**Module Design Document**

**For**

**CF13 PSA State Handler**

**July 17, 2017**

**Prepared For:**

**Software Engineering**

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# Introduction

## Purpose

Module Design Document for CF13 PSA State Handler.

## Scope

The following definitions are used throughout this document:

* **Shall**: indicates a mandatory requirement without exception in compliance.
* **Should**: indicates a mandatory requirement; exceptions allowed only with documented justification.
* **May**: indicates an optional action.

# CF13 PSA State Handler & High-Level Description

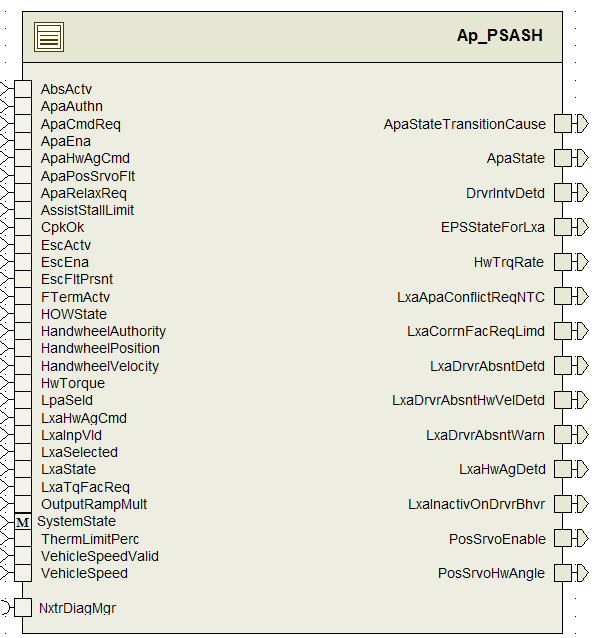
PSA state handler function will determine the state of the City Park. The states include Unavailable, Available, Control in Progress and Defective.

The states of the City Park State Handler Function are dependent upon Vehicle speed, Activation Request from the PSA City Park Controller, System Ambient temperature, Thermal Derating and Hand wheel Torque.

This City Park State Handler provides input to the Torque Arbitrator of City Park function.

# Design details of software module

## Graphical representation of CF13 PSA State Handler



## Data Flow Diagram

Refer FDD

### Module level DFD

Refer FDD

### Sub-Module level DFD

Refer FDD

## Component diagram

Refer FDD

## Variable Data Dictionary

### User defined ‘typedef’ definition/declaration

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Typedef Name | Element Name | User Defined Type | Legal Range  (min) | Legal Range  (max) |
| None |  |  |  |  |

### Variable definition for enumerated types

|  |  |  |
| --- | --- | --- |
| Enum Name | Element Name | Value |
| None |  |  |

## Constant Data Dictionary

### Program Constants

#### Local Constants

|  |  |  |  |
| --- | --- | --- | --- |
| Constant Name | Resolution | Units | Value |
| D\_APA\_UNAVAILABLE\_CNT\_U08 | 1 | Cnt | 0 |
| D\_APA\_UNAVAILABLE\_THERMALLIMIT\_CNT\_U08 | 1 | Cnt | 1 |
| D\_APA\_UNAVAILABLE\_NOAUTHORIZATION\_CNT\_U08 | 1 | Cnt | 2 |
| D\_APA\_DEFECT\_CNT\_U08 | 1 | Cnt | 3 |
| D\_APA\_AVAILABLE\_CNT\_U08 | 1 | Cnt | 4 |
| D\_APA\_AVAILABLE\_VEHICLESPEEDTOOHIGH\_CNT\_U08 | 1 | Cnt | 5 |
| D\_APA\_AVAILABLE\_HWTORQUETOOHIGH\_CNT\_U08 | 1 | Cnt | 6 |
| D\_APA\_AVAILABLE\_MOTORSTALLED\_CNT\_U08 | 1 | Cnt | 7 |
| D\_APA\_AVAILABLE\_HWANGLECONTROLERROR\_CNT\_U08 | 1 | Cnt | 8 |
| D\_APA\_CONTROLPROGRESS\_CNT\_U08 | 1 | Cnt | 9 |
| D\_APA\_DEFAULT\_CNT\_U08 | 1 | Cnt | 255 |
| D\_LXA\_UNAUTHORIZED\_CNT\_U08 | 1 | Cnt | 0 |
| D\_LXA\_AUTHORIZED\_CNT\_U08 | 1 | Cnt | 1 |
| D\_LXA\_AVAILABLE\_CNT\_U08 | 1 | Cnt | 2 |
| D\_LXA\_ACTIVE\_CNT\_U08 | 1 | Cnt | 3 |
| D\_LXA\_DEFECT\_CNT\_U08 | 1 | Cnt | 4 |
| D\_LXA\_DEFAULT\_CNT\_U08 | 1 | Cnt | 255 |
| D\_FLTEPSILON\_ULS\_F32 | Single Precision float | Uls | 1.192092896e-07 |
| D\_HWTRQBUFSIZE\_ULS\_U08 | 1 | Uls | 250 |
| D\_HWTRQRATEMAXLIM\_HWDEGPS\_F32 | Single Precision float | HwDegPS | 2000.0 |
| D\_HWTRQRATEMINLIM\_HWDEGPS\_F32 | Single Precision float | HwDegPS | 0.0 |
| D\_LXATQFACREQAVRG\_ULS\_F32 | Single Precision float | Uls | 0.04 |
| D\_LXATQFACREQBUFSIZE\_CNT\_U08 | 1 | Cnt | 25 |
| D\_LXATQFACREQBUFSIZE\_ULS\_F32 | Single Precision float | Uls | 25 |
| D\_ONE\_CNT\_U08 | 1 | Cnt | 1 |
| D\_POSSERVOHWAGMAXLIM\_HWDEG\_F32 | Single Precision float | HwDeg | 1600.0 |
| D\_POSSERVOHWAGMINLIM\_HWDEG\_F32 | Single Precision float | HwDeg | -1600.0 |
| D\_SAMPLETIME\_CNT\_U16 | 1 | Cnt | 2 |
| D\_U16MAX\_CNT\_U16 | 1 | Cnt | 65535U |
| D\_U16MAX\_HWDEG\_F32 | Single Precision float | HwDeg | 65535U.0 |
| D\_ZERO\_CNT\_U08 | 1 | Cnt | 0 |
| D\_ZERO\_HWDEG\_F32 | Single Precision float | HwDeg | 0.0 |
| D\_ZERO\_HWNMPS\_F32 | Single Precision float | HwNmPS | 0.0 |
| D\_ZERO\_SEC\_F32 | Single Precision float | Sec | 0.0 |

#### Global Constants

|  |
| --- |
| Constant Name |
| D\_FALSE\_CNT\_LGC |
| D\_TRUE\_CNT\_LGC |
| D\_2MS\_SEC\_F32 |
| D\_MSECPERSEC\_ULS\_F32 |
| D\_MTRTRQCMDHILMT\_MTRNM\_F32 |
| D\_ONE\_ULS\_F32 |
| D\_ZERO\_ULS\_F32 |
| D\_PSAAPASTINIT\_CNT\_ENUM |
| D\_PSAAPATRANCAUSEINIT\_CNT\_ENUM |
| D\_PSAEPSSTLXAINIT\_CNT\_ENUM |
| D\_PSALXASTINIT\_CNT\_ENUM |
| D\_ZERO\_CNT\_S8 |
| D\_ZERO\_CNT\_U16 |
| D\_ONE\_CNT\_U8 |
| D\_ZERO\_CNT\_U8 |

### Module Specific Lookup Tables

|  |  |  |  |
| --- | --- | --- | --- |
| Constant Name | Resolution | Value | Software Segment |
| None | - | - | - |

## Software Module Implementation

### Sub-Module Functions

#### Initialization sub-module PSASH\_Init1

Refer FDD

#### Periodic sub-module PSASH\_Per1

Refer FDD

#### Non Periodic sub-module {\_NONPer()}

None

### Interrupt Service Routines

None

### \_SCOMM () Functions

None

### Module Internal (Local) Functions

#### Local Function ComputeLxaDrvrBhvr

Implementation of "Compute\_LxaDrvrBhvr" block in the FDD.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeLxaDrvrBhvr | Type | Min | Max |
| **Arguments Passed** | LxaSelected\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | HOWState\_Cnt\_T\_s08 | sint8 | -3 | 3 |
|  | LxaInpVld\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaState\_Cnt\_T\_enum | enum | 0 | 6 |
|  | HandwheelVelocity\_HwRadpS\_T\_f32 | float32 | -32 | 32 |
|  | HwTqFild\_HwNm\_T\_f32 | float32 | -10 | 10 |
|  | LpaSeld\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | AbsltHwPosn\_HwDeg\_T\_f32 | float32 | 0 | 1600 |
|  | VehicleSpeed\_Kph\_T\_u9p7 | uint16 | 0 | 65408 |
| **Return Value** | DrvrIntvDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | HwTrqRate\_HwNmpS\_T\_f32 | float32 | 0 | 2000 |

#### Local Function ComputeLxaHwAgThd

Implementation of "Compute\_LxaHwAgThd" block. This function determines 'LxaHwAgDetnCntrNStep\_Cnt\_T\_u16', ‘LxaHwAgDetnCntrPStep\_Cnt\_T\_u16' and ‘LxaHwAgThd\_HwDeg\_T\_f32'.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeLxaHwAgThd | Type | Min | Max |
| **Arguments Passed** | VehicleSpeed\_Kph\_T\_u9p7 | uint16 | 0 | 65408 |
|  | AbsltHwPosn\_HwDeg\_T\_f32 | float32 | 0 | 1600 |
| **Return Value** | LxaHwAgDetnCntrNStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
|  | LxaHwAgDetnCntrPStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
|  | LxaHwAgThd\_HwDeg\_T\_f32 | float32 | 0 | 65535 |

#### Local Function ComputeLxaHwVelThd

Implementation of "Compute\_LxaHwVelThd" block.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeLxaHwVelThd | Type | Min | Max |
| **Arguments Passed** | VehicleSpeed\_Kph\_T\_u9p7 | uint16 | 0 | 65408 |
|  | HandwheelVelocity\_HwRadpS\_T\_f32 | float32 | -32 | 32 |
|  | HwTqFild\_HwNm\_T\_f32 | float32 | -10 | 10 |
| **Return Value** | LxaHwVelDetnCntrNStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
|  | LxaHwVelDetnCntrPStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
|  | LxaDrvrAbsntHwVelDetnCntrNStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
|  | LxaDrvrAbsntHwVelDetnCntrPStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
|  | LxaDrvrAbsntHwVelThd\_HwRadpS\_T\_f32 | float32 | 0 | 128 |
|  | LxaHwVelThd\_HwRadpS\_T\_f32 | float32 | 0 | 128 |

#### Local Function ComputeLxaHowDetnTime

Implementation of "Compute\_LxaHowDetnTime" block. This function determines 'LxaDrvrAbsntDetdTi\_Sec\_T\_f32'.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeLxaHowDetnTime | Type | Min | Max |
| **Arguments Passed** | VehicleSpeed\_Kph\_T\_u9p7 | uint16 | 0 | 65408 |
|  | LpaSeld\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
| **Return Value** | LxaDrvrAbsntDetdTi\_Sec\_T\_f32 | float32 | 0 | 512 |

#### Local Function ComputeLxaInactivOnDrvrBhvr

Implementation of "Compute\_LxaInactivOnDrvrBhvr" state flow in the FDD.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeLxaInactivOnDrvrBhvr | Type | Min | Max |
|  | LxaInpVld\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | DrvrIntvDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | HwTqFild\_HwNm\_T\_f32 | float32 | -10 | 10 |
|  | AbsltHandwheelVelocity\_HwRadpS\_T\_f32 | float32 | 0 | 32 |
|  | LxaHwVelThd\_HwRadpS\_T\_f32 | float32 | 0 | 128 |
|  | LxaHwVelDetnCntrNStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
|  | LxaHwVelDetnCntrPStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
|  | AbsltHwPosn\_HwDeg\_T\_f32 | float32 | 0 | 1600 |
|  | LxaHwAgThd\_HwDeg\_T\_f32 | float32 | 0 | 65535 |
|  | LxaHwAgDetnCntrNStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
|  | LxaHwAgDetnCntrPStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
| **Return Value** | LxaInactivOnDrvrBhvr\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | HwTrqRate\_HwNmpS\_T\_f32 | float32 | 0 | 2000 |
|  | LxaHwAgDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | HwVelDetnCntr\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
|  | TempLxaInactivRstTmrDi\_Cnt\_T\_lgc | boolean | FALSE | TRUE |

#### Local Function LxaHwAgMon

Implementation of "LxaHwAgMon" state flow in the FDD.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | LxaHwAgMon | Type | Min | Max |
| **Arguments Passed** | AbsltHwPosn\_HwDeg\_T\_f32 | float32 | 0 | 1600 |
|  | LxaHwAgThd\_HwDeg\_T\_f32 | float32 | 0 | 65535 |
|  | LxaHwAgDetnCntrNStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
|  | LxaHwAgDetnCntrPStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
| **Return Value** | LxaHwAgDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | TempLxaInactivRstTmrDi\_Cnt\_T\_lgc | boolean | FALSE | TRUE |

#### Local Function LxaHwTrqMon

Implementation of "LxaHwTrqMon" state flow in the FDD.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | LxaHwTrqMon | Type | Min | Max |
| **Arguments Passed** | HwTqFild\_HwNm\_T\_f32 | float32 | -10 | 10 |
| **Return Value** | LxaInactivOnDrvrBhvr\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | HwTrqRate\_HwNmpS\_T\_f32 | float32 | 0 | 2000 |
|  | TempLxaInactivRstTmrDi\_Cnt\_T\_lgc | boolean | FALSE | TRUE |

#### Local Function LxaHwVelMon

Implementation of "LxaHwVelMon" state flow in the FDD.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | LxaHwVelMon | Type | Min | Max |
| **Arguments Passed** | AbsltHandwheelVelocity\_HwRadpS\_T\_f32 | float32 | 0 | 32 |
|  | LxaHwVelThd\_HwRadpS\_T\_f32 | float32 | 0 | 128 |
|  | LxaHwVelDetnCntrNStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
|  | LxaHwVelDetnCntrPStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
| **Return Value** | LxaInactivOnDrvrBhvr\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | HwVelDetnCntr\_Cnt\_T\_u16 | uint16 | 0 | 655335 |
|  | TempLxaInactivRstTmrDi\_Cnt\_T\_lgc | boolean | FALSE | TRUE |

#### Local Function ComputeLxaDrvrAbsntDetd

Implementation of "Compute\_LxaDrvrAbsntDetd" state flow in the FDD.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeLxaDrvrAbsntDetd | Type | Min | Max |
| **Arguments Passed** | DrvrIntvDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaDrvrAbsntDetdTi\_Sec\_T\_f32 | float32 | 0 | 512 |
|  | AbsltHandwheelVelocity\_HwRadpS\_T\_f32 | float32 | 0 | 32 |
|  | LxaDrvrAbsntHwVelThd\_HwRadpS\_T\_f32 | float32 | 0 | 128 |
|  | LxaDrvrAbsntHwVelDetnCntrPStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
|  | LxaDrvrAbsntHwVelDetnCntrNStep\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
|  | HwVelDetnCntr\_Cnt\_T\_u16 | uint16 | 0 | 65535 |
|  | TempLxaInactivRstTmrDi\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
| **Return Value** | LxaDrvrAbsntHwVelDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaInactivRstTmrDi\_Cnt\_T\_lgc | boolean | FALSE | TRUE |

#### Local Function ComputeLxaInactivRstTmr

Implementation of "Compute\_LxaInactivRstTmr" block flow in the FDD.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeLxaInactivRstTmr | Type | Min | Max |
| **Arguments Passed** | LxaInactivOnDrvrBhvr\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaDrvrAbsntHwVelDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaHwAgDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LpaSeld\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaState\_Cnt\_T\_enum | enum | 0 | 6 |
|  | LxaInactivRstTmrDi\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | VehicleSpeed\_Kph\_T\_u9p7 | uint16 | 0 | 65408 |
| **Return Value** | N/A |  |  |  |

#### Local Function ComputeEPSState

Implementation of "Compute\_EPSState" block. This function determines 'EPSState\_Cnt\_T\_enum’.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeEPSState | Type | Min | Max |
| **Arguments Passed** | SystemState\_Cnt\_T\_u08 | sint8 | 0 | 4 |
|  | OutputRampMult\_Uls\_T\_f32 | float32 | 0 | 1 |
|  | FTermActv\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
| **Return Value** | EPSState\_Cnt\_T\_enum | enum | 0 | 2 |

#### Local Function ComputeLxaCorrnFacReqLimd

Implementation of " Compute\_LxaCorrnFacReqLimd" block. This function determines 'LxaCorrnFacReqLimd\_Uls\_T\_f32’.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeLxaCorrnFacReqLimd | Type | Min | Max |
| **Arguments Passed** | LxaTqFacReq\_Uls\_T\_f32 | float32 | 0 | 1 |
|  | LxaInpVld\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
| **Return Value** | LxaCorrnFacReqLimd\_Uls\_T\_f32 | float32 | 0 | 1 |

#### Local Function ComputeEPSStateForLxa

Implementation of "Compute\_EPSStateForLxa" state flow in the FDD.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeEPSStateForLxa | Type | Min | Max |
| **Arguments Passed** | EscActv\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | AbsActv\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | EscFltPrsnt\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | EscEna\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | VehSpdCdn\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaInactivOnDrvrBhvr\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaDrvrAbsntHwVelDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | EPSState\_Cnt\_T\_enum | enum | 0 | 2 |
|  | LxaState\_Cnt\_T\_enum | enum | 0 | 6 |
|  | LxaHwAgDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | HwAuthyCdn\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LpaSeld\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | HwTqCdn\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaInpVld\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaDrvrAbsntDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaTqReqFacCdn\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaSelected\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
| **Return Value** | EPSStateForLxa\_Cnt\_T\_enum | enum | 0 | 4 |

#### Local Function ComputeEPSStateForLxa\_ParentTransitions

Fragment of implementation of "Compute\_EPSStateForLxa" state flow.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeEPSStateForLxa\_ParentTransitions | Type | Min | Max |
| **Arguments Passed** | EscActv\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | AbsActv\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | EscFltPrsnt\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | EscEna\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | VehSpdCdn\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaInactivOnDrvrBhvr\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaDrvrAbsntHwVelDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | EPSState\_Cnt\_T\_enum | enum | 0 | 2 |
|  | LxaState\_Cnt\_T\_enum | enum | 0 | 6 |
|  | LxaHwAgDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | HwAuthyCdn\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaInpVld\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaNtcCdn\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
| **Return Value** | N/A |  |  |  |

#### Local Function ComputeEPSStateForLxa\_ChildTransitions

Fragment of implementation of "Compute\_EPSStateForLxa" state flow.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeEPSStateForLxa\_ChildTransitions | Type | Min | Max |
| **Arguments Passed** | EscActv\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | AbsActv\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | EscFltPrsnt\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | EscEna\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | VehSpdCdn\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaInactivOnDrvrBhvr\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaDrvrAbsntHwVelDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | EPSState\_Cnt\_T\_enum | enum | 0 | 2 |
|  | LxaState\_Cnt\_T\_enum | enum | 0 | 6 |
|  | LxaHwAgDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | HwAuthyCdn\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LpaSeld\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | HwTqCdn\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaInpVld\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaDrvrAbsntDetd\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaTqReqFacCdn\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaSelected\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | LxaNtcCdn\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
| **Return Value** | N/A |  |  |  |

#### Local Function ComputeAPA

Implementation of "APA" block in the FDD.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeApa | Type | Min | Max |
| **Arguments Passed** | AssistStallLimit\_MtrNm\_T\_f32 | float32 | 0 | 8.8 |
|  | ApaEna\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ThermLimitPerc\_Uls\_T\_f32 | float32 | 0 | 1 |
|  | VehicleSpeedValid\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | CpkOk\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaPosSrvoFlt\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaAuthn\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaCmdReq\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaRelaxReq\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | HandwheelAuthority\_Uls\_T\_f32 | float32 | 0 | 1 |
|  | SystemState\_Cnt\_T\_enum | enum | 0 | 4 |
|  | OutputRampMult\_Uls\_T\_f32 | float32 | 0 | 1 |
|  | VehicleSpeed\_Kph\_T\_f32 | float32 | 0 | 511 |
|  | HwTqFild\_HwNm\_T\_f32 | float32 | -10 | 10 |
|  | HandwheelPosition\_HwDeg\_T\_f32 | float32 | -1600 | 1600 |
|  | ApaHwAgCmd\_HwDeg\_T\_f32 | float32 | -1440 | 1440 |
|  | FTermActv\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
| **Return Value** | ApaState\_Cnt\_T\_enum | enum | 0 | 3 |
|  | ApaStateTransitionCause\_Cnt\_T\_enum | enum | 0 | 7 |

#### Local Function ComputeApaAllw

Implementation of "Compute\_ApaAllw" block in the FDD.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeApaAllw | Type | Min | Max |
| **Arguments Passed** | ApaAuthn\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | HandwheelAuthority\_Uls\_T\_f32 | float32 | 0 | 1 |
|  | SystemState\_Cnt\_T\_enum | enum | 0 | 4 |
|  | OutputRampMult\_Uls\_T\_f32 | float32 | 0 | 1 |
| **Return Value** | ApaAllw\_Cnt\_T\_lgc | boolean | FALSE | TRUE |

#### Local Function ComputeApaLimits

Implementation of "Compute\_ApaLimits" block in the FDD.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeApaLimits | Type | Min | Max |
| **Arguments Passed** | VehicleSpeed\_Kph\_T\_u9p7 | uint16 | 0 | 511 |
|  | ThermLimPerc\_Uls\_T\_f32 | float32 | 0 | 1 |
|  | AssistStallLimit\_MtrNm\_T\_f32 | float32 | 0 | 8.8 |
| **Return Value** | VehSpdTooHi\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ThrmlLmtReached\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | MtrStalled\_Cnt\_T\_lgc | boolean | FALSE | TRUE |

#### Local Function ComputeApaDrvrIntv

Implementation of "Compute\_ApaDrvrIntv" block in the FDD.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeApaDrvrIntv | Type | Min | Max |
| **Arguments Passed** | HwTqFild\_HwNm\_T\_f32 | float32 | -10 | 10 |
| **Return Value** | ApaHwMinTrqReached\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaHwMaxTrqReached\_Cnt\_T\_lgc | boolean | FALSE | TRUE |

#### Local Function ComputeApaHwAgCtrlErr

Implementation of "Compute\_ApaHwAgCtrlErr" block in the FDD.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeApaHwAgCtrlErr | Type | Min | Max |
| **Arguments Passed** | HandwheelPosition\_HwDeg\_T\_f32 | float32 | -1600 | 1600 |
|  | ApaHwAgCmd\_HwDeg\_T\_f32 | float32 | -1440 | 1440 |
| **Return Value** | ApaHwAgCtrlErr\_Cnt\_T\_lgc | boolean | FALSE | TRUE |

#### Local Function ComputeApaFltActv

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeApaFltActv | Type | Min | Max |
| **Arguments Passed** | VehicleSpeedValid\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | CpkOk\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaPosSrvoFlt\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | FTermActv\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
| **Return Value** | ApaFltActv\_Cnt\_T\_lgc | boolean | FALSE | TRUE |

#### Local Function ComputeApaState

Implementation of "Compute\_ApaState" state flow in the FDD.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeApaState | Type | Min | Max |
| **Arguments Passed** | ApaAllw\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaEna\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | VehSpdTooHi\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ThrmlLmtReached\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | MtrStalled\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaCmdReq\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaHwMinTrqReached\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaHwMaxTrqReached\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaHwAgCtrlErr\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaFltActv\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaRelaxReq\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
| **Return Value** | ApaState\_Cnt\_T\_enum | enum | 0 | 3 |
|  | ApaStateTransitionCause\_Cnt\_T\_enum | enum | 0 | 7 |

#### Local Function ComputeApaState\_ParentTransitions

Fragment of implementation of "Compute\_ApaState" state flow.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeApaState\_ParentTransitions | Type | Min | Max |
| **Arguments Passed** | ApaFltActv\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ThrmlLmtReached\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
| **Return Value** | N/A |  |  |  |

#### Local Function ComputeApaState\_ChildTransitions

Fragment of implementation of "Compute\_ApaState" state flow.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputeApaState\_ChildTransitions | Type | Min | Max |
| **Arguments Passed** | ApaAllw\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaEna\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | VehSpdTooHi\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ThrmlLmtReached\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | MtrStalled\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaCmdReq\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaHwMinTrqReached\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaHwMaxTrqReached\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaHwAgCtrlErr\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaFltActv\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaRelaxReq\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
| **Return Value** | N/A |  |  |  |



#### Local Function ComputePosSrvoEnable

Implementation of " Compute\_PosSrvoEnable" block in the FDD

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ComputePosSrvoEnable | Type | Min | Max |
| **Arguments Passed** | EPSStateForLxa\_Cnt\_T\_enum | enum | 0 | 4 |
|  | ApaState\_Cnt\_T\_enum | enum | 0 | 3 |
|  | LxaHwAgCmd\_HwDeg\_T\_f32 | float32 | -1440 | 1440 |
|  | ApaRelaxReq\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | ApaHwAgCmd\_HwDeg\_T\_f32 | float32 | -1440 | 1440 |
|  | VehicleSpeed\_Kph\_T\_u9p7 | uint16 | 0 | 65408 |
|  | HandwheelPosition\_HwDeg\_T\_f32 | float32 | -1600 | 1600 |
| **Return Value** | OutApaState\_Cnt\_T\_enum | enum | 0 | 3 |
|  | PosSrvoEnable\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | PosSrvoHwAngle\_HwDeg\_T\_f32 | float32 | -1600 | 1600 |
|  | OutEPSStateForLxa\_Cnt\_T\_enum | enum | 0 | 4 |

### Transition Functions

None

# Known Limitations with Design

None

# UNIT TEST CONSIDERATION

FDD describes functionality and structural breakdown of this component. Data dictionary contains all attributes of variables and calibrations used.

1. Abbreviations and Acronyms

| **Abbreviation or Acronym** | **Description** |
| --- | --- |
| DFD | Design functional diagram |
| MDD | Module design Document |
| FDD | Functional Design Document |
| CF | Customer Function |

1. Glossary

**Note**: Terms and definitions from the source “Nexteer Automotive” take precedence over all other definitions of the same term. Terms and definitions from the source “Nexteer Automotive” are formulated from multiple sources, including the following:

* ISO 9000
* ISO/IEC 12207
* ISO/IEC 15504
* Automotive SPICE® Process Reference Model (PRM)
* Automotive SPICE® Process Assessment Model (PAM)
* ISO/IEC 15288
* ISO 26262
* IEEE Standards
* SWEBOK
* PMBOK
* Existing Nexteer Automotive documentation

| **Term** | **Definition** | **Source** |
| --- | --- | --- |
| MDD | Module Design Document |  |
| DFD | Data Flow Diagram |  |

1. References

| **Ref. #** | **Title** | **Version** |
| --- | --- | --- |
| 1 | AUTOSAR Specification of Memory Mapping (Link:[AUTOSAR\_SWS\_MemoryMapping.pdf](http://www.autosar.org/download/R4.0/AUTOSAR_SWS_MemoryMapping.pdf)) | v1.3.0 R4.0 Rev 2 |
| 2 | MDD Guideline EA3 | 01.04.00 |
| 3 | Software Naming Conventions | 2.0 |
| 4 | Software Design and Coding Standards | 2.1 |
| 5 | CF13 PSA State handler FDD | CF013A\_PSASH\_Design\_8.3.0 |