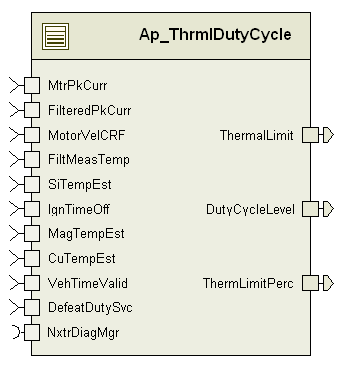
# Module – Thermal Duty Cycle

# High-Level Description

This module computes a duty cycle limit based on system temperatures. It also outputs a unity scalar value to scale the assist command and a value representing the percentage of reduction.

# Figures

## Component Diagram



# Variable Data Dictionary

For details on module input / output variable, refer to the Data Dictionary for the application. Input / output variable names are listed here for reference.

|  |  |  |
| --- | --- | --- |
| Module Inputs | Module Outputs | |
| MtrPkCurr\_AmpSq\_f32 | | ThermalLimit\_MtrNm\_f32 |
| FilteredPkCurr\_AmpSq\_f32 | | DutyCycleLevel\_Uls\_f32 |
| MotorVelCRF\_MtrRadpS\_f32 | | ThermLimitPerc\_Uls\_f32 |
| FiltMeasTemp\_DegC\_f32 | |  |
| SiTempEst\_DegC\_f32 | |  |
| MagTempEst\_DegC\_f32 | |  |
| CuTempEst\_DegC\_f32 | |  |
| DiagStsDefTemp \_Cnt\_lgc | |  |
| DefeatDutySvc\_Cnt\_lgc | |  |
| IgnTimeOff\_Cnt\_u32 | |  |
| VehTimeValid\_Cnt\_lgc | |  |

## Module Internal Variables

This section identifies the name, range and resolutions for module specific data created by this module. If there are no range restrictions on the variable, the term “FULL” is placed into the table for legal range.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable Name | | Resolution | Legal Range  (min) | Legal Range  (max) | Software Segment |
| ThrmDutyCycle\_TrqCmdTblYRam\_MtrNm\_M\_u9p7[8] | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_16 |
| ThrmDutyCycle\_AbsTempFltAcc\_Cnt\_M\_u16 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_16 |
| ThrmDutyCycle\_Filter1KSV\_M\_str | | LPF32KSV\_Str |  |  | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_UNSPECIFIED |
|  | SV\_Uls\_f32 | See Data Dictionary | See Data Dictionary | See Data Dictionary |  |
|  | K\_Uls\_f32 | See Data Dictionary | See Data Dictionary | See Data Dictionary |  |
| ThrmDutyCycle\_Filter2KSV\_M\_str | | LPF32KSV\_Str |  |  | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_UNSPECIFIED |
|  | SV\_Uls\_f32 | See Data Dictionary | See Data Dictionary | See Data Dictionary |  |
|  | K\_Uls\_f32 | See Data Dictionary | See Data Dictionary | See Data Dictionary |  |
| ThrmDutyCycle\_Filter3KSV\_M\_str | | LPF32KSV\_Str |  |  | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_UNSPECIFIED |
|  | SV\_Uls\_f32 | See Data Dictionary | See Data Dictionary | See Data Dictionary |  |
|  | K\_Uls\_f32 | See Data Dictionary | See Data Dictionary | See Data Dictionary |  |
| ThrmDutyCycle\_Filter4KSV\_M\_str | | LPF32KSV\_Str |  |  | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_UNSPECIFIED |
|  | SV\_Uls\_f32 | See Data Dictionary | See Data Dictionary | See Data Dictionary |  |
|  | K\_Uls\_f32 | See Data Dictionary | See Data Dictionary | See Data Dictionary |  |
| ThrmDutyCycle\_Filter5KSV\_M\_str | | LPF32KSV\_Str |  |  | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_UNSPECIFIED |
|  | SV\_Uls\_f32 | See Data Dictionary | See Data Dictionary | See Data Dictionary |  |
|  | K\_Uls\_f32 | See Data Dictionary | See Data Dictionary | See Data Dictionary |  |
| ThrmDutyCycle\_Filter6KSV\_M\_str | | LPF32KSV\_Str |  |  | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_UNSPECIFIED |
|  | SV\_Uls\_f32 | See Data Dictionary | See Data Dictionary | See Data Dictionary |  |
|  | K\_Uls\_f32 | See Data Dictionary | See Data Dictionary | See Data Dictionary |  |
| ThrmDutyCycle\_AbsTempLimit\_MtrNm\_M\_f32 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_32 |
| ThrmDutyCycle\_Mult12Temp\_DegC\_D\_f32 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_32 |
| ThrmDutyCycle\_Mult36Temp\_DegC\_D\_f32 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_32 |
| ThrmDutyCycle\_MaxOut\_AmpSq\_D\_u16p0 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_16 |
| ThrmDutyCycle\_ThermLim\_MtrNm\_D\_f32 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_32 |
| ThrmDutyCycle\_Mult1\_Uls\_D\_u3p13 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_16 |
| ThrmDutyCycle\_Mult2\_Uls\_D\_u3p13 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_16 |
| ThrmDutyCycle\_Mult3\_Uls\_D\_u3p13 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_16 |
| ThrmDutyCycle\_Mult4\_Uls\_D\_u3p13 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_16 |
| ThrmDutyCycle\_Mult5\_Uls\_D\_u3p13 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_16 |
| ThrmDutyCycle\_Mult6\_Uls\_D\_u3p13 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_16 |
| ThrmDutyCycle\_LastTblVal\_MtrNm\_D\_u9p7 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_16 |
| ThrmDutyCycle\_LastTblValSlew\_MtrNm\_D\_u9p7 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_16 |
| ThrmDutyCycle\_AbsCtrlTempLimit\_MtrNm\_D\_f32 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_32 |
| ThrmDutyCycle\_AbsCuTempLimit\_MtrNm\_D\_f32 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_32 |
| ThrmDutyCycle\_AbsTempLimit\_MtrNm\_D\_f32 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_32 |
| ThrmDutyCycle\_ThrmLoadLmtTblYVal\_MtrNm\_D\_f32 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_32 |
| ThrmDutyCycle\_CntrFlagInit\_Cnt\_M\_lgc | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_BOOLEAN |
| ThrmDutyCycle\_ReInitCntrFlag\_Cnt\_M\_lgc | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_BOOLEAN |
| ThrmDutyCycle\_ReInitCntrVal\_Sec\_M\_f32 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_32 |
| ThrmDutyCycle\_eFilt3ValPowerup\_Cnt\_M\_u8 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_8 |
| ThrmDutyCycle\_eFilt4ValPowerup\_Cnt\_M\_u8 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_8 |
| ThrmDutyCycle\_eFilt5ValPowerup\_Cnt\_M\_u8 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_8 |
| ThrmDutyCycle\_eFilt6ValPowerup\_Cnt\_M\_u8 | | See Data Dictionary | See Data Dictionary | See Data Dictionary | THRMLDUTYCYCLE\_START\_SEC\_VAR\_CLEARED\_8 |

### User defined typedef definition/declaration

This section documents any user types uniquely used for the module.

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

# Constant Data Dictionary

## Calibration Constants

This section lists the calibrations used by the module. For details on calibration constants, refer to the Data Dictionary for the application.

|  |
| --- |
| Constant Name |
| k\_EOCCtrlTemp\_DegC\_f32 |
| k\_CtrlTempSlc\_Cnt\_lgc |
| k\_MtrPrTempSlc\_Cnt\_lgc |
| k\_AbsMtrVelBkt\_MtrRadps\_f32 |
| t\_MultTblX\_DegC\_s15p0[5] |
| t\_Mult1NSTblY\_Uls\_u3p13[5] |
| t\_Mult2NSTblY\_Uls\_u3p13[5] |
| t\_Mult3NSTblY\_Uls\_u3p13[5] |
| t\_Mult4NSTblY\_Uls\_u3p13[5] |
| t\_Mult5NSTblY\_Uls\_u3p13[5] |
| t\_Mult6NSTblY\_Uls\_u3p13[5] |
| t\_Mult1STblY\_Uls\_u3p13[5] |
| t\_Mult2STblY\_Uls\_u3p13[5] |
| t\_Mult3STblY\_Uls\_u3p13[5] |
| t\_Mult4STblY\_Uls\_u3p13[5] |
| t\_Mult5STblY\_Uls\_u3p13[5] |
| t\_Mult6STblY\_Uls\_u3p13[5] |
| t\_LastTblValNS\_MtrNm\_u9p7[5] |
| t\_LastTblValS\_MtrNm\_u9p7[5] |
| k\_TrqCmdSlewDown\_MtrNm\_u9p7 |
| k\_TrqCmdSlewUp\_MtrNm\_u9p7 |
| k\_SlowFltTempSlc\_Cnt\_lgc |
| t\_AbsCtrlTmpTblX\_DegC\_s15p0[4] |
| t\_AbsCtrlTmpTblY\_MtrNm\_u9p7[4] |
| t\_AbsCuTmpTblX\_DegC\_s15p0[4] |
| t\_AbsCuTmpTblY\_MtrNm\_u9p7[4] |
| k\_AbsTmpTrqSlewLmt\_MtrNm\_f32 |
| k\_MultTempSlc\_Cnt\_lgc |
| k\_AbsTempDiag\_Cnt\_str |
| k\_DutyCycFltTrshld\_AmpSq\_u16p0 |
| t\_ThrmLoadLmtTblX\_AmpSq\_u16p0[8] |
| t\_ThrmLoadLmtTblY\_MtrNm\_u9p7[8] |
| k\_DefaultIgnOffTime\_Sec\_f32 |
| k\_IgnOffCntrEnb\_Cnt\_lgc |
| k\_IgnOffMsgWaitTime\_Sec\_f32 |

## Program (fixed) Constants

### Embedded Constants

All embedded constants whose values are provided in Eng units will be evaluated to the equivalent counts by using the FPM\_InitFixedPoint\_m() macro within the #define statement.

#### Local

|  |  |  |  |
| --- | --- | --- | --- |
| Constant Name | Resolution | Units | Value |
| D\_FILT1LPFKN\_HZ\_F32 | Single Precision Float | Hz | 1/(2\*pi\*1.59) |
| D\_FILT2LPFKN\_HZ\_F32 | Single Precision Float | Hz | 1/(2\*pi\*15.9) |
| D\_FILT3LPFKN\_HZ\_F32 | Single Precision Float | Hz | 1/(2\*pi\*159) |
| D\_FILT4LPFKN\_HZ\_F32 | Single Precision Float | Hz | 1/(2\*pi\*300) |
| D\_FILT5LPFKN\_HZ\_F32 | Single Precision Float | Hz | 1/(2\*pi\*1590) |
| D\_FILT6LPFKN\_HZ\_F32 | Single Precision Float | Hz | 1/(2\*pi\*4000) |
| D\_1PERC\_ULS\_F32 | Single Precision Float | Unitless | 0.01 |
| D\_FILTOUTLIM\_ULS\_F32 | Single Precision Float | Unitless | 200.0 |
| D\_DEFEATDUTYCYCLELEVEL\_ULS\_F32 | Single Precision Float | Unitless | 0.0 |
| D\_DEFEATTHERMLIMITPERC\_ULS\_F32 | Single Precision Float | Unitless | 0.0 |
| D\_DEFEATTHERMLIMIT\_MTRNM\_F32 | Single Precision Float | MtrNm | 8.8 |
| D\_TAU3\_SEC\_F32 | Single Precision Float | Sec | 159 |
| D\_TAU4\_SEC\_F32 | Single Precision Float | Sec | 300 |
| D\_TAU5\_SEC\_F32 | Single Precision Float | Sec | 1590 |
| D\_TAU6\_SEC\_F32 | Single Precision Float | Sec | 4000 |
| D\_PER1EXECRATE\_SEC\_F32 | Single Precision Float | Sec | 0.1 |
| D\_EFILTVALMIN\_ULS\_F32 | Single Precision Float | Unitless | 0.0 |
| D\_EFILTVALMAX\_ULS\_F32 | Single Precision Float | Unitless | 200.0 |

#### Global

This section lists the global constants used by the module. For details on global constants, refer to the Data Dictionary for the application.

|  |
| --- |
| Constant Name |
| D\_MTRTRQCMDHILMT\_MTRNM\_F32 |
| D\_ZERO\_ULS\_F32 |
| D\_ZERO\_CNT\_U32 |
| D\_ONE\_ULS\_F32 |
| D\_ONE\_CNT\_U16 |
| D\_ONE\_CNT\_U32 |
| D\_100MS\_SEC\_F32 |
| D\_ZERO\_CNT\_U8 |

### Module specific Lookup Tables Constants

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

# Functions/Macros used by the Sub-Modules

## Library Functions / Macros

The library and functions / Macros that are called by the various sub modules are identified below,

1. TableSize\_m
2. FPM\_FixedToFloat\_m
3. FPM\_FloatToFixed\_m
4. LPF\_KUpdate\_f32\_m
5. LPF\_OpUpdate\_f32\_m
6. Abs\_f32\_m
7. IntplVarXY\_u16\_s16Xu16Y\_Cnt
8. IntplVarXY\_u16\_u16Xu16Y\_Cnt
9. Max\_m
10. Min\_m
11. Limit\_m
12. DiagPStep\_m
13. DiagNStep\_m
14. DiagFailed\_m

## Data Hiding Functions

1. None

## Global Functions/Macros Defined by this Module

None

## Local Functions/Macros Used by this MDD only

### Local Function #1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Function Name** | StepVarXY\_u16\_s16Xu16Y\_Cnt | Type | Min | Max | UTP Tol. |
| **Arguments Passed** | TableX | sint16\* | -32,768 | 32,767 | N/A |
|  | TableY | uint16\* | 0 | 65535 | N/A |
|  | Size | uint16 | 1 | 65535 | N/A |
|  | input | sint16 | -32,768 | 32,767 | N/A |
| **Return Value** | See description | uint16 | 0 | 65535 | 0 |

NOTE – this function is able to be called with the range of argument values as shown; full range will not necessarily be reached in the actual calls to this function in this component. UTP will test this function only to the limits of the actual parameters in the actual function calls.

#### Description



# Software Module Implementation

## Runtime Environment (RTE) Initial Values

This section lists the initial values of data written by this module but controlled by the RTE. After RTE initialization, the data in this table will contain these values.

|  |  |
| --- | --- |
| Data | Value |
| Rte\_InitValue\_CuTempEst\_DegC\_f32 | 0 |
| Rte\_InitValue\_DutyCycleLevel\_Uls\_f32 | 0 |
| Rte\_InitValue\_FiltMeasTemp\_DegC\_f32 | 0 |
| Rte\_InitValue\_FilteredPkCurr\_AmpSq\_f32 | 0 |
| Rte\_InitValue\_MagTempEst\_DegC\_f32 | 0 |
| Rte\_InitValue\_MotorVelCRF\_MtrRadpS\_f32 | 0 |
| Rte\_InitValue\_MtrPkCurr\_AmpSq\_f32 | 0 |
| Rte\_InitValue\_SiTempEst\_DegC\_f32 | 0 |
| Rte\_InitValue\_ DiagStsDefTemp \_Cnt\_lgc | FALSE |
| Rte\_InitValue\_ThermLimitPerc\_Uls\_f32 | 0 |
| Rte\_InitValue\_ThermalLimit\_MtrNm\_f32 | 8.8 |
| Rte\_InitValue\_DefeatDutySvc\_Cnt\_lgc | FALSE |
| Rte\_InitValue\_ IgnTimeOff\_Cnt\_u32 | 0 |
| Rte\_InitValue\_ VehTimeValid\_Cnt\_lgc | FALSE |

## Initialization Functions

### Init: ThrmlDutyCycle\_Init1

#### Design Rationale

None

#### Module Outputs

None

#### Store Module Inputs to Local copies

IgnTimeOff\_Sec\_T\_u32 = Rte\_IRead\_ThrmlDutyCycle\_Init1\_IgnTimeOff\_Cnt\_u32()

VehTimeValid\_Cnt\_T\_lgc = Rte\_IRead\_ThrmlDutyCycle\_Init1\_VehTimeValid\_Cnt\_lgc()

DefeatDutySvc\_Cnt\_T\_lgc = Rte\_IRead\_ThrmlDutyCycle\_Init1\_DefeatDutySvc\_Cnt\_lgc()

#### Module Internal



## Periodic Functions

### Per: ThrmlDutyCycle\_Per1

#### Design Rationale

Function NxtrDiagMgr\_GetNTCFailed with argument NTC\_Num\_Thermistor is used to get the input called Diag\_Status in the FDD. This function returns TRUE if the specified NTC is currently in a FAILED state. The FDD owner has confirmed that this is what is meant in the FDD by the use of the Diag\_Status input described as “Thermistor fault flag” and also called “Temp\_Sens\_DTC\_Active”.

#### Program Flow Start

Rte\_Call\_ThrmlDutyCycle\_Per1\_CP0\_CheckpointReached()

#### Store Module Inputs to Local copies

CuTempEst\_DegC\_T\_f32 = Rte\_IRead\_ThrmlDutyCycle\_Per1\_CuTempEst\_DegC\_f32()

FiltMeasTemp\_DegC\_T\_f32 = Rte\_IRead\_ThrmlDutyCycle\_Per1\_FiltMeasTemp\_DegC\_f32()

FiltPkCurr\_AmpSq\_T\_f32 = Rte\_IRead\_ThrmlDutyCycle\_Per1\_FilteredPkCurr\_AmpSq\_f32()

MagTempEst\_DegC\_T\_f32 = Rte\_IRead\_ThrmlDutyCycle\_Per1\_MagTempEst\_DegC\_f32()

MotorVelCRF\_MtrRadpS\_T\_f32 = Rte\_IRead\_ThrmlDutyCycle\_Per1\_MotorVelCRF\_MtrRadpS\_f32()

MtrPkCurr\_AmpSq\_T\_f32 = Rte\_IRead\_ThrmlDutyCycle\_Per1\_MtrPkCurr\_AmpSq\_f32()

SiTempEst\_DegC\_T\_f32 = Rte\_IRead\_ThrmlDutyCycle\_Per1\_SiTempEst\_DegC\_f32()

DefeatDutySvc\_Cnt\_T\_lgc = Rte\_IRead\_ThrmlDutyCycle\_Per1\_DefeatDutySvc\_Cnt\_lgc\_Cnt\_lgc();

PrevAbsTempLimit\_MtrNm\_T\_f32 = AbsTempLimit\_MtrNm\_M\_f32

AbsMotorVelCRF\_MtrRadpS\_T\_f32 = Abs\_f32\_m(MotorVelCRF\_MtrRadpS\_T\_f32)

Rte\_Call\_NxtrDiagMgr\_GetNTCFailed(NTC\_Num\_Thermistor, &DiagStsDefTemp\_Cnt\_T\_lgc)

VehTimeValid\_Cnt\_T\_lgc = Rte\_IRead\_ThrmlDutyCycle\_Per1\_VehTimeValid\_Cnt\_lgc();

IgnTimeOff\_Cnt\_T\_u32 = Rte\_IRead\_ThrmlDutyCycle\_Per1\_IgnTimeOff\_Cnt\_u32();

#### Filter Re-Init



#### Temperature Selection



#### Load Limiting – Multiplier



#### Load Limiting – Max Filter Percentage



#### Load Limiting – Thermal Load Limit



#### Temperature Limiting



#### Temperature Limiting Status



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

ThrmDutyCycle\_AbsTempLimit\_MtrNm\_M\_f32 = AbsTempLimitSlew\_MtrNm\_T\_f32

ThrmDutyCycle\_Mult12Temp\_DegC\_D\_f32 = Mult12Temp\_DegC\_T\_f32

ThrmDutyCycle\_Mult36Temp\_DegC\_D\_f32 = Mult36Temp\_DegC\_T\_f32

ThrmDutyCycle\_MaxOut\_AmpSq\_D\_u16p0 = MaxOut\_Uls\_T\_u16p0

ThrmDutyCycle\_ThermLim\_MtrNm\_D\_f32 = ThermalLoadLmt\_MtrNm\_T\_f32

ThrmDutyCycle\_Mult1\_Uls\_D\_u3p13 = Mult1\_Uls\_T\_u3p13

ThrmDutyCycle\_Mult2\_Uls\_D\_u3p13 = Mult2\_Uls\_T\_u3p13

ThrmDutyCycle\_Mult3\_Uls\_D\_u3p13 = Mult3\_Uls\_T\_u3p13

ThrmDutyCycle\_Mult4\_Uls\_D\_u3p13 = Mult4\_Uls\_T\_u3p13

ThrmDutyCycle\_Mult5\_Uls\_D\_u3p13 = Mult5\_Uls\_T\_u3p13

ThrmDutyCycle\_Mult6\_Uls\_D\_u3p13 = Mult6\_Uls\_T\_u3p13

ThrmDutyCycle\_LastTblVal\_MtrNm\_D\_u9p7 = LastTblValRaw\_MtrNm\_T\_u9p7

ThrmDutyCycle\_LastTblValSlew\_MtrNm\_D\_u9p7 = LastTblVal\_MtrNm\_T\_u9p7

ThrmDutyCycle\_AbsCtrlTempLimit\_MtrNm\_D\_f32 = AbsCtrlTempLimit\_MtrNm\_T\_f32

ThrmDutyCycle\_AbsCuTempLimit\_MtrNm\_D\_f32 = AbsCuTempLimit\_MtrNm\_T\_f32

ThrmDutyCycle\_AbsTempLimit\_MtrNm\_D\_f32 = AbsTempLimit\_MtrNm\_T\_f32

ThrmDutyCycle\_ThrmLoadLmtTblYVal\_MtrNm\_D\_f32 = DivFactor\_MtrNm\_T\_f32

Rte\_IWrite\_ThrmlDutyCycle\_Per1\_DutyCycleLevel\_Uls\_f32(MaxSlowFilt\_Uls\_T\_f32)

Rte\_IWrite\_ThrmlDutyCycle\_Per1\_ThermLimitPerc\_Uls\_f32(ThermLimitPerc\_Uls\_T\_f32)

Rte\_IWrite\_ThrmlDutyCycle\_Per1\_ThermalLimit\_MtrNm\_f32(ThermalLimit\_MtrNm\_T\_f32)

#### Program Flow End

Rte\_Call\_ThrmlDutyCycle\_Per1\_CP1\_CheckpointReached()

## Fault Recovery Functions

None

## Shutdown Functions

None

## Interrupt Functions

None

## Serial Communication Functions

None

# Execution Requirements

## Execution Rates for sub-modules called by the Scheduler

This table serves as reference for the Scheduler design

|  |  |  |
| --- | --- | --- |
| Function Name | Calling Frequency | System State(s) in which the function is called |
| ThrmlDutyCycle\_Init1 | On Event | On Init |
| ThrmlDutyCycle\_Per1 | 100 ms | ALL |

## Execution Requirements for Serial Communication Functions

|  |  |
| --- | --- |
| Function Name | Sub-Module called by (Serial Comm Function Name) |
| None |  |

# Memory Map Definition Requirements

## Sub Modules (Functions)

This table identifies the software segments for functions identified in this module.

|  |  |
| --- | --- |
| Name of Sub Module | Software Segment |
| ThrmlDutyCycle\_Init1 | RTE\_START\_SEC\_AP\_THRMLDUTYCYCLE\_APPL\_CODE |
| ThrmlDutyCycle\_Per1 | RTE\_START\_SEC\_AP\_THRMLDUTYCYCLE\_APPL\_CODE |

## Local Functions

This table identifies the software segments for local functions identified in this module.

|  |  |
| --- | --- |
| Name of Sub Module | Software Segment |
| None |  |

# Known Issues / Limitations With Design

1. INLINE functions defined in GlobalMacro.h are not unit tested.
2. Unit test of StepVarXY\_u16\_s16Xu16Y\_Cnt() function will test argument range only to the limits of the actual parameters in the actual function calls in the module.

# Revision Control Log

|  |  |  |  |
| --- | --- | --- | --- |
| **Rev #** | **Change Description** | **Date** | **Author Initials** |
| 1.0 | Initial Version (implements SF-09 v001) | 21-May-12 | OT |
| 2.0 | Updated initial value of AssistThermScalar output, added limit on maxout terms to prevent overflow per new FDD design | 30-May-12 | LWW |
| 3.0 | Updated values of 6 filter embedded data constants- Anom 3445 | 16-June-12 | NRAR |
| 4.0 | Updated to SF-09 v003 | 09-Jul-12 | OT |
| 5.0 | Updated to SF-09 v004 | 09-Aug-12 | BWL |
| 6.0 | MDD fixes per unit test review. | 10-Aug-12 | BWL |
| 7.0 | Added checkpoints and memmap software segment is updated for static variables | 24-Sep-12 | Selva |
| 8.0 | Replaced multiplier interpolation with step function. | 16-Oct-12 | BWL |
| 9.0 | Updated to SF-09 v006 | 29-Jan-13 | Selva |
| 10 | Corrected Diag\_Status reading function | 31-Jan-13 | Selva |
| 11 | Updated to SF-09 v007 | 20-Feb-13 | SP |
| 12 | Fix Anomoly 4517 | 28-Feb-13 | Selva |
| 13,14 | Updated to SF-09 v008`  Tessy Unit test fixes | 09-Apr-13 | Selva |
| 15 | Updated to SF-09 v010 – new logic for calculating AbsTempLimit; also updated module and display variable names per naming conventions. | 05-Sep-13 | KMC |
| 16 | Updated to SF-09 v11 -- new logic for reinit of the filter state variables based on ignition off time. | 17-Sep-13 | KJS |
| 17 | Updated to SF-09 v012 – updated filter init and reinit to use the default ignition off time when DefeatDutySvc is TRUE | 25-Sep-13 | KMC |
| 18 | Updated some incorrect module level variable names; added notes regarding unit test of function StepVarXY\_u16\_s16Xu16Y\_Cnt() | 27-Sep-13 | KMC |
| 19 | Updated flowcharts for naming conventions, SetNTCStatus parameter byte 0x00 when PASSED, and limiting on ThermLimitPerc output. Added note about NTCFailed. All for CR10070. | 1-Oct-13 | KMC |
| 20 | Added 4 new module internal variables and modified flowcharts for fix of anomaly 5736; added two new constants and modified flowcharts for fix of anomaly 5739. | 14-Nov-13 | KMC |
| 21 | Updated to SF09 revision 14. Moved the four filters from TypeH to their own NvM block | 22-Nov-13 | KJS |