Research & Vehicle Technology
"Infotainment Systems Product Development"

Feature – Gauges Display

Infotainment Subsystem Part Specific Specification (SPSS)

Version 1.0

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Revision History

Date	Version	Notes	
August 11, 2021	**1.0**	**Initial Release**	

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1 Architectural Design

1.1 Overview

This feature represents a set of functions whose main intention is to provide information for various vehicle data, such as Engine Temp, Vacuum value etc to the user. These are called Gauges and their availability could depend on the vehicle type.

1.2 GAUG-CLD-REQ-416226/A-Gauges Client

Client provides information to the user through graphical interface.

1.3 GAUG-CLD-REQ-416227/A-Gauges Server

Server is the various vehicle modules that provide data to the client.

1.4 Logical Signal Mapping

The CAN signals mentioned throughout this document shall refer to the CAN signal's logical name. The logical names shall be mapped to their actual CAN signal names. Please use the table below to perform the mapping. The InfoCAN database file is the master file for the actual CAN signal names. Note: some CAN signals referenced throughout this document may use the logical name while some may use the actual CAN signal name.

Logical Name	CAN Signal Name
IgnSt	Ignition_Status
LAirtoFuelRatio	EngIpcDsplyAfr_Rt_Actl
LAxleOilTemp	RearDiffOil_Te_Actl
LCylHeadTemp	EngIpcDsplyCht_Te_Actl
LVacuum	EngMnfld_P_Actl
LEngOil	EngOil_Te_Actl
LManifoldTemp	EngMnfldChrg_Te_Actl
LCoolTemp	EngInnrClnt_Te_Actl
LinletAirTemp	EngAirIn_Te_Actl
LTransFluidTemp	GboxOil_Te_Actl
LAccLong	VehLongComp_A_Actl
LAccLat	VehLatComp_A_Actl
LOilP	EngOil_P_Actl

1.5 GAUG-IIR-REQ-416228/A-Gauges Client Rx

1.5.1 GAUG-REQ-416215/A-IgnSt

IgnSt: This signal is received by the client. It provides vehicle power state.

Parameter	Parameter Description
0x0	Unknown
0x1	Off
0x2	Accessory
0x4	Run
0x8	Start
0xF	Invalid

1.5.2 GAUG-REQ-416216/A-LAirtoFuelRatio

LAirtoFuelRatio : This signal is used to describe Air To Fuel ratio.

Parameter	Parameter Description
0x0	0
0xFF	25.5

1.5.3 GAUG-REQ-416217/A-LAxleOilTemp

LAxleOilTemp: This signal provides axle oil temperature data.

Parameter	Parameter Description
0x0	-40
0x1FE	510
0x1FF	Faulty

1.5.4 GAUG-REQ-416218/A-LCylHeadTemp

LCylHeadTemp: This signal is sent to the client to indicate cylinder head temperature data.

Parameter	Parameter Description
0x0	-60
0xFF	195

1.5.5 GAUG-REQ-416219/A-LVacuum

LVacuum : This signal data is used by the vacuum features.

Parameter	Parameter Description
0x0	0
0x1FFF	8191

1.5.6 GAUG-REQ-416220/A-LEngOil

LEngOil: This signal is used to indicate engine temperature.

Parameters	Parameter Description
0x0	-60
0xFD	193
0xFE	Unknown
0xFF	Fault

1.5.7 GAUG-REQ-416221/A-LManifoldTemp

LManifoldTemp: This signal is used to indicate manifold temperature.

Parameter	Parameter Description
0x0	-20
0x7E	No data Exists
0x7F	Faulty

1.5.8 GAUG-REQ-416222/A-LCoolTemp

LCoolTemp: This signal is used to indicate Intercooler coolant temperature value.

Parameter	Parameter Description
0x0	-20
0x7E	No Data Exists
0x7F	Faulty

1.5.9 GAUG-REQ-416223/A-LinletAirTemp

LinletAirTemp: This signal is used to indicate the value of air temperature in the cold air inlet tube.

Parameter	Parameter Description
0x0	-128
0x3FD	127.25
0x3FE	No Data Exists
0x3FF	Faulty

1.5.10 GAUG-REQ-416481/A-LTransFluidTemp

LTransFluidTemp is sent from the server to the client to indicate transmission fluid temperature. The signal content is written below:

Parameter	Parameter Description
0x0	-60
0xFD	193
0xFE	Unknown
0xFF	Fault

1.5.11 GAUG-REQ-416489/A-LAccLong

LAccLong: this signal is sent from the server to indicate acceleration longitude value.

Parameter	Parameter Description
0x0	-17.9
0x3FD	17.835
0x3FE	Unknown
0x3FF	Fault

1.5.12 GAUG-REQ-416490/A-LAccLat

LAccLat: This signal is sent from the server to the client to indicate the acceleration latitude value.

Parameter	Parameter Description
0x0	-17.9
0x3FD	17.835
0x3FE	Unknown
0x3FF	Fault

1.5.13 GAUG-REQ-428174/A-LOilP

LOilP: It's a 10 bit long signal. The signal is used to indicate Engine Oil Pressure

2 General Requirements

2.1 GAUG-REQ-416054/A-Gauges Availability

Not all vehicle will necessarily have all the gauges described in this documentation. All gauges should have their own configuration values properly documented in diagnostics spec. When a gauge is not available, any data or display elements related to that gauge should not be displayed.

2.2 GAUG-REQ-416055/A-Power Mode Operation

The feature should be accessible for interaction to the user while signal IgnSt is 0x4 (Run) or 0x8 (Start).

2.3 GAUG-REQ-416056/A-Gauges Boundary Limits

This feature is visual heavy in detail and requirements. Various gauges have min and max data display limits. This boundary is depended on vehicle type hence its sort of "dynamic". The gauges could have numerical content color coded, such as high values red and low values green. This SPSS does not document the limits of the gauges nor the colors. Please refer to HMI or diagnostics specs for those details.

2.4 GAUG-REQ-416061/A-Unit Displays

The client shall differentiate between English and non English unit systems. It shall convert the data provided by the signals accordingly based on what unit the data is being received and what unit the data needs to be displayed.

2.5 GAUG-REQ-416062/A-Signal Offset And Resolution

This documentation will provide some algorithms needed to convert raw data provided by the signal to user friendly format. It may include signal offset and/or resolution if any are applicable. The client could do some of this conversion painlessly for developers so the formulas will need to be readjusted. Pay attention to what CCPU is providing for programming so that the conversion the client does from raw data to user friendly data match when doing the conversion manually following the formula.

2.6 GAUG-REQ-416185/A-Missing Signal Definition

A missing signal is being defined as a signal not being received by the client for 5 consecutive seconds. When this occurs, the gauges should indicate rest position.

2.7 GAUG-REQ-416628/A-Truncation

Some formulas or data conversion use the shortcut TRUNC. This means that the client should use only the full digit numerical value provided by the formula and discard any decimal values when displaying the data.

2.8 GAUG-REQ-433537/A-Non Valid States

Some gauge signals have scalar values only while some other gauge signals have additional parameters such as “No Data Exist”, Unknown or Faulty.

In case client receives any of these parameters “No Data Exist” or Unknown or Faulty , or the signal has some type fault as defined by CAN protocol, the client shall display that particular gauge in the rest position.

3 Functional Definition

3.1 GAUG-FUN-REQ-416609/A-Air To Fuel Ratio

3.1.1 Overview

The purpose of the Air/Fuel ratio gauge display is to provide a read out of ratio of Air to Fuel in the engine.

3.1.2 Requirements

3.1.2.1 GAUG-REQ-416060/A-Air To Fuel Ratio Gauge

Client shall use the data provided by the signal LAirtoFuelRatio to display Air To Fuel Ratio Gauge.

3.2 GAUG-FUN-REQ-416610/A-Axle Oil Temperature

3.2.1 Overview

The purpose of the Axle Oil Temperature Gauge is to inform the driver of the vehicle's rear differential oil temperature.

3.2.2 Requirements

3.2.2.1 GAUG-REQ-416091/A-Axle Oil Temperature

Client shall use the data provided by the signal LAxleOilTemp to display Axle Oil Temperature Gauge.

3.2.2.2 GAUG-REQ-416092/A-Data Conversion

Data conversion for this gauge is necessary in order to understand the raw hex signal data into a user friendly temperature readout. The formula to do so is provided below.

For English units:
Axle Oil Temp Display= Trunc((LAxleOilTemp- 40)*9/5+32)

For Metric units:
Axle Oil Temp Display= Trunc(LAxleOilTemp- 40)

3.3 GAUG-FUN-REQ-416611/A-Cylinder Head Temperature

3.3.1 Overview

The purpose of the Cylinder Head Temperature gauge display is to provide a read out of the vehicle's cylinder heads temperature to the user.

3.3.2 Requirements

3.3.2.1 GAUG-REQ-416097/A-Cylinder Head Temperature Signal

The client must update the Cylinder head Temperature Display Gauge with the data provided by signal LCylHeadTemp.

3.3.2.2 GAUG-REQ-416098/A-CHT Data Conversion

Data conversion for this gauge is necessary in order to understand the raw hex signal data into a user friendly temperature readout. The formula to do so is provided below.

For English:

Cylinder Head Temp Display= Trunc((LCylHeadTemp- 60)*9/5+32)

For non English:
Cylinder Head Temp Display= Trunc(LCylHeadTemp- 60)

3.4 GAUG-FUN-REQ-416612/A-Inlet Air Temperature

3.4.1 Overview

The purpose of the Inlet Air Temperature gauge display is to provide a read out of the temperature of the air in the cold air inlet tube.

3.4.2 Requirements

3.4.2.1 GAUG-REQ-416224/A-Air Inlet Temp Signal

The client must update Air Inlet Temperature gauge with data from LinletAirTemp signal.

3.4.2.2 GAUG-REQ-416225/A-Air Inlet Data Conversion

Depending on unit setup, Metric or English, and the value of LVacuum, the signal data gets processed like below before the end result gets displayed to the user.

In English Units:
Inlet Air Temperature Display = TRUNC[{(LinletAirTemp *0.25)-128} *9/5 +32]

In Non English Units:
Inlet Air Temperature Display = {(LinletAirTemp *0.25)-128}

3.5 GAUG-FUN-REQ-416613/A-Transmission Fluid Temperature

3.5.1 Overview

The purpose of the Transmission Temperature Gauge display is to inform the driver of the vehicle's transmission temperature.

3.5.2 Requirements

3.5.2.1 GAUG-REQ-416479/A-Fluid Temperature Data Conversion

Data conversion for this gauge is necessary in order to understand the raw hex signal data into a user friendly temperature readout. The formula to do so is provided below.

For English units:
Transmission Temp Display= Trunc((LTransFluidTemp- 60)*9/5+32)

For not English units:
Transmission Temp Display= (LTransFluidTemp - 60)

3.5.2.2 GAUG-REQ-416478/A-Trans Fluid Temperature Signal

Client shall use the data provided by the signal LTransFluidTemp to display Transmission Fluid Temperature gauge.

3.6 GAUG-FUN-REQ-416614/A-Vacuum Temperature

3.6.1 Overview

The purpose of the Vacuum Gauge feature is to inform the driver of the amount of vacuum created in the intercooler.

3.6.2 Requirements

3.6.2.1 GAUG-REQ-416176/A-Vacuum Signal

The client must update the Vacuum gauge with the data from the signal LVacuum.

3.6.2.2 GAUG-REQ-416177/A-Vacuum Data Conversion

To convert the data to display format, in Hg, the signal data will need to be processed like below:

if LVacuum <=0

English Units
Vacuum indication= [ABS (LVacuum-206.8)*0.2961] in HG

Non English Units
Vacuum indication= [ABS {(LVacuum-206.8)*0.2961}*25.32] mm Hg

If LVacuum >0
Gauge should stay in “Rest” position.

3.7 GAUG-FUN-REQ-416615/A-Boost Vacuum

3.7.1 Overview

The Boost/Vacuum gauge display informs the driver of the pressure or vacuum in the intercooler.

The CAN message will report all pressures in units of kPa. A zero value in the CAN input will correspond to atmospheric pressure and read zero for boost and vacuum pressure. A negative value in the message will correspond to vacuum and the cluster will convert the vacuum to inches of Hg. A positive value in the message will correspond to boost pressure.

3.7.2 Requirements

3.7.2.1 GAUG-REQ-416179/A-Boost Vacuum Signal

The client must update the Boost Vacuum gauge with the data from the signal LVacuum.

3.7.2.2 GAUG-REQ-416180/A-Boost Vacuum Data Conversion

Depending on unit setup, Metric or English, and the value of LVacuum, the signal data gets processed like below before the end result gets displayed to the user.

In English System:
Lvacuum <0 kPA,
Boost Vacuum Display = [ABS (LVacuum – 206.8)*0.2961] in Hg

Lvacuum >0 kPA,
Boost Vacuum Display = [(LVacuum – 206.8)*0.145] psi

In Non English System

Lvacuum <0 kPA,
Boost Vacuum Display = {ABS [(LVacuum – 206.8)*0.2961] *25.32 } mm Hg

Lvacuum >0 kPA,
Boost Vacuum Display = {[(LVacuum – 206.8)*0.145] *(7/100) } bar

If in any unit system the LVacuum = 0, the gauge should display “Rest” position.

3.8 GAUG-FUN-REQ-416616/A-Voltage

3.8.1 Overview

The purpose of the Voltage Gauge is to inform the user of the vehicle’s battery voltage.

3.8.2 Requirements

3.8.2.1 GAUG-REQ-416183/A-Voltage Data

To acquire voltage data refer to S23e_IPC_remote_services_Inbound_Diagnostic .

3.9 GAUG-FUN-REQ-416617/A-Accelerometer Display

3.9.1 Overview

The accelerometer gauge displays instantaneous acceleration and max values for the positive and negative sides of both the longitudinal and latitudinal axes. The longitudinal axis represents forward acceleration in the negative direction and braking in the positive direction. The latitudinal axis represents right acceleration in the positive direction and left acceleration in the negative direction.

3.9.2 Requirements

3.9.2.1 GAUG-REQ-416484/A-Accelerometer Latitude Signal

Accelerometer gauge shall use the signal LAccLat to acquire and show latitude acceleration.

3.9.2.2 GAUG-REQ-416485/A-Accelerometer Longitude Signal

Accelerometer gauge shall use the signal LAccLong to acquire and show longitude acceleration.

3.9.2.3 GAUG-REQ-416491/A-Display Value

Accelerometer Gauge shall display the values the signals after they are processed as below:

When
Absolute value (LAccLong) < or = 0.98 or Absolute value (LAccLat) < or = 0.98
Client shall display 0 for those respective signal values.

Client shall display
LAccLong/9.8 and LAccLat /9.8

If there are any negative values, their respective absolute values should be shown.

3.9.2.4 GAUG-REQ-416486/A-Maximum Value

The client shall store and display the absolute maximum value to the user. The user should be able to reset the maximum value.

3.9.2.5 GAUG-REQ-416487/A-Units

The Accelerometer units are in G's (multiples of acceleration of gravity). One G = 9.8 m/sec^2, so the Accelerometer shall be in the range of -1.5 to +1.5 G's. The maximum Acceleration shall be set at 1.5 G.

3.10 GAUG-FUN-REQ-416618/A-Engine Oil Temperature

3.10.1 Overview

The purpose of the Engine Oil Temperature gauge display is to inform the user of the engine oil temperature.

3.10.2 Requirements

3.10.2.1 GAUG-REQ-416202/A-Engine Oil Display Signal

The client must update Engine Oil Temperature Gauge with the data from the signal LEngOil.

3.10.2.2 GAUG-REQ-416203/A-Engine Oil Temp Data Conversion

The Gauge will display different values depending on what unit system is active in client, English or non English.
The below information tells how to do that data conversion from the raw signal value.

For English Unit:

Engine Oil Temperature Display = TRUNC ((LEngOil – 60)*9/5+32)

For non English System:
Engine Oil Temperature Display = (LEngOil – 60)

3.11 GAUG-FUN-REQ-416619/A-Manifold Charge Temperature

3.11.1 Overview

The purpose of the Manifold Temperature gauge display is to inform the user of the temperature of the air in the cold air inlet tube.

3.11.2 Requirements

3.11.2.1 GAUG-REQ-416209/A-Manifold Charge Temperature Signal

Manifold Charge Temperature should read and display data provided by signal LManifoldTemp.

3.11.2.2 GAUG-REQ-416210/A-Manifold Charge Data Conversion

Data displayed depends if Client is displaying units in English or non English. The data conversion is done as below:

English Units
Manifold Charge Temperature Display = TRUNC [LManifoldTemp*9/5 + 32]
Units are F

Non English Units:
Manifold Charge Temperature Display = LManifoldTemp
Units are Degree C

3.12 GAUG-FUN-REQ-416620/A-Intercooler Coolant Temperature

3.12.1 Overview

The purpose of the Intercooler Coolant Temperature (ICT) gauge display is to inform the user of the temperature of coolant in the supercharger.

3.12.2 Requirements

3.12.2.1 GAUG-REQ-416212/A-Intercooler Cooler Temperature Signal

Intercooler Cooler Temperature gauge should use the data provided from the signal LCoolTemp to update the gauge value.

3.12.2.2 GAUG-REQ-416213/A-Intercooler Cooler Temperature Conversion

Data displayed depends if Client is displaying units in English or non English. The data conversion is done as below:

English Units
Intercooler Cooler Temperature Display = TRUNC [LCoolTemp*9/5 + 32]
Units are F

Non English Units:
Intercooler Cooler Temperature Display = LCoolTemp
Units are Degree C

3.13 GAUG-FUN-REQ-428063/A-Oil Pressure

3.13.1 Overview

The purpose or Oil Pressure Gauge is to notify the user for the engine oil pressure.

3.13.2 Requirements

3.13.2.1 GAUG-REQ-428149/A-Engine Oil Pressure

Client shall use the data provided by the signal LOilP to display Engine Oil Pressure Gauge.

3.13.2.2 GAUG-REQ-428150/A-Data Conversion

Depending on what unit the data is being displayed it may need some conversion based on the algorithm below:

English display:
Oil Pressure Displayed = [(LOilP*145)/1000]psi

For non English units display:
Oil Pressure Displayed = [{(LOilP*145)/1000}* (7/100)] bar

4 Appendix: Reference Documents

The list below contains the source documentation from where the requirements in this SPSS have been derived from.

Air to Fuel Ratio Gauge Display-CGEA1.3
Axle Oil Temperature Virtual Gauge Display - CGEA1.3
Cylinder Head Temperature Gauge CGEA1.3
Inlet-Air Temperature Gauge Display - CGEA1.3
Transmission Fluid Temperature Virtual Gauge Display - CGEA1.3_v3.0
Vacuum Gauge - CGEA1.3
Boost Vacuum Virtual Gauge Display - CGEA1.3
Accelerometer Display - CGEA 1.3
Manifold Charge Temperature Gauge Display - CGEA1.3
Intercooler Coolant Temperature Gauge Display - CGEA1.3
Oil Pressure Virtual Gauge Display Sensor Based- CGEA1.3_v1.4

S23e_IPC_remote_services_Inbound_Diagnostic