1 HUD_Distance to Empty (DTE) Display Function – CGEA 1.3

1.1 Functional Description

The purpose of the Distance To Empty (DTE) function is to give the driver information on how far the vehicle can travel with the fuel remaining in the tank with the current fuel economy conditions. This DTE function can be used for the following powertrains: Gasoline, Diesel, Hybrid/Electric (HEV), Plug-In Hybrid/Electric (PHEV) and Flex-Fuel.

The DTE function is also expanded to include low fuel warning by changing the color of fuel icon from “white” to “amber”.

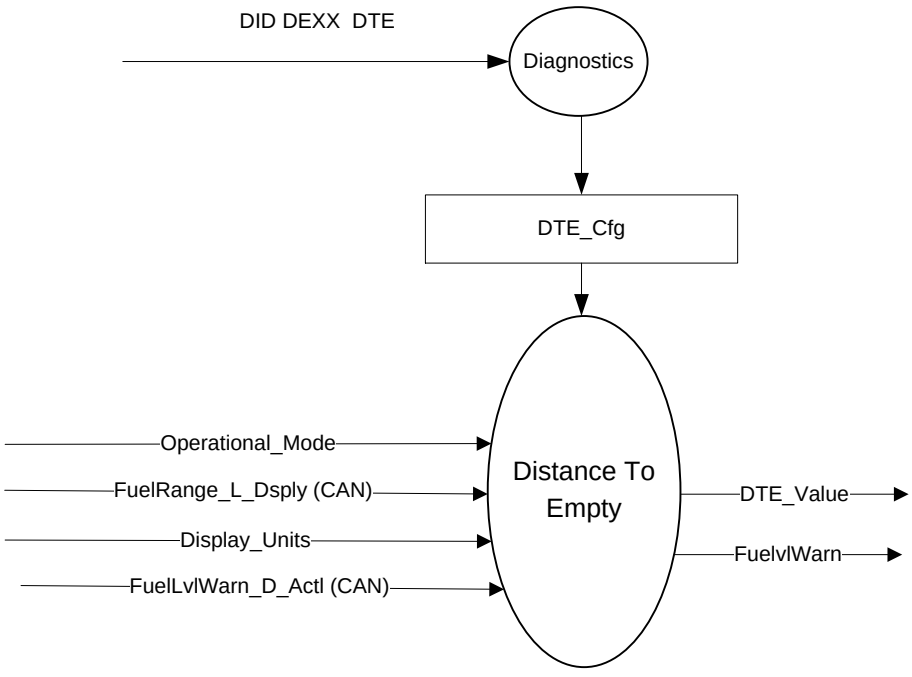
The DTE display in HUD is a client function of the IPC where DTE value is calculated and output to the CAN bus. IPC as the server is responsible for the integrity, accuracy, filtering of the DTE signals while HUD as a client is responsible for display and unit conversion.

The DTE function is a display of integers in either Kilometers or Miles.

1.2 Interfaces

1.2.1 Interface Context Diagram (I/O Block Diagram)

DTE Context Diagram



1.2.2 Inputs

1.2.2.1 IR-REQ-300063/A-Internal

- Operational_Mode

- Display_Units

1.2.2.2 MUX signals on the CAN Bus

1.2.2.2.1 SIG-REQ-300060/A-FuelRange_L_Dsply (CAN) Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
FuelRange_L_Dsply	14		km	0.1	0		0 (0x00)	(0x3FFF)

1.2.2.2.2 SIG-REQ-300061/A-FuelLvlWarn_D_Actl (CAN) Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
FuelLvlWarn_D_Actl	2		SED	1	0		0 (0x0)	3 (0x3)
		OK				0 (0x0)		
		Low				1 (0x1)		
		Very Low				2 (0x2)		
		Not Used				3 (0x3)		

1.2.3 IR-REQ-300065/A-Outputs

- DTE_Value
- FuelLvlWarn

1.3 Function/Performance

1.3.1 F-REQ-300064/A-Operational Modes

Mode	Differentiating Vehicle Conditions
Sleep Mode	DTE control function text message disabled
Limiting Mode	DTE control function text message disabled
Normal Mode	DTE control function text message enabled/disabled
Crank Mode	DTE control function text message enabled/disabled

1.3.2 Voltage Levels

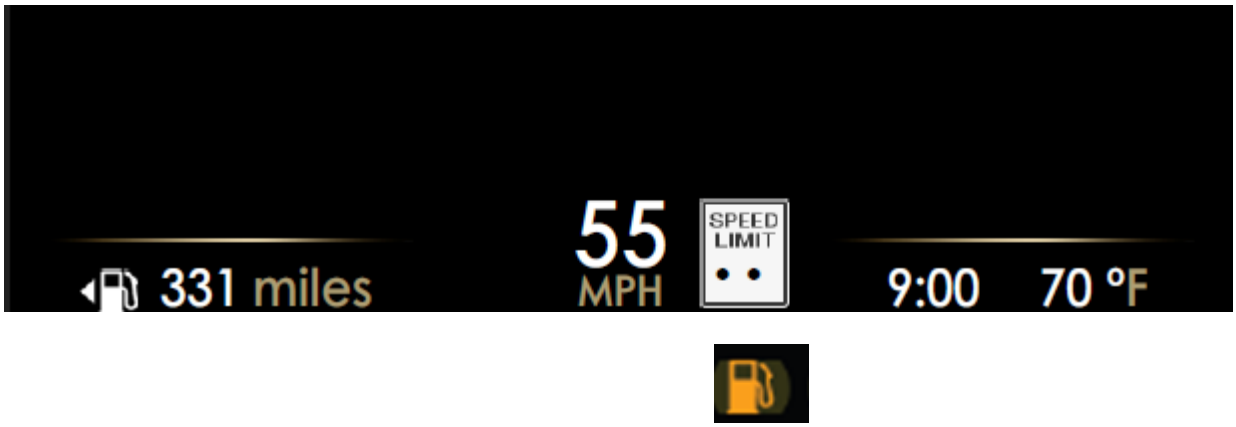
Refer to HUD Features Table located in the Operational Mode and Voltage Range Strategies Section of this SPSS.

1.3.3 Human-Machine Interface

1.3.3.1 Visual

1.3.3.1.1 Indicator Graphics / Display Format

Refer to Graphics Section in the Master Document Section in this SPSS. Example shown below.



1.3.3.1.2 Indicator Color Coordinates

Reference section COLOR & ILLUMINATION REQUIREMENTS (GRAPHICS)

1.3.3.1.3 HMI-REQ-300062/A-Indicator Characteristics

DTE display shall have a range of 0-999 miles and 0-999 km displayed in whole units while suppressing the leading zero. If possible, increase the km maximum display to 1999.

1.3.3.2 Audio

None

1.3.4 PFM-REQ-300066/A-System Accuracy

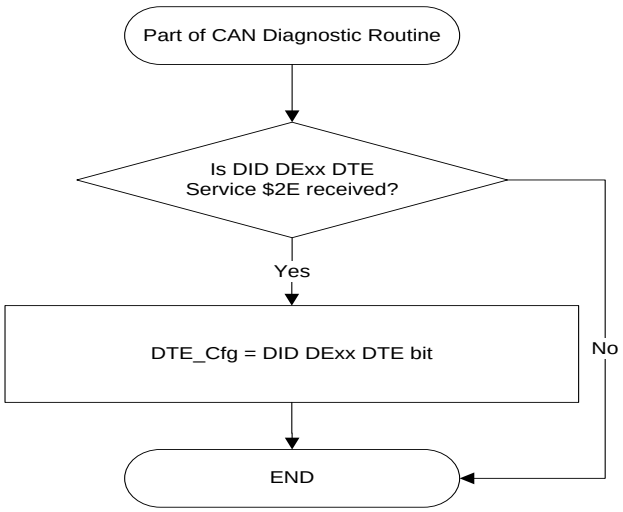
- Shall update DTE display every 100ms

1.3.5 Operation: Performance and Functional

1.3.5.1 Subsystem Algorithm Flowchart / State Diagram

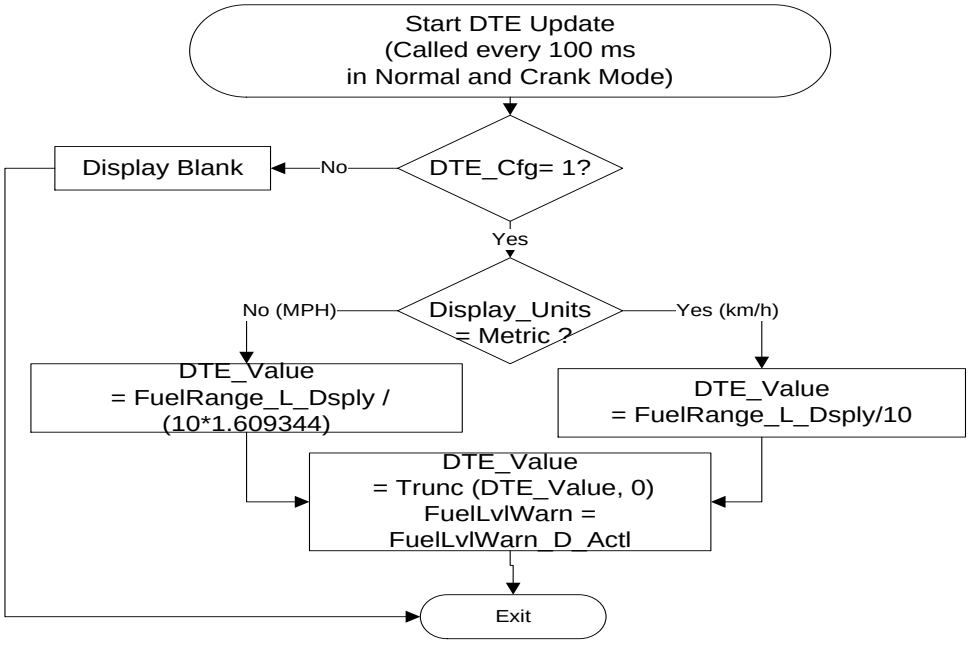
1.3.5.1.1 F-REQ-300067/A-CAN Diagnostic Routine

CAN Routine



1.3.5.1.2 F-REQ-300068/A-Subsystem Algorithm Flowchart

Subsystem Flowchart



1.3.5.2 Operation Description (supports algorithm flowchart /state diagram)

1.3.5.2.1 F-REQ-300069/A-Display Unit

The km value to be displayed to the customer shall be the same value from IPC. When the display is to be in English units, DTE_Value shall be divided by 1.609344 to convert it from km to mi prior to its truncation. (For example, when DTE_Value is 0.9 km and the display is in km, the driver sees “0 km”. Similarly, when DTE_Value is 1.6 km and the display is in miles, the driver sees “0 miles”.)

1.3.5.2.2 F-REQ-300070/A-Fuel Icon Color

The color of fuel icon shall change from “white” to “amber” (As indicated in section 1.3.31.1 Indicator Graphics / Display Format) when FuelLvlWarn = 0x1 (Low) or FuelLvlWarn = 0x2 (Very Low)

1.3.5.3 FS-REQ-300072/A;1-Function Safety Classification (EMC)

B

1.3.5.4 NVM-REQ-300071/A-Memory Storage

Parameter Name	Description	Value at Battery connect	Value at Module Wake-up
DTE_Value	Display distance to empty to the driver	0	Do Not Init
FuelRange_L_Dsply	CAN signal from IPC based on DTE_MC_Value in units of km with a resolution of 0.1.	0	Do Not Init
FuelLvlWarn_D_Actl	CAN signal from IPC	0x0(OK)	Do Not Init
Operational_Mode	4 State indicator for HUD operational mode	Limited	Limited or Normal or Crank
Display_Units	Unit mirrored from CAN signal from IPC	Default (Metric)	Default (Last known)
FuelLevWarn	Mirrored from CAN signal from IPC (FuelLvlWarn_D_Actl)	0x0(OK)	Do Not Init
DTE_Cfg	State Indicator for presence of DTE display	Use Stored Value	Use Stored Value

1.3.5.5 Prove Out

No

1.3.5.6 Reconfigurable Telltale

No

1.3.5.7 Message Center Msg

None

1.4 Error Handling

1.4.1 Missing Message Strategy

1.4.1.1 Missing Reference

The signals will be declared missing as per the Diagnostics Section of this SPSS.

1.4.1.2 SR-REQ-300073/A-Receiving a valid message

This function shall indicate as per its state matrix within 100mS of receiving a valid message.

1.4.2 Hardware failure

1.4.3 Invalid Message Strategy

None

1.5 Diagnostics

1.5.1 Self Test

None

1.5.2 Engineering Test Mode

Refer to the DTE function ETM displays of DTE.

1.5.3 Part 2 Performance

1.5.3.1 DID-REQ-300074/A-Supported Diagnostic DIDs

Number	DID / CommonID Name	PID Type	Comments
$4195	Distance To Empty - Displayed	Numeric	This will report the current displayed Distance To Empty (DTE_Value) calculation in km.

1.5.3.2 DTC-REQ-300075/A-Supported Diagnostic Trouble Codes (DTCs)

DTC	Description
C15500	Lost communication with IPC

1.5.3.3 DCR-REQ-300076/A-DID DExx

Block Num	Block Description	Size (bits)	Type	Byte(s)	Bits	State: Description	"0"	"1"	Default	Comments/ Information
PACKETED BLOCKS										

$xx	Option Content (B&A)	*	1	*	*	DTE_Cfg	Disabled	Enabled	Enabled	Enabled turns on DTE display.
*Byte and bit location to be identified in Part II Specification for this HUD										

1.6 Reference Specification

IPC - Distance to Empty Function - CGEA1.3_v14.0

1.7 Revision History

STSS Module Revision History

Revision Level	Name	Change Description	Date
1.0	M. Ye	Initial Release	4/24/2014
1.1	M.Ye	Introduced low fuel warning amber color change to the fuel icon	3/18/2015
1.2	P.Dendukuri	Initial VSEM RM Release	03/06/2018