# Power Distribution Gauge – CGEA 1.2

## Functional Description

The Gauge information screen is used to educate the driver about the advantages of having an active system. Unlike other systems such as traction control or ABS, the Power Distribution system is always active. As road conditions require, engine torque is sent to the front and/or rear wheels to help maintain optimum traction. The dynamics of torque transfer boost output when wheels are slipping and cease torque transfer on steady state highway driving to save gas and reduce heat.

## Interfaces

### Interface Context Diagram (I/O Block Diagram)

Figure 1 Power Distribution Gauge Context Diagram



### Inputs

* INTERNAL:
  + Operational\_Mode
* MUX messages on the CAN Bus

1. PrplWhlTot\_Tq\_Actl Signal

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Signal Name** | **Size (bits)** | **Detail** | **Units** | **Res.** | **Offset** | **State**  **Encoded** | **Min** | **Max** |
| PrplWhlTot\_Tq\_Actl | 16 | - | newton\*meter | 4 | -131072 |  | -131072 | 131060 |
|  |  | No data exists |  |  |  | 0xFFFE |  |  |
|  |  | Fault |  |  |  | 0xFFFF |  |  |

1. AwdLck\_Tq\_Actl Signal

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Signal Name** | **Size (bits)** | **Detail** | **Units** | **Res.** | **Offset** | **State**  **Encoded** | **Min** | **Max** |
| AwdLck\_Tq\_Actl | 12 | - | newton\*meter | 1 | 0 |  | 0 | 4093 |
|  |  | Unknown |  |  |  | 0xFFE |  |  |
|  |  | Fault |  |  |  | 0xFFF |  |  |

1. AwdRnge\_D\_Actl Signal

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Signal Name** | **Size (bits)** | **Detail** | **Units** | **Res.** | **Offset** | **State**  **Encoded** | **Min** | **Max** |
| AwdRnge\_D\_Actl | 3 | - |  |  |  |  | 0 | 7 |
|  |  | Low range locked |  |  |  | 0x0 |  |  |
|  |  | Low range auto |  |  |  | 0x1 |  |  |
|  |  | Low range 2wd |  |  |  | 0x2 |  |  |
|  |  | Neutral |  |  |  | 0x3 |  |  |
|  |  | High range locked |  |  |  | 0x4 |  |  |
|  |  | High range auto |  |  |  | 0x5 |  |  |
|  |  | High range 2wd |  |  |  | 0x6 |  |  |
|  |  | Unknown |  |  |  | 0x7 |  |  |

1. Veh\_V\_ActlEng Signal

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Signal Name** | **Size (bits)** | **Detail** | **Units** | **Res.** | **Offset** | **State**  **Encoded** | **Min** | **Max** |
| Veh\_V\_ActlEng | 16 | - | kilometers / hour | 0.01 | 0 |  | 0 | 655.35 |

1. AwdRngeFalt\_D\_Stat Signal

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Signal Name** | **Size (bits)** | **Detail** | **Units** | **Res.** | **Offset** | **State**  **Encoded** | **Min** | **Max** |
| AwdRngeFalt\_D\_Stat | 2 | - | - | 1 | 0 |  | 0 | 3 |
|  |  | No\_Fault |  |  |  | 0x0 |  |  |
|  |  | Change\_Not\_Possible |  |  |  | 0x1 |  |  |
|  |  | Not\_Calibrated |  |  |  | 0x2 |  |  |
|  |  | Unknown |  |  |  | 0x3 |  |  |

1. GearLvrPos\_D\_Actl Signal

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Signal Name** | **Size (bits)** | **Detail** | **Units** | **Res.** | **Offset** | **State**  **Encoded** | **Min** | **Max** |
| GearLvrPos\_D\_Actl | 4 | - | SED | 1 | 0 |  | 0  (0x0) | 15  (0xF) |
|  |  | Park |  |  |  | 0x0 |  |  |
|  |  | Reverse |  |  |  | 0x1 |  |  |
|  |  | Neutral |  |  |  | 0x2 |  |  |
|  |  | Drive |  |  |  | 0x3 |  |  |
|  |  | Sport\_DriveSport |  |  |  | 0x4 |  |  |
|  |  | Low |  |  |  | 0x5 |  |  |
|  |  | first |  |  |  | 0x6 |  |  |
|  |  | second |  |  |  | 0x7 |  |  |
|  |  | third |  |  |  | 0x8 |  |  |
|  |  | fourth |  |  |  | 0x9 |  |  |
|  |  | fifth |  |  |  | 0xA |  |  |
|  |  | sixth |  |  |  | 0xB |  |  |
|  |  | Undefined\_Treat\_as\_Fault |  |  |  | 0xC |  |  |
|  |  | Undefined\_Treat\_as\_Fault |  |  |  | 0xD |  |  |
|  |  | Unknown\_Position |  |  |  | 0xE |  |  |
|  |  | Fault |  |  |  | 0xF |  |  |

### Outputs

1. IPC Parameters

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **IPC Internal Parameter Name** | **Size (bits)** | **Detail** | **Units** | **Res.** | **Offset** | **State**  **Encoded** | **Min** | **Max** |
| PWR\_D\_Front\_Percent\_Fill | 8 | Internal Filtered and properly saturated percent fill value. This is an input to the HMI display logic. | percent | 1 | 0 | - | 0 | 100 |
| PWR\_D\_Rear\_Percent\_Fill | 8 | Internal Filtered and properly saturated percent fill value. This is an input to the HMI display logic. | percent | 1 | 0 | - | 0 | 100 |

## Function/Performance

### Operational Modes

|  |  |
| --- | --- |
| **Mode** | **Differentiating Vehicle Conditions** |
| Sleep Mode | PWR\_D Gauge Function Off |
| Limited Mode | PWR\_D Gauge Function Off |
| Normal Mode | PWR\_D Gauge Function Functioning |
| Crank Mode | PWR\_D Gauge Function Functioning |

### Voltage Levels

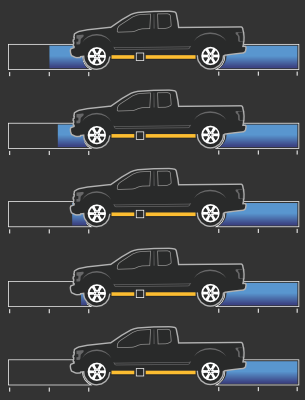
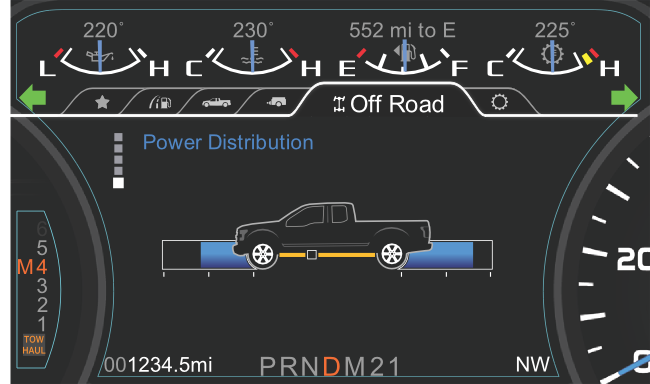
Refer to Cluster Features table located in Operational Modes and Voltage Range Strategies Section in this SPSS.

### Human-Machine Interface

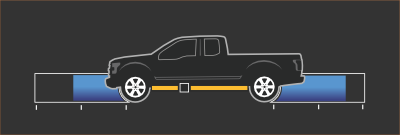
#### Visual

#### Indicator Graphics / Display Format (Graphics shown are typical examples, use correct images from Studio model)

**PWR\_D Gauge Screen Layout** **Rear Axle at 100% fill and Front Axle from 50% to 0% fill.**

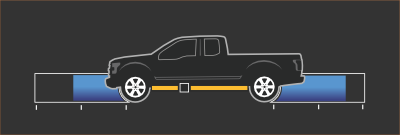


**Power distribution icon**

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* 0-100% Area Fill / Axle
* Represents the magnitude of engine power at the axle
* Power level closest to the axle represents the lowest power level. As the power at the axle increases, the area fills away from the axle

**Power level definition**

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Rear axle power

level 100%

Rear axle power

level 0%

Front axle power

level 100%

Front axle power

level 0%

As power increases, area moving outward from the vehicle fills

When power level turns “on”:

Percent fill = (Axle power / Max axle power)^linearity factor OR Percent fill = Result from lookup table

-Max axle power has an initial value but can increase if axle power is greater than max axle torque

-The linearity factor allows the fill area to have more resolution on the low side and less on the high side

- A lookup table will be provide to aid implementation of the linearity factor

-The axle power is a calculated value based on CAN signals

##### TT Graphics - full truck

Perspective View

##### Indicator Color Coordinates

As per Ford Studio Drawing

##### Indicator Characteristics

As per Ford Studio Drawing

#### Audio

None

#### Switch Control Logic

Consumer access to the PWR\_D Gauge Function’s display shall be as specified in the Menu Structure Section (STSS).

### System Accuracy

Within a 100msec of receiving a message that results in a change of state the cluster will update the display to the proper status.

### Operation: Performance and Functional

#### Subsystem Algorithm Flowchart / State Diagram

Figure 2 CAN Diagnostic Routine



Figure 3 Subsystem Flowchart



Figure 4 Model Execution Flow



#### Operation Description (supports algorithm flowchart /state diagram)

* The displayed PWR\_D Gauge update rate shall be every 100ms or faster with Ford Core Driver Information approval.
* The gauge shall not be displayed when PWR\_D\_Gauge\_Feature\_Cfg = Disabled
* The graphic fill will be linear to the value of PWR\_D\_xyz\_Percent\_Fill value. If the total fill is 50 pixels, then 0% and 1% will be 0 pixels, 2% and 3% will be 1 pixel, etc.

#### Function Safety Classification (EMC)

Class B

#### Memory Storage

| **Parameter Name** | **Description** | **Value at Battery connect** | **Value at**  **Module Wake-up** |
| --- | --- | --- | --- |
|  |  |  |  |
| PrplWhlTot\_Tq\_Actl | CAN Input. The calculated torque currently being delivered to all the axles at wheel level. | 0 | Do Not Init |
| AwdLck\_Tq\_Actl | CAN Input. Commanded center differential or coupling locking torque. | 0 | Do Not Init |
| AwdRnge\_D\_Actl | CAN Input. Current state of transfer box in terms of range and coupling locking. | 0 | Do Not Init |
| Veh\_V\_ActlEng | CAN Input. Vehicle speed. | 0 | Do Not Init |
| AwdRngeFalt\_D\_Stat | Status of All Wheel Drive system | 0 | Do Not Init |
| GearLvrPos\_D\_Actl | Automatic Transmission Gear Lever Position (Driver Selected Gear Lever Position). | Unknown Position (0xE) | Unknown Position (0xE) |
| PWR\_D\_Front\_Percent\_Fill | Filtered front fill percent. | 0 | 0 |
| PWR\_D\_Rear\_Percent\_Fill | Filtered rear fill percent | 0 | 0 |
| Operational\_Mode | Input to this routine that is a 4 State indicator for cluster operational mode | As per Operational Modes and Voltage Range Strategies Section (STSS) | As per Operational Modes and Voltage Range Strategies Section (STSS) |

#### Prove Out

No

#### Reconfigurable Telltale

No

#### Message Center Msg

Refer to Ford Studio Drawing

## Error Handling

### Missing Message Strategy

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

DTCs states and history will be determined as per the Diagnostics section of this SPSS.

If PWR\_D\_Gauge\_Feature\_Cfg = Disabled (0x0), the cluster shall never log a missing message DTC due to this feature.

### Invalid Data Strategy

See Figure 1.3.

## Diagnostics

### Self Test

None

### Engineering Test Mode

Reference section “Dealer / Engineering Test Mode (ETM)”

### Part II Performance

**Supported Diagnostic DIDs (Service $22 and $2E)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number** | **DID / CommonID Name** | **Initial and Default Value** | **Resolution** | **Min Engineering Value** | **Max Engineering Value** | **DID Type** |
| $FDxx | PG\_LINEARITY\_FACTOR | Defined in attached PDG\_CALS\_CGEA\_1\_2\_v1\_0.m | 0.1 | 0.1 | 1 | Numeric |
| PG\_MAX\_POWER\_VALUE | 1 | 50 | 200 |
| PG\_PERCENT\_FILL\_CONV\_CONSTANT | 0.01 | 0.1 | 1 |
| PG\_POWER\_CONV\_CONSTANT | 1 | 1000 | 50000 |
| PG\_POWER\_MULITPLIER | 0.01 | 0 | 2 |
| PG\_REAR\_AXLE\_RATIO | 0.01 | 2 | 5 |
| PG\_WHEEL\_RPM\_CONV\_CONSTANT | 0.01 | 3 | 8 |
| PG\_PRPLWHL\_TQ\_LOW\_LIMIT | 1 | 1 | 20 |
| PG\_WHL\_TRQ\_FILTER | 0.1 | 0.1 | 1 |
| PG\_DECAY\_RISING | 0.1 | 0.1 | 1 |
| PG\_DECAY\_FALLING\_HI\_TORQ | 0.01 | 0.01 | 1 |
| PG\_DECAY\_FALLING\_LO\_TORQ | 0.01 | 0.01 | 1 |
| PG\_DECAY\_FALLING\_SWITCHPOINT | 10 | 10 | 2500 |
| PG\_PT\_TORQUE\_MAX | 10 | 10 | 10000 |

**Supported Diagnostic Trouble Codes (DTCs)**

|  |  |
| --- | --- |
| **DTC** | **Description** |
| C10000 | Lost Communication With ECM/PCM "A" |
| C40100 | Invalid Data From ECM/PCM |
| C10200 | Lost Communication With Transfer Case Control Module |
| C40300 | Invalid Data From Transfer Case Control Module |

**DID DE00**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Block**  **Num** | **Block Description** | **Byte(s)** | **Bits** | **State: Description** | **"0"** | **"1"** | **Default** | **Comments/**  **Information** |
| PACKETED BLOCKS | |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| $00 | Option Content (B&A) | \* | 1 | PWR\_D Gauge Feature | Disabled | Enabled | Disabled |  |
|  |  |  |  |  |  |  |  |  |

## **Model Attachments**

|  |  |
| --- | --- |
| **Description** | **Model Attachments** |
| Use this attachment to view the model in a web browser. No modeling tools needed. |  |
| Simulink model. |  |
| Model constants. |  |
| Interpolation table. |  |

## **Reference Specification**

IS-0344 GENERAL REQUIREMENTS (MSGCENTR)

IS-0379 NORTH AMERICAN WARNINGS AND INDICATORS STRATEGY

2015\_U22x\_GAS\_V10c Message List

## Revision History

**SPSS Module Revision History**

| **Revision Level** | **Name** | **Change Description** | **Date** |
| --- | --- | --- | --- |
| 1.0 | Model: Filip Tomik  Interpolation Table: Richard McKamie  STSS: Jim Miloser | CGEA 1.2 initial version.  Modifications of CGEA 1.3 v 2.0:   1. changed PrplWhlTot2\_Tq\_Actl to PrplWhlTot\_Tq\_Actl and changed Faulty to Fault for 0xFFFF 2. Added Calibrations to support PG Torque Decay and Engine Brake Logic blocks. 3. Added C10200 for TCCM DTC. 4. Changed AwdLck\_Tq\_Rq to AwdLck\_Tq\_Actl. 5. Changed AwdSrvcRqd\_B\_Rq to AwdRngeFalt\_D\_Stat 6. Removed AWD DTCs. 7. Changed GearLvrPos\_D\_Actl detail meaning to match message list. | 11/14/2013 |
| 1.1 | STSS: Jim Miloser  Auto-code & integration:  Arturo Rodriguez Bollain ([arodr313@ford.com](mailto:arodr313@ford.com))  Resolution and Ranges:  James Asirvatham  (Jamesraj.Asirvatham@continental-corporation.com) | Section 1.5.3:  Changed service $2F to $2E.  Added resolution and ranges.  Added “ and Default” to Initial Value column.  Table 1.6:  Updated .m file’s PG\_PERCENT\_FILL\_CONV\_CONSTANT from 0.7 to 0.65 and attached new version. (PDG\_CALS\_CGEA\_1\_2\_v1\_1)  Updated Interpolation Table’s LINEARITY FACTOR constant to 0.8 and attached new version. (InterpolationTable\_v1.1)  Auto-code is located in [VSEM](https://www.vsemweb.ford.com:443/tc/launchapp?-attach=true&-s=226TCSession&-o=yFXNtJeDx3NrTDAAAAAAAAAAAAA):  PDG\_CGEA\_1\_2\_V2\_1 - fixed point.  PDG\_CGEA\_1\_2\_V1\_0 - floating point. | 07/29/2014 |
| 1.2 | Jim Miloser | Figure 3:  Changed “Veh\_V\_ActlEng is declared missing” to “Veh\_V\_ActlEng is declared missing or invalid” to account for Veh\_V\_ActlEng\_D\_Qf signal. | 7/31/2014 |