

**Research & Vehicle Technology**

**“Infotainment Systems Product Development”**

**Feature – Tire Pressure Monitor System Information on Demand**

**Infotainment Subsystem Part Specific Specification (SPSS)**

Version 1.0

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**FORD CONFIDENTIALF**

**Revision History**

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**Table of Contents**

[Revision History 2](#_Toc2668633)

[1 Overview 4](#_Toc2668634)

[2 Architectural Design 5](#_Toc2668635)

[2.1 TPMS-CLD-REQ-340179/A-TPMS Interface Client 5](#_Toc2668636)

[2.2 TPMS-CLD-REQ-340181/A-TPMS Server 5](#_Toc2668637)

[2.3 Physical Mapping of Classes 5](#_Toc2668638)

[2.4 Logical Signal Mapping 5](#_Toc2668639)

[2.5 TPMSInterfaceClient Interface 6](#_Toc2668640)

[2.5.1 TPMS-IIR-REQ-340211/A-TPMSInterfaceClient\_Rx 6](#_Toc2668641)

[3 General Requirements 10](#_Toc2668642)

[3.1 TPMS-REQ-342319/A-Powermode Conditions 10](#_Toc2668643)

[3.2 TPMS-REQ-342320/A-Feature Configuration 10](#_Toc2668644)

[3.3 TPMS-REQ-346038/A-Dually Configuration 10](#_Toc2668645)

[3.4 TPMS-REQ-342323/A-Missing Message Strategy 10](#_Toc2668646)

[4 Functional Definition 11](#_Toc2668647)

[4.1 TPMS-FUN-REQ-344470/A-TPMS Display 11](#_Toc2668648)

[4.1.1 Requirements 11](#_Toc2668649)

[4.1.2 Use Cases 12](#_Toc2668650)

[4.1.3 White Box Views 13](#_Toc2668651)

[5 Appendix: Reference Documents 16](#_Toc2668652)

# Overview

The Tire Pressure Monitor System IoD (information on demand) displays the driver information Tire Pressure data on the Centerstack HMI. See the HMI Spec for details of how this is displayed.

# Architectural Design

## TPMS-CLD-REQ-340179/A-TPMS Interface Client

The Tire Pressure Monitor System Interface Client (TPMSInterfaceClient) is responsible for the tasks listed below:

* Receiving tire pressure data and status from TPMSServer
* Displaying active tire pressure data and status on user interface

Please review the implementation guide/block diagram to locate the TPMSInterfaceClient class.

## TPMS-CLD-REQ-340181/A-TPMS Server

The Tire Pressure Monitor System Server (TPMSServer) is responsible for the tasks listed below:

* Monitoring and handling active tire pressure data and status
* Transmitting tire pressure data and status to TPMSInterfaceClient

Please review the implementation guide/block diagram to locate the TPMSServer class.

## Physical Mapping of Classes

The table below shows an example of how the logical classes that make up the TPMS IOD feature can be mapped into physical modules. This mapping is an example only and does not necessarily carryover to other carlines or vehicle architectures.

|  |  |
| --- | --- |
| **Logical Class** | **Physical Module (ECU)** |
| TPMSServer | BCM |
| TPMSInterfaceClient | SYNC |

## 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: There may be cases where the actual CAN signal name is used in this documentation.

|  |  |
| --- | --- |
| **Logical Name** | **CAN Signal Name** |
| TirePressureLeftFront\_St | Tire\_Press\_LF\_Stat |
| TirePressureRightFront\_St | Tire\_Press\_RF\_Stat |
| TirePressureLeftRear\_St | Tire\_Press\_LR\_OLR\_Stat |
| TirePressureRightRear\_St | Tire\_Press\_RR\_ORR\_Stat |
| TirePressureInnerLeftRear\_St | Tire\_Press\_ILR\_Stat |
| TirePressureInnerRightRear\_St | Tire\_Press\_IRR\_Stat |
| TirePressureDataLeftFront\_St | Tire\_Press\_LF\_Data |
| TirePressureDataRightFront\_St | Tire\_Press\_RF\_Data |
| TirePressureDataLeftRear\_St | Tire\_Press\_LR\_OLR\_Data |
| TirePressureDataRightRear\_St | Tire\_Press\_RR\_ORR\_Data |
| TirePressureDataInnerLeftRear\_St | Tire\_Press\_ILR\_Data |
| TirePressureDataInnerRightRear\_St | Tire\_Press\_IRR\_Data |

Table: Logical name/CAN signal mapping

## TPMSInterfaceClient Interface

### TPMS-IIR-REQ-340211/A-TPMSInterfaceClient\_Rx

#### MD-REQ-288953/A-TirePressureLeftFront\_St

Message Type: Status

Signal indicating the left front tire pressure status.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Left front tire pressure status |
|  | Unknown | 0x0 |  |
|  | Normal | 0x1 |  |
|  | Low | 0x2 |  |
|  | Fault | 0x3 |  |
|  | Alert | 0x4 |  |

#### MD-REQ-288954/A-TirePressureRightFront\_St

Message Type: Status

Signal indicating the right front tire pressure status.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Right front tire pressure status |
|  | Unknown | 0x0 |  |
|  | Normal | 0x1 |  |
|  | Low | 0x2 |  |
|  | Fault | 0x3 |  |
|  | Alert | 0x4 |  |

#### MD-REQ-288955/A-TirePressureLeftRear\_St

Message Type: Status

Signal indicating the left rear tire pressure status.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Left rear tire pressure status |
|  | Unknown | 0x0 |  |
|  | Normal | 0x1 |  |
|  | Low | 0x2 |  |
|  | Fault | 0x3 |  |
|  | Alert | 0x4 |  |

#### MD-REQ-288956/A-TirePressureRightRear\_St

Message Type: Status

Signal indicating the right rear tire pressure status.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Right rear tire pressure status |
|  | Unknown | 0x0 |  |
|  | Normal | 0x1 |  |
|  | Low | 0x2 |  |
|  | Fault | 0x3 |  |
|  | Alert | 0x4 |  |

#### MD-REQ-288957/A-TirePressureInnerLeftRear\_St

Message Type: Status

Signal indicating the inner left rear tire pressure status.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Inner left rear tire pressure status |
|  | Unknown | 0x0 |  |
|  | Normal | 0x1 |  |
|  | Low | 0x2 |  |
|  | Fault | 0x3 |  |
|  | Alert | 0x4 |  |

#### MD-REQ-288958/A-TirePressureInnerRightRear\_St

Message Type: Status

Signal indicating the inner right rear tire pressure status.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Inner right rear tire pressure status |
|  | Unknown | 0x0 |  |
|  | Normal | 0x1 |  |
|  | Low | 0x2 |  |
|  | Fault | 0x3 |  |
|  | Alert | 0x4 |  |

#### MD-REQ-289045/A-TirePressureDataLeftFront\_St

Message Type: Status

Status used to indicate pressure of the left front tire.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Indicates left front tire pressure  Unit: kilopascal  Resolution:1  Offset:0 |
|  | kilopascal | 0x0 to 0xFFFD |  |

#### MD-REQ-289046/A-TirePressureDataRightFront\_St

Message Type: Status

Status used to indicate pressure of the right front tire.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Indicates right front tire pressure  Unit: kilopascal  Resolution:1  Offset:0 |
|  | kilopascal | 0x0 to 0xFFFD |  |

#### MD-REQ-289048/A-TirePressureDataLeftRear\_St

Message Type: Status

Status used to indicate pressure of the left rear tire.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Indicates left rear tire pressure  Unit: kilopascal  Resolution:1  Offset:0 |
|  | kilopascal | 0x0 to 0xFFFD |  |

#### MD-REQ-289049/A-TirePressureDataRightRear\_St

Message Type: Status

Status used to indicate pressure of the right rear tire.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Indicates right rear tire pressure  Unit: kilopascal  Resolution:1  Offset:0 |
|  | kilopascal | 0x0 to 0xFFFD |  |

#### MD-REQ-289050/A-TirePressureDataInnerLeftRear\_St

Message Type: Status

Status used to indicate pressure of the inner left rear tire.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Indicates inner left rear tire pressure  Unit: kilopascal  Resolution:1  Offset:0 |
|  | kilopascal | 0x0 to 0xFFFD |  |

#### MD-REQ-289051/A-TirePressureDataInnerRightRear\_St

Message Type: Status

Status used to indicate pressure of the inner right rear tire.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Indicates inner right rear tire pressure  Unit: kilopascal  Resolution:1  Offset:0 |
|  | kilopascal | 0x0 to 0xFFFD |  |

# General Requirements

## TPMS-REQ-342319/A-Powermode Conditions

The TPMSInterfaceClient shall only allow the functionality defined by this feature/SPSS when the IgnitionStatus\_St = Run/Start, and the touch screen display is On.

If IgnitionStatus\_St != Run/Start, the TPMSInterfaceClient shall display dashes (ex. “- - -”) in place of any TPMS data.

## TPMS-REQ-342320/A-Feature Configuration

The TPMSInterfaceClient shall have a configurable parameter to determine whether the vehicle supports the TPMS IoD.

* If the parameter indicates the vehicle supports TPMS IoD, then all of the functionality and signals defined in this SPSS shall be supported, and the TPMS IoD shall be made available to the user.
* If the parameter indicates the vehicle does not support TPMS IoD, then none of the functionality defined in this SPSS shall be supported, and the TPMS IoD shall not be made available to the user.

## TPMS-REQ-346038/A-Dually Configuration

The TPMSInterfaceClient shall use the Drive Type configurable parameter (DE04 Byte 7) to determine whether the TPMS IoD shall use/display the Dual Rear Wheel (Dually) pressure data values.

If the parameter is set to “Dually” (any variant, ex. 2WD, 4WD) the Dually pressure/status shall be shown and the below signals shall be used:

* TirePressureInnerLeftRear\_St
* TirePressureInnerRightRear\_St
* TirePressureDataInnerLeftRear\_St
* TirePressureDataInnerRightRear\_St

## TPMS-REQ-342323/A-Missing Message Strategy

If any of the signals defined in this SPSS (used for displaying any TPMS data) become unavailable or missing from the bus for more than 5 seconds, the TPMSInterfaceClient shall display dashes (ex. “- - -”) in place of the corresponding TPMS data values with a “normal” status (no warning).

# Functional Definition

## TPMS-FUN-REQ-344470/A-TPMS Display

### Requirements

#### TPMS-REQ-344471/A-Displaying TPMS Data

The TPMSInterfaceClient shall display the TPMS data values for each of the TPMS locations based on the table below:

|  |  |
| --- | --- |
| **TPMS Location** | **TPMS Signal** |
| Left Front Tire | TirePressureDataLeftFront\_St |
| Right Front Tire | TirePressureDataRightFront\_St |
| Left Rear Tire | TirePressureDataLeftRear\_St |
| Right Rear Tire | TirePressureDataRightRear\_St |
| Left Rear Inner Tire | TirePressureDataInnerLeftRear\_St |
| Right Rear Inner Tire | TirePressureDataInnerRightRear\_St |

The TPMSInterfaceClient shall convert the data values accordingly

(where TirePressureDataXXXX\_St represents any of the above signals):

|  |  |  |
| --- | --- | --- |
| **TPMS Units**  **(REQ-344472)** | **TirePressureDataXXXX\_St** | **Value Displayed** |
| PSI | 0x0 – 0xFFFC | ### = Round(1)((TirePressureDataXXXX\_St)\*.14504) |
| kPa | 0x0 – 0xFFFC | ### = Round(2)(TirePressureDataXXXX\_St) |
| BAR | 0x0 – 0xFFFC | #. # = Round(3)((TirePressureDataXXXX\_St)\*.01) |
| (PSI) l (kPa) | (0xFFFD – 0xFFFF) | Dashes (- - -) |
| (BAR) | (0xFFFD – 0xFFFF) | Dashes (- . -) |

1. Round means to round to nearest ones digit (.1 - .4 round down, .5 - .9 round up)
2. Round means to round ones digit by fives (1, 2 round down), (3 – 7 round to 5), (8, 9 round up).
   1. For ex: (341, 342,) 🡪 340; (343, 344, 345,346, 347) 🡪 345; (348,349) 🡪 350.
3. Round means to round to nearest tenths digit (.01 - .04 round down, .05 – .09 round up)

#### TPMS-REQ-344639/A-Displaying TPMS Status

The TPMSInterfaceClient shall display the TPMS status for each of the TPMS locations based on the table below:

|  |  |
| --- | --- |
| **TPMS Location** | **TPMS Signal** |
| Left Front Tire | TirePressureLeftFront\_St |
| Right Front Tire | TirePressureRightFront\_St |
| Left Rear Tire | TirePressureLeftRear\_St |
| Right Rear Tire | TirePressureRightRear\_St |
| Left Rear Inner Tire | TirePressureInnerLeftRear\_St |
| Right Rear Inner Tire | TirePressureInnerRightRear\_St |

If any of the signals above read (0x2) Low or (0x4) Alert, the TPMSInterfaceClient shall display the corresponding TPMS data value with a “warning” status. All other encodings shall not display a “warning” status.

#### TPMS-REQ-344472/A-Displaying TPMS Units

The TPMSInterfaceClient shall display the TPMS units that were queried/set as defined in the “Settings In Infotainment Centerstack SPSS.” The requirement specific to TPMS units is VS-SR-REQ-234035-Tire Pressure Unit.

### Use Cases

#### TPMS-UC-REQ-344474/A-Displaying TPMS Data to the User

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | Powermode Conditions are met  TPMSInterfaceClient is ON |
| **Scenario Description** | The user selects the TPMS IOD on the TPMSInterfaceClient |
| **Post-conditions** | The TPMSInterfaceClient displays the TPMS Data and corresponding Status |
| **List of Exception Use Cases** | REQ-344475-Displaying Missing Data to the User |
| **Interfaces** | TPMSInterfaceClient  CAN, G-HMI |

#### TPMS-UC-REQ-344475/A-Displaying Missing Data to the User

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | Powermode Conditions are not met, OR  Signals from TPMSServer are missing from bus  TPMSInterfaceClient is ON |
| **Scenario Description** | The user selects the TPMS IOD on the TPMSInterfaceClient |
| **Post-conditions** | The TPMSInterfaceClient displays dashes (ex. “--.-”) in place of the all TPMS Data |
| **List of Exception Use Cases** |  |
| **Interfaces** | TPMSInterfaceClient  CAN, G-HMI |

### White Box Views

#### Activity Diagrams

##### TPMS-ACT-REQ-344477/A-TPMS Display

Activity Diagram



#### Sequence Diagrams

##### TPMS-SD-REQ-344478/A-TPMS Display

Constraints

Pre-Condition

Powermode Conditions are met

TPMSInterfaceClient is ON

Scenarios

Normal Usage

The user selects the TPMS IOD on the TPMSInterfaceClient

Post-Condition

The TPMSInterfaceClient displays the TPMS Data

Sequence Diagram



# Appendix: Reference Documents

|  |  |
| --- | --- |
| Reference # | Document Title |
| 1 | Settings In Infotainment CenterStack SPSS |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |
| 11 |  |
| 12 |  |
| 13 |  |
| 14 |  |
| 15 |  |
| 16 |  |
| 17 |  |