# Gear Display Control Function w/IOD - Ford Performance Specific – CGEA1.3

## Functional Description

The Gear Display Control Function w/IOD displays the gear position either as a continuous IOD or as a pop-up warning based on user preference. This feature provides the user the ability to set up the gear display so that it is displayed as a pop-up whenever the gear is changed provided the user is in “Manual” or “Live-and-drive” (paddle shifters) gear state.

During SST mode, the primary ePRNDS is traditionally displaying "M" or “S”. However, there is a new feature called "Live in Drive", which allows SST mode when the primary ePRNDL is "D". When the gear is in the tap up/tap down mode, referred to as Select Shift, a Number (1 through 7) will illuminate.

The Gear Display Control Function w/IOD correlates the TrnIpcDsplyGear\_D\_Actl signal, TrnIpcDsplyGear\_D\_Stat signal, ePRNDL display value, and the message center switch press events along with the Operational\_Mode to display the gear position as an IOD or a popup.

## Interfaces

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

**Figure 1: Gear Display Control Function w/IOD Context Diagram**



### Inputs

* + - * Operational\_Mode
      * Gear\_Select\_Cfg
      * M/C Display Status
      * M/C Switch Event
      * ePRNDL Display Value (From ePRNDL ES, Table 1, section 3.1.1.1)
      * Gear\_Disp\_Continious\_Cfg (supplier internal per end item)
      * MUX message on the CAN Bus

1. TrnIpcDsplyGear\_D\_Stat Signal

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Signal Name** | **Size**  **(bits)** | **Detail** | **Units** | **Res.** | **Offset** | **State Encoded** | **Min** | **Max** |
| TrnIpcDsplyGear\_D\_Stat | 2 |  | SED | 1 | 0 |  | 0 (0x0) | 3 (0x3) |
|  |  | Blank\_No\_Display |  |  |  | 0x0 |  |  |
|  |  | On |  |  |  | 0x1 |  |  |
|  |  | Flash |  |  |  | 0x2 |  |  |
|  |  | Reserved\_Blank\_No\_Display |  |  |  | 0x3 |  |  |

1. TrnIpcDsplyGear\_D\_Actl Signal

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Signal Name** | **Size (bits)** | **Detail** | **Units** | **Res.** | **Offset** | **State Encoded** | **Min** | **Max** |
| TrnIpcDsplyGear\_D\_Actl | 4 |  | SED | 1 | 0 |  | 0 (0x0) | 15 (0xF) |
|  |  | Neutral |  |  |  | 0x0 |  |  |
|  |  | 1st Gear |  |  |  | 0x1 |  |  |
|  |  | 2nd Gear |  |  |  | 0x2 |  |  |
|  |  | 3rd Gear |  |  |  | 0x3 |  |  |
|  |  | 4th Gear |  |  |  | 0x4 |  |  |
|  |  | 5th Gear |  |  |  | 0x5 |  |  |
|  |  | 6th Gear |  |  |  | 0x6 |  |  |
|  |  | 7th Gear |  |  |  | 0x7 |  |  |
|  |  | 8th Gear |  |  |  | 0x8 |  |  |
|  |  | 9th Gear |  |  |  | 0x9 |  |  |
|  |  | 10th Gear |  |  |  | 0xA |  |  |
|  |  | 11th Gear |  |  |  | 0xB |  |  |
|  |  | 12th Gear |  |  |  | 0xC |  |  |
|  |  | 13th Gear |  |  |  | 0xD |  |  |
|  |  | 14th Gear |  |  |  | 0xE |  |  |
|  |  | No Gear Selected |  |  |  | 0xF |  |  |

### Outputs

* Gear\_Display\_MC\_Warn\_Status\_Flag
* Gear\_Display\_Setup\_MC
* Gear\_IOD\_Display\_Value
* Gear\_RTT\_Display\_Value
* Gear\_Popup\_Display\_Value

## Function/Performance

### Operational Modes

| **Mode** | **Differentiating Vehicle Conditions** |
| --- | --- |
| Sleep Mode | Gear Select display OFF |
| Limited Mode | Gear Select display OFF |
| Normal Mode | Gear Select display ON / OFF |
| Crank Mode | Gear Select display ON / OFF |

The above table references the setting of the flags as per this section. However, the actual Gear Select display operation is defined in the Message Center section of this SPSS.

### Voltage Levels

Refer to the Cluster Features Table located in the Operational Modes and Voltage Range Strategies of this SPSS.

### Human-Machine Interface

#### Visual

##### Indicator Graphics / Display Format

**High-End Display (TFT) with SST**

1

For program specific display, refer to “<*Program*> Cluster Menu Structure.xls” and Program VAPS Model.

**Example Graphics:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Menu level 2** | **Menu Level 3** | **Menu level 4** |  | **Menu level 5** |
| Settings | Gauges | Gear Display |  | OFF (Default Setting) |
| 🞎 | ON |

##### Indicator Color Coordinates

Reference IL-0017.

##### Indicator Characteristics

As per HMI direction

#### Audio

None

### System Accuracy

Select Shift display shall respond within 100 msec of a state change as indicated in the state matrix.

### Operation: Performance and Functional

#### Subsystem Algorithm Flowchart / State Diagram

**Figure 2: Gear Display RTT/IOD Activation Process**



1. State Matrix for Gear Display IOD Value

|  |  |  |  |
| --- | --- | --- | --- |
| TrnIpcDsplyMde\_D\_Actl = 0x4 (Sport) or 0x3 (Drive)  AND  TrnIpcDsplyMde\_D\_Stat = 0x1 (On)  (i.e. ePRNDL Display Value is  “S” or "D" per ePRNDL ES) | TrnIpcDsplyGear\_D\_Stat  Signal | TrnIpcDsplyGear\_D\_Actl  Signal | Gear\_IOD\_Display\_Value |
| True | On (0x1) | 1st Gear (0x1) | 1 |
| Flash (0x2) | 1\* |
| On (0x1) | 2nd Gear (0x2) | 2 |
| Flash (0x2) | 2\* |
| On (0x1) | 3rd Gear (0x3) | 3 |
| Flash (0x2) | 3\* |
| On (0x1) | 4th Gear (0x4) | 4 |
| Flash (0x2) | 4\* |
| On (0x1) | 5th Gear (0x5) | 5 |
| Flash (0x2) | 5\* |
| On (0x1) | 6th Gear (0x6) | 6 |
| Flash (0x2) | 6\* |
| On (0x1) | 7th Gear (0x7) | 7 |
| Flash (0x2) | 7\* |
| X | X | Declared Missing | Dash |
| All Other Cases | | | Blank |

\* = Flash Gear value ON/Off at 2 Hz and 50%DC

1. State Matrix for Gear Display RTT Value

|  |  |  |  |
| --- | --- | --- | --- |
| **TrnIpcDsplyMde\_D\_Actl = 0x4 (Sport) or 0x3 (Drive)**  **AND**  **TrnIpcDsplyMde\_D\_Stat = 0x1 (On)**  **(i.e. ePRNDL Display Value is**  “S” or "D" per ePRNDL ES) | TrnIpcDsplyGear\_D\_Stat  Signal | TrnIpcDsplyGear\_D\_Actl  Signal | Gear\_RTT\_Display\_Value |
| True | On (0x1) | 1st Gear (0x1) | 1 |
| Flash (0x2) | 1\* |
| On (0x1) | 2nd Gear (0x2) | 2 |
| Flash (0x2) | 2\* |
| On (0x1) | 3rd Gear (0x3) | 3 |
| Flash (0x2) | 3\* |
| On (0x1) | 4th Gear (0x4) | 4 |
| Flash (0x2) | 4\* |
| On (0x1) | 5th Gear (0x5) | 5 |
| Flash (0x2) | 5\* |
| On (0x1) | 6th Gear (0x6) | 6 |
| Flash (0x2) | 6\* |
| On (0x1) | 7th Gear (0x7) | 7 |
| Flash (0x2) | 7\* |
| X | X | Declared Missing | Dash |
| All Other Cases | | | Blank |

\* = Flash Gear value ON/Off at 2 Hz and 50%DC

**Figure 3: Gear Popup Display Selection Process**



1. Gear Display Setup MC and next state based on M/C Switch Event

|  |  |  |  |
| --- | --- | --- | --- |
| **Gear\_Display\_Setup\_MC** | **Display Menu** | **M/C Switch Selection Event** | **Next**  **Gear\_Display\_Setup\_MC**  **State** |
| Off  (0x0) |  | Yes | On (0x1) |
| On  (0x1) |  | Yes | Off (0x0) |

Figure 3: Gear Display Pop-up Activation Process



1. State Matrix for Gear Display Popup Value

|  |  |  |  |
| --- | --- | --- | --- |
| **TrnIpcDsplyGear\_D\_Stat**  **Signal** | **TrnIpcDsplyGear\_D\_Actl**  **Signal** | **Gear\_Display\_MC\_**  **Warn\_Status\_Flag** | **Gear\_Popup\_Display\_Value** |
| On (0x1) | 1st Gear (0x1) | Active | 1 |
| Flash (0x2) | 1\* |
| On (0x1) | 2nd Gear (0x2) | 2 |
| Flash (0x2) | 2\* |
| On (0x1) | 3rd Gear (0x3) | 3 |
| Flash (0x2) | 3\* |
| On (0x1) | 4th Gear (0x4) | 4 |
| Flash (0x2) | 4\* |
| On (0x1) | 5th Gear (0x5) | 5 |
| Flash (0x2) | 5\* |
| On (0x1) | 6th Gear (0x6) | 6 |
| Flash (0x2) | 6\* |
| On (0x1) | 7th Gear (0x7) | 7 |
| Flash (0x2) | 7\* |
| X | Declared Missing | Dash |
| All Other Cases | | | Blank |

**\* = Flash Gear value ON/Off at 2 Hz and 50%DC**

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

* If the cluster operational mode transitions from SLEEP OR LIMITED to CRANK OR NORMAL, the cluster shall set Gear\_Select\_MC\_Status\_Flag equal to Inactive until the TrnIpcDsplyGear\_D\_Actl signal is received.
* The Gear/PRNDS RTT shall become inactive while the Gear Display IOD is active.
* The Gear Popup shall not get displayed while the Gear IOD is actively displayed.
* However, the Gear/PRNDS RTT shall remain actively displayed while the Gear Display Popup is active.
* The Gear Popup shall get displayed only when the user has Enabled the feature via the user menu.
* The IPC shall save the user gear display setting via the Gear\_Display\_Setup\_MC.
* The state of Gear\_Display\_Setup\_MC is retained thru ignition and cluster sleep/wake-up cycles.
* Gear\_Select\_Cfg is to be set to SST or Non-SST as per DID DE01. It is to be set to Non-SST as default at the cluster Supplier Plant.

#### Function Safety Classification (EMC)

B

#### Memory Storage

| **Parameter Name** | **Description** | **Value at**  **Battery Connect** | **Value at**  **Module**  **Wake-up** |
| --- | --- | --- | --- |
| Gear\_Display\_MC\_Warn\_  Status\_Flag | Used to control the state of the display for the Message Center arbitrator | Inactive | Inactive |
| Gear\_Display\_Setup\_MC | Used to save the state of the user setting option | Off | Do Not Init |
| Gear\_IOD\_Display\_Value | Determines the gear position displayed on the IOD screen | Blank | Blank |
| Gear\_RTT\_Display\_Value | Determines the gear position displayed on the IOD screen | Blank | Blank |
| Gear\_Popup\_Display\_Value | Determines the gear position displayed as a popup | Blank | Blank |
| Gear\_Select\_Cfg | State Indicator for feature presence controlled via CAN at EOL at VO plant. Defaulted to Non-SST at supplier manufacturing. | Use Stored Value | Use Stored Value |
| Gear\_Disp\_Continuous\_Cfg | Supplier internal NVM bit set to 0x1 (Enabled) when a cluster program desires continuous gear display. (Note that Gear\_Select\_Cfg has to be set to “SST” for this feature to work as well). Set as required per cluster end item part number. | Use Stored Value | Use Stored Value |
| TrnIpcDsplyGear\_D\_Actl  Signal | Input signal sent from the PCM to the IC | Neutral (0x0) | Neutral (0x0) |
| TrnIpcDsplyGear\_D\_Stat  Signal | Input signal sent from the PCM to the IC | Blank\_No\_Display (0x0) | Blank\_No\_Display (0x0) |
| Operational\_Mode | 4 state indicator for cluster operational mode | Limited | Limited or Normal or Crank |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Timer Name** | **Duration** | **Description** | **Min** | **Max** | **Resolution** |
| Gear\_Popup\_Display\_Timer | 2000ms | Used to limit the amount of time that the Gear popup is displayed. | 0ms | 2000ms | 100ms |

Note: Timers shall be programmable within the shown range, to at least the max value listed. Higher max values and finer resolutions are acceptable.

#### Prove Out

No

#### Reconfigurable Telltale

PRNDS RTT/icon

#### Message Center Msg

None

## 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.

## Diagnostics

### Self Test

None

### Engineering Test Mode

None

### Part II Performance

**Supported Diagnostic Trouble Codes (DTCs)**

| **DTC** | **Description** |
| --- | --- |
| C10000 | Lost communication with PCM |

**DID DExx**

| **Block**  **Num** | **Block Description** | **Byte(s)** | **Bits** | **State: Description** | **"0"** | **"1"** | **Default** | **Comments/ Information** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PACKETED BLOCKS | |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| $01 | Option Content (B&A) | \* | \* | Gear Select | Non-SST | SST | Non-SST | Set to Enable (0x1) on SST equipped vehicles |
|  |  |  |  |  |  |  |  |  |

## Reference Specification

ELECTRONIC PRNDL Requirements Specification (Reference ONLY)

## Revision History

**SPSS Module Revision History**

| **Revision Level** | **Name** | **Change Description** | **Date** |
| --- | --- | --- | --- |
| 1.0 | V.Patel | Initial revision  (Leveraged from Gear Selection Function with Primary ePRNDL – CGEA1.3 v6.1 STSS)  Feature owner: 2019 S550 EVO Systems  DI CC approval: 8/3/2017 | 9/12/2017 |
| 1.1 | V. Patel | The EVO team wants the gear position to be displayed at all times, except when the gear position is displayed as an IOD. This version adds this functionality. All changes are in yellow  DI CC approval: 10/05/2017  Feature owner: Todd Scaminaci (EVO team)  **Section 1.2**: Added Gear\_Disp\_Continuous\_Cfg as an internal config parameter and Gear\_RTT\_Display\_Value as an output. Also, replaced “GearRvrse\_D\_Actl” with the ePRNDL display value from the ePRNDL ES.  **Section 1.3.5.1**,  **Figure 2**: Developed a new flowchart that determines when to display the Gear RTT vs the Gear IOD screen.  **Table 1.3**: Modified the table since some of the inputs got moved to the flowchart in figure 2. Also, replaced “GearRvrse\_D\_Actl” with the ePRNDL display value from the ePRNDL ES.  **Table 1.4**: Created a new table that determines how/when the Gear RTT is displayed.  **Figure 3**: Replaced “GearRvrse\_D\_Actl” with the ePRNDL display value from the ePRNDL ES.  **Section 1.3.5.4**: Added the required init values for new input and output parameters.  Changed the default value of the Gear\_Popup\_Display\_Timer to 2 seconds based on HMI rules. | 10/26/2017 |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |