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## SOFTWARE SPECIFICATION BLUE BIRD CLUSTER

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## 1. DOCUMENT REVISION HISTORY

Section	Document Revision	Changed by	Change description	Reason
Document header	6	A. Beltrán	Document identifier updated	Document number field in the header was missed in previous document versions
3.1	6	A. Beltrán	Part numbers updated	New part numbers were defined to handled common configurations.
3.4.1.2	6	A. Beltrán	Updated information on bulb test associated parameters.	It was incorrect to say that setting 0 into EE_TIME_OUT_BULB parameter would disable bulb test. Accurate description was needed.
3.4.1.3	6	A. Beltrán	Section title changed from Audible Alarm to Speaker Test	The purpose of the sounds generated during start up is to test the speaker. New title is more descriptive.
5.14	6	A. Beltrán	Wait to Start activation condition changed to J1939 message independently of the configured engine.	BB request
6.1	6	A. Beltrán	Audible alarm associated to Wait to Start was removed Low fuel level audible alarm changed from continuous to single.	BB request
6.1.12	6	A. Beltrán	Section 6.1.12 corresponded to Wait to Start, it was removed then all labels were updated from that point	Audible alarm associated to Wait to start was removed
6.1.14	6	A. Beltrán	Description of the alarm activation has been updated	Changes to sound duration required a brief explanation.
6.1.17	6	A. Beltrán	Headlamps On reminder alarm added	BB request
9.2.1	6	A. Beltrán	Added park brake switch status to the data transmitted in CCVS message	BB request
9.2.3	6	A. Beltrán	Added ABS active input status to the data transmitted in EBC1 message	BB request
9. 2.5	6	A. Beltrán	Added WFI message to the messages periodically transmitted by the cluster on J1939 data link	BB request
Figure 3, Figure 6, Figure 7	6	A. Beltrán	Ammeter and Transmission oil temperature icons improved following BB recommendations.	BB request
5.20	05	A. Beltrán	WIF telltale removed	Water in fuel telltale changed to the status window per customer request
7.1.5	05	A. Beltrán	Table 6. One row added: Water in Fuel	Customer decided not to include the WIF telltale as a lamp. The WIF indicator will be displayed in the

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				status window.
7.1.5.6	05	A. Beltrán	WIF section added	Water in fuel indicator added to the status window per customer request
7.1.5.1	05	A. Beltrán	Logic to set/clear Cruise control indicator updated	Set CC indicator only if the status from the Engine confirms the CC was set; in this way the displayed information is more accurate.
7.2	05	A. Beltrán	Figure 7 updated to include hour meter option	Hour meter option added to "Time / distance" menu
7.2.3.5	05	A. Beltrán	Hour meter section added per customer request	Customer indicated that hour meter was a required function.
3.4.3.1	05	A. Beltrán	Table 3. Park lamps changed to Backlight signal	Park lamps digital input is not available to the cluster anymore; to wake up the cluster the dimmer signal will be used
9.2.1	05	A. Beltrán	Message contents updated. Cruise control related fields that are not associated to the inputs monitored by the cluster are set to Off (00)	Engine requires some fields set to Off for CC proper operation.
9.2.4	05	A. Beltrán	Section added. PGN 59904 is needed to request vehicle hours information	Hour meter information is obtained from s message that is transmitted by request.
9.4.9	05	A. Beltrán	Cruise control states description added	Cruise control states are monitored to determine CC indicator status
9.4.15	05	A. Beltrán	Section added. PGN 65253 contains Total engine hours. The information is displayed in the hour meter option	Hour meter information is obtained from Hours message SPN Total engine hours
-	04	A. Beltrán	Additions and changes to comply with customer requirements for 2007 Engines.	Changes to the document to act in accordance with 2007 Engines
3	04	A. Beltrán	Reference to SAE J1939-73 added	DM13 is described in SAE J1939-73
5.14	04	A. Beltrán	Wait to start activation conditions updated to take into consideration configured engine	Change requested by the customer to handle the telltale using the digital input or the status received via CAN
5.18.3	04	A. Beltrán	Section added to the Service Engine Telltale	Add "Idle Shutdown Driver Alert" as another condition that activates the Service Engine telltale
7.1.5	04	A. Beltrán	Table 6. Two rows added: regenerate and exhaust high temperature	Customer added 2 more telltales in the display
7.1.5.3.	04	A. Beltrán	Section added	Regenerate indicator added to the status window per customer request
7.1.5.4.	04	A. Beltrán	Section added	Exhaust high temperature indicator added to the status window per customer request
9.4.13	04	A. Beltrán	PGN 65252 added	Customer requested processing SPN 594 transmitted in PGN 65252 (Shutdown) to activate service engine telltale

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9.4.14	04	A. Beltrán	PGN 64892 added	Customer requested processing SPN 3697 and 3698 transmitted in PGN 64892 to activate emissions related indicators
5.20	03	A. Beltrán	WIF telltale added	Water in fuel telltale added per customer request
9.4.12	03	A. Beltrán	PGN 57088 (DM13) added	Customer requested that the cluster processes DM13 message (Stop Start Broadcast PG)
7.3	03	A. Beltrán	Figure 8. Fault Diagnostics menu updated	ECU list changed to have the same menu for 8 and 6 gauges versions
7.3.2.5	02	A. Beltrán	Table 12. ABS input added	Configurable parameter added
7.3.2.5	02	A. Beltrán	Table 12. Brake interlock and Stop Light Inhibit parameters description updated	Previous description was not accurate.
5.16	02	A. Beltrán	Commentary added for combinations not included in the tables for the service brake telltale	Make clear the status of the service brake telltale for combinations that were not consider.
7.1.6.3	02	A. Beltrán	Low Air pressure alarm added	Missed alarm.
9.4.5	02	A. Beltrán	PGN number in decimal changed and Fuel rate description added	Fix to the correct PGN number in decimal. Missed SPN added
All	01	A. Beltrán	Document name changed from "1213_001-274456 06 Software Specification Blue Bird Vision cluster" to "050-274568 01 Software Specification BB Vision cluster" to follow TED naming standards	Initial document name was defined using SRE nomenclature
8.3.1	01	A. Beltrán	Added description for Display settings menu options	Clarify the purpose of each option in this menu
8.1.3	01	A. Beltrán	Added description for the maximum odometer reached condition.	It was not clear what would happen when the odometer reaches the maximum value that can be displayed
7.2.3.2	01	A. Beltrán	Added range and rollover description for trip odometer	Indicate trip odometer operation characteristics
7.3.2.2	01	A. Beltrán	Section added	Describe Selftest option
7.3.2.3	01	A. Beltrán	Section added	Describe Part Number option
6.18	06	A. Beltrán	Clarified that sections 6.18.x correspond to the conditions that activate the stop lamp.	It was not obvious that conditions in sections 6.18.x cause the stop lamp to be turned ON.
8	06	A. Beltrán	Changed "escape" key to "select" key to change from default driving mode to interactive driving mode	Interface consistency verification
8.1.4	06	A. Beltrán	Favorite window contents description revised	It was not clear the information to be displayed in this window
8.1.5	06	A. Beltrán	Added Electronic Traction Control as one of the reported conditions in the status window	Customer request
8.2.1.1 Table 8 9.1	06	A. Beltrán	Requirements associated to EE_MANUAL_TRANSMISSION parameter were removed including the parameter itself.	Customer informed that manual transmission models are not available anymore
8.3	06	C. García	Figure 8 updated to show correct path access for configuration, part number and password options in the Non-driving mode	Have correct menu structure



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8.3.2 9	06	C. García	EEPROM parameters added EE_AMMETER_ENABLE and EE_AIR_SUSP_GAUGE_ENABLE	Parameters needed to save configuration information
4.3.2	06	A. Beltrán	"Error" and "Not available" status removed from the list of status that can be reported for cruise control inputs	All digital inputs are read either as on or off then just 2 status can be reported
8.1.6.3	06	A. Beltrán	Correct PGN that contains amber lamp status that generates the condition "Engine Maintenance"	EFL1 (PGN 65263) was referred as amber lamp status source, correct value is DM1 (PGN 65226)
8.1.6.4 10.5	06	A. Beltrán	Inconsistent use of "No J1939 data bus" and "J1939 data bus failure" messages to indicate that a communication problem was detected. Message changed to "J1939 comm. Failure"	Consistency verification
8.1.6.4	06	A. Beltrán	Detailed the conditions that generate the error "J1939 comm. Failure"	Requirement has been narrowed with the customer and detailed.
11 Appendix A	06	C. García	Menu charts updated	Charts updated to match information in DID section
8.5	06	A. Beltrán	User interface using the stalk switches clarified while input diagnostics is accessed	Screen navigation was not clear for input diagnostics option
8	06	C. García	References to Default driving mode, Interactive driving mode and Non-driving mode verified for consistency	Screen and mode used inconsistently through the document
8	06	A. Beltrán	Added timeout association to EEPROM parameters: EE_DRIVING_M_TIMEOUT and EE_NON_DRIVING_M_TIMEOUT	Parameters existed in the list of Manufacturer Parameters but they were not referenced
8.2.1.4 Figure 7	06	C. García	Front and rear air application pressure gauges will be displayed in the same window	Improve user interface showing related information in the same window
8.2.1.4	06	C. García	Added reference to configuration parameter associated to this function.	Clarify that air application gauges will be displayed according to the cluster type parameter (8 gauges only)
9.2.25	06	C. García	Section added	Parameter was referred but not listed in the Manufacturer Parameters
9.2.26	06	C. García	Section added	Parameter was referred but not listed in the Manufacturer Parameters
9.2.27	06	C. García	Section added	Parameter was referred but not listed in the Manufacturer Parameters
Table 8	06	C. García	Added description of the actions that are enabled/disabled with the EE_SELFTEST configuration parameter	Actions included in the self test were not described anywhere in the document
Table 8	06	A. Beltrán	EE_TEST_PANEL parameter scope clarified	Before it was not explicitly indicated that EE_TEST_PANEL has precedence over EE_CLUSTER_TYPE
Table 8	06	A. Beltrán	EE_FUEL_100_US_GALLONS parameter added	This information is needed to calculate distance to empty, it can not have a fixed value because 2 options are possible in the buses that will include this cluster
4.1	06	C. García	Section added	Document part numbers and associated cluster version
4.4.4	06	C. García	Added a timeout to return to sleep mode from	It was not defined what



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			"Limited Functionality Mode"	would happen after entering "limited functionality mode"
8.2.1.3	06	A. Beltrán	Added explanation that the same analog input is used to read Front Air Application pressure and Hydraulic air pressure	Avoid confusion when analog inputs map is revised
Table 10	06	A. Beltrán	Navigation buttons removed from digital inputs to be diagnosed	Navigation buttons status can not be displayed since they affect the selected screen
Table 12	06	C. García	Table completed, TBD resolved	Table had incomplete information
9.2	06	A. Beltrán	Removed 2 EE parameters associated to conditions that were previously removed from the display: EE_CHECK_TRANS_WARNING_TYPE, EE_HIGH_OIL_TRANS_TEMP_WARNING_TY PE, EE_HYDRAULIC_OIL_TEMP_TYPE	Remove information that is not used.
9.2	06	A. Beltrán	Removed EE parameter EE_TURN_SIGNAL_WARNING_TYPE	Parameter purpose was duplicated.
8.3.4	06	A. Beltrán	Mechanic and Owner password levels removed. Now just one password is defined to enable protected options and disable the timeout..	All protected functions are diagnostic oriented and defining 2 passwords had no practical use.
8.13	05	C. García	Odometer saving rate to EEPROM was increased to every 0.5 mile	Customer required
8	05	C. García	A shorter timeout to return to default screen when the vehicle is moving has been added	Since no manual way to return to defaults screen is provided a shorter timeout was agreed.
11 Appendix A	05	C. García	Menu charts updated	Charts didn't correspond to menu structure as described in DID section
8.4	04	C. García	Table background changed	Document cosmetics
8.1.6	03	A. Beltrán	Check transmission, High oil transmission temperature and Hydraulic Oil Temperature High indicators were moved from the DID to a dedicated telltale	Change requested by Bluebird
10.2	03	C. García	Corrections to CAN messages information	Source address and transmission rate were missed for some PGNS
All	02	A. Beltrán	Table 12 updated caption, added ABS state	
7.2.2.2	02	E. Zepeda	Removed Trip Fuel Used.	Messages missing from CAT and Cummings Engine through J1708 to calculate it.



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## 2. INTRODUCTION

This document describes the application software in the **BLUE BIRD VISION CLUSTER**.

The product is assembled in 2 versions: 6 gauges and 8 gauges; the version also relates to the brake system that will be installed in the vehicle: hydraulic and air respectively.

There are 2 microcontrollers in the product. One is referred, thorough this document, as “main processor” powered by the “main power supply” and is responsible of the execution of the application software; the other is the “slave processor” and is used to monitor wake up inputs during sleep mode.

## 3. RELEVANT DOCUMENTS

The appendices and documents listed below are of essential value for the understanding of this document.

Document

Ref. Document no./Title

[1] Blue bird Vision TR issued by Stoneridge-EPD Dec 9/2005

[2] C7 & C9 Truck Engines 2004 Model Year. Electrical and Electronic Application and Installation Guide, issue by Caterpillar

[3] SAE J1939-71 Issued 1994-08; Revised 2004-12

[4] SAE J1939-73 Issued 1996-02; Revised 2001-06

[5] “Flash tool user manual” by Stoneridge-EPD (release pending)

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## GENERAL

### 3.1. Cluster Versions

The Blue-Bird Vision Cluster has 16 different variations based on the following configurable options:

- 6/8 gauges (hydraulic / air brake system)
- Ammeter available or not available
- Engine type: CAT or Cummings
- Metric or English units

“Options - Part numbers” cross reference is included in the following table:

Generic Model	Cat no amp gauge	Cat w/amp gauge	Cummins no amp Gauge	Cummins W/amp Gauge
<b>8 Gauge (E)</b>				
<b>BBC Part Number</b>	<b>0102937</b>	<b>0108672</b>	<b>0108673</b>	<b>0108674</b>
<b>8 Gauge (M)</b>				
<b>BBC Part Number</b>	<b>0102939</b>	<b>0108684</b>	<b>0108685</b>	<b>0108686</b>
<b>6 Gauge (E)</b>				
<b>BBC Part Number</b>	<b>0102938</b>	<b>0108679</b>	<b>0108682</b>	<b>0108683</b>
<b>6 Gauge (M)</b>				
<b>BBC Part Number</b>	<b>0102940</b>	<b>0108687</b>	<b>0108688</b>	<b>0108689</b>

#### Options – Part numbers cross reference

The cluster identifies its version using Manufacturer parameter EE\_CLUSTER\_TYPE described in Section 8.2.21. This parameter selects between 6 or 8 gauges (and hence, between Air and Hydraulic Brake Systems). Gauge scales are equivalent in Metric and English units, for this reason there is no need to configure the software for this variant.



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### 3.2. Backlighting

The PWM dimmer for panel illumination feeds into the gauge package so that the gauge components can match the dimming of other panel components. The gauge package interprets this input, received in the form of an analog input, as indicated in the table below.

Dimmer Input	Gauge Backlight
10%	Min
11-100% Ignition V	Linearly go from min to max brightness

**Table 1: Dimmer ranges**

### Voltage Conversion Table

% DUTY CYCLE (FREQ 302Hz)	VOLTAGE @BATTERY (Volts)	VOLTAGE @ANALOG INPUT P5.5 (mv)
25	10	80
50	10	150
75	10	220
100	10	300
25	12	90
50	12	180
75	12	260
100	12	350
25	14	100
50	14	200
75	14	300
100	14	400
25	16	120
50	16	240
75	16	350
100	16	480

**Table 2: PWM Voltage Conversion**

### 3.3. Binary IO

#### 3.3.1. Speed Detect

The Speed Detect output on the CPU shall be high when vehicle speed > 1 MPH and engine speed > 500 RPM conditions are present.

#### 3.3.2. Cruise Control

The cluster will have three digital inputs for the Cruise Control functions. The status of these inputs will be broadcasted periodically as defined in J1939 PGN 65,265 (CCVS).

The three inputs for the Cruise Control are the following:



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- On
- Set
- Resume

The On and Off status will be reported on the CCVS bit fields “Cruise Control Enable Switch”, “Cruise Control Set Switch” and “Cruise Control Resume”, SPNs 596, 599 and 601 respectively.

<b>Bit States Switch State</b>	
00	Off/Disabled
01	On

### 3.3.3. Lift Authorization

The purpose of this function is to authorize the lift of the bus, when the appropriate conditions have been met. The role of the cluster on this activity can be classified as a supervisor, as it will not control the actual door or lift, but rather provide a digital output which will indicate when the conditions have been met to use the lift.

The following digital inputs are evaluated:

- Ignition Switch
- Park Brake
- Door Open
- Lift Not Stowed

Signals evaluated received via J1939:

- ETC#2 (PGN61445) – Current Gear

Digital output controlled:

- Lift Authorization Output, which will provide the Authorized/No Authorized status.

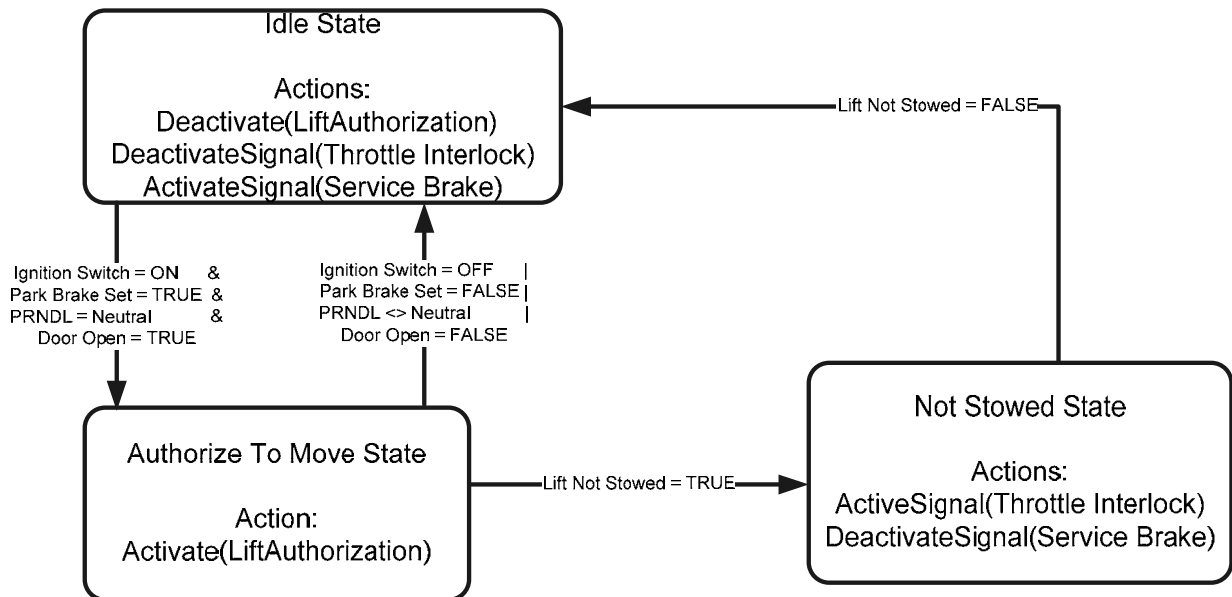
Signals transmitted via J1939 messages that are affected by this function:

- *Throttle Interlock* [PGN: 61441-Accelerator Interlock switch for Cummings engine or PGN 65264-Engine PTO enable switch for CAT engines]
- *Service Break* [PGN: 65265-Brake switch]

Figure 1 depicts the state machine that controls such supervision activity.

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**Figure 1: Lift Authorization State Machine**

The default state of the Lift Authorization Output is deactivated (not authorized) or also known as the *Idle State*. Such state must be preserved until the conditions are met to authorize the lift.

Such conditions are:

- *Ignition Switch* should be ON,
- *Park Brake* should be Set,
- *PRNDL* should be in Neutral and
- The *Door Open* digital input must be active.

When all these conditions are met, the *Lift Authorization Output* goes active (authorizing the lift). Once this state is reached the logic will be waiting for the digital input *Lift Not Stowed* to go active. In the meanwhile if any of the four conditions is unset (e.g. *Ignition Switch* goes to OFF) the *Lift Authorization Output* is disabled and the state machine returns to the *Idle State*. However, if the *Lift Not Stowed* is set in the *Authorize To Move State*, then the *Lift Authorization Output* will be latched, and the state machine will be in the *Not Stowed State*, as is shown in Figure 1 two signals are set once this state is reached: *Throttle Interlock* [PGN: 61441-Accelerator Interlock switch for Cummings engine; PGN 65264-Engine PTO enable switch for CAT engine] and *Service Break* [PGN: 65265-Brake switch] over J1939. At this point only one condition can return the state machine to the *Idle State*. Such condition is: *Lift Not Stowed* is not set.

### 3.3.4. PTO – High Idle

The cluster will have one digital input labeled PTO/ High Idle. The status of this input will be broadcasted periodically as the SPN: “Engine PTO enable switch” in J1939 PGN 65,264 (PTO).

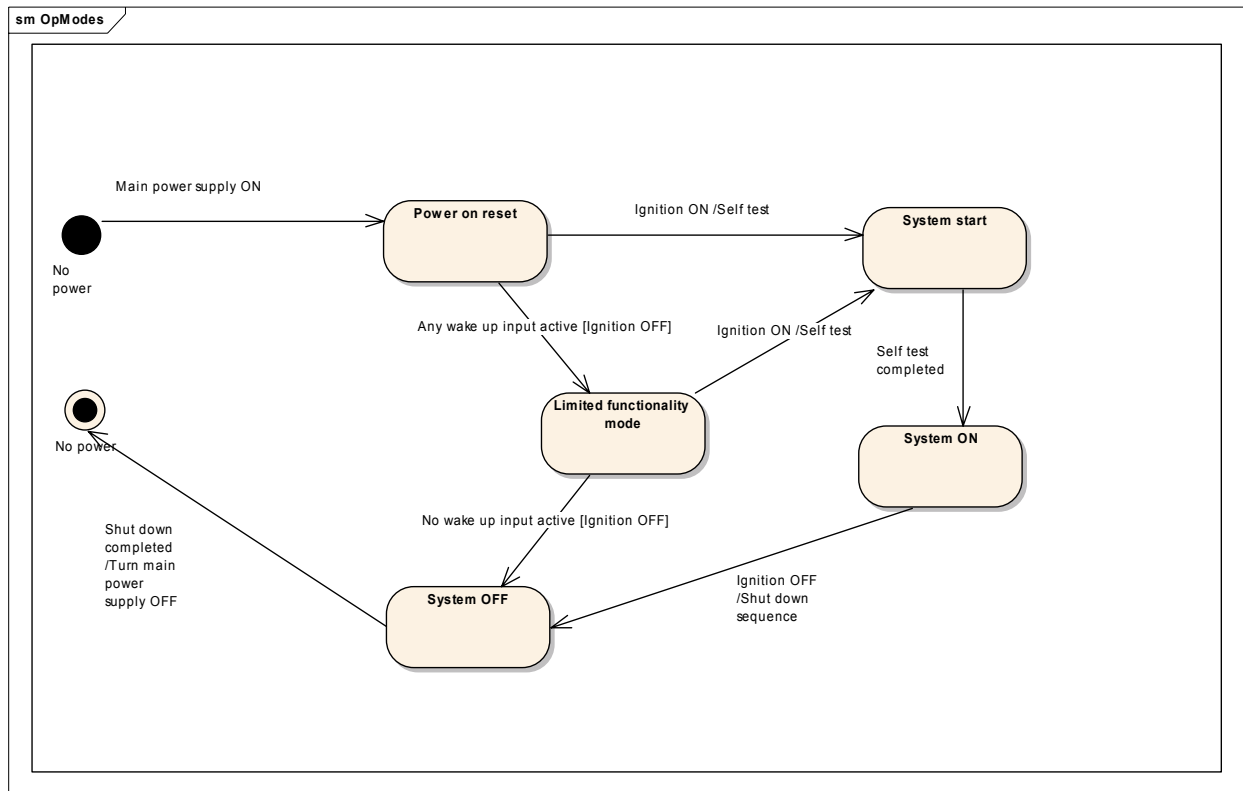
When a CAT engine is present SPN “Engine Remote PTO Preprogrammed Speed Control Switch” (referred as “PTO set speed input A” in [2]) will also be set when the PTO/High Idle digital input is active.

## 3.4. System states

The following state chart presents software operation modes and how the transition between them occurs.

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**Figure 2: System States**

### 3.4.1. System Start

#### 3.4.1.1. Gauges

At key on a gauge sweep from zero position to max position and back to min position will be executed.

#### 3.4.1.2. Bulb Test

At key on all warning lights will turn on for EE configurable number of seconds (EE\_TIME\_OUT\_BULB) and then turn off. This function is called "Bulb\_Test". If the EE parameter is set to 0 it is equivalent to set it to 1. To disable the bulb test it is necessary to disable the start up self test that includes pointer sweep, speaker and bulb test. Startup self test is enabled or disabled using the EE parameter EE\_SELFTEST.

Active warning lights will turn on after the Bulb\_Test is completed.

#### 3.4.1.3. Speaker Test

Two different tones will be generated for one second each.

### 3.4.2. System ON

With ignition ON, the cluster is fully operative: gauges, telltales and DID respond, as described in this document, to events and information generated in the vehicle.

Once startup is completed the display will show the default screen (see Figure 6: Default Driving Mode). For a complete description of the available options refer to the Driver Information Display (DID) section.



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### 3.4.3. System Off

When the ignition line goes low the micro shall zero ( $-90^\circ \pm 3^\circ$ ) all gauges, except the fuel gauge, and store the current odometer value in EEPROM before power off the main processor.

#### 3.4.3.1. Sleep Mode

This is not an operation mode for the main processor; it applies just to the slave processor.

When the system is in Sleep Mode the main power supply and the main cluster processor are OFF while the slave processor monitors the wakeup inputs.

Wake up inputs
Hazard (Left & Right turn signals at the same time)
Backlight signal (pwm duty cycle $\geq 10\%$ )
Select key
Ignition ON

**Table 3: Wakeup Inputs**

The system exits the Sleep mode when one of the wakeup inputs becomes active and the slave processor turns ON the main power supply which in turn activates the main processor.

### 3.4.4. Limited functionality Mode

When the cluster is waken up it can either enter "System start" mode, if ignition is ON, or "Limited functionality" mode if ignition is OFF. (Refer to Table 3 for inputs that can wake up the unit while in sleep mode)

In "Limited functionality" mode available functions of the cluster are restricted to:

- Hazard lights activation (right and left turn signals)
- Backlighting
- Odometer Reading

If unit enters Limited functionality Mode, the unit will return to the Sleep Mode after 30 seconds of no-activity in the wake-up inputs described in Table 3.

### 3.5. Reprogram capability.

Application software running in the cluster can be reprogrammed via the CAN bus. The procedure is started using J1939 DM14 transmitted from the Flash tool. For more details refer to the Flash tool manual.

## 4. GAUGES

### 4.1. Speedometer

The speedometer is a standard gauge used to display road speed. The speedometer data source will be J1939 Wheel-based Vehicle Speed in PGN65265 (0xFEf1).

### 4.2. Tachometer

The tachometer gauge is a standard gauge used to display engine RPM. The tachometer data source will be J1939 Engine Speed in PGN61444 (0xF004).

### 4.3. Engine Oil Pressure

The oil pressure gauge is a standard gauge used to display engine oil pressure. The oil pressure data source will be J1939 in PGN65263 (0xFEEF).

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#### 4.4. Engine Coolant Temperature

The coolant temperature gauge is a standard gauge used to display engine coolant temperature. The coolant temperature data source will be J1939 Engine Coolant Temperature in PGN65262 (0xFEEE).

#### 4.5. Fuel Level

The fuel gauge is a standard gauge used to display fuel tank level. The Fuel Level is driven by the fuel level sender analog input. Fuel level will be sampled over a time period to prevent fuel slosh effect on the gauge.

#### 4.6. Voltmeter

The voltmeter gauge is a standard gauge used to display current voltage. The voltage gauge is driven by analog input key on.

#### 4.7. Primary Air Pressure (only on 8 gauge cluster)

The primary air pressure gauge is a gauge that only exists on 8 gauge clusters. It is used to display Front Air pressure read from the analog input "front air".

#### 4.8. Secondary Air Pressure (only on 8 gauge cluster)

The secondary air pressure gauge is a gauge that only exists on 8 gauge clusters. It is used to display rear air pressure read from the analog input "rear air".

### 5. TELLTALES

#### 5.1. Oil Pressure gauge warning lamp

Source: Engine oil pressure in PGN65263 (0xFEEF).  
 Activation: When oil pressure goes below activation level  
 Deactivation: When oil pressure goes above activation level  
 EE parameter: EE\_INT\_FAULT\_LOW\_OIL\_PRESSURE

#### 5.2. Coolant Temperature gauge warning lamp

Source: Engine Coolant Temperature in PGN65262 (0xFEEE).  
 Activation: When coolant temperature goes over activation level  
 Deactivation: When coolant temperature goes below activation level  
 EE parameter: EE\_INT\_FAULT\_HIGH\_COOLANT\_TEMP

#### 5.3. Fuel Level gauge warning lamp

Source: Analog input fuel level.  
 Activation: When fuel level goes below activation level for more than 30 seconds.  
 Deactivation: When fuel level goes above activation level  
 EE parameter: EE\_INT\_FAULT\_LOW\_FUEL\_LEVEL

#### 5.4. Voltmeter gauge warning lamp

Source: Key on analog input  
 Activation:

- When voltage is below EE\_INT\_FAULT\_VOLT\_LOW – EE\_INT\_FAULT\_VOLT\_HYST for EE\_INT\_FAULT\_VOLT\_TIME and EE\_INT\_FAULT\_VOLT\_LOW\_OUTPUT is set to activate.
- When voltage is above EE\_INT\_FAULT\_VOLT\_HIGH + EE\_INT\_FAULT\_VOLT\_HYST for EE\_INT\_FAULT\_VOLT\_TIME and EE\_INT\_FAULT\_VOLT\_HIGH\_OUTPUT is set to activate.

Deactivation:

- When voltage is above EE\_INT\_FAULT\_VOLT\_LOW + EE\_INT\_FAULT\_VOLT\_HYST

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- When voltage is below EE\_INT\_FAULT\_VOLT\_HIGH – EE\_INT\_FAULT\_VOLT\_HYST

EE parameter:

- EE\_INT\_FAULT\_VOLT\_LOW
- EE\_INT\_FAULT\_VOLT\_LOW\_OUTPUT
- EE\_INT\_FAULT\_VOLT\_HIGH
- EE\_INT\_FAULT\_VOLT\_HIGH\_OUTPUT
- EE\_INT\_FAULT\_VOLT\_HYST
- EE\_INT\_FAULT\_VOLT\_TIME

### 5.5. Front air pressure gauge warning lamp (only on 8 gauge cluster)

Source: Analog input front air

Activation: When air pressure goes below activation level

Deactivation: When air pressure goes above activation level + hysteresis.

EE parameter: EE\_INT\_FAULT\_BRAKE\_PRESSURE\_LOW,  
EE\_INT\_FAULT\_BRAKE\_PRESSURE\_HYST\_TH

### 5.6. Rear air pressure gauge warning lamp (only on 8 gauge cluster)

Source: Analog input rear air

Activation: When air pressure goes below activation level

Deactivation: When air pressure goes above activation level + hysteresis.

EE parameter: EE\_INT\_FAULT\_BRAKE\_PRESSURE\_LOW,  
EE\_INT\_FAULT\_BRAKE\_PRESSURE\_HYST\_TH

### 5.7. Left Turn (left arrow)

Source: Digital input

Activation: When the digital input goes active

Deactivation: When the digital input goes inactive

EE parameter: N/A

Left turn indicator turns on when the left turn digital input is active. If the left turn indicator is left on for a measured distance of 1 mile, then the alert tone will be activated and the indicator "Turn signal ON" will be displayed in the DID.

### 5.8. Right Turn (right arrow)

Source: Digital input

Activation: When the digital input goes active

Deactivation: When the digital input goes inactive

EE parameter: N/A

Right turn indicator turns on when the right turn digital input is active. If the right turn indicator is left on for a measured distance of 1 mile, then the alert tone will be activated and the message "Turn signal ON" will be displayed in the DID.

Note. Left and right turn signals will be activated simultaneously to implement the hazard function.

### 5.9. High Beam (Icon)

Source: Digital input

Activation: When the digital input goes active

Deactivation: When the digital input goes inactive

EE parameter: N/A

### 5.10. Park Brake Telltale (P)

Source: Digital input

Activation: When the digital input goes active

Deactivation: When the digital input goes inactive



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EE parameter: N/A

Park Brake indicator will function as described in the following conditions

- Park brake indicator shall be continuously illuminated whenever the park brake input is set as long as the cluster is powered.
- If the park brake input is not set when the ignition is turned off the park brake indicator shall flash until the park brake input is set or a period of 2 minutes elapsed.
- The park brake indicator shall flash while the park brake input is set and the speed of the vehicle is > 1 MPH

## 5.11. ABS telltale (ABS)

Source: Digital input

Activation: When the digital input goes active

Deactivation: When the digital input goes inactive

EE parameter: N/A

### 5.11.1. Check transmission Telltale (Check trans)

Source: DM1 PGN 65226 (0xFECA) from the Transmission (SA=03).

Activation: When Amber\_Warning\_Lamp\_Status = 01b and SPN = 2003

Deactivation: When activation conditions are not present (SPN <> 2003 or Amber\_Warning\_Lamp\_Status <> 01b)

EE parameter: N/A

## 5.12. Transmission Temperature Telltale (Icon)

Source: Transmission Oil Temperature in PGN65272 (0xFE8).

Activation: When the transmission temp goes above activation level

Deactivation: When the transmission temp goes below activation level.

EE parameter: EE\_INT\_FAULT\_TRA\_TEMP\_HIGH

## 5.13. Range Inhibit Telltale (Range inhibit)

Source: Transmission shift inhibit indicator in PGN65098 (0xFE4A)

Activation: When range inhibit indicator value is 01b

Deactivation: Any other value on shift inhibit indicator

EE parameter: N/A

## 5.14. Wait to Start Telltale (Wait to Start)

Source: Wait to start lamp status received via PGN 65252 (0xFEE4)

Activation: When received wait to start lamp status is 01b

Deactivation: Any received value different from 01b

EE parameter: N/A

## 5.15. Hydraulic oil temperature Telltale (Icon)

Source: Digital input

Activation: When the digital input goes active (high temperature indicator)

Deactivation: When the digital input goes inactive

EE parameter: N/A

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### 5.16. Service Brake Telltale (Icon)

Source: Service brake, brake interlock alarm and brake interlock request digital inputs

Activation/deactivation: see activation logic below

EE parameter: EE\_STOP\_LIGHT\_INHIBIT

#### Air Brakes System with brake interlock.

Brake interlock alarm digital input	Brake interlock request digital input	Service brake digital input	EE_STOP_LIGHT_INHIBIT	Service Brake telltale status
X	Active	Active	Off	ON
X	Active	Active	On	OFF
X	Inactive	Active	Off	ON
X	Inactive	Active	On	OFF
X	Active	Inactive	X	Flash

#### Hydraulic Brakes System with brake interlock.

Brake interlock alarm digital input	Brake interlock request digital input	Service brake digital input	EE_STOP_LIGHT_INHIBIT	Service Brake telltale status
Inactive	Active	Active	Off	ON
Inactive	Active	Active	On	OFF
Inactive	Inactive	Active	Off	ON
Inactive	Inactive	Active	On	OFF
Active	Active	X	X	Flash

#### No brake interlock system

Brake interlock alarm digital input	Brake interlock request digital input	Service brake digital input	EE_STOP_LIGHT_INHIBIT	Service Brake telltale status
X	X	Active	Off	ON
X	X	Active	On	OFF
X	X	Inactive	Off	OFF
X	X	Inactive	On	OFF

Note. Configurable parameter Brake interlock = off (EE parameter: EE\_BRAKE\_INTERLOCK\_SYSTEM)  
For combinations not included in the table Service Brake telltale will be off.

X= don't care

### 5.17. Hydraulic brake failure (Brake pressure) (only on 6 gauge cluster)

Source: Digital input

Activation: When the digital input goes active

Deactivation: When the digital input goes inactive

EE parameter: N/A

### 5.18. Service Engine Telltale (Icon)

Service Engine indicator (amber lamp) will be activated when any of the following conditions is active. It will be deactivated just when none of the conditions is present.

Flashing has priority over continuously ON.

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### 5.18.1. Service

Source: Service distance and service delay in J1939 (PGN65216).

Activation: Turn amber lamp ON when service distance > 16126 km or when Service delay > 4000 h

Deactivation: When Service distance <= 16126 km or when Service delay <= 4000 h

EE parameter: N/A

### 5.18.2. Amber lamp in DM1

Source: Amber warning lamp status in DM1 PGN 65226 (0xFECA) from the ECM.

Activation: Flash amber lamp when amber lamp status = 01b

Deactivation: When amber lamp status <> 01b

The ECM will broadcast the DM1 message on J1939 to illuminate amber Check Engine Lamp in the following conditions:

Coolant level faults, SID-FMI: 111-01 for low and SID-FMI: 111-11 for very low

Coolant temperature faults, SID-FMI: 110-00 for high and SID-FMI: 110-11 for very high

Oil pressure faults, SID-FMI: 100-01 for low and SID-FMI: 100-11 for very low.

Other conditions activating the lamp may be transmitted by the ECM.

### 5.18.3. Idle Shutdown Driver Alert

Source: Idle Shutdown Driver Alert Mode in J1939 (PGN 65252).

Activation: Flash amber lamp while received status = 01

Deactivation: When received status <> 01

EE parameter: N/A

## 5.19. Stop Engine Telltale (Stop)

Stop indicator will be activated when any of the following conditions is active. It will be deactivated just when none of the conditions is present.

### 5.19.1. Red lamp in DM1

Source: Red stop lamp status in DM1 PGN 65226 (0xFECA) from the ECM.

Activation: Stop lamp ON when red stop lamp status = 01b

Deactivation: When stop lamp status <> 01b

The ECM will broadcast the DM1 message on J1939 to illuminate Red stop lamp in the following conditions:

Coolant level faults, SID-FMI: 111-11 for very low

Coolant temperature faults, SID-FMI: 110-11 for very high

Oil pressure faults, SID-FMI: 100-11 for very low.

Other conditions activating the lamp may be transmitted by the ECM.

### 5.19.2. Ignition voltage out of range

Source: Ignition voltage analog input

Activation: Stop lamp ON when voltage is out of range (see voltmeter warning lamp description)

Deactivation: Voltage in normal range (see voltmeter warning lamp description)



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### 5.19.3. Low front or rear air pressure

Source: Front/rear analog inputs

Activation: Stop lamp ON when front or rear air pressure low (see rear air pressure gauge warning lamp and front air pressure gauge warning lamp)

Deactivation: Normal air pressure in both inputs (see rear air pressure gauge warning lamp and front air pressure gauge warning lamp).

### 5.19.4. High Transmission temperature

Source: Transmission Oil Temperature in PGN65272 (0xFEf8).

Activation: Stop lamp ON when the transmission temp goes above activation level

Deactivation: When the transmission temp goes below activation level.

EE parameter: EE\_INT\_FAULT\_TRA\_TEMP\_HIGH

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## 6. SOUNDS

### 6.1. Audible Alarm

The audible alarm is used in the following conditions:

Function	Priority	Sound playback	Sound number
High Hydraulic Oil Temperature	1	Continuous	1
Stop engine	1	Continuous	1
Very low coolant level	1	Continuous	1
Low Oil Pressure	1	Continuous	1
High Coolant Temperature	1	Continuous	1
High Transmission Temp	1	Continuous	1
Check Transmission	1	Continuous	1
Low/High chassis voltage	2	Continuous	1
ABS	3	Continuous	1
Front low air pressure	4	Continuous	1
Rear low air pressure	4	Continuous	1
Wait to start	2	Continuous	2
Range inhibit	5	Continuous	2
Service engine soon	5	Continuous	2
Low Fuel Level	6	Single	2
Park brake reminder	3	Continuous	3
Turn signal	4	Single	4
Headlamps On reminder	3	Continuous	3

Note: The design of the Sounds will be approved by BBC.

#### 6.1.1. Table 4: Audible Alarms

Activation: when the [High Hydraulic Oil Temperature telltale](#) is active.

#### 6.1.2. Stop engine

Activation: when the [Stop Engine telltale](#) is active.

#### Very low coolant level

#### 6.1.3. High Hydraulic Oil Temperature

Source: The data source is J1939 Coolant Level in (PGN65263).

Activation: Coolant level = 0

Deactivation: Coolant level > 50%

EE parameter: N/A

#### 6.1.4. Low oil pressure

Activation: when [Oil Pressure gauge warning lamp](#) is active.

#### 6.1.5. High coolant temp

Activation: when [Coolant Temperature gauge warning lamp](#) is active.

#### 6.1.6. High transmission temp

Activation: when High [Transmission Oil Temperature warning message](#) is active



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### 6.1.7. Check transmission

Source: DM1 PGN65226 from the Transmission (SA=03).

Activation: When Amber\_Warning\_Lamp\_Status = 01b and SPN = 2003

Deactivation: When the activation condition is not present: SPN <> 2003 or Amber\_Warning\_Lamp\_Status <> 01b)

EE parameter: N/A

### 6.1.8. Low/high chassis voltage

Source: Ignition analog input

Activation:

- When voltage is below EE\_INT\_FAULT\_VOLT\_LOW – EE\_INT\_FAULT\_VOLT\_HYST for EE\_INT\_FAULT\_VOLT\_TIME and EE\_INT\_FAULT\_VOLT\_LOW\_OUTPUT is set to activate.
- When voltage is above EE\_INT\_FAULT\_VOLT\_HIGH + EE\_INT\_FAULT\_VOLT\_HYST for EE\_INT\_FAULT\_VOLT\_TIME and EE\_INT\_FAULT\_VOLT\_HIGH\_OUTPUT is set to activate.

Deactivation:

- When voltage is above EE\_INT\_FAULT\_VOLT\_LOW + EE\_INT\_FAULT\_VOLT\_HYST
- When voltage is below EE\_INT\_FAULT\_VOLT\_HIGH – EE\_INT\_FAULT\_VOLT\_HYST

EE parameter:

- EE\_INT\_FAULT\_VOLT\_LOW
- EE\_INT\_FAULT\_VOLT\_LOW\_OUTPUT
- EE\_INT\_FAULT\_VOLT\_HIGH
- EE\_INT\_FAULT\_VOLT\_HIGH\_OUTPUT
- EE\_INT\_FAULT\_VOLT\_HYST
- EE\_INT\_FAULT\_VOLT\_TIME

### 6.1.9. ABS

Activation: same conditions that ABS telltale (see ABS Telltale section)

### 6.1.10. Front low air pressure (only on 8 gauge cluster)

Activation: when the [Front air pressure gauge warning lamp](#) is active.

### 6.1.11. Rear low air pressure (only on 8 gauge cluster)

Activation: when the [Rear air pressure gauge warning lamp](#) is active.

### 6.1.12. Range inhibit

Source: Transmission shift inhibit indicator in PGN65098 (0xFE4A)

Activation: When shift inhibit indicator value is 01b

Deactivation: Any other value on shift inhibit indicator

EE parameter: N/A

### 6.1.13. Service engine soon

Activation: when [Service Engine Telltale](#) is active



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#### 6.1.14. Low fuel level

Activation: when [Fuel level gauge warning lamp](#) turns On. Audible alarm will last for 2 seconds after detecting low fuel condition; if the condition is cleared or if an ignition cycle is executed the alarm will sound after detecting low fuel again.

#### 6.1.15. Park brake reminder

Activation: When the [Park Brake Telltale](#) is flashing.

#### 6.1.16. Turn signal

Source: Digital input right turn, digital input left turn

Activation: When one of the digital inputs goes active

Deactivation: When none of the digital inputs are active

EE parameter: N/A

#### 6.1.17. Headlamps On reminder

Source: Dimmer level analog input

Activation: If the dimmer level is > 10% when ignition is turned off, the audible alarm will continue sounding until lights are turned off (dimmer level < 10%) or a period of 2 minutes elapsed.

EE parameter: N/A



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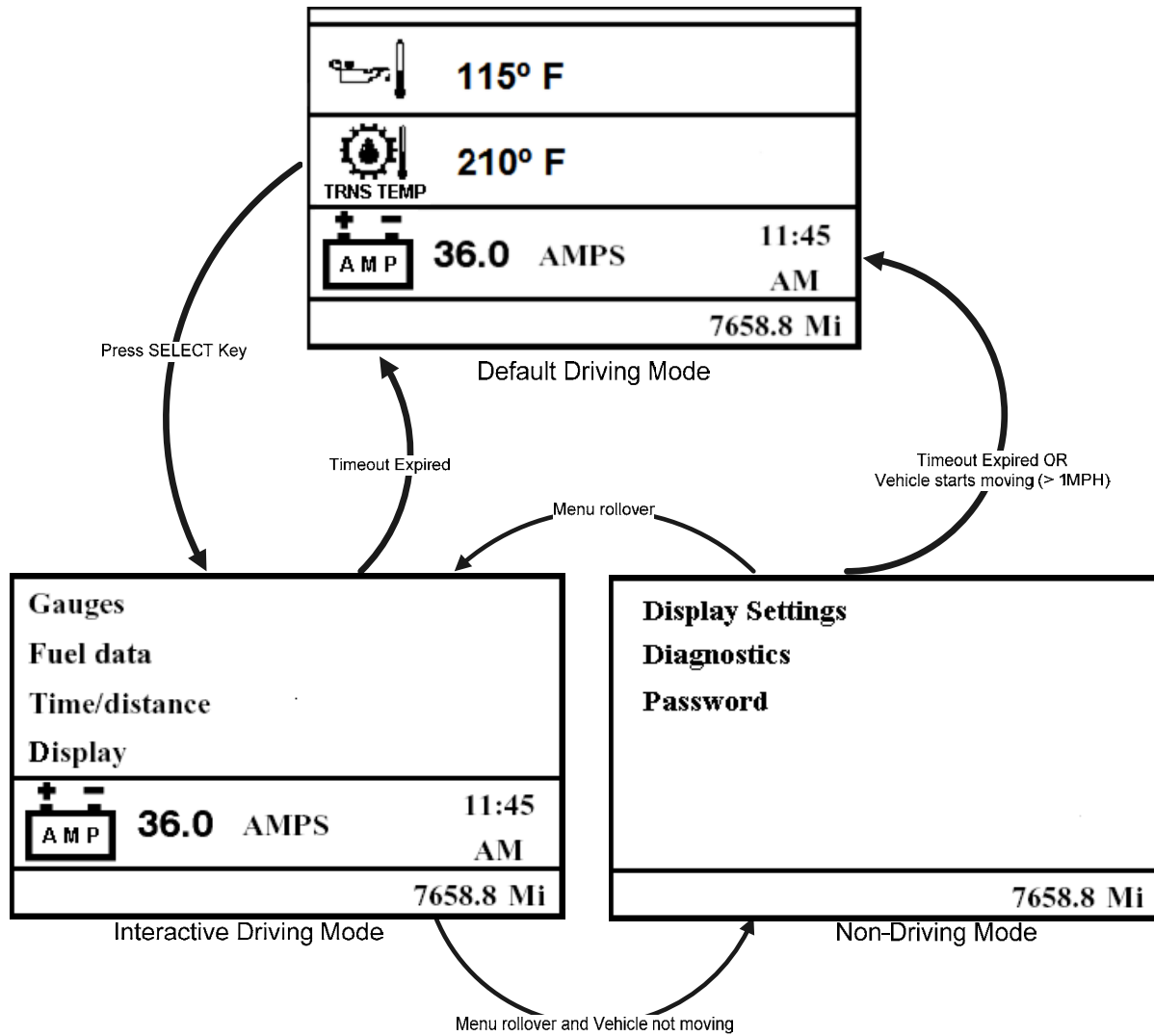
## 7. DRIVER INFORMATION DISPLAY (DID)

The DID is intended to provide information to the driver in a graphical way. The DID is capable of displaying gauges, telltales and messages. The DID has several modes that depend on the current status of the vehicle (i.e. driving or not driving). While in driving mode, the DID should always show gauge information if there is no user interaction. Three different modes have been defined in order to simplify the understanding of the possible states that the DID supports. Such modes are:

- **Default Driving Mode (DDM):** This is the default view of the display, regardless of the state of the vehicle (i.e. moving or not moving). The cluster will always return to this view after a period of no activity, in the Stalk user interface. The allowed time without activity will depend on whether the bus is moving (speed > 1 MPH) or not (speed < 1 MPH) when a Stalk switch was pressed, while in the interactive driving mode. In the first case the timeout will be 7 seconds in the second case the timeout will be 15 seconds. Table 5 describes this conditioning in detail.  
Timeout values are handled through EEPROM parameters: EE\_DRIVING\_M\_TIMEOUT, EE\_NON\_DRIVING\_M\_TIMEOUT.
- **Interactive Driving Mode (IDM):** This mode is accessed when the user presses the select key, while in the default view (DDM). Additional information can be accessed during this mode.
- **Non Driving Mode (NDM):** Accessed when a rollover of the menu is performed and the vehicle is not moving. Access to diagnostics and data log can be accessed in this mode.

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**Figure 3: Display Menu logic**

Stalk	Vehicle Speed	Timeout
No	> 1 MPH	7 sec.
activity	<= 1 MPH	15 sec

**Table 5: Stalk inactivity timeout**

Allowed inactivity period is determined every time the stalk switches are operated and is not changed when the bus speed changes. For example if vehicle was stopped, and the select button is pressed the timeout is started (15 seconds) then the vehicle starts moving (speed > 1MPH) the timeout value will remain as 15 seconds.

Using the password option it is possible to disable the timeout that returns from any screen to the Default Driving Mode (DDM) after the interval of inactivity has expired. This action allows the user to work with the unit in a debug mode, where the timeout is not returning to the default driving menu after 15 seconds of inactivity. Details about password protected functionality are provided in following sections.

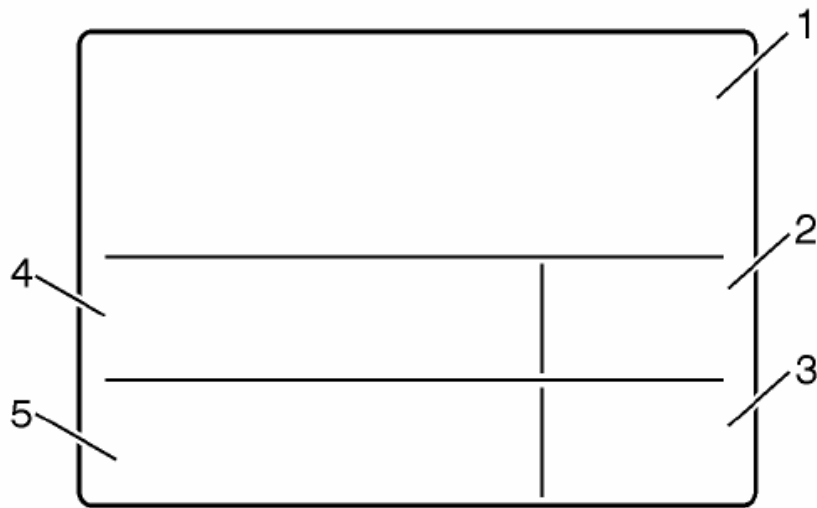
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### 7.1. Display Areas.

Figure 1 show the areas included in the display screen.

- Top Level**      Menu field
- Middle Level**    Favorite Display
- Bottom Level**    Status Bar and Odometer

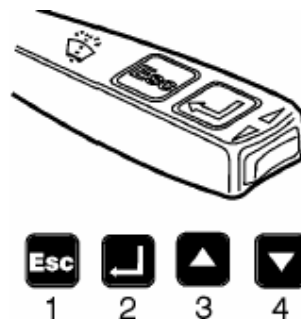


W3005515

- 1    Driving Mode window
- 2    Clock window
- 3    Odometer window
- 4    Favorite Display window
- 5    Status window

**Figure 4: Display Windows**

Menu navigation and option selection is done by pressing the Esc, Select, Up and Down buttons located in the stalk switch control lever. See Figure 5



**Figure 5: Stalk switch control lever**



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- Esc (escape) is used to return to the pervious menu and cancel a setting operation
- <J Select is used to activate the highlighted option in the menu. Also it is used as the “enter” key.
- Up arrow moves the cursor up, also increments a numeric value during setting operations.
- Down arrow moves the cursor down, also decrements a numeric value during setting operations.

### 7.1.1. Driving Mode window

This area is always present regardless of vehicle speed.

### 7.1.2. Clock window

This area displays current time information in the format selected via “Display settings” menu.

### 7.1.3. Odometer window

The odometer displays 0.0 to 9,999,999.9 km or miles that correspond to total vehicle distance value. The resolution is 0.1 miles or 0.1 km depending on the current unit selection.

If the maximum value that can be displayed is exceeded the cluster will continue accumulating distance but the most significant digit will be invisible to the driver.

Odometer value is calculated using vehicle speed received via J1939 **Cruise Control/Vehicle Speed** message from the ECM PGN 65265 (0xFEf1), SPN Wheel-based Vehicle Speed.

Calculated value will be stored in the non-volatile memory every half a mile (0.5 mile) and when ignition OFF is detected.

It can be displayed in miles or kilometers as selected via “Display settings” menu.

The odometer information must be transferable to a new gauge package in situations when a gauge package fails. The parameter to use is EE\_COV. The EE\_COV value is a 32 bit unsigned value with resolution 0.01 miles/bit added to the odometer value. EE\_COV value can be updated using Volvo Workshop tool.

It is recommended to reset the trip odometer after EE\_COV parameter is updated since the trip odometer value may result in an inaccurate value.

The odometer shall be readable with the ignition off when the vehicle back lighting (headlight switch in park light position) is activated.

The cluster should be able to accurately save/retrieve the odometer value for a minimum of 1,000,000 miles.

### 7.1.4. Favorite Display window

This window will display the first gauge of the “Default Driving Mode” screen. For the 8 gauges version this window will always display the reading corresponding to air application. For the 6 gauges version it might contain any of the gauges available in the display: air suspension, transmission temperature or ammeter.

In the Interactive driving mode (IDM) the same gauge information is displayed.



In the non-driving mode (NDM) this window becomes part of menu window.

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### 7.1.5. Status window

This window will show information equivalent to a telltale using an icon.

Condition	Displayed information
Cruise Control Set input active	CC
Alternator digital input active	ALT
Electronic Traction Control	ETC
Regenerate	
Exhaust high temperature	

**Table 6: Telltales using icons**

#### 7.1.5.1. Cruise Control

Source: Cruise Control States in J1939 message CCVS (PGN 65265)  
 Activation: CC state <> off and <> not available  
 Deactivation: When CC state = Off or service brake digital input becomes active

#### 7.1.5.2. Alternator

Source: Digital input – Alternator (located at C2)  
 Activation: When digital input is active (active low)  
 Deactivation: When digital input is inactive.

#### 7.1.5.3. Electronic Traction Control

Source: Digital input – ETC (located at C17)  
 Activation: When digital input is active (active low)  
 Deactivation: When digital input is inactive.

#### 7.1.5.4. Regenerate

Source: Particulate Trap Lamp Command in J1939 (PGN 64982)  
 Activation: Icon will be displayed when Particulate Trap Lamp Command = 001  
 Icon will flash when Particulate Trap Lamp Command = 100  
 Deactivation: Particulate Trap Lamp Command <> 001 and <> 100

#### 7.1.5.5. Exhaust high temperature

Source: Exhaust high temperature in J1939 (PGN 64982)  
 Activation: Icon will be displayed when Exhaust high temperature = 001  
 Deactivation: Exhaust high temperature <> 001

#### 7.1.5.6. Water in fuel (WIF)

Source: Digital input  
 Activation: When the digital input goes active  
 Deactivation: When the digital input goes inactive  
 EE parameter: N/A

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### 7.1.6. Information, warning and alarm indicators

DID will display 3 types of indicators: information, warnings and alarms. When specific conditions are detected a window displaying an icon that represents the condition will popup.

Information, warning and alarm indicators can be acknowledged by pressing the ESC button. Once an information or warning message is acknowledged it will not be displayed again until the associated condition becomes inactive and then active again. Alarm indicators will popup cyclically (every 10 seconds) since they can not be inhibited. Alarms are associated to high-risk conditions, and hence they will keep alerting the user, as the condition exists.

The info/warning/alarm works slightly different depending on current operation mode, these differences are described below.

More than one indicator can be active at the same time. A displayed message can be replaced by a new message provided the new message has a higher priority.

The displayed message is the highest priority; in the same category the more recent message.

#### 7.1.6.1. Popup message in driving mode

- Info - will popup and overwrite the information present in the driving mode window
- Warning - will popup and overwrite the information present in the driving mode window
- Alarm – will popup over the driving mode, clock and favorite display windows.

#### 7.1.6.2. Popup message in non driving mode

- Info - will not be shown until Driving mode is entered.
- Warning - will not be shown until Driving mode is entered.
- Alarm - will popup and overwrite the information present in the driving mode, clock window and favorite windows.

#### 7.1.6.3. Information, warning and alarm conditions

Detected condition	EEPROM parameter *	Default type
Battery voltage error	EE_BATTERY_ERROR_WARNING_TYPE	Alarm
Low Air pressure	EE_INT_FAULT_BRAKE_PRESSURE	Alarm
Engine Maintenance	EE_ENG_MAINTENANCE_WARNING_TYPE	Warning
J1939 comm. Failure	EE_J1939_BUS_FAILURE_WARNING_TYPE	Warning
Vehicle speed error	EE_SPEED_ERROR_WARNING_TYPE	Warning
Service engine soon	EE_SERVICE_ENG_WARNING_TYPE	Info
Turn signal ON	EE_TURNED_LIGHT_WARNING_TYPE	Info

**Table 7: Indicator Types**

\* EEPROM parameter configures the indicator type

##### 7.1.6.3.1. Engine maintenance

Source: Amber warning lamp status in J1939 DM1 from the ECM.

Activation: display indicator when amber lamp status = 01b

Deactivation: remove indicator when amber lamp status <> 01b

##### 7.1.6.3.2. J1939 comm. failure

Activation: When J1939 ETC1 (SA = 3) or EEC1 (SA=0) or both messages are not received for 5 consecutive seconds

Deactivation: message reception reestablished.



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### 7.1.6.3.3. Service engine soon

Source: Service distance and service delay in J1939 SERV message (PGN65216).

Activation: indicator will be displayed when service distance > 16126 km or when Service delay > 4000 h

Deactivation: When Service distance <= 16126 km or when Service delay <= 4000 h

### 7.1.6.3.4. Battery voltage error

See [Low/high chassis voltage](#) alarm section.

Source: Ignition analog input

Activation:

- When voltage is below EE\_INT\_FAULT\_VOLT\_LOW – EE\_INT\_FAULT\_VOLT\_HYST for EE\_INT\_FAULT\_VOLT\_TIME and EE\_INT\_FAULT\_VOLT\_LOW\_OUTPUT is set to activate.
- When voltage is above EE\_INT\_FAULT\_VOLT\_HIGH + EE\_INT\_FAULT\_VOLT\_HYST for EE\_INT\_FAULT\_VOLT\_TIME and EE\_INT\_FAULT\_VOLT\_HIGH\_OUTPUT is set to activate.

Deactivation:

- When voltage is above EE\_INT\_FAULT\_VOLT\_LOW + EE\_INT\_FAULT\_VOLT\_HYST
- When voltage is below EE\_INT\_FAULT\_VOLT\_HIGH – EE\_INT\_FAULT\_VOLT\_HYST

### 7.1.6.3.5. Vehicle speed error

Source: J1939 Wheel-based Vehicle Speed in PGN65265 (0xFEf1).

Activation: speed value = data not available (0xFExx) or sensor error (0xFFxx)

Deactivation: valid speed valid is received

### 7.1.6.3.6. Turn signal ON

Activation: When left or right turn signal has been on for more than 1 mile

Deactivation: One second after the flasher has been deactivated.

## 7.2. Driving Mode

During this mode, the DID will show the display-gauges using the areas 1 and 4 from Figure 4. A representation of such mode is depicted in Figure 6.

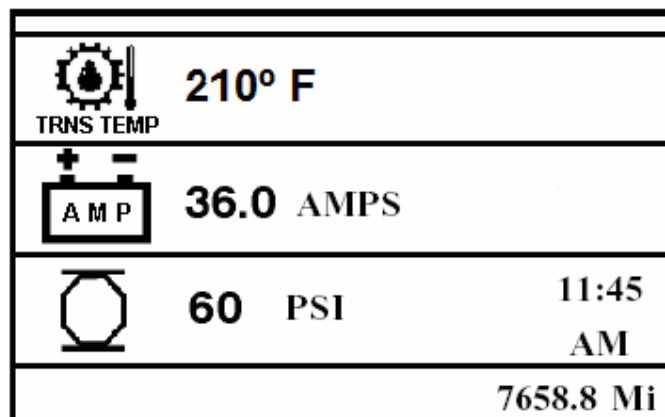
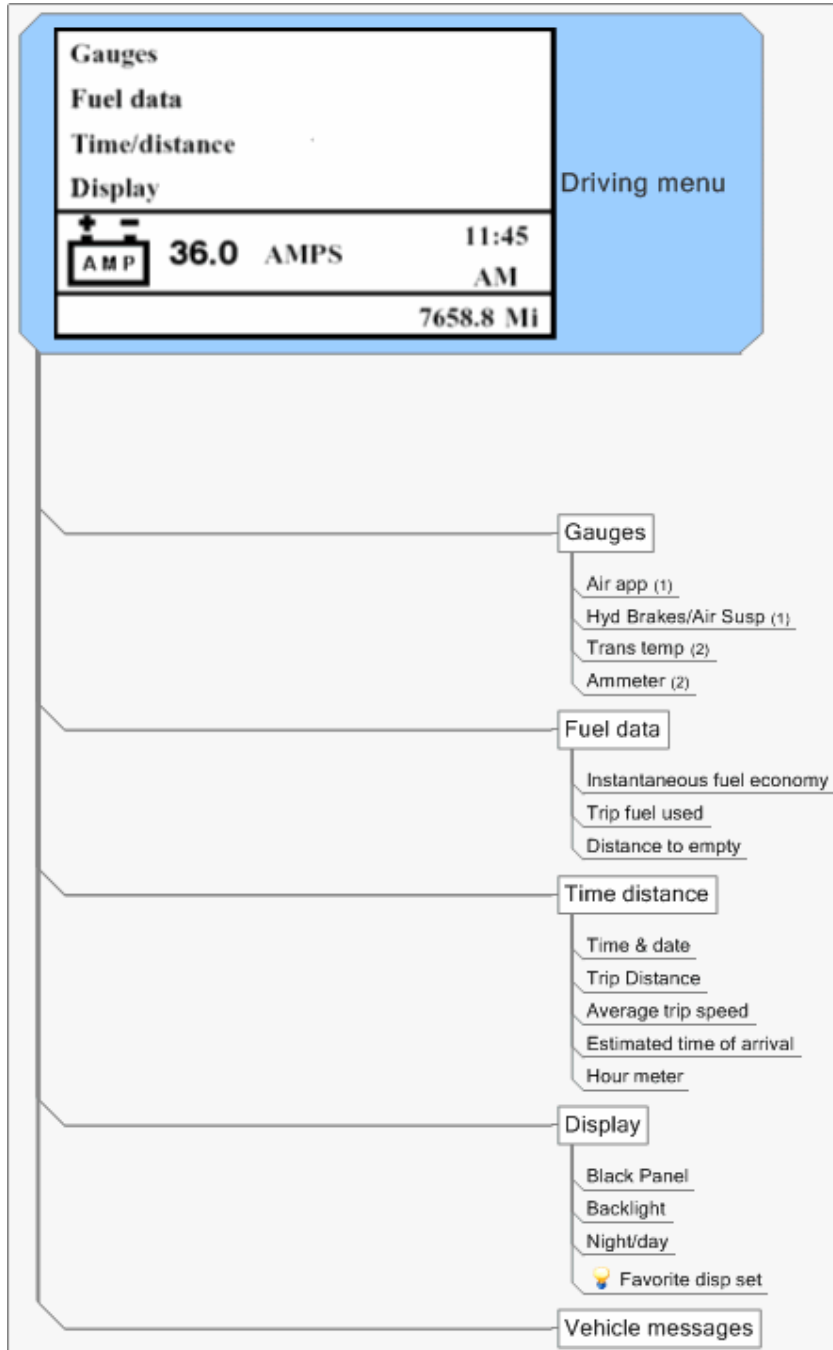


Figure 6: Default Driving Mode

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If the select button from the Stalk is pressed, then the display will enter the Interactive Driving Mode. Options displayed in such mode are depicted in Figure 7. Under this interactive mode, the user can navigate thru several menus. After a period of inactivity in the Stalk interface (already described), the driving menu will timeout and return to its default (DDM) view shown in Figure 6.



**Figure 7: Interactive Driving Mode**

- (1) availability depends on cluster type (6/8 gauges)
- (2) availability depends on configuration (option can be enabled or disabled)

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## 7.2.1. Gauges

Based on the cluster type the available gauges in this option will vary. In both versions it is possible to have all the available gauges displayed in the Default Driving Mode screen.

For air brake systems (8 gauges) available options are:

- Air application pressure (Air app)
- Transmission temperature (Trans temp)
- Ammeter (Ammeter)

For hydraulic systems (6 gauges) available options are:

- Transmission temperature (Trans temp)
- Air suspension (Hyd Brakes/Air Susp)
- Ammeter (Ammeter)

Configuration also determines available gauges. Ammeter and air suspension gauges can be disabled via the configuration menu and in consequence will not be included in the gauge menu.

### 7.2.1.1. Trans temp

The transmission temperature gauge option displays transmission oil temperature. The transmission temperature data source will be J1939 Transmission Oil Temperature in PGN65272 (0xFE8).

### 7.2.1.2. Ammeter

The ammeter gauge option will show current value from the power regulator in the bus. Displayed value is associated to an analog input. The presence of this gauge depends on the EEPROM parameter EE\_AMMETER\_ENABLE. Such parameter is configurable via the Configuration Menu.

### 7.2.1.3. Hydraulic air pressure (Hyd Brakes/Air Susp)

The hydraulic air pressure gauge option only exists in buses with hydraulic brake system. It displays air pressure value retrieved from an analog input. This gauge will be displayed based on the configuration of the EEPROM parameter EE\_AIR\_SUSP\_GAUGE\_ENABLE. Such parameter is configurable via the Configuration Menu.

This gauge will use the same analog input used for Front Air Application Gauge. There is no valid configuration for the cluster where both, Hydraulic and Air are supported simultaneously.

### 7.2.1.4. Front/Rear Air Application Pressure

The front and rear air application pressure gauge option only exists in buses with air brake system. It displays front and rear air application pressure readings from the analog inputs front and rear air application. This display-gauge can be seen by selecting the appropriate option in the interactive mode of the driving menu. This option will be displayed based on the EEPROM parameter EE\_CLUSTER\_TYPE.

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## 7.2.2. Fuel Data

This option will provide information to the user related to fuel economy.

### 7.2.2.1. Instantaneous Fuel Economy



**mpg** This option will present instantaneous and average fuel consumption received from the engine via J1939 PGN 65,266 (LFE).

### 7.2.2.2. Distance to Empty



**mpg** This option will display the calculated distance that can still be traveled based on average fuel rate, fuel level and tank capacity.

## 7.2.3. Time Distance Data

### 7.2.3.1. Time and date



**11:45 001013**  
**AM**

This option will display current time and date. The select button is used to enter new settings. Date will be formatted according to the selection done via Display Settings menu options.

### 7.2.3.2. Trip odometer



**1**

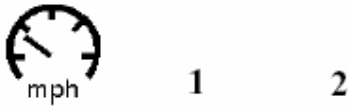
**2**

2 Trip odometers are handled. Values can be reset by pressing the select button. Value range is 0 to 99999 mi or km, no decimal places are displayed. When the maximum displayed value is reached the trip odometer is set to zero.

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### 7.2.3.3. Average Trip Speed



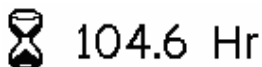
This option will display average speed. Values can be reset by pressing the select button.

### 7.2.3.4. Time of arrival



Time of arrival will be calculated using average speed and the distance to be traveled. Distance to be traveled can be entered by pressing the select button.

### 7.2.3.5. Hour meter



This option displays Total Engine Hours received from the engine via Hours message (PGN 65253). The cluster is periodically requesting this message (6 times/minute). Displayed resolution is tenths of an hour. In case the information is not received or it is not valid dashes will be shown.

## 7.2.4. Display

### 7.2.4.1. Set Blackpanel

This option will set the display backlight to a minimum value. It could be used as an option for nocturnal driving. To return to normal illumination the following sequence shall be executed: select "set blackpanel" option and press escape before the timeout to return to default driving mode expires

### 7.2.4.2. Backlight

This option will allow setting the backlight intensity.

### 7.2.4.3. Day/Night Mode

Each time the select button is pressed when this option is selected toggles between day and night display modes.

Day mode sets dark text over light background

Night mode sets light text over dark background.

### 7.2.4.4. Favorite Display set

This option shall be used to define the contents of Default Driving Mode screen.

There are 3 areas available to display a gauge. Available gauges depend on cluster type and selected configuration.

Once the "Favorite Display set" option is selected follow the steps below to customize the "Default Driving Mode" screen:

- Move to the desired display area using the up and down buttons, press select then use the up and down buttons to see available gauges, when the desired gauge is displayed press select.

The procedure is repeated for each of the available areas (3). The area at the bottom of the screen is always visible even when the Driving Mode menu is displayed (area 4 in figure 4).

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### 7.3. Non-Driving Mode

While vehicle is not moving (speed <= 1 MPH) user can enter into the Non-driving mode (NDM) moving the arrow one more position while in the last or first menu item of the IDM. NDM is depicted in Figure 8. Configuration and diagnostics options are available in this mode. The non-driving mode consists of the driving mode window, the favorite window and the clock window shown in Figure 4.

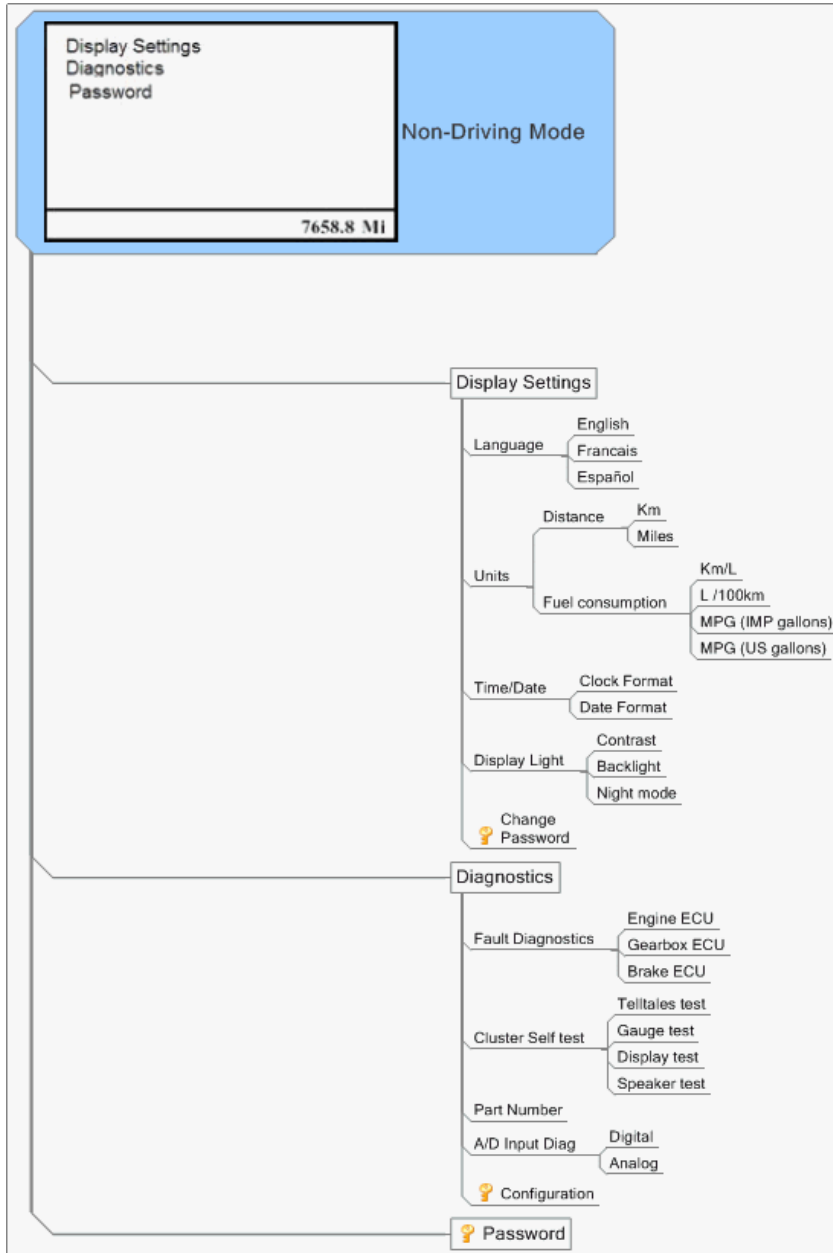


Figure 8: Non-driving Mode

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### 7.3.1. Display Setting

#### 7.3.1.1. Language

Select between English, Français and Español options. This setting is used to display the appropriate text in the menu options and warning messages.

#### 7.3.1.2. Units

Measurement units selection for options associated to distance and fuel consumption functions.

#### 7.3.1.3. Time/Date

Select between 24 and 12 hrs time format and between “yymmdd”, “ddmmyy”, “mmdyyy” date formats.

#### 7.3.1.4. Display Light

Set display viewing parameters: contrast, back illumination and night mode.

#### 7.3.1.5. Change password

Password protected option to configure a new secret code that limits access to specific options. To access this option the user should know current password.

### 7.3.2. Diagnostics

The DID shall provide monitoring capabilities. They can be divided in two different needs:

- **Monitor all digital and analog inputs in real-time:** The intent is to provide a way to easily diagnose all digital and analog inputs connected to the cluster. This is done, providing a reading of the current state of all digital and analog inputs as is described in detail in A/D Input Diagnostics.
- **Fault Diagnostics:** The purpose of this feature is to provide a way to monitor data trouble codes (DTCs) generated by the ECUs in the vehicle: Engine, Automatic Transmission, Hydraulic ABS System and Air Brake System. Details of these functions are provided in the next paragraphs.

#### 7.3.2.1. Fault Diagnostics

Vision Cluster is connected to J1939 and J1708 networks of the vehicle. Not all the ECUs will report their Data Trouble Codes (DTC) in both networks. Table 8 indicates the network used by each ECU to report its faults. Only active faults will be displayed.

ECU	Protocol
Engine	J1939 or J1587
Hydraulic ABS	J1587
Air Brake System	J1939 or J1587
Transmission	J1939

**Table 8: Communication Protocol and DTCs**

DTC information will be accessible through the Diagnostics option in the Non-Driving Menu.

#### 7.3.2.2. Cluster Self test

This option is provided as a way to exercise the telltales, gauges, display and speaker. Selecting one of the available options in this menu starts the test, to stop it press the ESC button.

#### 7.3.2.3. Part number

Cluster identification information is displayed when this option is selected.



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#### 7.3.2.4. A/D Input Diagnostics

The cluster should provide means for reading the current state of all digital and analog inputs at a given time. Outputs will not be monitored. The cluster will use the DID to provide such information to the user. The DID will reflect any change of the status of the input no later than 1 second after a state transition occurred.

Under this option it will be possible to select between digital or analog inputs. Once selected the type of inputs to monitor, a set of 5 inputs with their current status will be displayed. The name of the input that will be used is provided in Table 10 and Table 11 in the *Caption* column; input value will be displayed as described in the Readout column. As an example, the first screen of the digital inputs will display as depicted in Table 9.

R. Turn	OFF
Park Brk	OFF
Park Brk L.	ON
L. Turn	ON
High Beam	OFF

**Table 9: First Screen of Digital Inputs**

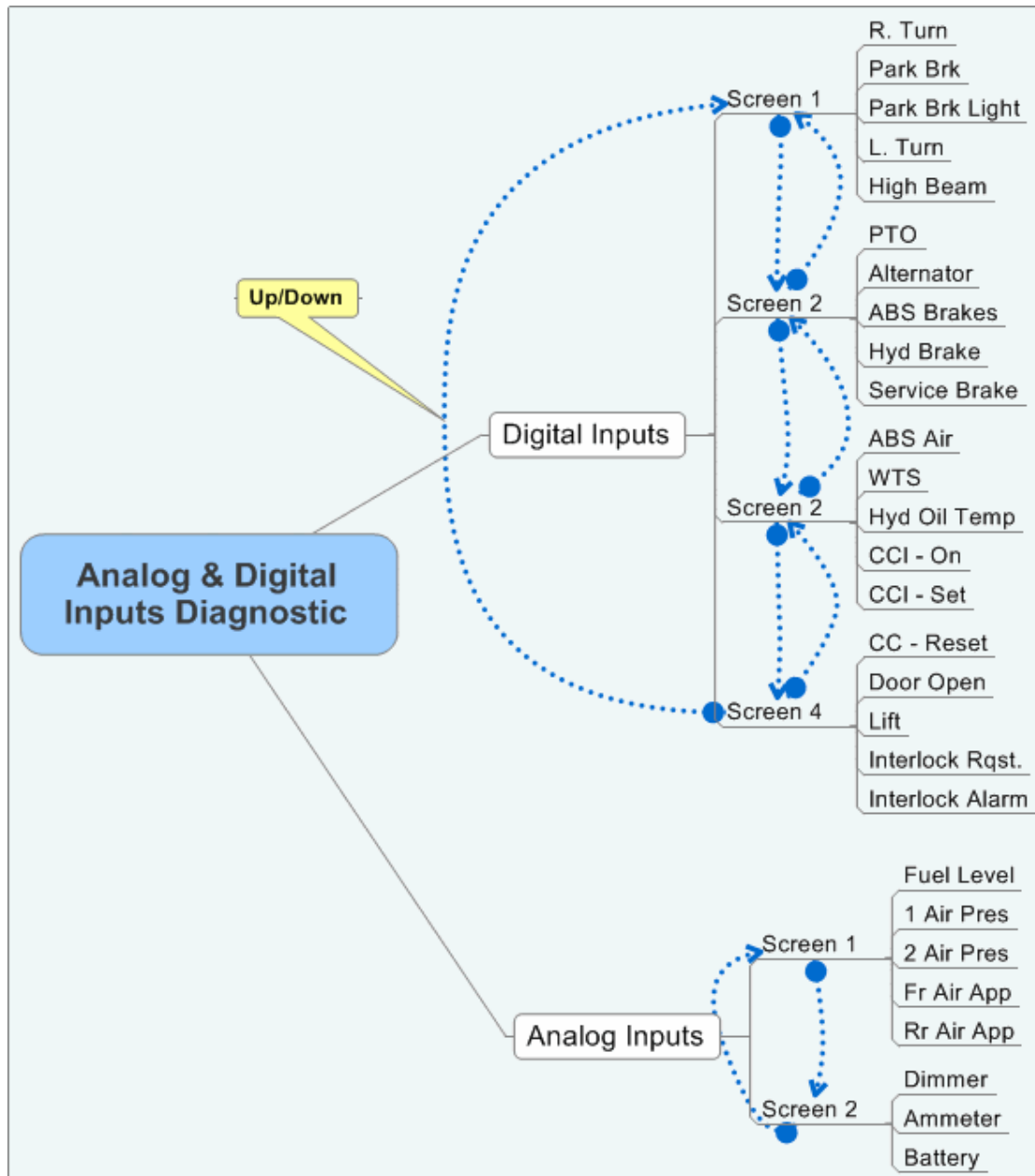
More than one screen will be needed to display all inputs available in the cluster. Navigation will be done using *UP/DOWN* buttons. Once the last screen is reached, pressing down button will result in displaying the first page again; similarly if up is pressed when the first screen is displayed the last page will be shown. None of the navigation keys is included in the digital inputs to be diagnosed.

A high level representation on how this should be implemented is presented in Figure 9.



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**Figure 9: Input Diagnostic Screen Navigation**

Inputs available in the diagnostic screens are listed in Table 10 and Table 11:

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<b>PIN</b>	<b>Digital Inputs</b>	<b>Caption</b>	<b>Readout</b>	<b>Resolution</b>
A21	Right Turn Signal	R. Turn	ON / OFF	Binary
B23	Park Brake Set	Park Brk	ON / OFF	Binary
B24	Park Brake Light	Park Brk Light	ON / OFF	Binary
B25	Left Turn Signal	L. Turn	ON / OFF	Binary
B28	High Beam	High Beam	ON / OFF	Binary
C1	PTO/High Idle	PTO	ON / OFF	Binary
C2	Alternator	Alternator	ON / OFF	Binary
C3	ABS Hydraulic Brakes	ABS Brakes	ON / OFF	Binary
C5	Hydraulic Brake	Hyd. Brake	ON / OFF	Binary
C8	Service Brake	Service Brake	ON / OFF	Binary
C10	ABS Air	ABS Air	ON / OFF	Binary
C12	Wait To Start	WTS	ON / OFF	Binary
C16	High Hydraulic Oil Temp	Hyd Oil Temp.	ON / OFF	Binary
C24	Cruise Control - On	CC - ON	ON / OFF	Binary
C25	Cruise Control - Set	CC - Set	ON / OFF	Binary
C26	Cruise Control - Reset	CC - Reset	ON / OFF	Binary
C7	Door Open	Door Open	ON / OFF	Binary
C6	Lift Not Stowed	Lift	ON / OFF	Binary
C22	Brake Interlock Reqst.	Interlock Rqst. Interlock	ON / OFF	Binary
C23	Brake Interlock Alarm	Alarm	ON / OFF	Binary

**Table 10: Digital Inputs to be displayed**

<b>PIN</b>	<b>Analog Inputs</b>	<b>Caption</b>	<b>Range</b>	<b>Resolution</b>
B3	Fuel Level	Fuel Level	0 – 100%	1%
C13	Primary Air Pressure (8 gauges only)	1 Air Pres. Hyd Brake /Air	0-180 PSI	1 PSI
C13	Hyd. Air Pres. (Air Suspension)	Susp	0-180 PSI	1 PSI
C14	Secondary Air Pressure	2 Air Pres.	0-180 PSI	1 PSI
B13	Front Air Application Pressure	Fr. Air App.	0-180 PSI	1 PSI
B14	Rear Air Application Pressure	Rr Air App.	0-180 PSI	1 PSI
B9	Dimmer	Dimmer Sw	0 – 100% -150 – 150	1%
B6	Ammeter	Ammeter	A	1 A
A3	Ignition Switch	Battery	0 – 14V	0.01 V

**Table 11: Analog Inputs to be displayed**

If the value present at the analog input is out of the operation range, the diagnostic screen will display “Out of Range” for that particular input.

When one of these inputs is not available based on the cluster type the information provided by the diagnostic screen will be N/A.

C13 displayed caption will change based on the parameter EE\_CLUSTER\_TYPE: “1 Air Pres” for 8 gauges version and “Air Susp.” for 6 gauges.



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### 7.3.2.5. Configuration

The Vision cluster should provide a way to configure a specific set of parameters during the manufacturing process at Bluebird facility.

The configuration of the cluster will be accomplished using the cluster user interface (i.e. stalk switches and DID). Access to the Configuration option is protected and requires the user to provide the access code via the “**Password**” option to enable it.

The configuration items that will be displayed in the configuration menu are described in Table 12.

It is necessary to execute an ignition cycle (OFF/ON), after revising desired parameters, for EE parameter changes to take effect.

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Parameter	Description	Caption	Configuration	Default Value
Trip (EE_TRIP_ODO)	whether or not a trip odometer is present	Trip Odometer	ON/OFF	ON
Default Parameters (EE_INFORMATION_LINE)	Activates/Deactivates windows 3 and 5 (Odometer and Status Window) in the DID	Default Parameters	ON/OFF	ON
Self Test (EE_SELFTEST)	Turns the self test function at start-up on and off. This will enable/disable: <ul style="list-style-type: none"> <li>Gauge Sweep</li> <li>Bulb Test</li> <li>Speaker Test</li> </ul> As described in Section 3.4.1	Self Test	ON/OFF	ON
Transmission Diagnostics (EE_TRANS_DIAG)	When turned on, shows active SPN and FMI transmission faults. This feature will enable the associated diagnostic screen for SPNs and FMIs.	Trans. Diagnostics	ON/OFF	ON
Test Panel Enabled (EE_TEST_PANEL)	This parameter renders inoperative the configured cluster type, when selected value is 6 or 8. Under this condition the cluster can be used as a production chassis test fixture, whose type is given by EE_TEST_PANEL parameter value.	Test Panel	OFF/6/8	OFF
Turn Signal Click (EE_TURN_SIGNAL_CLICK)	when turned on, the turn signal click is active and when turned off, there is no turn signal click	Turn Signal Click	ON/OFF	ON
Stop Light Inhibit (EE_STOP_LIGHT_INHIBIT)	Parameter used to evaluate the conditions that control service brake telltale. See section 5.16	Stop Light Inhibit	ON/OFF	OFF
Engine Type (EE_ENGINE_TYPE)	Selection between possible engines. Note: Cummins and Cat will be the two engines available for MY 2006. MY 2007 will require supporting additionally J. Deere or GM engines, which will be added into the possible configuration list.	Engine Type	CMS / CAT	CAT
Brake Interlock (EE_BRAKE_INTERLOCK_SYSTEM)	Indicates if the brake system includes brake interlock,. Parameter used to evaluate the conditions that control service brake telltale. See section 5.16	Brake Interlock	ON/OFF	OFF
Lift Authorization (EE_LIFT_AUTHORIZATION)	when turned on, software is enabled for the lift authorization function	Lift Authorization	ON/OFF	OFF
Ammeter Enable (EE_AMMETER_ENABLE)	When set, the Ammeter DID-gauge will be present. Otherwise it will be disabled.	Ammeter	ON/OFF	ON
Air Suspension Enable (EE_AIR_SUSP_GAUGE_ENABLE)	When set, the Air suspension DID gauge will be present; otherwise it will be disabled and not shown.	Air Suspension	ON/OFF	ON



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ABS active state (EE_ABS_INPUT_HIGH_OR_LOW)	This option configures the active state of the ABS input	ABS Input	LOW/HIGH	HIGH
Tank Fuel Capacity (EE_FUEL_100_US_GALLONS)	It selects between 60 or 100 gallons fuel tank capacity	Fuel Tank	60/100	60

**Table 12: Configuration Items**

### 7.3.3. Password

The user will select this option to provide the secret code that will enable some menu options that otherwise would not be accessible.

By providing this secret code, the user gains access to all protected functions i.e. screens and information that are password protected. This password should be only known by Blue-Bird production line or engineering development personnel. Entering this key word authorizes access to crucial configuration parameters, that when set improperly can make the cluster malfunction.

The privileges granted are:

- **Configure operation parameters:** “Configuration”, “Change password” and “Favorite disp set” options will be accessible to allow the user to change current settings.
- **Disable timeout:** Once the password is entered and validated, the timeout that returns the display to the Default Driving Mode is disabled. The purpose of disabling the timeout is to facilitate diagnostic and configuration functions by allowing the user to stay in current screen even after 15 seconds of inactivity in the stalk switches.  
  
The timeout will be indefinitely disabled and the only way to go back to normal operation is executing an ignition cycle (OFF-ON)
- **Navigation into Non-Driving Menu:** The non-driving menu will be accessible even when vehicle speed is greater than 1MPH. This provides a way to access diagnostics even when the vehicle is moving, which is useful for bus verification.

If the password has not been entered, using this path, when a protected option is selected the secret code will be requested and the effect will be the same described in this paragraph.

It is possible to change the passwords by selecting the “Change Password” option in the “Display Settings” menu.

An ignition cycle will reset the protection level and make the user loose all granted privileges.

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## 8. EE PARAMETERS:

This section describes all the EEPROM parameters that can be configured in the Blue-Bird Vision Cluster. These parameters are divided in two classifications, as not all the parameters can be configured in the Configuration Window described in section **Error! Reference source not found.**. The two classifications are:

- **Customer Parameters:** Modifiable via the Configuration screen in the cluster.
- **Manufacturer Parameters:** These are parameters that can be modified by Stoneridge, but can not be modified using the configuration screen.

### 8.1. Customer Parameters

This section describes all the parameters that can be configured via the Configuration screen in the cluster described in section **Error! Reference source not found.**

#### 8.1.1. EE\_UNITS\_DISTANCE\_FORMAT

Resolution: 1 = miles  
0 = km  
Data range: N/A

#### 8.1.2. EE\_TRIP\_ODO

Resolution: N/A  
Data range: List: {ON, OFF}  
Default Value: ON

#### 8.1.3. EE\_INFORMATION\_LINE

Resolution: N/A  
Data range: List: {ON, OFF}  
Default Value: ON

#### 8.1.4. EE\_SELFTEST

Resolution: N/A  
Data range: List: {ON, OFF}  
Default Value: ON

#### 8.1.5. EE\_TRANS\_DIAG

Resolution: N/A  
Data range: List: {ON, OFF}  
Default Value: ON

#### 8.1.6. EE\_TEST\_PANEL

Resolution: N/A  
Data range: List: {OFF, 6, 8}  
Default Value: OFF

#### 8.1.7. EE\_TURN\_SIGNAL\_CLICK

Resolution: N/A  
Data range: List: {ON, OFF}  
Default Value: ON

#### 8.1.8. EE\_STOP\_LIGHT\_INHIBIT

Resolution: N/A  
Data range: List: {ON, OFF}  
Default Value: OFF



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### 8.1.9. EE\_BRAKE\_INTERLOCK\_SYSTEM

Resolution: N/A  
Data range: List: {ON, OFF}  
Default Value: OFF

### 8.1.10. EE\_ENGINE\_TYPE

Resolution: N/A  
Data range: List: {CMS, CAT}  
Default Value: YES

### 8.1.11. EE\_LIFT\_AUTHORIZATION

Resolution: N/A  
Data range: List: {ON, OFF}  
Default Value: OFF

### 8.1.12. EE\_AMMETER\_ENABLE

Resolution: N/A  
Data range: List: {ON, OFF}  
Default Value: ON

### 8.1.13. EE\_AIR\_SUSP\_GAUGE\_ENABLE

Resolution: N/A  
Data range: List: {ON, OFF}  
Default Value: OFF

### 8.1.14. EE\_FUEL\_TANK\_100\_US\_GALLONS

Resolution: N/A  
Data range: List: {60,100}  
Default Value: 60

## 8.2. Manufacturer Parameters

The following parameters can be modified only by the manufacturer. Such modification can be done using a J1708 tool developed by Stoneridge.  
(Find more information in [2]).

### 8.2.1. EE\_INT\_FAULT\_LOW\_OIL\_PRESSURE

Resolution: 1 psi/bit gain, 0 psi offset  
Data range: 0 to 255 psi

### 8.2.2. EE\_INT\_FAULT\_HIGH\_COOLANT\_TEMP

Resolution: 2 °F/bit, 0 °F offset  
Data range: 0 to 511°F (-18 to 266 °C)

### 8.2.3. EE\_INT\_FAULT\_TRA\_TEMP\_HIGH

Resolution: 10 °F/bit, 0 °C offset  
Data range: 0 to 2550°F (-18 to 1399°C)

### 8.2.4. EE\_INT\_FAULT\_LOW\_FUEL\_LEVEL

Resolution: 0,1 %/bit,  
Data range: 0 – 25,5%



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**8.2.5. EE\_INT\_FAULT\_BRAKE\_PRESSURE\_LOW**

Resolution: 1 psi/bit,  
Data range: 1-255 psi

**8.2.6. EE\_INT\_FAULT\_BRAKE\_PRESSURE\_HYST\_TH**

Resolution: 1 psi/bit,  
Data range: 0-255 psi

**8.2.7. EE\_TIME\_OUT\_BULB**

Resolution: 100 msec/bit  
Data range: 0-25.5 sec

**8.2.8. EE\_INT\_FAULT\_VOLT\_LOW**

Resolution: 0.1 V/bit  
Data range: 0.1-25.5 V

**8.2.9. EE\_INT\_FAULT\_VOLT\_LOW\_OUTPUT**

Resolution:  
Data range: Bit 2-3: 11b = not activated else activated.

**8.2.10. EE\_INT\_FAULT\_VOLT\_HIGH**

Resolution: 0.1 V/bit  
Data range: 0.1 - 25.5 V

**8.2.11. EE\_INT\_FAULT\_VOLT\_HIGH\_OUTPUT**

Resolution:  
Data range: Bit 2-3: 11b = not activated else activated.

**8.2.12. EE\_INT\_FAULT\_VOLT\_HYST**

Resolution: 0.1 V/bit  
Data range: 1-25.5 V

**8.2.13. EE\_INT\_FAULT\_VOLT\_TIME**

Resolution: 1 sec/bit  
Data range: 1-255 sec

**8.2.14. EE\_COV**

Resolution: 0.01 miles/bit  
Data range: 0 – 42949672,95 miles

**8.2.15. EE\_ENG\_MAINTENANCE\_WARNING\_TYPE**

Resolution: N/A  
Data range: List: {Warning, Info, Alarm, Disabled}  
Default Value: Warning

**8.2.16. EE\_J1939\_BUS\_FAILURE\_WARNING\_TYPE**

Resolution: N/A  
Data range: List: {Warning, Info, Alarm, Disabled}  
Default Value: Warning

**8.2.17. EE\_SERVICE\_ENG\_WARNING\_TYPE**

Resolution: N/A





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Data range: List: {Warning, Info, Alarm, Disabled}  
 Default Value: Info

**8.2.18. EE\_BATTERY\_ERROR\_WARNING\_TYPE**

Resolution: N/A  
 Data range: List: {Warning, Info, Alarm, Disabled}  
 Default Value: Alarm

**8.2.19. EE\_SPEED\_ERROR\_WARNING\_TYPE**

Resolution: N/A  
 Data range: List: {Warning, Info, Alarm, Disabled}  
 Default Value: Warning

**8.2.20. EE\_TURNED\_LIGHT\_WARNING\_TYPE**

Resolution: N/A  
 Data range: List: {Warning, Info, Alarm, Disabled}  
 Default Value: Info

**8.2.21. EE\_CLUSTER\_TYPE**

Resolution: N/A  
 Data range: List: {6 gauges (Hydraulic), 8 gauges (Air)}  
 Default Value: Hydraulic

**8.2.22. EE\_DRIVING\_M\_TIMEOUT**

Resolution: 1 sec/bit  
 Data range: 1-255 sec  
 Default Value: 7 sec

**8.2.23. EE\_NON\_DRIVING\_M\_TIMEOUT**

Resolution: 1 sec/bit  
 Data range: 1-255 sec  
 Default Value: 15 sec

**9. COMMUNICATION**

**9.1. J1708/1587**

This protocol will be used only to monitor DTCs from the ECUs as described in Fault Diagnostics (Section 7.3.2.1) No other functionality will be performed in this protocol.

Stoneridge will have additionally diagnostic capabilities under this protocol that will be used only for development purpose

**9.2. J1939 - TX**

There is one communication channel for data communication that complies with CAN 2.0B/SAE J1939 (Controller Area Network).

All frames transmitted by the gauge package on J1939 are continuously sent at the standard broadcast rate for the frame using source address (SA) 23dec (17h).

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### 9.2.1. PGN65265 (0xFEf1) CCVS

Byte	Description	Bit	Function
1			
	Two speed axle switch	2-1	11b
	Parking Brake switch	4-3	Park brake switch status
	Cruise Control Pause switch	6-5	00b (Off)
	Reserved	8-7	11b
2-3	FFFFh		
4		2-1	11b
	Cruise control enable switch	4-3	Cruise control On switch status
		6-5	Brake switch status
	Clutch switch	8-7	00b (Off)
5	Cruise control set switch	2-1	Cruise control set switch status
	Cruise control coast (decelerate) switch	4-3	00b (Off)
	Cruise control resume switch	6-5	Cruise control resume switch status
	Cruise control accelerate switch	8-7	00b (Off)
6-8	0xFF		

#### 9.2.1.1. Transmission rate

The message is broadcasted every 100ms

#### 9.2.1.2. Brake switch status

Data length: 2 bits  
 Resolution: -  
 Data range: 00b = Brake pedal released  
 01b = Brake pedal depressed  
 10b = Error  
 11b = Not available

### 9.2.2. PGN65264 (0xFEf0) PTO

Byte	Description	Bit	Function
1-5	0xFF		
6	Engine PTO Enable switch	2-1	PTO /High input   Throttle interlock
	Engine Remote PTO Preprogrammed Speed Control Switch	4-3	PTO digital input
		8-5	1111b
7-8	0xFF		

#### 9.2.2.1. Transmission rate

The message is broadcasted every 100ms

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### 9.2.3. PGN61441 (0xF001) EBC1

Byte	Description	Bit	Function
1	0xFF	4-1	11b (not available)
	Antilock braking active	6-5	ABS active input status
		8-7	11b (not available)
2-3	0xFF		
4	Accelerator Interlock switch	2-1	Throttle interlock
		8-3	1111 11b
5-8	0xFF		

Note: This message is transmitted if Cummings engine is selected, when CAT engine is present Throttle interlock is transmitted via PTO message.

#### 9.2.3.1. Transmission rate

The message is broadcasted every 100ms

### 9.2.4. PGN59904 (0xEA00) Request

Byte	Description	Bit	Function
1-3	PGN being requested	8-1	Used to request VH message

#### 9.2.4.1. Transmission rate

The message is transmitted addressed to the Engine whenever the hour meter option is accessed.

### 9.2.5. PGN65279 (0xFEFF) WFI

Byte	Description	Bit	Function
1	Water in fuel indicator	2-1	Water in fuel input status
		8-3	11b (not available)
2-8	0xFF		

#### 9.2.5.1. Transmission rate

The message is broadcasted every 10 seconds

## 9.3. J1939 – RX

Below are described the messages that are received by the cluster via J1939

### 9.4. PGN61442 (0xF002) ETC1

Byte	Description	Bit	Function
1-8	Not Used		

#### 9.4.1.1. Communication heart beat

This signal is only used as heart beat, no values inside signal is used.

#### 9.4.1.2. Source address

Message accepted from source: 0x03

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## 9.4.2. PGN61444 (0xF004) EEC1

Byte	Description	Bit	Function
1-3	Not Used		
4-5	Engine speed		
6-8	Not Used		

### 9.4.2.1. Engine Speed

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

Data length: 2 bytes  
 Resolution: 0,125 rpm/bit gain, 0 rpm offset  
 Upper byte resolution = 32 rpm/bit  
 Data range: 0 to 8031,875 rpm

### 9.4.2.2. Source address

Message accepted from source: 0x00

## 9.4.3. PGN65098 (0xFE4A) ETC7

Byte	Description	Bit	Function
1	Not used		
2		8-7	Range inhibit indicator
		6-1	Not used
3-8	Not used		

### 9.4.3.1. Range inhibit indicator

Status of range inhibit: 01b = active, 00b = inactive, 10b = reserved, 11b = no action

### 9.4.3.2. Source address

Message accepted from source: 0x03

## 9.4.4. PGN65216 (0xFEC0) SERV

Byte	Description	Bit	Function
1	Not used		
2-3	Service distance		
4-6	Not used		
7-8	Service delay		

### 9.4.4.1. Service distance

Data length: 2 bytes  
 Resolution: 5 km/bit, -160635 km offset  
 Data range: -160636 – 160640 km

### 9.4.4.2. Service delay

Data length: 2 bytes  
 Resolution: 1 h/bit, - 32127 h offset

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Data range: -32127 – 32128 h

#### 9.4.4.3. Source address

Message accepted from source: 0x00

#### 9.4.5. PGN65266 (0xFEf2) LFE

Byte	Description	Bit	Function
1-2	Fuel rate		
3-4	Instantaneous fuel economy		
5-6	Average fuel economy		
7-8	Not used		

##### 9.4.5.1. Fuel rate

Data length: 2 bytes  
Resolution: 0.5 l/h per bit, 0 offset  
Data range: 0 – 3212.75 l/hr

##### 9.4.5.2. Instantaneous fuel economy

Data length: 2 bytes  
Resolution: 1/512 km/l, 0 offset  
Data range: 0 – 125.5 km/l

##### 9.4.5.3. Average fuel economy

Data length: 2 bytes  
Resolution: 1/512 km/l, 0 offset  
Data range: 0 – 125.5 km/l

#### 9.4.6. PGN65226 (0xFECA) DM1

Byte	Description	Bit	Function
1	Lamp status		
2	Not used		
3	SPN		Least significant byte
4	SPN		Second significant byte
5	SPN	8-6	Most significant byte
	FMI	5-1	
6-8	Not Used		

##### 9.4.6.1. Lamp status

Bits 8-7 Malfunction Indicator Lamp Status  
Bits 6-5 Red Stop Lamp Status  
Bits 4-3 Amber Warning Lamp Status  
Bits 2-1 Protect Lamp Status

##### 9.4.6.2. Source address

Message accepted from source: All

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### 9.4.7. PGN65262 (0xFEFE) ET1

Byte	Description	Bit	Function
1	Engine coolant temp		
2-8	Not Used		

#### 9.4.7.1. Engine Coolant Temperature

Temperature of liquid found in engine cooling system.

Resolution: 1 °C/bit gain, -40 °C offset  
 Data range: -40 to + 210 °C (-40 to 410 °F)

#### 9.4.7.2. Source address

Message accepted from source: 0x00

### 9.4.8. PGN65263 (0xFEFE) EFL/P1

Byte	Description	Bit	Function
1-3	Not Used		
4	Engine oil pressure		
5-7	Not Used		
8	Coolant level		

#### 9.4.8.1. Engine Oil Pressure

Gage pressure of oil in engine lubrication system as provided by oil pump

Data length: 1 byte  
 Resolution: 4 kPa/bit gain, 0 kPa offset  
 Data range: 0 to +1000 kPa (0 to 145 psi)

#### 9.4.8.2. Coolant level

Data length: 1 byte  
 Resolution: 0,4 %/bit gain, 0% offset  
 Data range: 0 to 100%

#### 9.4.8.3. Source address

Message accepted from source: 0x00

### 9.4.9. PGN65265 (0xFEFE) CCVS

Byte	Description	Bit	Function
1	Not Used		
2-3	Wheel based vehicle speed		
4-6	Not Used		
7	Not used	1-5	Not used by this application
	Cruise Control States	6-8	Determines the status of the CC indicator in the display
8	Not used		Not used by this application

#### 9.4.9.1. Wheel-based Vehicle Speed

Data length: 2 bytes  
 Resolution: 1/256 km/h/bit gain, 0km/h offset (1/412 mph/bit gain, 0 mph offset)  
 Upper byte resolution = 1.0 km/h/bit (0,62 mph/bit)

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Data Range: 0 to 250,996 km/h (0 to 155,87 mph)

### 9.4.9.2. Cruise Control States

Data length: 3 bits  
Data Range: 000 – 111b

Bit states	Cruise Control State
000	Off/disabled
001	Hold
010	Accelerate
011	Decelerate/coast
100	Resume
101	Set
110	Accelerator override
111	Not available

### 9.4.9.3. Source address

Message accepted from source: 0x00

### 9.4.10. PGN65272 (0xFEf8) TF

Byte	Description	Bit	Function
1-4	Not used		
5-6	Transmission oil temp		
7-8	Not Used		

#### 9.4.10.1. Transmission Oil Temperature

Temperature of the transmission lubricant

Resolution: 0,03125 °C/bit gain, -273 °C offset  
Data range: -273 to +1735,0 °C (-459,4 to 3155,0 °F)

#### 9.4.10.2. Source address

Message accepted from source: 0x03

### 9.4.11. PGN61445 (0xF005) ETC2

Byte	Description	Bit	Function
1	Transmission Selected Gear	8-1	
2-3	Not used	16-1	
4	Not used	8-1	
5-6	Not used	16-1	
7-8	Not used	16-1	

#### 9.4.11.1. Transmission Selected Gear

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

Resolution: 1 gear value/bit, -125 offset



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Data range: -125 to 125

Operational Range: -125 to +125, negative values are reverse gears, positive values are forward gears, and zero is neutral. 251 (0xFB) is park.

**9.4.11.2. Source address**

Message accepted from source: 0x03

**9.4.12. PGN57088 (0xDF00) DM13**

Byte	Description	Bit	Function
1	Current data link	8-7	Not used by this application
	J1587	6-5	Not used by this application
	J1922	4-3	Not used by this application
	J1939 Network #1	8-7	Stop/start message broadcast
2-3	Not used	8-1	Not used by this application
4	Hold signal	8-5	
	SAE reserved	4-1	
5-8	SAE reserved		

The cluster responds to this request by stopping J1939 message transmission when J1939 Network #1 field= 00. Message transmission will be reestablished by any of the following conditions:

- 1) DM13. J1939 Network #1 = 01 (start message broadcast)
- 2) 6 seconds elapsed without receiving DM13 hold signal= 000 or 001
- 3) Ignition is turned Off/On

**9.4.12.1. J1939 Network #1, Primary Vehicle Network**

Identifies the action to be performed on the J1939 Network #1 communications port.

Resolution: bit  
 Data range: 00-11  
 00 Stop broadcast  
 01 Start broadcast  
 10 reserved  
 11 Don't care/take no action

**9.4.12.2. Hold signal**

Resolution: bit  
 Data range: 0000 - 1111

**Bit States for bits 8-5 Devices to take action**

0000 All Devices  
 0001 Devices whose broadcast state has been modified  
 0010 to 1110 Reserved  
 1111 Not Available

**9.4.13. PGN65252 (0xFEE4) Shutdown**

Byte	Description	Bit	Function
1	Not used	2-1	Not used by this application
	Idle Shutdown Driver Alert Mode	4-3	
		8-4	Not used by this application
2-3	Not Used		
4	Wait to Start Lamp	2-1	
7-8	Not Used		





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#### **9.4.13.1. Idle Shutdown Driver Alert Mode**

Status signal which indicates the status of the driver alert mode of the idle shutdown timer system

Resolution: bit  
Data range: 0/1  
00 Inactive  
01 Active

#### **9.4.13.2. Wait to Start Lamp**

Lamp signal which indicates that the engine is too cold to start and the operator should wait until the signal becomes inactive (turns off).

Resolution: bit  
Data range: 00 to 11  
00 Off  
01 On

#### **9.4.13.3. Source address**

Message accepted from source: 0x00

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#### 9.4.14. PGN64892 (0xFD7C) PTC1

Byte	Description	Bit	Function
1	Particulate Trap Lamp Command	3-1	Emissions related lamp status
	Not Used	8-4	Not used by this application
2-6	Not Used		Not used by this application
7	Not Used	2-1	Not used by this application
	Exhaust high temperature lamp	5-3	Emmissions related lamp status
	Not Used	8-6	Not used by this application
8	Not Used	8-1	Not used by this application

##### 9.4.14.1. Particulate Trap Control Command

Emissions related lamp status

Resolution: bit

Data range: 000 to 111

000 Off

001 On-solid

010 reserved for SAE assignment

101 reserved for SAE assignment

100 On-fasr blink (1 Hz)

101 reserved for SAE assignment

110 reserved for SAE assignment

111 Not available

##### 9.4.14.2. Exhaust high temperature lamp

Emissions related lamp status

Resolution: bit

Data range: 000 to 111

000 Off

001 On

010 reserved for SAE assignment

101 reserved for SAE assignment

100 reserved for SAE assignment

101 reserved for SAE assignment

110 reserved for SAE assignment

111 Not available

#### 9.4.15. PGN65253 (0xFEE5) Hours

Byte	Description	Bit	Function
1-4	Total Engine Hours	8-1	Hour meter value to be displayed
4-8	Total Engine Revolutions		Not used

##### 9.4.15.1. Total Engine Hours

Accumulated time of Operation of Engine.

Data length:

4 bytes

Resolution:

0.05 hr/bit, 0 offset

Data range:

0 to 210,554,060.75 hr



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#### 9.4.15.2. Source address

Message accepted from source: 0x00

#### 9.5. Communication Errors

A communication failure will be detected by monitoring the presence of 2 specific messages:

- ETC1 from the transmission (SA = 3)
- EEC1 from the engine (SA = 0)

“Comm. failure” will be displayed when ETC1 or EEC1 or both are not received for 5 seconds.

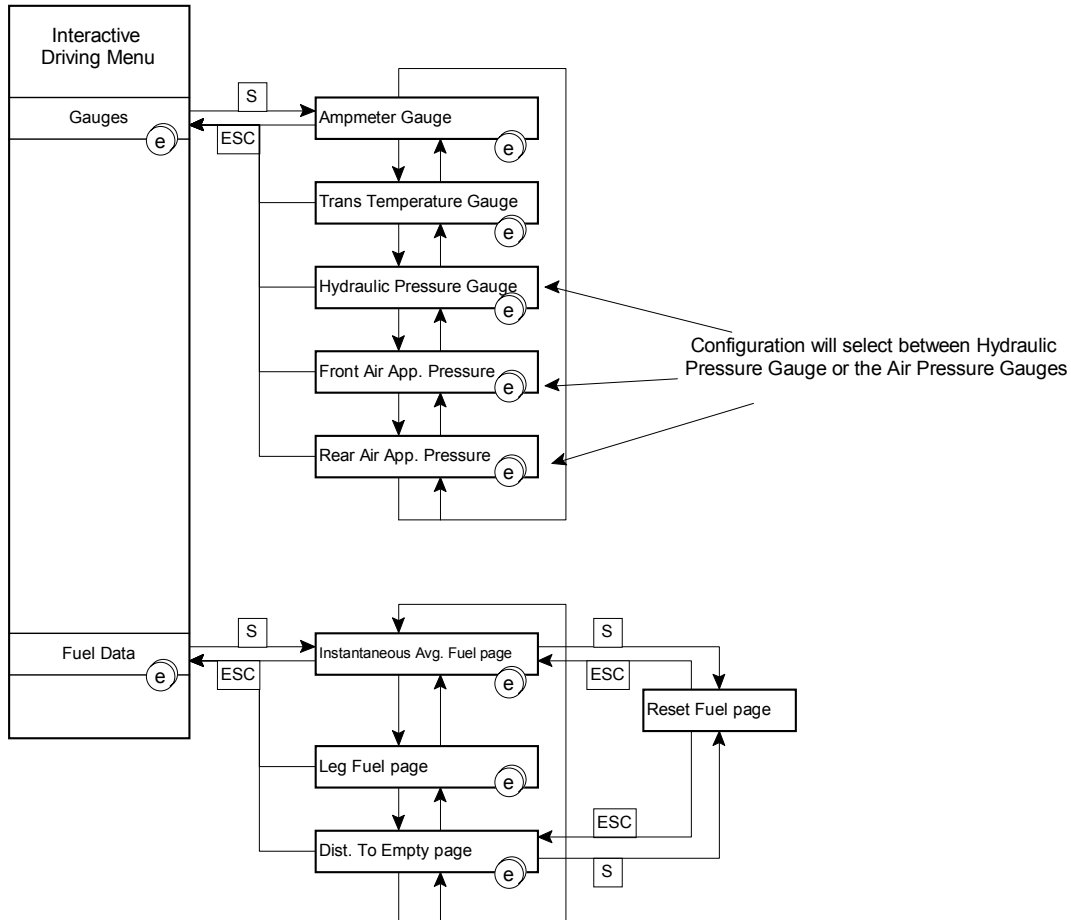
If a parameter that the cluster expects to receive via J1939 data link, is missed for a continuous period of 5 seconds. DID will display dashes for missed information (-----); gauges will show the condition by positioning the pointer below the first tick mark in the scale.

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## 10. APPENDIX I

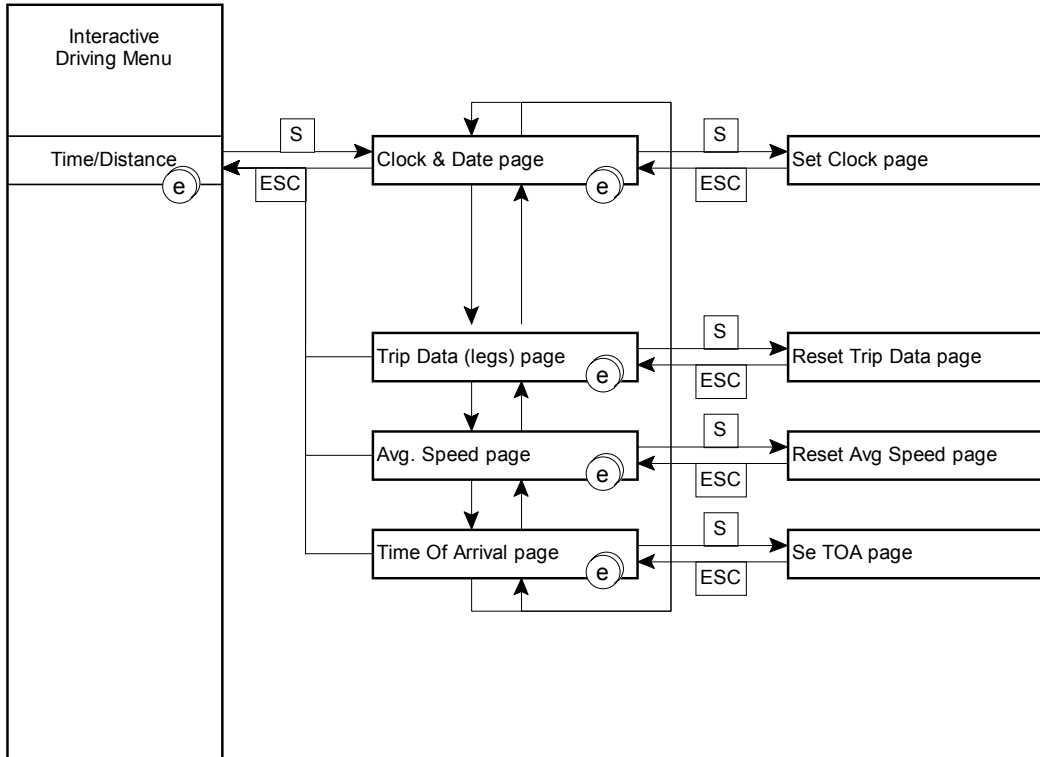
### 10.1. Interactive Drive Menu / Gauges and Fuel Data



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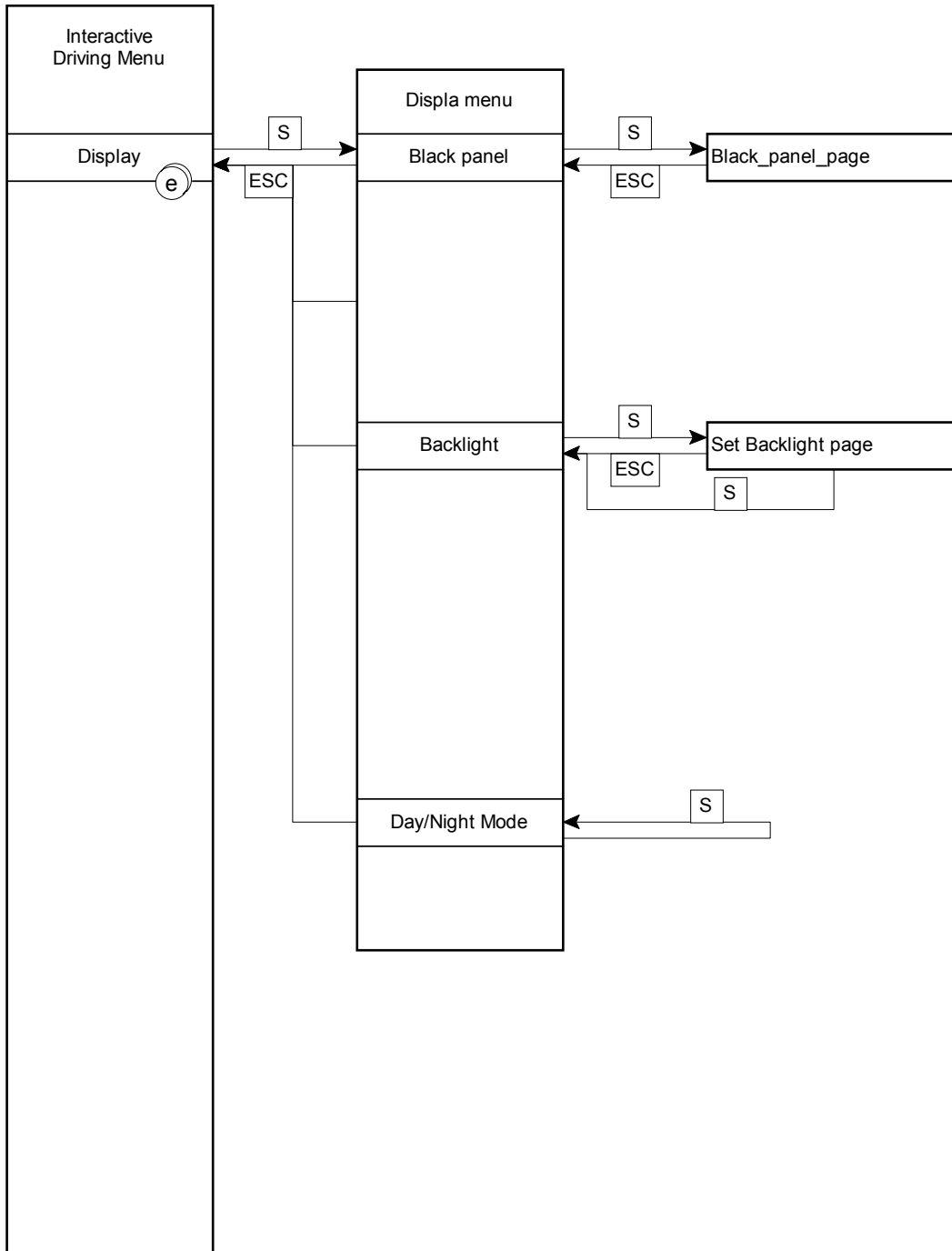
## 10.2. Interactive Drive Menu / Time & Date



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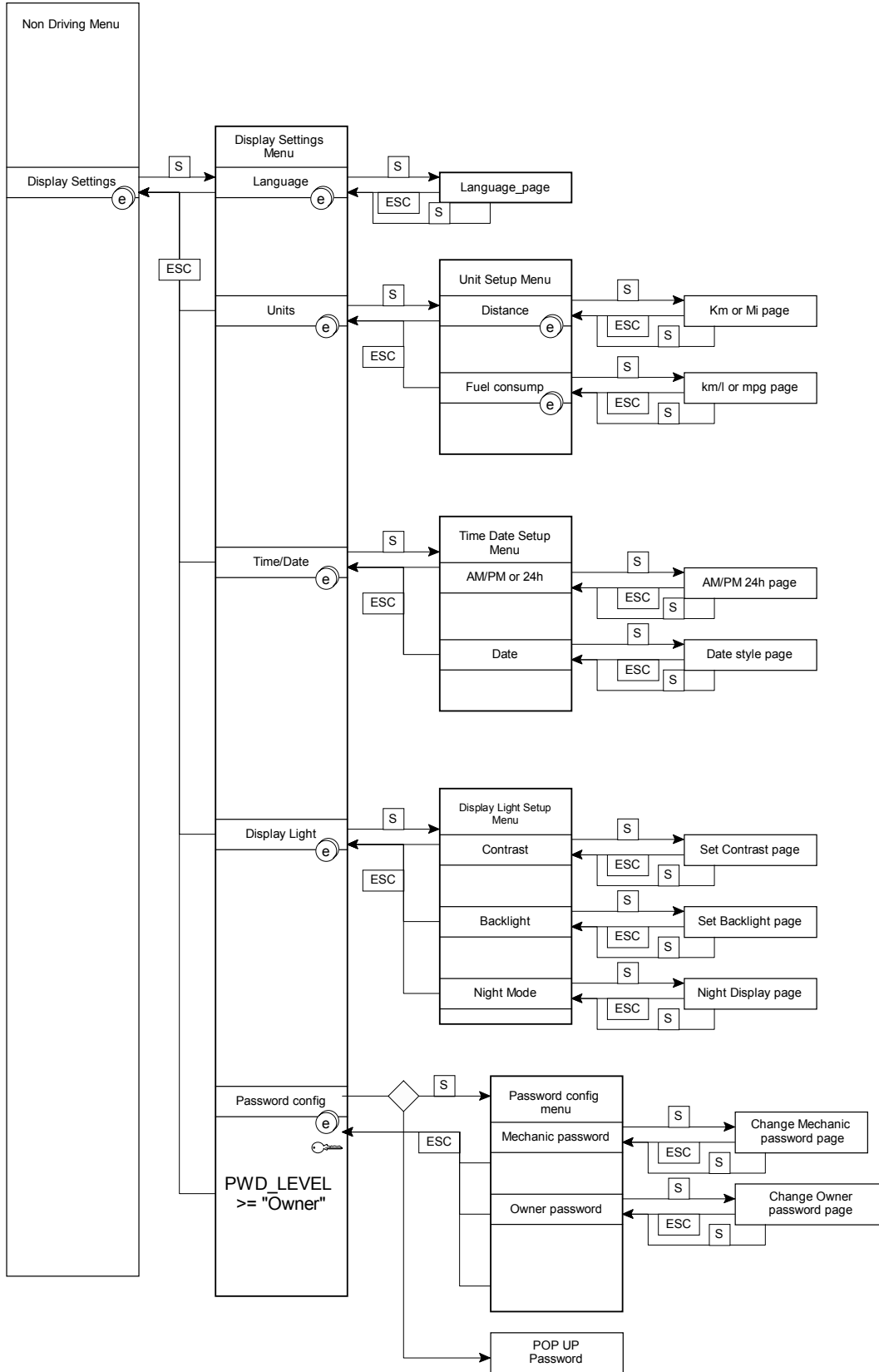
### 10.3. Interactive Drive Menu / Display



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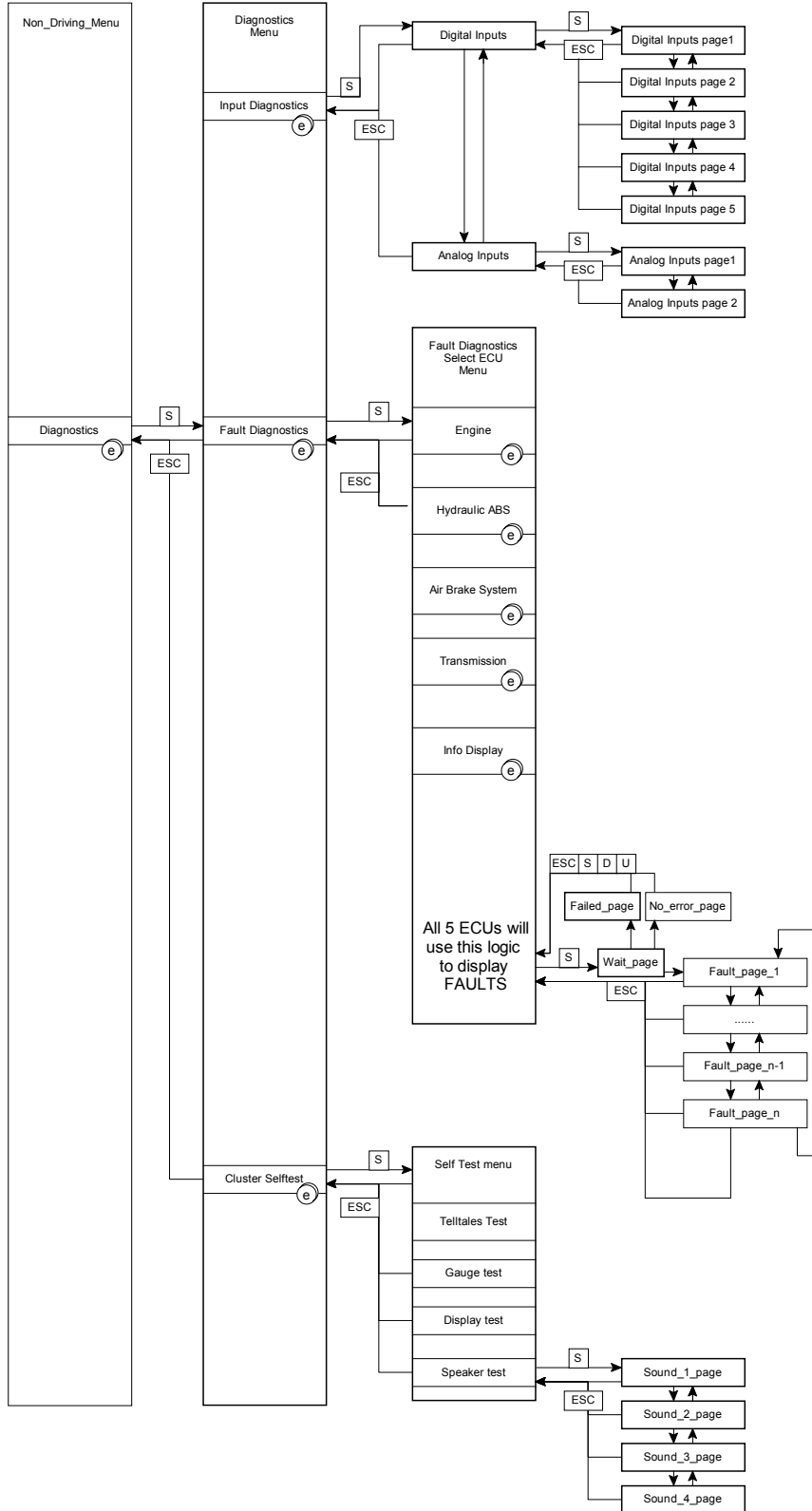
## 10.4. Non Drive Menu / Display Setting Menu



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### 10.5. Non Drive Menu / Diagnostics





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## 10.6. Non Drive Menu / Configuration, Part Number & Password

