *m*sec	Recovery time to NORM_V from UNDER_V (Ref.: EC-0043)	
R: 2.10.36	HiRecovTime_Cfg[VR_080_160_VB]	200 *m*sec	Recovery time to NORM_V from OVER_V	

2.10.4.2 Diagnostic Trouble Code (DTC) Logging (VR_100_155_VB)

R: 2.10.37	• Shown in the table below are the operating voltages that have been specified as critical for proper logging of Diagnostic_Trouble_Codes_Logging [VR_100_155_VB] and are to be monitored in dataflow VBattState[VR_100_155_VB]. • Reference **Figure 2.10-2 Voltage Range Monitoring Finite State Machine** and • **Table 2.10-6 Voltage Range Configuration for DTC Logging** • This voltage range **shall not** be merged into another, wider voltage range

Table 2.10-6 Voltage Range Configuration for DTC Logging

Rqmt. No.	Dataflow/Other	Value	Description	Index i
R: 2.10.38	VMin_Cfg[VR_100_155_VB], VMinRcv_Cfg[VR_100_155_VB]	10.0 volts	Minimum/Maximum voltage for DTC reporting	I:1
R: 2.10.39	VMax_Cfg[VR_100_155_VB], VMaxRcv_Cfg[VR_100_155_VB]	15.5 volts		
R: 2.10.40	LoTime_Cfg[VR_100_155_VB]	15 *m*sec	Recovery time to NORM_V from LO_V	
R: 2.10.41	HiTime_Cfg[VR_100_155_VB]	15 *m*sec	Recovery time to NORM_V from HI_V	
R: 2.10.42	LoOvrTime_Cfg[VR_100_155_VB]	500 *m*sec	LO_V too long, enter UNDER_V	
R: 2.10.43	HiOvrTime_Cfg[VR_100_155_VB]	500 *m*sec	HI_V too long, enter OVER_V	
R: 2.10.44	LoRecovTime_Cfg[VR_100_155_VB]	2,000 *m*sec	Recovery time to NORM_V from UNDER_V	
R: 2.10.45	HiRecovTime_Cfg[VR_100_155_VB]	2,000 *m*sec	Recovery time to NORM_V from OVER_V	
R: 2.10.46	Use VBattState[VR_100_155_VB] for compliance to Body Software Requirements #0021, #0064 and #0066			

2.10.4.3 MS/HS CAN Interface (VR_080_160_CAN)

R: 2.10.47	• Shown in the table below are the operating voltages that have been specified as critical for proper operation of MS and HS CAN interfaces and are to be monitored in dataflow VBattState[VR_080_160_CAN]. • Reference **Figure 2.10-2 Voltage Range Monitoring Finite State Machine** and • **Table 2.10-7 Voltage Range Configuration for MS/HS CAN** • This voltage range **shall not** be merged into another, wider voltage range

Table 2.10-7 Voltage Range Configuration for MS/HS CAN

<table>
<tr><th>Rqmt. No.</th><th>Dataflow/Other</th><th>Value</th><th>Description</th><th>Index i</th></tr>
<tr><td>R: 2.10.48</td><td>VMin_Cfg[VR_080_160_CAN], VMinRcv_Cfg[VR_080_160_CAN]</td><td>8.0 volts</td><td rowspan="2">Inherits:
• worst-case feature voltage range in module
• worst-case feature voltage range of shared, network inputs (not used by any class C features in your module, but is critical to another class C feature in another module and your module transmits this input on network).
(For Body features, voltage ranges are specified in ELCOMP SDS, Rqmt EC-0058 details.)</td><td rowspan="9">I:2</td></tr>
<tr><td>R: 2.10.49</td><td>VMax_Cfg[VR_080_160_CAN], VMaxRcv_Cfg[VR_080_160_CAN]</td><td>16.0 volts</td></tr>
<tr><td>R: 2.10.50</td><td>LoTime_Cfg[VR_080_160_CAN]</td><td>15 msec</td><td>Recovery time to NORM_V from LO_V</td></tr>
<tr><td>R: 2.10.51</td><td>HiTime_Cfg[VR_080_160_CAN]</td><td>15 msec</td><td>Recovery time to NORM_V from HI_V</td></tr>
<tr><td>R: 2.10.52</td><td>LoOvrTime_Cfg[VR_080_160_CAN]</td><td>20 msec</td><td>LO_V too long, enter UNDER_V</td></tr>
<tr><td>R: 2.10.53</td><td>HiOvrTime_Cfg[VR_080_160_CAN]</td><td>160 msec</td><td>HI_V too long, enter OVER_V</td></tr>
<tr><td>R: 2.10.54</td><td>LoRecovTime_Cfg[VR_080_160_CAN]</td><td>200 msec</td><td>Recovery time to NORM_V from UNDER_V</td></tr>
<tr><td>R: 2.10.55</td><td>HiRecovTime_Cfg[VR_080_160_CAN]</td><td>200 msec</td><td>Recovery time to NORM_V from OVER_V</td></tr>
<tr><td>R: 2.10.56</td><td colspan="3">Use VBattState[VR_080_160_CAN] for compliance to Body Software Requirements #0021, #0064 and #0066</td></tr>
</table>

2.10.5 Shutdown Detection Voltage Range (VRange_SDown)

R: 2.10.57	• Shown below in **Table 2.10-8 Voltage Range Configuration for Low Voltage Shutdown Detection** are the Shutdown Detection and Recovery voltages and are to be monitored in dataflow VBattState[VRange_SDown]. • Reference **Figure 2.10-2 Voltage Range Monitoring Finite State Machine** • This voltage range **shall not** be merged into another, wider voltage range. • Note: for faster shutdown detection, battery voltage may be sampled using a sampling period less than 5 *m*sec, but the number of samples and the timing must be approved by Ford. This value should be faster than the feature VRM sampling rate.

Table 2.10-8 Voltage Range Configuration for Low Voltage Shutdown Detection

Rqmt No.	Dataflow/Other	Value	Description
R: 2.10.58	VMin_Cfg[VRange_SDown]	6.0 volts	Low voltage shutdown for power dropout requirement in EMC spec.
R: 2.10.59	VMinRcv_Cfg[VRange_SDown]	8.0 volts	Low voltage shutdown voltage hysteresis for recovery from UNDER_V
R: 2.10.60	VMax_Cfg[VRange_SDown], VMaxRcv_Cfg[VRange_SDown]	25.0 volts	No need for high voltage shutdown
R: 2.10.61	LoTime_Cfg[VRange_SDown]	0 *m*sec	Recovery time to NORM_V from LO_V (1 sample)
R: 2.10.62	HiTime_Cfg[VRange_SDown]	0 *m*sec	Recovery time to NORM_V from HI_V (1 sample)
R: 2.10.63	LoOvrTime_Cfg[VRange_SDown]	10 *m*sec	LO_V too long, enter UNDER_V (3 samples min)
R: 2.10.64	HiOvrTime_Cfg[VRange_SDown]	160 *m*sec	HI_V too long, enter OVER_V
R: 2.10.65	LoRecovTime_Cfg[VRange_SDown]	10 *m*sec	Recovery time to NORM_V from UNDER_V (3 samples min)
R: 2.10.66	HiRecovTime_Cfg[VRange_SDown]	2,000 *m*sec	Recovery time to NORM_V from OVER_V

2.10.6 Summary of Voltage Range Monitors

The following table defines each voltage range supported by the AVAS module VRM.

Table 2.10-9 Index “I” for VBattState

	Voltage Range	**Index 'i' for VBattState in** Error! Reference source not found.	**Feature**
VR_080_160_VB	I:0	Voltage Range to help determine AVAS state	
VR_100_155_VB	I:1	Voltage Range to determine capability of setting DTCs	
VR_080_160_CAN	I:2	Voltage Range to determine capability of MS/HS CAN Interface	
VRange_SDown	I:3	System Shutdown Voltage Range	

2.11 DIAGNOSTICS

2.11.1 Overview

References to ISO 14229 and Ford Generic Global Diagnostic Specification (GGDS) are used throughout this section. These documents are to be referenced for definitions of diagnostic services, sub-functions, data-parameters, general parameter definitions, response codes, etc.

2.11.2 Supported Diagnostic Identifiers

Table 2.11-1 General Diagnostic Requirements

ECU Information	
ECU Name:	Pedestrian Alert Control Module
ECU Acronym:	PACM
Diagnostic Communication Link:	HS-CAN
ECU Diagnostic Reception ID:	750
ECU Diagnostic Transmission ID:	758
Functional Diagnostic ID:	7DF
Network Initialization ID:	
Specification Versions	
GGDS Specification Version:	003
SWDL Specification Version:	005
ECU Configuration Version:	003

Miscellaneous	
Bootloader Supported	Yes

2.11.3 Supported Security Levels

2.11.3.1 Security Level (0x01) Specific Information

Table 2.11-2 Security Level (0x01) Specific Information

Detailed Information for Security Level 0x01	
Security Level Number	0x01
Security Level Name	Programming Security Level
Security Level Usage Description	Used to unlock capability of flash programming
Security Level Entry Criteria	Valid seed/key sequence for security level 0x01
Security Level Exit Criteria	Transition to same diagnostic session (via service 0x10), transition to a different diagnostic session, or transition to a different security level via a valid seed / key sequence
Sessions Supported In	0x02
Number of False Access Attempts	0
False Access Delay Time	0ms

2.11.3.2 Security Level (0x03) Specific Information

Table 2.11-3 Security Level (0x03) Specific Information

Detailed Information for Security Level 0x03	
Security Level Number (request seed SF)	0x03
Security Level Name	WriteDataByIdentifier Security Level
Security Level Usage Description	Used to unlock capability to write data by identifier
Security Level Entry Criteria	Valid seed/key sequence for security level 0x03
Security Level Exit Criteria	Transition to same diagnostic session (via service 0x10), transition to a different diagnostic session, or transition to a different security level via a valid seed / key sequence
Sessions Supported In	0x03
Number of False Access Attempts	0
False Access Delay Time	0ms
Session 0x03 security protected services	0x2E

2.11.4 AVAS Supported Diagnostic Services

Table 2.11-4 Table of Supported Diagnostic Services

Rqmt. No.	Services	Functionality	Default ($01)	Program ($02)	Extend ($03)
R: 2.11.1	$10	DiagnosticSessionControl ($01- Default, $02- Programming, $03- Extended)	Y	Y	Y
R: 2.11.2	$11	ECUReset	Y	Y	Y
R: 2.11.3	$14	ClearDiagnosticInformation	Y	-	Y
R: 2.11.4	$19	Read DTCInformation	Y	-	Y
R: 2.11.5	$22	ReadDataByIdentifier	Y	Y	Y
R: 2.11.6	$27	SecurityAccess	-	Y	Y
R: 2.11.7	$2E	WriteDataByIdentifier (DID/Method 2)	Y	-	Y
R: 2.11.8	$31	RoutineControl	-	Y	Y
R: 2.11.9	$34	PBL: RequestDownload (to RAM) SBL: RequestDownload (to Flash)	-	Y	-
R: 2.11.10	$36	TransferData	-	Y	-
R: 2.11.11	$37	RequestTransferExit	-	Y	-
R: 2.11.12	$3E	TesterPresent PBL: TesterPresent	Y	Y	Y
R: 2.11.13	$85	ControlDTCSetting (turn off missing msg DTCs)	-	-	Y

2.11.5 AVAS Diagnostic Session Control (0x10) Service

2.11.5.1 Supported Diagnostic Session Control

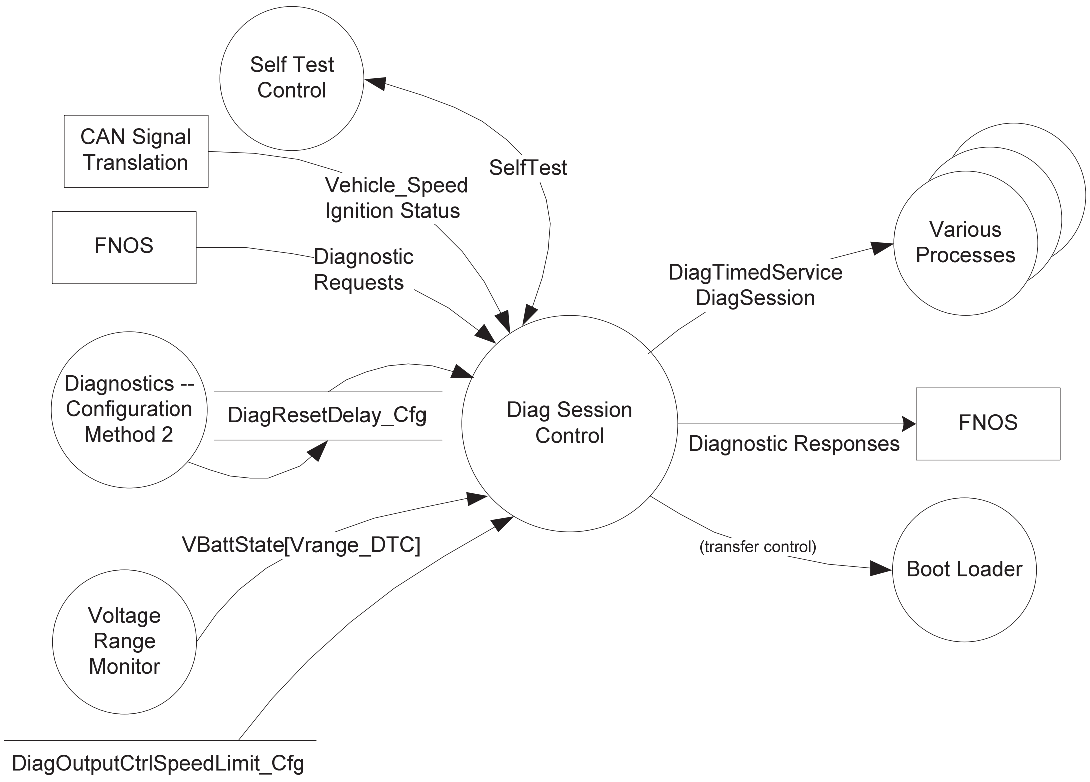


Figure 2.11-1 Diagnostic Session Control Context Diagram

2.11.5.2 Preconditions for a Diagnostic Session Change (Service 0x10)

The system starts in the DEFAULT session. Sessions can be changed but only when the following conditions are satisfied.

Table 2.11-5 Diagnostic Session Change Preconditions

Rqmt. No.	VBattState [VR_Diagnostics]	Vehicle_Speed	SelfTest	Ignition_ Status	ChangeSessionPreCond
R: 2.11.14	UNDER_V	Don't care	Don't care	Don't care	NOT_OK
R: 2.11.15	<> UNDER_V	> DiagOutputCtrlSpeedLimit_Cfg	Don't care	Don’t care	NOT_OK
R: 2.11.16	<> UNDER_V	<= DiagOutputCtrlSpeedLimit_Cfg	Don't care	<> RUN	NOT_OK
R: 2.11.17	<> UNDER_V	<= DiagOutputCtrlSpeedLimit_Cfg	TEST	RUN	NOT_OK
R: 2.11.18	<> UNDER_V	<= DiagOutputCtrlSpeedLimit_Cfg	NULL	RUN	OK

Note: Due to issues with service charging a dead battery at 16+ volts and then not getting the ECU(CPDB) to enter EXTEND Session, we are modifying this preconditions to allow OVER_V to enter EXTEND Session, but we will not allow SelfTest or I/O control (read/writeDIDs and other execution routines are ok).

Table 2.11-5a OTA Diagnostic Session Change Preconditions

Rqmt. No.	VBattState [VR_Diagnostics]	Vehicle_Speed	SelfTes t	Ignition_ Status	Veh_RunStart _Source	OTAChangeSessio nPreCond
R: 2.11.18a	UNDER_V	Don't care	Don't care	Don't care	Don’t Care	NOT_OK
R: 2.11.18b	<> UNDER_V	> DiagOutputCtrlSpeedLimit_Cfg	Don't care	Don’t care	Don’t Care	NOT_OK
R: 2.11.18c	<> UNDER_V	<= DiagOutputCtrlSpeedLimit_Cfg	Don't care	<> OFF	Don’t Care	NOT_OK
R: 2.11.18d	<> UNDER_V	<= DiagOutputCtrlSpeedLimit_Cfg	TEST	OFF	Don’t Care	NOT_OK
R: 2.11.18e	<> UNDER_V	<= DiagOutputCtrlSpeedLimit_Cfg	NULL	OFF	< > OTA	NOT_OK
R: 2.11.18f	<> UNDER_V	<= DiagOutputCtrlSpeedLimit_Cfg	NULL	OFF	OTA	OK

2.11.5.3 Extended Session Exit Conditions

The following conditions will force an exit from an extended session (indicated by the value of exit in the exitSessCond.)

Table 2.11-6 Diagnostic Session Change Preconditions (leaving 0x01 to 0x02 or 0x03)

Rqmt. No.	Ignition_Status	Vehicle_Speed	ExitSessCond
R: 2.11.19	RUN	> DiagOutputCtrlSpeedLimit_Cfg	EXIT
R: 2.11.20	<> RUN	Don't care	EXIT
R: 2.11.21	RUN	<= DiagOutputCtrlSpeedLimit_Cfg	NULL

2.11.5.4 Diagnostic Session Control State Transition Diagram

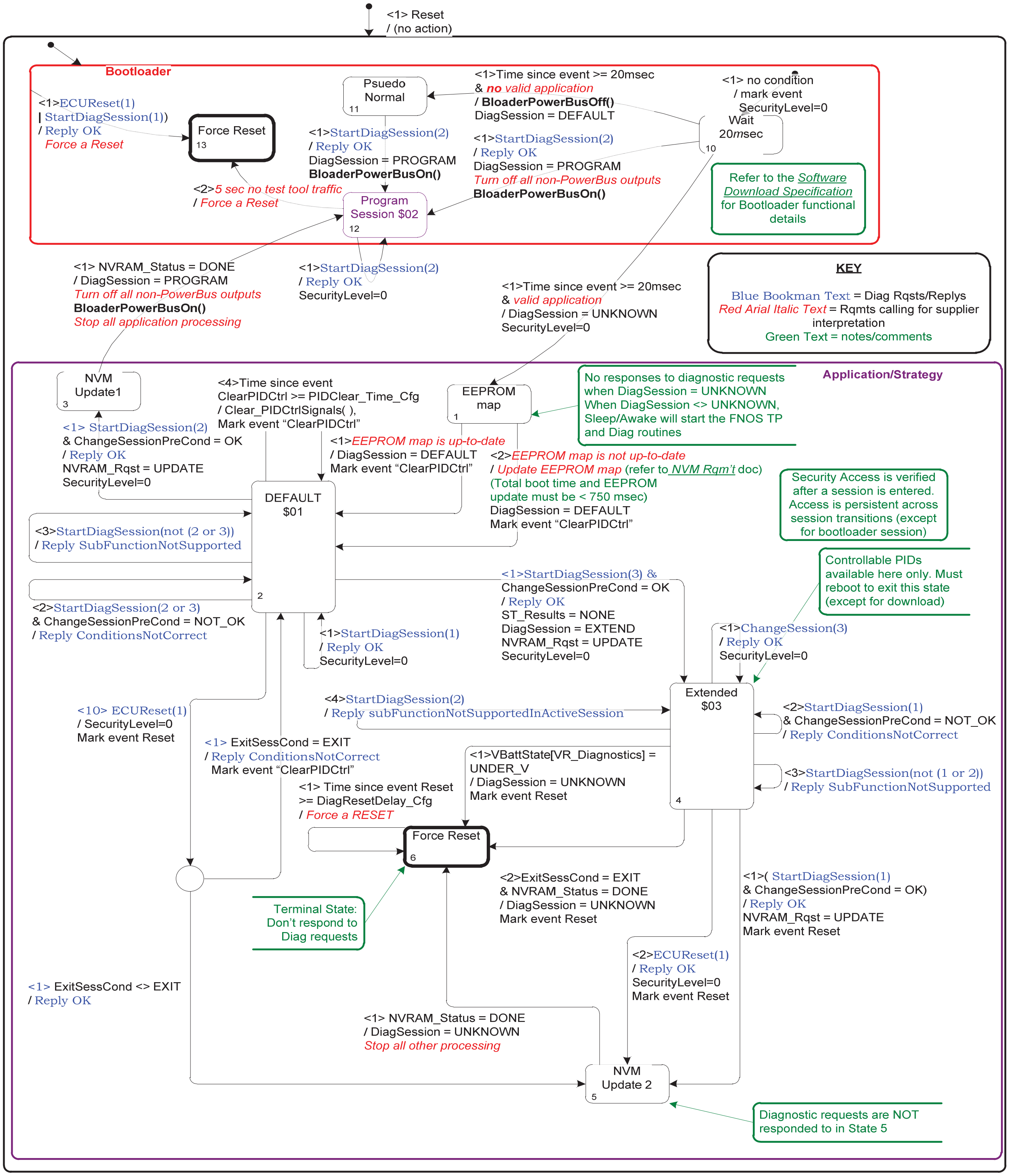


Figure 2.11-2 Diagnostic Session Control Sate Transition Diagram

Note: It is left to the supplier if transitions 1->2.1 and 1->2.2 are necessary or need to be modified.

Figure 2.11-2 Diagnostic Session Control Sate Transition Diagram is used only for reference and it is not necessary to be synchronized with **Table 2.11-7 Diagnostic Session Control Requirements**. In case of any discrepancy consider **Table 2.11-7 Diagnostic Session Control Requirements** as the final requirement.

Table 2.11-7 Diagnostic Session Control Requirements

Rqmt. No.	Current Diag (psuedo)Session	Condition Additional Conditions	Other Actions	Next Diag (pseudo)Session
R: 2.11.22	Boot - PBL	NoValidApp & delay elapses & GotoPRGM_Flag = NULL	BloaderPowerBusOff() DiagSession =DEFAULT	PseudoNORMAL – PBL
R: 2.11.23	Boot - PBL	DiagTool request for PROGRAM sessions	GotoPRGM_Flag = NULL BloaderPowerBusOn() *Turn Off all non-PowerBus outputs* DiagSession = PROGRAM	PROGRAM – PBL
R: 2.11.24	Boot - PBL	NoValidApp & delay elapses & GotoPRGM_Flag = PROGRAM	GotoPRGM_Flag = NULL BloaderPowerBusOn() *Turn Off all non-PowerBus outputs* DiagSession = PROGRAM	PROGRAM – PBL
R: 2.11.25	Boot - PBL	ValidApp & delay elapses & GotoPRGM_Flag = PROGRAM	GotoPRGM_Flag = NULL BloaderPowerBusOn() *Turn Off all non-PowerBus outputs* DiagSession = PROGRAM	PROGRAM – PBL
R: 2.11.26	Boot - PBL	ValidApp & delay elapses & GotoPRGM_Flag = NULL	*This shall happen at the beginning of application* UpdateEEPROMmap() UpdateResetCauseDID() DiagSession = DEFAULT	DEFAULT - Strategy
R: 2.11.27	Boot - PBL	Does not respond to DiagTool reset request		
R: 2.11.28	Boot - PBL	No other transitions are supported		
R: 2.11.29	PseudoNORMAL – PBL	DiagTool request for PROGRAM sessions	BloaderPowerBusOn() DiagSession = PROGRAM	PROGRAM – PBL
R: 2.11.30	PseudoNORMAL – PBL	DiagTool Reset request	GotoPRGM_Flag = NULL ForceReset()	Boot – PBL
R: 2.11.31	PseudoNORMAL – PBL	No other exit transitions are supported		
R: 2.11.32	PROGRAM - PBL	DiagTool Reset request	GotoPRGM_Flag = NULL ForceReset()	Boot – PBL
R: 2.11.33	PROGRAM - PBL	Servicing of Change Session requests only occurs after Flash writes and EEPROM updates have completed		
R: 2.11.34	PROGRAM - PBL	No other exit transitions are supported		

Note: AVAS does not act as a power bus for any other ECUs and directives for BloaderPowerBusOn() and BloaderPowerBusOff() maybe be ignored.

Rqmt. No.	Current Diag (psuedo)Session	Condition Additional Conditions	Other Actions	Next Diag (pseudo)Session
R: 2.11.35	DEFAULT - Strategy	DiagTool request for PROGRAM session & (ChangeSessionPreCond = OK | (Veh_Start_Inhibit = TRUE & DID $D04F preconditions are set to 0 & otaChangedSessionPreCond = OK))	WaitEEPROMUpdate() BloaderPowerBusOn() DiagSession = PROGRAM *Turn Off all non-PowerBus outputs* *Stop all application processing*	PROGRAM – PBL
R: 2.11.36		DiagTool request for EXTEND session & (ChangeSessionPreCond = OK | OTAChangeSessionPreCond = OK)	ST_Results = NONE SelfTest = NULL DiagSession = EXTENDED	EXTEND - Strategy
R: 2.11.37		DiagTool Reset request & ExitSessCond <> EXIT	GotoPRGM_Flag = NULL WaitEEPROMUpdate() *Stop all application processing* ForceReset()	Boot – PBL
R: 2.11.38		DiagTool Reset request & ExitSessCond = EXIT	Reply ConditionsNotCorrect	DEFAULT - Strategy
R: 2.11.39		DiagTool request for EXTEND session & ChangeSessionPreCond = NOT_OK	Reply ConditionsNotCorrect	DEFAULT - Strategy
R: 2.11.40		Periodically calls Clear_PIDCtrlSignals() every PIDClear_Time_Cfg (5 seconds or so)		
R: 2.11.41		No other exit transitions are supported		
R: 2.11.42	EXTEND - Strategy	DiagTool request for DEFAULT session & ChangeSessionPreCond = OK	GotoPRGM_Flag = NULL WaitEEPROMUpdate() ForceReset()	Boot – PBL (DEFAULT)
R: 2.11.43		DiagTool request for PROGRAM session & (ChangeSessionPreCond = OK | (Veh_Start_Inhibit = TRUE & DID $D04F preconditions are set to 0 & OTAChangeSessionPreCond = OK))	GotoPRGM_Flag = PROGRAM WaitEEPROMUpdate() ForceReset()	Boot – PBL (PROGRAM)
R: 2.11.44		DiagTool Reset request	GotoPRGM_Flag = NULL WaitEEPROMUpdate() ForceReset()	Boot – PBL
R: 2.11.45		ExitSessCond = EXIT	GotoPRGM_Flag = NULL WaitEEPROMUpdate() ForceReset()	Boot – PBL (DEFAULT)
R: 2.11.46		No other exit transitions are supported		
R: 2.11.47	The Session Manager in the Strategy (not bootloader) shall publish these dataflows (at a minimum) for use by any process in the Strategy: • SecurityLevel • DiagSession			

Note 1: AVAS does not act as a power bus for any other ECUs and directives for BloaderPowerBusOn() and BloaderPowerBusOff() maybe be ignored.

Note 2: DID $D04F preconditions byte 1, bit 7 = 0 indicates preconditions supported. The AVAS module checks vehicle speed, ignition status, and self -test status in **Table 2.11-5a OTA Diagnostic Session Change Preconditions**

2.11.5.4.1 WaitEEPROMUpdate() Function

Table 2.11-8 WaitEEPROMUpdate() Function Requirements

Rqmt. No.	Requirements
R: 2.11.48	This function shall: • Set NVRAM_Rqst = UPDATE ▪ Wait for EEPROM to finish updating before returning ▪ Or – give up after a short time and return (due to the voltage being too low for too long) • Set NVRAM_Status = DONE

2.11.5.4.2 ForceReset() Function

Table 2.11-9 ForceReset() Function Requirements

Rqmt. No.	Requirements
R: 2.11.49	This function shall: • Wait a configurable (DiagResetDelay_Cfg) amount of time to allow other ECUs to complete EEPROM writes • Set the “Diag Forced Reset” flag • Force the microprocess or reset line to assert **Note:** It is better to start from a known hardware and software point.

2.11.5.4.3 UpdateEEPROMmap() Function

Table 2.11-10 Update EEPROMMap() Function Requirements

Rqmt. No.	Requirements
R: 2.11.50	This function shall: • Compare *Existing EEPROM map* version with the *Required EEPROM map* version • If the *Required EEPROM map* version is incompatible with the *Existing EEPROM map* version then this function shall create any missing elements. **Note:** The allowed strategies for this are defined in the Software SOW package (Non-Volatile Memory.docx file)

2.11.5.4.4 UpdateResetCauseDID() Function

Table 2.11-11 UpdateResetCauseDID() Function Requirements

Rqmt. No.	Requirements
R: 2.11.51	This function shall: • Update the reset reason flags/counts in DID D700 and D701 • “Forced software reset” (e.g. Diag tool reset, extending from extended session to programming session) shall not be counted as watch dog rest, power on reset. • “Diag Forced Reset” flag is used to determine force rest • Clear these flags so they don’t get counted again on the next reset

2.11.5.5 Diagnostic Timer Monitor

Now as part of FNOS, all diag services that require the tester to be present, are now run from within Extended Session.

2.11.6 AVAS Routine Control (0x31) Service

2.11.6.1 Supported Functional Execution Routines

Control routines are executable routines resident within an ECU that may be invoked by a tester to evaluate the ECU and its associated components or to execute specific functionality. Refer to section 4.3 Control routine in Ford's Generic Global Diagnostic Specification for generic Routine implementation requirements.

CGEA 1.3 AVAS supports the following Execution Routines in Service #31.

Table 2.11-12 Supported Functional Execution Routine Requirements

Rqmt. No.	Routine Identifier	Routine Type	Functionality	Default ($01)	Program (0x02)	Extended (0x03)
R: 2.11.52	$0301	1	Activate Secondary Boot-loader	-	Y	-
R: 2.11.53	$0304	1	Check Valid Application	-	Y	-
R: 2.11.54	$FF00	1	Flash Erase	-	Y	-
R: 2.11.55	$FF01	1	Check Programming Dependencies	-	Y	-
R: 2.11.56	$0202	2	On Demand Self-test	-	-	Y
R: 2.11.56a	TBD	1	Control Routine	-	-	Y

Rqm't Num.	Requirement
R: 2.11.56b	The ECU may allow required Control Routines (Service 31) to be executed when ignition is OFF and VehOnSrc_D_Stat = OverTheAir. This may include any routines that are needed to run after an OTA SW re-flash.

2.11.6.2 Type 1 Routines

Requirements for supported type 1 routines are defined in the NETCOM Statement of Work (SOW).

2.11.6.3 Type 2 Routines

2.11.6.3.1 On-Demand Self-Test ($0202)

2.11.6.3.1.1 Overview

On Demand Self-Test is a diagnostic execution routine in service $31 with Routine Identified $0202. This routine shall detect and identify the ECU's I/O circuit faults. Upon completion of the test, the outputs shall return to normal ECU control. The routines return a special case of routine results with a data type of DTC. The DTC data type reports a list of repeating 3 byte values referred to as On-Demand DTCs. Refer to section 4.3.3 Fault Detection Control Routines in Ford's Generic Global Diagnostic Specification.

The AVAS ECU should complete its on-demand self-test within maximum of 5000 msec after receiving the request to perform the test.

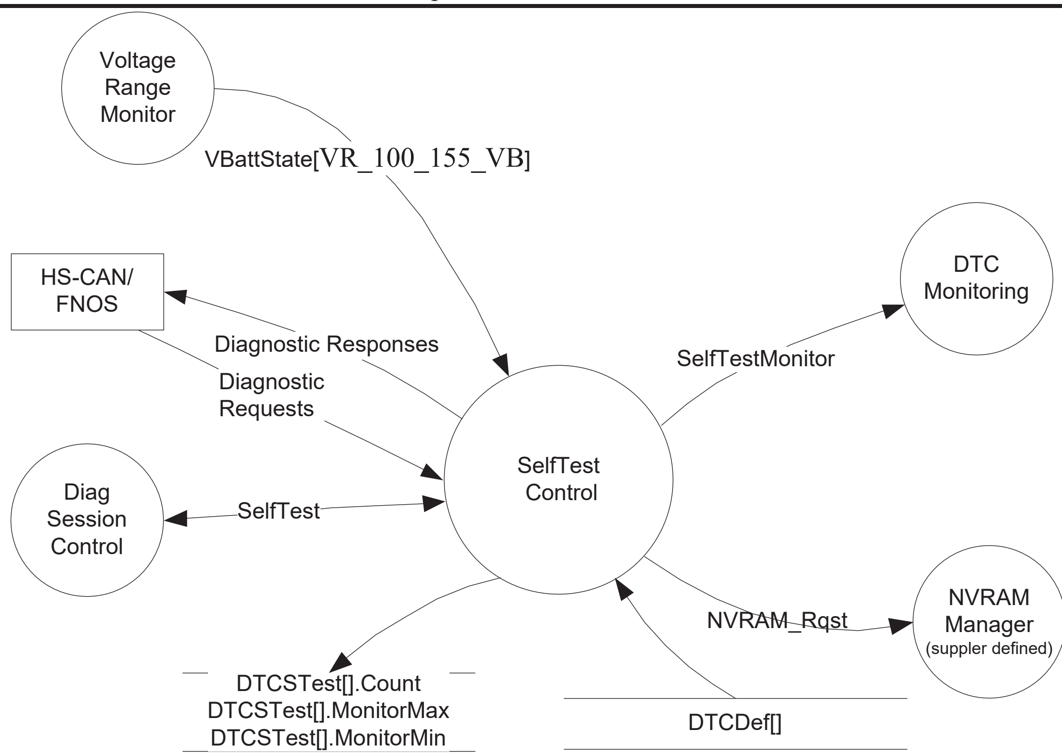


Figure 2.11-3 Self-Test Control Context Diagram

Table 2.11-13 Voltage Requirements and Ignition Status Requirements for Self-Test

Rqmt. No.	VBattState[VR_100_155_VB]	Ignition_Status	Okay to run self-test?
R: 2.11.57	UNDER_V | OVER_V	Don't Care	No
R: 2.11.58	NORM_V | LO_V | HI_V	<> RUN	No
R: 2.11.59	NORM_V | LO_V | HI_V	RUN	Yes

NOTE: Vehicle Speed is not considered as a pre-condition for Self-Test because it has already been considered as a pre-condition for being in Extended Session.

Table 2.11-14 Criteria for Entering Self-Test

Rqmt. No.	**Description**
R: 2.11.60	Okay to run self-test is "Yes" as in **Voltage Requirements and Ignition Status Requirements for Self-Test**
R: 2.11.61	Extended Session
R: 2.11.62	On-Demand is requested by Tester

Table 2.11-15 Criteria for Existing Self-Test

Rqmt. No.	**Description**
R: 2.11.63	Okay to run self-test is "No" as in **Voltage Requirements and Ignition Status Requirements for Self-Test**
R: 2.11.64	A stop routine command is issued.
R: 2.11.65	Tester does NOT communicate for more than five (5) seconds.
R: 2.11.66	Test is complete.

2.11.6.3.1.2 Self-Test Output Activation

Note 1: It is left to the supplier to define what is tested when and which outputs are activated in what order. Ford requires the supplier to provide a description of the self-test in the Part II Diagnostic Spec.

Table 2.11-16 Self-Test Output Activation

Rqmt No.	Requirement
R: 2.11.67	Output activation must be staggered by at least 50 *m*sec between sets of 10 amp loads.
R: 2.11.68	It is the supplier's responsibility to avoid causing DTCs due to interactions between inputs and outputs assuming there are no power closure products (power lift gate, power sliding door…) on the vehicle. This means that a normal lift gate might open when the power lift gate release is activated.
R: 2.11.69	General SelfTest Sequence: • First turn all outputs off and wait long enough to detect short circuits • Then turn on all outputs and wait long enough to ensure that any short is detected.
R: 2.11.70	Use PIDCtrl dataflows to control the outputs – even though these may interfere with I/O control currently being used.
R: 2.11.71	After completion of Self-test set all PIDCtrl dataflows to NULL

2.11.6.3.1.3 Self-Test Input Testing

Note 1: It is left to the supplier when any input validation testing is performed during the self-test sequence. Ford requires the supplier to provide a description of the self-test in the Part II Diagnostic Spec.

Rqmt No.	Requirement
R: 2.11.72	Any supplemental diagnostic circuit to test the validity of input hardware shall be used either before or after all output testing.
R: 2.11.73	General SelfTest Sequence: • Activate input diagnostic circuit, • wait long enough for the circuit to stabilize • Then sample input circuit to test for valid range

2.11.6.4 Type 3 Routines

No Type 3 control routines are supported by this ECU.

2.11.7 AVAS Data Identifiers (DIDs)

2.11.7.1 ReadDataByIdentifer (0x22) Service

Note: Supplier DIDs are not in the Ford GMRDB. Each supplier range DID was assigned by picking a unique ID number within the range of $FD00 - $FEFF.

2.11.7.1.1 Miscellaneous Service $22 Requirements

Table 2.11-17 Miscellaneous Data Identifier Requirements

Rqmt No.	Requirement
R: 2.11.74	To all DID requests for DIDs that have been configured OFF/DISABLED reply RequestOutOfRange
R: 2.11.75	For bit-mapped or packeted DIDs, all fields shall be set to 0 for any datavalue that is disabled via configuration.

2.11.7.1.2 Supported DID List

Table 2.11-18 Supported DID List					Diag Session		
Rqmt. No.	**DID**	**DID Name/Description**	**Config Reqts**	**Dataflow**	**01**	**02**	**03**
R: 2.11.76	0x0202	Number of Trouble Codes Set due to Diagnostic Test	n/a	Supplier Defined	R	-	R
R: 2.11.77	0xD100	Active Diagnostic Session	n/a	DiagSession	R	R	R
R: 2.11.78	0xF110	On-Line Diagnostic Database Reference Number	n/a	Supplier Defined	R	-	R
R: 2.11.79	0xF111	ECU Core Assembly P/N	n/a	Supplier Defined	R	R	R
R: 2.11.80	0xF113	ECU Delivery Assembly P/N	n/a	Supplier Defined	R	R	R
R: 2.11.81	0xF17C	NOS Bootloader Generation Tool Version Number	n/a	Supplier Defined	R	R	R
R: 2.11.82	0xF15F	NOS Generation Tool Version Number	n/a	Supplier Defined	R	-	R
R: 2.11.83	0xF160	NOS Diagnostic Version Number	n/a	Supplier Defined	R	-	R
R: 2.11.84	0xF161	NOS CAN Communication Layer Version Number	n/a	Supplier Defined	R	-	R
R: 2.11.85	0xF162	Software Download Specification Version	n/a	Supplier Defined	-	R	-
R: 2.11.86	0xF163	Diagnostic Specification Version	n/a	Supplier Defined	R	-	R
R: 2.11.87	0xF166	NOS Message Database #1 Version Number	n/a	Supplier Defined	R	-	R
R: 2.11.88	0xF170	NOS Bootloader Package Version Number	n/a	Supplier Defined	-	R	-
R: 2.11.89	0xF171	NOS Bootloader Main Version Number	n/a	Supplier Defined	-	R	-
R: 2.11.90	0xF172	NOS Bootloader Diagnostic Version Number	n/a	Supplier Defined	-	R	-
R: 2.11.91	0xF173	NOS Bootloader Network/Transport Layer Version Number	n/a	Supplier Defined	-	R	-
R: 2.11.92	0xF174	NOS Bootloader Flash Routines Version Number	n/a	Supplier Defined	-	R	-
R: 2.11.93	0xF175	NOS Bootloader Hardware File Version Number	n/a	Supplier Defined	-	R	-

R: 2.11.94	0xF176	NOS Bootloader API Version Number	n/a	Supplier Defined	-	R	-
R: 2.11.95	0xF177	NOS Bootloader Security Algorithm Version Number	n/a	Supplier Defined	-	R	-
R: 2.11.96	0xF178	NOS Bootloader Flash I/O Version Number	n/a	Supplier Defined	-	R	-
R: 2.11.97	0xF17B	NOS Bootloader Memory I/O Version Number	n/a	Supplier Defined	-	R	-
R: 2.11.98	0xF188	Vehicle Manufacturer ECU Software Number	n/a	Supplier Defined	R	-	R
R: 2.11.99	0xD111	ECU Power Supply Voltage	n/a	ECU Power Supply Voltage	R	-	R
R: 2.11.100	0xF180	Boot Software Identification	n/a	Supplier Defined	R	R	R
R: 2.11.101	0xF10A	ECU Cal-Config Part Number	n/a	Supplier Defined	R	-	R
R: 2.11.102	0xF18C	ECU Serial Number	n/a	Supplier Defined	R	R	R
R: 2.11.103	0x0599	PowerPack State	n/a	PowerPack State	R	-	R
R: 2.11.104	0x40B5	Ignition Position Final Status	n/a	Ignition Position Final Status	R	-	R
R: 2.11.105	0x7218	Reverse Gear Position	n/a	Reverse Gear Position	R	-	R
R: 2.11.106	0xD115	Vehicle Speed	n/a	Vehicle Speed	R	-	R
R: 2.11.107	0x0130	Transmission Shift Lever Position	n/a	Transmission Shift Lever Position	R	-	R
R: 2.11.108	0xF124	ECU Calibration Data #1 Number	n/a	Supplier Defined	-	-	R
R: 2.11.109	0xF125	ECU Calibration Data #2 Number	n/a	Supplier Defined	-	-	R
R: 2.11.110	0xD700	Critical Software Parameter Monitoring #1	n/a	Supplier Defined	R	-	RW
R: 2.11.111	0xD701	Critical Software Parameter Monitoring #2	n/a	Supplier Defined	R	-	RW
R: 2.11.111a	0xD028	Application Signature Validation Status	n/a	Supplier Defined	R	-	R
R:2.10.111b	0xD03F	In-Use Application Signing Public Key Hash	n/a	Supplier Defined	-	-	R
NOTE 1: DIDs that support diagnosing SW signing need to be available when the ECU is in Bootloader and Application **NOTE 2**: If an ECU consists of multiple VBFs, report information on the first VBF that fails SW signing. Otherwise if SW signing passes, report information on the last VBF downloaded or the main application VBF.							
R:2.10.111c	0xD04F	OTA Programming	n/a	Byte 1, bit 0 - ESCL Lock Pending Byte 2, bit 0 – Park Lamps On	R	-	R

		Session Entry and A/B Swap Precondition Status		Byte 1, bit 1 - Ignition Off / Acc Functionality Active Byte 2, bit 1 - Liftgate Ajar Byte 1, bit 2 - Hazards On Byte 2, bit 2 - Ignition Status Out of Range Byte 1, bit 3 - PRNDL Out of Range Byte 2, bit 3 -Charging Fault Byte 1, bit 4 - Charging in Progress Byte 3, bit 2 - Park Brake Out of Range or Activation in Progress Byte 2, bit 4 - Engine RPM Too High (or Torque Available) Byte 1, bit 5 - Voltage Out of Range Byte 3, bit 3 - Brake Pedal Pressed Byte 2, bit 5 - Diagnostic Self-Test Active Byte 1, bit 6 - Vehicle Speed Too High Byte 3, bit 4 – Motor Movement Active Byte 2, bit 6 - Steering Pinsion Torque Out of Range Byte 1, bit 7 - No Preconditions Supported Byte 3, bit 5 - Door Ajar Byte 3, bit 6 - Illuminated Exit Active Byte 2, bit 7 - Alarm Actively Sounding Byte 3, bit 7 - Limp Home Active			
Note on 0xD04F: Any bits that are not applicable to the AVAS module may be set to 0. If any bits are applicable, then Byte 1, bit 7 must be set to 0 to indicate that Preconditions are supported by AVAS.							

Note: R – Supports Diagnostic Service $22 ReadDataByIdentifer; W – Supports Diagnostic Service $2E WriteDataByIdentifier

2.11.7.2 Writeable DIDs (service $2E)

2.11.7.2.1 General Writeable DID Requirements

Table 2.11-19 General Writeable DID Requirements Table	
Rqmt. No.	**Description**
R: 2.11.112	All Values written to DIDs shall come into effect immediately.

2.11.7.2.2 DID $D700 – Critical Parameters #1

Table 2.11-20 – DID $D700 Writing Requirements

Rqmt. No.	DID $D700 Write Value		Result
R: 2.11.113	Zero (0)		DID $D700 Power on reset count = 0 DID $D700 Illegal op-code count = 0 DID $D700 Watchdog timer reset count = 0 DID $D700 Data range failure count = 0 Reply OK
R: 2.11.114	Non-Zero		Reply RequestOutOfRange
R: 2.11.115	When AVAS is configured and before delivery to Ford, clear the counts used by $D700		

2.11.7.2.3 DID $D701 – Critical Parameters #2

Table 2.11-21 – DID $D701 Writing Requirements

Rqmt. No.	**DID $D701 Write Value**		**Result**
R: 2.11.116	Zero (0)		DID $D701 Stack overflow count = 0 DID $D701 Loss of idle time count = 0 DID $D701Minimum idle time = 255 DID $D701 Recover from power dropout count= 0 Reply OK
R: 2.11.117	Non-Zero		Reply RequestOutOfRange
R: 2.11.118	When AVAS is configured and before delivery to Ford, clear the counts used by $D701 (**note:** minimum idle time set to 255))		

2.11.7.3 Supplier Range DIDs

AVAS supports configuration of the module by the supplier through DIDs in the FD00-FEFF range. Configuration parameters in this range are not read or modified by Ford Motor Company in the factory at end-of-line nor during service. Ford relies on the supplier to correctly configure these parameters as described in **2.11.9.4AVAS Configuration Data (Supplier Range FD00-FEFF).**

2.11.8 AVAS Diagnostic Trouble Codes (DTCs)

2.11.8.1 Diagnostic Trouble Codes General Requirements

A basic aim of diagnostics is to detect and report faults in an ECU, its peripherals, and the subsystem/vehicle. A Diagnostic Trouble Codes (DTC) is a 3-byte numerical identifier for a specific fault condition that can be identified by the ECU's on-board diagnostic system. The first two most significant bytes of a DTC are referred to as the root DTC. The least significant byte of a DTC is referred to as the Failure Type Byte. (e.g., Failure Type Byte $11 = "Circuit Short to Ground"). In general, the root DTC will not contain the failure type but will rather consist of the root component. However, when the root DTC description does already contain the failure type information, then the actual Failure Type Byte value shall be set to $00 indicating no additional failure type information.

Every DTC has certain status information associated with it which indicates information such as whether the fault detection test has completed during the current DTC operation cycle, whether the result of the test is a pass or fail, and whether or not a warning indicator is actively being illuminated for the DTC.

2.11.8.2 ControlDTCSetting (0x85) Service

The Test tool can request the ECU to suppress detection of all DTCs. This state machine responds to these requests and publishes the dataflow *DTC_Ctrl* for the DTC detection routine to use.

This state machine also detects when the DTC $F00049 (ECU Fault) is set and responds by setting DTC_Ctrl to IGNORE in order to minimize the number of preconditions that the DTCs need to evaluate before evaluating the status of a DTC.

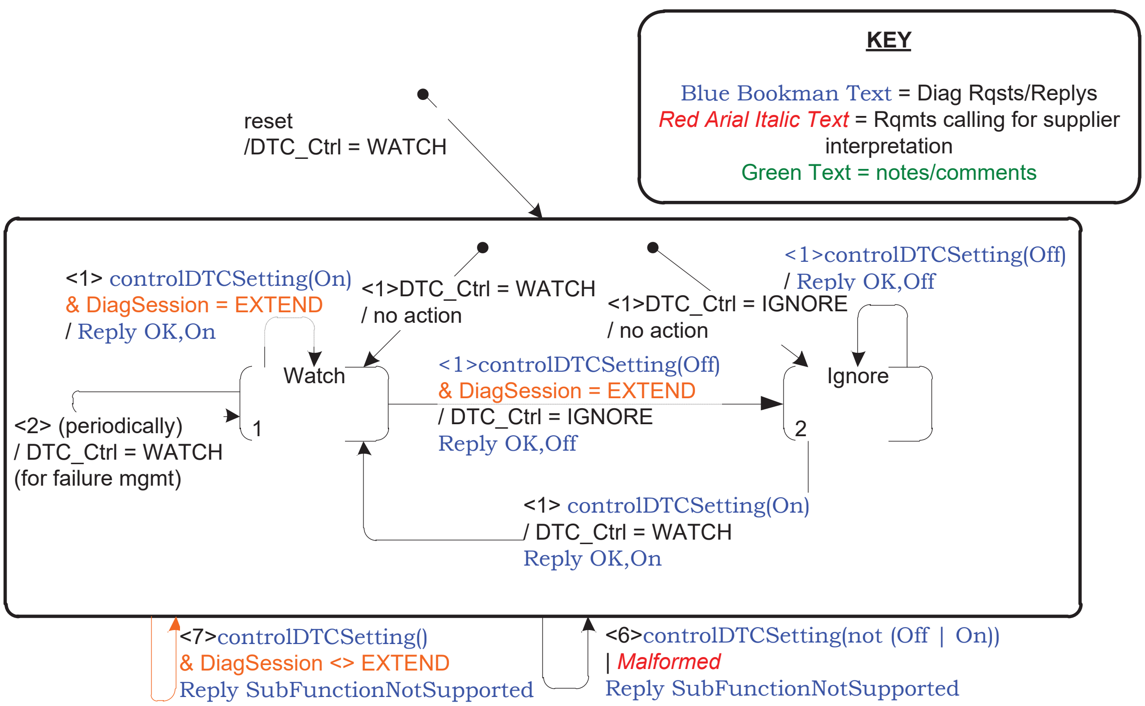


Figure 2.11-4 Control DTC Setting FSM

Table 2.11-22 Control Setting DTC FSM Requirements

Rqmt. No.	Source State -> Destination State Rqmt. No.
R: 2.11.119	0->1.1
R: 2.11.120	0->2.1
R: 2.11.121	1->1.1
R: 2.11.122	1->1.2
R: 2.11.123	1->1.7
R: 2.11.124	1->1.6
R: 2.11.125	1->2.1
R: 2.11.126	2->2.1
R: 2.11.127	2->2.7
R: 2.11.128	2->2.6
R: 2.11.129	2->1.1

Note: You can only use ControlDTCSetting in the EXTEND state. The EXTEND state always exits with a reset so there is no recovery from **Ignore** to **Watch** – we leave it to the reset. Also, we don't check to see if we are in EXTEND when we are in the **Ignore** state since the only way you can be in **Ignore** is to be in EXTEND.

2.11.8.3 DTCs for Hardware Outputs

Table 2.11-23 Unique DTCs for Hardware Outputs Requirements

Rqmt Num.	Driver Type	Unique DTC Requirement
R: 2.11.130	High-Side (low or high current)	Open-circuit or Short-to-Battery
R: 2.11.131	High-Side (low or high current)	Short-to-ground
R: 2.11.132	Low-Side	Open-circuit / Short-to-ground
R: 2.11.133	Low-Side	Short-to-VBatt

2.11.8.4 Asynchronous Fault Detection

In order to avoid synchronization issues with DTC monitoring, detection of high-current faults (short circuits) and low-current faults (open circuit) will use a latched dataflow indicating the status of the circuit the last time the circuit was in a state that allowed fault detection by the ECU.

Table 2.11-24 Asynchronous DTC Sampling Requirements

Rqmt. No.	Requirements
R: 2.11.134	There shall be a high-current fault status dataflow indicating if a high current fault exists (based on the last time the circuit was in a state where the ECU can detect high-current faults)
R: 2.11.135	There shall be a low-current fault status dataflow indicating if a low current fault exists (based on the last time the circuit was in a state where the ECU can detect low-current faults)

Note: when both the high-current & low-current fault dataflows indicate no problem, the circuit is operating normally.

2.11.8.5 Control SettingAging of DTCs Finite State Machine

The following state machine controls when each DTC can be sampled, whether it can be evaluated or not at this time and its detection criteria using the requirements listed in Section **2.11.8.7 DTC Definitions and Requirements Table**. If the detection criteria indicate there may be a DTC, a unique 8-bit signed counter is incremented by a specified value. If the criteria indicate there isn't a DTC, the counter is decremented by a specified value. When the MAX value is reached, a DTC will be set. When the MIN value is reached, the DTC will be aged at the end of the monitoring cycle (as long as DTC isn't later detected).

General Information:

- All hardware-based DTCs require multiple (at least 4 – preferably more) samples indicating a fault exits before a DTC is set.
- “Functional” DTC (DTCs requested due to functional processes of the feature) will usually jump right to the MAX value in one step. Functional DTCs include: Missing Vehicle Speed Message, RKE Transmitter out-of-sync…

Incrementing the counter always sets a negative counter to 0 before incrementing it, while decrementing a counter never zeros the counter first.

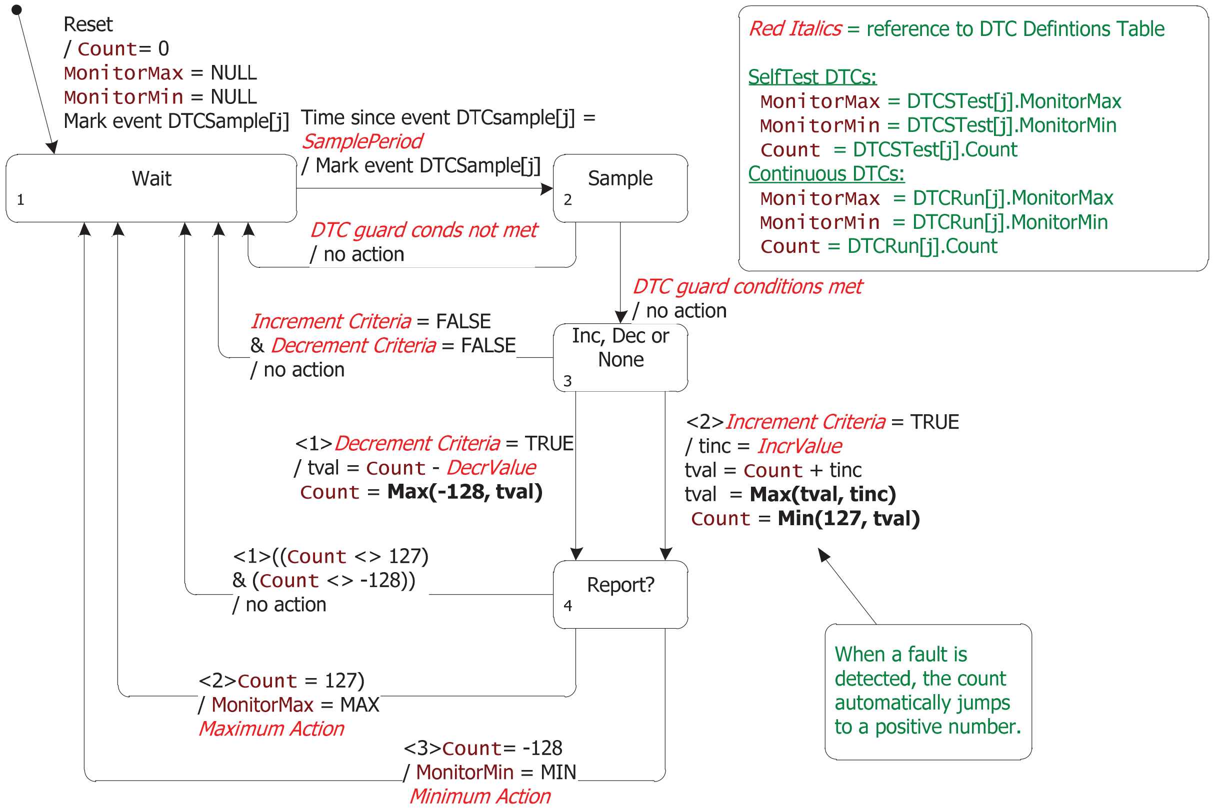


Figure 2.11-5 Control Setting/Aging of DTCs State Transition Diagram Requirements

Table 2.11-25 Control Setting/Aging of DTCs State Transition Diagram Requirements

Rqmt. No.	Source State -> Destination State
R: 2.11.136	0->1.1
R: 2.11.137	1->2.1
R: 2.11.138	2->1.1
R: 2.11.139	2->3.1
R: 2.11.140	3->1.1
R: 2.11.141	3->4.1
R: 2.11.142	3->4.2
R: 2.11.143	4->1.1
R: 2.11.144	4->1.2
R: 2.11.145	4->1.3

Functional DTCs

"Functional" DTCs (DTCs set by feature processing) normally do not have a method for clearing them – they just age until gone (or service 14). To avoid EEPROM wear-out, DTC aging occurs at the end of the monitoring cycle (start of a new cycle). A new cycle is defined to start on a RUN to OFF ignition transition.

The standard interface for "Functional" DTCs is a dataflow that is SET by the requesting feature and cleared by the Diagnostic DTC routines. If the dataflow is unset at the end of a monitoring cycle, the associated Functional DTC will be aged.

2.11.8.6 DTC Definitions

These notes apply to the *DTC Definition Tables* below.

General Note	SelfTest DTCs must use/modify the structure DTCSTest[n]. Continuous DTCs must use/modify the structure DTCRun[n]. The definitions below generally modify the .count and the .monitorMin/ .monitorMax values in both these structure. If a DTC is self-test only, then it doesn't need to report on a Continuous DTC. It is nice to have a Continuous DTC set when the matching SelfTest fails – that is what we are attempting to do for this ECU. This is where we call out specifically a call to DTCMaxAction() which allocates NVM for the Continuous DTC. SelfTest DTCs are only stored in RAM Continuous DTCs are stored in EEPROM Refer ECU Software Req #0043 for Ignition switch position change and micro reset.
Note 1	VBattState[VR_100_155_VB] = NORM_V (according to ECU Software Rqmt #0064)
Note 2	Fault detection must use the appropriate value of FETOpenThreshold_Cfg[FET_Ctrl_Index] or FETShortThreshold_Cfg[FET_Ctrl_Index] determine the presence of a fault. Also, only increment or decrement the counter if the specific fault is detectable.
Note 3	Output high-current short DTCs are not limited by *VBattGuard*. We decided that if the FET was disabled and the lifecount incremented, we want to leave tracks about which circuit was affected. This is especially important when $F00049 is also set due to the lifecount. For consistency, the BJT outputs also follow this same rule even though the lifecount doesn't matter.
Note 4	Once $F00049 is set, do not set any other DTCs. Ensure that other pending DTCs are set before $F00049 (don't want to lose the reason $F00049 was set due to short circuit DTC). Possibly only evaluate DTCs for one more second. This is intended to limit using all DTC memory and causing EEPROM memory issues.

Note: AVAS does not use FETs or $F00049 and as such some of these notes will not apply.

2.11.8.7 DTC Definitions and Requirements Table

Rqmt. No.	DTC	DTC Name	Config_Reqts	Rate(msec)	Self-Test	VBatt Guard	Inc_Criteria	Inc_Val	Max Action	Dec_Criteria	Dec_Val	Min Action
R: 2.11.146	0x9A0101	Speaker #1 General Electrical Failure	DTC_Ctrl = WATCH &Supplier Defined	200	TEST	n/a	Speaker fails during self-test.	33	DTCSTest[].MonitorMAX=MAX	Speaker does not fail during self-test.	33	DTCSTest[].MonitorMIN=MIN
R: 2.11.147	0x9A0101	Speaker #1 General Electrical Failure	DTC_Ctrl = WATCH &Supplier Defined	1000	NULL	n/a	Speaker Failure during normal operation.	33	DTCMaxAction()	Speaker Failure during normal operation.	33	DTCMinAction()
R: 2.11.148	0x9a0111	Speaker #1 Circuit Short To Ground	DTC_Ctrl = WATCH &Supplier Defined	200	TEST	n/a	Test fails speaker short to ground.	127	DTCSTest[].MonitorMAX=MAX	Test Passes speaker not short to ground	33	DTCSTest[].MonitorMIN=MIN
R: 2.11.149	0x9a0111	Speaker #1 Circuit Short To Ground	DTC_Ctrl = WATCH &Supplier Defined	1000	NULL	n/a	Short to Ground detected during normal operation (Continuous DTC)	127	DTCMaxAction()	Short to Ground detected during normal operation (Continuous DTC)	33	DTCMinAction()
R: 2.11.150	0x9A0112	Speaker #1 Circuit Short to Battery	DTC_Ctrl = WATCH &Supplier Defined	200	TEST	n/a	Test fails speaker short to battery.	33	DTCSTest[].MonitorMAX=MAX	Test Passes speaker not short to battery	33	DTCSTest[].MonitorMIN=MIN
R: 2.11.151	0x9A0112	Speaker #1 Circuit Short to Battery	DTC_Ctrl = WATCH &Supplier Defined	1000	NULL	n/a	Short to battery detected during normal operation (Continuous DTC)	33	DTCMaxAction()	Short to battery not detected during normal operation (Continuous DTC)	33	DTCMinAction()

R: 2.11.152	0x9A0113	Speaker #1 Circuit Open	DTC_Ctrl = WATCH &Supplier Defined	200	TEST	n/a	Test fails speaker open circuit	33	DTCSTest[].MonitorMAX=MAX	Test Passes speaker not open circuit	33	DTCSTest[].MonitorMIN=MIN
R: 2.11.153	0x9A0113	Speaker #1 Circuit Open	DTC_Ctrl = WATCH &Supplier Defined	1000	NULL	n/a	Open Circuit Detected in normal operation (Continuous DTC)	33	DTCMaxAction()	Open Circuit not detected during normal operation (Continuous DTC)	33	DTCMinAction()
R: 2.11.154	0x9A0201	Speaker #2 General Electrical Failure	AVAS_Spkr_Cfg = 0x0 & DTC_Ctrl = WATCH &Supplier Defined	200	TEST	n/a	Speaker fails during self-test.	33	DTCSTest[].MonitorMAX=MAX	Speaker does not fail during self-test.	33	DTCSTest[].MonitorMIN=MIN
R: 2.11.155	0x9A0201	Speaker #2 General Electrical Failure	AVAS_Spkr_Cfg = 0x0 & DTC_Ctrl = WATCH &Supplier Defined	1000	NULL	n/a	Speaker Failure during normal operation.	33	DTCMaxAction()	Speaker Failure during normal operation.	33	DTCMinAction()
R: 2.11.156	0x9A0211	Speaker #2 Circuit Short To Ground	AVAS_Spkr_Cfg = 0x0 & DTC_Ctrl = WATCH &Supplier Defined	200	TEST	n/a	Test fails speaker short to ground.	127	DTCSTest[].MonitorMAX=MAX	Test Passes speaker not short to ground	33	DTCSTest[].MonitorMIN=MIN
R: 2.11.157	0x9A0211	Speaker #2 Circuit Short To Ground	AVAS_Spkr_Cfg = 0x0 & DTC_Ctrl = WATCH &Supplier Defined	1000	NULL	n/a	Short to Ground detected during normal operation (Continuous DTC)	127	DTCMaxAction()	Short to Ground detected during normal operation (Continuous DTC)	33	DTCMinAction()
R: 2.11.158	0x9A0212	Speaker #2 Circuit Short to Battery	AVAS_Spkr_Cfg = 0x0 & DTC_Ctrl = WATCH &Supplier Defined	200	TEST	n/a	Test fails speaker short to battery.	33	DTCSTest[].MonitorMAX=MAX	Test Passes speaker not short to battery	33	DTCSTest[].MonitorMIN=MIN

R: 2.11.159	0x9A0212	Speaker #2 Circuit Short to Battery	AVAS_Spkr_Cfg = 0x0 & DTC_Ctrl = WATCH &Supplier Defined	1000	NULL	n/a	Short to battery detected during normal operation (Continuous DTC)	33	DTCMaxAction()	Short to battery not detected during normal operation (Continuous DTC)	33	DTCMinAction()
R: 2.11.160	0x9A0213	Speaker #2 Circuit Open	AVAS_Spkr_Cfg = 0x0 & DTC_Ctrl = WATCH &Supplier Defined	200	TEST	n/a	Test fails speaker open circuit	33	DTCSTest[].MonitorMAX=MAX	Test Passes speaker not open circuit	33	DTCSTest[].MonitorMIN=MIN
R: 2.11.161	0x9A0213	Speaker #2 Circuit Open	AVAS_Spkr_Cfg = 0x0 & DTC_Ctrl = WATCH &Supplier Defined	1000	NULL	n/a	Open Circuit Detected in normal operation (Continuous DTC)	33	DTCMaxAction()	Open Circuit not detected during normal operation (Continuous DTC)	33	DTCMinAction()
R: 2.11.162	0xC10000	Lost Communication with ECM/PCM "A"	DTC_Ctrl = WATCH & Ignition_Status = RUN (last known) & PwPckTq_D_Stat <> PwPckStrtInPrgrss_TqNotAvail (last known)	500	TEST	n/a	GearRverse_Status_Available= Lost & GearRevrse_D_Actl_Signal_Received_Flag = NULL	127	DTCMaxAction(), DTCSTest[].MonitorMAX=MAX	GearRverse_Status_Available= Available	128	DTCSTest[].MonitorMIN=MIN
R: 2.11.163	0xC10000	Lost Communication with ECM/PCM "A"	DTC_Ctrl = WATCH & Ignition_Status = RUN (last known) & PwPckTq_D_Stat <> PwPckStrtInPrgrss_TqNotAvail (last known)	1000	NULL	n/a	GearRverse_Status_Available= Lost & GearRevrse_D_Actl_Signal_Received_Flag = NULL	32	DTCMaxAction()	GearRverse_Status_Available= Available	16	DTCMinAction()
R: 2.11.164	0xc14000	Lost Communication with Body Control Module	DTC_Ctrl = WATCH & Ignition_Status = RUN (last known) & PwPckTq_D_Stat <> PwPckStrtInPrgrss_TqNotAvail (last known)	500	TEST	n/a	Ignition_Status_Available = Lost & Ignition_Status_Signal_Received_Flag = NULL	127	DTCMaxAction(), DTCSTest[].MonitorMAX=MAX	Ignition_Status_Available = Available	128	DTCSTest[].MonitorMIN=MIN

R: 2.11.165	0xc14000	Lost Communication with Body Control Module	DTC_Ctrl = WATCH & Ignition_Status = RUN (last known) & PwPckTq_D_Stat <> PwPckStrtInPrgrss_TqNotAvail (last known)	1000	NULL	n/a	Ignition_Status_Available = Lost & Ignition_Status_Signal_Received_Flag = NULL	32	DTCMaxAction()	Ignition_Status_Available = Available	16	DTCMinAction()
R: 2.11.166	0xC42200	Invalid Data Received from Body Control Module	PwPckTq_D_Stat <> PwPckStrtInPrgrss_TqNotAvail (last known)	500	TEST	n/a	Ignition_Status_Available = Available & Ignition_Status in message 0x3B3 is equal to invalid for five (5) seconds	127	DTCMaxAction(), DTCSTest[].MonitorMAX=MAX	Ignition_Status_Available = Available	128	DTCSTest[].MonitorMIN=MIN
R: 2.11.167	0xC42200	Invalid Data Received from Body Control Module	PwPckTq_D_Stat <> PwPckStrtInPrgrss_TqNotAvail (last known)	500	NULL	n/a	Ignition_Status_Available = Available & Ignition_Status in message 0x3B3 is equal to invalid for five (5) seconds	127	DTCMaxAction()	Ignition_Status_Available = Available	128	DTCMinAction()
R: 2.11.168	0xE01A51	Control Module Main Calibration Data Not Programmed	key in Run, ACC or Delayed Acc & Voltage between 10 and 15.5volts	Check at power on, ODST and changes in reverse status	TEST	n/a	Set when calibration data area is in an erased state.	127	DTCMaxAction(), DTCSTest[].MonitorMAX=MAX	Set when calibration data area is valid.	128	DTCSTest[].MonitorMIN=MIN
R: 2.11.169	0xE01A51	Control Module Main Calibration Data Not Programmed	key in Run, ACC or Delayed Acc & Voltage between 10 and 15.5volts	Check at power on, ODST and changes in reverse status	NULL	n/a	Set when calibration data area is in an erased state.	127	DTCMaxAction()	Set when calibration data area is valid.	128	DTCMinAction()

R: 2.11.170	0xF00041	Control Module General Checksum Failure	key in Run, ACC or Delayed Acc & Voltage between 10 and 15.5volts	Check at power on and ODST	TEST	n/a	Flash ROM Checksum Failure	127	DTCMaxAction(), DTCSTest[].MonitorMAX=MAX	Flash ROM Checksum – No failure detected	128	DTCSTest[].MonitorMIN=MIN
R: 2.11.171	0xF00041	Control Module General Checksum Failure	key in Run, ACC or Delayed Acc & Voltage between 10 and 15.5volts	Check at power on and ODST	NULL	n/a	Flash ROM Checksum Failure	127	DTCMaxAction()	Flash ROM Checksum – No failure detected	128	DTCMinAction()
R: 2.11.172	0xF00042	Control Module General Memory Failure	key in Run, ACC or Delayed Acc & Voltage between 10 and 15.5volts	Checked during serial	TEST	n/a	EEPROM Write Error	127	DTCMaxAction(), DTCSTest[].MonitorMAX=MAX	No EEPROM Write Error detected	128	DTCSTest[].MonitorMIN=MIN
R: 2.11.173	0xF00042	Control Module General Memory Failure	key in Run, ACC or Delayed Acc & Voltage between 10 and 15.5volts	Checked during serial	NULL	n/a	EEPROM Write Error	127	DTCMaxAction()	No EEPROM Write Error detected	128	DTCMinAction()
R: 2.11.174	0xF00096	Control Module Component Internal Failure	key in Run, ACC or Delayed Acc & Voltage between 10 and 15.5volts	Check at power on, ODST and changes in reverse status	TEST	n/a	Set when calibration data contains an invalid checksum.	127	DTCMaxAction(), DTCSTest[].MonitorMAX=MAX	Set when calibration data contains a valid checksum.	128	DTCSTest[].MonitorMIN=MIN

R: 2.11.175	0xF00096	Control Module Component Internal Failure	key in Run, ACC or Delayed Acc & Voltage between 10 and 15.5volts	Check at power on, ODST and changes in reverse status	NULL	n/a	Set when calibration data contains an invalid checksum.	127	DTCMaxAction()	Set when calibration data contains a valid checksum.	128	DTCMinAction()
R: 2.11.176	0xF00316	Batter Voltage Circuit Voltage Below Threshold	key in Run, ACC or Delayed Acc	50	NULL	n/a	Voltage transitions to UNDER_VOLT as specified in 2.10.3 Voltage Range State Machine & VoltBelowThresholdDelayCfg time has passed.	127	DTCMaxAction()	Voltage transitions to NORM_VOLT as specified in 2.10.3 Voltage Range State Machine	128	DTCMinAction()
R: 2.11.177	0xF00317	Battery Voltage Circuit Voltage Above Threshold	key in Run, ACC or Delayed Acc	50	NULL	n/a	Voltage transitions to OVER_VOLT as specified in 2.10.3 Voltage Range State Machine	32	DTCMaxAction()	Voltage transitions to NORM_VOLT as specified in 2.10.3 Voltage Range State Machine	16	DTCMinAction()
R: 2.11.177a	$E02B-61	TBD	(DTCSuppression_Cfg[DTCSuppression_Cfg_Index], bit0 = 1)	1000	NULL	n/a	SWSigning_KeyMode = DEVELOPMENT Note: Supplier needs to define this dataflow.	127	DTCMaxAction()	SWSigning_KeyMode = PRODUCTION	255	DTCMinAction()
R: 2.11.177b	$E02B-61	TBD	(DTCSuppression_Cfg[DTCSuppression_Cfg_Index], bit1 = 1)	200	TEST	n/a	SWSigning_KeyMode = DEVELOPMENT Note: Supplier needs to define this dataflow.	127	DTCSTest[].MonitorMAX=MAX	SWSigning_KeyMode = PRODUCTION	255	DTCSTest[].MonitorMIN=MIN
R: 2.11.177c	$E02B-62	TBD	(DTCSuppression_Cfg[DTCSuppression_Cfg_Index], bit0 = 1)	1000	NULL	n/a	SWSigning_KeyMode = PRODUCTION & SWSignedKeysFound = DEVELOPMENT Note: Supplier needs to define these dataflows.	127	DTCMaxAction()	SWSigning_KeyMode = PRODUCTION & SWSignedKeysFound = PRODUCTION	255	DTCMinAction()

R: 2.11.177d	$E02B-62	TBD	(DTCSuppression_Cfg[DTCSuppression_Cfg_Index], bit1 = 1)	200	TEST	n/a	SWSigning_KeyMode = PRODUCTION & SWSignedKeysFound = DEVELOPMENT Note: Supplier needs to define these dataflows	127	DTCSTest[].MonitorMAX=MAX	SWSigning_KeyMode = PRODUCTION & SWSignedKeysFound = PRODUCTION	255	DTCSTest[].MonitorMIN=MIN

2.11.8.8 DTCMaxAction(index) Function

This function will only be called for continuous DTCs (in continuous and SelfTest DTC checks).

Table 2.11-26 DTCMaxAction(index) Requirements

Rqmt No.	Minimal Requirements
R: 2.11.178	Set DTCRun[index].Monitor = MAX
R: 2.11.179	Allocate NVM aging storage for the requested DTC
R: 2.11.180	If NVM aging storage is full, it shall commandeer the NVM of the oldest (as defined by the value of the aging count) DTC. If there are multiple "oldest" DTCs, then it is left to the supplier which NVM location to commandeer.
R: 2.11.181	If the DTC already exists in NVM, it shall restart its aging count.
R: 2.11.182	Set AVAS as Faulted
R: 2.11.183	(can perform other tasks – clearing functional latches, for example)

2.11.8.9 DTCMinAction(index) Function

This function will only be called for continuous DTCs.

Table 2.11-27 DTCMinAction(index) Requirements

Rqmt. No.	Minimal Requirements
R: 2.11.184	Shall set DTCRun[index].Monitor = MIN
R: 2.11.185	If there are no active DTCs set AVAS as ACTIVE/INACTIVE (Not Faulted)
R: 2.11.186	(can perform other tasks)

2.11.8.10 DTC Suppression

DTCs mapped in **Table 2.11-29 DTC Index Map for DTC Suppression** shall be able to be suppressed by disabling the DTC mask. This does not change the detection requirements, nor does it eliminate the need of the module to manage the failure mode or take mitigating actions. It only controls the actual logging of the DTC.

Table 2.11-28 Suppressing DTCs

Rqmt No.	Requirements
R: 2.11.187	Each DTC shall be represented by a bit map in the DTC Suppression array – DTCSuppression_Cfg[n]. Bitmap values as follow: Hex 00 (Binary 00) : both self-test and continuous DTC are suppressed, they cannot be set or cleared Hex 1 (Binary 01) : only continuous can be set and cleared, self-test DTC is suppressed Hex 2 (Binary 10) : only self-test can be set and cleared, continuous DTC is suppressed Hex 3 (Binary 11) : both self-test and continuous DTC can be set and cleared Example: When (DTCSuppression_Cfg[n] = 1 | DTCSuppression_Cfg[n] = 3): Continuous DTC can be set and cleared When (DTCSuppression_Cfg[n] = 2 | DTCSuppression_Cfg[n] = 3): Self-test DTC can be set and cleared
R: 2.11.188	Refer to **Table 2.11-29 DTC Index Map for DTC** for mapping details.
R: 2.11.189	Continuous DTCs are defined by SelfTest = NULL
R: 2.11.190	Self-test or On-Demand DTCS are defined by SelfTest = TEST

Table 2.11-29 DTC Index Map for DTC Suppression

Rqmt. No.	DTCSuppression_Cfg_Index	DTC Number	Description	DTCSuppression_Cfg[DTCSuppression_Cfg_Index] Initial Value
R: 2.11.191	AVAS is currently not supporting DTC Suppression thus no DTCs are included in this index.			

2.11.8.11 Definitions for DTC Status Bits

Table 2.11-30 Definitions for DTC Status Bits

Rqmt. No.	Bit	Name	Supported	Value
R: 2.11.192	0	TestFailed	No	Always 0
R: 2.11.193	1	TestFailedThisOperationCycle	Yes	If (DTC in EEPROM & DTCRun[x].MonitorMax = MAX) then 1 Else 0
R: 2.11.194	2	PendingDTC	No	Always 0
R: 2.11.195	3	ConfirmedDTC	Yes	If (DTC in EEPROM) then 1 Else 0
R: 2.11.196	4	TestNotCompletedSinceLastCleared	No	Always 0
R: 2.11.197	5	TestFailedSinceLastCleared	No	Always 0
R: 2.11.198	6	TestNotCompletedThisOperationCycle	Yes	If (DTCRun[x].MonitorMax = MAX | DTCRun[x].MonitorMin = MIN) then 0 Else 1
R: 2.11.199	7	WarningIndicatorRequested	No	Always 0

2.11.8.12 Diagnostic Cycle Monitor

This state machine controls the diagnostic cycle monitor. The cycle monitor is defined to restart on a transition to ignition OFF. When this transition occurs, there is some maintenance work that needs to be done in the AgeAppropriateDTCs() function, the ClearLatches() function, and the ResetDTCcounters() function.

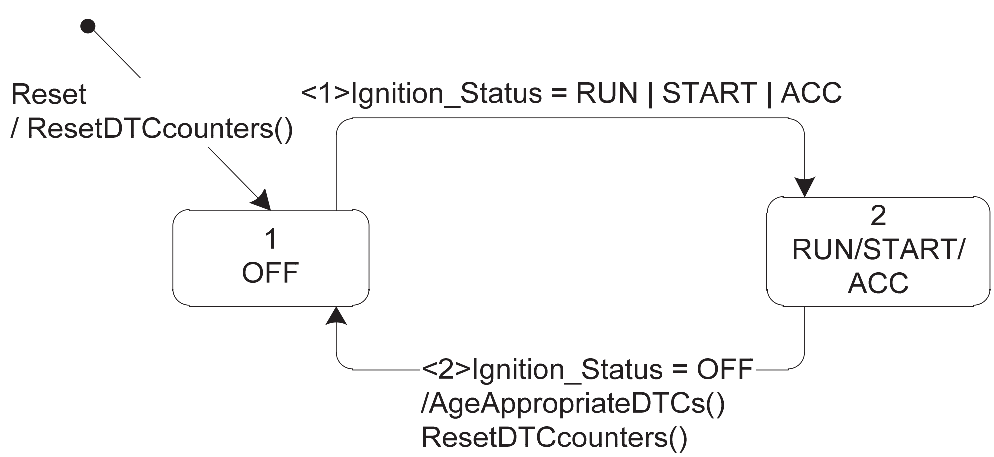


Figure 2.11-6 Control DTC Setting State Transition Diagram

Table 2.11-31 Diagnostic Cycle Monitor State Transition Diagram Requirements

Rqmt No.	Source State -> Destination State
R: 2.11.200	0->1.1
R: 2.11.201	1->2.1
R: 2.11.202	2->1.1

2.11.8.13 ResetDTCCounters() Function

```
ResetDTCcounters()

/* Set all DTCRun[].Count Continuous DTC instances to 0*/
For j = 0 to MAXDTCIDX
  DTCRun[j].Count = 0
End For

/* Set all DTCRun[].Monitor Continuous DTC instances to NULL*/
For j = 0 to MAXDTCIDX
  DTCRun[j].MonitorMax = NULL
  DTCRun[j].MonitorMin = NULL
End For
```

2.11.8.14 AgeAppropriateDTCs() Function

Step through all the DTCs and any of them with MIN set get aged. Need to call the *CheckLatchDTCs()* function before calling this function

```
AgeAppropriateDTCs()

/* Set all Continuous DTCs with DTCRun[j].MonitorMin=MIN, AgeDTC()*/
For j = 0 to MAXDTCIDX
  If DTCRun[j].MonitorMin=MIN, then AgeDTC(j)
End For
```

2.11.8.15 AgeDTC(index)

Table 2.11-32 AgeDTC(index) Requirements

Rqmt. No.	Minimal Requirements
R: 2.11.203	If the DTC exists in NVM, it shall age the DTC
R: 2.11.204	If the DTC has been aged and it is now completely aged, then free up the DTC aging NVM
Note:	It is left to the supplier to select the maximum aging value that meetings Ford NetCom requirements.

2.11.9 AVAS Configuration Data (Method 2 & 3)

2.11.9.1 A note about Method 2 data versus Method 3 data

In general, Method 2 (DID written) data is used for configuration values that can change between specific instances of vehicles or classes of vehicles within a platform.

Method 3 (file download) data is used to configure general behaviors of the module, such as timers and levels; as well as data that will not vary within a platform, such as vehicle geometries.

Note: AVAS does not use any Method 2 or Method 3 configuration data.

2.11.9.2 Method 2 Data

Table 2.11-33 Miscellaneous Service $2E Requirements

R: 2.11.205	All Method 2 Configuration Parameters must be stored using "Double Redundant" EEPROM events or better.

Inhale/Exhale - Configuration Data which is located in a configuration DID (DE00….DExx) prior to the buffer block.

As-Built - Configuration data which is written at Ford EOL (Vehicle Operation Column) AND in the inhale exhale range.

Module Manufacturer - Configuration items which are just written at the tier 1 suppliers manufacturing plant.

FCSD Customer Preference - Items which may be written/configured at Ford Customer Service Division due to Customer Preferences

2.11.9.3 Method 2 Configuration Parameters

The following parameters are used to configure AVAS using Method 2 configuration. Default values are taken from the Data Dictionary.

Table 2.11-34 Method 2 Configuration Parameters

Rqmt. No	Name of Data	Description	Initial Value	Unit	Inhale/Exhale	As-Built/Vehicle Operations	Module Manufacturer	FCSD Customer Preference
Note: AVAS does not use Method 2 data for Configuration.								

2.11.9.4 AVAS Configuration Data (Supplier Range FD00-FEFF)

The parameters listed in **Table 2.11-35 Supplier Range Configuration Parameters** are configurable parameters set by the supplier in the FD00-FEFF range of DIDs. FMC does not maintain these parameters and will not write to them at end of line nor store them in the As-Built database.

Table 2.11-35 Supplier Range Configuration Parameters

Rqmt. No	Name of Data	Description	Initial Value	Unit
R: 2.11.206	Max_Speed_Sound_Cfg	Maximum limit value to produce sound	See Data Dictionary for Initial/Default value	KPH
R: 2.11.207	Vehicle_Type_Cfg	Vehicle Brand		
R: 2.11.208	Speaker_On_Off_Cfg	Indicates if the system should use a switch to turn on/off the sound.		
R: 2.11.209	AVAS_Spkr_Cfg	Number of Speakers in actual hardware		

R: 2.11.210	TransitionDelayCfg	Delay in msec before transitioning from playing sound in the front speaker to playing sound in the rear speaker and vice versa.		Milliseconds
R: 2.11.211	The supplier shall ensure these parameters are set to their correct value as defined in the data dictionary before delivery to Ford.			

Parameter Information

Parameter # 1				
Parameter Name	Max_Speed_Sound_Cfg			
Description	Maximum limit value to produce sound			
DataIdentifier Size (bits)	*8*			
Format Information:				
Size (bits)	**Parameter Info**	**Units**	**Min Scaled Value**	***Max Scaled Value***
8	Max_Speed_Sound_Cfg	*kph*	*0*	*655*

Parameter # 2	
Parameter Name	Vehicle_Type_Cfg
Description	Vehicle brand
DataIdentifier Size (bits)	*1*
Format Information:	
Value	*State Description*
0	*FORD*
1	*LINCOLN*

Parameter # 3	
Parameter Name	Speaker_On_Off_Cfg
Description	Indicates if the system should use a switch to turned ON/OFF the sound
DataIdentifier Size (bits)	*1*
Format Information:	
Value	*State Description*
0	*SWITCH_DISABLED*
1	*SWITCH_ENABLED*

Parameter # 4	
Parameter Name	AVAS_Spkr_Cfg
Description	The number of speakers supported by the AVAS's actual hardware. Currently, it can be one or two.
DataIdentifier Size (bits)	*1*
Format Information:	
Value	*State Description*
0x0	*2 Speaker Configuration*
0x1	*1 Speaker Configuration*

Parameter # 5	
Parameter Name	TransitionDelayCfg
Description	Delay in msec before transitioning from playing sound in the front speaker to playing sound in the rear speaker and vice versa.
DataIdentifier Size (bits)	*10*
Format Information:	

Size (bits)	**Parameter Info**	**Units**	**Min Scaled Value**	***Max Scaled Value***
10	TransitionDelayCfg	*msec*	*0*	*1000*

2.11.10 Fault conditions for Speaker

DTC (HEX)	DTC	DTC Type	Root Description	Failure Type Byte Description
0x9A0101	B1A01-01	D	Speaker #1	General Electrical Failure
0x9A0111	B1A01-11	D	Speaker #1	Circuit Short To Ground
0x9A0112	B1A01-12	D	Speaker #1	Circuit Short To Battery
0x9A0113	B1A01-13	D	Speaker #1	Circuit Open
0x9A0201	B1A02-01	D	Speaker #2	General Electrical Failure
0x9A0211	B1A02-11	D	Speaker #2	Circuit Short To Ground
0x9A0212	B1A02-12	D	Speaker #2	Circuit Short To Battery
0x9A0213	B1A02-13	D	Speaker #2	Circuit Open

2.11.11 Fault conditions for Lost Communication

When the system detects lost Communication with any of the signals received, the module should set a DTC.

In the document: “DiagnosticFaultCoverageAndDTCNumbersDesignConsideration” Table 3.2, the recommended filtering time is 10 samples. So for each lost DTC, the time to wait before setting a LOST communication DTC with a module is 10 times the signal transmission rate.

When Communication is lost with the ECM/PCM (Veh_V_ActlEng, VehVActlEng_D_Qf, GearLvrPos_D_Actl, GearRvrse_D_Actl, PwPckTq_D_Stat) the AVAS module should set a DTC after MediumLostTime_Cfg.

DTC (HEX)	DTC	DTC Type	Root Description	Failure Type Byte Description
0xC100 00	U0100-00	C	Lost Communication With ECM/PCM "A"	**No Sub Type Information**

When Ignition_Status is not received from BCM, the AVAS module should set a DTC after SlowLostTime_Cfg.

DTC (HEX)	DTC	DTC Type	Root Description	Failure Type Byte Description
0xC14000	U0140-00	C	Lost Communication With Body Control Module	**No Sub Type Information**

When data from BCM is not valid, module should set the following DTC:

DTC (HEX)	DTC	DTC Type	Root Description	Failure Type Byte Description
0xC42200	U0422-00	C	Invalid Data Received From Body Control Module	**No Sub Type Information**

2.11.12 Fault conditions for Internal Failures with AVAS ECU:

Following faults represent internal failures of the module:

DTC (HEX)	DTC	DTC Type	Root Description	Failure Type Byte Description
0xF00041	U3000-41	CD	Control Module	General Checksum Failure
0xF00042	U3000-42	C	Control Module	General Memory Failure
0xF00096	U3000-96	CD	Control Module	Component Internal Failure

For issues related with configuration, module should set the corresponding DTC:

DTC (HEX)	DTC	DTC Type	Root Description	Failure Type Byte Description
0xE01A51	U201A-51	CD	Control Module Main Calibration Data	No Sub Type Information

For issues related with battery conditions, module should set the corresponding DTC:

DTC (HEX)	DTC	DTC Type	Root Description	Failure Type Byte Description
0xF00316	U3003-16	CD	Battery Voltage	Circuit Voltage Below Threshold
0xF00317	U3003-17	CD	Battery Voltage	Circuit Voltage Above Threshold

The DTC to report circuit voltage below threshold should only be set after a configurable delay (VoltBelowThresholdDelayCfg):

2.11.13 CAN Based Data Identifiers

2.11.13.1 DID 0x1505 Vehicle Speed - High Resolution

DataIdentifier Value	*0x1505*
DataIdentifier Name	*Vehicle Speed - High Resolution*
DataIdentifier Size (bytes)	*2*
DataIdentifier Type	*unsigned*

Read Information (Service 0x22 - ReadDataByIdentifier)

Readable in Sessions	*0x01,0x03*

DataIdentifier Format Information

Parameter Info	**Offset**	**Resolution**	**Units**	**Min Scaled Value**	***Max Scaled Value***
Vehicle Speed - High Resolution	*0*	*0.0078*	*Kph*	*0*	*511.9921875*

Note: Signal *Veh_V_ActlEng* does not have the same resolution as DID 0x1505, in order to have compatible values, module should report the most accurate value from signal *Veh_V_ActlEng.*

2.11.13.2 DID 0x7218 Reverse Gear Position

DataIdentifier Value	*0x7218*
DataIdentifier Name	*Reverse Gear Position*
DataIdentifier Size (bytes)	*1*
DataIdentifier Type	*State encoded*

Read Information (Service 0x22 - ReadDataByIdentifier)

Readable in Sessions	*0x01,0x03*

DataIdentifier Format Information

Value	***State Description***	***GearRvrse_D_Actl***
0x00	*Not Engaged*	*Inactive_Not_Confirmed || Inactive_Confirmed || Active_Not_Confirmed*
0x01	*Engaged*	*Active_Confirmed*
0x02	*Malfunction*	*Fault*
0xFF	*Invalid Error State*	*N/A*

2.11.13.3 DID 0x0599 PowerPack State

DataIdentifier Value	*0x0599*
DataIdentifier Name	*PowerPack State*
DataIdentifier Size (bytes)	*1*
DataIdentifier Type	*State encoded*

Read Information (Service 0x22 - ReadDataByIdentifier)

Readable in Sessions	*0x01,0x03*

DataIdentifier Format Information

Value	*State Description*	*PwPckTq_D_Stat*
0x00	*Power Pack is not available, e.g., key-off, accessory mode, key in run (but requiring state 2 before entering state 1 or 3).*	*OFF_NO_TQ*
0x01	*Power Pack is available for non-propulsive purposes only. Typically, due to a remote start to warm up or cool the vehicle.*	*ON_NO_TQ*
0x02	*Customer has initiated a start request (to transition to state 1 or 3), and that procedure is imminent or in progress.*	*START_IN_PROGRESS*
0x03	*Power Pack is available for propulsive and non-propulsive purposes. Put in gear & step on accel pedal and vehicle will move.*	*ON_TQ_AVAILABLE*

2.11.13.4 DID 0x40B5 Ignition Position Final Status

DataIdentifier Value	*0x40B5*
DataIdentifier Name	*Ignition Position Final Status*
DataIdentifier Size (bytes)	*1*
DataIdentifier Type	*State encoded*

Read Information (Service 0x22 - ReadDataByIdentifier)

Readable in Sessions	*0x01,0x03*

DataIdentifier Format Information

Value	*State Description*	*Ignition_Status*
0x00	*Null – Unknown Info*	*UNKNOWN || INVALID*
0x01	*Off*	*OFF*
0x02	*Acc*	*ACCESORY*
0x03	*Run*	*RUN*
0x04	*Start*	*START*

2.11.13.5 DID 0x0130 Transmission Shift Lever Position

DataIdentifier Value	*0x0130*
DataIdentifier Name	*Transmission Shift Lever Position*
DataIdentifier Size (bytes)	*1*
DataIdentifier Type	*State encoded*

Read Information (Service 0x22 - ReadDataByIdentifier)

Readable in Sessions	*0x01,0x03*

DataIdentifier Format Information

Value	*State Description*	*Transmission Shift Lever Position*
0x00	*Park*	*Park*
0x01	*Reverse*	*Reverse*
0x02	*Neutral*	*Neutral*
0x03	*Drive*	*Drive*
0x05	*Sport*	*Sport/Drive Sport*
0x06	*Low*	*1*
0x07	*Manuel Gear Select – 1st*	*2*
0x08	*Manuel Gear Select – 2nd*	*3*
0x09	*Manuel Gear Select – 3rd*	*4*
0x0A	*Manuel Gear Select –4th*	*5*
0x0B	*Manuel Gear Select –5th*	*6*
0x0F	*Fault*	*Fault*

2.11.14 Bootloader

The bootloader will be responsible for signature verification of downloaded VBF files to an ECU. To verify the authenticity of a VBF, the bootloader will require the production/development key(s) to be flashed into a read only area of the bootloader (i.e. data block). Depending on an ECUs capability the bootloader can have the following public key storage solution.

1) Single Key Storage
2) Two Key Storage

Note: Public key shall NOT be allowed to be modified via diagnostics or internal ECU application(s).

Once the public key(s) have been flashed into the bootloader, an ECU can verify the Software Signatures of the VBF files downloaded to ensure the software is secure and authentic. The signature verification will occur for each Logical Block in the VBF file. Each downloadable SW VBF needs to be individually signed. The bootloader can erase multiple SW download areas, but due to the way the signature process works each VBF must be handled sequentially. The bootloader will be responsible for the signature verification process below.

The ECU supplier will be responsible for populating the SW Signature, Public Key Hash, and Verification Structure fields in the VBF for development builds using HexView. For production builds, the ECU supplier is only responsible for populating the Public Key Hash, and Verification Structure fields. The SW Signature field can only be populated by Ford IVS Team.

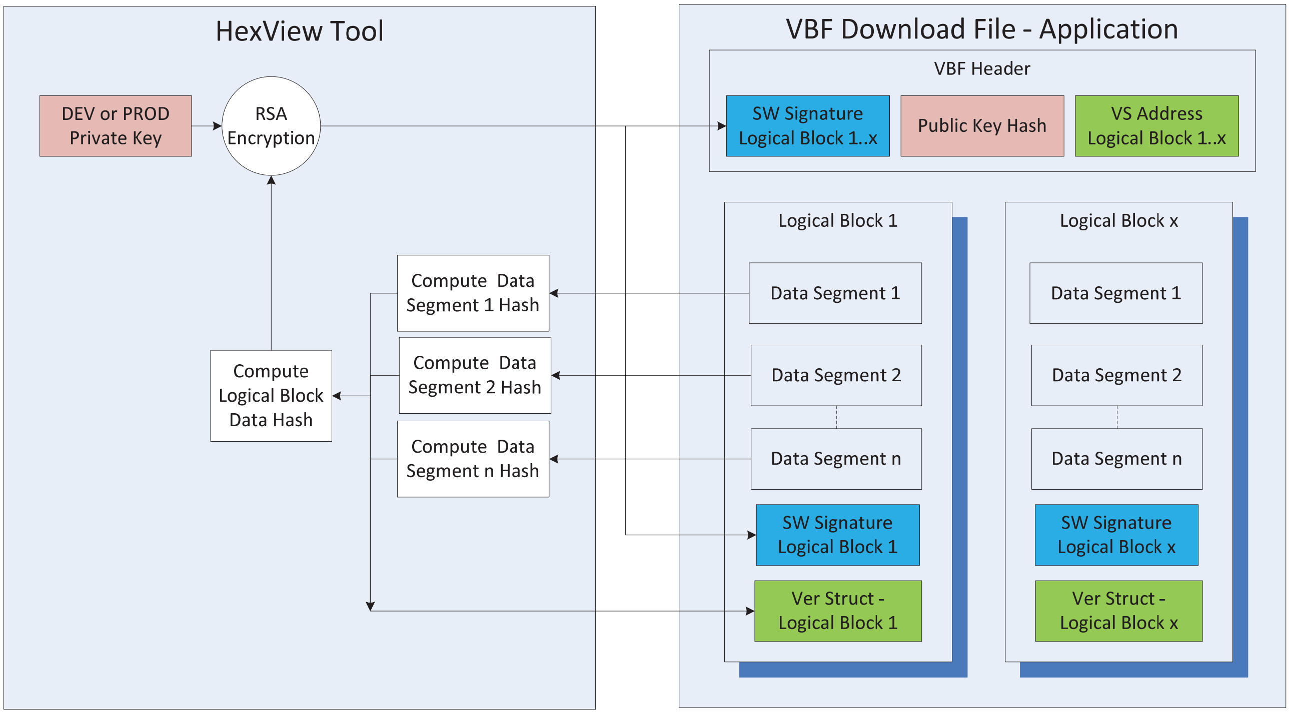


Figure 2-7 Software Signature & VS Generation Process

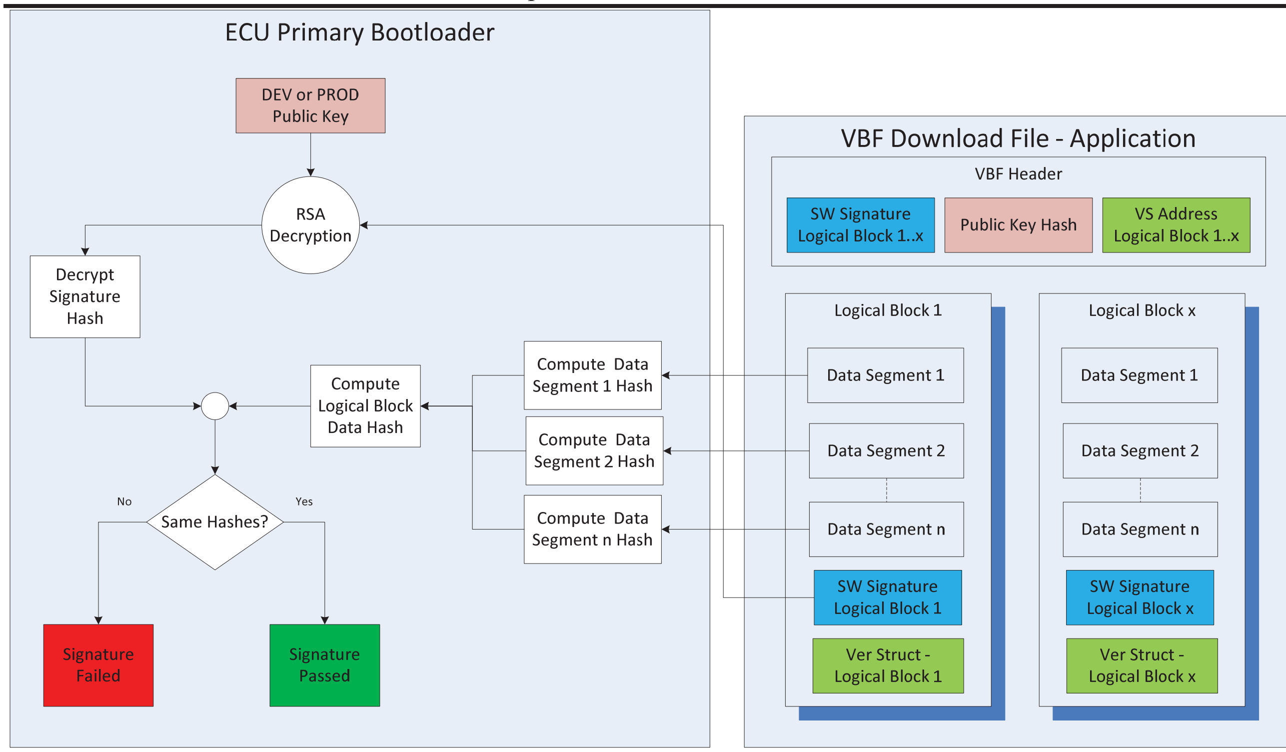


Figure 2-8 Software Signature Verification Process for One Key

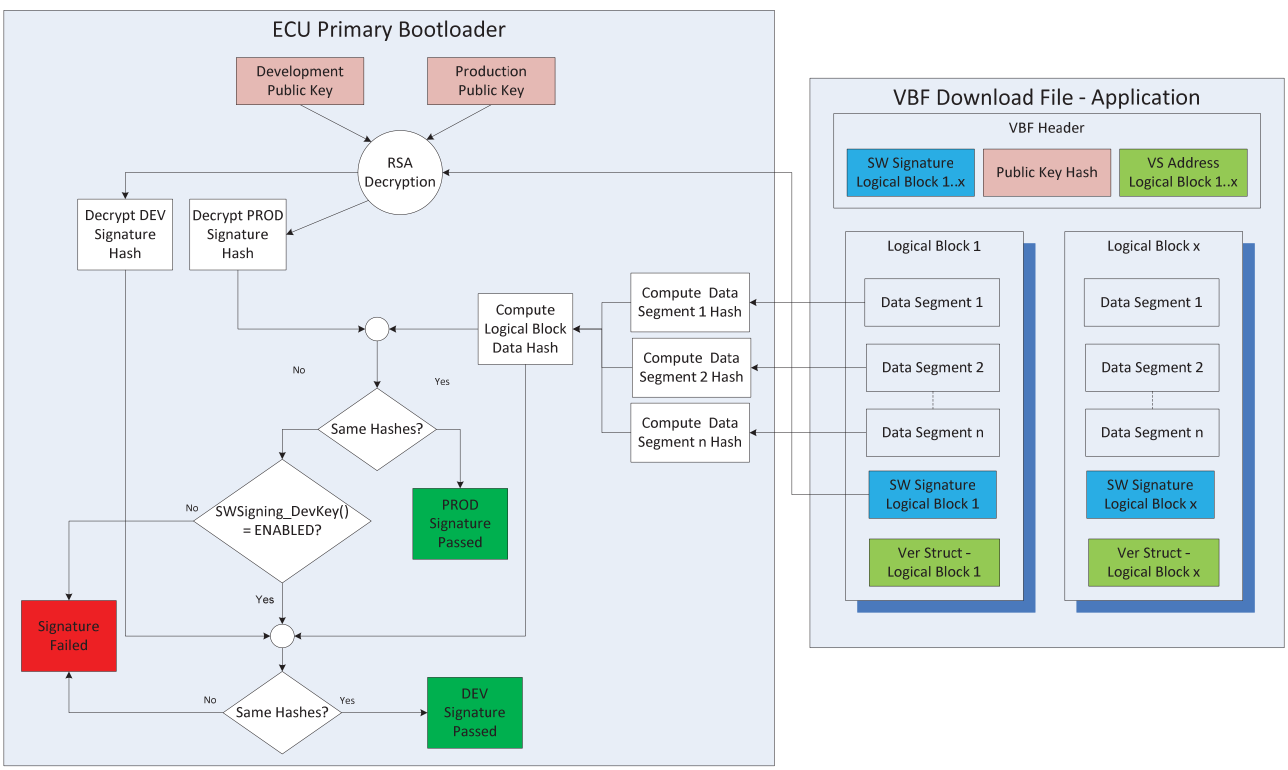


Figure 2-9 Software Signature Verification Process for Two Keys

2.11.14.1 Single Key Storage

An ECU can store a single public key in the bootloader which can be used in the SW signature verification. This method allows only one public key to be store which could be a development key or production key based on the target build. For all Development builds (before TT builds), the Development public key will be included into the bootloader. Development SW shall be signed by the SW developers. For production builds (TT builds and beyond), the production public key will be included into the bootloader. At any point in time, when a development SW build needs to be tested on a production vehicle then the module will need to be replaced with a module that supports development builds.

Implications

- Two different HW part numbers are required for Development and Production
- Cannot install Development SW on a Production ECU
- Cannot install Production SW on a Development ECU
- Production SW has to be signed Via IVS
- Testing SW on a Production ECU will require
  - Swapping the Production ECU with a Development ECU
  - Or Releasing Experimental SW Production signed by IVS

Table 2-36 – Single Key Storage Requirements

Rqm't Num.	Requirement
R: 2.11.177e	The ECU shall store only one public key in the primary bootloader for SW signing verification.
R: 2.11.177f	The development public key shall be store in the PBL for pre TT vehicles.
R: 2.11.177g	The production public key shall be store in the PBL for TT vehicles and beyond.
R: 2.11.177h	The public key shall be store in read only area.

2.11.14.2 Two Key Storage

An ECU can store two public keys in the bootloader which can be used in the SW signature verification. This method allows two public keys to be stored which will be a development key and production key. By default, the bootloader will be configured to use the production public key. When development builds are required, the ECU can switch to using the development public key using a diagnostic routine. If the ECU is using the production public key, it can only be switched to using the development key with backend authentication (i.e. FIMCO).

Implications

- Requires only one HW part number
- Cannot install Development SW on an ECU with a disabled Development key
- Can install Production SW on an ECU with an enabled or disabled Development Key
- Production SW has to be signed by IVS
- Installing Development SW on an ECU with a disabled Development Key requires
  - Enabling the Development key, but this requires using a test tool connected to that vehicle. (OTA will not support this)
  - Then you can install Development or Production SW (OTA supports both)
- Switching from Production to Development requires a secure method approved by the SW Security team.
  - This is only available in the application. The bootloader cannot do the switch.
  - The bootloader must be able to determine if the Development key is enabled or not even if the application is missing. This implies the Development key enable is store in a special Data Flash

- Switching from Development to Production does not require any security.
- The secure method for switching to Development requires the ECU manufacturer to maintain a database with ECU serial number to ESN mapping. The diagnostic routine that supports switching to Development will use the ESN in encrypted format.
- The security team didn't want a common method for this diagnostic routine.
- Service Test tool will not support Switching Routine.

Table 2-37 – Two Key Storage

Rqm't Num.	Requirement
R: 2.11.177i	The ECU shall store both the development and production public keys in the primary bootloader or HSM for SW signing verification. Note: Storing the keys in the bootloader introduces issues when supporting AB Swap since the application needs to access the keys.
R: 2.11.177j	The ECU shall use the production key as the default public key.
R: 2.11.177k	The ECU shall disable the development public key using a type1 diagnostic routine with no unique ESN or FIMCO access required.
R: 2.11.177l	The ECU shall allow the enable development public key using a type1 diagnostic routine only after gaining access using a unique ESN password or backend authentication access "FIMCO".
R: 2.11.177m	The public key shall be stored in read only area.

2.12 FACTORY MODE AND TRANSPORT MODE

Requirement Number	Description
R: 2.12.1	The behavior of the AVAS module in FACTORY mode and TRANSPORT mode is identical to its behavior in NORMAL mode and does not change.

2.13 DATA DICTIONARY

AVAS

FS-ML3T-14G113-AA

Data Dictionary v1.0

Tuesday, August 21, 2018 Revision 1.0

DataFlow Name **Avas Output**

Definition **Describes the module output.**

Attributes

Units	Range	Default	Number of Values
??	??		

DataFlow Name **AVAS_Ignition_Status**

Definition **Internal dataflow to store the value of Ignition_Status**

Attributes

Units	Range	Default	Number of Values
Hex Value	0x0, 0x1, 0x2, 0x4, 0x8, 0xF	0	6

DataFlow Value	Description
0x0	UNKNOWN
0x1	OFF
0x2	ACCESORY
0x4	RUN
0x8	START
0xF	INVALID

DataFlow Name **AVAS_PwPckTq_D_Stat**

Definition **Internal dataflow to store the value of PwPckTq_D_Stat**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-3	0	4

DataFlow Value	Description
0x0	OFF_NO_TQ

0x1	ON_NO_TQ
0x2	START_IN_PROGRESS
0x3	ON_TQ_AVAILABLE

DataFlow Name **AVAS_Spkr_Cfg**

Definition **The number of speakers supported by the AVAS's actual hardware. As of FS-KU5T-14G113-AA it can be one or two.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-1	0	2

DataFlow Value	Description
0x0	2 Speaker Configuration
0x1	1 Speaker Configuration

DataFlow Name **AVAS_State**

Definition **Indicates when module should be producing sound if the conditions are met.**

Attributes

Units	Range	Default	Number of Values
Integer Values	0-2	1	3

DataFlow Value	Description
0	INACTIVE: AVAS is not producing sound.
1	ACTIVE: AVAS is producing sound.
2	FAULT: AVAS is faulted and cannot produce sound.

DataFlow Name	**AVAS_Temp_Disable**
Definition	**Dataflow which indicates whether the AVAS module is temporarily disabled by the customer.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-1	0	2

DataFlow Value	Description
0x0	OFF: AVAS is operating normally and not temporarily disabled.
0x1	ON: Customer has temporarily disabled the AVAS manually.

DataFlow Name	**controlDTCSetting**
Definition	**0x85 Service to request ECU to suppress detection of DTCs.**

Attributes

Units	Range	Default	Number of Values
Discrete	Off, On	0	2

DataFlow Name	**DiagOutputCtrlSpeedLimit_Cfg**
Definition	**Speed limit above which SelfTest and extended diagnostic session (I/O control) stop running.**

Attributes

Units	Range	Default	Number of Values
KPH	5-255	5	250

DataFlow Value	Description

5	KPH above which SelfTest and extended diagnostic session (I/O control) stop running.

DataFlow Name **DiagResetDelay_Cfg**

Definition **Amount of time in msec to delay before resetting due to (1) Test tool request to RESET; (2) Exiting Extended Session.**

Attributes

Units	Range	Default	Number of Values
msec	0-12750	500	255

DataFlow Value	Description
500	Since various ECUs can misbehave, the request is that we use a Method 2 config to allow VO to adjust the delay.

DataFlow Name **DiagSession**

Definition **Indicates the active session of Diagnostics**

Attributes

Units	Range	Default	Number of Values
Discrete	DEFAULT, EXTEND, PROGRAM, UNKNOWN	UNKNOWN	4

DataFlow Name **DTC_Ctrl**

Definition **Used by the controlDTCSetting state machine to determine if a DTC**

should be watched or ignored.

Attributes

Units	Range	Default	Number of Values
Discrete	IGNORE, WATCH	IGNORE	2

DataFlow Name **DTCRun[].Count**

Definition **A unique 8-bit signed counter for every continuous test DTC which is incremented/decremented by a specified value based on if the failure is Present/Not_Present**

Attributes

Units	Range	Default	Number of Values
Numeric	(-128)-127	0	256

DataFlow Name **DTCRun[].Monitor**

Definition **Array to hold values of whether a DTC has reached max increment or minimum increment for continuous DTCs**

Attributes

Units	Range	Default	Number of Values
Discrete	NULL, MIN, MAX	NULL	3

DataFlow Name **DTCRun[].MonitorMax**

Definition **When this is set to MAX, a continuous DTC has reached a threshold where it must be set.**

Attributes

Units	Range	Default	Number of Values
Discrete	NULL, MIN, MAX	NULL	3

DataFlow Name **DTCRun[].MonitorMin**

Definition **When this is set to MIN, a continuous DTC has reached a threshold where it has aged to where it can be cleared.**

Attributes

Units	Range	Default	Number of Values
Discrete	NULL, MIN, MAX	NULL	3

DataFlow Name **DTCSTest[].Count**

Definition **A unique 8-bit signed counter for every self-test DTC which is incremented/decremented by a specified value based on if the failure is Present/Not_Present.**

Attributes

Units	Range	Default	Number of Values
Numeric	(-128)-127	0	256

DataFlow Name **DTCSTest[].Monitor**

Definition **Array to hold values of whether a DTC has reached a max increment or minimum increment for Self-Test (on demand) DTCs**

Attributes

Units	Range	Default	Number of Values
Discrete	NULL, MIN, MAX	NULL	3

DataFlow Name **DTCSTest[].MonitorMax**

Definition **When this is set to MAX, an on demand, self-test DTC has reached a threshold where it must be set.**

Attributes

Units	Range	Default	Number of Values
Discrete	NULL, MIN, MAX	NULL	3

DataFlow Name **DTCSTest[].MonitorMin**

Definition **When this is set to MIN, an on demand, self-test DTC has reached a threshold where it can be cleared.**

Attributes

Units	Range	Default	Number of Values
Discrete	NULL, MIN,	NULL	3

MAX

DataFlow Name **DTCSuppression_Cfg**

Definition **Array containing a representation of each DTC that may be suppressed. See the Diagnostics section of the FS for more details.**

Attributes

Units	Range	Default	Number of Values
Bitmap	00, 01, 10, 11	None	4

DataFlow Value	Description
00	Both self-test and continuous DTCs are suppressed, they cannot be set or cleared
01	Only continuous DTCs can be set and cleared, self-test DTCs are suppressed
10	Only self-test DTCs can be set and cleared, continuous DTCs are suppressed
11	Both self-test and continuous DTC can be set and cleared

DataFlow Name **GearLvrPos_Available**

Definition **This value is LOST when the GearLvrPos_D_Actl signal is lost or its value is Fault. This value is AVAILABLE when signal is present and the value is not Fault.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-1	0	2

DataFlow Value Description

0x0	LOST: GearLvrPos_D_Actl is missing or its value is Fault.
0x1	AVAILABLE: GearLvrPos_D_Actl is present and its value is not Fault.

DataFlow Name **GearLvrPos_D_Actl**

Definition **NETCOM signal indicating automatic transmission gear lever position. Obsolete and incorrect usage starting with MY2020 Gen4 HEV. This signal is in 0x230 message "TransGearData."**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-7	0	16

DataFlow Value	Description
0x0	Park
0x1	Reverse
0x2	Neutral
0x3	Drive
0x4	Sport/Drive Sport
0x5	Low
0x6	1
0x7	2
0x8	3
0x9	4
0xA	5
0xB	6
0xC	undefined
0xD	undefined
0xE	unknown position
0XF	fault

DataFlow Name **GearLvrPos_D_Actl_Signal_Received_Flag**

Definition **Dataflow that contains NULL when no GearLvrPos_D_Actl signal was received and RECEIVED when the signal was received. After checking, AVAS must set the value of this dataflow to NULL.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-1	0	2

DataFlow Value	Description
0x0	NULL: No GearLvrPos_D_Actl signal was received.
0x1	RECEIVED: A GearLvrPos_D_Actl signal was received.

DataFlow Name **GearLvrPos_Status_TimeLost_Cfg**

Definition **Time to wait when the GearLvrPos_D_Actl received flag is NULL before transitioning to LOST state.**

Attributes

Units	Range	Default	Number of Values
Milliseconds	0-5000	5000	5000

DataFlow Value	Description
5000	Delay in mSec before declaring GearLvrPos_D_Actl as lost.

DataFlow Name **GearPark_Status**

Definition **This dataflow shows whether or not the vehicle is in a state where the gear lever position is park or not. It also indicates if the state is unknown because the signal is LOST.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-2	0	3

DataFlow Value	Description
0x0	LOST: GearLvrPos_D_Actl signal is lost or is faulty and we cannot determine if the vehicle gear lever is in park.
0x1	ACTIVE: The gear lever position is in park.
0x2	INACTIVE: The gear lever position is not in park.

DataFlow Name **GearRverse_Status**

Definition **Indicates if the reverse gear is active, inactive, or lost.**

Attributes

Units	Range	Default	Number of Values
Integer Values	0-2	0	3

DataFlow Value	Description
0	LOST: The transmitter of GearRvrse_D_Actl has gone missing or is faulty and cannot be trusted.
1	INACTIVE: The gear lever position is not in Reverse.
2	ACTIVE: The gear lever position is in Reverse.

DataFlow Name **GearRverse_Status_Available**

Definition **Set the status communication of the signal indicating if reverse signal is available in system.**

Attributes

Units	Range	Default	Number of Values
Integer Values	0-1	0	2

DataFlow Value	Description
0	LOST: signal not available in the system.
1	AVAILABLE: Signal is available in the system.

DataFlow Name **GearRvrse_D_Actl**

Definition **NETCOM Signal indicating if the reversing gear is in use or not.**

Attributes

Units	Range	Default	Number of Values
Integer Values	0-7	0	8

DataFlow Value	Description
0x0	Inactive_not_confirmed
0x1	Inactive_confirmed
0x2	Active_not_confirmed
0x3	Active_confirmed
0x4	Not used
0x5	Not used
0x6	Not used
0x7	Fault

DataFlow Name **GearRvrse_D_Actl_Signal_Received_Flag**

Definition **Dataflow that contains NULL when no GearRvrse_D_Actl signal was received and RECEIVED when the signal was received. After checking, AVAS must set the value of this dataflow back to NULL.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-1	0	2

DataFlow Value	Description
0x0	NULL: No GearRvrse_D_Actl signal was received.
0x1	Received: A GearRvrse_D_Actl signal was received.

DataFlow Name **GearRvrseStatus_TimeLost_Cfg**

Definition **Time to wait when GearRvrse_D_Actl_Signal_Received_Flag remains NULL before transitioning to LOST.**

Attributes

Units	Range	Default	Number of Values
Milliseconds	0-5000	5000	5000

DataFlow Value	Description
5000	Time in mSec from when signal goes missing to wait before setting DTC when GearRvrse_D_Actl is lost.

DataFlow Name **HiOvrTime_Cfg**

Definition **Defines the amount of time to wait in a high voltage (HI_V) condition before declaring an OVER_V condition.**

Attributes

Units	Range	Default	Number of Values
Milliseconds	0-9000	500	900

DataFlow Name **HiRecovTime_Cfg**

Definition **Defines the amount of time that the voltage must be below Vmax_Cfg[i] before recovering from an OVER_V condition and allowing input**

sampling again.

Attributes

Units	Range	Default	Number of Values
Milliseconds	0-6000	2000	600

DataFlow Name **HiTime_Cfg**

Definition **After Vbatt pops high, this is the minimum amount of time normal voltage must be present before allowing inputs to be read again (return to NORM_V). This value must be based on worst-case analysis of the slowest circuit that uses this voltage range.**

Attributes

Units	Range	Default	Number of Values
Milliseconds	0-2000	55	400

DataFlow Name **Ignition_Status**

Definition **Indicates current ignition. This signal is in 0x3B3 message "BodyInfo_3"**

Attributes

Units	Range	Default	Number of Values
Integer Values	0-F	0	6

DataFlow Value	Description
0x0	UNKNOWN
0x1	OFF
0x2	ACCESORY

0x4	RUN
0x8	START
0xF	INVALID

DataFlow Name **Ignition_Status_Available**

Definition **Indicates whether the Ignition_Status signal is lost or available.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-1	0	2

DataFlow Value	Description
0x0	LOST: The Ignition_Status signal was lost or is INVALID or UNKNOWN. AVAS cannot determine the state of the ignition status.
0x1	AVAILABLE: The Ignition_Status signal was received and is not INVALID or UNKNOWN. AVAS can determine the state of the ignition status.

DataFlow Name **Ignition_Status_Signal_Received_Flag**

Definition **Dataflow that contains NULL when no Ignition_Status signal was received and RECEIVED when the signal was received. After checking, AVAS must set the value of this dataflow to NULL.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-1	0	2

DataFlow Value	Description
0x0	NULL: No Ignition_Status signal was received.

0x1	RECEIVED: The Ignition_Status signal was received.

DataFlow Name **InvalidDataTime_Cfg**

Definition **Delay in milliseconds to wait when receiving faulty or invalid data before setting an Invalid Data DTC.**

Attributes

Units	Range	Default	Number of Values
Milliseconds	0-5000	2100	50

DataFlow Value	Description
2100	Delay in milliseconds to wait when receiving faulty or invalid data before setting an Invalid Data DTC.

DataFlow Name **Ignition_Status_TimeLost_Cfg**

Definition **Time to wait when Ignition Status received flag is NULL before transitioning to lost state.**

Attributes

Units	Range	Default	Number of Values
Milliseconds	0-5000	5000	5000

DataFlow Value	Description
5000	Delay in mSec before declaring Ignition_Status signal as lost.

DataFlow Name **LoOvrTime_Cfg**

Definition **Defines the amount of time to wait in a low voltage (LO_V) condition before declaring an UNDER_V condition.**

Attributes

Units	Range	Default	Number of Values
Milliseconds	0-6000	See FS	600

DataFlow Name **LoRecovTime_Cfg**

Definition **Defines the amount of time that the voltage must be above Vmin_Cfg[i] before recovering from an UNDER_V condition and allowing input sampling again.**

Attributes

Units	Range	Default	Number of Values
Milliseconds	0-6000	1000	600

DataFlow Name **LoTime_Cfg**

Definition **After Vbatt dips low, this is the minimum amount of time normal voltage must be present before allowing inputs to be read again (return to NORM_V). This value must be set based on worst-case analysis of the slowest circuit that uses this Voltage Range.**

Attributes

Units	Range	Default	Number of Values
Milliseconds	0-2000	15	400

DataFlow Name **LowVoltTimer_Cfg**

Definition **Duration that AVAS will wait when it detects voltage as under voltage before it sets a DTC to report the undervoltage event.**

Attributes

Units	Range	Default	Number of Values
Milliseconds	0-10000	10000	10

DataFlow Value	Description
10000	Delay in mSec before reporting an undervoltage DTC when first detecting an undervoltage event.

DataFlow Name **Max_Speed_Sound_Cfg**

Definition **Indicates the MAX speed above which the AVAS ECU will not produce sound.**

Attributes

Units	Range	Default	Number of Values
KPH	0-655.35	655	

DataFlow Value	Description
0-655.35	Max Speed to play sounds in KPH

DataFlow Name **MediumLostTime_Cfg**

Definition **The medium time duration for detecting a missing CAN signal.**

Attributes

Units	Range	Default	Number of Values
Milliseconds	1000	1000	1

DataFlow Value Description

1000	The medium time duration in milliseconds for detecting a missing CAN signal.

DataFlow Name **PdstrnAlrt_B_Falt**

Definition **Module's NETCOM TX signal that indicates current status of the module. This signal indicates if the module is working OK. "Yes" indicates module is in failure mode.**

Attributes

Units	Range	Default	Number of Values
Integer Values	0-1	0	2

DataFlow Value	Description
0x0	"NO" Module is working okay and not faulted.
0x1	"YES" Module is not working okay and is in failure mode.

DataFlow Name **PIDClear_Time_Cfg**

Definition **Time interval for clearing all PIDCtrl Signals in DEFAULT Session**

Attributes

Units	Range	Default	Number of Values
Seconds	1-5	5	5

DataFlow Name **PwPckTq_D_Stat**

Definition **NETCOM Signal that indicates power pack is in a motive (wheel torque producing) or non-motive (non-wheel torque producing) mode. This**

signal is included in message 0x167 "VehicleOperatingModes."

Attributes

Units	Range	Default	Number of Values
Integer Values	0-3	0	4

DataFlow Value	Description
0x0	PwPckOff_TqNotAvailable
0x1	PwPckOn_TqNotAvailable
0x2	PwPckStrInProg_Tq_NotAvail
0x3	PwPckOnTqAvailable

DataFlow Name **PwPckTq_D_Stat_Signal_Received_Flag**

Definition **Dataflow that contains NULL when no PwPckTq_D_Stat signal was received and RECEIVED when the signal was received. After checking, AVAS must set the dataflow to NULL.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-1	0	2

DataFlow Value	Description
0x0	NULL: No PwPckTq_D_Stat signal was received.
0x1	RECEIVED: PwPckTq_D_Stat signal was received.

DataFlow Name **PwPckTq_D_Stat_TimeLost_Cfg**

Definition **Time to wait when PwPckTq_D_Stat received flag is NJLL before transitioning to lost state.**

Attributes

Units	Range	Default	Number of Values
Milliseconds	0-5000	5000	5000

DataFlow Value	Description
5000	Delay in mSec before declaring PwPckTq_D_Stat signal as lost.

DataFlow Name **PwPckTq_Status_Available**

Definition **Indicates whether the PwPckTq_D_Stat signal is lost or available.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-1	0	2

DataFlow Value	Description
0x0	LOST: The PwPckTq_D_Stat signal is lost. AVAS cannot determine the state of torque.
0x1	AVAILABLE: The PqPckTq_D_Stat signal is available and AVAS can determine the state of torque.

DataFlow Name **SlowLostTime_Cfg**

Definition **The slow time duration for detecting a missing CAN signal.**

Attributes

Units	Range	Default	Number of Values
Milliseconds	5000	5000	1

DataFlow Value	Description
5000	The slow time duration for detecting a missing CAN signal.

DataFlow Name **Speaker_OnOff_Cfg**

Definition **This configuration indicates if the module should work with a local switch to allow the user to turn On or OFF the sound of the module.**

Attributes

Units	Range	Default	Number of Values
Integer Values	0-1	0	2

DataFlow Value	Description
0x0	Disable Switch
0x1	Enable Switch

DataFlow Name **TesterPhysicalResPACM**

Definition **NETCOM Tx to cluster. Indicates AVAS module status.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-4	0	

DataFlow Value	Description
0-655.35	Vehicle Speed as reported over CAN

DataFlow Name **Trans_Signal_Status**

Definition **Combined status of GearRverse_Status and GearPark_Status.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-2	0	3

DataFlow Value	Description
0x0	LOST: Either GearRvrse_Status or GearPark_Status is lost.
0x1	INACTIVE: GearRvrse_Status is inactive. GearPark_Status is not lost.
0x2	ACTIVE: GearRvrse_Status is active. GearPark_Status is not lost.

DataFlow Name **TransitionDelayCfg**

Definition **Delay in mSec before transitioning from playing sound in the front speaker to playing sound in the rear speaker and vice versa.**

Attributes

Units	Range	Default	Number of Values
Milliseconds	0-1000	500	101

DataFlow Value	Description
500	Delay in mSec before transitioning from playing sound in the front speaker to playing sound in the rear speaker and vice versa.

DataFlow Name **VBattRaw**

Definition **Measured and calculated voltage for Battery Source in Voltage Range Monitor**

Attributes

Units	Range	Default	Number of Values
Volts	0-25.2	12.5	252

DataFlow Name **VBattState**

Definition **Array indicating current state of a specific voltage range.**

Attributes

Units	Range	Default	Number of Values
Discrete	OVER_V to UNDER_V	NORM_V	5

DataFlow Value	Description
HI_V	Temporary High Voltage
LO_V	Temporary Low Voltage
NORM_V	Normal Voltage
OVER_V	Too high too long, Over Voltage
UNDER_V	Too low too long, Under Voltage

DataFlow Name **Veh_V_ActlEng**

Definition **Indicates vehicle speed. This signal is included in message 0x202 "EngVehicleSpThrottle."**

Attributes

Units	Range	Default	Number of Values
KPH	0-655.35	0	

DataFlow Value	Description
0-655.35	KPH

DataFlow Name **Veh_V_ActlEng_Signal_Received_Flag**

Definition **Dataflow that contains NULL when no Veh_V_ActlEng signals was received and RECEIVED when the signal was received. After checking, AVAS must set this dataflow back to NULL.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-1	0	2

DataFlow Value	Description
0x0	NULL: No Veh_V_ActlEng signal was received.
0x1	RECEIVED: No Veh_V_ActlEng signal was received.

DataFlow Name **Vehicle_Mode**

Definition **Indicates the current state of the vehicle, this state is the result of evaluating powerpack and ignition status.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-4	3	7

DataFlow Value	Description
0x0	ACCESORY
0x1	DIAGNOSTIC MODE
0x2	CRANKING
0x3	IGNITION OFF
0x4	POWERPACK ON
0x5	GEAR PARK
0x6	VEHICLE MODE LOST

DataFlow Name **Vehicle_Speed**

Definition **The speed of the vehicle as reported by the PCM/ECM over CAN in KPH, Veh_V_ActlEng * VehicleSpeedMultiplier**

Attributes

Units	Range	Default	Number of Values
KPH	0-655.35	0	0

DataFlow Value	Description
0-655.35	The speed of the vehicle as reported by the PCM/ECM over CAN in KPH, Veh_V_ActlEng * VehicleSpeedMultiplier

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DataFlow Name **Vehicle_Speed_Available**

Definition **Set the status communication of the signal indicating if the vehicle speed signal is available in the system.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-1	0	2

DataFlow Value	Description
0	LOST: The Vehicle Speed signal is unavailable.
1	AVAILABLE: The Vehicle Speed signal is available and not faulty.

DataFlow Name **Vehicle_Speed_TimeLost_Cfg**

Definition **Time to wait when the Veh_V_ActlEng_Signal_Received_Flag is NULL before declaring the signal as lost.**

Attributes

Units	Range	Default	Number of Values
Milliseconds	0-5000	500	5000

DataFlow Value	Description
500	Delay in mSec before declaring Veh_V_ActlEng signal as lost.

DataFlow Name **Vehicle_Type_Cfg**

Definition **Indicates the brand name of the vehicle.**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-1	0	2

DataFlow Value	Description
0x0	FORD
0x1	LINCOLN

DataFlow Name **VehicleSpeedMultiplier**

Definition **The value to multiply Veh_V_ActlEng by to get vehicle speed in KPH.**

Attributes

Units	Range	Default	Number of Values
Double Value	.01-.01	0.01	1

DataFlow Value	Description
0.01	The value to multiply Veh_V_ActlEng by to get vehicle speed in KPH.

DataFlow Name **VehVActlEng_D_Qf**

Definition **Quality factor for NETCOM signal Veh_V_ActlEng**

Attributes

Units	Range	Default	Number of Values
Integer Value	0-3	1	4

DataFlow Value	Description
0x0	Faulty
0x1	No data exists
0x2	Not within specifications
0x3	OK

DataFlow Name **Vmax_Cfg**

Definition **Defines maximum voltage for a voltage range. Suppliers will perform a worst case analysis of the circuits and supply updated values for the data dictionary to be included in subsequent builds and verification and validation testing.**

Attributes

Units	Range	Default	Number of Values
Numeric	0-25.2	See FS	252

DataFlow Name **VMaxRcv_Cfg**

Definition **Defines Voltage Hysteresis for recovering from the OVER_V state. Suppliers will perform a worst case analysis of the circuits and supply updated values for the data dictionary to be included in subsequent builds and verification and validation testing.**

Attributes

Units	Range	Default	Number of Values
Numeric	0-25.2	See FS	252

DataFlow Name **Vmin_Cfg**

Definition **Defines minimum voltage for a voltage range. Suppliers will perform a worst case analysis of the circuits and supply updated values for the data dictionary to be included in subsequent builds and verification and validation testing.**

Attributes

Units	Range	Default	Number of Values
Numeric	0-25.2	See FS	252

DataFlow Name **VMinRcv_Cfg**

Definition **Defines Voltage Hysteresis for recovering from the UNDER_V state. Suppliers will perform a worst case analysis of the circuits and supply updated values for the data dictionary to be included in subsequent builds and verification and validation testing.**

Attributes

Units	Range	Default	Number of Values
Numeric	0-25.2	See FS	252

DataFlow Name **VoltBelowThresholdDelayCfg**

Definition **The time to wait before setting an undervoltage DTC.**

Attributes

Units	Range	Default	Number of Values
Seconds	0-15	10	15

DataFlow Value	Description
10	The delay in seconds to wait before setting an undervoltage DTC once an undervoltage event has been detected.

2.14 REVISION HISTORY

2.14.1 Version 2.0 (Author: Peter Sripinyo 7/30/2019) FS-ML3T-14G113-AB

DATE	SUMMARY OF CHANGES	CREATOR/REVIEWER
	Initial Release Change sound range from 0 to 50kph to 0 to 655 kph **2.8 Generate AVAS Output** updated with new NVH requirements **2.8.3 Signal Generation Block Requirements** section added **2.8.4 Filter Block Requirements** section added **2.8.5 One Speaker Systems versus Multi-Speaker System** subsection number change **2.8.6 AVAS Output Timing Requirements** section added requirements from 1.6.3 Added missing values to Vehicle Mode dataflow as per Supplier input **2.10.8.6 DTC Definitions** add continuous DTCs/timing for faults	Peter Sripinyo
7/31/2019	**Release AB (Version 2.0)** **2.10.8** Self-Test DTCs labeled as continuous changed to Self-test/Null (issue 21) **2.0** OTA functionality for GEN III AVAS_PACM (issue 23) **2.10.8.7** Change DTC Max action for Lost Comms to 4 seconds (issue 25) **2.0, Data Dictionary** Add invalid Data from DTC for PCM/ECM (issue 26) **2.7 Determine AVAS State** Add check for gear position PARK	Peter Sripinyo