**Module Design Document**

**For**

**PosServo**

**February 23, 2018**

**Prepared For:**

**Software Engineering**

**Nexteer Automotive,**

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**SEPG,**

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**Saginaw, MI, USAChange History**

|  |  |  |  |
| --- | --- | --- | --- |
| **Description** | **Author** | **Version** | **Date** |
| Initial version | YY | 1 | 07-Jun-11 |
| Corrected anomaly 2371 to prevent potential overflow of intermediate D-Term calculation. | YY | 2 | 16-Jun-11 |
| Initial version for PosServo CBD | VK | 3 | 16-Dec-11 |
| Changed VehSpd\_T\_u12p4 to u9p7 and changed the precision for the table associated. | VK | 4 | 09-Jan-12 |
| Changed the range for hand wheel position to be +/-900 throughout and updated the software segment | VK | 5 | 02-02-12 |
| Updated to SF-20 v002 | OT | 6 | 01-Aug-12 |
| Fixed UTP Issue (typecasting bilinear interpolation overflow) | OT | 7 | 08-Aug-12 |
| Fixed more UTP issues (fixed point math overflow) | OT | 8 | 10-Aug-12 |
| Updated to SF-20 v003 | KJS | 9 | 29-Aug-12 |
| Added checkpoints and memmap software segment is updated for static variables | Selva | 10 | 21-Sep-12 |
| UTP corrections to MDD | KJS | 11 | 19-Oct-12 |
| UTP corrections to MDD | KJS | 12 | 19-Oct-12 |
| Updated to SF v004 | SP | 13 | 15-Mar-13 |
| Updated to FDD ver 005 | Jared | 14 | 10-May-13 |
| Updated to FDD ver 006, new template | Krzysztof Byrski | 15 | 23-Feb-2018 |

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# Introduction

## Purpose

Module Design Document for SF020A PosServo.

## Scope

The following definitions are used throughout this document:

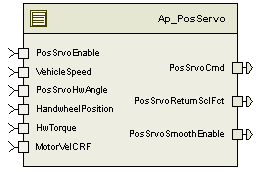
* **Shall**: indicates a mandatory requirement without exception in compliance.
* **Should**: indicates a mandatory requirement; exceptions allowed only with documented justification.
* **May**: indicates an optional action.

# PosServo & High-Level Description

This module provides the ability for the EPS system to track a position input command.

# Design details of software module

## Graphical representation of PosServo



## Data Flow Diagram

Refer FDD.

### Module level DFD

### Sub-Module level DFD

## 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\_2MS\_MS\_F32 | Single Precision Float | Ms | 2 |
| D\_DGAINMAX\_MTRNM\_F32 | Single Precision Float | MtrNm | 255 |
| D\_DGAINMIN\_MTRNM\_F32 | Single Precision Float | MtrNm | -255 |
| D\_EXECRATE\_HZ\_F32 | Single Precision Float | Hz | 500 |
| D\_POSSERVOMAXRAMP\_ULS\_F32 | Single Precision Float | Uls | 1 |
| D\_POSSERVOMINRAMP\_ULS\_F32 | Single Precision Float | Uls | 0 |
| D\_RAMPCMPL\_ULS\_U6P10 | 0.0009765625 | Uls | 0 |
| D\_ZERO\_HWDEG\_F32 | Single Precision Float | HwDeg | 0 |
| D\_ZERO\_MTRNMPHWDEGS\_U12P4 | 0.0625 | MtrNmpHwDegS | 0 |
| D\_ZERO\_MTRNM\_F32 | Single Precision Float | MtrNm | 0 |

#### Global Constants

|  |
| --- |
| Constant Name |
| D\_2MS\_SEC\_F32 |
| D\_ZERO\_ULS\_F32 |

### Module Specific Lookup Tables

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

## Software Module Implementation

### Sub-Module Functions

#### Initialization sub-module { PosServo\_Init1()}

Refer FDD.

#### Periodic sub-module {PosServo\_Per1()}

Refer FDD

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

None

### Interrupt Service Routines

None

### \_SCOMM () Functions

None

### Module Internal (Local) Functions

#### Local Function FilterDesiredAngle

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | FilterDesiredAngle | Type | Min | Max |
| **Arguments Passed** | RampCmpl\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | PosSrvoHwAngle\_HwDeg\_T\_f32 | float32 | -1600 | 1600 |
|  | HandwheelPosition\_HwDeg\_T\_f32 | float32 | -1600 | 1600 |
|  | PosSrvoEnable\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | VehicleSpeed\_Kph\_T\_u9p7 | uint16 | 0 | 65408 |
| **Return Value** | FildTarHwAg\_HwDeg\_T\_f32 | float32 | -1600 | 1600 |

#### Local Function TransitionControl

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | TransitionControl | Type | Min | Max |
| **Arguments Passed** | HwTorque\_HwNm\_T\_f32 | float32 | -10 | 10 |
|  | PosSrvoEnable\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
| **Return Value** | PosSrvoReturnSclFct\_Uls\_T\_f32 | float32 | 0 | 1 |
|  | PosSrvoSmoothEnable\_Uls\_T\_f32 | float32 | 0 | 1 |
|  | RampCmpl\_Cnt\_T\_lgc | boolean | FALSE | TRUE |

#### Local Function PIDControl

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | PIDControl | Type | Min | Max |
| **Arguments Passed** | FildTarHwAg\_HwDeg\_T\_f32 | float32 | -1600 | 1600 |
|  | HandwheelPosition\_HwDeg\_T\_f32 | float32 | -1600 | 1600 |
|  | VehicleSpeed\_Kph\_T\_u9p7 | uint16 | 0 | 65408 |
|  | PosSrvoEnable\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
|  | RampCmpl\_Cnt\_T\_lgc | boolean | FALSE | TRUE |
| **Return Value** | PidCmd\_MtrNm\_T\_f32 | float32 | -100 | 100 |

#### Local Function OutputTorque

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | OutputTorque | Type | Min | Max |
| **Arguments Passed** | VehicleSpeed\_Kph\_T\_u9p7 | uint16 | 0 | 65408 |
|  | PosSrvoSmoothEnable\_Uls\_T\_f32 | float32 | 0 | 1 |
|  | PidCmd\_MtrNm\_T\_f32 | float32 | -100 | 100 |
|  | MotorVelCRF\_MtrRadpS\_T\_f32 | float32 | -1350 | 1350 |
| **Return Value** | PosSrvoCmd\_MtrNm\_T\_f32 | float32 | -8.8 | 8.8 |

### Transition Functions

None

# Known Limitations with Design

1. INLINE functions defined are not unit tested

# UNIT TEST CONSIDERATION

None

1. Abbreviations and Acronyms

| **Abbreviation or Acronym** | **Description** |
| --- | --- |
|  |  |

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 | SF020A\_PosnTrakgServo\_Design | ver006 |