**Module Design Document**

**For**

**BmwHwAgArbnAndEotPosn**

**12-Jul-2018**

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**Saginaw, MI, USAChange History**

|  |  |  |  |
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| Updated graphic to include 2 new inputs, modified and added functions | Shawn Penning | 6 | 12-Jul-2018 |

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# Introduction

## Purpose

Module Design Document for CF071A\_BmwHwAgArbnAndEotPosn\_Impl.

## Scope

The following definitions are used throughout this document:

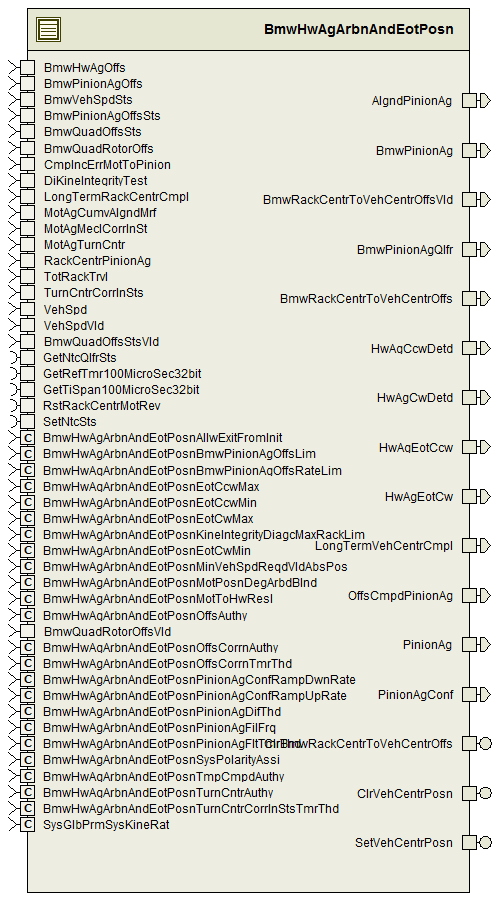
* **Shall**: indicates a mandatory requirement without exception in compliance.
* **Should**: indicates a mandatory requirement; exceptions allowed only with documented justification.
* **May**: indicates an optional action.

# BmwHwAgArbnAndEotPosn & High-Level Description

This function will be responsible for determining the hand wheel position using the motor position to provide an estimate of the hand wheel position.

# Design details of software module

## Graphical representation of BmwHwAgArbnAndEotPosn



## Data Flow Diagram

Refer FDD

### Component level DFD

N/A

### Function level DFD

N/A

# Constant Data Dictionary

## Program (fixed) Constants

### Embedded Constants

#### Local Constants

None

# Software Component Implementation

## Sub-Module Functions

The sub-module functions are grouped based on similar functionality that needs to be executed in a given “State” of the system (refer States and Modes). For a given module, the MDD will identify the type and number of sub-modules required. The sub-module types are described below.

### Init: Init1

#### Design Rationale

Refer FDD

#### Module Outputs

Refer FDD

### Per: Per1

#### Design Rationale

Refer FDD

#### Store Module Inputs to Local copies

Refer FDD

#### (Processing of function)………

Refer FDD

#### Store Local copy of outputs into Module Outputs

Refer FDD

## Server Runables

### ClrBmwRackCentrToVehCentrOffs\_Oper

#### Design Rationale

Refer FDD

#### (Processing of function)………

Refer FDD

### ClrVehCentrPosn\_Oper

#### Design Rationale

Refer FDD

#### (Processing of function)………

Refer FDD

### SetVehCentrPosn\_Oper

#### Design Rationale

Refer FDD

#### (Processing of function)………

Refer FDD

## Interrupt Functions

None

## Module Internal (Local) Functions

### HwAgSnsrNotTrimNTC

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | HwAgSnsrNotTrimNTC | Type | Min | Max |
| **Arguments Passed** | None |  |  |  |
| **Return Value** | HwAgSnsrNotTrimFlt\_Cnt\_T\_logl | boolean | FALSE | TRUE |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### HwPosnFltDetn

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | HwPosnFltDetn | Type | Min | Max |
| **Arguments Passed** | MotAgVld\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | HwAgSnsrNotTrimFlt\_Cnt\_T\_logl | boolean | FALSE | TRUE |
| **Return Value** | PinionAgFltTmrElpd\_Cnt\_T\_logl | boolean | FALSE | TRUE |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### PinionAgFltTmr

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | PinionAgFltTmr | Type | Min | Max |
| **Arguments Passed** | HwAgSnsrNotTrimFlt\_Cnt\_T\_logl | boolean | FALSE | TRUE |
| **Return Value** | PinionAgFltTmrElpd\_Cnt\_T\_logl | boolean | FALSE | TRUE |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### OffsCorrnTmr

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | OffsCorrnTmr | Type | Min | Max |
| **Arguments Passed** | None |  |  |  |
| **Return Value** | OffsCorrnTmrElpd\_Cnt\_T\_logl | boolean | FALSE | TRUE |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### InitTmr

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | InitTmr | Type | Min | Max |
| **Arguments Passed** | None |  |  |  |
| **Return Value** | AllwExitFromInit\_Cnt\_T\_logl | boolean | FALSE | TRUE |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### CalcBmwMotAgOffsSelnSt

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | CalcBmwMotAgOffsSelnSt | Type | Min | Max |
| **Arguments Passed** | TurnCntrVld\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | BmwQuadOffsSts\_Cnt\_T\_enum | enum | 0 | 15 |
|  | PinionAgFltTmrElpd\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | OffsCorrnTmrElpd\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | HwAgNotVldFltPrsnt\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | AllwExitFromInit\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | AllwTran\_Cnt\_T\_logl | boolean | FALSE | TRUE |
| **Return Value** | None |  |  |  |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### CalcBmwMotAgOffsSelnStOffsCmpd

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | CalcBmwMotAgOffsSelnStOffsCmpd | Type | Min | Max |
| **Arguments Passed** | TurnCntrVld\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | BmwQuadOffsSts\_Cnt\_T\_enum | enum | 0 | 15 |
|  | HwAgNotVldFltPrsnt\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | AllwTran\_Cnt\_T\_logl | boolean | FALSE | TRUE |
| **Return Value** | None |  |  |  |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### CalcBmwMotAgOffsSelnStSubVal

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | CalcBmwMotAgOffsSelnStSubVal | Type | Min | Max |
| **Arguments Passed** | BmwQuadOffsSts\_Cnt\_T\_enum | enum | 0 | 15 |
|  | HwAgNotVldFltPrsnt\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | AllwTran\_Cnt\_T\_logl | boolean | FALSE | TRUE |
| **Return Value** | None |  |  |  |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### CalcBmwMotAgOffsSelnStTmpCmpd

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | CalcBmwMotAgOffsSelnStTmpCmpd | Type | Min | Max |
| **Arguments Passed** | BmwQuadOffsSts\_Cnt\_T\_enum | enum | 0 | 15 |
|  | HwAgNotVldFltPrsnt\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | AllwTran\_Cnt\_T\_logl | boolean | FALSE | TRUE |
| **Return Value** | None |  |  |  |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### CalcBmwMotAgOffsSelnStOffsCorrn

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | CalcBmwMotAgOffsSelnStOffsCorrn | Type | Min | Max |
| **Arguments Passed** | OffsCorrnTmrElpd\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | HwAgNotVldFltPrsnt\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | AllwTran\_Cnt\_T\_logl | boolean | FALSE | TRUE |
| **Return Value** | None |  |  |  |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### CalcBmwMotAgOffsSelnStSigInvld

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | CalcBmwMotAgOffsSelnStSigInvld | Type | Min | Max |
| **Arguments Passed** | TurnCntrVld\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | PinionAgFltTmrElpd\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | HwAgNotVldFltPrsnt\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | AllwTran\_Cnt\_T\_logl | boolean | FALSE | TRUE |
| **Return Value** | None |  |  |  |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### CalcBmwMotAgOffsSelnStIni

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | CalcBmwMotAgOffsSelnStIni | Type | Min | Max |
| **Arguments Passed** | TurnCntrVld\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | HwAgNotVldFltPrsnt\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | AllwExitFromInit\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | AllwTran\_Cnt\_T\_logl | boolean | FALSE | TRUE |
| **Return Value** | None |  |  |  |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### BmwMotAgOffsSelnStTranCase

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | BmwMotAgOffsSelnStTranCase | Type | Min | Max |
| **Arguments Passed** | BmwQuadOffsSts\_Cnt\_T\_enum | enum | 0 | 15 |
|  | HwAgSnsrNotTrimFlt\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | MotAgTurnCntrDeg\_MotDeg\_T\_f32 | float32 | -82944000 | 83008800 |
|  | TurnCntrVld\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | PrevLoopBmwMotAgSelnSt\_Cnt\_T\_enum | enum | 2 | 15 |
|  | BmwQuadRotorOffs\_MotRev\_T\_s08 | sint8 | -127 | 127 |
|  | MotAgCumvAlgnMrf\_MotDeg\_T\_f32 | float32 | -262144 | 262143.9998 |
| **Return Value** | PinionAgTarConf\_Uls\_T\_f32 | float32 | 0 | 1 |
|  | MotPosnDegArbd\_MotDeg\_T\_f32 | float32 | - 83206144 | 83270944> |

### ChkNrcvrlFlt

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ChkNrcvrlFlt | Type | Min | Max |
| **Arguments Passed** | Ntc8CSts\_Cnt\_T\_enum | enum | 1 | 2 |
|  | Ntc8ESts\_Cnt\_T\_enum | enum | 1 | 2 |
| **Return Value** | - | - | - | - |

### TurnCntrCorrlnStsTmr

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | TurnCntrCorrlnStsTmr | Type | Min | Max |
| **Arguments Passed** | TurnCntrCorrlnSts\_Cnt\_T\_u08 | enum | 0 | 3 |
| **Return Value** | - | - | - | - |

### ChkTurnCntrCorrlnStsCdn

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ChkTurnCntrCorrlnStsCdn | Type | Min | Max |
| **Arguments Passed** | TurnCntrCorrlnSts\_Cnt\_T\_u08 | enum | 0 | 3 |
| **Return Value** | - | - | - | - |

### ProcessBmwQuadRotorOffs1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ProcessBmwQuadRotorOffs | Type | Min | Max |
| **Arguments Passed** | BmwQuadOffsSts\_Cnt\_T\_enum, , | Enum | 0 | 15 |
|  | BmwQuadRotorOffs\_MotRev\_T\_s08 | sint8 | -127 | 127 |
|  | ChgdValDetd\_Cnt\_T\_logl | boolean | FALSE | TRUE |
| **Return Value** | - | - | - | - |

### ProcessBmwQuadRotorOffs2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ProcessBmwQuadRotorOffs | Type | Min | Max |
| **Arguments Passed** | BmwQuadOffsSts\_Cnt\_T\_enum, , | Enum | 0 | 15 |
|  | BmwQuadRotorOffs\_MotRev\_T\_s08 | sint8 | -127 | 127 |
|  | ChgdValDetd\_Cnt\_T\_logl | boolean | FALSE | TRUE |
| **Return Value** | - | - | - | - |

### 

### ProcessBmwQuadOffsSts

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ProcessBmwQuadOffsSts | Type | Min | Max |
| **Arguments Passed** | BmwQuadOffsSts\_Cnt\_T\_enum | enum | 0 | 15 |
|  | ChgdValDetd\_Cnt\_T\_logl | boolean | FALSE | TRUE |
| **Return Value** | - | - | - | - |

### ActvtLpFil

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ActvtLpFil | Type | Min | Max |
| **Arguments Passed** | - | - | - | - |
| **Return Value** | - | - | - | - |

### CalcBmwPinionAgOffs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | CalcBmwPinionAgOffs | Type | Min | Max |
| **Arguments Passed** | BmwPinionAgOffs\_HwDeg\_T\_f32 | float32 | -45 | 45 |
|  | BmwPinionAgOffsSts\_Cnt\_T\_enum | enum | 1 | 4 |
| **Return Value** | -BmwPinionAgOffsOutp\_HwDeg\_T\_f32 | float32 | -1440 | 1440 |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### BmwMotAgSelnStOffsCmpd

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | BmwMotAgSelnStOffsCmpd | Type | Min | Max |
| **Arguments Passed** | BmwQuadRotorOffs\_MotRev\_T\_s08 | sint8 | -127 | 127 |
| **Return Value** | PinionAgTarConf\_Uls\_T\_f32 | float32 | 0 | 1 |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### BmwMotAgSelnStSigInvld

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | BmwMotAgSelnStSigInvld | Type | Min | Max |
| **Arguments Passed** | TurnCntrVld\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | PrevLoopBmwMotAgSelnSt\_Cnt\_T\_enum | enum | 2 | 15 |
|  | HwAgSnsrNotTrimFlt\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | MotAgTurnCntrDeg\_MotDeg\_T\_f32 | float32 | -82944000 | 83008800 |
| **Return Value** | PinionAgTarConf\_Uls\_T\_f32 | float32 | 0 | 0 |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### PinionAgCalc

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | PinionAgCalc | Type | Min | Max |
| **Arguments Passed** | OffsCpmpdMotPosn\_MotDeg\_T\_f32 | float32 | -82989720 | 83054520 |
|  | CmplncErrMotToPinion\_HwDeg\_T\_f32 | float32 | -5 | 5 |
| **Return Value** | BmwPinionAg\_HwDeg\_T\_f32 | float32 | -1440 | 1440 |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### ClrNotCmplPinionAgFlg

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | ClrNotCmplPinionAgFlg | Type | Min | Max |
| **Arguments Passed** | LongTermRackCentrCmpl\_Cnt\_T\_logl | boolean | FALSE | TRUE |
| **Return Value** | None |  |  |  |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### CalcEot

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | CalcEot | Type | Min | Max |
| **Arguments Passed** | TotRackTrvl\_HwDeg\_T\_f32 | float32 | -2880 | 2880 |
|  | LongTermRackCentrCmpl\_Cnt\_T\_logl | boolean | FALSE | TRUE |
| **Return Value** | HwAgEotCw\_HwDeg\_T\_f32 | float32 | 360 | 900 |
|  | HwAgEotCcw\_HwDeg\_T\_f32 | float32 | -900 | -360 |
|  | HwAgCwDetd\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | HwAgCcwDetd\_Cnt\_T\_logl | boolean | FALSE | TRUE |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### SetBmwRackCentrToVehCentrOffs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | SetBmwRackCentrToVehCentrOffs | Type | Min | Max |
| **Arguments Passed** | LongTermRackCentrCmpl\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | RackCentrPinionAg\_HwDeg\_T\_f32 | float32 | -1440 | 1440 |
| **Return Value** | None |  |  |  |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

### HndlgNTC

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Function Name** | HndlgNTC | Type | Min | Max |
| **Arguments Passed** | VehSpdVld\_Cnt\_T\_logl | boolean | FALSE | TRUE |
|  | VehSpd\_Kph\_T\_f32 | float32 | 0 | 350 |
|  | BmwVehSpdSts\_Cnt\_T\_enum | enum | 1 | 15 |
|  | DiKineIntegrityTest\_Cnt\_T\_logl | boolean | FALSE | TRUE |
| **Return Value** | None |  |  |  |

#### Design Rationale

Refer FDD

#### Processing

Refer FDD

## GLOBAL Function/Macro Definitions

None

# Known Limitations with Design

None

# UNIT TEST CONSIDERATION

None

1. Abbreviations and Acronyms

| **Abbreviation or Acronym** | **Description** |
| --- | --- |
| FDD | Functional Design Document. (See references) |

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](https://www.autosar.org/fileadmin/files/standards/classic/4-0/software-architecture/implementation-integration/standard/AUTOSAR_SWS_MemoryMapping.pdf)) | v1.4.0 R4.0 Rev 3 |
| 2 | MDD Guideline EA4 | 01.00.01 |
| 3 | EA4 Software Naming Conventions | 01.01.00 |
| 4 | Software Design and Coding Standards | 2.1 |
| 5 | CF071A\_BmwHwAgArbnAndEotPosn\_Design | See Synergy Sub Project Version |