3 AIRT
Air temperature

3.1 AIRT General

▶ General Information

The goal of the aggregate AIRT is to provide ambient air temperature and temperatures in the intake system which are required by several other Aggregates.

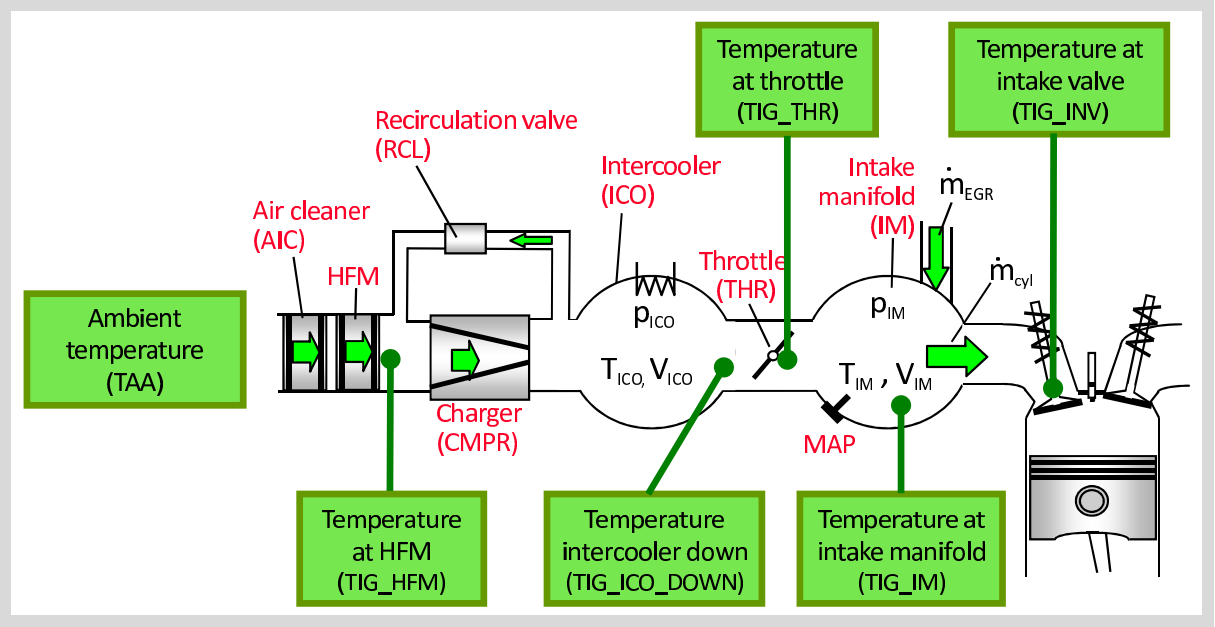

Figure 3.1.1: Configuration and sensor positions of a standard turbocharged engine

As main outputs, the AGGR offers:

- Ambient air temperature (TAA) and a status for this value (STATE_TAA)
- Temperature at HFM (TIG_HFM)
- Temperature upstream and downstream intercooler (TIG_ICO_UP/ _DOWN)
- Temperature at throttle (TIG_THR)
- Temperature at intake manifold (TIG_IM)
- Temperature at intake valve (TIG_INV).

Furthermore values for the temperatures at start (e.g. TAA_ST) as well as at start in current driving cycle (e.g. TAA_ST_DC) are provided.

Data for mode $01 is provided with TAA_SAE and TIG_MES_SAE.

The AGGR basically consists of the following parts:

- Acquisition
- Diagnoses
- Temperature models and calculation of temperatures

▶ Architecture Overview

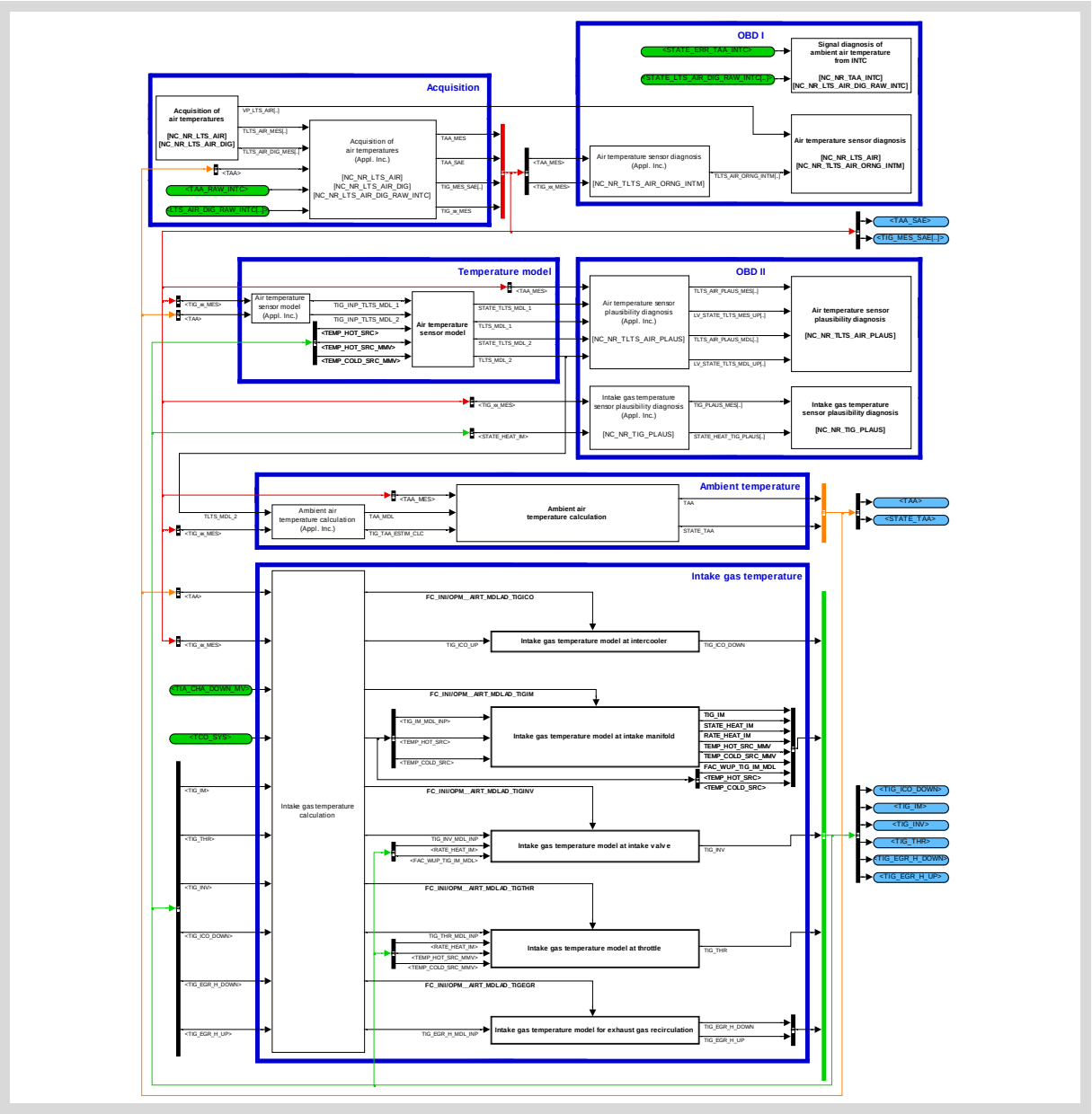

Figure 3.1.2:

Acquisition:

With the current solution it is possible to acquire temperatures from analog sensors (as voltage) as well as from digitally delivered signals (PWM). Furthermore temperatures from CAN as well as from SENT sensors can be acquired.

Diagnoses:

The AGGR offers the following diagnoses to check the validity of the signals:

- Air temperature sensor electrical diagnosis (open circuit / shortcut to plus)
- Air temperature sensor intermittent diagnosis
- Air temperature sensor out of range diagnosis (low / high)

- Air temperature sensor plausibility diagnosis
- Intake gas temperature sensor plausibility diagnosis (stuck / dyn)

Air temperature sensor plausibility diagnosis and *intake gas temperature sensor plausibility diagnosis* can be deactivated via NC to save resources in case they are not needed.

Temperature models and calculation of temperatures:

The following temperature models are available in AIRT AGGR:

- Air temperature sensor model
- Intake gas temperature model at throttle
- Intake gas temperature model at intake manifold
- Intake gas temperature model at intake valve

Remark: For the modules *intake gas temperature model at intercooler* and *intake gas temperature model for exhaust gas recirculation* currently only placeholders are implemented !

For the given intake gas temperature models, the input temperatures depend on the project specific sensor configuration. Therefore the definition of the input temperatures and the resulting calculation order of the modules is defined in the module *intake gas temperature calculation*.

In all of these models an offset is added to the input temperature (TIG_xx_MDL_INP). The offset is calibrated by IP and is basically depending on the air mass flow. Therefore it is set to 0 at engine stop.

The modelled intake gas temperature is filtered. With LC_TIG_MDL_FIL_SWI it is possible to switch between two filter strategies. One is to filter the whole value (input + offset), the other one is to filter the offset only.

If any intake gas temperature model is not needed (i.e. if the sensor is directly mounted at the respective position) it can be deactivated via NC to save resources.

In the module *ambient air temperature calculation* the measured air temperature is estimated. Furthermore the coordination between estimated and modelled air temperature (calculated in *air temperature sensor model*) is done to determine the ambient air temperature.

3.2 AIRT Configuration data

▶ Configuration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
NC_NR_LEN_CAM_EX_TIG_INV_MDL	O	1... 10H	1... 16	1	-
Number of CAM_EX breakpoints for LDPM_CAM_EX_1_AIRT					
NC_NR_LEN_CAM_IN_TIG_INV_MDL	O	1... 10H	1... 16	1	-
Number of CAM_IN breakpoints for LDPM_CAM_IN_1_AIRT					
NC_NR_LEN_M_GAS_TIG_INV_MDL	O	1... 10H	1... 16	1	-
Number of M_GAS breakpoints for LDPM_M_GAS_TIG_INV_MDL_1_AIRT					
NC_NR_LEN_N_TIG_INV_MDL	O	1... 10H	1... 16	1	-
Number of engine speed breakpoints for LDPM_N_TIG_INV_MDL_1_AIRT					
NC_NR_LEN_RATE_HEAT_TIG_INV_MDL	O	1... 10H	1... 16	1	-
Number of RATE_HEAT_IM breakpoints for LDPM_RATE_HEAT_IM_1_AIRT					
NC_NR_LEN_TLTS_AIR_DIG_MES	O	1... 10H	1... 16	1	-
Number of PWM breakpoints for IP_TLTS_AIR_DIG_MES					
NC_NR_LEN_TLTS_AIR_MES	O	1... 10H	1... 16	1	-
Number of VP breakpoints for IP_TLTS_AIR_MES					
NC_NR_LEN_VS_TIG_INV_MDL	O	1... 10H	1... 16	1	-
Number of VS breakpoints for LDPM_VS_1_AIRT					
NC_NR_LTS_AIR	O	0... AH	0... 10	1	-
Number of air temperature sensors					
NC_NR_LTS_AIR_DIG	O	0... AH	0... 10	1	-
Number of digitally delivered air temperature sensors					
NC_NR_TAA_INTC	O	1... 10H	1... 16	1	-
Number of failure instances which are implemented in signal diagnosis of ambient air temperature from INTC					
NC_NR_TIG_PLAUS	O	0... FFH	0... 255	1	-
Number of temperature sensors for intake gas temperature sensor plausibility diagnosis					
NC_NR_TIG_SENS	O	0... AH	0... 10	1	-
Number of intake gas temperature sensors					
NC_NR_TLTS_AIR_ORNG_INTM	O	0... AH	0... 10	1	-
Number of air temperature sensors for air temperature sensor out of range and intermittend diagnosis					
NC_NR_TLTS_AIR_PLAUS	O	0... FFH	0... 255	1	-
Number of temperature sensors for air temperature sensor plausibility diagnosis					
NC_TAA_BOL	O	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Lower limit for ambient air temperature					
NC_TAA_SENS_USE	O	0... 4H	0 ...4	1	-
Configuration constant used to indicate whether a TAA sensor is available (1=Yes, 0=No)					
NC_TAA_TOL	O	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Upper limit for ambient air temperature					
NC_TIG_IM_CONF	O	0... 4H	0 ...4	1	-
Configuration constant used to indicate whether a TIG_IM model is used					
NC_TIG_INV_CONF	O	0... 6H	0 ...6	1	-
Configuration constant used to indicate whether a TIG_INV model is used					
NC_TIG_PLAUS_CONF	O	0... 4H	0 ...4	1	-

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
Configuration constant used to indicate whether the TIG_PLAUS diagnosis is used					
NC_TIG_THR_CONF	O	0... 4H	0 ...4	1	-
Configuration constant used to indicate whether a TIG_THR model is used					
NC_TLTS_AIR_PLAUS_CONF	O	0... 4H	0 ...4	1	-
Configuration constant used to indicate whether the TLTS_AIR_PLAUS diagnosis is used					
NC_TLTS_MDL_CONF	O	0... 4H	0 ...4	1	-
Configuration constant used to indicate whether a TLTS_MDL is used					
NLC_LTS_AIR_DIG_ACT	O	0... 1H	0 ...1	1	-
Activation of digitally delivered air temperature sensors					

General Information

This configuration module contains the configuration switches for the AIRT aggregate.
They are set once at the beginning of the project.

NC_TAA_SENS_USE definition:
Configuration constant used to indicate whether a TAA (ambient air temperature) sensor is available (1 = Yes, 0 = No)

NLC_LTS_AIR_DIG_ACT definition:
Configuration constant used to indicate whether a digitally delivered sensor signal is used (1 = Yes, 0 = No)

NC_TIG_INV_CONF definition:
Configuration constant used to indicate whether a TIG_INV model is used
0 = TIG_INV model not calculated
1 = VVTI & VVLI model not calculated
2 = VVTI model calculated only
3 = VVTI & VVLI model calculated

NC_TIG_IM_CONF definition:
Configuration constant used to indicate whether a TIG_IM model is used
0 = TIG_IM model not calculated
1 = TIG_IM model calculated

NC_TIG_THR_CONF definition:
Configuration constant used to indicate whether a TIG_THR model is used
0 = TIG_THR model not calculated
1 = TIG_THR model calculated

NC_TLTS_MDL_CONF definition:
Configuration constant used to indicate whether a TLTS_MDL is used
0 = TLTS_MDL_1 & TLTS_MDL_2 not calculated
1 = TLTS_MDL_1 calculated only
2 = TLTS_MDL_2 calculated only
3 = TLTS_MDL_1&2 calculated

NC_TIG_PLAUS_CONF definition:
Configuration constant used to indicate whether the TIG_PLAUS diagnosis is used

0 = TIG_PLAUS diagnosis not calculated
1 = TIG_PLAUS_STUCK diagnosis calculated only
2 = TIG_PLAUS_DYN diagnosis calculated only
3 = TIG_PLAUS_STUCK & TIG_PLAUS_DYN diagnosis calculated

NC_TLTS_AIR_PLAUS_CONF definition:
Configuration constant used to indicate whether the TLTS_AIR_PLAUS diagnosis is used
0 = TLTS_AIR_PLAUS diagnosis not calculated
1 = TLTS_AIR_PLAUS diagnosis calculated

NC_NR_TIG_SENS definition:
Following sensors are implemented in:
Acquisition of air temperatures (Appl. Inc.)

For NC_NR_TIG_SENS look on below table:

[Array - INDEX]	Display name extension	Array index in SW
0	IM	NC_IDX_TIG_SENS_IM

NC_NR_LTS_AIR definition:
Following sensors (failure instances) are implemented in:
Acquisition of air temperatures
Air temperature sensor diagnosis

For NC_NR_LTS_AIR look on below table:

[Array - INDEX]	Display name extension	Array index in SW
0	IM	NC_IDX_LTS_AIR_IM

NC_IDX_ERR_LTS_AIR[..] is filled with the corresponding single
Error-Symptom-Instance: LTS_AIR[Name of failure instance**]**

Remark: In case of no hardwired ambient air temperature sensor
NC_IDX_LTS_AIR_TAA must be set to 0

NC_NR_LTS_AIR_DIG definition:
Following sensors (failure instances) are implemented in:
Acquisition of air temperatures

For NC_NR_LTS_AIR_DIG look on below table:

[Array - INDEX]	Name of failure instance	Array index in SW
0	-	NC_IDX_LTS_AIR_DIG_xx

NC_IDX_ERR_LTS_AIR_DIG[..] is filled with the corresponding single
Error-Symptom-Instance: LTS_AIR_DIG[Name of failure instance**]**

NC_NR_TLTS_AIR_ORNG_INTM definition:
Following sensors (failure instances) are implemented in
Air temperature sensor diagnosis.

For NC_NR_TLTS_AIR_ORNG_INTM look on below table:

[Array - INDEX]	Display name extension	Array index in SW
0	TAA	NC_IDX_TLTS_AIR_ORNG_INTM_TAA
1	IM	NC_IDX_TLTS_AIR_ORNG_INTM_IM

NC_IDX_ERR_TLTS_AIR_PLAUS[..] is filled with the corresponding single
Error-Symptom-Instance: TLTS_AIR_ORNG_INTM[Name of failure instance**]**

NC_NR_TLTS_AIR_PLAUS definition:
Following sensors (failure instances) are implemented in
Air temperature sensor plausibility diagnosis.

For NC_NR_TLTS_AIR_PLAUS look on below table:

[Array - INDEX]	Display name extension	Array index in SW
0	TAA	NC_IDX_TLTS_AIR_PLAUS_TAA

NC_IDX_ERR_TLTS_AIR_PLAUS[..] is filled with the corresponding single
Error-Symptom-Instance: TLTS_AIR_PLAUS[Name of failure instance**]**

NC_NR_TIG_PLAUS definition:
Following sensors (failure instances) are implemented in
Intake gas temperature sensor plausibility diagnosis.

For NC_NR_TIG_PLAUS look on below table:

[Array - INDEX]	Display name extension	Array index in SW
0	IM	NC_IDX_TIG_PLAUS_IM

NC_IDX_ERR_TIG_PLAUS[..] is filled with the corresponding single
Error-Symptom-Instance: TIG_PLAUS[Name of failure instance**]**

NC_NR_TAA_INTC definition:
Monitoring of received OBD failure state of ambient temperature sensor.
For the reason that the ambient temperature is evaluated from another control unit,
the received failure-state-error has to be debounced and implemented into ERRM from ECU.

Following failure instances are implemented in signal diagnosis of ambient air temperature from INTC

For NC_NR_TAA_INTC look on below table

[Array - INDEX]	Display name extension	Array index in SW
0	EL_L	NC_IDX_TAA_INTC_EL_L
1	EL_H	NC_IDX_TAA_INTC_EL_H

NC_IDX_ERR_TAA_INTC[..] is filled with the corresponding single
Error-Symptom-Instance: TAA_INTC [Name of failure instance**]**

Definition of axis length for several IP_xx's:

Acquisition of air temperatures:
NC_NR_LEN_TLTS_AIR_MES
NC_NR_LEN_TLTS_AIR_DIG_MES

Intake gas temperature model at intake valve
NC_NR_LEN_CAM_EX_TIG_INV_MDL
NC_NR_LEN_CAM_IN_TIG_INV_MDL
NC_NR_LEN_M_GAS_TIG_INV_MDL
NC_NR_LEN_N_TIG_INV_MDL
NC_NR_LEN_RATE_HEAT_TIG_INV_MDL
NC_NR_LEN_VS_TIG_INV_MDL

▶ Global Configuration Data:

Here are listed the configuration data, which can be used in other aggregates:

Configuration Item	Range	Value	Comment
NC_NR_TIG_SENS *Number of intake gas temperature sensors*	0... 10 0... AH	1 [-] 0x1	1 intake gas temperature sensor
NC_TAA_SENS_USE *Configuration constant used to indicate whether a TAA sensor is available (1=Yes, 0=No)*	0 ...4 0... 4H	1 [-] 0x1	Ambient air temperature sensor available and used

▶ Local Configuration Data:

Here are listed the configuration data, which can be used within an aggregate:

Configuration Item	Range	Value	Comment
NC_NR_LEN_CAM_EX_TIG_INV_MDL *Number of CAM_EX breakpoints for LDPM_CAM_EX_1_AIRT*	1... 16 1... 10H	3 [-] 0x3	
NC_NR_LEN_CAM_IN_TIG_INV_MDL *Number of CAM_IN breakpoints for LDPM_CAM_IN_1_AIRT*	1... 16 1... 10H	3 [-] 0x3	
NC_NR_LEN_M_GAS_TIG_INV_MDL *Number of M_GAS breakpoints for LDPM_M_GAS_TIG_INV_MDL_1_AIRT*	1... 16 1... 10H	8 [-] 0x8	
NC_NR_LEN_N_TIG_INV_MDL *Number of engine speed breakpoints for LDPM_N_TIG_INV_MDL_1_AIRT*	1... 16 1... 10H	8 [-] 0x8	
NC_NR_LEN_RATE_HEAT_TIG_INV_MDL *Number of RATE_HEAT_IM breakpoints for LDPM_RATE_HEAT_IM_1_AIRT*	1... 16 1... 10H	4 [-] 0x4	
NC_NR_LEN_TLTS_AIR_DIG_MES *Number of PWM breakpoints for IP_TLTS_AIR_DIG_MES*	1... 16 1... 10H	1 [-] 0x1	No digitally delivered temperature sensor available, therefore map reduced to 1
NC_NR_LEN_TLTS_AIR_MES *Number of VP breakpoints for IP_TLTS_AIR_MES*	1... 16 1... 10H	16 [-] 0x10	
NC_NR_LEN_VS_TIG_INV_MDL *Number of VS breakpoints for LDPM_VS_1_AIRT*	1... 16 1... 10H	4 [-] 0x4	
NC_NR_LTS_AIR *Number of air temperature sensors*	0... 10 0... AH	1 [-] 0x1	1 air temperature sensor in intake system (TIG_IM)
NC_NR_LTS_AIR_DIG *Number of digitally delivered air temperature sensors*	0... 10 0... AH	1 [-] 0x1	Count of digital temperature sensor, only used if NLC_LTS_AIR_DIG_ACT=1
NC_NR_TAA_INTC *Number of failure instances which are implemented in signal diagnosis of ambient air temperature from INTC*	1... 16 1... 10H	2 [-] 0x2	2 failure instance send from INTC
NC_NR_TIG_PLAUS *Number of temperature sensors for intake gas temperature sensor plausibility diagnosis*	0... 255 0... FFH	1 [-] 0x1	Diagnosis is made for 1 air temperature sensor (TIG_IM)
NC_NR_TLTS_AIR_ORNG_INTM *Number of air temperature sensors for air temperature sensor out of range and intermittend diagnosis*	0... 10 0... AH	2 [-] 0x2	Out of range diagnosis done for all sensors
NC_NR_TLTS_AIR_PLAUS *Number of temperature sensors for air temperature sensor plausibility diagnosis*	0... 255 0... FFH	1 [-] 0x1	Diagnosis is made for 1 air temperature sensor (TAA)

Configuration Item	Range	Value	Comment
NC_TAA_BOL *Lower limit for ambient air temperature*	-256... 255.992188 8000... 7FFFH	-40 [°C] 0xEC00	Lower limit for ambient air temperature
NC_TAA_TOL *Upper limit for ambient air temperature*	-256... 255.992188 8000... 7FFFH	55 [°C] 0x1B80	Upper limit for ambient air temperature
NC_TIG_IM_CONF *Configuration constant used to indicate whether a TIG_IM model is used*	0 ...4 0... 4H	1 [-] 0x1	TIG_IM model calculated
NC_TIG_INV_CONF *Configuration constant used to indicate whether a TIG_INV model is used*	0 ...6 0... 6H	3 [-] 0x3	VVTI & VVLI model calculated
NC_TIG_PLAUS_CONF *Configuration constant used to indicate whether the TIG_PLAUS diagnosis is used*	0 ...4 0... 4H	3 [-] 0x3	TIG_PLAUS_STUCK & TIG_PLAUS_DYN diagnosis calculated
NC_TIG_THR_CONF *Configuration constant used to indicate whether a TIG_THR model is used*	0 ...4 0... 4H	1 [-] 0x1	TIG_THR model calculated
NC_TLTS_AIR_PLAUS_CONF *Configuration constant used to indicate whether the TLTS_AIR_PLAUS diagnosis is used*	0 ...4 0... 4H	1 [-] 0x1	TLTS_AIR_PLAUS diagnosis calculated
NC_TLTS_MDL_CONF *Configuration constant used to indicate whether a TLTS_MDL is used*	0 ...4 0... 4H	3 [-] 0x3	TLTS_MDL_1&2 calculated
NLC_LTS_AIR_DIG_ACT *Activation of digitally delivered air temperature sensors*	0 ...1 0... 1H	0 [-] 0x0	No digital temperature sensor mounted

3.3 AGGR adaptation: AIRT

▶ Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
CONF_TAM	O	0... 3H	0 ...3	1	-
Status information for ambient temperature configuration					
FLOW_EGR_AIRT	O	0... FFFFH	0... 2047.96875	0.03125	kg/h
Exhaust gas recirculation flow for AIRT aggregate					
LV_TAM_MES_VLD	O/V	0... 1H	0 ...1	1	-
Logical variable indicating the validity of the measured TAM signals i.e. the validity of only the data transfer to ECU is considered here and the plausiblity of the value itself.					
M_GAS_TIG_IM_AIRT	O/V	0... FFFFH	0... 2778	0.04238956	mg/stk
Intake gas mass for calculation of intake gas temperature model at intake manifold					
M_GAS_TIG_INV_AIRT	O/V	0... FFFFH	0... 2778	0.04238956	mg/stk
Intake gas mass for calculation of intake gas temperature model at intake valve					
M_GAS_TIG_THR_AIRT	O/V	0... FFFFH	0... 2778	0.04238956	mg/stk
Intake gas mass for calculation of intake gas temperature model at throttle					
M_GAS_TLTS_MDL_AIRT	O/V	0... FFFFH	0... 2778	0.04238956	mg/stk
Intake gas mass for calculation of air temperature model					
MFL_GAS_IM_AIRT	O/V	0... FFFFH	0... 4095.9375	0.0625	kg/h
Intake gas mass flow at intake manifold for AIRT aggregate					
PQ_AIRT	O/V	0... FFH	0... 7.96875	0.03125	-
Ratio of intake manifold pressure to ambient pressure for AIRT aggregate					
TAM	O/V	0... FEH	-48... 142.5	0.75	°C
Ambient temperature					
TAM_ST	O/V	0... FEH	-48... 142.5	0.75	°C
Ambient air temperature at Start					
TEGR_H_AIRT	O	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Exhaust gas temperature of high pressure EGR for AIRT aggregate					
TIA	O/V	0... FEH	-48... 142.5	0.75	°C
Intake air temperature					
TIA_CYL	O/V	0... FEH	-48... 142.5	0.75	°C
intake air temperature at cylinder inlet					
TIA_CYL_CBK [NC_CBK_IN_NR]	O	0... FEH	-48... 142.5	0.75	°C
Intake air temperature at cylinder inlet - Cylinder bank dependent					
TIA_IM	O/V	0... FEH	-48... 142.5	0.75	°C
Air temperature in the intake manifold					
TIA_MES [NC_SENS_NR_TIA]	O/V	0... FEH	-48... 142.5	0.75	°C
Intake air raw measured value					
TIA_SIGSTAT	O/V	0... 4H	0 ...4	1	-
Signalstatus for TIA [0 (bin = 000) = valid value, 1 (bin = 001) = init value, 3 (bin = 011) = not supported, 4 (bin = 100) = invalid value]					
TIA_ST	O/V	0... FEH	-48... 142.5	0.75	°C
Intake air temperature at Start					
TIA_THR	O/V	0... FEH	-48... 142.5	0.75	°C
Air temperature at the throttle body					
TIA_THR_ST	O/V	0... FEH	-48... 142.5	0.75	°C

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
Air temperature at the throttle body at start					
TIA_THR_ST_DC	O/V	0... FEH	-48... 142.5	0.75	°C
Intake-air-temperature at throttle at first start of current driving cycle					
TIG_CMPR_DOWN	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature downstream compressor					

Input Data

AMP {p. 13840}	LV_FID_READY {p. 11388}	LV_TAA_FIL_INTC_AVL {p. 19541}	LV_TAA_MES_VLD {p. 1172}
MAF_CYL {p. 13893}	MAF_STK_CYL {p. 13894}	MAP {p. 13894}	NC_CBK_IN_NR {p. 13446}
NC_FID_TIG_IM_MES_ENA {p. 1199}	NC_INTC_PQX {p. 21838}	STATE_INTC_VEH_TYP {p. 21836}	TAA {p. 1177}
TAA_RAW_INTC {p. 19087}	TAA_ST {p. 1178}	TIA_CHA_DOWN_MV {p. 2388}	TIG_IM {p. 1204}
TIG_IM_MES {p. 1150}	TIG_IM_ST {p. 1204}	TIG_INV {p. 1215}	TIG_THR {p. 1223}
TIG_THR_ST {p. 1223}	TIG_THR_ST_DC {p. 1223}		

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_TAA_RAW_INTC_VLD	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Threshold for calculation of LV_TAA_RAW_INTC_VLD					

Configuration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
NC_IDX_FID_TAA_RAW_INTC_VLD	O	0... FFFFH	0... 65535	1	-
Auxiliary input indicating that TAA_RAW_INTC is valid					
NC_SENS_NR_TIA	O	0... 3H	0 ...3	1	-
Number of TIA sensors for AIRT Aggregate only (ie: excluding CHRG Aggregate)					
NC_TIA_CONF	O	0... 28H	0... 40	1	-
TIA sensor(s) intake system hardware definition (compiler switch)					

Import actions:

ACTION_FARM_GetPermission(**IN** <PRM_FID>, **OUT** <PRM_LV_PRMS>)

ACTION_FARM_SetAuxiliaryStatus(**IN** <PRM_IDX>, **IN** <PRM_STATE>)

▶ General Information

The aim of this module is to satisfy the interface of the old variables to the AGGRs
Additionally the project specific variables needed for AIRT are calculated,
therefore the module is split into two parts - one before and one after AIRT AGGR!!!

3.3.1 Calculations before the AIRT AGGR 100ms

▶ General Information

This chapter is calculated before the AIRT AGGR

▶ Application Conditions

Initialisation:

```
at  reset:
PQ_AIRT = 1
CONF_TAM = 0
FLOW_EGR_AIRT = 0
TIG_CMPR_DOWN = TIA_CHA_DOWN_MV

all other variables in formula section are set to 0
```

Activation: always

Deactivation: never

Recurrence: 100ms

▶ Function Description

PQ_AIRT = MAP / AMP
M_GAS_TIG_IM_AIRT = MAF_STK_CYL
M_GAS_TIG_INV_AIRT = MAF_STK_CYL
M_GAS_TIG_THR_AIRT = MAF_STK_CYL
M_GAS_TLTS_MDL_AIRT = MAF_STK_CYL
MFL_GAS_IM_AIRT = MAF_CYL
TIG_CMPR_DOWN = TIA_CHA_DOWN_MV

3.3.2 Calculation of auxiliary before AIRT AGGR 100ms

▶ General Information

Within this section an auxiliary for TAA_RAW_INTC is defined which is concerning INTC platform PQx (initial value 'AINI' and message not available 'ANAV')

▶ Application Conditions

Initialisation: `at reset and IGKON: calculate formula section`

Activation: always

Deactivation: never

Recurrence: 100ms

▶ Function Description

```
if STATE_INTC_VEH_TYP = NC_INTC_PQX // INTC platform: PQx
then
 LF_TMP = 0
 if TAA_RAW_INTC > 6400dec and TAA_RAW_INTC < C_TAA_RAW_INTC_VLD and
      LV_TAA_FIL_INTC_AVL = 0
 then LF_TMP bit 4 = 1  // initial value (AINI) (6400dec = -50°C)
 elseif TAA_RAW_INTC = 6400dec and LV_TAA_FIL_INTC_AVL = 0
 then LF_TMP bit 3 = 1  // not attached (ANAV)
 endif
 ACTION_FARM_SetAuxiliaryStatus(IN<NC_IDX_FID_TAA_RAW_INTC_VLD>,IN<LF_TMP>)
endif
```

3.3.3 Calculations after the AIRT AGGR

▶ General Information

This chapter is calculated after the AIRT AGGR

▶ Application Conditions

Initialisation:

```
// Configuration variables
NC_SENS_NR_TIA = 1
NC_TIA_CONF = 10

at reset:
TIA_SIGSTAT = 1 // initvalue
calculate formula section
```

Activation: always

Deactivation: never

Recurrence: 100ms

▶ Function Description

```
TAM = TAA
TAM_ST = TAA_ST

LV_TAM_MES_VLD = LV_TAA_MES_VLD

TIA = TIA(0) = TIA_IM = TIG_IM // in SW 'TIA_VEC' is used instead of 'TIA', because of
TIA double definition
TIA_ST = TIG_IM_ST
TIA_CYL = TIG_INV
TIA_THR = TIG_THR
TIA_THR_ST = TIG_THR_ST
TIA_THR_ST_DC = TIG_THR_ST_DC
TIA_MES(0) = TIG_IM_MES
TIA_CYL_CBK(0) = TIA_CYL

if  LV_FID_READY = 1
then
  if ACTION_FARM_GetPermission(IN<NC_FID_TIG_IM_MES_ENA>)
  then TIA_SIGSTAT = 0 // valid value
  else TIA_SIGSTAT = 4 // failure
  endif
else TIA_SIGSTAT = 1 // initvalue
endif
```

3.4 Acquisition of air temperatures

▶ Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
PWM_LTS_AIR_DIG [NC_NR_LTS_AIR_DIG]	O/V	0... FFFFH	0... 99.99847412109	0.00152588	%
Air temperature sensor digitally delivered PWM signal					
TLTS_AIR_DIG_MES [NC_NR_LTS_AIR_DIG]	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Measured air temperature digitally delivered from sensor					
TLTS_AIR_MES [NC_NR_LTS_AIR]	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Measured air temperature from sensor					
VP_LTS_AIR [NC_NR_LTS_AIR]	O/V	0... 7FFFH	0... 4.999847412109	152.588e-6	V
Air temperature sensor voltage					

▶ Input Data

NC_NR_LEN_TLTS_AIR_DIG_MES {p. 1136}	NC_NR_LEN_TLTS_AIR_MES {p. 1136}	NC_NR_LTS_AIR {p. 1136}	NC_NR_LTS_AIR_DIG {p. 1136}
NLC_LTS_AIR_DIG_ACT {p. 1137}			

▶ Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_TLTS_AIR_DIG_MES_AS [NC_NR_LTS_AIR_DIG]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Calibration constant to set digitally delivered measured air temperature manually					
C_TLTS_AIR_MES_AS [NC_NR_LTS_AIR]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Calibration constant to set measured air temperature manually					
IP_TLTS_AIR_DIG_MES [NC_NR_LTS_AIR_DIG]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
LDP_PWM_IP_TLTS_AIR_DIG_MES	NC_NR_LEN_TLTS_AIR_DIG_MES	0... FFFFH	0... 99.99847412109	0.00152588	%
Conversion map for digitally delivered PWM signal to physical air temperature value					
IP_TLTS_AIR_MES [NC_NR_LTS_AIR]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
LDP_VP_IP_TLTS_AIR_MES	NC_NR_LEN_TLTS_AIR_MES	0... 7FFFH	0... 4.999847412109	152.588e-6	V
Conversion map for sensor voltage to physical air temperature value					

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
LC_TLTS_AIR_DIG_MES_AS [NC_NR_LTS_AIR_DIG]	V	0... 1H	0 ...1	1	-
Logical constant to set digitally delivered measured air temperature manually					
LC_TLTS_AIR_MES_AS [NC_NR_LTS_AIR]	V	0... 1H	0 ...1	1	-
Logical constant to set measured air temperature manually					

▶ Import actions:

ACTION_INFR_GetPwmLtsAirDig(**IN** <PRM_IDX_LTS_AIR_DIG>, **OUT** <PRM_PWM_LTS_AIR_DIG>)

ACTION_INFR_GetVpLtsAir(**IN** <PRM_IDX_LTS_AIR>, **OUT** <PRM_VP_LTS_AIR>)

▶ General Information

This module includes the sensor signal acquisition and conversion to the measured air temperature value for all connected sensors.

3.4.1 Analog delivered temperature sensors

▶ General Information

For analog delivered sensors (voltage from ADC) the number of sensors is defined with NC_NR_LTS_AIR

▶ Application Conditions

Initialisation: **at** reset **and** IGKON:
calculate formula section

Activation: Always

Deactivation: Never

Recurrence: 100 ms

▶ Function Description

```
for j = 0 to NC_NR_LTS_AIR - 1
 VP_LTS_AIR(j) = ACTION_INFR_GetVpLtsAir(IN<j>)

 if LC_TLTS_AIR_MES_AS(j) = 0
 then TLTS_AIR_MES(j) = IP_TLTS_AIR_MES(VP_LTS_AIR(j))
  // axis LDP_VP_IP_TLTS_AIR_MES also vectorized with NC_NR_LTS_AIR
 else TLTS_AIR_MES(j) = C_TLTS_AIR_MES_AS(j)
 endif
endfor
```

3.4.2 Digitally delivered temperature sensors

▶ General Information

For digitally delivered sensors (PWM frequency signal) the number of sensors is defined with NC_NR_LTS_AIR_DIG

▶ Application Conditions

Initialisation:	**at** reset **and** IGKON: calculate formula section
Activation:	Always
Deactivation:	Never
Recurrence:	100 ms

▶ Function Description

```
#if NLC_LTS_AIR_DIG_ACT = 1
#then

for j = 0 to NC_NR_LTS_AIR_DIG - 1
 PWM_LTS_AIR_DIG(j) = ACTION_INFR_GetPwmLtsAirDig(IN<j>)

 if LC_TLTS_AIR_DIG_MES_AS(j) = 0
 then TLTS_AIR_DIG_MES(j) = IP_TLTS_AIR_DIG_MES(PWM_LTS_AIR_DIG(j))
 // axis LDP_PWM_IP_TLTS_AIR_DIG_MES also vectorized with NC_NR_LTS_AIR_DIG
 else TLTS_AIR_DIG_MES(j) = C_TLTS_AIR_DIG_MES_AS(j)
 endif
endfor

#else
#endif
```

3.5 Acquisition of air temperatures (Appl. Inc.)

Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
TAA_MES	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Measured ambient air temperature					
TAA_SAE	O/V	0... FFH	-40 ...215	1	°C
Ambient air temperature in SAE definition					
TAA_SENS_CONF	O/V	0... 4H	0 ...4	1	-
Configuration variable to indicate source of measured ambient air temperature(0=no sensor, 1 = delivered via CAN, 2 = delivered as voltage)					
TIG_IM_MES	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature at intake manifold, measured					
TIG_MES_SAE [NC_NR_TIG_SENS]	O/V	0... FFH	-40 ...215	1	°C
PID68 Intake gas temperature					

Input Data

CONF_TAM {p. 1143}	NC_NR_LTS_AIR {p. 1136}	NC_NR_TIG_SENS {p. 1136}	NC_TAA_SENS_USE {p. 1136}
TAA {p. 1177}	TAA_RAW_INTC {p. 19087}	TLTS_AIR_MES [NC_NR_LTS_AIR] {p. 1147}	

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_TAA_MES_MAN	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Calibration constant for manually measured ambient air temperature					
C_TAA_SENS_CONF	V	0... 4H	0 ...4	1	-
Configuration variable to indicate source of measured ambient air temperature (0=no sensor, 1 = delivered via CAN, 2 = delivered as voltage)					
LC_TAA_MES_MAN	V	0... 1H	0 ...1	1	-
Logical constant to set measured ambient air temperature manually					

Configuration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
NC_FID_TAA_SAE_VLD	-	0... FFFFH	0... 65535	1	-
Input for TAA_SAE variable valid					

▶ Import actions:

```
ACTION_FARM_GetPermission(IN <PRM_FID>, OUT <PRM_LV_PRMS>)
```

▶ General Information

This module provides all necessary measured temperatures for the AIRT aggregate at their position in the intake system.
Therefore the variable TLTS_AIR_MES[xx] are copied to the respective TIG_xx_MES variables.

The measured ambient air temperature TAA_MES is calculated dependent on the system configuration:
C_TAA_SENS_CONF => 0=no sensor, 1 = delivered via CAN, 2 = delivered as voltage.

For tester communication SAE variables are calculated in the defined range and resolution.

3.5.1 Calculation of TIG_xx_MES

▶ General Information

▶ Application Conditions

Initialisation:
```
at reset and IGKON:
calculate formula section
```

Activation: always

Deactivation: never

Recurrence: 100 ms

▶ Function Description

TIG_IM_MES = TLTS_AIR_MES(IM)

3.5.2 Calculation of TAA_MES

▶ General Information

▶ Application Conditions

Initialisation:
```
at reset and IGKON:

if C_TAA_SENS_CONF > 2
then TAA_SENS_CONF = CONF_TAM
else TAA_SENS_CONF = C_TAA_SENS_CONF
endif

calculate formula section
```

Activation: always

Deactivation: never

Recurrence: 100 ms

▶ Function Description

```
if LC_TAA_MES_MAN = 0

then  // normal operation mode
 if  TAA_SENS_CONF = 1
 then
   TAA_MES = TAA_RAW_INTC
 elseif  TAA_SENS_CONF = 2
 then
   TAA_MES = TLTS_AIR_MES(TAA)
 else
   TAA_MES = C_TAA_MES_MAN
 endif
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
else  // testing mode
TAA_MES = C_TAA_MES_MAN
endif
```

3.5.3 Calculation of SAE variables

▶ General Information

Proposal for NC_FID_TAA_SAE_VLD:

AUX_TAA_RAW_INTC	AERR
AUX_TAA_RAW_INTC	ASYM
AUX_TAA_RAW_INTC	AINI
AUX_TAA_RAW_INTC	ANAV

▶ Application Conditions

Initialisation:	**at** reset **and** IGKON: calculate formula section
Activation:	always
Deactivation:	never
Recurrence:	100 ms

▶ Function Description

```
TIG_MES_SAE(IM) = TLTS_AIR_MES(IM)

if(1) NC_TAA_SENS_USE = 1
then(1)// TAA sensor used
  if(2)  TAA_SENS_CONF = 1// TAA via CAN
     if(3)  ACTION_FARM_GetPermission(NC_FID_TAA_SAE_VLD)
     then(3)  TAA_SAE = TAA_MES // TAA value available
     else(3) TAA_SAE = FFH // "Least likely value to be expected under normal condition"
     endif(3)
  elseif(2)  TAA_SENS_CONF = 2// TAA sensor hardwired
```

```
  then(2) TAA_SAE = TAA_MES
   else(2)// No TAA sensor used
    TAA_SAE = TAA// TAA model is used
  endif(2)
else(1)// No TAA sensor used
 TAA_SAE = TAA// TAA model is used
endif(1)
```

3.6 Air temperature sensor model (Appl. Inc.)

Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
LV_TLTS_MDL_1_INP_VLD	O/V	0... 1H	0 ...1	1	-
Inputs for air temperature MDL_1 valid					
LV_TLTS_MDL_2_INP_VLD	O/V	0... 1H	0 ...1	1	-
Inputs for air temperature MDL_2 valid					
TIG_INP_TLTS_MDL_1	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Air temperature input value for MDL_1 calculation					
TIG_INP_TLTS_MDL_2	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Air temperature input value for MDL_2 calculation					

Input Data

LV_IGK {p. 24082}	TAA {p. 1177}	TIG_IM_MES {p. 1150}	

Configuration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
NC_FID_TLTS_MDL_1_INP_VLD	O	0... FFFFH	0... 65535	1	-
Input variables for air temperature sensor MDL_1 valid					
NC_FID_TLTS_MDL_2_INP_VLD	O	0... FFFFH	0... 65535	1	-
Input variables for air temperature sensor MDL_2 valid					

Import actions:

ACTION_FARM_GetPermission(**IN** <PRM_FID>, **OUT** <PRM_LV_PRMS>)

General Information

This module provides all necessary variables and valid flags for the core specification

Proposal for NC_FID_TLTS_MDL_1/2_INP_VLD:

LTS_AIR_OC/_SCG	ERR
LTS_AIR_OC/_SCG	SYM
TLTS_AIR_ORNG_H/_L	ERR
TLTS_AIR_ORNG_H/_L	SYM
TLTS_AIR_INTM	ERR
TLTS_AIR_INTM	SYM
TIG_PLAUS	ERR

Remark:
Additionally the failure instances of all inputs used from other aggregates (e.g. TCO_SYS) for model calculation have to be linked to the NC_FID_TLTS_MDL_1/2_INP_VLD.

▶ Application Conditions

Initialisation:

```
at   reset and  IGKON:
if ACTION_FARM_GetPermission(IN<NC_FID_TLTS_MDL_1_INP_VLD>)
then
LV_TLTS_MDL_1_INP_VLD = 0
TIG_INP_TLTS_MDL_1 = MIN  (TIG_IM_MES, TAA)
else
LV_TLTS_MDL_1_INP_VLD = 0
TIG_INP_TLTS_MDL_1 = TAA
endif

if ACTION_FARM_GetPermission(IN<NC_FID_TLTS_MDL_2_INP_VLD>)
then
LV_TLTS_MDL_2_INP_VLD = 0
TIG_INP_TLTS_MDL_2 = MIN  (TIG_IM_MES, TAA)
else
LV_TLTS_MDL_2_INP_VLD = 0
TIG_INP_TLTS_MDL_2 = TAA
endif
```

Activation: `LV_IGK = 1`

Deactivation: `when activation condition is not fulfilled`

Recurrence: `1s`

▶ Function Description

if ACTION_FARM_GetPermission(**IN**<NC_FID_TLTS_MDL_1_INP_VLD>)
then
LV_TLTS_MDL_1_INP_VLD = 1
TIG_INP_TLTS_MDL_1 = TIG_IM_MES
else
LV_TLTS_MDL_1_INP_VLD = 0
TIG_INP_TLTS_MDL_1 = $TIG\_INP\_TLTS\_MDL\_1_{N-1}$
endif

if ACTION_FARM_GetPermission(**IN**<NC_FID_TLTS_MDL_2_INP_VLD>)
then
LV_TLTS_MDL_2_INP_VLD = 1
TIG_INP_TLTS_MDL_2 = TIG_IM_MES
else
LV_TLTS_MDL_2_INP_VLD = 0
TIG_INP_TLTS_MDL_2 = $TIG\_INP\_TLTS\_MDL\_2_{N-1}$
endif

3.7 Air temperature sensor model

▶ Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
CTR_TIG_STAB_TLTS_MDL_2	V	0... FFH	0... 255	1	-
Counter for air temperature stability criterion					
FAC_TLTS_MDL_2	V	0... FFH	0... 1.9921875	0.0078125	-
Temperature correction factor of warm-up for TLTS_MDL_2 calculation					
LV_CDN_VEH_STAB_TLTS_MDL_2	V	0... 1H	0 ...1	1	-
Condition for vehicle stability criterium fulfilled for TLTS_MDL_2					
LV_TLTS_MDL_1_VLD	O/V	0... 1H	0 ...1	1	-
Modeled air temperature value from MDL_1 valid					
LV_TLTS_MDL_2_VLD	O/V	0... 1H	0 ...1	1	-
Modeled air temperature value from MDL_2 valid					
LV_VEH_STAB_TLTS_MDL_2	V	0... 1H	0 ...1	1	-
Vehicle stability criterium fulfilled for TLTS_MDL_2					
STATE_TIG_STAB_TLTS_MDL_2	V	0... FFH	0... 255	1	-
State of air temperature stability criterion for TLTS_MDL_2					
STATE_TLTS_MDL_1	O/V	0... FFH	0... 255	1	-
Status of modeled air temperature value from MDL_1					
STATE_TLTS_MDL_2	O/V	0... FFH	0... 255	1	-
Status of modeled air temperature value from MDL_2					
T_TLTS_MDL_1	V	0... FFH	0... 255	1	s
Timer value for TLTS_MDL_1					
T_TLTS_MDL_2	V	0... FFH	0... 255	1	s
Timer value for TLTS_MDL_2					
TIG_OFS_TLTS_MDL_2	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Air temperature offset for TLTS_MDL_2 value calculation					
TIG_STAB_DIF_TLTS_MDL_2	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Air temperature difference value for stability criteria					
TIG_STAB_MAX_TLTS_MDL_2	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Maximum air temperature value for stability criteria					
TIG_STAB_MIN_TLTS_MDL_2	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Minimum air temperature value for stability criteria					
TLTS_MDL_1	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Modeled air temperature value from MDL_1					
TLTS_MDL_2	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Modeled air temperature value from MDL_2					
TLTS_MDL_2_ACT	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Actual modeled air temperature value from MDL_2					

Input Data

FLOW_EGR_AIRT {p. 1143}	LV_IGK {p. 24082}	LV_TLTS_MDL_1_INP_VLD {p. 1154}	LV_TLTS_MDL_2_INP_VLD {p. 1154}
M_GAS_TLTS_MDL_AIRT {p. 1143}	N {p. 8079}	NC_TLTS_MDL_CONF {p. 1137}	PQ_AIRT {p. 1143}
RATE_HEAT_IM {p. 1204}	TEMP_COLD_SRC_MMV {p. 1204}	TEMP_HOT_SRC {p. 1198}	TEMP_HOT_SRC_MMV {p. 1204}
TIG_INP_TLTS_MDL_1 {p. 1154}	TIG_INP_TLTS_MDL_2 {p. 1154}	VS {p. 26240}	

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_CTR_TIG_STAB_TLTS_MDL_2	V	0... FFH	0... 255	1	-
Counter for air temperature stability criterion					
C_FLOW_EGR_MAX_TLTS_MDL_2	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Maximum EGR flow value for timer T_TLTS_MDL_2 calculation					
C_M_GAS_MAX_TLTS_MDL_2	V	0... FFFFH	0... 2778	0.04238956	mg/stk
Maximum intake gas mass value for timer T_TLTS_MDL_2 calculation					
C_M_GAS_MIN_TLTS_MDL_2	V	0... FFFFH	0... 2778	0.04238956	mg/stk
Minimum intake gas mass value for timer T_TLTS_MDL_2 calculation					
C_N_MIN_TLTS_MDL_2	V	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed value for timer T_TLTS_MDL_2 calculation					
C_PQ_MAX_TLTS_MDL_2	V	0... FFH	0... 7.96875	0.03125	-
Maximum PQ value for timer T_TLTS_MDL_2 calculation					
C_RATE_HEAT_IM_TLTS_MDL_2	V	0... FFFFH	0... 1310.7	0.02	-
Maximum heat quantity stored in the intake manifold for timer T_TLTS_MDL_2 calculation					
C_T_TLTS_MDL_1_DEC	V	0... FFH	0... 255	1	s
Timer decrement value for TLTS_MDL_1 calculation					
C_T_TLTS_MDL_1_INC	V	0... FFH	0... 255	1	s
Timer increment value for TLTS_MDL_1 calculation					
C_T_TLTS_MDL_1_MAX	V	0... FFH	0... 255	1	s
Maximum timer value for TLTS_MDL_1 calculation					
C_T_TLTS_MDL_2_DEC	V	0... FFH	0... 255	1	s
Timer decrement value for TLTS_MDL_2 calculation					
C_T_TLTS_MDL_2_INC	V	0... FFH	0... 255	1	s
Timer increment value for TLTS_MDL_2 calculation					
C_T_TLTS_MDL_2_MAX	V	0... FFH	0... 255	1	s
Maximum timer value for TLTS_MDL_2 calculation					
C_TEMP_HOT_MAX_TLTS_MDL_2	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Maximum TEMP_HOT_SRC value for timer T_TLTS_MDL_2 calculation					
C_TEMP_HOT_MIN_TLTS_MDL_2	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Minimum TEMP_HOT_SRC value for timer T_TLTS_MDL_2 calculation					
C_TIG_STAB_DIF_TLTS_MDL_2	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
Maximum allowed TIG variation for stability condition					
C_TLTS_MDL_1_DIF_LIM	V	0... 7FFFH	0... 255.9921875	0.0078125	°C
Modeled air temperature value difference limitation for MDL_1					
C_TLTS_MDL_2_DIF_LIM	V	0... 7FFFH	0... 255.9921875	0.0078125	°C
Modeled air temperature value difference limitation for MDL_2					
C_TLTS_MDL_CLC_SRC	V	0... FFH	0... 255	1	-
Selection of which model is calculated					
C_VS_MAX_TLTS_MDL_2	V	0... FFH	0... 255	1	km/h
Maximum vehicle speed value for timer T_TLTS_MDL_2 calculation					
C_VS_MIN_TLTS_MDL_1	V	0... FFH	0... 255	1	km/h
Minimum vehicle speed value for timer T_TLTS_MDL_1 calculation					
C_VS_MIN_TLTS_MDL_2	V	0... FFH	0... 255	1	km/h
Minimum vehicle speed value for timer T_TLTS_MDL_2 calculation					
IP_FAC_TLTS_MDL_2	V	0... FFH	0... 1.9921875	0.0078125	-
LDP_TEMP_COLD_IP_FAC_TLTS_MDL_2	12	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
LDP_TEMP_HOT_IP_FAC_TLTS_MDL_2	12	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Temperature correction factor for warm-up of TLTS_MDL_2 calculation					
IP_TLTS_MDL_1_OFS	V	80... 7FH	-96... 95.25	0.75	°C
LDPM_VS_1_AIRT	4	0... FFH	0... 255	1	km/h
Vehicle speed influence on TLTS_MDL_1 calculation					
IP_TLTS_MDL_2_OFS_1	V	80... 7FH	-96... 95.25	0.75	°C
LDPM_N_1_AIRT	8	0... 1FE0H	0... 8160	1	rpm
LDPM_M_GAS_2_AIRT	8	0... FFFFH	0... 2778	0.04238956	mg/stk
Engine speed and intake gas mass influence on TLTS_MDL_2 calculation					
IP_TLTS_MDL_2_OFS_2	V	80... 7FH	-96... 95.25	0.75	°C
LDPM_VS_1_AIRT	4	0... FFH	0... 255	1	km/h
LDPM_FLOW_EGR_1_AIRT	4	0... FFFFH	0... 2047.96875	0.03125	kg/h
Vehicle speed and EGR mass flow influence on TLTS_MDL_2 calculation					
IP_TLTS_MDL_2_OFS_3	V	80... 7FH	-96... 95.25	0.75	°C
LDPM_VS_1_AIRT	4	0... FFH	0... 255	1	km/h
LDPM_RATE_HEAT_IM_1_AIRT	4	0... FFFFH	0... 1310.7	0.02	-
Vehicle speed and RATE_HEAT_IM influence on TLTS_MDL_2 calculation					

▶ General Information

The aim of this function is to determine the air temperature from a model.

Two different models are proposed:

TLTS_MDL_1:
Within this model, it is checked whether the vehicle speed was long enough above a certain threshold. As soon as this condition is fulfilled for a defined time, a new value for TLTS_MDL_1 is calculated, which is based on TIG_INP_TLTS_MDL_1 and a temperature offset which depends on the vehicle speed.

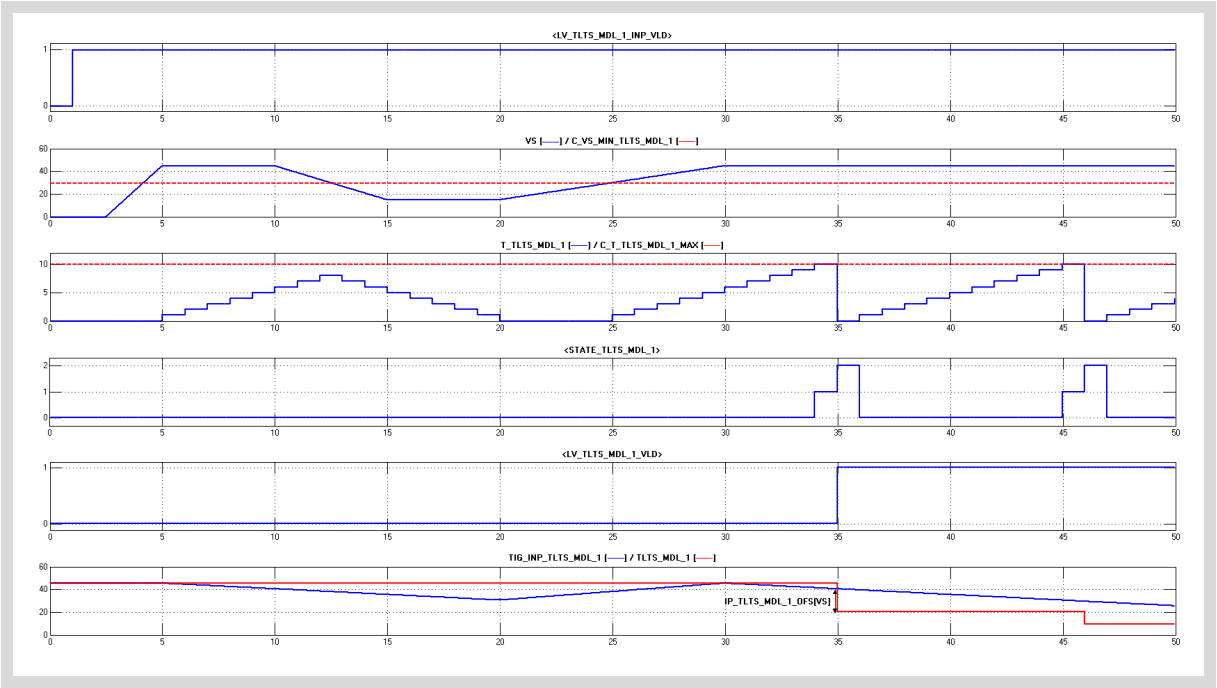

Figure 3.7.1: Overview for TLTS_MDL_1

TLTS_MDL_2:

This modeled value of air temperature also consists of a base temperature (TIG_INP_TLTS_MDL_2) and an offset. In contrast to model 1, the second model takes a lot more influences into account (load, engine speed, reference cold source and hot source temperature) to determine if the engine/vehicle is currently in stable conditions (LV_VEH_STAB_TLTS_MDL_2). Furthermore, the model is only updated, if the base temperature is regarded as stable (STATE_TIG_STAB_TLTS_MDL_2).

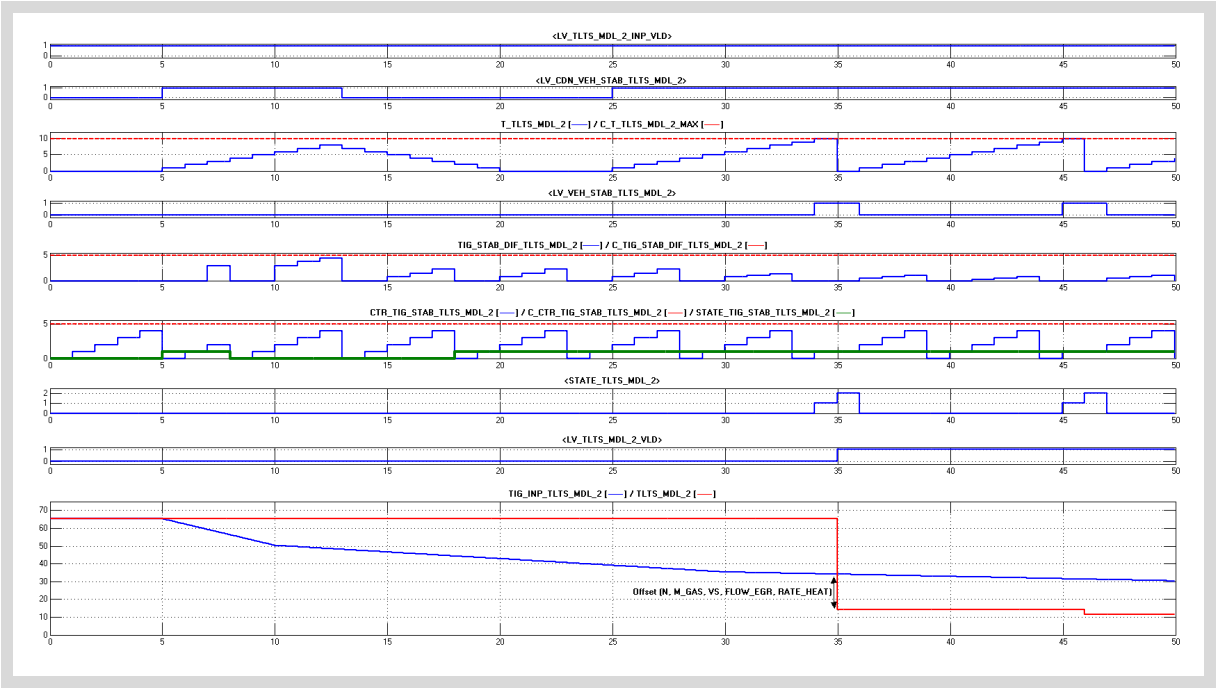

Figure 3.7.2: Overview for TLTS_MDL_2

Application Conditions

Initialisation:	`RST, IGKON`
Activation:	`LV_IGK`
Deactivation:	`if activation not true`
Recurrence:	`1S`

Function Description

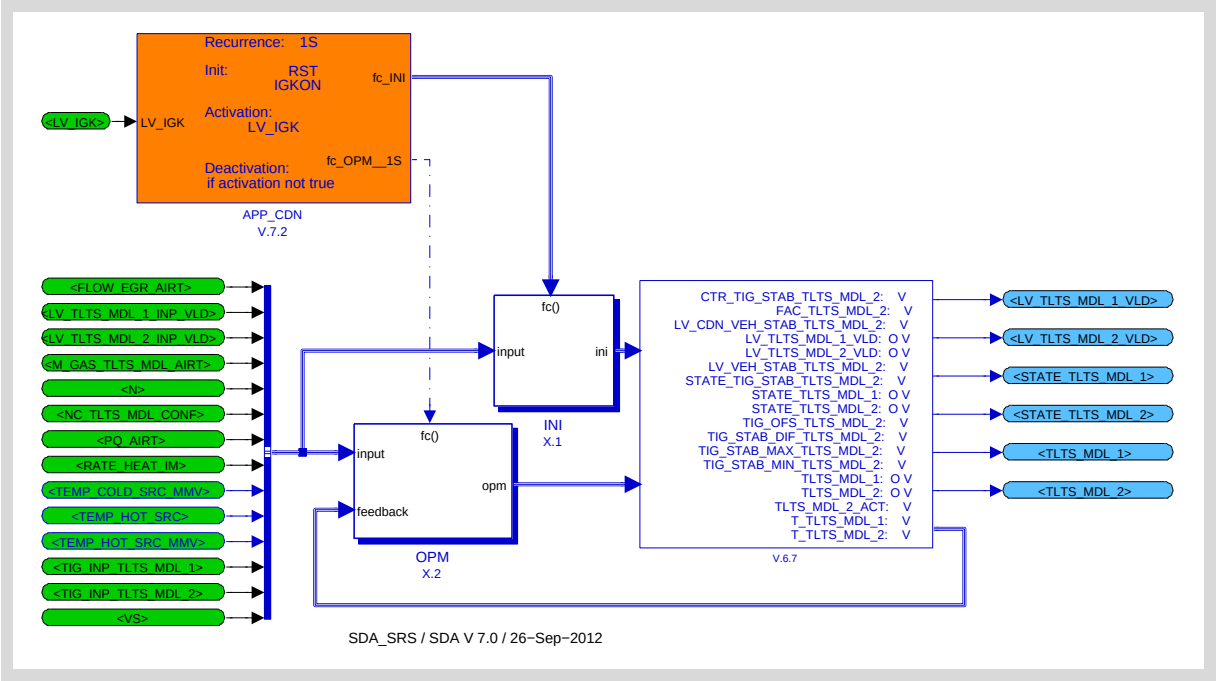

Figure 3.7.3:

3.7.1 Initialization at Reset and IGKON

With NC_TLTS_MDL_CONF the respective variables of the unused model are invisible.

Variables TLTS_MDL_1/_2 are initialized with the respective TIG_INP_TLTS_MDL1/_2.
All other variables are initialized with 0, except the trailing pointers(min = phys_max; max = phys_min).

3.7.2 Overview of air temperature models

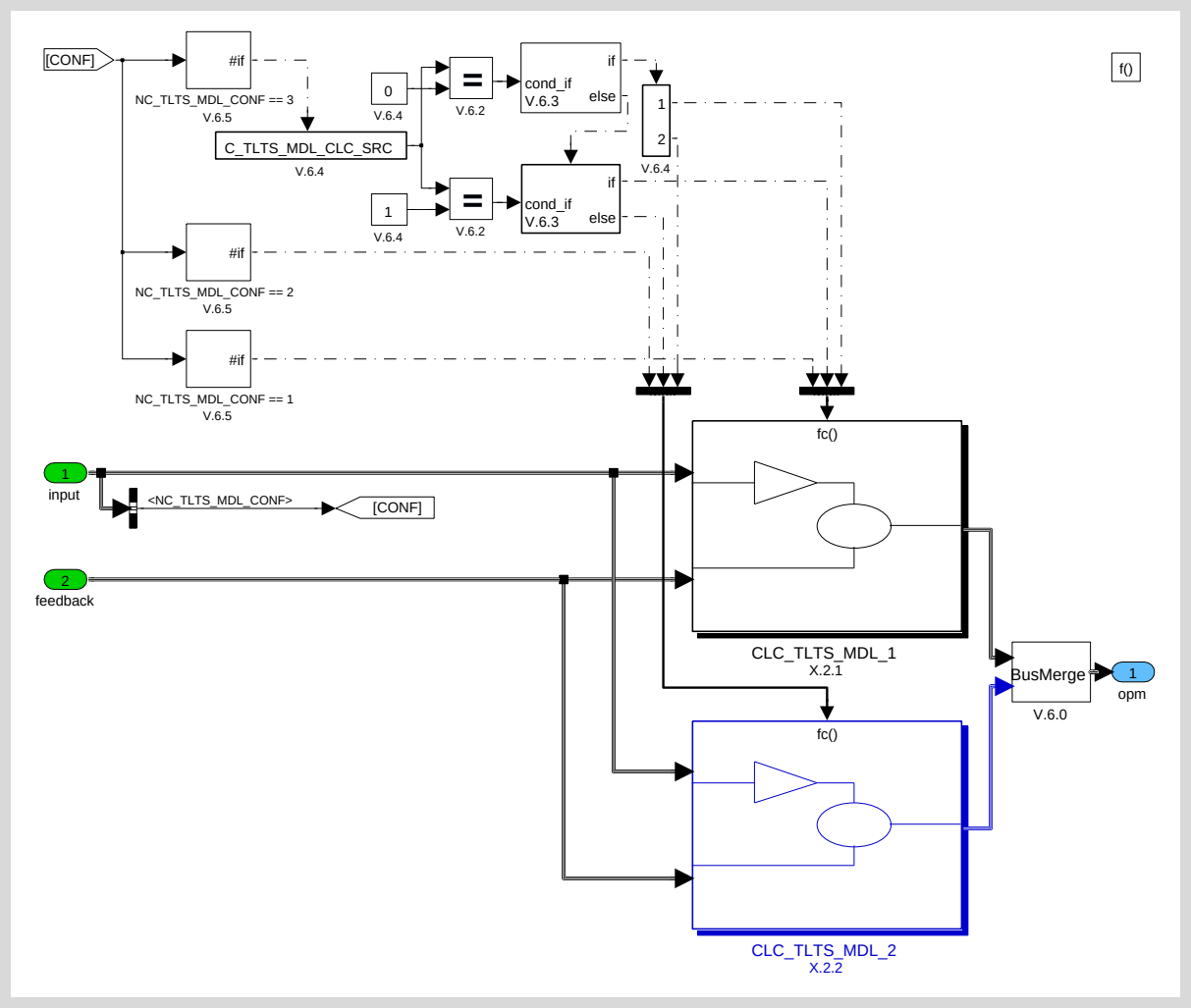

Figure 3.7.4:

3.7.2.1 Overview of air temperature model 1

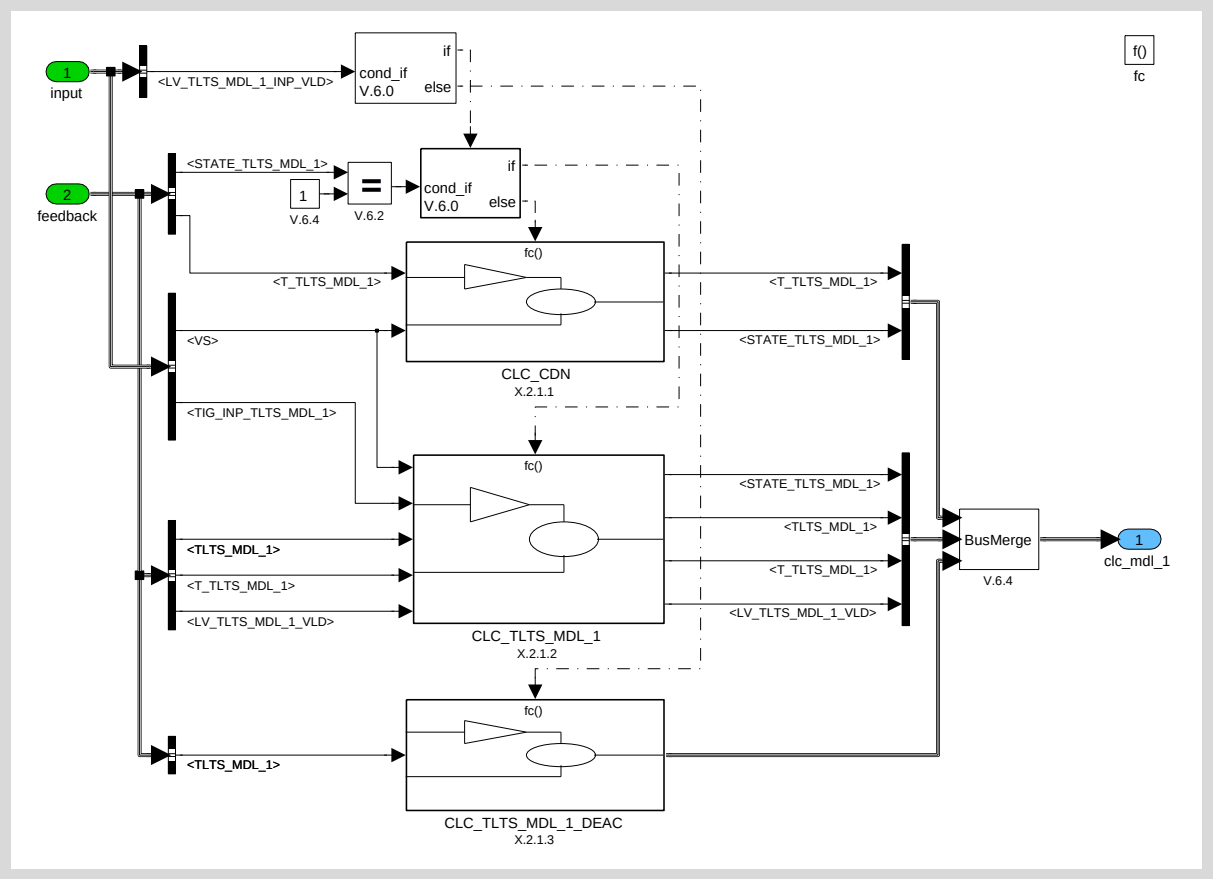

Figure 3.7.5:

3.7.2.1.1 Calculation of stability

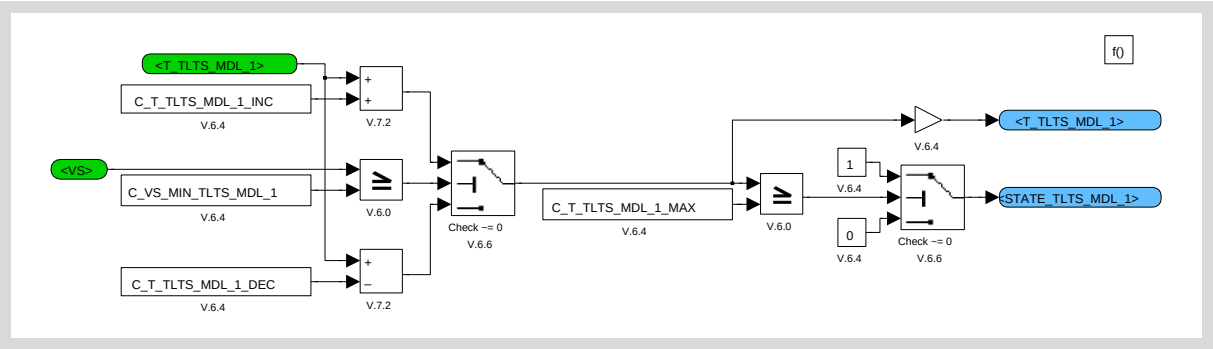

Figure 3.7.6:

3.7.2.1.2 Calculation of air temperature model value

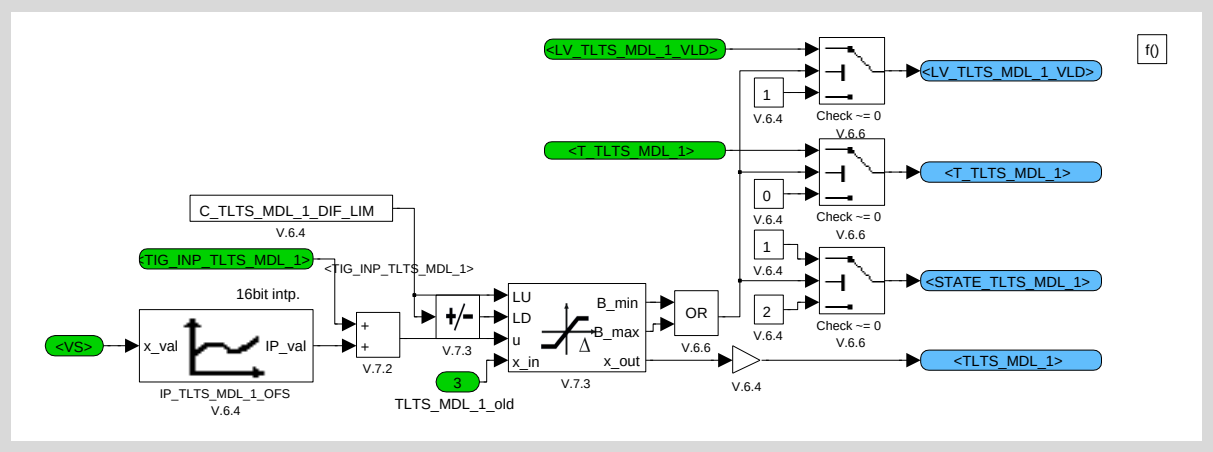

Figure 3.7.7:

3.7.2.1.3 Calculation when condition deactivated

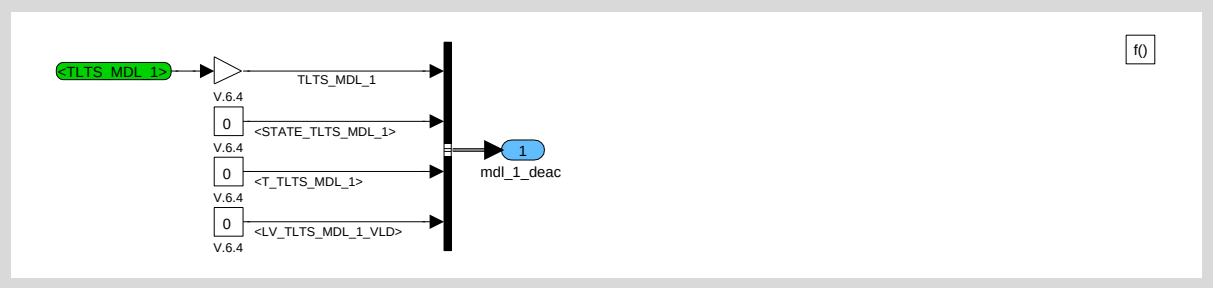

Figure 3.7.8:

3.7.2.2 Overview of air temperature model 2

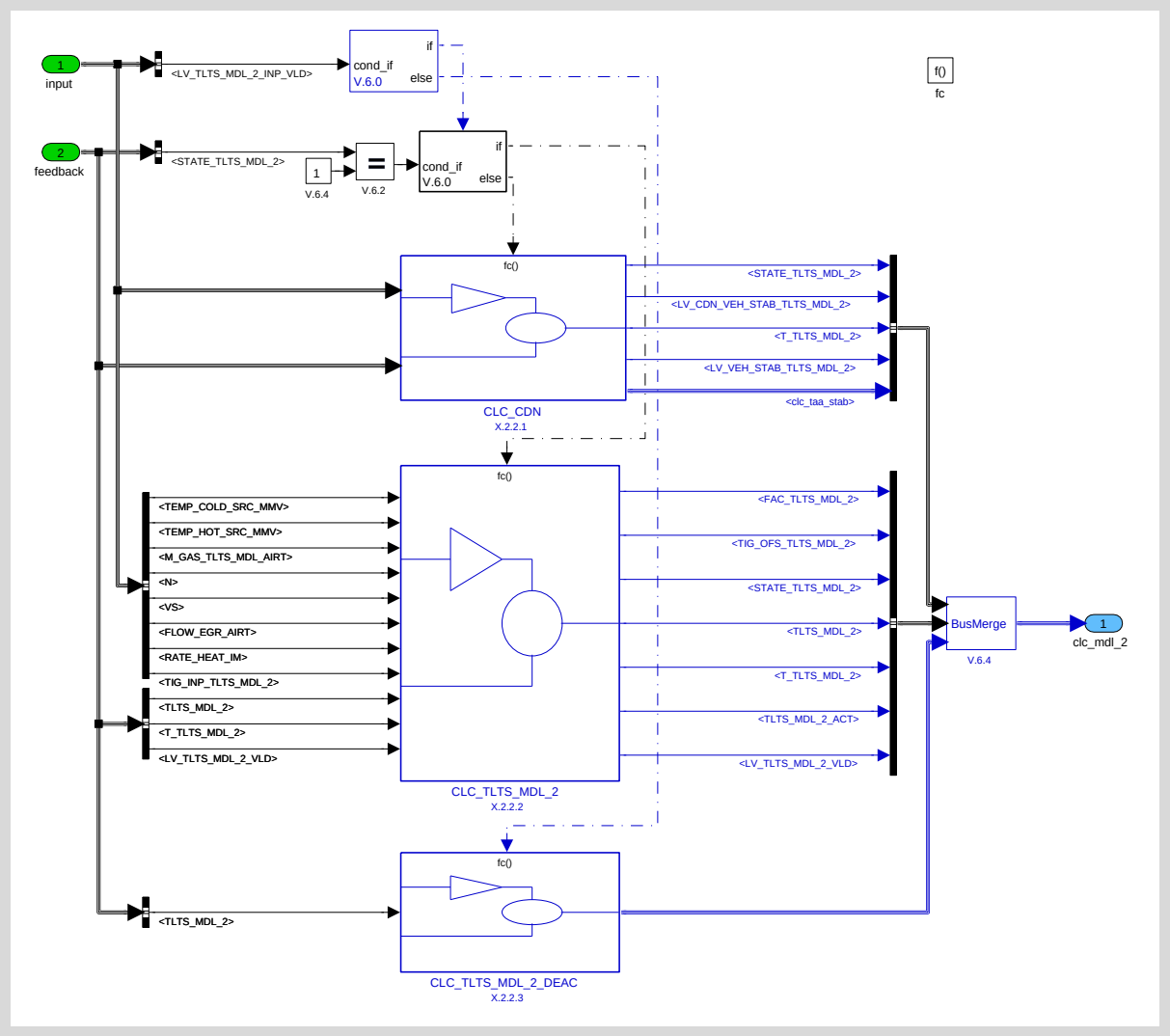

Figure 3.7.9:

3.7.2.2.1 Overview of calculation for stability

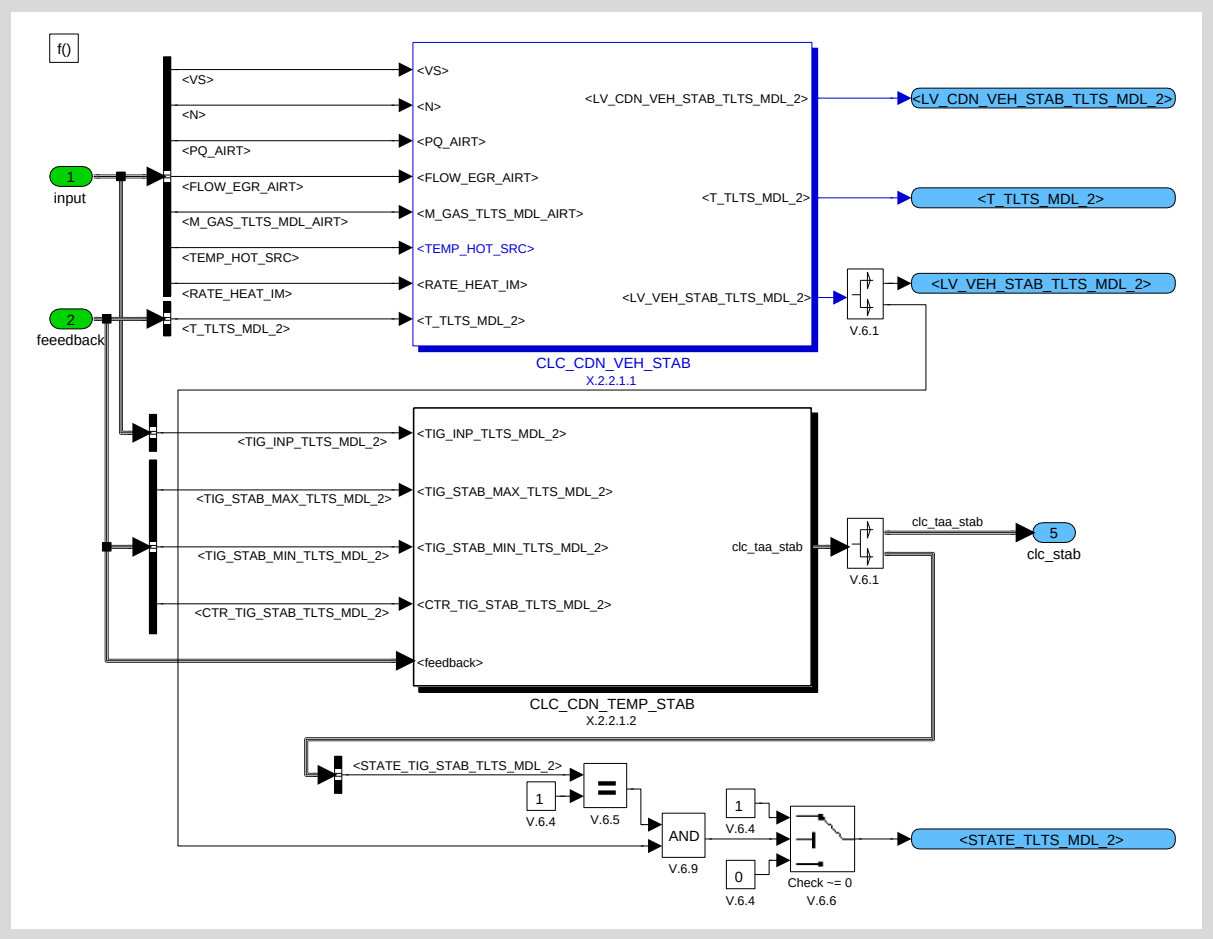

Figure 3.7.10:

3.7.2.2.1.1 Calculation of vehicle stability

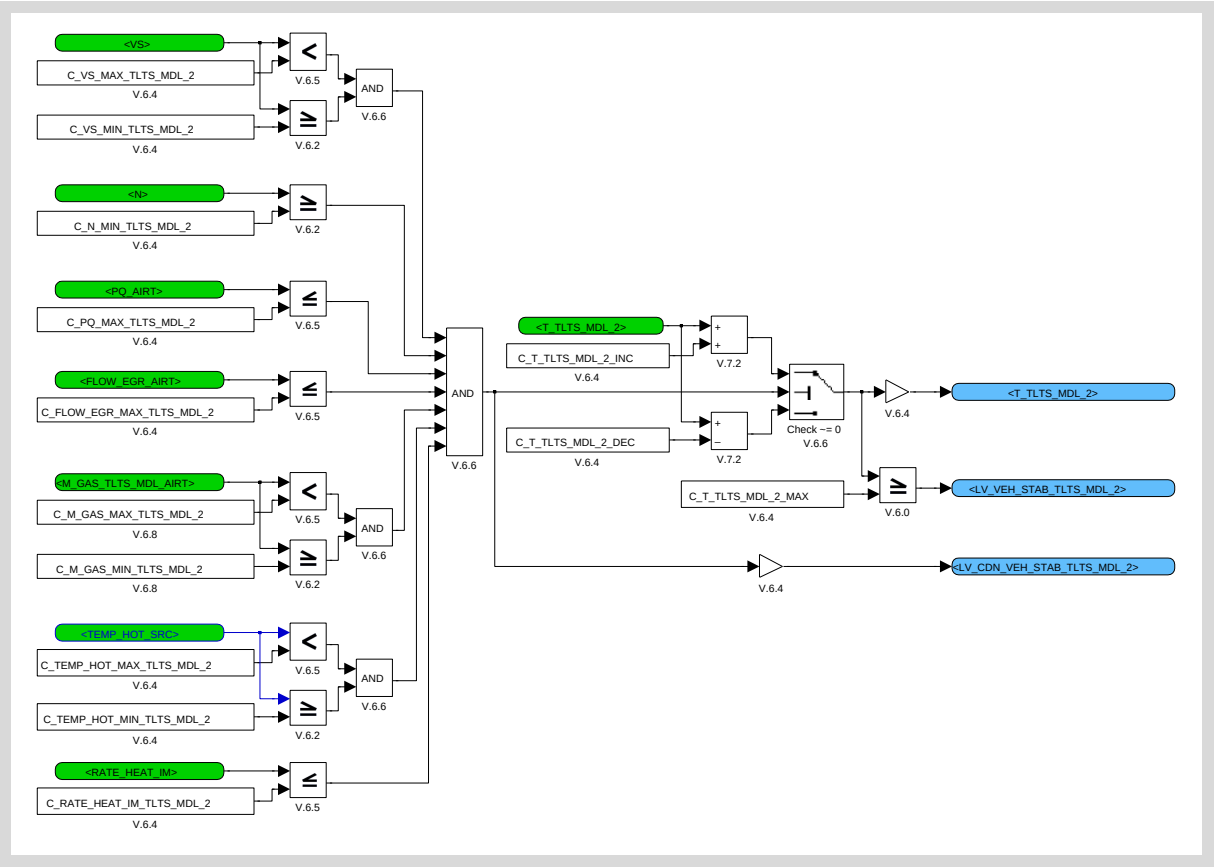

Figure 3.7.11:

3.7.2.2.1.2 Overview of calculation for temperature stability

The air temperature sensor signal is defined as stable, if the difference between minimum and maximum value of temperature is smaller than a defined threshold over a certain period of time.
The state of the stability check is calculated, as this information is needed for the reset of certain variables.

STATE_TIG_STAB_TLTS_MDL_2 is defined as follows:
- 2 (sensor signal not stabled)
- 1 (sensor signal stable)
- 0 (stability check pending)

3.7.2.2.1.2.1 Calculation of trailing pointers, temperature difference and counter for stability check

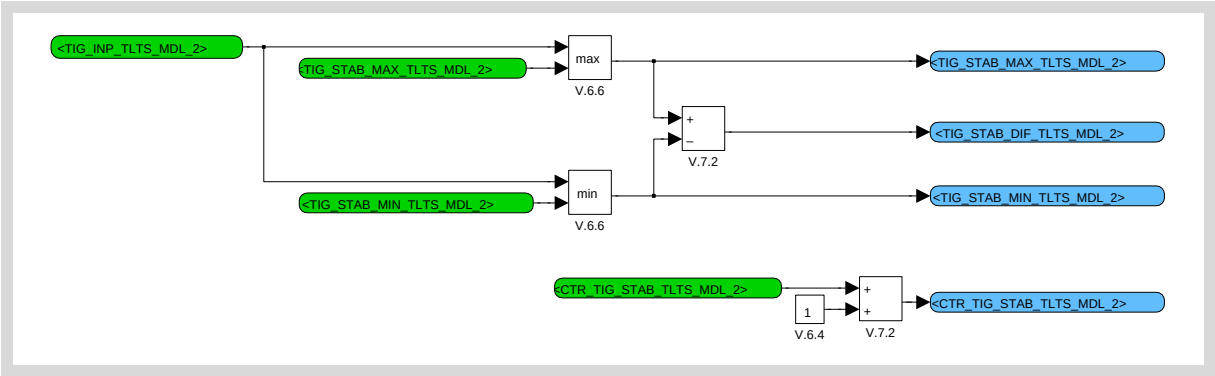

Figure 3.7.12:

3.7.2.2.1.2.2 Calculation of the state of the stability check

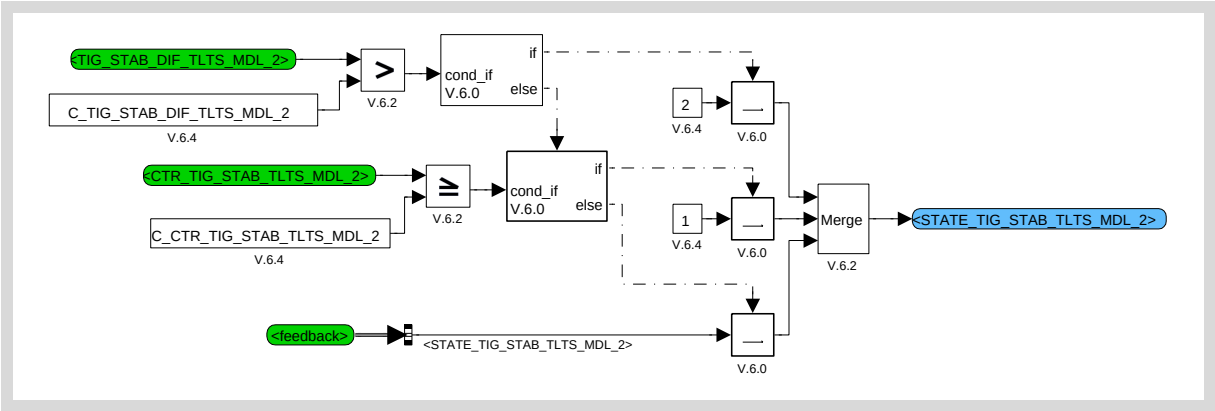

Figure 3.7.13:

3.7.2.2.1.2.3 Reset of variables depending on the state of the stability check

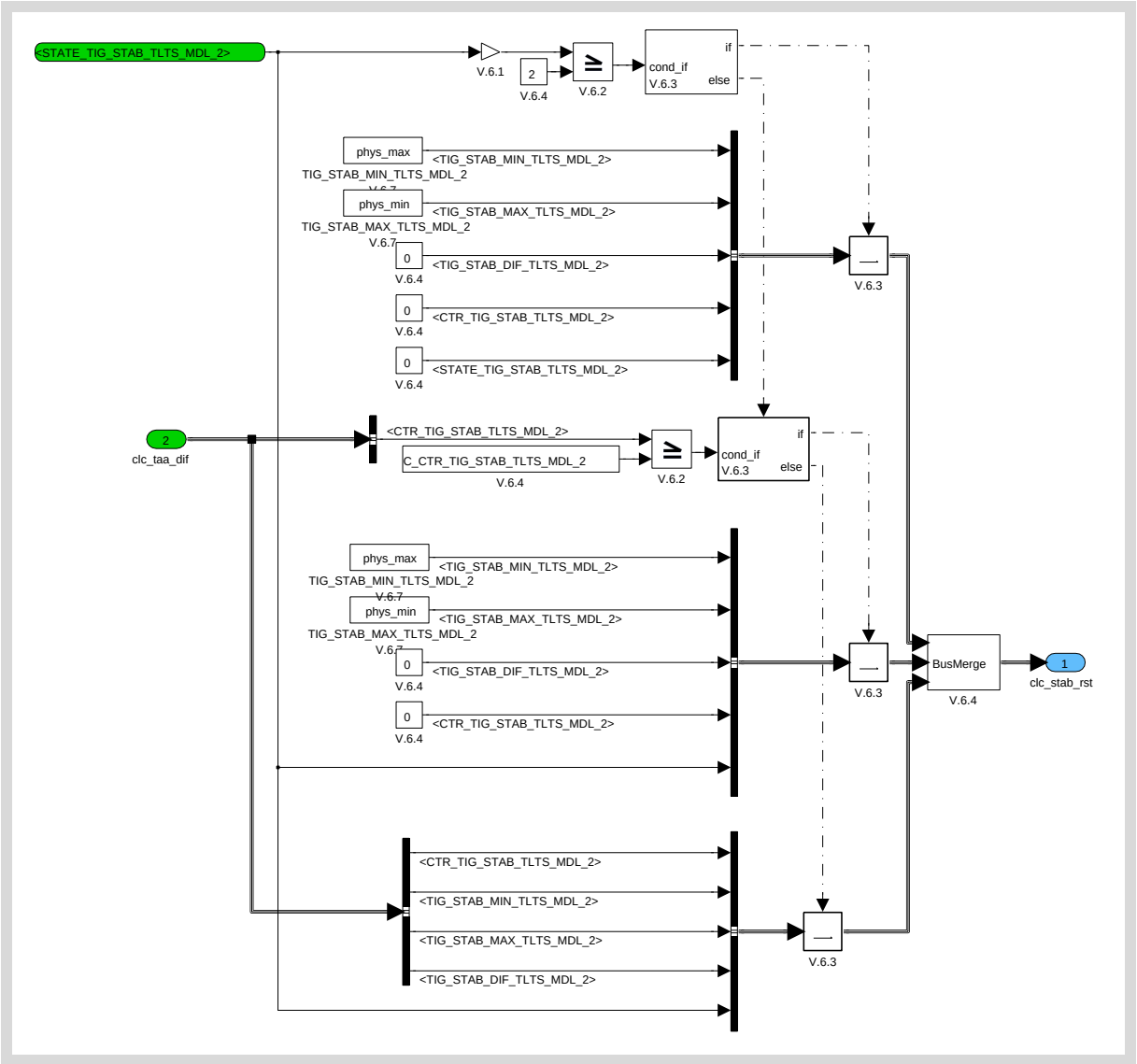

Figure 3.7.14:

3.7.2.2.2 Overview of calculation of air temperature model value

3.7.2.2.2.1 Calculation of temperature offset value

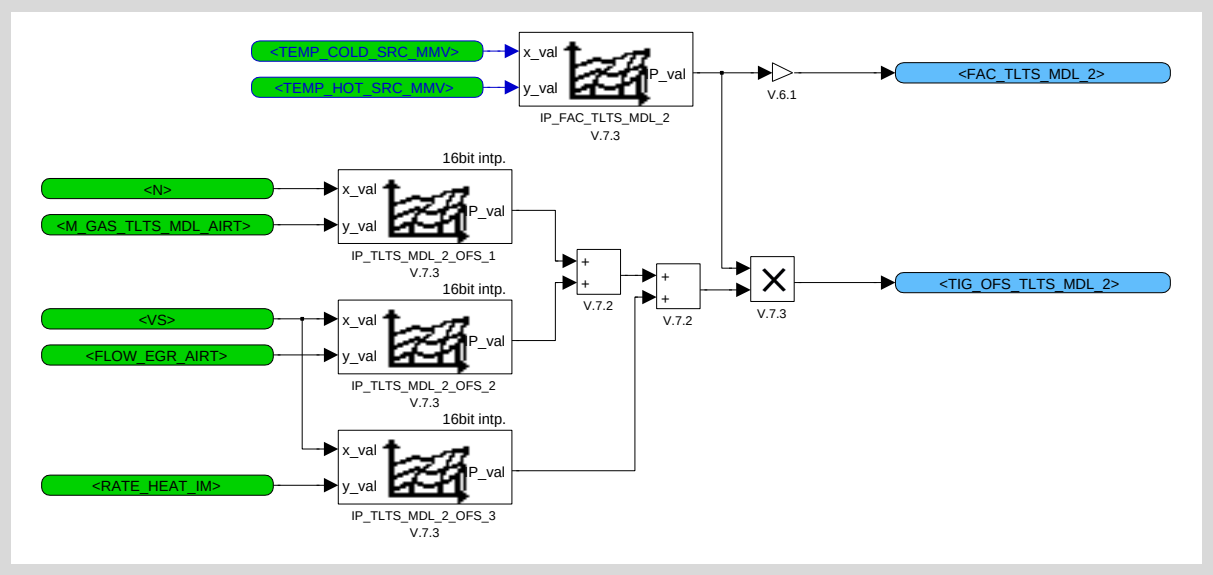

Figure 3.7.15:

3.7.2.2.2.2 Calculation of air temperature model value

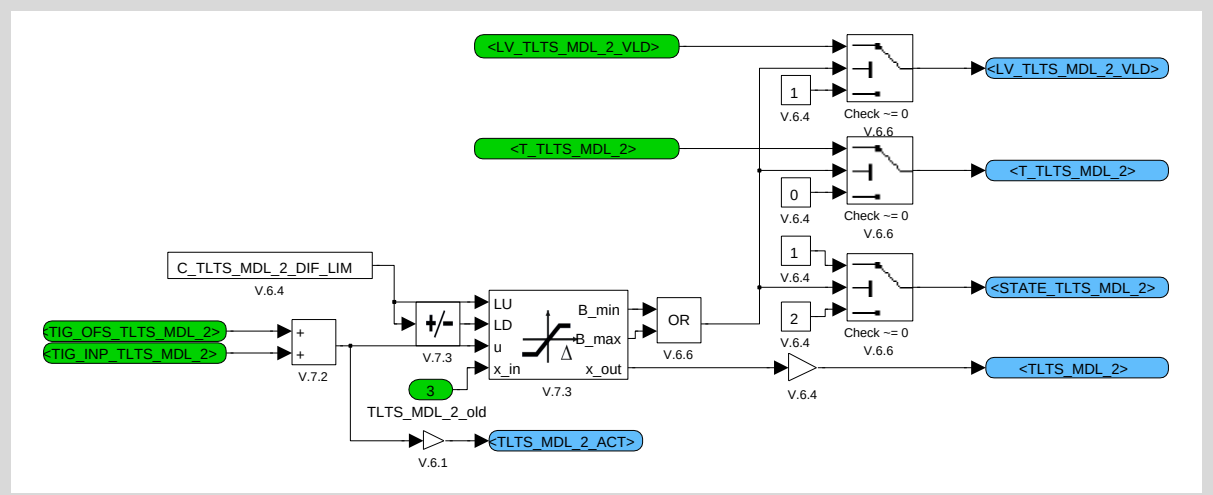

Figure 3.7.16:

3.7.2.2.3 Calculation when condition deactivated

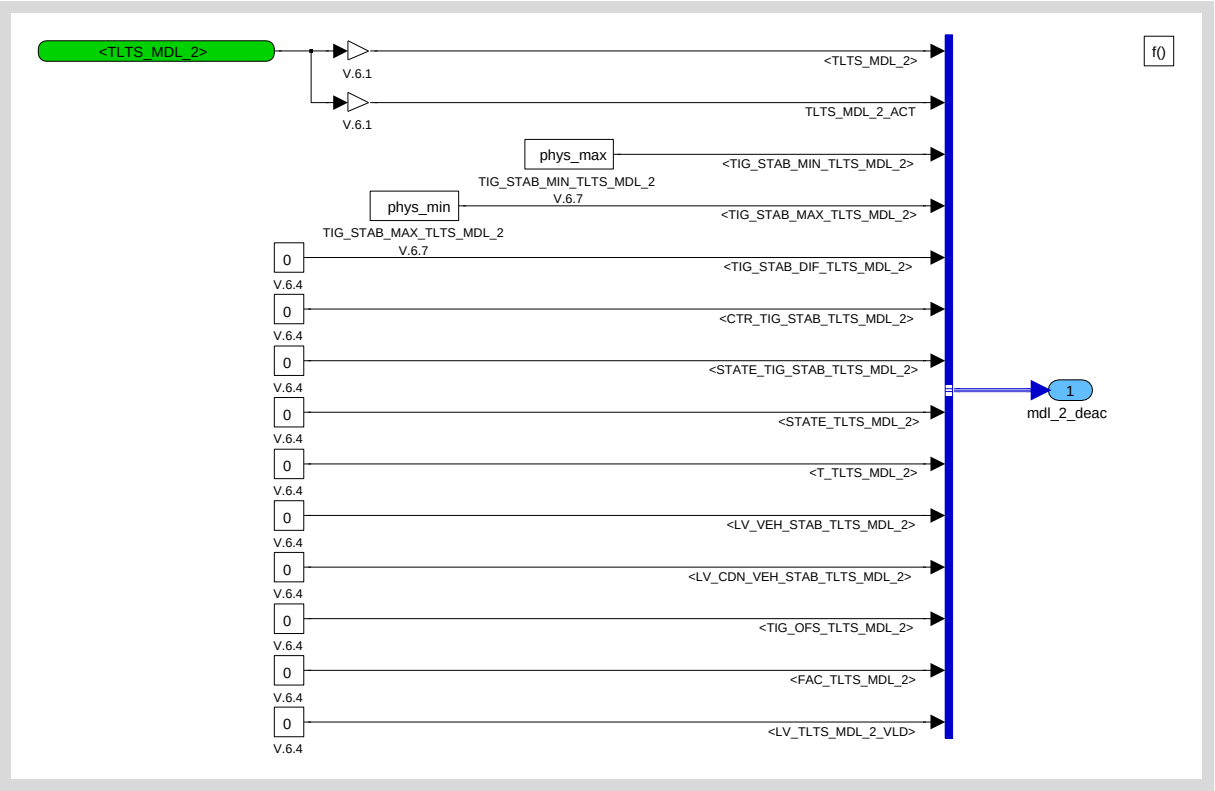

Figure 3.7.17:

3.8 Ambient air temperature calculation (Appl. Inc.)

Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
CRLC_TAA_ESTIM_FIL_EXT	O	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Filtering factor for the external filtering calculation of ambient air temperature estimation					
LV_TAA_CUS_ACT	O/V	0... 1H	0 ...1	1	-
Flag that enables the ambient air temperature from customer					
LV_TAA_ESTIM_FIL_EXT	O	0... 1H	0 ...1	1	-
Flag that enables the external filtering calculation for ambient air temperature estimation					
LV_TAA_MDL_VLD	O/V	0... 1H	0 ...1	1	-
Ambient air temperature model valid					
LV_TAA_MES_VLD	O/V	0... 1H	0 ...1	1	-
Ambient air temperature measured value valid					
LV_TAA_SENS_ENA	O/V	0... 1H	0 ...1	1	-
Ambient air temperature sensor enable					
LV_TCO_ENA_AIRT	O/V	0... 1H	0 ...1	1	-
Engine coolant temperature enable for AIRT					
LV_TIG_TAA_ESTIM_CLC	O/V	0... 1H	0 ...1	1	-
Intake gas temperature enabled for TAA_ESTIM calculation					
LV_VS_ENA_AIRT	O/V	0... 1H	0 ...1	1	-
Vehicle speed enable for AIRT					
TAA_CUS	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Ambient air temperature from customer					
TAA_MDL	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Modeled TAA value					
TIG_TAA_ESTIM_CLC	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature for TAA_ESTIM calculation					

Input Data

LV_FID_READY {p. 11388}	LV_TLTS_MDL_2_VLD {p. 1156}	T_IGK {p. 24055}	TAA_FIL_INTC {p. 19541}
TAA_SENS_CONF {p. 1150}	TIG_IM_MES {p. 1150}	TLTS_MDL_2 {p. 1156}	

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_CRLC_TAA_ESTIM_FIL_EXT	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Correlation constant for the external filtering calculation of ambient air temperature estimation					
C_T_IGK_TAA_RAW_INTC_VLD	V	0... FFFFH	0... 655.35	0.01	s

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
Time after ignition key on to lock the calculation of LV_TAA_RAW_INTC_VLD					
LC_TAA_CUS_ACT	V	0... 1H	0 ...1	1	-
Logical constant that enables the ambient air temperature from customer					
LC_TAA_ESTIM_FIL_EXT	V	0... 1H	0 ...1	1	-
Logical constant to enable the external filtering calculation for ambient air temperature estimation					

Configuration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
NC_FID_TAA_SENS_CONF_1_ENA	O	0... FFFFH	0... 65535	1	-
Enable ambient air temperature sensor with TAA_SENS_CONF = 1 for air temperature calculation					
NC_FID_TAA_SENS_CONF_1_VLD	O	0... FFFFH	0... 65535	1	-
Measured ambient air temperature with TAA_SENS_CONF = 1 is valid and can be used					
NC_FID_TAA_SENS_CONF_2_ENA	O	0... FFFFH	0... 65535	1	-
Enable ambient air temperature sensor with TAA_SENS_CONF = 2 for air temperature calculation					
NC_FID_TAA_SENS_CONF_2_VLD	O	0... FFFFH	0... 65535	1	-
Measured ambient air temperature with TAA_SENS_CONF = 2 is valid and can be used					
NC_FID_TCO_ENA_AIRT	O	0... FFFFH	0... 65535	1	-
Enable engine coolant temperature for AIRT functionalities					
NC_FID_TIG_TAA_ESTIM_CLC	O	0... FFFFH	0... 65535	1	-
Intake gas temperature TIG_TAA_ESTIM_CLC is valid and can be used for TAA_ESTIM calculation					
NC_FID_VS_ENA_AIRT	O	0... FFFFH	0... 65535	1	-
Enable vehicle speed for AIRT functionalities					

Import actions:

ACTION_FARM_GetPermission(**IN** <PRM_FID>, **OUT** <PRM_LV_PRMS>)

General Information

This module provides all necessary variables and valid flags for the core specification.

Proposal for NC_FID_TAA_SENS_CONF_1_VLD:

AUX_TAA_RAW_INTC	AERR
AUX_TAA_RAW_INTC	ASYM
AUX_TAA_RAW_INTC	AINI
AUX_TAA_RAW_INTC	ANAV
ERR_TAA_INTC[NC_NR_TAA_INTC]	SYM
TLTS_AIR_ORNG_H/_L[TAA]	SYM
TLTS_AIR_INTM[TAA]	SYM

Proposal for NC_FID_TAA_SENS_CONF_1_ENA:

AUX_TAA_RAW_INTC	AERR
CAN_xx	ERR
ERR_TAA_INTC[NC_NR_TAA_INTC]	ERR
TLTS_AIR_ORNG_H/_L[TAA]	ERR
TLTS_AIR_INTM[TAA]	ERR
TLTS_AIR_PLAUS[TAA]	ERR

Proposal for NC_FID_TAA_SENS_CONF_2_VLD:

LTS_AIR_OC/_SCG[TAA]	SYM
TLTS_AIR_ORNG_H/_L[TAA]	SYM
TLTS_AIR_INTM[TAA]	SYM

Proposal for NC_FID_TAA_SENS_CONF_2_ENA:

LTS_AIR_OC/_SCG[TAA]	ERR
TLTS_AIR_ORNG_H/_L[TAA]	ERR
TLTS_AIR_INTM[TAA]	ERR
TLTS_AIR_PLAUS[TAA]	ERR

Proposal for NC_FID_TIG_TAA_ESTIM_CLC:

LTS_AIR_OC/_SCG	SYM/ERR
TLTS_AIR_ORNG_H/_L	SYM/ERR
TLTS_AIR_INTM	SYM/ERR
TIG_PLAUS	SYM/ERR

Remark:
Use only the failure instances of the respective TIG sensor

3.8.1 Calculation of input variables for core module

- General Information

- Application Conditions

Initialisation:	`at reset and IGKON:` `calculate formula section`
Activation:	`always`
Deactivation:	`never`
Recurrence:	`100 ms`

▶ Function Description

```
if TAA_SENS_CONF = 1 // delivered via CAN
then
  if ACTION_ FARM_GetPermission(IN<NC_FID_TAA_SENS_CONF_1_VLD>)
   and LV_FID_READY = 1
   and T_IGK >= C_T_IGK_TAA_RAW_INTC_VLD
  then LV_TAA_MES_VLD = 1
  else LV_TAA_MES_VLD = 0
  endif
LV_TAA_SENS_ENA = ACTION_FARM_GetPermission(IN<NC_FID_TAA_SENS_CONF_1_ENA>)

elseif TAA_SENS_CONF = 2 // hardwired sensor
then
LV_TAA_MES_VLD = ACTION_ FARM_GetPermission(IN<NC_FID_TAA_SENS_CONF_2_VLD>)
LV_TAA_SENS_ENA = ACTION_FARM_GetPermission(IN<NC_FID_TAA_SENS_CONF_2_ENA>)

else
LV_TAA_MES_VLD = 0
LV_TAA_SENS_ENA = 0
endif


LV_TAA_CUS_ACT = LC_TAA_CUS_ACT and LV_TAA_SENS_ENA
TAA_CUS = TAA_FIL_INTC

TAA_MDL = TLTS_MDL_2

LV_TAA_MDL_VLD = LV_TLTS_MDL_2_VLD

TIG_TAA_ESTIM_CLC = TIG_IM_MES

LV_TIG_TAA_ESTIM_CLC = ACTION_FARM_GetPermission(IN<NC_FID_TIG_TAA_ESTIM_CLC>)

LV_TCO_ENA_AIRT = ACTION_FARM_GetPermission(IN<NC_FID_TCO_ENA_AIRT>)

LV_VS_ENA_AIRT = ACTION_FARM_GetPermission(IN<NC_FID_VS_ENA_AIRT>)
```

3.8.2 Activation condition for external filtering of TAA_ESTIM

▶ General Information

This chapter provides an interface to the core module if a special filtering is required from customer.

▶ Application Conditions

Initialisation:

```
at reset:
LV_TAA_ESTIM_FIL_EXT = LC_TAA_ESTIM_FIL_EXT // directly assigned

CRLC_TAA_ESTIM_FIL_EXT =
                    C_CRLC_TAA_ESTIM_FIL_EXT // directly assigned
```

Activation: always

Deactivation: never

Recurrence: 100ms

3.9 Ambient air temperature calculation

▶ Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
LV_TAA_ESTIM_FIL_COLD	V	0... 1H	0 ...1	1	-
Flag that enables filtering calculation for ambient air temperature estimation at cold engine					
LV_TAA_ESTIM_TRAN	O/V	0... 1H	0 ...1	1	-
Boolean indicating whether the state transition is active					
LV_TAA_MES_GRD_DEC	V	0... 1H	0 ...1	1	-
Boolean indicating whether the gradient decrease					
LV_TAA_MES_GRD_INC	V	0... 1H	0 ...1	1	-
Boolean indicating whether the gradient increase					
LV_TAA_ST_CAN_INI	O/V	0... 1H	0 ...1	1	-
Flag that indicates an TAA_ST update after CAN initialisation					
LV_TEMP_MAX_TAA_ESTIM_2_LST_DC	V/S	0... 1H	0 ...1	1	-
Maximum TEMP_HOT_SRC temperature to activate the filtering of TAA_ESTIM calculation rised at the second to last DC					
LV_VS_THD_TAA_ESTIM	V	0... 1H	0 ...1	1	-
Flag to indicate vehicle speed over threshold for TAA_ESTIM calculation					
STATE_TAA	O/V	0... FFH	0... 255	1	-
Status of value of ambient air temperature					
STATE_TAA_ESTIM	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H AH	INIT_WAKE_UP POST_WAKE_UP NORMAL_FIL NORMAL_FIL_LS TRANSITION_VS TRANSITION_GRD HOLD_VAL SENS_ERR NO_SENS COLD_FIL EXTERNAL_FIL	-	-
State which indicates how TAA_ESTIM is calculated					
T_TAA_MES_GRD	V	0... FFH	0... 25.5	0.1	s
Timer for gradient calculation					
T_VS_TAA_ESTIM	V	0... FFFFH	0... 6553.5	0.1	s
Timer for tracking how long the vehicle speed is over threshold					
TAA	O/V/S	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Ambient air temperature					
TAA_ESTIM	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Estimated value for ambient air temperature					
TAA_MES_GRD	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Gradient of TAA_MES					
TAA_MES_SAMPLE	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Value of gradient taken in the reset of gradient counter					

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
TAA_ST	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Ambient air temperature at start					
TAA_ST_DC	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Ambient air temperature at start in current Driving Cycle					

Input Data

CRLC_TAA_ESTIM_FIL_EXT {p. 1172}	LC_AD_CLR_AIRT {p. 5779}	LV_IGK {p. 24082}	LV_T_ES_VLD {p. 8333}
LV_TAA_CUS_ACT {p. 1172}	LV_TAA_ESTIM_FIL_EXT {p. 1172}	LV_TAA_MDL_VLD {p. 1172}	LV_TAA_MES_VLD {p. 1172}
LV_TAA_SENS_ENA {p. 1172}	LV_TCO_ENA_AIRT {p. 1172}	LV_TIG_TAA_ESTIM_CLC {p. 1172}	LV_VS_ENA_AIRT {p. 1172}
NC_TAA_BOL {p. 1136}	NC_TAA_SENS_USE {p. 1136}	NC_TAA_TOL {p. 1136}	T_ES {p. 8334}
TAA_CUS {p. 1172}	TAA_MDL {p. 1172}	TAA_MES {p. 1150}	TAA_SENS_CONF {p. 1150}
TCO_SYS {p. 8870}	TEMP_HOT_SRC_MMV {p. 1204}	TIG_TAA_ESTIM_CLC {p. 1172}	VS {p. 26240}

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_CRLC_TAA_ESTIM_FIL_COLD	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Correlation constant for filtering of ambient air temperature estimation at cold engine					
C_CRLC_VS_ERR_TAA_ESTIM	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Correlation constant in case of vehicle speed error for ambient air temperature estimated					
C_T_ES_MIN_TAA_ESTIM	V	0... FFFFH	0... 65535	1	min
Minimum engine stop time to cool-down completely to ambient temperature					
C_T_TAA_MES_GRD	V	0... FFH	0... 25.5	0.1	s
Calibration constant to set the gradient calculation periode					
C_T_VS_DEC_TAA_ESTIM	V	0... FFFFH	0... 6553.5	0.1	s
Decrement time for T_VS_TAA_ESTIM timer					
C_T_VS_INC_TAA_ESTIM	V	0... FFFFH	0... 6553.5	0.1	s
Increment time for T_VS_TAA_ESTIM timer					
C_T_VS_TAA_ESTIM_GRD_DEC	V	0... FFFFH	0... 6553.5	0.1	s
Period time for state transition to be active, triggered by vehicle speed					
C_T_VS_TAA_ESTIM_GRD_INC	V	0... FFFFH	0... 6553.5	0.1	s
Period time for state transition to be active, triggered by increasing gradient					
C_TAA_DIF_LIM	V	0... 7FFFH	0... 255.9921875	0.0078125	°C
Maximum allowed difference of ambient air temperature					
C_TAA_ESTIM_DIF_LIM	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
Maximum allowed increasing difference of TAA_ESTIM during state transition					
C_TAA_ESTIM_GRD_GAIN	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Factor to increase the speed of TAA_ESTIM in state transition					
C_TAA_ESTIM_INI	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Calibration constant for TAA_ESTIM initialisation in wake-up phase					
C_TAA_MAN	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Calibration constant for manually ambient air temperature					
C_TAA_MES_GRD_THD_DEC	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Threshold to detect a decreasing gradient of TAA_MES_GRD					
C_TAA_MES_GRD_THD_INC	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Threshold to detect a increasing gradient of TAA_MES_GRD					
C_TCO_MIN_TAA_ESTIM	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Engine coolant temperature threshold for TAA_ESTIM calculation in wake-up phase					
C_TEMP_DIF_MAX_STATE_TAA	V	0... 7FFFH	0... 255.9921875	0.0078125	°C
Maximum temperature difference for STATE_TAA calculation					
C_TEMP_DIF_MAX_TAA_ESTIM	V	0... 7FFFH	0... 255.9921875	0.0078125	°C
Maximum temperature difference for TAA_ESTIM calculation in wake-up phase					
C_TEMP_HOT_SRC_MAX_TAA_ESTIM	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Maximum TEMP_HOT_SRC temperature to activate the filtering of TAA_ESTIM calculation					
C_VS_MAX_HYS_TAA_ESTIM	V	0... FFH	0... 255	1	km/h
Maximum VS value for TAA_ESTIM calculation					
C_VS_MIN_HYS_TAA_ESTIM	V	0... FFH	0... 255	1	km/h
Minimum VS value for TAA_ESTIM calculation					
IP_CRLC_TAA_ESTIM	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
LDP_VS_IP_CRLC_TAA_ESTIM	4	0... FFH	0... 255	1	km/h
LDP_TEMP_DIF_IP_CRLC_TAA_ESTIM	4	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Correlation constant for TAA_ESTIM					
LC_TAA_CLC_FMY_SWI	V	0... 1H	0 ...1	1	-
Switch for TAA calculation at clear failure memory					
LC_TAA_ESTIM_INI_SRC	V	0... 1H	0 ...1	1	-
Logical bit to select between different TAA_ESTIM initialisation					
LC_TAA_MAN	V	0... 1H	0 ...1	1	-
Logical constant to set ambient air temperature manually					
LC_TAA_ST_CAN_INI	V	0... 1H	0 ...1	1	-
Logical constant to activate update of TAA_ST after CAN initialization					

▶ General Information

This functionality is to estimate and coordinate the variables related to ambient air temperature

The main functionality is the estimation of ambient air temperature based on sensor (TAA_MES) value according to the project configuration.
Afterwards the coordination between the estimated (TAA_ESTIM) and modeled (TAA_MDL) value is done to determine the ambient air temperature (TAA).

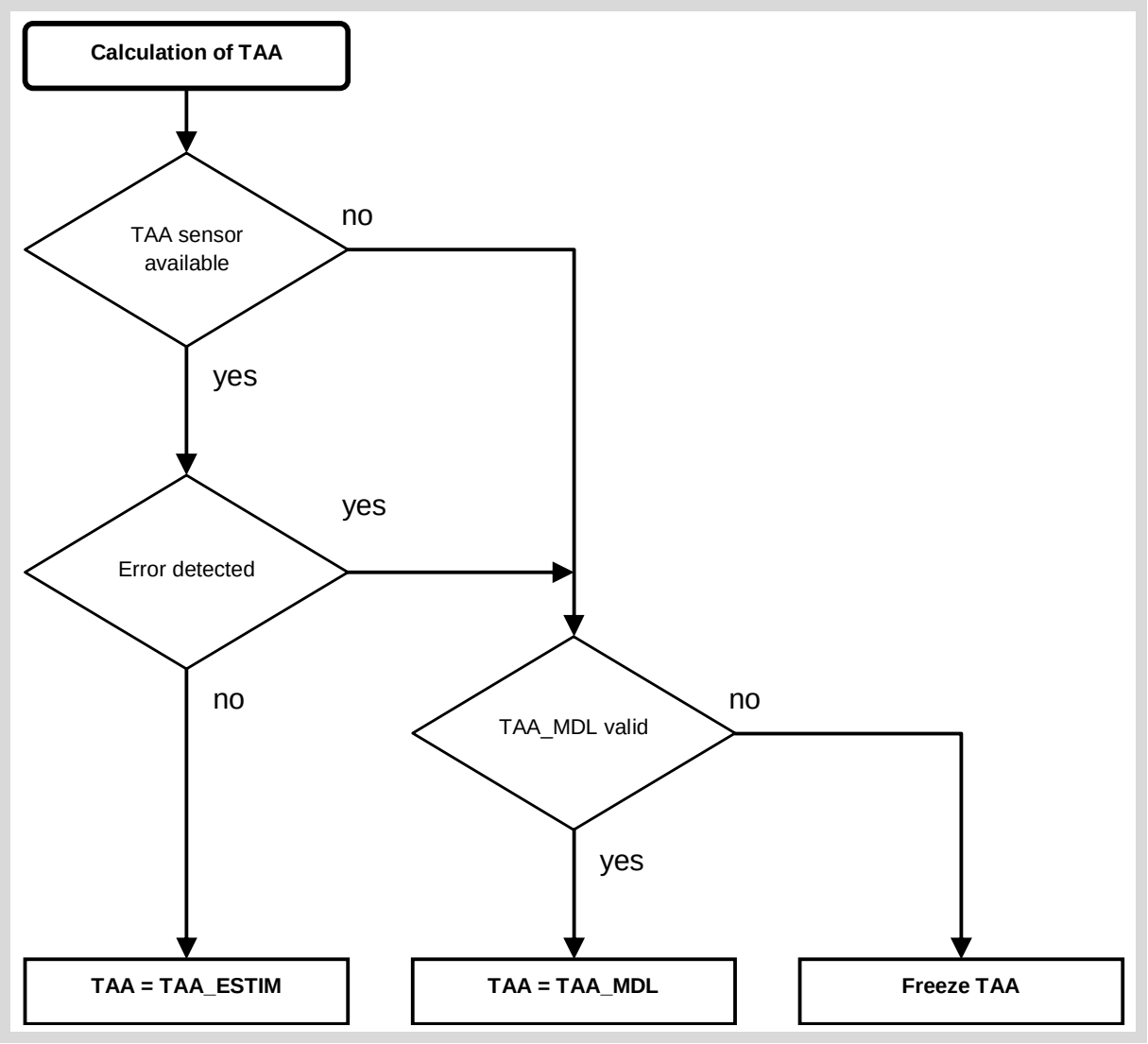

Figure 3.9.1: Calculation of ambient air temperature

The input TAA_MES is the value of the measured ambient air temperature. Depending on the system configuration (TAA_SENS_CONF) this can be either a voltage value delivered to ECU via A/D converter or a temperature over CAN-line.

TAA_ESTIM:
Under certain conditions like key-on, CAN communication is not present or vehicle is in idle etc...
the value of the sensor does not show the 'real' ambient air temperature.
Therefore the ambient air temperature TAA has to be calculated with an estimated value.

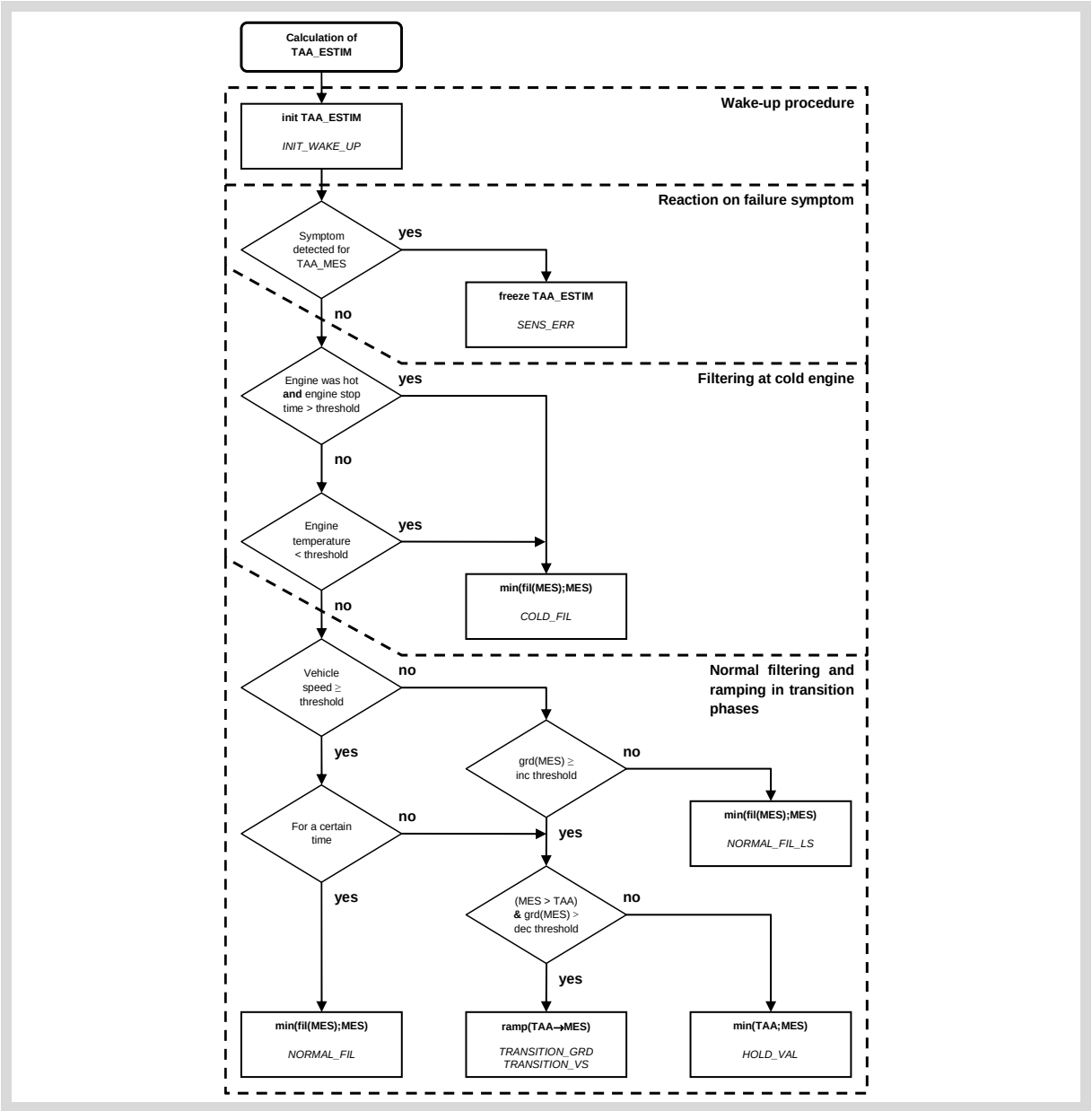

Figure 3.9.2: Calculation of TAA_ESTIM

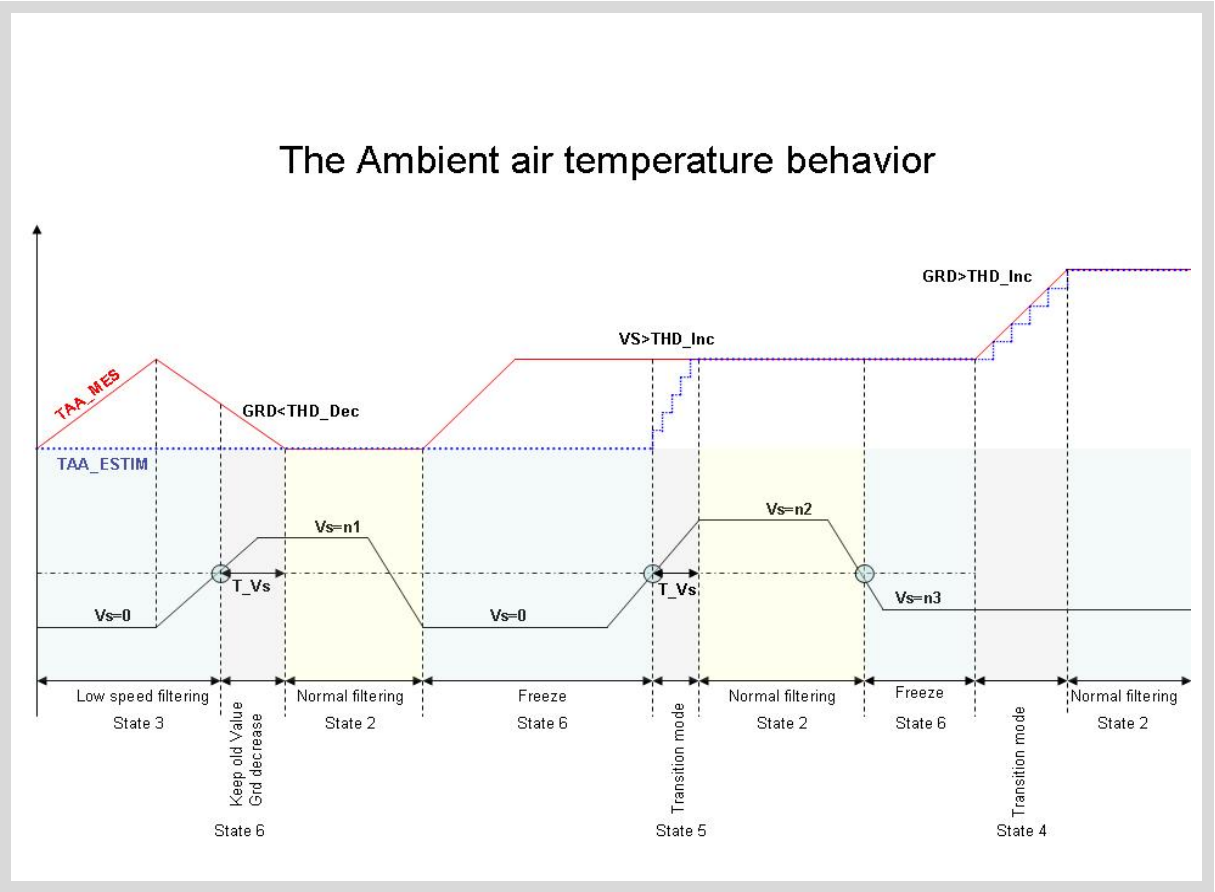

Figure 3.9.3:

▶ Application Conditions

Initialisation: `RST, IGKON, CLRFMY, ES2ERU, DCON, NVMRES, NVMINI, NVMSTO`

Deactivation: `if activation not true or if activation-condition of other event is true`

Recurrence:
`100MS activated if STATE_TAA_ESTIM==0&&LV_IGK==1`
`1S activated if STATE_TAA_ESTIM>0&&LV_IGK==1`

▶ Function Description

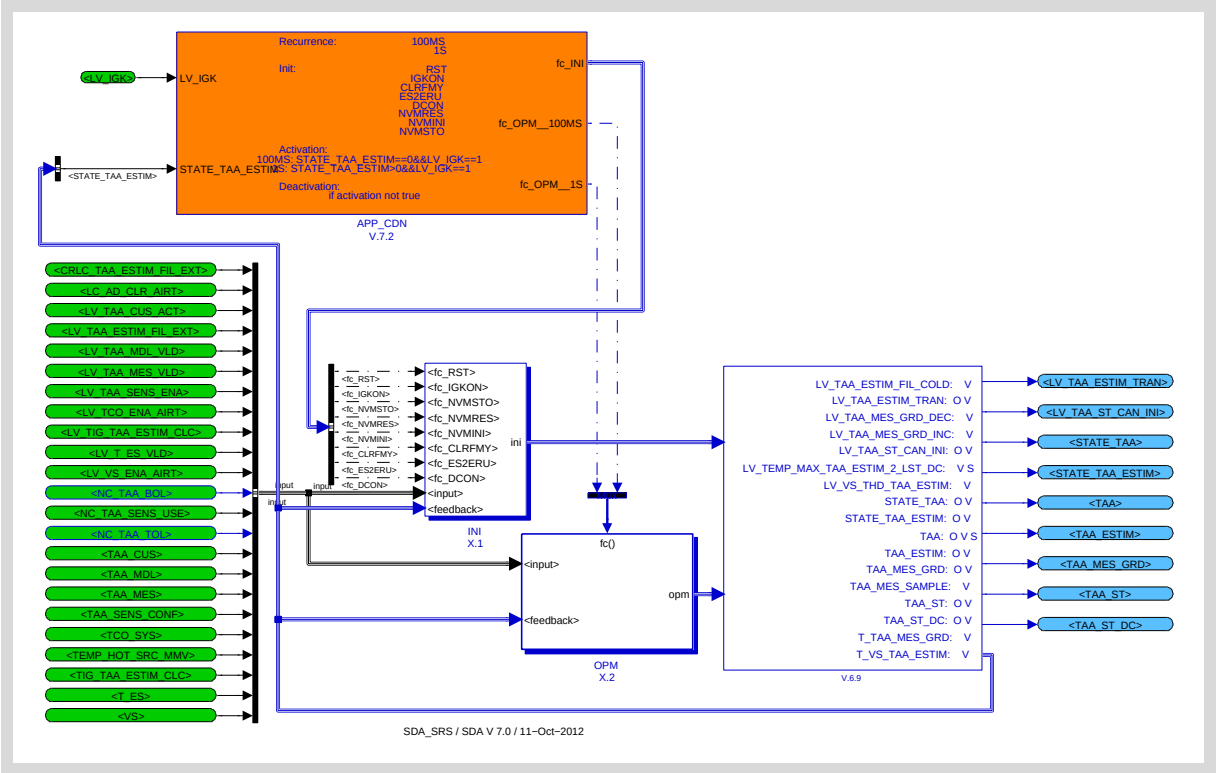

Figure 3.9.4:

3.9.1 Initialization

3.9.1.1 NVMY Data handling

TAA and LV_TEMP_MAX_TAA_ESTIM_2_LST_DC are stored in EEPROM.

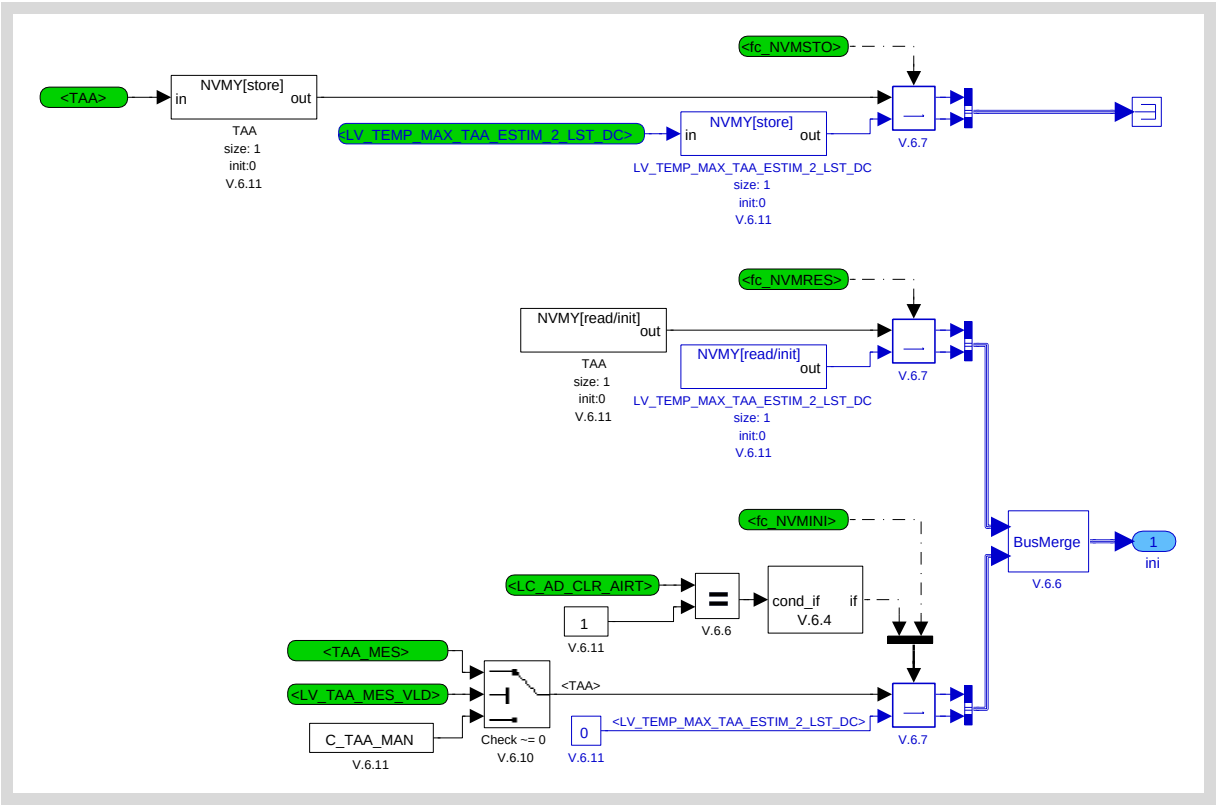

Figure 3.9.5:

3.9.1.2 Initialization at RST

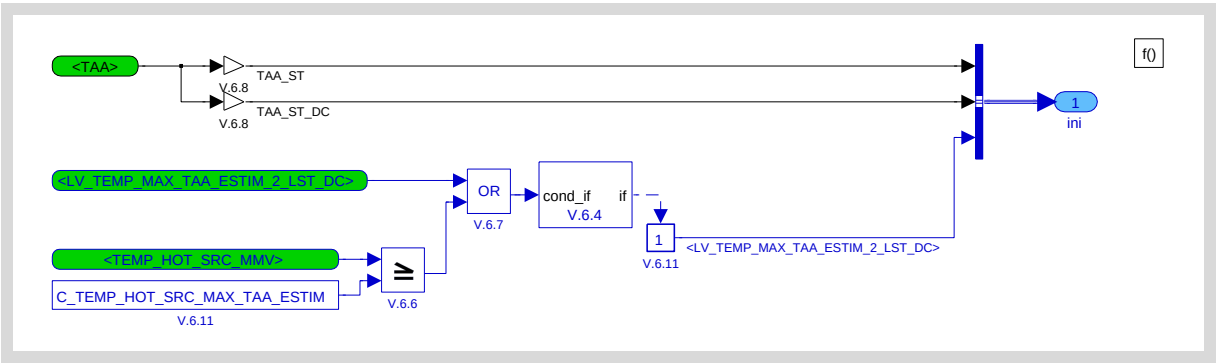

Figure 3.9.6:

3.9.1.3 Initialization at RST and IGKON

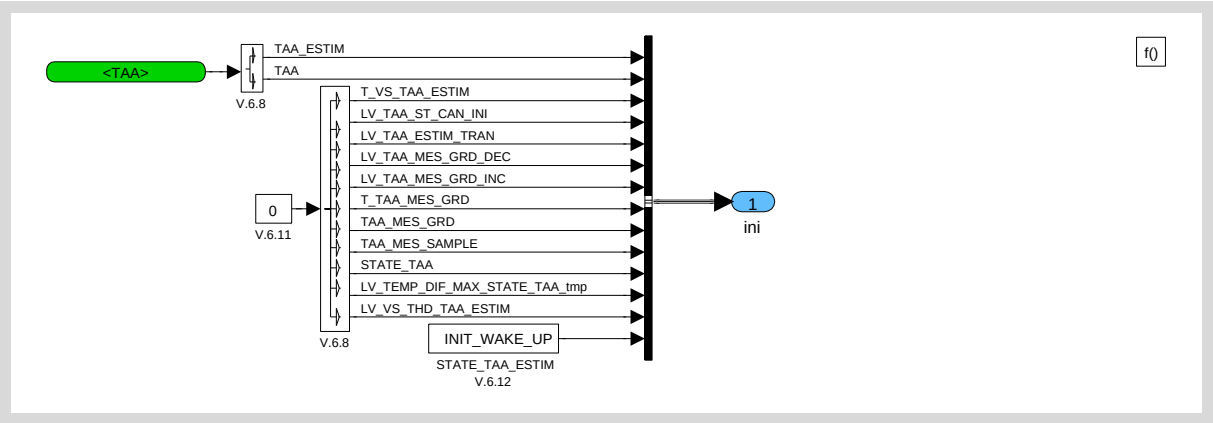

Figure 3.9.7:

3.9.1.4 Calculation at CLFMY

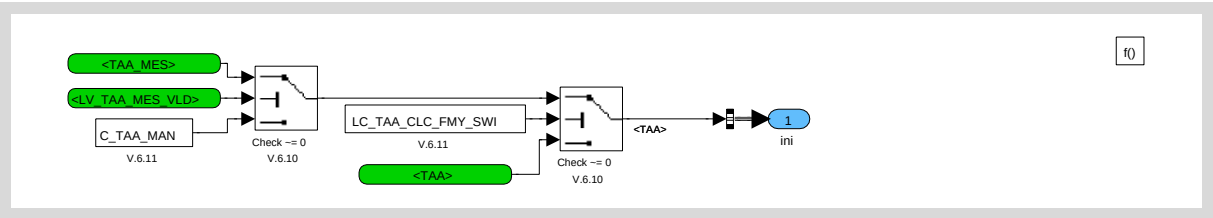

Figure 3.9.8:

3.9.1.5 Calculation at ES2ERU

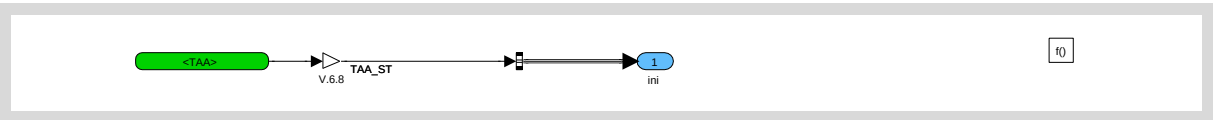

Figure 3.9.9:

3.9.1.6 Calculation at DCON

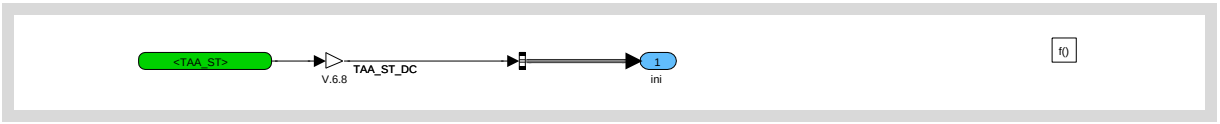

Figure 3.9.10:

3.9.2 Overview of ambient air temperature calculation

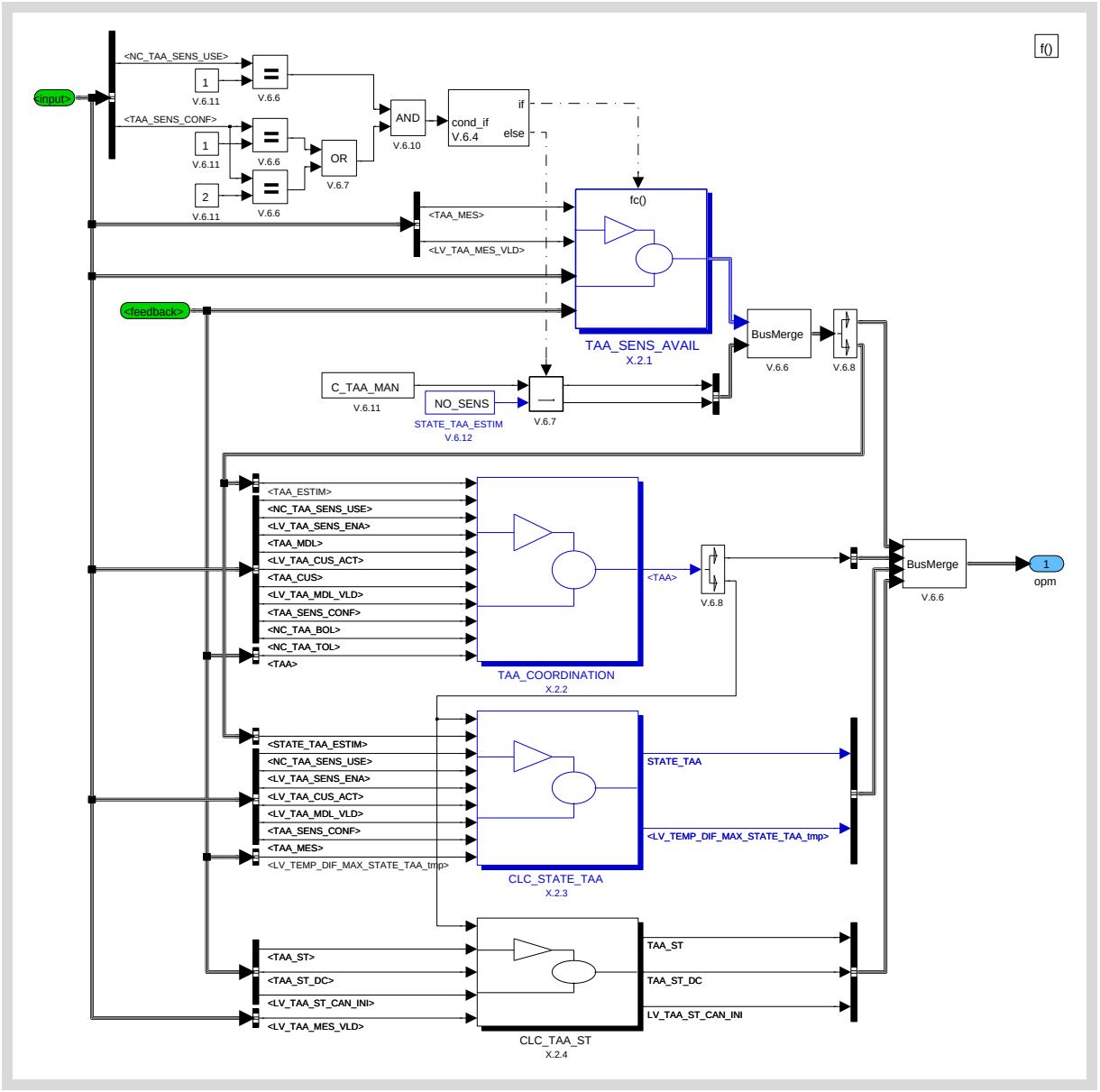

Figure 3.9.11:

3.9.2.1 Coordination of ambient air temperature calculation

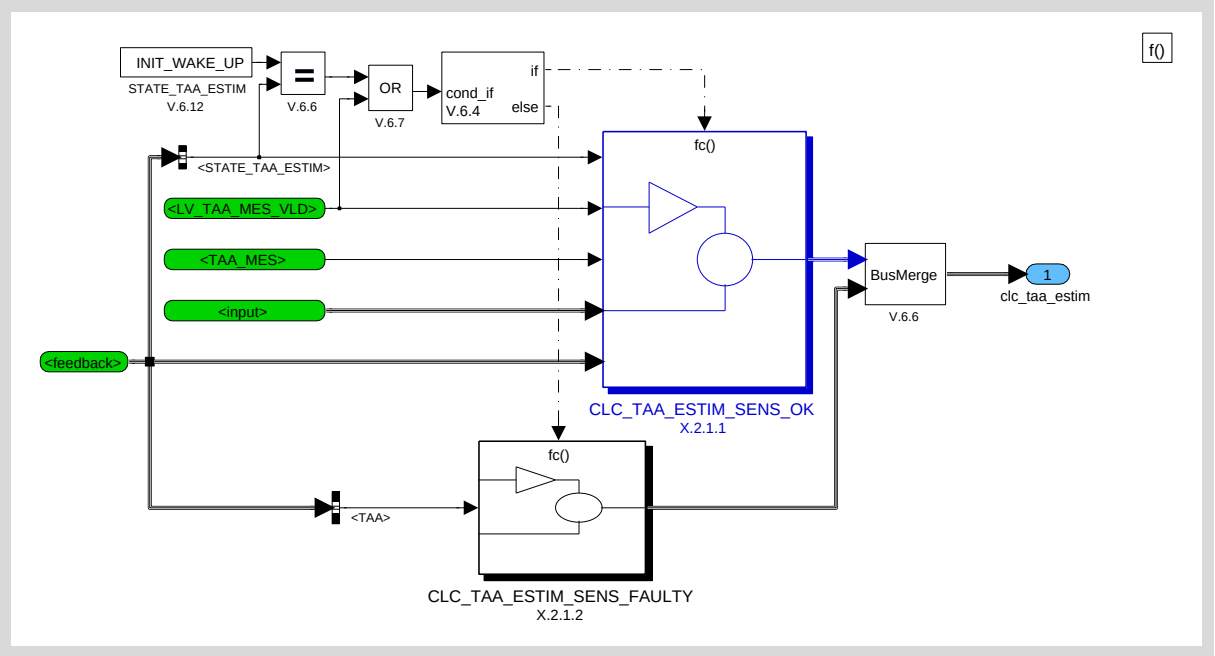

Figure 3.9.12:

3.9.2.1.1 Coordination of ambient air temperature calculation when sensor not faulty

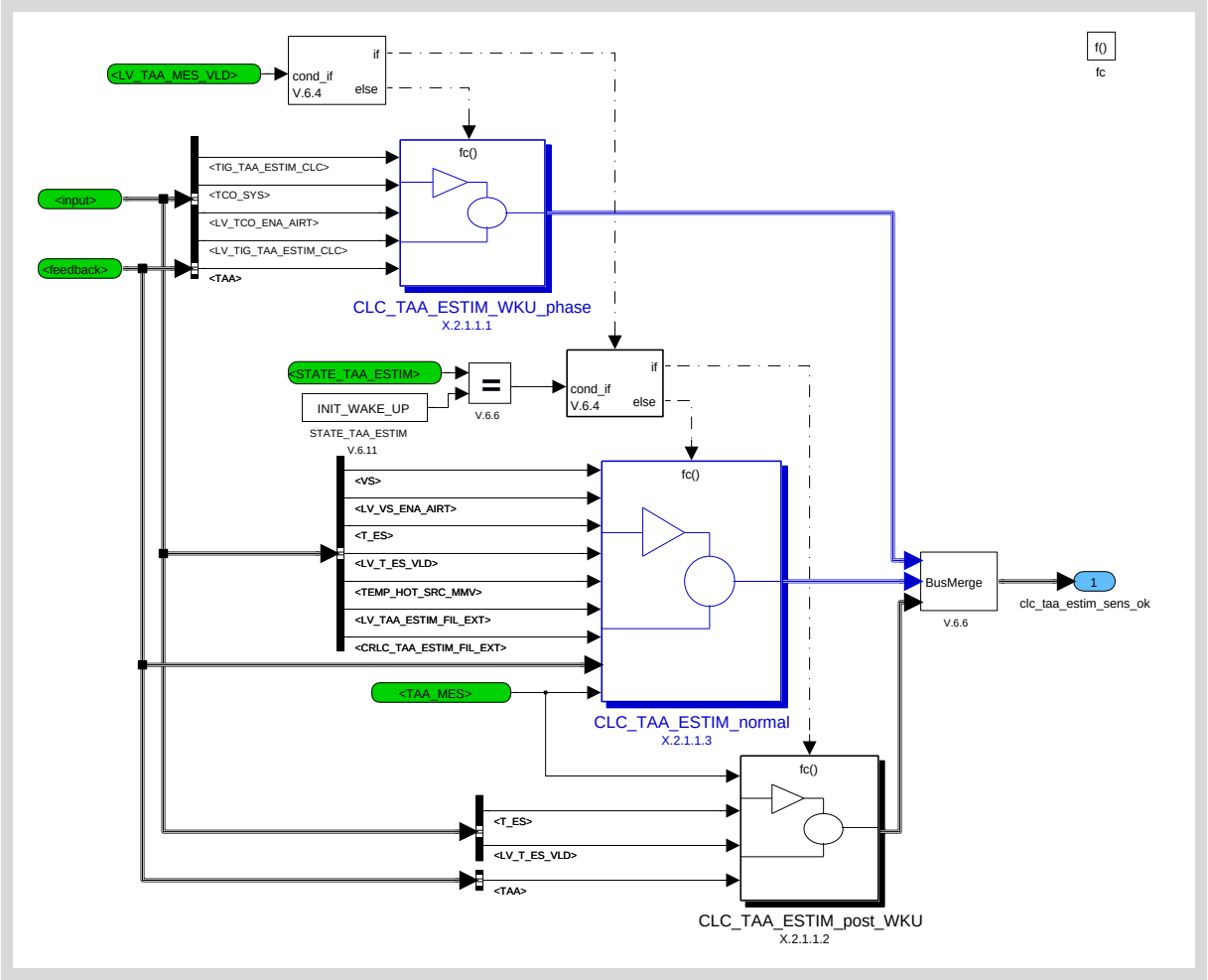

Figure 3.9.13:

3.9.2.1.1.1 Calculation of ambient air temperature during Wake-Up Phase after Key-on

During wake-up phase (CAN communication not yet available) TAA_ESTIM must be calculated out of other temperatures. In general, the temperature from the last driving cycle (TAA_ESTIM_PREV_DC) is used out of the EEPROM. If the intake gas temperature is smaller than the temperature from the last DC this temperature is directly used.

In case the position of the intake air temperature sensor for TIG_TAA_ESTIM_CLC is far away from the engine and the difference between the coolant temperature (TCE) and the intake gas temperature is smaller than a threshold (C_TCE_MIN_TAA_ESTIM), the engine is cooled down and the intake gas temperature can be directly used.

If the intake air temperature sensor is close to the engine, C_TEMP_DIF_MAX_TAA_ESTIM has to be calibrated to 0.

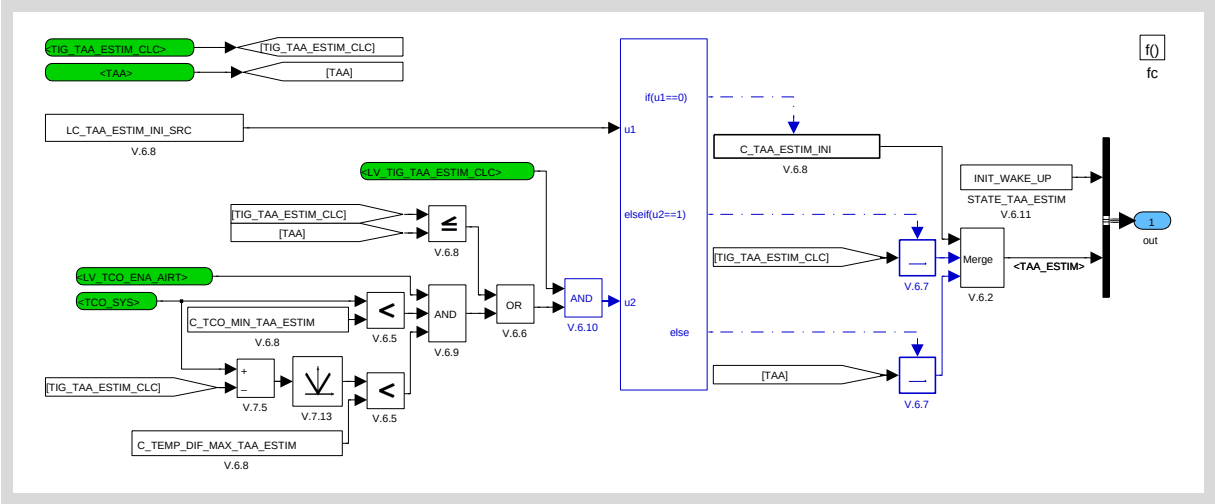

Figure 3.9.14:

3.9.2.1.1.2 Calculation of Ambient air temperature when first valid sensor-signal is received by ECU

In the post wake-up phase, when the engine is off during a minimum defined period (C_T_ES_MIN_TAA_ESTIM), the temperature from sensor (TAA_MES) is cooled down and can be used directly to estimate the ambient air temperature

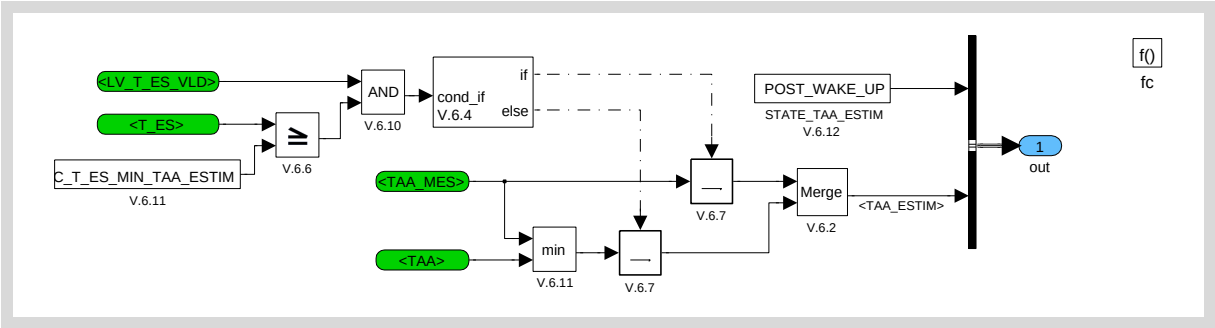

Figure 3.9.15:

3.9.2.1.1.3 Coordination of ambient air temperature calculation under normal driving conditions

3.9.2.1.1.3.1 Calculation of condition for filtering at cold engine

If the engine is cold a normal filtering of the TAA_MES value can be done, as there are no warm-up effects on the sensor from the engine cooler. If the engine (engine cooler) gets hot the standard filtering has to be activated again and the special filtering is deactivated.

To ensure that the engine was not hot at the last DC the engine stop temperature stored in EEPROM has to be compared to a threshold to deactivate the filtering. Additionally a flag has to be stored to memorize a heated up engine in the DC before, to avoid filtering at short-trips with hot engine. This flag is reset only when the engine stop time rises above a certain threshold to ensure that the engine has cooled down.

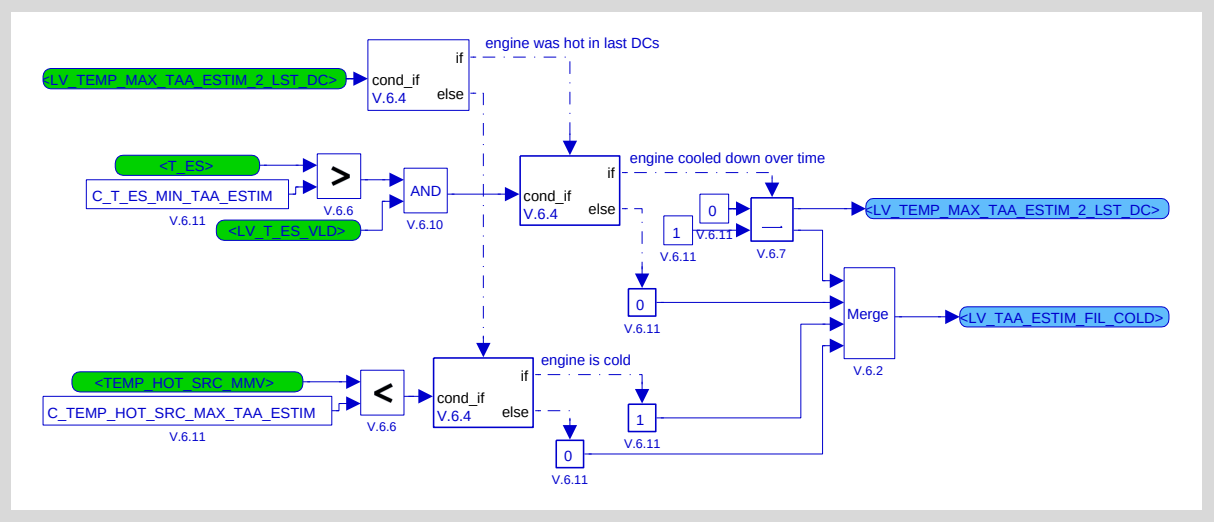

Figure 3.9.16:

3.9.2.1.1.3.2 Calculation of ambient air temperature gradient from sensor and velocity counter for transition mode

With the calibration constant (C_T_TAA_MES_GRD) the period of gradient calculation can be changed.

Dependent on the two different 'TRANSITION' states, the period time can be calibrated separately with C_T_VS_TAA_ESTIM_GRD_INC/DEC.

If the trigger for transition is caused by a defined positive gradient, C_T_VS_TAA_ESTIM_GRD_INC should be calibrated as short as it takes for the sensor to detect e.g. 'driving into a garage'.

If the trigger for transition is caused by vehicle speed, C_T_VS_TAA_ESTIM_GRD_DEC should be calibrated as long as the response time needs for cooling done the sensor to the actual ambient temperature by driving the car.

3.9.2.1.1.3.2.1 Calculation of gradient of measured ambient air temperature

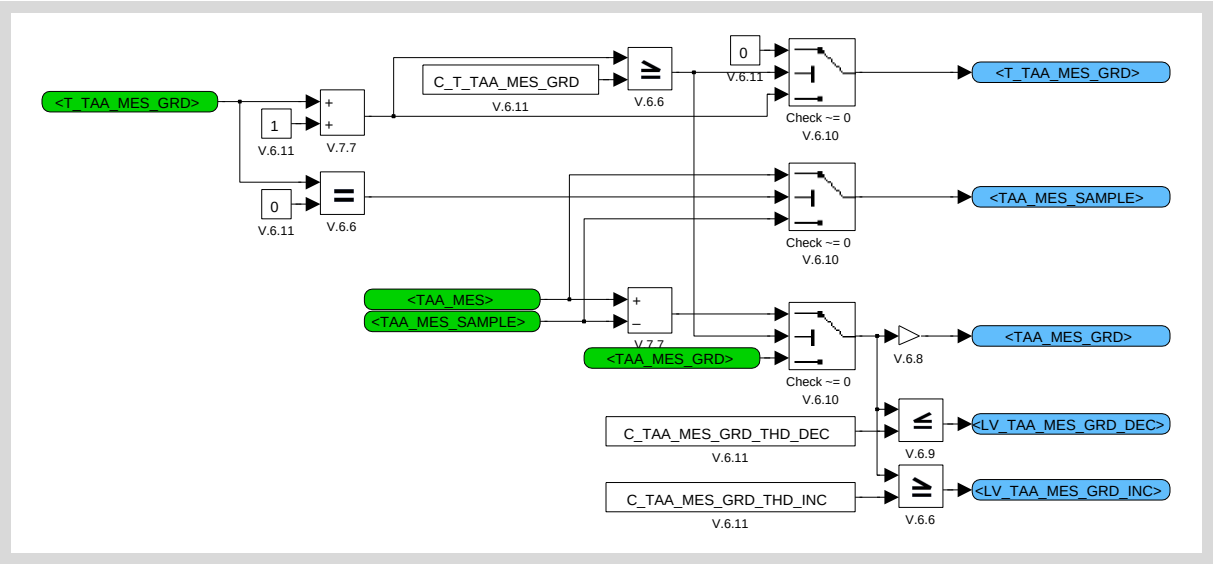

Figure 3.9.17:

3.9.2.1.1.3.2.2 Velocity counter for transition mode

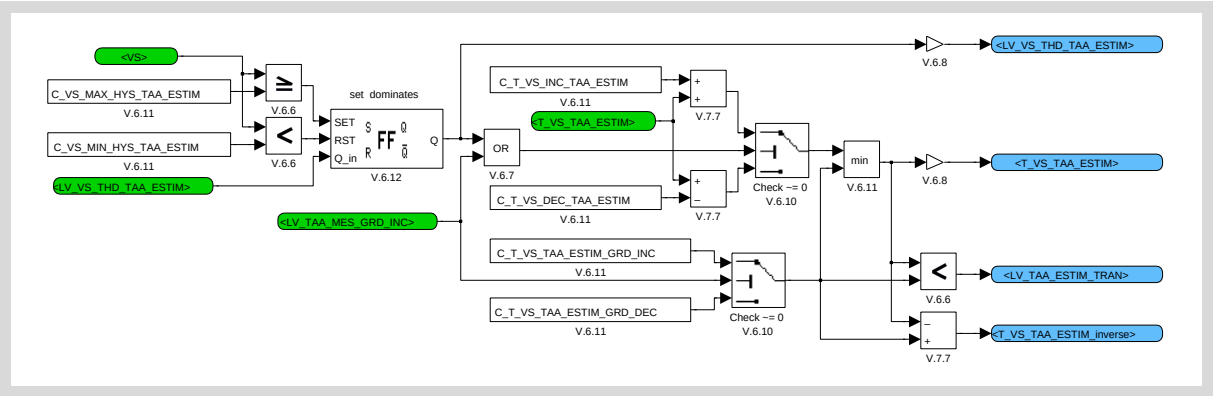

Figure 3.9.18:

3.9.2.1.1.3.3 Coordination of TAA_ESTIM calculation

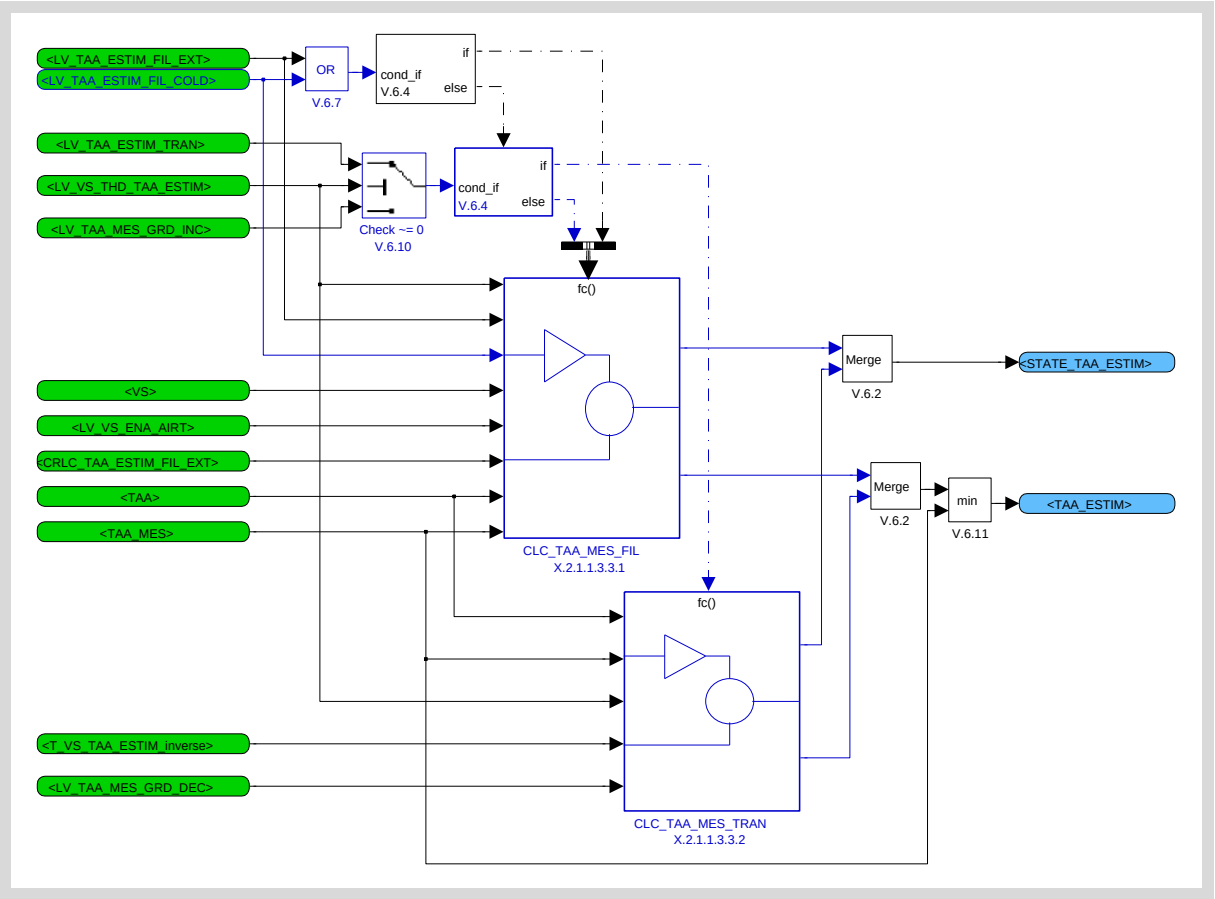

Figure 3.9.19:

3.9.2.1.1.3.3.1 Calculation of filtering and the respective state

Depending on the vehicle speed the filtering of the measured ambient air temperature is calculated.

During the low-vehicle-speed phase (NORMAL_FIL_LOW_SPEED – speed below threshold C_VS_MIN_HYS_TAA_ESTIM) a freeze of the measured ambient air temperature should be done; the filtering lookup table IP_CRLC_TAA_ESTIM must be calibrated to zero in case of low vehicle speed filtering. Otherwise a normal filtering is done.

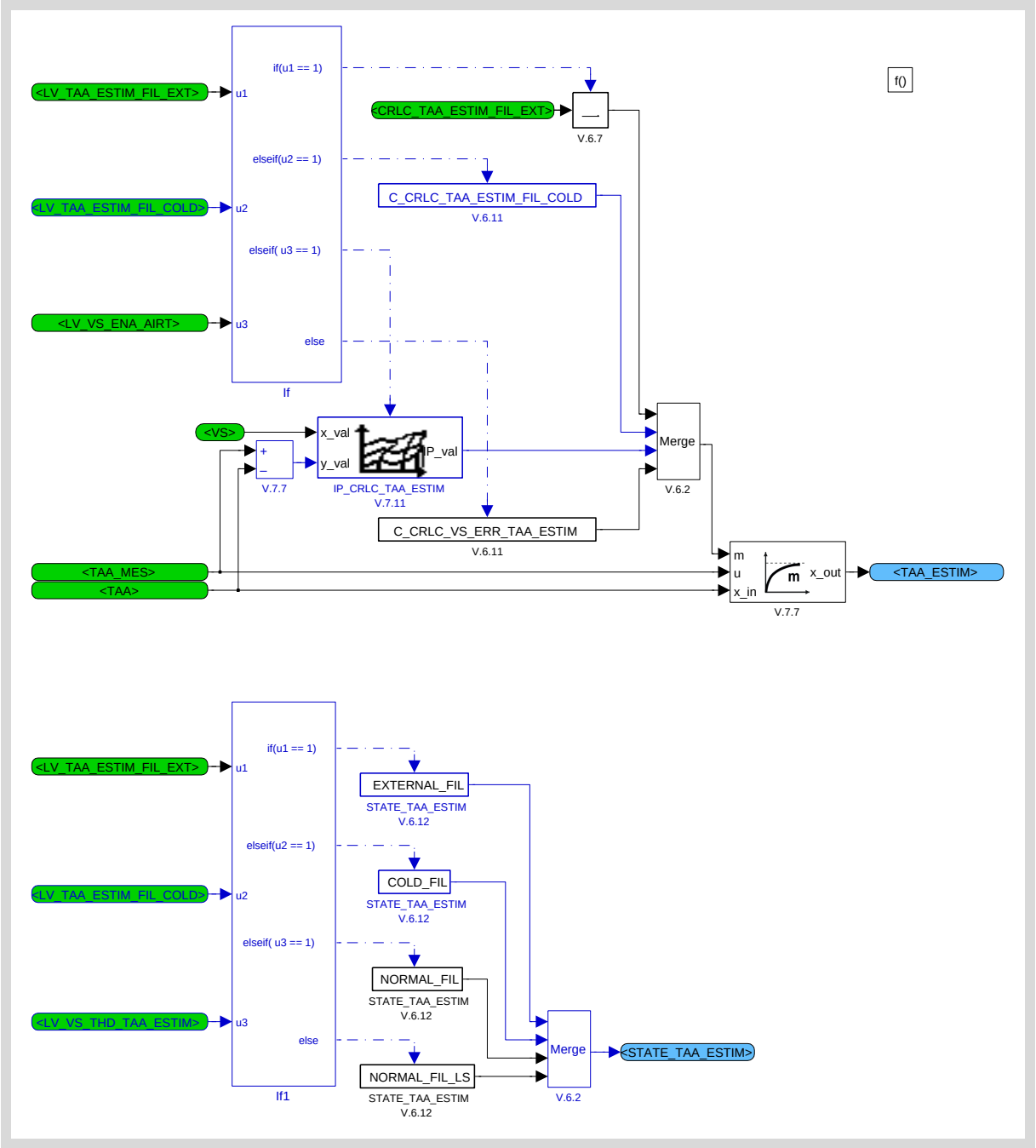

Figure 3.9.20:

3.9.2.1.1.3.3.2 Coordination of transition states

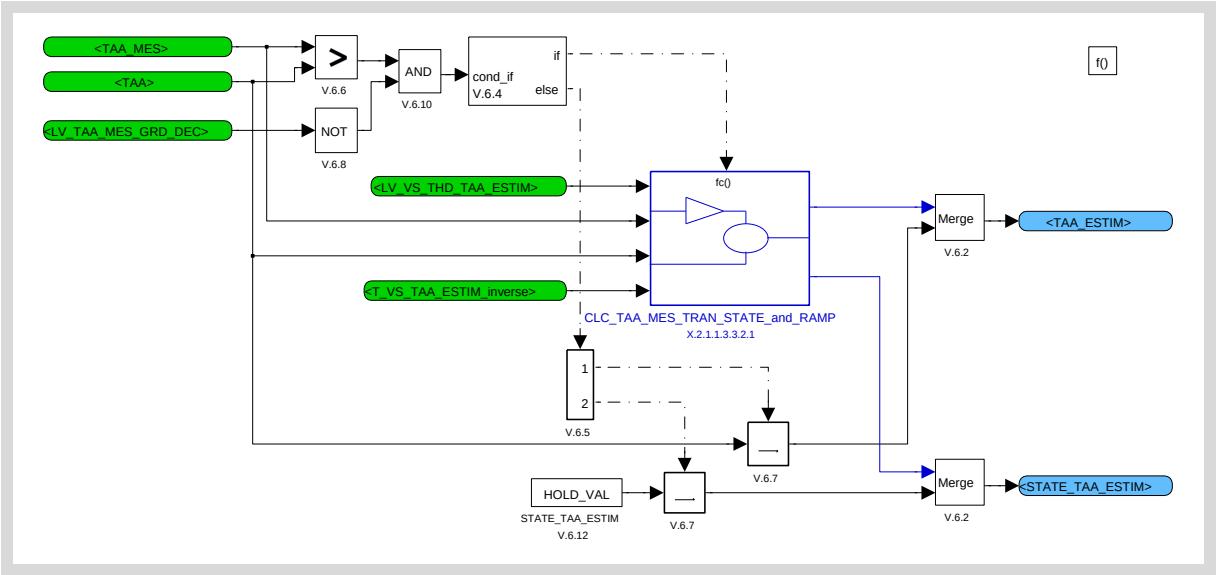

Figure 3.9.21:

3.9.2.1.1.3.3.2.1 Calculation of transition

In the state TRANSITION the speed of TAA_ESTIM can be tuned by calibration constant. C_TAA_ESTIM_GRD_GAIN smaller than 1 increases the speed of TAA_ESTIM.

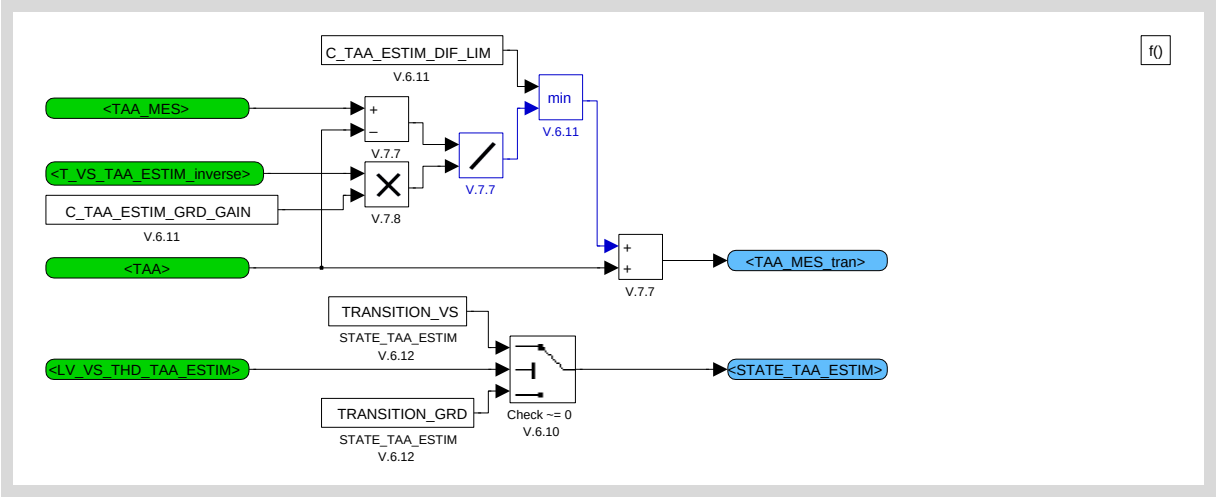

Figure 3.9.22:

3.9.2.1.2 Calculation of ambient air temperature in case of a Sensor-fault

If there is an error on the sensor signal (eg: failure in CAN communication or break in the wiring) in order to provide the other ECU functionalities with an 'realistic' value for TAA the last validate TAA signal is frozen.

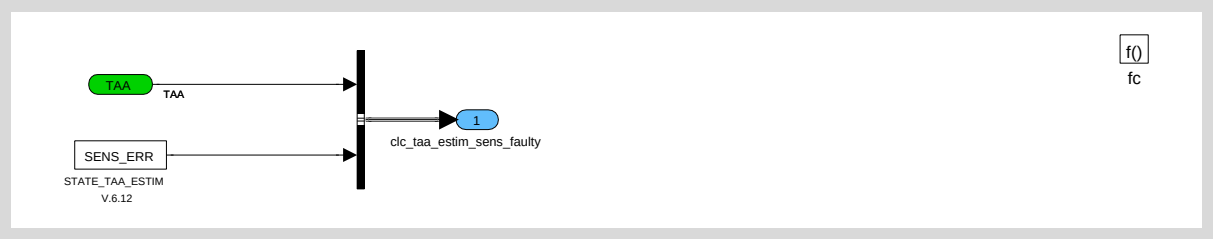

Figure 3.9.23:

3.9.2.2 Ambient air temperature coordination

If no correct sensor value for the estimated ambient air temperature is provided a TAA model is used.
To avoid big steps during the transition between estimated (TAA_ESTIM) and modeled value of ambient air temperature a limiter calibration is used (C_TAA_DIF_LIM).

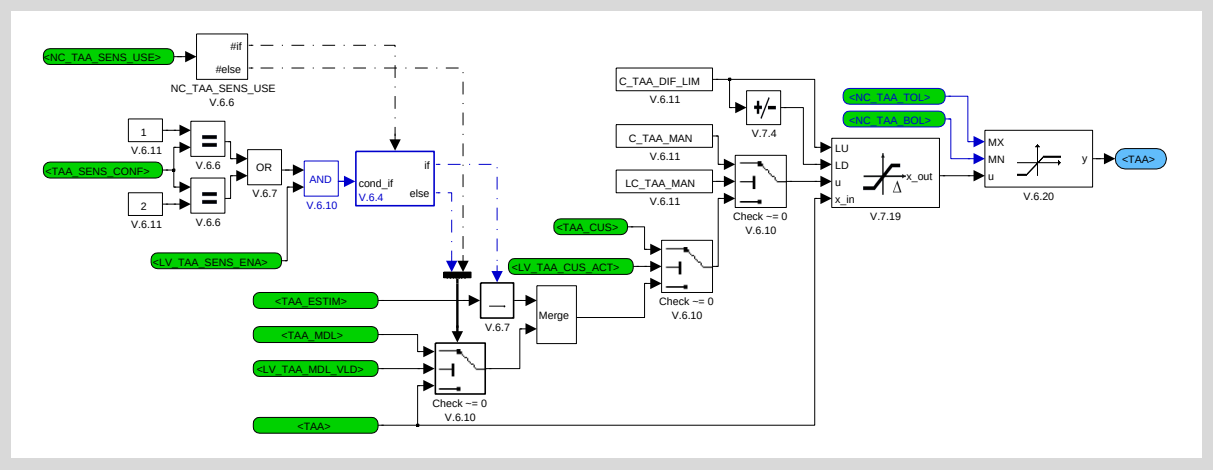

Figure 3.9.24:

3.9.2.3 Calculation of STATE_TAA

STATE_TAA indicates how TAA is calculated. The states are defined as follows:

0: Substitute value
1: Substitute value based on measured value
2: Measured value
3: Modeled value
4: Customer value
5: Manual value

It is distinguished between 'substitute value' and 'substitute value based on measured value'.
The 'substitute value' can be seen as the most likely value in case no other approved value is available.
If the actual measured value (TAA_MES) is used for the calculation of TAA, but the difference between TAA_MES and TAA does not meet the defined threshold (due to filtering respectively ramping), STATE_TAA is set to 1, which means 'substitute value based on measured value'.

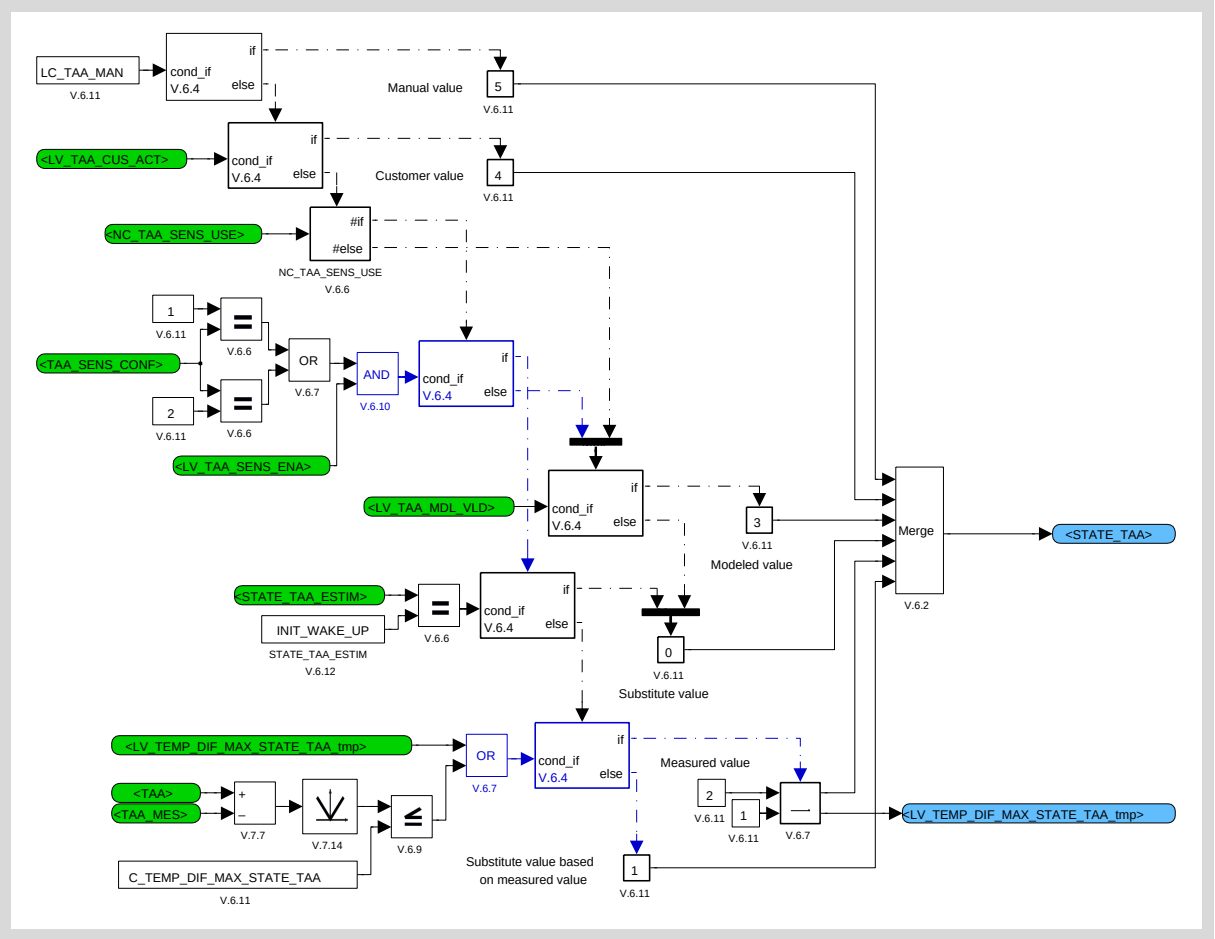

Figure 3.9.25:

3.9.2.4 Calculation of ambient air temperature at start

Due to the fact that the CAN signals are delayed, because of start-up communication between control units, the initialization of TAA_ST and TAA_ST_DC has to be done after CAN is available (LV_TAA_MES_VLD=1).
For activation LC_TAA_ST_CAN_INI must be set to 1.
The Flag LV_TAA_ST_CAN_INI indicates that the initialization is done.

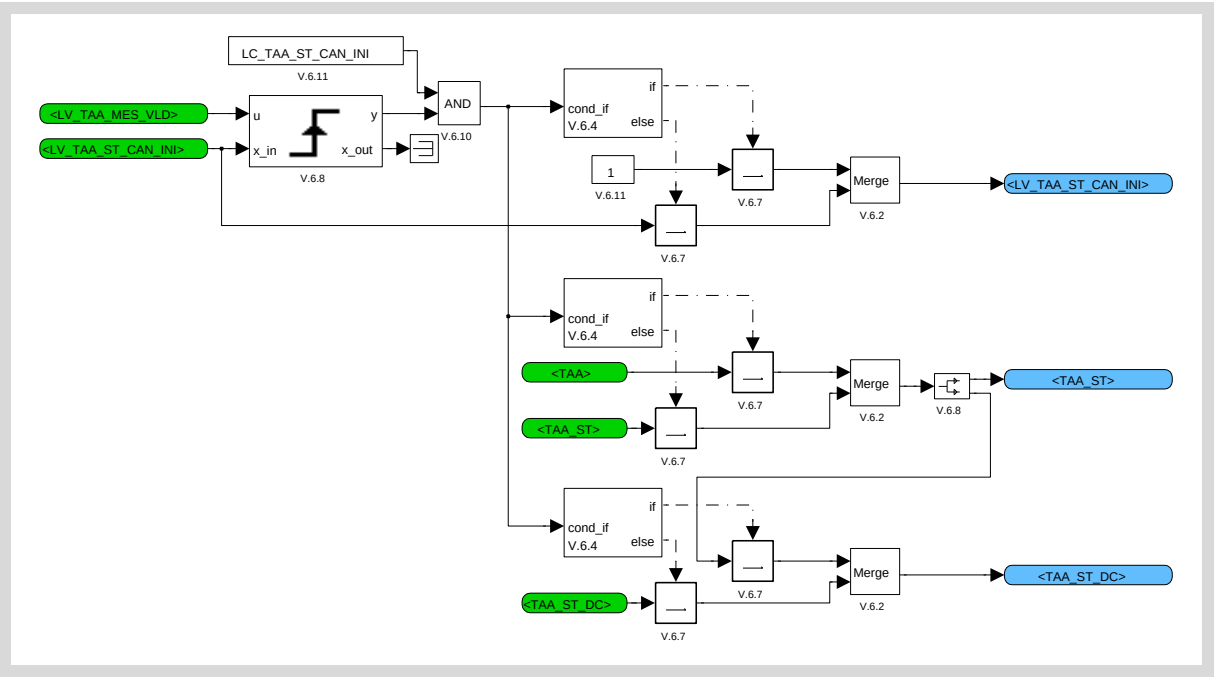

Figure 3.9.26:

3.10 Intake gas temperature calculation

▶ Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
LV_T_ES_NOT_AVL_AIRT	O	0... 1H	0 ...1	1	-
Flag that indicates that engine off time is not available in project for AIRT functionalities					
LV_TIG_MDL_FIL_SWI	O	0... 1H	0 ...1	1	-
Switch between filtering strategies for intake gas temperature model					
TEMP_COLD_SRC	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Cold source reference temperature of engine					
TEMP_HOT_SRC	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Hot source reference temperature of engine					
TIG_CMPR_UP	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature upstream compressor					
TIG_EGR_H_MDL_INP	O	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature input value for intake gas temperature model of high pressure exhaust gas recirculation					
TIG_HFM	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature at HFM					
TIG_HFM_ST	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature at HFM at start					
TIG_HFM_ST_DC	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature at HFM at start in current Driving Cycle					
TIG_ICO_MDL_INP	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature input value for intake gas temperature model at intercooler					
TIG_ICO_UP	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature upstream intercooler					
TIG_IM_MDL_INP	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature input value for intake gas temperature model at intake manifold					
TIG_IM_MDL_INP_SUB	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Substitute value for TIG_IM_MDL_INP value					
TIG_INV_MDL_INP	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature input value for intake gas temperature model at intake valve					
TIG_THR_MDL_INP	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature input value for intake gas temperature model at throttle					

Input Data

FC_INI_AIRT_MDLAD_TIGEGR {p. 1230}	FC_INI_AIRT_MDLAD_TIGICO {p. 1228}	FC_INI_AIRT_MDLAD_TIGIM {p. 1204}	FC_INI_AIRT_MDLAD_TIGINV {p. 1215}
FC_INI_AIRT_MDLAD_TIGTHR {p. 1223}	FC_OPM_AIRT_MDLAD_ TIGEGR {p. 1230}	FC_OPM_AIRT_MDLAD_ TIGICO {p. 1228}	FC_OPM_AIRT_MDLAD_TIGIM {p. 1204}
FC_OPM_AIRT_MDLAD_ TIGINV {p. 1215}	FC_OPM_AIRT_MDLAD_ TIGTHR {p. 1223}	LV_ES {p. 7530}	NC_FID_TCO_ENA_AIRT {p. 1173}
TAA {p. 1177}	TAA_ST {p. 1178}	TAA_ST_DC {p. 1178}	TCO_SYS {p. 8870}
TIG_CMPR_DOWN {p. 1144}	TIG_IM {p. 1204}	TIG_IM_MES {p. 1150}	TIG_THR {p. 1223}
TOIL {p. 7287}			

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_TAA_OFS_TIG_SUB_CLC	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Ambient air temperature offset for substitute value calculation of TIG_IM_MDL_INP_SUB					
C_TCO_TIG_SUB_CLC	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Engine coolant temperature threshold for substitude value calculation of TIG_IM_MDL_INP_SUB					
C_TIG_IM_MDL_INP_SUB_BOL	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Lower substitute value for TIG_IM_MDL_INP_SUB					
C_TIG_IM_MDL_INP_SUB_TOL	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Upper substitute value for TIG_IM_MDL_INP_SUB					
LC_T_ES_NOT_AVL_AIRT	V	0... 1H	0 ...1	1	-
Logical switch that indicates that engine off time is not available in project for AIRT functionalities					
LC_TEMP_COLD_SRC_SWI	V	0... 1H	0 ...1	1	-
Switch to choose temperature value of TEMP_COLD_SRC					
LC_TEMP_HOT_SRC_SWI	V	0... 1H	0 ...1	1	-
Switch to choose temperature value of TEMP_HOT_SRC					
LC_TIG_IM_MDL_INP_SUB_SWI	V	0... 1H	0 ...1	1	-
Switch for substitute value calculation of TIG_IM_MDL_INP_SUB					
LC_TIG_MDL_FIL_SWI	V	0... 1H	0 ...1	1	-
Switch between filtering strategies for intake gas temperature model					

Configuration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
NC_FID_TIG_IM_MES_ENA	O	0... FFFFH	0... 65535	1	-
Measured value of intake gas temperature at intake manifold enabled (no error)					
NC_FID_TIG_IM_MES_VLD	O	0... FFFFH	0... 65535	1	-

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
Measured value of intake gas temperature at intake manifold valid					

▶ **Import actions:**

ACTION_FARM_GetPermission(**IN** <PRM_FID>, **OUT** <PRM_LV_PRMS>)

▶ **General Information**

The aim of this module is the coordination and interface allocation for the intake gas temperature model calculation.
A detailed overview picture can be found in the module Configuration Data (**xx100Qxx**).

To fulfill all requirements of the customer with his complex system architectures a maximum on flexibility of the AIRT AGGR is necessary.
Therefore the different sensor locations and the arrangement of the different models for temperature calculation can be adjusted.

Hint for calibration in FARM:
- NC_FID_TCO_ENA_AIRT: all errors of TCO sensor
- NC_FID_TIG_IM_MES_VLD: all symptoms of TIG_IM sensor
- NC_FID_TIG_IM_MES_ENA: all errors of TIG_IM sensor

If TIG_IM is acquired from a digital sensor, also communication errors have to be taken into account !

3.10.1 Calculate substitute value

▶ **General Information**

▶ **Application Conditions**

Initialisation:	**at** reset: calculate formula section
Activation:	always
Deactivation:	never
Recurrence:	100ms

▶ **Function Description**

if LC_TIG_IM_MDL_INP_SUB_SWI = 1
then
  TIG_IM_MDL_INP_SUB = TAA + C_TAA_OFS_TIG_SUB_CLC
else
  if **ACTION_FARM_GetPermission**(NC_FID_TCO_ENA_AIRT) **and**
    TCO_SYS < C_TCO_TIG_SUB_CLC
  then
    TIG_IM_MDL_INP_SUB = C_TIG_IM_MDL_INP_SUB_BOL
  else
    TIG_IM_MDL_INP_SUB = C_TIG_IM_MDL_INP_SUB_TOL
  endif
endif

3.10.2 Calculate sequencing and interface

▶ General Information

▶ Application Conditions

Initialisation:

```
at  reset:
// calculation of intake gas temperature model at intake manifold
ifACTION_FARM_GetPermission(NC_FID_TIG_IM_MES_VLD)
then
    TIG_IM_MDL_INP = TIG_IM_MES
else
    TIG_IM_MDL_INP = TIG_IM_MDL_INP_SUB
endif

LV_T_ES_NOT_AVL_AIRT = LC_T_ES_NOT_AVL_AIRT // directly assigned
LV_TIG_MDL_FIL_SWI = LC_TIG_MDL_FIL_SWI // directly assigned

if  LC_TEMP_COLD_SRC_SWI = 0
then  TEMP_COLD_SRC = TIG_IM_MDL_INP
else  TEMP_COLD_SRC = TAA

if  LC_TEMP_HOT_SRC_SWI = 0
then  TEMP_HOT_SRC = TCO_SYS
else  TEMP_HOT_SRC = TOIL
endif

FC_INI__AIRT_MDLAD_TIGIM(TIG_IM_MDL_INP)  //calculate xx40G3xx

// calculation of intake gas temperature model at intake valve
TIG_INV_MDL_INP = TIG_IM
FC_INI__AIRT_MDLAD_TIGINV(TIG_INV_MDL_INP)  //calculate xx40G5xx

// calculation of intake gas temperature model at throttle
TIG_THR_MDL_INP = TIG_IM
FC_INI__AIRT_MDLAD_TIGTHR(TIG_THR_MDL_INP)  //calculate xx40G4xx

// calculation of intake gas temperature model at intercooler

TIG_ICO_MDL_INP = TIG_THR
FC_INI__AIRT_MDLAD_TIGICO(TIG_ICO_MDL_INP) //calculate xx40G6xx

// calculation of intake gas temperature model for exhaust gas
recirculation
TIG_EGR_H_MDL_INP = TIG_IM
FC_INI__AIRT_MDLAD_TIGEGR(TIG_EGR_H_MDL_INP)  //calculate xx40G7xx
```

Activation: always

Deactivation: never

Recurrence: 100ms

▶ Function Description

```
// calculation of module intake gas temperature model at intake manifold
ifACTION_FARM_GetPermission(NC_FID_TIG_IM_MES_ENA)
then
 ifACTION_FARM_GetPermission(NC_FID_TIG_IM_MES_VLD)
 then
   TIG_IM_MDL_INP = TIG_IM_MES
 else
   TIG_IM_MDL_INP = TIG_IM_MDL_INP_N-1
else
TIG_IM_MDL_INP = TIG_IM_MDL_INP_SUB
endif

LV_T_ES_NOT_AVL_AIRT = LC_T_ES_NOT_AVL_AIRT// directly assigned
LV_TIG_MDL_FIL_SWI = LC_TIG_MDL_FIL_SWI  // directly assigned

if LC_TEMP_COLD_SRC_SWI = 0
then TEMP_COLD_SRC = TIG_IM
else TEMP_COLD_SRC = TAA
endif

if LC_TEMP_HOT_SRC_SWI = 0
then TEMP_HOT_SRC = TCO_SYS
else TEMP_HOT_SRC = TOIL
endif

FC_OPM__AIRT_MDLAD_TIGIM(TIG_IM_MDL_INP) // calculate xx40G3xx


// calculation of module intake gas temperature model at intake valve
if LV_ES = 1 // calculation in 100ms only when engine stopped
then
TIG_INV_MDL_INP = TIG_IM
FC_OPM__AIRT_MDLAD_TIGINV(TIG_INV_MDL_INP) // calculate xx40G5xx
endif


// calculation of module intake gas temperature model at throttle
TIG_THR_MDL_INP = TIG_IM
FC_OPM__AIRT_MDLAD_TIGTHR(TIG_THR_MDL_INP) // calculate xx40G4xx


// calculation of intake gas temperature model at intercooler
TIG_ICO_MDL_INP = TIG_THR
FC_INI__AIRT_MDLAD_TIGICO(TIG_ICO_MDL_INP) //calculate xx40G6xx


// calculation of module intake gas temperature model for exhaust gas recirculation
TIG_EGR_H_MDL_INP = TIG_IM
FC_OPM__AIRT_MDLAD_TIGEGR(TIG_EGR_H_MDL_INP) // calculate xx40G7xx
```

3.10.3 Calculate sequencing and interface for TIG_INV in segment

▶ General Information

▶ Application Conditions

Initialisation:	–
Activation:	`LV_ES = 0`
Deactivation:	`when activation condition not fulfilled`
Recurrence:	`segment`

▶ Function Description

// calculation of module intake gas temperature model at intake valve
TIG_INV_MDL_INP = TIG_IM
FC_OPM_AIRT_MDLAD_TIGINV(TIG_INV_MDL_INP***)*** *// calculate xx**40G5**xx*

3.10.4 Calculate specific AGGR output variables

▶ General Information

Within this chapter all specific variables which are AGGR output are calculated.

▶ Application Conditions

Initialisation:	**`at`** `reset:` `calculate formula section`
Activation:	`always`
Deactivation:	`never`
Recurrence:	`100ms`

▶ Function Description

TIG_HFM = TAA
TIG_HFM_ST = TAA_ST
TIG_HFM_ST_DC = TAA_ST_DC

TIG_CMPR_UP = TIG_HFM
TIG_ICO_UP = TIG_CMPR_DOWN

3.11 Intake gas temperature model at intake manifold

▶ Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
CRLC_TIG_IM_MDL	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Filtering factor for intake gas temperature model at intake manifold					
FAC_WUP_TIG_IM_MDL	O/V	0... FFH	0... 1.9921875	0.0078125	-
Warm-up factor for intake gas temperature model at intake manifold					
FC_INI_AIRT_MDLAD_TIGIM	O	0... 1H	0 ...1	1	-
Function call for initialization of intake gas temperature model at intake manifold					
FC_OPM_AIRT_MDLAD_TIGIM	O	0... 1H	0 ...1	1	-
Function call for operating mode of intake gas temperature model at intake manifold					
LV_FAC_STATE_HEAT_IM_DEC	V	0... 1H	0 ...1	1	-
Flag that indicates mass flow and pressure quotient influence on STATE_HEAT_IM calculation for decrease					
LV_FAC_STATE_HEAT_IM_INC	V	0... 1H	0 ...1	1	-
Flag that indicates mass flow and pressure quotient influence on STATE_HEAT_IM calculation for increase					
LV_RATE_HEAT_IM_INI	V	0... 1H	0 ...1	1	-
Initialisation of RATE_HEAT_IM and TEMP_HOT_SRC_MMV finished					
RATE_HEAT_IM	O/V/S	0... FFFFH	0... 1310.7	0.02	-
Heat quantity stored in the intake manifold during long idle phase					
RATE_HEAT_IM_DIF_DC	O/V	0... FFFFH	0... 1310.7	0.02	-
Difference between minimum and maximum value of RATE_HEAT_IM during current DC					
RATE_HEAT_IM_MAX_DC	O/V	0... FFFFH	0... 1310.7	0.02	-
Maximum value of RATE_HEAT_IM in current DC					
RATE_HEAT_IM_MIN_DC	O/V	0... FFFFH	0... 1310.7	0.02	-
Minimum value of RATE_HEAT_IM in current DC					
STATE_HEAT_IM	O/V	0H 1H 2H	CON INC DEC	-	-
State flag: "CON" = heat level constant / "INC" = heat level increase / "DEC" = heat level decrease					
TEMP_COLD_SRC_MMV	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Filtered cold source reference temperature of engine					
TEMP_HOT_SRC_MMV	O/V/S	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Filtered hot source reference temperature of engine					
TIG_IM	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature at intake manifold					
TIG_IM_FIL_TMP	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Temporary filter value for intake gas temperature at intake manifold calculation					
TIG_IM_MDL_OFS	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Temperature offset for intake gas temperature model at intake manifold					
TIG_IM_ST	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature at intake manifold at start					

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
TIG_IM_ST_DC	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature at intake manifold at start in current driving cycle					

Input Data

LV_ES {p. 7530}	LV_T_ES_NOT_AVL_AIRT {p. 1198}	LV_T_ES_VLD {p. 8333}	LV_TIG_MDL_FIL_SWI {p. 1198}
M_GAS_TIG_IM_AIRT {p. 1143}	MFL_GAS_IM_AIRT {p. 1143}	N {p. 8079}	NC_TIG_IM_CONF {p. 1136}
PQ_AIRT {p. 1143}	T_AST {p. 8436}	T_ES {p. 8334}	TAA {p. 1177}
TCO_1_STOP {p. 8870}	TCO_SYS {p. 8870}	TEMP_COLD_SRC {p. 1198}	TEMP_HOT_SRC {p. 1198}
TIG_IM_MDL_INP {p. 1198}	VS {p. 26240}		

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_CRLC_TEMP_COLD_SRC_MMV	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Filtering factor of cold source reference temperature of engine					
C_CRLC_TEMP_HOT_SRC_MMV	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Filtering factor of hot source reference temperature of engine					
C_CRLC_TIG_IM_MDL_AST	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Filtering factor of intake gas temperature model at intake manifold for defined time after start					
C_CRLC_TIG_IM_MDL_ES	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Filtering factor of intake gas temperature model at intake manifold at engine stop					
C_FAC_MAX_STATE_HEAT_IM_DEC	V	0... 80H	0 ...1	0.0078125	-
Maximum value to set LV_FAC_RATE_HEAT_IM_DEC					
C_FAC_MAX_STATE_HEAT_IM_INC	V	0... 80H	0 ...1	0.0078125	-
Maximum value to set LV_FAC_RATE_HEAT_IM_INC					
C_FAC_MIN_STATE_HEAT_IM_DEC	V	0... 80H	0 ...1	0.0078125	-
Minimum value to set LV_FAC_RATE_HEAT_IM_DEC					
C_FAC_MIN_STATE_HEAT_IM_INC	V	0... 80H	0 ...1	0.0078125	-
Minimum value to set LV_FAC_RATE_HEAT_IM_INC					
C_RATE_HEAT_IM_TOL	V	0... FFFFH	0... 1310.7	0.02	-
Maximum possible value for RATE_HEAT_IM					
C_T_AST_MAX_CRLC_TIG_IM_MDL	V	0... FFFFH	0... 6553.5	0.1	s
Maximum time after start to activate normal filtering factor					
C_TCO_MIN_STATE_HEAT_IM_INC	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Minimum engine coolant temperature for heat increase in the intake manifold					

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_TEMP_DIF_MIN_STATE_HEAT_DEC	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Minimum engine coolant temperature difference for heat decrease in the intake manifold					
C_VS_STATE_HEAT_IM_DEC	V	0... FFH	0... 255	1	km/h
Minimum vehicle speed for heat decrease in the intake manifold					
C_VS_STATE_HEAT_IM_INC	V	0... FFH	0... 255	1	km/h
Maximum vehicle speed for heat increase in the intake manifold					
IP_CRLC_TIG_IM_MDL	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
LDPM_TIG_DIF_1_AIRT	6	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Filtering factor for intake gas temperature model at intake manifold					
IP_FAC_RATE_HEAT_IM_INI	V	0... FFH	0... 1.9921875	0.0078125	-
LDP_T_ES_IP_RATE_HEAT_INI	4	0... FFFFH	0... 65535	1	min
LDP_TEMP_DIF_IP_RATE_HEAT_INI	5	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Correction factor for RATE_HEAT_IM calculation at initialization					
IP_FAC_STATE_HEAT_IM_DEC	V	0... 1H	0 ...1	1	-
LDPM_PQ_1_AIRT	6	0... FFH	0... 7.96875	0.03125	-
LDPM_MFL_IM_1_AIRT	8	0... FFFFH	0... 4095.9375	0.0625	kg/h
Mass flow and pressure quotient influence on STATE_HEAT_IM calculation for decrease					
IP_FAC_STATE_HEAT_IM_INC	V	0... 1H	0 ...1	1	-
LDPM_PQ_1_AIRT	6	0... FFH	0... 7.96875	0.03125	-
LDPM_MFL_IM_1_AIRT	8	0... FFFFH	0... 4095.9375	0.0625	kg/h
Mass flow and pressure quotient influence on STATE_HEAT_IM calculation for increase					
IP_FAC_TEMP_HOT_SRC_MMV_INI	V	0... 80H	0 ...1	0.0078125	-
LDP_T_ES_IP_TEMP_HOT_SRC_INI	4	0... FFFFH	0... 65535	1	min
Correction factor to consider engine stop time in TEMP_HOT_SRC_MMV calculation					
IP_FAC_WUP_TIG_IM_MDL	V	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TEMP_COLD_SRC_3_AIRT	8	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
LDPM_TEMP_HOT_SRC_2_AIRT	8	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Warm-up factor for correction of intake gas temperature model at intake manifold					
IP_RATE_HEAT_IM_DEC	V	0... FFFFH	0... 1310.7	0.02	-
LDPM_RATE_HEAT_IM_1_AIRT	4	0... FFFFH	0... 1310.7	0.02	-
LDPM_TEMP_HOT_SRC_1_AIRT	6	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Decrement value for RATE_HEAT_IM					
IP_RATE_HEAT_IM_INC_1	V	0... FFFFH	0... 1310.7	0.02	-
LDPM_RATE_HEAT_IM_1_AIRT	4	0... FFFFH	0... 1310.7	0.02	-
LDPM_TEMP_HOT_SRC_1_AIRT	6	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Increment value for RATE_HEAT_IM at engine running					
IP_RATE_HEAT_IM_INC_2	V	0... FFFFH	0... 1310.7	0.02	-
LDPM_RATE_HEAT_IM_1_AIRT	4	0... FFFFH	0... 1310.7	0.02	-
LDPM_TEMP_HOT_SRC_1_AIRT	6	8000... 7FFFH	-256... 255.9921875	0.0078125	°C

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
Increment value for RATE_HEAT_IM at engine stop					
IP_TIG_IM_MDL_OFS_1	V	80... 7FH	-96... 95.25	0.75	°C
LDPM_N_1_AIRT	8	0... 1FE0H	0... 8160	1	rpm
LDPM_M_GAS_2_AIRT	8	0... FFFFH	0... 2778	0.04238956	mg/stk
Intake gas mass and engine speed influence on intake gas temperature model at intake manifold					
IP_TIG_IM_MDL_OFS_2	V	80... 7FH	-96... 95.25	0.75	°C
LDPM_VS_1_AIRT	4	0... FFH	0... 255	1	km/h
LDPM_RATE_HEAT_IM_1_AIRT	4	0... FFFFH	0... 1310.7	0.02	-
Vehicle speed and RATE_HEAT_IM influence on intake gas temperature model at intake manifold					

General Information

The aim of this function is to determine the intake gas temperature at intake manifold (TIG_IM).

In general TIG_IM consists of a model input value (i.e. value from sensor or neighbouring model) and an offset.
This offset depends on engine speed, intake gas mass, vehicle speed and heat storage in the intake manifold. Furthermore the offset considers a warm-up factor, which takes cold and hot source reference temperature of the engine into account.
With LC_TIG_MDL_FIL_SWI it is possible to switch between two filter strategies.
One is to filter the whole value (sensor + offset), the other one is to filter the offset only.

For the heat storage of the intake manifold (RATE_HEAT_IM) a model is calculated.

Application Conditions

Initialisation: `INI__AIRT_MDLAD_TIGIM, ES2ERU, DCON, NVMINI, NVMSTO, NVMRES`

Activation: `always`

Deactivation: `never`

Recurrence: `AIRT_MDLAD_TIGIM`

Function Description

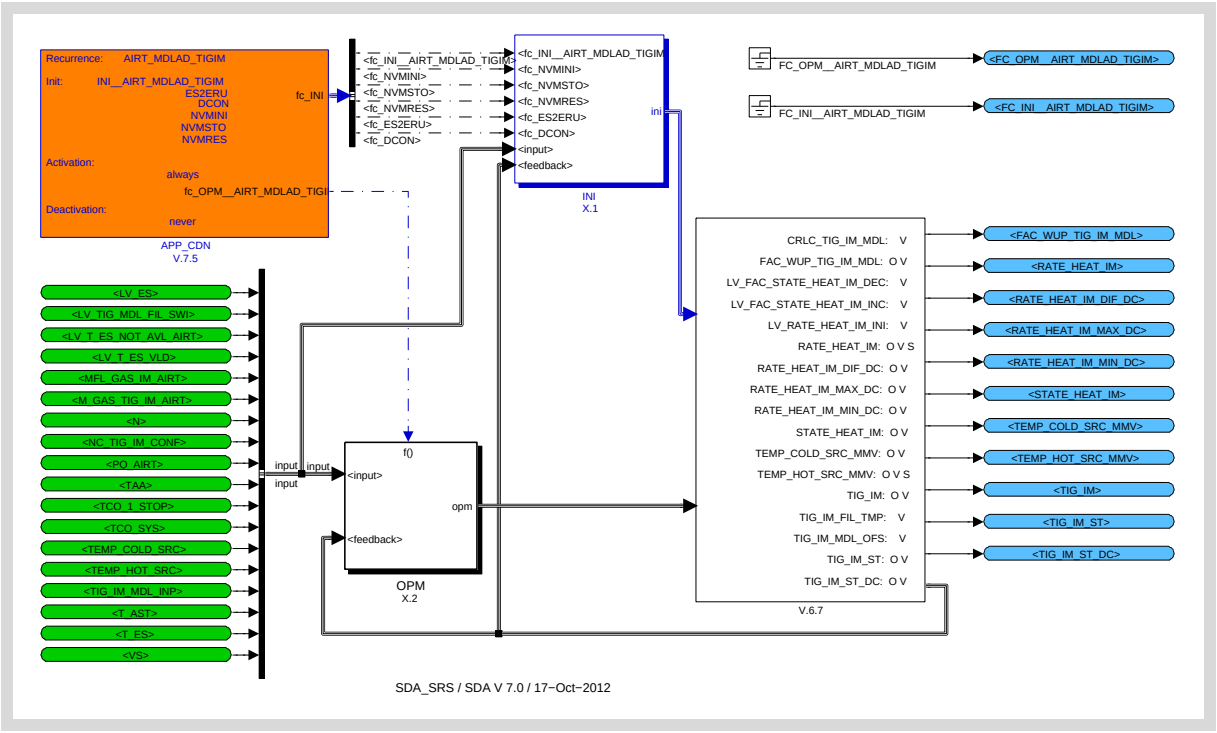

Figure 3.11.1:

3.11.1 Initialization

3.11.1.1 Initialization at RST

All temperature variables are initialized with TIG_IM_MDL_INP

3.11.1.2 NVMY Data handling

On brand new ECU the variable TEMP_HOT_SRC_MMV is initialized with 20°C and RATE_HEAT_IM is initialized with its maximum value.

3.11.1.3 Calculation at ES2ERU

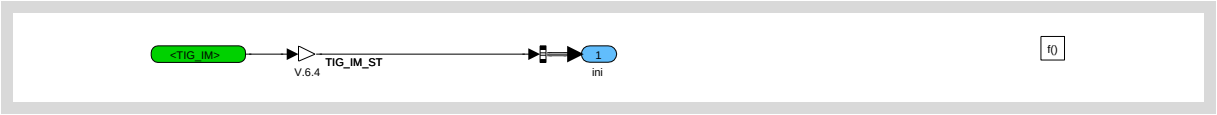

Figure 3.11.2:

3.11.1.4 Calculation at DCON

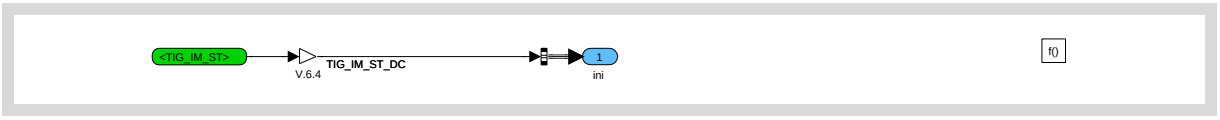

Figure 3.11.3:

3.11.2 Formula section

3.11.2.1 Modelling of heat storage in intake manifold

The heat storage in the intake manifold has a large influence on the behaviour of the intake gas temperature. First a decision is done, if the operating state of the engine is causing a heating up or cooling down of the intake manifold. Therefore the STATE_HEAT_IM is calculated.
Depending on this state the heat storage of the intake manifold is realized as an integrator whose increment is calculated based on the engine temperature (TEMP_HOT_SRC_MMV).

3.11.2.1.1 Initialization of RATE_HEAT_IM and TEMP_HOT_SRC_MMV

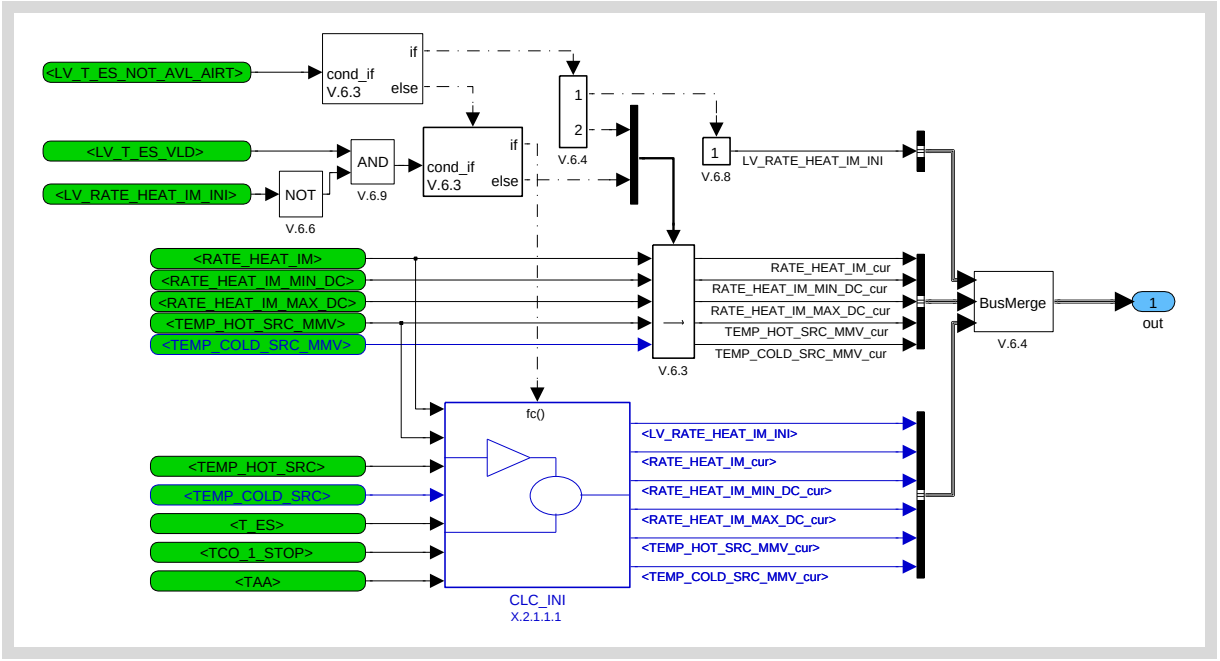

Figure 3.11.4:

3.11.2.1.1.1 Calculation of RATE_HEAT_IM and TEMP_HOT_SRC_MMV initialization

At the end of the last driving cycle RATE_HEAT_IM and TEMP_HOT_SRC_MMV were stored in the EEPROM. Due to the fact that the temperature at the intake manifold increases after engine stop for a certain time (e.g. 1 hour) and afterwards decreases towards ambient temperature the values of RATE_HEAT_IM and TEMP_HOT_SRC_MMV have to be initialized depending on the engine-off time.

To cover this behaviour (increase / decrease) for RATE_HEAT_IM the IP_FAC_RATE_HEAT_IM_INI can be calibrated above 1 (for increase) and below 1 (for decrease). This factor is a weighting between the stored value and the minimum and maximum.
For TEMP_HOT_SRC_MMV the weighting can be done between the stored and the actual value.

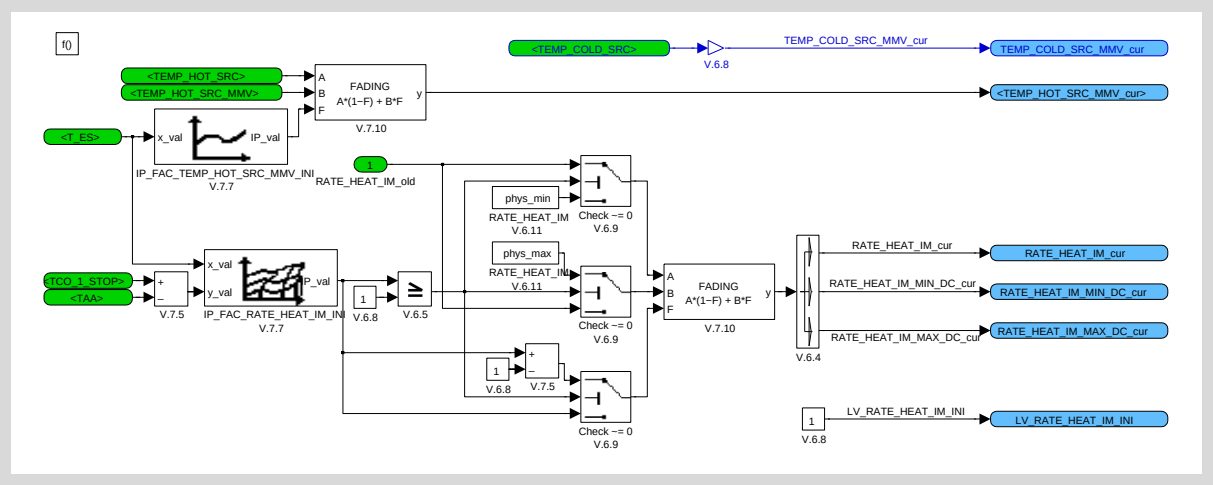

Figure 3.11.5:

3.11.2.1.2 Calculation of warm up factor

As the intake manifold needs time to reach the temperature level of the medium which causes the heating, the medium temperatures (TEMP_COLD / _HOT_SRC) have to be filtered.
Out of these temperatures the warm-up factor is calculated.
Calculation will be done only with LV_RATE_HEAT_IM_INI = 1.

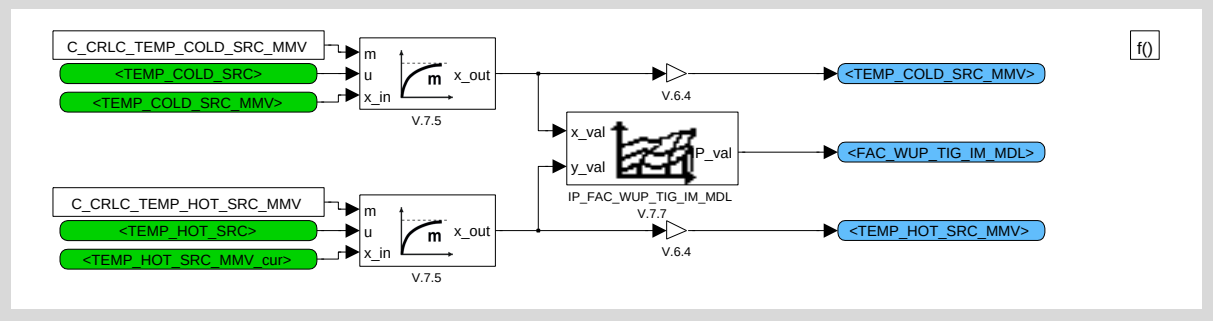

Figure 3.11.6:

3.11.2.1.3 Calculation of STATE_HEAT_IM

To set the STATE_HEAT_IM in a certain operating state the IP_FAC_STATE_HEAT_IM_INC has to be calibrated to 1. The default calibration of C_FAC_MAX_STATE_HEAT_IM_INC is 1 and C_FAC_MIN_STATE_HEAT_IM is 0. With this calibration a hysteresis can be calibrated inside IP_FAC_STATE_HEAT_IM_INC with its length dependent on the distance of the respective LDP breakpoints.
By setting MAX and MIN to the same value, a direct switch can be calibrated (no hysteresis).
The same can be done for the state DEC.
Calculation will be done only with LV_RATE_HEAT_IM_INI = 1

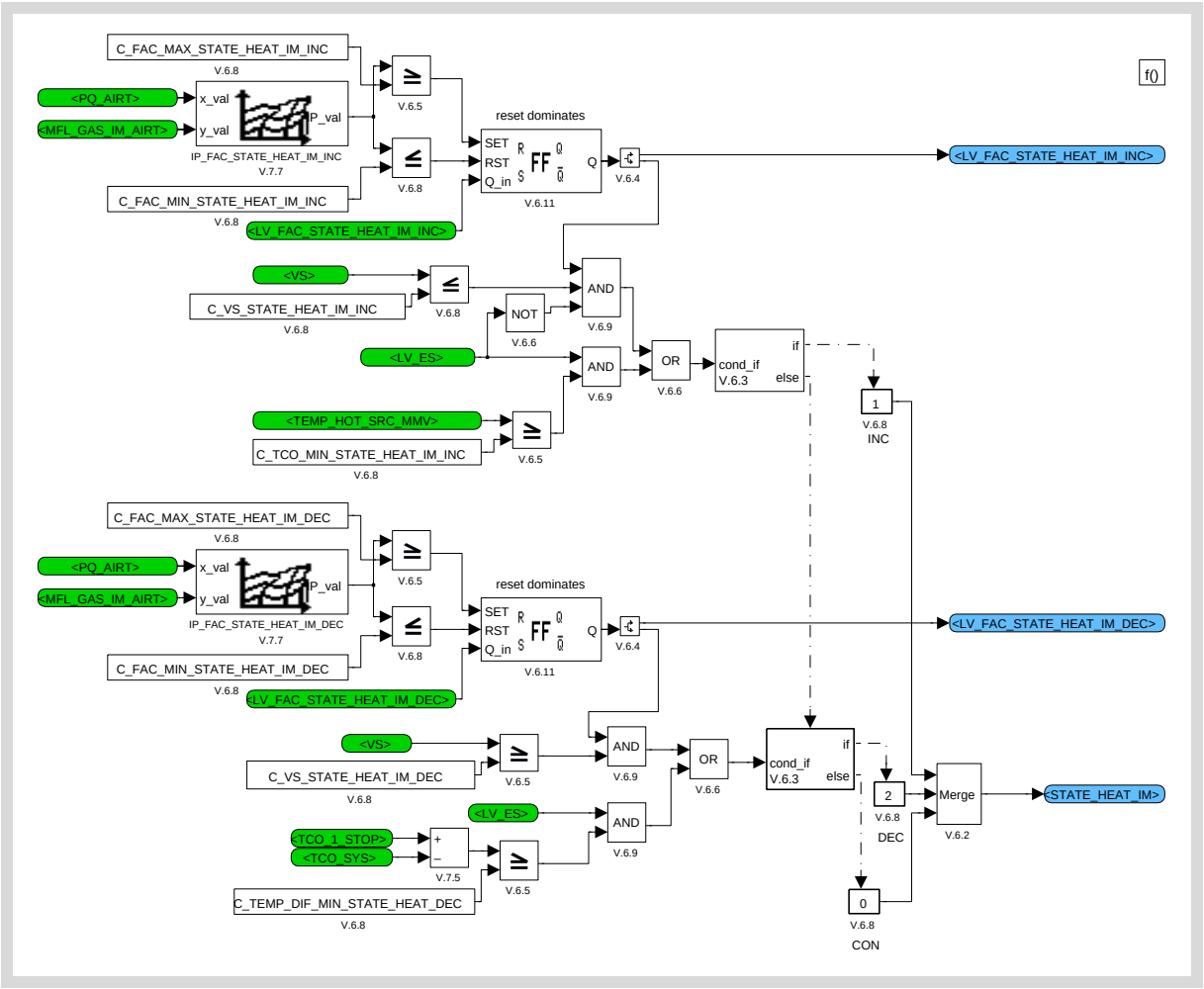

Figure 3.11.7:

3.11.2.1.4 Modelling of heat level in intake manifold under engine-running and engine stopped conditions

Calculation will be done only with LV_RATE_HEAT_IM_INI = 1

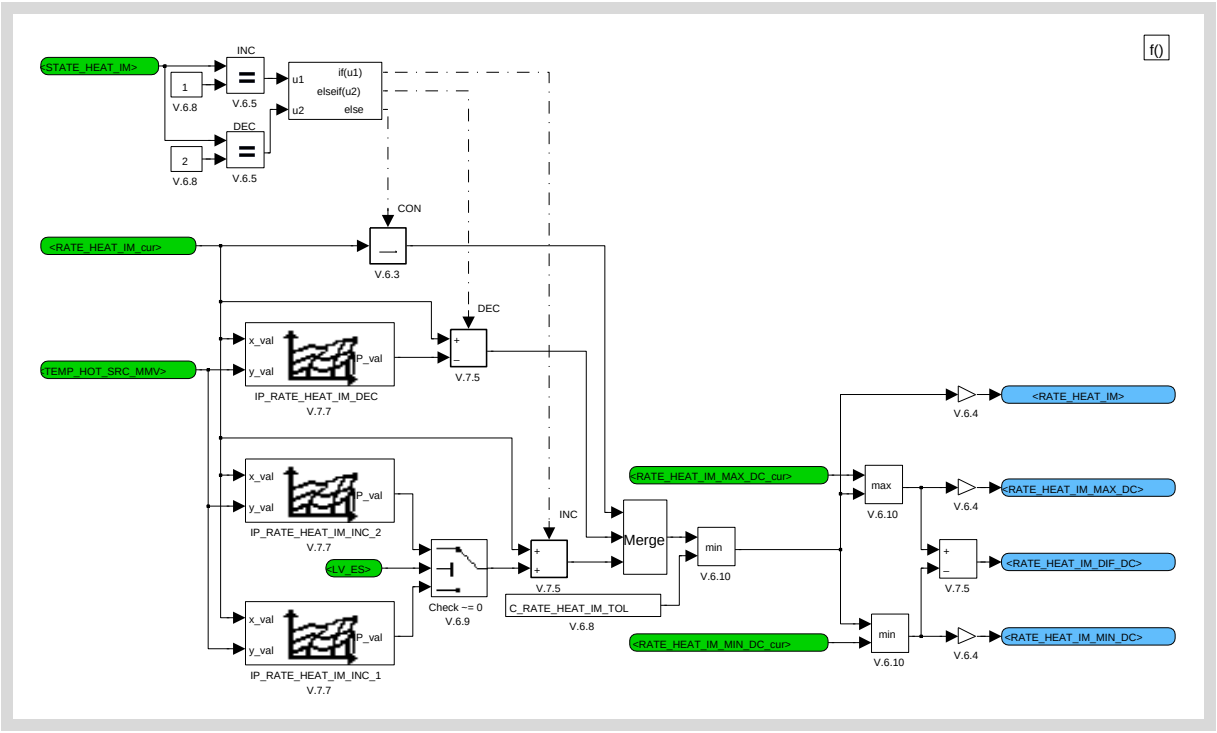

Figure 3.11.8:

3.11.2.2 Overview of intake gas temperature model at intake manifold

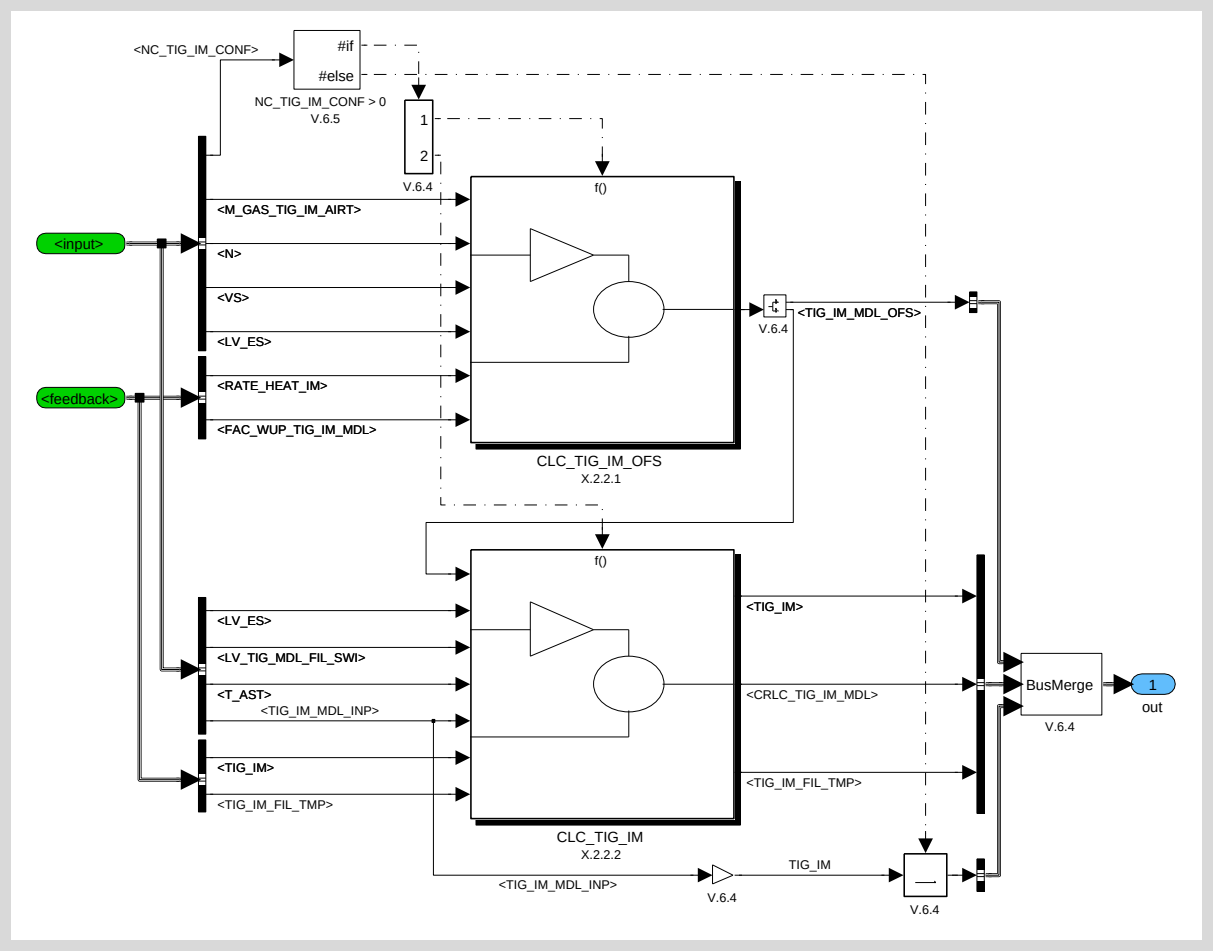

Figure 3.11.9:

3.11.2.2.1 Calculation of temperature offset value

As the influence of the offset is depending on the air mass flow, the offset will be set to 0 at engine stop.

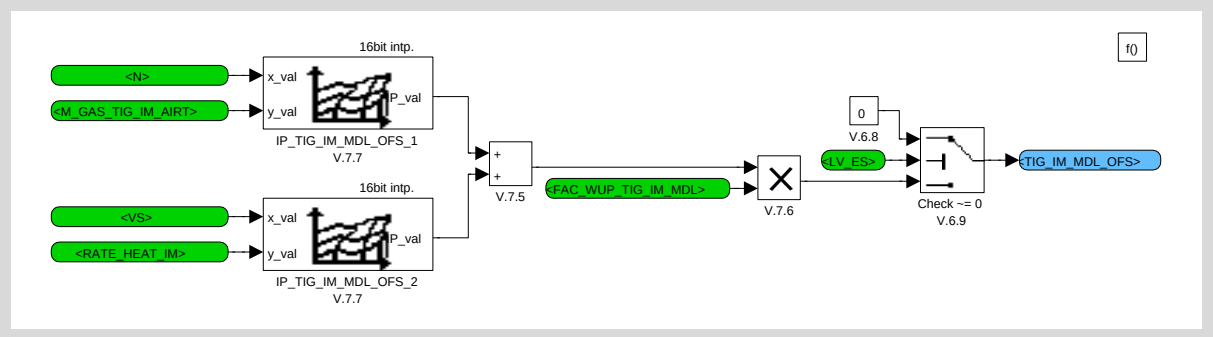

Figure 3.11.10:

3.11.2.2.2 Calculation of intake gas temperature at intake manifold

With LV_TIG_MDL_FIL_SWI it is possible to switch between the filter strategies, filter the whole value (sensor + offset) or filter the offset only.
The filter algorithm can be separated into three parts:
- At engine stop the filtering constant C_CRLC_TIG_IM_MDL_ES is used to either hold the old value (value 0) or to directly take the input value (value 1).
- At engine start the filtering constant C_CRLC_TIG_IM_MDL_AST is used and ramped for a certain time after start to the normal filtering value. This is done because the offset starts with the value 0.
- At engine run the filtering constant is read out of IP_CRLC_TIG_IM_MDL depending on the difference of old and new value.

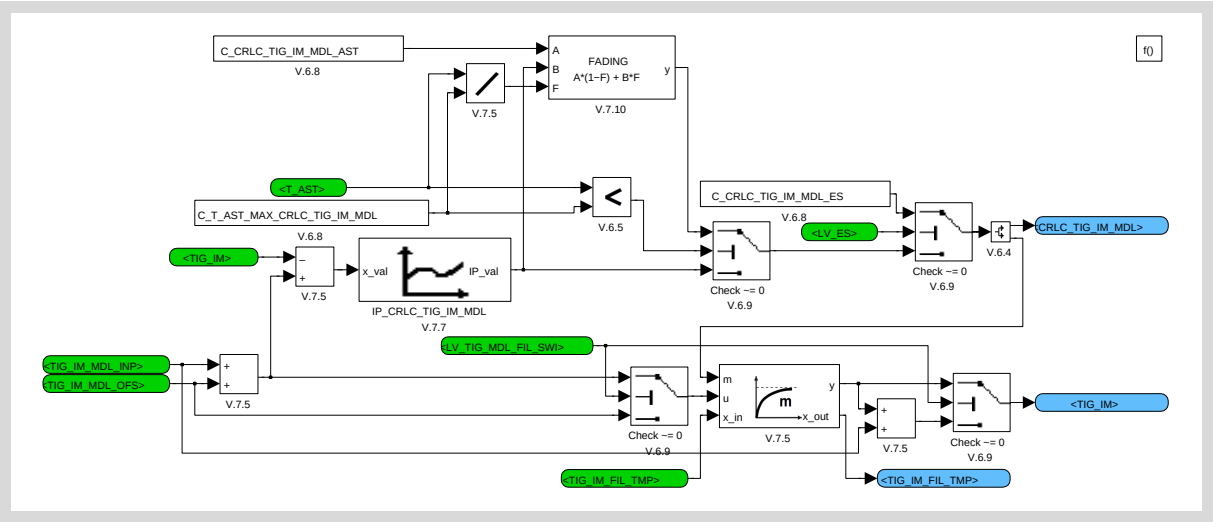

Figure 3.11.11:

3.12 Intake gas temperature model at intake valve

Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
CRLC_TIG_INV_MDL	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Filtering factor for intake gas temperature model at intake valve					
CTR_TIG_INV_MDL_RAMP	V	0... FFH	0... 255	1	-
Number of segments for ramping TIG_INV_MDL at valvelift switch					
FC_INI_AIRT_MDLAD_TIGINV	O	0... 1H	0 ...1	1	-
Function call for initialization of intake gas temperature model at intake valve					
FC_OPM_AIRT_MDLAD_TIGINV	O	0... 1H	0 ...1	1	-
Function call for operating mode of intake gas temperature model at intake valve					
IDX_CAM_EX_TIG_INV_VLFT	V	0... FFH	0... 255	1	-
Index of position of variable phased exhaust camshaft at lower LDPM_CAM_EX_1_AIRT breakpoint for IP_TIG_INV_VLFT_xx					
IDX_CAM_IN_TIG_INV_VLFT	V	0... FFH	0... 255	1	-
Index of position of variable phased inlet camshaft at lower LDPM_CAM_IN_1_AIRT breakpoint for IP_TIG_INV_VLFT_xx					
TIG_INV	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature at intake valve					
TIG_INV_FIL_TMP	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Temporary filter value for intake gas temperature at intake valve calculation					
TIG_INV_MDL_OFS	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Temperature offset for intake gas temperature model at intake valve					
TIG_INV_MDL_OFS_BAS	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Basic temperature offset for intake gas temperature model at intake valve					
TIG_INV_ST	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature at intake valve at start					
TIG_INV_ST_DC	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature at intake valve at start in current driving cycle					

Input Data

CAM_PHA_ENG [NC_NR_GES] [NC_NR_CBK_IVVT] {p. 26789}	FAC_WUP_TIG_IM_MDL {p. 1204}	LV_ES {p. 7530}	LV_TIG_MDL_FIL_SWI {p. 1198}
LV_VLFT_SWI_DIR {p. 26543}	M_GAS_TIG_INV_AIRT {p. 1143}	N {p. 8079}	NC_IDX_EX {p. 26736}
NC_IDX_IN {p. 26736}	NC_NR_CBK_IVVT {p. 26737}	NC_NR_GES {p. 26737}	NC_NR_LEN_CAM_EX_TIG_INV_MDL {p. 1136}
NC_NR_LEN_CAM_IN_TIG_INV_MDL {p. 1136}	NC_NR_LEN_M_GAS_TIG_INV_MDL {p. 1136}	NC_NR_LEN_N_TIG_INV_MDL {p. 1136}	NC_NR_LEN_RATE_HEAT_TIG_INV_MDL {p. 1136}

NC_NR_LEN_VS_TIG_INV_MDL {p. 1136}	NC_TIG_INV_CONF {p. 1136}	RATE_HEAT_IM {p. 1204}	T_AST {p. 8436}
TIG_INV_MDL_INP {p. 1198}	VS {p. 26240}		

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_CRLC_TIG_INV_MDL_AST	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Filtering factor of intake gas temperature model at intake manifold for defined time after start					
C_CRLC_TIG_INV_MDL_ES	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Filtering factor for intake gas temperature model at intake valve at engine stop					
C_CTR_TIG_INV_MDL_RAMP	V	0... FFH	0... 255	1	-
Maximum number of segments for ramping TIG_INV_MDL at valvelift switch					
C_T_AST_MAX_CRLC_TIG_INV_MDL	V	0... FFFFH	0... 6553.5	0.1	s
Maximum time after start to activate normal filtering factor					
IP_CRLC_TIG_INV_MDL	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
LDPM_TIG_DIF_1_AIRT	6	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Filtering factor for intake gas temperature model at intake vavle					
IP_TIG_INV_MDL_OFS_2	V	80... 7FH	-96... 95.25	0.75	°C
LDPM_VS_2_AIRT	NC_NR_LEN_VS_TIG_INV_MDL	0... FFH	0... 255	1	km/h
LDPM_RATE_HEAT_IM_3_AIRT	NC_NR_LEN_RATE_HEAT_TIG_INV_MDL	0... FFFFH	0... 1310.7	0.02	-
Vehicle speed and RATE_HEAT_IM influence on intake gas temperature model at intake					
IP_TIG_INV_VLFT_1 [NC_NR_LEN_CAM_IN_TIG_INV_MDL] [NC_NR_LEN_CAM_EX_TIG_INV_MDL]	V	80... 7FH	-96... 95.25	0.75	°C
LDPM_N_TIG_INV_MDL_1_AIRT	NC_NR_LEN_N_TIG_INV_MDL	0... 1FE0H	0... 8160	1	rpm
LDPM_M_GAS_TIG_INV_MDL_1_AIRT	NC_NR_LEN_M_GAS_TIG_INV_MDL	0... FFFFH	0... 2778	0.04238956	mg/stk
Valvelift dependent offset of intake gas temperature model at intake valve (LDPM_CAM_IN_1_AIRT and LDPM_CAM_EX_1_AIRT additionally used for 4D interpolation)					

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
IP_TIG_INV_VLFT_STND [NC_NR_LEN_CAM_IN_TIG_INV_MDL] [NC_NR_LEN_CAM_EX_TIG_INV_MDL]	V	80... 7FH	-96... 95.25	0.75	°C
LDPM_N_TIG_INV_MDL_1_AIRT	NC_NR_LEN_N_TIG_INV_MDL	0... 1FE0H	0... 8160	1	rpm
LDPM_M_GAS_TIG_INV_MDL_1_AIRT	NC_NR_LEN_M_GAS_TIG_INV_MDL	0... FFFFH	0... 2778	0.04238956	mg/stk
Valvelift dependent offset of intake gas temperature model at intake valve (LDPM_CAM_IN_1_AIRT and LDPM_CAM_EX_1_AIRT additionally used for 4D interpolation)					

▶ General Information

The aim of this function is to determine the intake gas temperature at intake valve (TIG_INV).

In general TIG_INV consists of a model input value (i.e. value from sensor or neighbouring model) and an offset.
This offset depends on engine speed, intake gas mass, vehicle speed and heat storage in the intake manifold. Depending on the system configuration (VVT / VVL) different maps are used for the offset calculation. Furthermore the offset considers a warm-up factor, which takes cold and hot source reference temperature of the engine into account.
With LC_TIG_MDL_FIL_SWI it is possible to switch between two filter strategies.
One is to filter the whole value (sensor + offset), the other one is to filter the offset only.

▶ Application Conditions

Initialisation: `INI__AIRT_MDLAD_TIGINV, ES2ERU, DCON`

Activation: `always`

Deactivation: `never`

Recurrence: `AIRT_MDLAD_TIGINV`

▶ Function Description

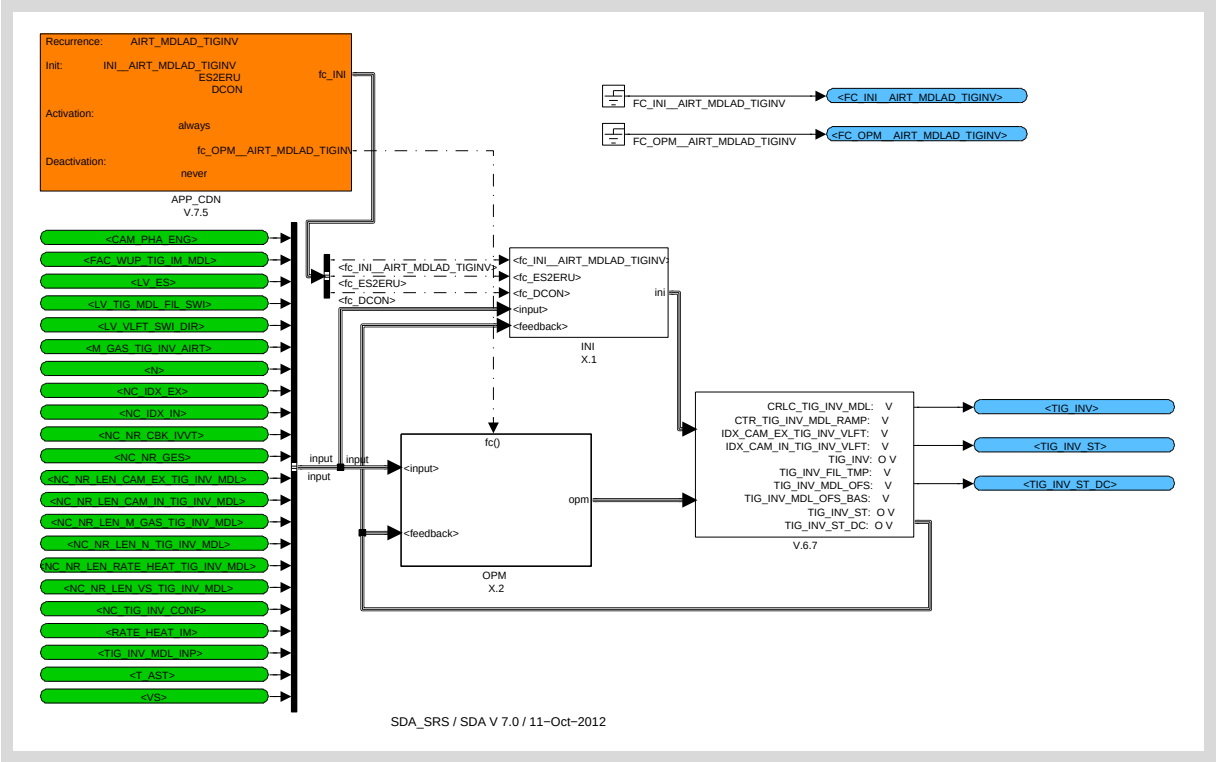

Figure 3.12.1:

3.12.1 Initialization

3.12.1.1 Initialization at reset

All temperature variables are initialized with TIG_INV_MDL_INP

3.12.1.2 Calculation at ES2ERU

Figure 3.12.2:

3.12.1.3 Calculation at DCON

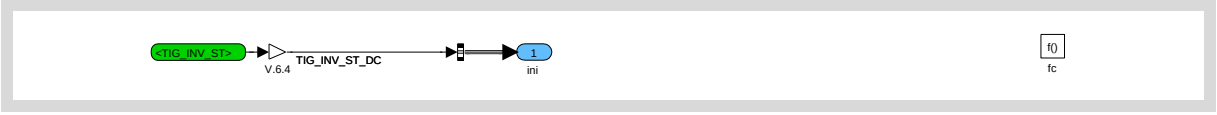

Figure 3.12.3:

3.12.2 Overview of intake gas temperature model at intake valve

3.12.2.1 Calculation of temperature offset value

Depending on the system configuration (NC_TIG_INV_CONF) different maps are used for the offset calculation.

NC_TIG_INV_CONF = 0 => TIG_INV model not calculated
NC_TIG_INV_CONF = 1 => VVTI & VVLI model not calculated
NC_TIG_INV_CONF = 2 => VVTI model calculated only
NC_TIG_INV_CONF = 3 => VVTI & VVLI model calculated

As the influence of the offset is depending on the air mass flow, the offset will be set to 0 at engine stop.

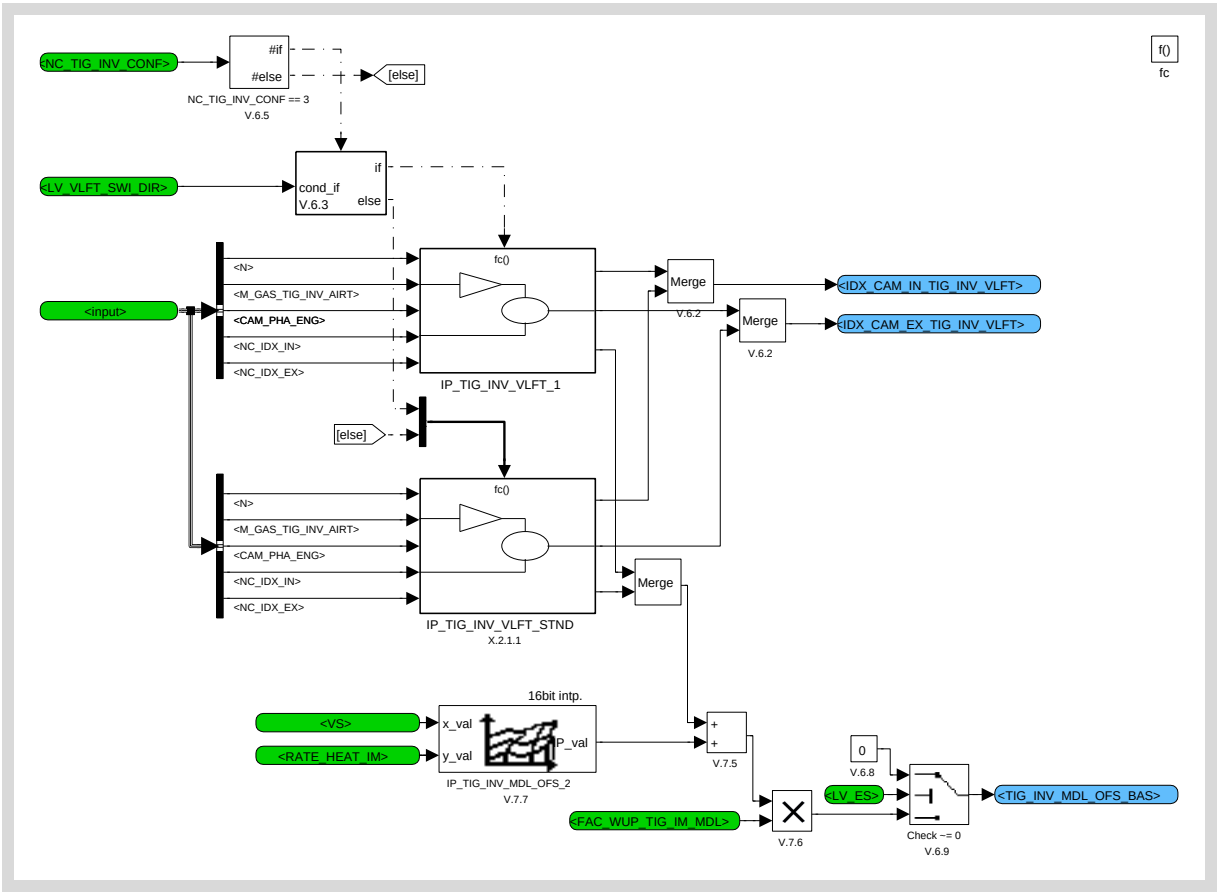

Figure 3.12.4:

3.12.2.1.1 4D interpolation for IP_TIG_INV_VLFT_xx

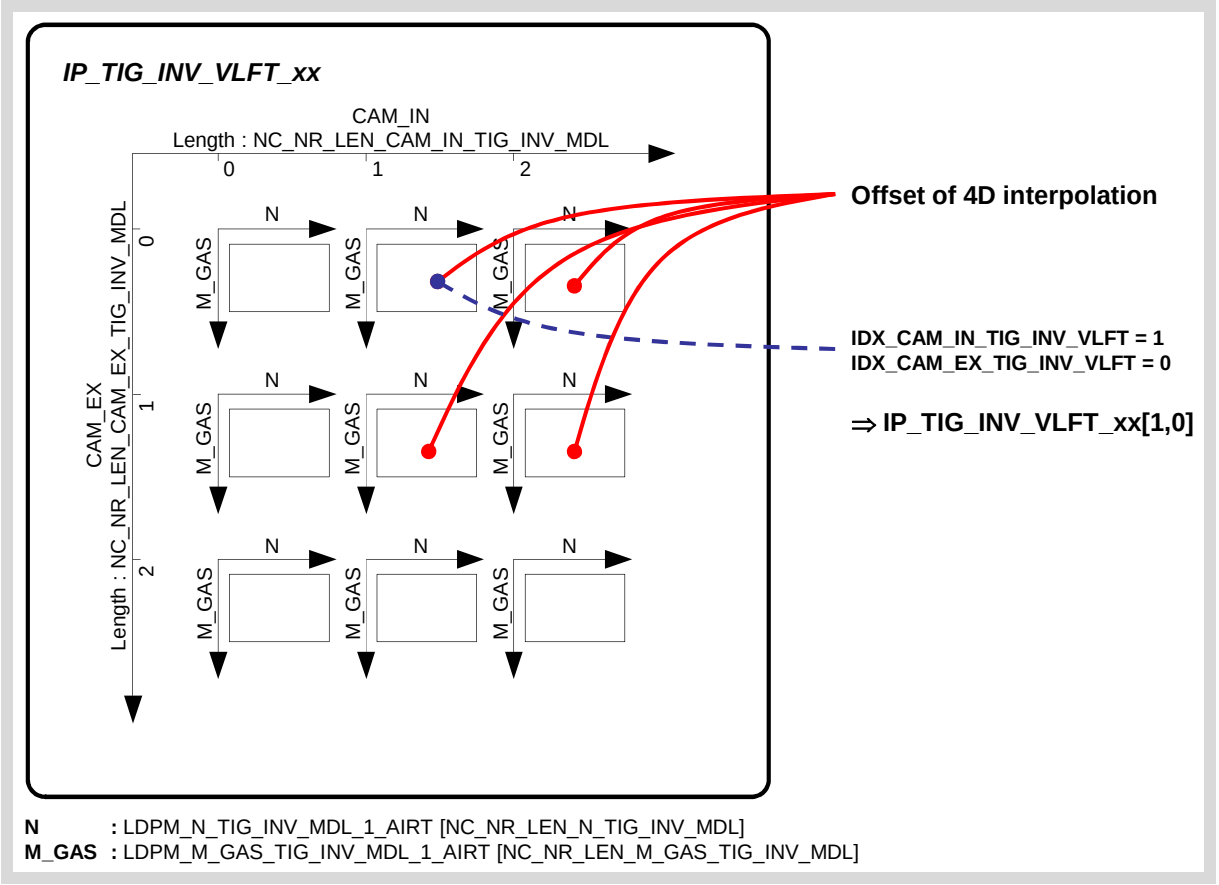

Figure 3.12.5: Overview

Definition of axes which are additionally used for 4D interpolation:

LDPM_CAM_IN_1_AIRT	NC_NR_LEN_CAM_IN_TIG_INV_MDL	8000... 7FFFH	-256... 255.9921875	0.0078125	°CRK
LDPM_CAM_EX_1_AIRT	NC_NR_LEN_CAM_EX_TIG_INV_MDL	8000... 7FFFH	-256... 255.9921875	0.0078125	°CRK

3.12.2.2 Ramping of temperature offset at switch of valve lift

For every valve lift an offset is taken from a separate map (IP_TIG_INV_VLFT_xx) therefore a ramping is done at every change. The ramping time can be calibrated as number of segment steps with C_CTR_TIG_INV_MDL_RAMP.

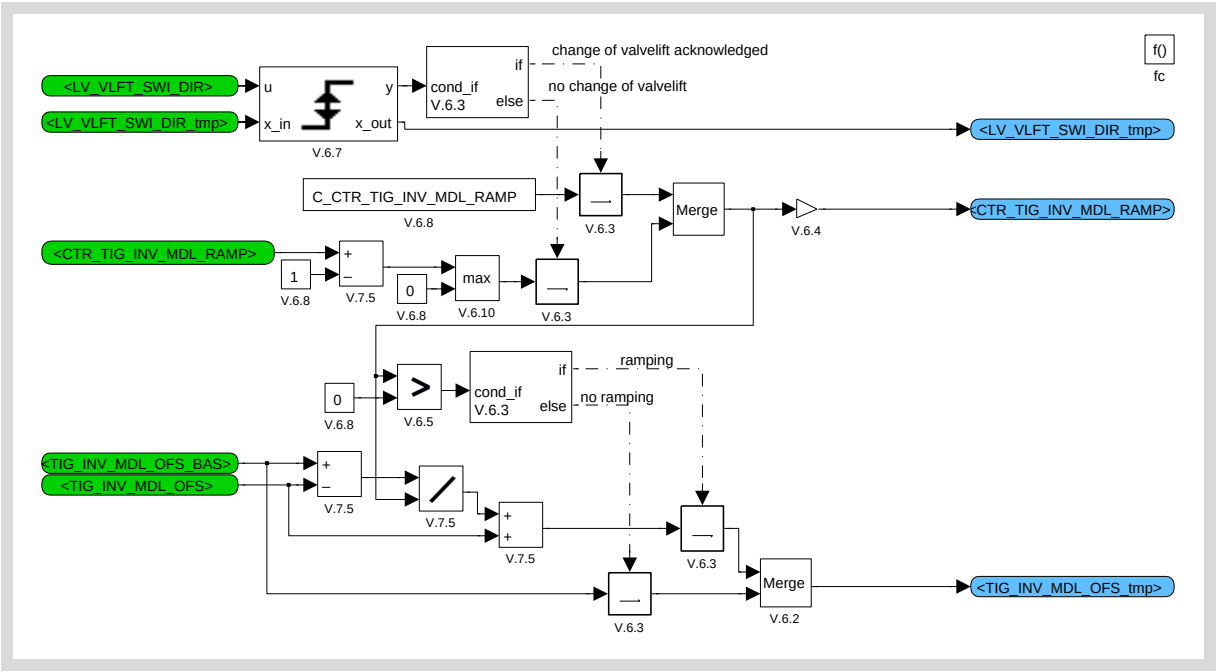

Figure 3.12.6:

3.12.2.3 Calculation of intake gas temperature at intake valve

With LV_TIG_MDL_FIL_SWI it is possible to switch between the filter strategies, filter the whole value (sensor + offset) or filter the offset only.
The filter algorithm can be separated into three parts:
- At engine stop the filtering constant C_CRLC_TIG_INV_MDL_ES is used to either hold the old value (value 0) or to directly take the input value (value 1).
- At engine start the filtering constant C_CRLC_TIG_INV_MDL_AST is used and ramped for a certain time after start to the normal filtering value. This is done because the offset starts with the value 0.
- At engine run the filtering constant is read out of IP_CRLC_TIG_INV_MDL depending on the difference of old and new value.

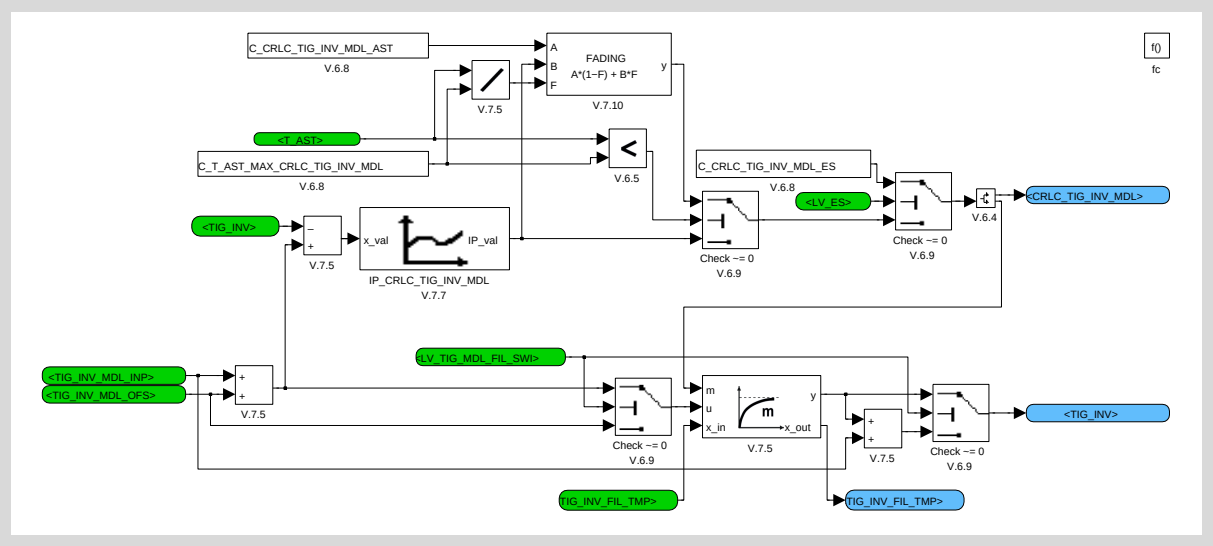

Figure 3.12.7:

3.13 Intake gas temperature model at throttle

Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
CRLC_TIG_THR_MDL	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Filtering factor for intake gas temperature model at throttle					
FAC_WUP_TIG_THR_MDL	V	0... FFH	0... 1.9921875	0.0078125	-
Warm-up factor for intake gas temperature model at throttle					
FC_INI_AIRT_MDLAD_TIGTHR	O	0... 1H	0 ...1	1	-
Function call for initialization of intake gas temperature model at throttle					
FC_OPM_AIRT_MDLAD_TIGTHR	O	0... 1H	0 ...1	1	-
Function call for operating mode of intake gas temperature model at throttle					
TIG_THR	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature at throttle					
TIG_THR_FIL_TMP	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Temporary filter value for intake gas temperature at throttle calculation					
TIG_THR_MDL_OFS	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Temperature offset for intake gas temperature model at throttle					
TIG_THR_ST	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature at throttle at start					
TIG_THR_ST_DC	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature at throttle at start in current driving cycle					

Input Data

LV_ES {p. 7530}	LV_TIG_MDL_FIL_SWI {p. 1198}	M_GAS_TIG_THR_AIRT {p. 1143}	N {p. 8079}
NC_TIG_THR_CONF {p. 1137}	RATE_HEAT_IM {p. 1204}	T_AST {p. 8436}	TEMP_COLD_SRC_MMV {p. 1204}
TEMP_HOT_SRC_MMV {p. 1204}	TIG_THR_MDL_INP {p. 1198}	VS {p. 26240}	

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_CRLC_TIG_THR_MDL_AST	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Filtering factor of intake gas temperature model at throttle for defined time after start					
C_CRLC_TIG_THR_MDL_ES	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Filtering factor of intake gas temperature model at throttle at engine stop					
C_T_AST_MAX_CRLC_TIG_THR_MDL	V	0... FFFFH	0... 6553.5	0.1	s

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
Maximum time after start to activate normal filtering factor					
IP_CRLC_TIG_THR_MDL	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
LDPM_TIG_DIF_1_AIRT	6	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Filtering factor for intake gas temperature model at throttle					
IP_FAC_WUP_TIG_THR_MDL	V	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TEMP_COLD_SRC_3_AIRT	8	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
LDPM_TEMP_HOT_SRC_2_AIRT	8	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Warm-up factor for correction of intake gas temperature model at throttle					
IP_TIG_THR_MDL_OFS_1	V	80... 7FH	-96... 95.25	0.75	°C
LDPM_N_1_AIRT	8	0... 1FE0H	0... 8160	1	rpm
LDPM_M_GAS_2_AIRT	8	0... FFFFH	0... 2778	0.04238956	mg/stk
Intake gas mass and engine speed influence on intake gas temperature model at throttle					
IP_TIG_THR_MDL_OFS_2	V	80... 7FH	-96... 95.25	0.75	°C
LDPM_VS_1_AIRT	4	0... FFH	0... 255	1	km/h
LDPM_RATE_HEAT_IM_1_AIRT	4	0... FFFFH	0... 1310.7	0.02	-
Vehicle speed and RATE_HEAT_IM influence on intake gas temperature model at throttle					

▶ General Information

The aim of this function is to determine the intake gas temperature at throttle (TIG_THR).

In general TIG_THR consists of a model input value (i.e. value from sensor or neighbouring model) and an offset.
This offset depends on engine speed, intake gas mass, vehicle speed and heat storage in the intake manifold. Furthermore the offset considers a warm-up factor, which takes cold and hot source reference temperature of the engine into account.
With LC_TIG_MDL_FIL_SWI it is possible to switch between two filter strategies.
One is to filter the whole value (sensor + offset), the other one is to filter the offset only.

▶ Application Conditions

Initialisation: `INI__AIRT_MDLAD_TIGTHR, ES2ERU, DCON`

Activation: `always`

Deactivation: `never`

Recurrence: `AIRT_MDLAD_TIGTHR`

▶ Function Description

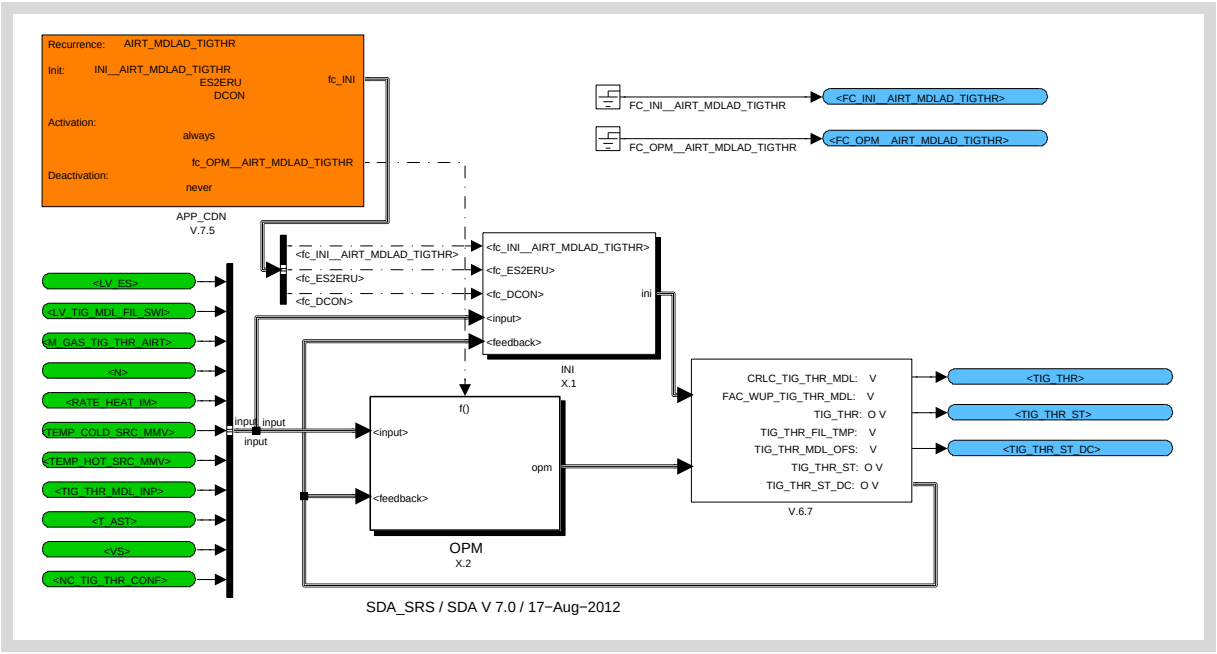

Figure 3.13.1:

3.13.1 Initialization

3.13.1.1 Initialization at reset

All temperature variables are initialized with TIG_THR_MDL_INP

3.13.1.2 Calculation at ES2ERU

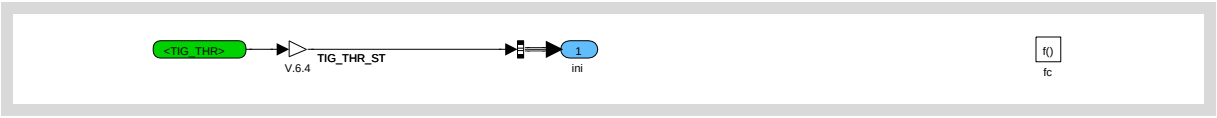

Figure 3.13.2:

3.13.1.3 Calculation at DCON

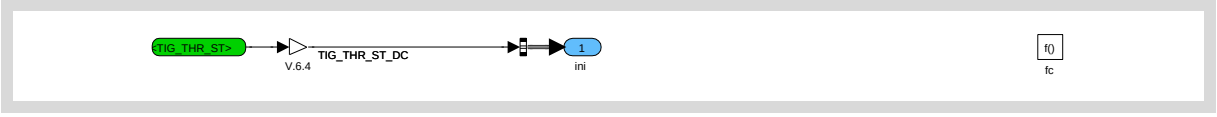

Figure 3.13.3:

3.13.2 Overview of intake gas temperature model at throttle

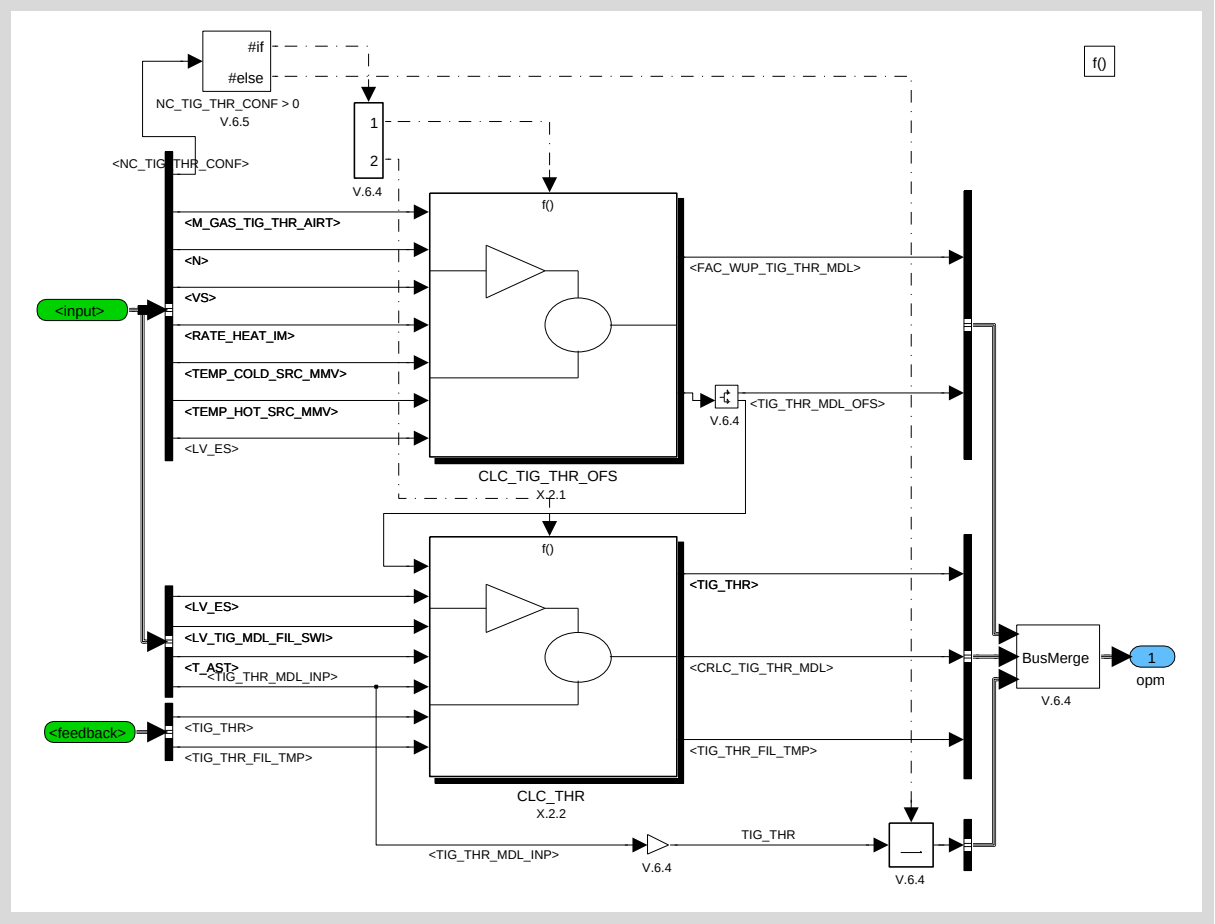

Figure 3.13.4:

3.13.2.1 Calculation of temperature offset value

As the influence of the offset is depending on the air mass flow, the offset will be set to 0 at engine stop.

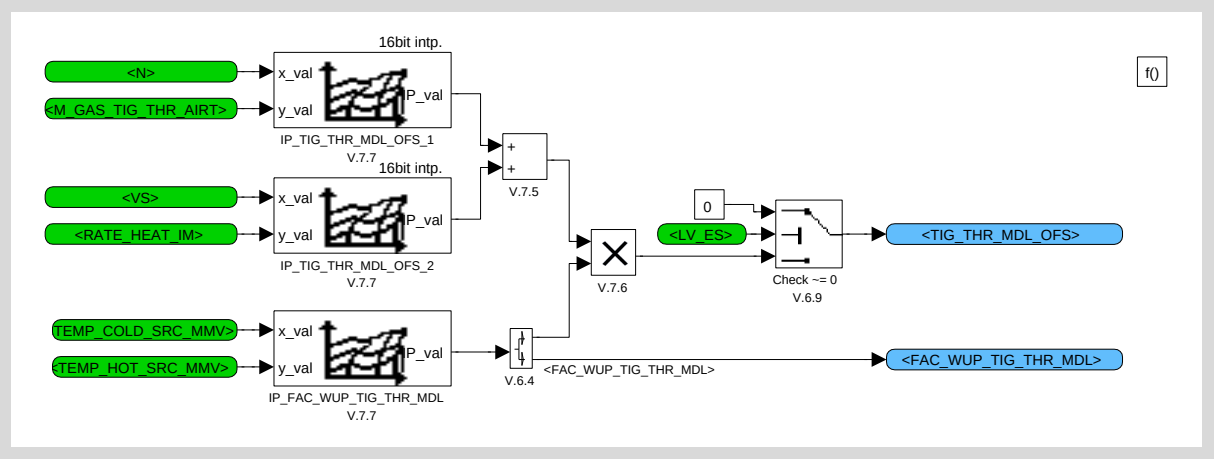

Figure 3.13.5:

3.13.2.2 Calculation of intake gas temperature at throttle

With LV_TIG_MDL_FIL_SWI it is possible to switch between the filter strategies, filter the whole value (sensor + offset) or filter the offset only.
The filter algorithm can be separated into three parts:
- At engine stop the filtering constant C_CRLC_TIG_THR_MDL_ES is used to either hold the old value (value 0) or to directly take the input value (value 1).
- At engine start the filtering constant C_CRLC_TIG_THR_MDL_AST is used and ramped for a certain time after start to the normal filtering value. This is done because the offset starts with the value 0.
- At engine run the filtering constant is read out of IP_CRLC_TIG_THR_MDL depending on the difference of old and new value.

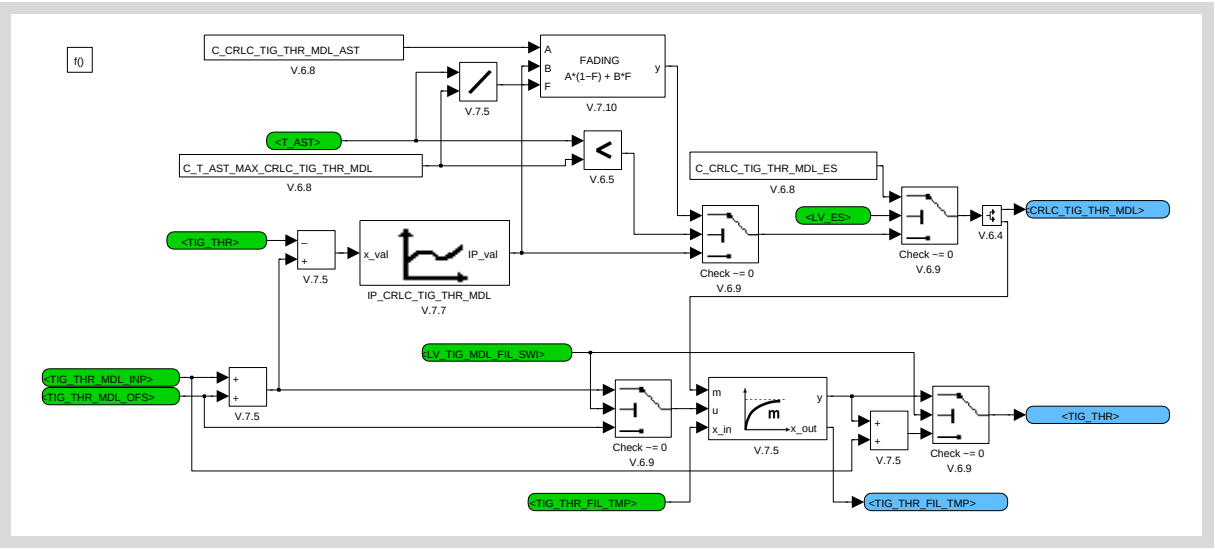

Figure 3.13.6:

3.14 Intake gas temperature model at intercooler

Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
FC_INI_AIRT_MDLAD_TIGICO	O	0... 1H	0 ...1	1	-
Function call for initialization of intake gas temperature model at intercooler					
FC_OPM_AIRT_MDLAD_TIGICO	O	0... 1H	0 ...1	1	-
Function call for operating mode of intake gas temperature model at intercooler					
TIG_ICO_DOWN	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature downstream intercooler					
TIG_ICO_DOWN_ST	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature downstream intercooler at start					
TIG_ICO_DOWN_ST_DC	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature downstream intercooler at start in current driving cycle					

Input Data

TIG_ICO_MDL_INP {p. 1198}			

General Information

This module is just a placeholder and used if no functionality is needed in the project.

Application Conditions

Initialisation: `INI__AIRT_MDLAD_TIGICO, ES2ERU, DCON`

Activation: `always`

Deactivation: `never`

Recurrence: `AIRT_MDLAD_TIGICO`

Function Description

3.14.1 Initialization

3.14.1.1 Initialization at reset

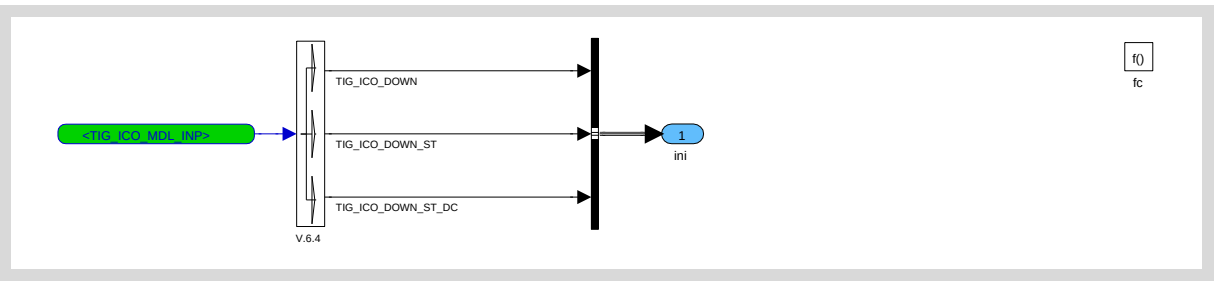

Figure 3.14.1:

3.14.1.2 Calculation of TIG_ICO_DOWN_ST at ES2ERU

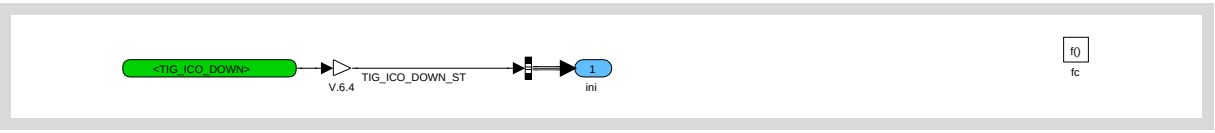

Figure 3.14.2:

3.14.1.3 Calculation of TIG_ICO_DOWN_ST_DC at DCON

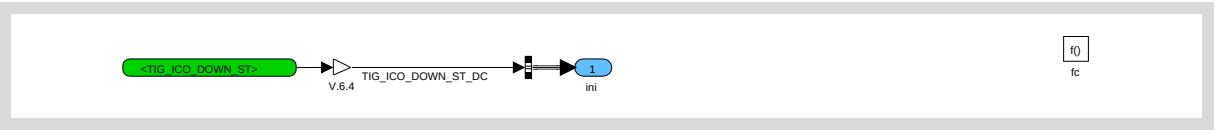

Figure 3.14.3:

3.14.2 Overview of intake gas temperature model at intercooler

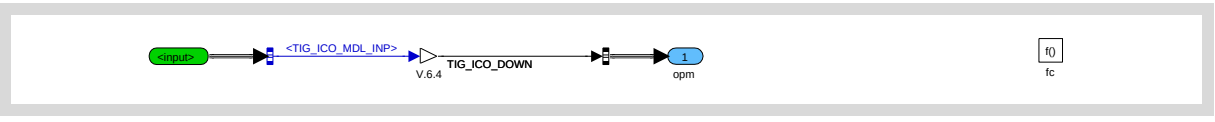

Figure 3.14.4:

3.15 Intake gas temperature model for exhaust gas recirculation

Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
FC_INI_AIRT_MDLAD_TIGEGR	O	0... 1H	0 ...1	1	-
Function call for initialization of intake gas temperature model for exhaust gas recirculation					
FC_OPM_AIRT_MDLAD_TIGEGR	O	0... 1H	0 ...1	1	-
Function call for operating mode of intake gas temperature model for exhaust gas recirculation					
TIG_EGR_H_DOWN	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature downstream high pressure exhaust gas recirculation inlet					
TIG_EGR_H_DOWN_ST	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature downstream high pressure exhaust gas recirculation inlet at start					
TIG_EGR_H_DOWN_ST_DC	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature downstream high pressure exhaust gas recirculation inlet at start in current driving cycle					
TIG_EGR_H_UP	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature uptstram high pressure exhaust gas recirculation inlet					
TIG_EGR_H_UP_ST	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature upstream high pressure exhaust gas recirculation inlet at start					
TIG_EGR_H_UP_ST_DC	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Intake gas temperature upstream high pressure exhaust gas recirculation inlet at start in current driving cycle					

Input Data

TEGR_H_AIRT {p. 1143}	TIG_EGR_H_MDL_INP {p. 1198}		

General Information

This module is just a placeholder and used if no functionality is needed in the project.

Application Conditions

Initialisation: `INI__AIRT_MDLAD_TIGEGR, ES2ERU, DCON`

Activation: `always`

Deactivation: `never`

Recurrence: `AIRT_MDLAD_TIGEGR`

Function Description

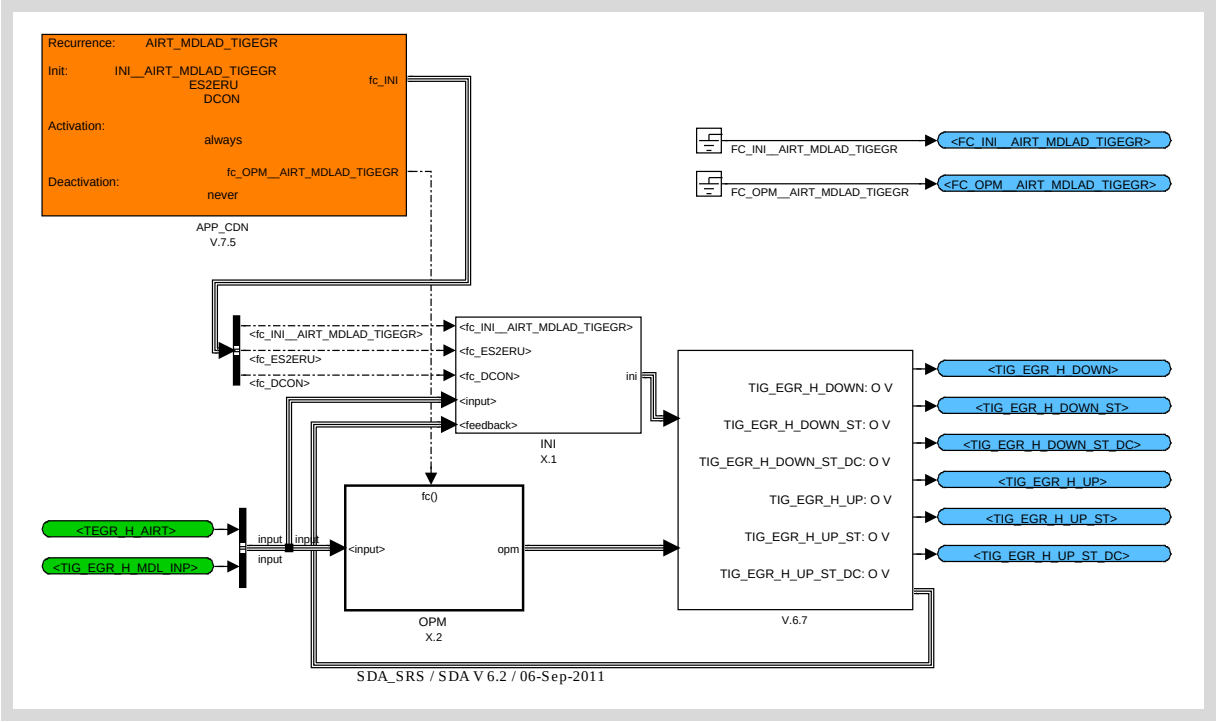

Figure 3.15.1:

3.15.1 Initialization

3.15.1.1 Initialization at reset

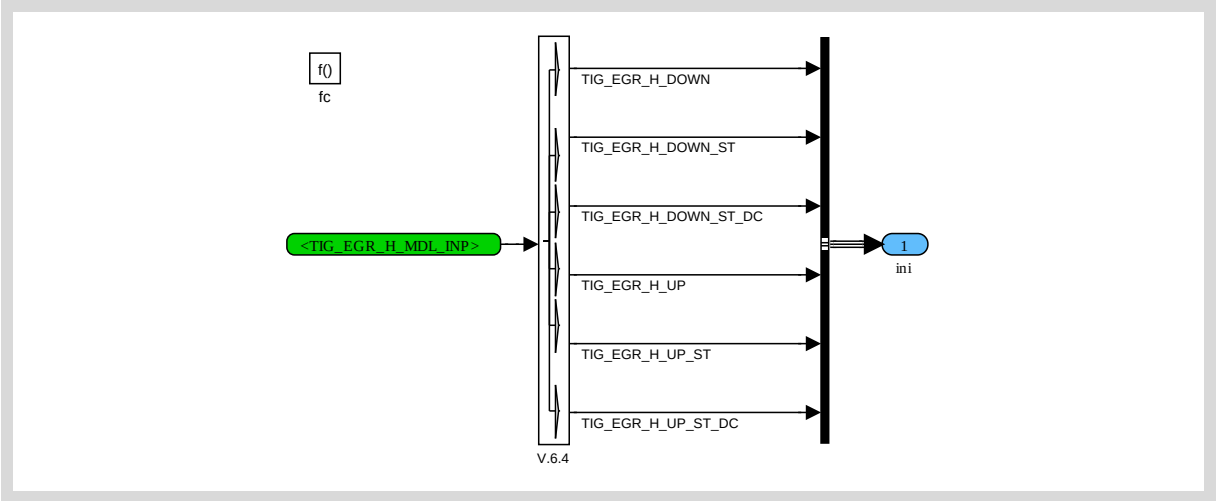

Figure 3.15.2:

3.15.1.2 Calculation of TIG_EGR_H_UP_ST and TIG_EGR_H_DOWN_ST at ES2ERU

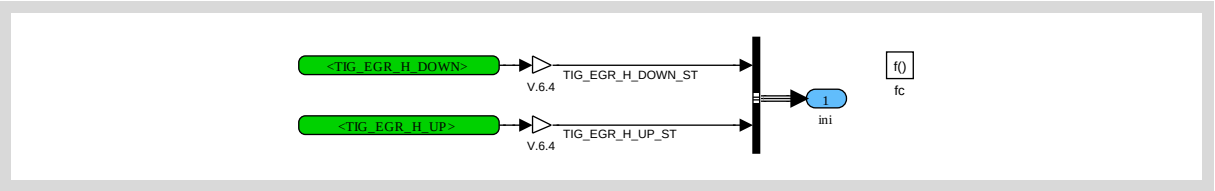

Figure 3.15.3:

3.15.1.3 Calculation of TIG_EGR_H_UP_ST and TIG_EGR_H_DOWN_ST at DCON

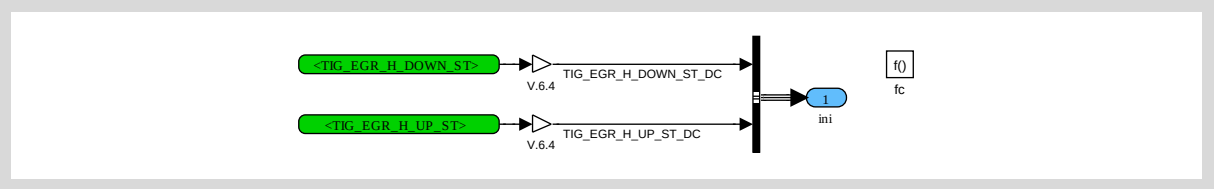

Figure 3.15.4:

3.15.2 Overview of intake gas temperature model for exhaust gas recirculation

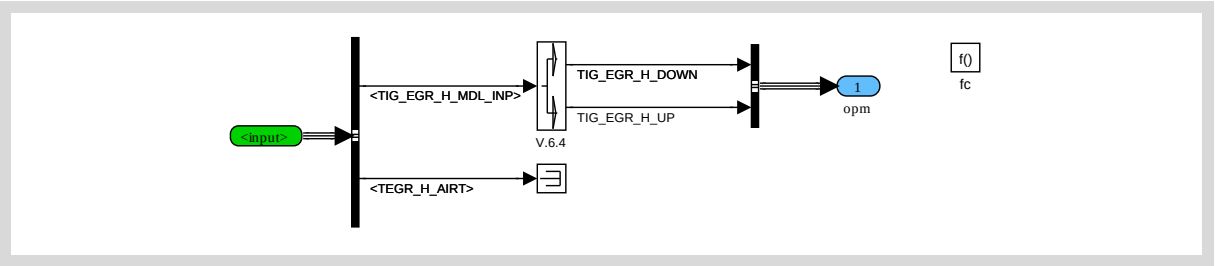

Figure 3.15.5:

3.16 Intercooler air temperature control

▶ Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
RCP_REQ_ICO	O	0... 4000H	0... 100	0.00610352	%
Cooling power request for intercooler					

▶ General Information

This placeholder module is used if no functionality is needed in the project.

▶ Application Conditions

Initialisation:
```
at reset:
RCP_REQ_ICO = 0
```

Activation: –

Deactivation: `true`

Recurrence: `100 ms`

3.17 Signal diagnosis of temperatures delivered by INTC

Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
LF_STATE_DGO_TAA_INTC [NC_NR_TAA_INTC]	V	0... FFH	0... 255	1	-
State of error information of ambient temperature sensor from INTC diagnosis					
LF_STATE_DGO_TAA_SRC_CONF_INTC	V	0... FFH	0... 255	1	-
State of ambient temperature sensor evaluation source configuration					
LF_STATE_DGO_TAA_SRC_RST_INTC	V	0... FFH	0... 255	1	-
State of ambient temperature sensor evaluation source in reset					

Input Data

C_T_IGK_TAA_RAW_INTC_VLD {p. 1172}	LV_ES {p. 7530}	LV_FID_READY {p. 11388}	LV_ST_END {p. 7530}
NC_NR_TAA_INTC {p. 1136}	STATE_ERR_TAA_INTC {p. 19087}	T_IGK {p. 24055}	

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_STATE_ERR_TAA_INTC_AS	V	0... FFH	0... 255	1	-
Calibration constant of error information from ambient temperature sensor for testing purpose					
LC_STATE_ERR_TAA_INTC_AS	V	0... 1H	0 ...1	1	-
Activation of error information from ambient temperature sensor for testing purpose					

Configuration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
NC_FID_ERR_TAA_INTC	O	0... FFFFH	0... 65535	1	-
Run the diagnostics error information of ambient temperature sensor from INTC					
NC_FID_ERR_TAA_SRC_CONF_INTC	O	0... FFFFH	0... 65535	1	-
Run the diagnostics ambient temperature sensor evaluation source configuration					
NC_FID_ERR_TAA_SRC_RST_INTC	O	0... FFFFH	0... 65535	1	-
Run the diagnostics ambient temperature sensor evaluation source in reset					
NC_FID_TAA_SRC_CONF_INTC	O	0... FFFFH	0... 65535	1	-
Information of ambient temperature sensor evaluation source configuration from INTC					
NC_FID_TAA_SRC_RST_INTC	O	0... FFFFH	0... 65535	1	-
Information of ambient temperature sensor evaluation source in reset from INTC					
NC_IDX_ERR_TAA_INTC [NC_NR_TAA_INTC]	O	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance error information of ambient temperature sensor from INTC					
NC_IDX_ERR_TAA_SRC_CONF_INTC	O	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance ambient temperature sensor evaluation source configuration					
NC_IDX_ERR_TAA_SRC_RST_INTC	O	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance ambient temperature sensor evaluation source in reset					

Import actions:

ACTION_ERRM_ResultDiag(**IN** <PRM_IDX_ERR>, **IN** <PRM_STATE_DGO>, **OUT** <PRM_STATE_FIL>)
ACTION_FARM_GetPermission(**IN** <PRM_FID>, **OUT** <PRM_LV_PRMS>)

Error treatment

Diagnostic Identifier	Diagnostic initialization function	NR_CONF	CARB class	OBD DTC
Diagnostic description				
NC_IDX_ERR_TAA_INTC [NC_NR_TAA_INTC]		0..NC_NR_TAA_INTC-1	CC	P0114 P0116
Failure index for diagnostic instance error information of ambient temperature sensor from INTC				

Definition of the behavior of the initialization				
ERR-Flag		Reset at ECU Reset	reset at Key ON	Latch error on fail
		YES	YES	NO
ABC	ABC-class	MAX-INC after Failure	No Reset at NEWDC	Init on Condition Loss
	ABC	NO	NO	NO
Description of the implementation				
	prestore FRF	RBM	Similar conditions	
	NO	NO		

Diagnostic Identifier	Diagnostic initialization function	NR_CONF	CARB class	OBD DTC
Diagnostic description				
NC_IDX_ERR_TAA_SRC_CONF_ INTC			CC	
Failure index for diagnostic instance ambient temperature sensor evaluation source configuration				

Definition of the behavior of the initialization				
ERR-Flag		Reset at ECU Reset	reset at Key ON	Latch error on fail
		YES	YES	NO
ABC	ABC-class	MAX-INC after Failure	No Reset at NEWDC	Init on Condition Loss
	ABC	NO	NO	NO
Description of the implementation				
	prestore FRF	RBM	Similar conditions	
	NO	NO		

Diagnostic Identifier	Diagnostic initialization function	NR_CONF	CARB class	OBD DTC
Diagnostic description				
NC_IDX_ERR_TAA_SRC_RST_INTC			CC	
Failure index for diagnostic instance ambient temperature sensor evaluation source in reset				

Definition of the behavior of the initialization				
ERR-Flag		**Reset at ECU Reset**	**reset at Key ON**	**Latch error on fail**
		YES	YES	NO
ABC	**ABC-class**	**MAX-INC after Failure**	**No Reset at NEWDC**	**Init on Condition Loss**
	ABC	NO	NO	NO
Description of the implementation				
	prestore FRF	**RBM**	**Similar conditions**	
	NO	NO		

▶ General Information

This module contains the monitoring of the received OBD failure state of ambient temperature sensor and the monitoring of the ambient temperature sensor evaluation source configuration and proper working (no reset).

3.17.1 Signal Diagnosis TAA_INTC

▶ General Information

For the reason that the ambient temperature is evaluated from another control unit,
the received failure-state-error has to be debounced and implemented into ERRM from ECU.

Following failure instances are implemented in signal diagnosis of ambient air temperature from INTC

For NC_NR_TAA_INTC = 2 look on below table

[Array - INDEX]	Name of failure instance
0	EL_L
1	EL_H

NC_IDX_ERR_TAA_INTC[..] is filled with the corresponding single **Error-Symptom-Instance:**
TAA_INTC [Name of failure instance**]**

Proposal for NC_FID_ERR_TAA_INTC:

AUX_STATE_ERR_TAA_INTC	AERR
AUX_STATE_ERR_TAA_INTC	ASYM
AUX_STATE_ERR_TAA_INTC	AINI
AUX_STATE_ERR_TAA_INTC	ANAV
ERR_TAA_SRC_CONF_INTC	ERR
ERR_TAA_SRC_RST_INTC	ERR

▶ Application Conditions

Initialisation: –

Activation: `Always`

Deactivation: `Never`

Recurrence: `100 ms`

▶ Function Description

```
% Activation of testing or normal mode

if(1) LC_STATE_ERR_TAA_INTC_AS = 1   // testing mode
then(1)
  STATE_ERR_TAA_INTC_tmp = C_STATE_ERR_TAA_INTC_AS
  LV_CDN_DIAG_TMP = 1   % diagnosis activation condition

else(1)    // normal operating mode
  STATE_ERR_TAA_INTC_tmp = STATE_ERR_TAA_INTC
   if(1.1)ACTION_FARM_GetPermission(IN<NC_FID_ERR_TAA_INTC>)
   then(1.1)LV_CDN_DIAG_TMP = 1  % diagnosis activation condition
   else(1.1)LV_CDN_DIAG_TMP = 0
   endif(1.1)
endif(1)


% Copy of error state to respective failure index

Reset of all STATE_TMP[...]   % Reset temporary variable

if(2)STATE_ERR_TAA_INTC_tmp = 1 % failure EL_L active
then(2)
   STATE_TMP[0] = 1  % Error set
elseif(2)STATE_ERR_TAA_INTC_tmp = 8 % failure EL_H active
then(2)
   STATE_TMP[1] = 1 % Error set
endif(2)


% Interface to error management

for i=0 to NC_NR_TAA_INTC - 1
```

```
if(3) LV_CDN_DIAG_TMP = 1
then(3)
  if(3.1)STATE_TMP[i] = 1
  then(3.1)
    LF_STATE_DGO_TAA_INTC[i] = 3 (CDN+SYM)       % failure detected
  else(3.1)
    LF_STATE_DGO_TAA_INTC[i] = 1 (CDN+NO_SYM)  % no failure detected
  endif(3.1)
else(3)
    LF_STATE_DGO_TAA_INTC[i] = 0 (NO_CDN)          % no condition
endif(3)

ACTION_ERRM_ResultDiag(NC_IDX_ERR_TAA_INTC[i], LF_STATE_DGO_TAA_INTC[i])
endfor
```

3.17.2 Diagnosis for TAA sensor evaluation source configuration

▶ General Information

For the reason that the ambient temperature is evaluated from another control unit, it has to be checked if the ambient temperature sensor evaluation source is configured correctly.

Proposal for NC_FID_ERR_TAA_SRC_CONF_INTC:

AUX_ERR_CAN_BOFF	AERR
AUX_ERR_CAN_TOT	AERR
AUX_CAN_AC_SENS_2	ASYM
AUX_CAN_AC_SENS_2	AERR
AUX_CAN_IF_5	AERR
AUX_CAN_IF_5	AINI
AUX_CAN_IF_CFT_74	AERR
AUX_CAN_IF_CFT_74	AINI
AUX_CAN_ICL_2	AERR
AUX_CAN_ICL_2	AINI

Proposal for NC_FID_TAA_SRC_CONF_INTC:

AUX_TAA_RAW_INTC	ANAV

▶ Application Conditions

Initialisation: –

Activation: `LV_IGK = 1`

Deactivation: `when activation condition not fulfilled`

Recurrence: 100ms

▶ Function Description

```
% Calculation of condition

ifACTION_FARM_GetPermission(IN<NC_FID_ERR_TAA_SRC_CONF_INTC>) and
  LV_FID_READY = 1 and T_IGK > C_T_IGK_TAA_RAW_INTC_VLD
thenLV_CDN_DIAG_TMP = 1 % diagnosis activation condition
elseLV_CDN_DIAG_TMP = 0
endif

% Calculation of symptom

if LV_CDN_DIAG_TMP = 1
then
  if ACTION_FARM_GetPermission(IN<NC_FID_TAA_SRC_CONF_INTC>)
  then
    LF_STATE_DGO_TAA_SRC_CONF_INTC = 1 (CDN+NO_SYM)  % no failure detected
  else
    LF_STATE_DGO_TAA_SRC_CONF_INTC = 3 (CDN+SYM)       % failure detected
else
   LF_STATE_DGO_TAA_SRC_CONF_INTC = 0 (NO_CDN)         % no condition
endif

ACTION_ERRM_ResultDiag(NC_IDX_ERR_TAA_SRC_CONF_INTC,
                       LF_STATE_DGO_TAA_SRC_CONF_INTC)
```

3.17.3 Diagnosis for TAA sensor evaluation source in reset

▶ General Information

For the reason that the ambient temperature sensor is evaluated from another control unit, it has to be checked if the ambient temperature sensor evaluation source is not in reset.

Proposal for NC_FID_ERR_TAA_SRC_RST_INTC:

AUX_ERR_CAN_BOFF	AERR
AUX_ERR_CAN_TOT	AERR
AUX_CAN_AC_SENS_2	ASYM
AUX_CAN_AC_SENS_2	AERR
AUX_CAN_IF_5	AERR
AUX_CAN_IF_5	AINI
AUX_CAN_IF_CFT_74	AERR
AUX_CAN_IF_CFT_74	AINI
AUX_CAN_ICL_2	AERR
AUX_CAN_ICL_2	AINI
ERR_TAA_INTC	END

Proposal for NC_FID_TAA_SRC_RST_INTC:

AUX_TAA_RAW_INTC	AINI

▶ Application Conditions

Initialisation: –

Activation: `LV_IGK = 1`

Deactivation: `when activation condition not fulfilled`

Recurrence: `100ms`

▶ Function Description

```
% Calculation of condition

ifACTION_FARM_GetPermission(IN<NC_FID_ERR_TAA_SRC_RST_INTC>) and
  LV_FID_READY = 1 and T_IGK > C_T_IGK_TAA_RAW_INTC_VLD and
  LV_ST_END = 1 and LV_ES = 0
thenLV_CDN_DIAG_TMP = 1 % diagnosis activation condition
elseLV_CDN_DIAG_TMP = 0
endif

% Calculation of symptom

if LV_CDN_DIAG_TMP = 1
then
  if ACTION_FARM_GetPermission(IN<NC_FID_TAA_SRC_RST_INTC>)
  then
    LF_STATE_DGO_TAA_SRC_RST_INTC = 1 (CDN+NO_SYM)  % no failure detected
  else
    LF_STATE_DGO_TAA_SRC_RST_INTC = 3 (CDN+SYM)       % failure detected
else
   LF_STATE_DGO_TAA_SRC_RST_INTC = 0 (NO_CDN)         % no condition
endif

ACTION_ERRM_ResultDiag(NC_IDX_ERR_TAA_SRC_RST_INTC,
                       LF_STATE_DGO_TAA_SRC_RST_INTC)
```

3.18 Air temperature sensor diagnosis (Appl. Inc.)

Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
LV_INH_ERR_LTS_AIR_OC [NC_NR_LTS_AIR]	O/V	0... 1H	0 ...1	1	-
Inhibition of air temperature sensor electrical diagnosis					
LV_INH_ERR_LTS_AIR_SCG [NC_NR_LTS_AIR]	O/V	0... 1H	0 ...1	1	-
Inhibition of air temperature sensor electrical diagnosis					
LV_INH_ERR_TLTS_AIR_INTM [NC_NR_TLTS_AIR_ORNG_INTM]	O/V	0... 1H	0 ...1	1	-
Inhibition of air temperature sensor intermittend diagnosis					
LV_INH_ERR_TLTS_AIR_ORNG_H [NC_NR_TLTS_AIR_ORNG_INTM]	O/V	0... 1H	0 ...1	1	-
Inhibition of air temperature sensor out of range diagnosis					
LV_INH_ERR_TLTS_AIR_ORNG_L [NC_NR_TLTS_AIR_ORNG_INTM]	O/V	0... 1H	0 ...1	1	-
Inhibition of air temperature sensor out of range diagnosis					
TLTS_AIR_ORNG_INTM [NC_NR_TLTS_AIR_ORNG_INTM]	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Air temperature value for air temperature sensor out of range and intermittend diagnosis					

Input Data

NC_NR_LTS_AIR {p. 1136}	NC_NR_TLTS_AIR_ORNG_INTM {p. 1136}	TAA_MES {p. 1150}	TAA_SENS_CONF {p. 1150}
TIG_IM_MES {p. 1150}			

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_TLTS_AIR_ORNG_INTM_TEST [NC_NR_TLTS_AIR_ORNG_INTM]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Air temperature value for testing mode of TLTS_AIR_ORNG_INTM					
LC_INH_DIAG_LTS_AIR_OC [NC_NR_LTS_AIR]	V	0... 1H	0 ...1	1	-
Logical bit to inhibit air temperature sensor electrical diagnosis					
LC_INH_DIAG_LTS_AIR_SCG [NC_NR_LTS_AIR]	V	0... 1H	0 ...1	1	-
Logical bit to inhibit air temperature sensor electrical diagnosis					
LC_INH_DIAG_TLTS_AIR_INTM [NC_NR_TLTS_AIR_ORNG_INTM]	V	0... 1H	0 ...1	1	-
Logical bit to inhibit intermittent diagnosis					
LC_INH_DIAG_TLTS_AIR_ORNG_H [NC_NR_TLTS_AIR_ORNG_INTM]	V	0... 1H	0 ...1	1	-
Logical bit to inhibit out of range high diagnosis					
LC_INH_DIAG_TLTS_AIR_ORNG_L [NC_NR_TLTS_AIR_ORNG_INTM]	V	0... 1H	0 ...1	1	-
Logical bit to inhibit out of range low diagnosis					
LC_TLTS_AIR_ORNG_INTM_TEST	V	0... 1H	0 ...1	1	-

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
Activation of testing mode for air temperature sensor out of range and intermittend diagnosis					

Configuration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
NC_FID_ERR_LTS_AIR_OC [NC_NR_LTS_AIR]	O	0... FFFFH	0... 65535	1	-
Run the air temperature sensor electrical diagnosis					
NC_FID_ERR_LTS_AIR_SCG [NC_NR_LTS_AIR]	O	0... FFFFH	0... 65535	1	-
Run the air temperature sensor electrical diagnosis					
NC_FID_ERR_TLTS_AIR_INTM [NC_NR_TLTS_AIR_ORNG_INTM]	O	0... FFFFH	0... 65535	1	-
Run the air temperature sensor intermittend diagnosis					
NC_FID_ERR_TLTS_AIR_ORNG_H [NC_NR_TLTS_AIR_ORNG_INTM]	O	0... FFFFH	0... 65535	1	-
Run the air temperature sensor out of range diagnosis					
NC_FID_ERR_TLTS_AIR_ORNG_L [NC_NR_TLTS_AIR_ORNG_INTM]	O	0... FFFFH	0... 65535	1	-
Run the air temperature sensor out of range diagnosis					

Import actions:

ACTION_FARM_GetPermission(**IN** <PRM_FID>, **OUT** <PRM_LV_PRMS>)

General Information

This module provides all necessary variables for the following diagnoses:
- Air temperature sensor electrical diagnosis
- Air temperature sensor out of range diagnosis
- Air temperature sensor intermittent diagnosis

For testing the out of range and intermittent diagnosis the switch LC_TLTS_AIR_ORNG_INTM_TEST can be used to set all parameters manually.

Proposal for NC_FID_ERR_TLTS_AIR_ORNG_H/L:

for TAA value

ERR_TAA_INTC[NC_NR_TAA_INTC]	ERR
TLTS_AIR_INTM[TAA]	ERR
TLTS_AIR_PLAUS[TAA]	ERR

for TIG value

LTS_AIR_OC/SCG[TIG_xx]	ERR
TLTS_AIR_INTM[TIG_xx]	ERR
TIG_PLAUS[TIG_xx]	ERR

Proposal for NC_FID_ERR_TLTS_AIR_INTM:

for TAA value

ERR_TAA_INTC[NC_NR_TAA_INTC]	ERR
TLTS_AIR_ORNG_H/_L[TAA]	ERR
TLTS_AIR_PLAUS[TAA]	ERR

for TIG value

LTS_AIR_OC/SCG[TIG_xx]	ERR
TLTS_AIR_ORNG_H/_L[TIG_xx]	ERR
TIG_PLAUS[TIG_xx]	ERR

3.18.1 Calculation for electrical diagnosis

▶ General Information

▶ Application Conditions

Initialisation: **at** reset **and** IGKON:
calculate formula section

Activation: always

Deactivation: never

Recurrence: 100 ms

▶ Function Description

```
for i = 0 to  NC_NR_LTS_AIR - 1
LV_INH_ERR_LTS_AIR_OC(i) =
      NOT  (ACTION_FARM_GetPermission(IN<NC_FID_ERR_LTS_AIR_OC(i)>))
            orLC_INH_DIAG_LTS_AIR_OC(i) = 1

LV_INH_ERR_LTS_AIR_SCG(i) =
      NOT  (ACTION_FARM_GetPermission(IN<NC_FID_ERR_LTS_AIR_SCG(i)>))
            orLC_INH_DIAG_LTS_AIR_SCG(i) = 1
endfor
```

3.18.2 Calculation for out of range and intermittent diagnosis

▶ General Information

▶ Application Conditions

Initialisation: **at** reset **and** IGKON:
calculate formula section

Activation: always

Deactivation: never

Recurrence: 100 ms

▶ Function Description

```
if  LC_TLTS_AIR_ORNG_INTM_TEST = 0  //  normal operation mode
then
  for i = 0 to NC_NR_TLTS_AIR_ORNG_INTM - 1
  LV_INH_ERR_TLTS_AIR_ORNG_H(i) =
        NOT  (ACTION_FARM_GetPermission(IN<NC_FID_ERR_TLTS_AIR_ORNG_H(i)>)
        or  LC_INH_DIAG_TLTS_AIR_ORNG_H(i) = 1

  LV_INH_ERR_TLTS_AIR_ORNG_L(i) =
        NOT  (ACTION_FARM_GetPermission(IN<NC_FID_ERR_TLTS_AIR_ORNG_L(i)>))
        or  LC_INH_DIAG_TLTS_AIR_ORNG_L(i) = 1

  LV_INH_ERR_TLTS_AIR_INTM(i) =
        NOT  (ACTION_FARM_GetPermission(IN<NC_FID_ERR_TLTS_AIR_INTM(i)>))
        or  LC_INH_DIAG_TLTS_AIR_INTM(i) = 1
  endfor

  TLTS_AIR_ORNG_INTM(TAA) = TAA_MES
  TLTS_AIR_ORNG_INTM(IM) = TIG_IM_MES

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
else      // testing mode

  for i = 0 to  NC_NR_TLTS_AIR_ORNG_INTM - 1
  LV_INH_ERR_TLTS_AIR_ORNG_H(i) = 0
  LV_INH_ERR_TLTS_AIR_ORNG_L(i) = 0
  LV_INH_ERR_TLTS_AIR_INTM(i) = 0
  TLTS_AIR_ORNG_INTM(i) = C_TLTS_AIR_ORNG_INTM_TEST(i)
  endfor

endif
```

3.19 Air temperature sensor diagnosis

Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
LF_STATE_DGO_LTS_AIR_OC [NC_NR_LTS_AIR]	O/V	0... FFH	0... 255	1	-
State of air temperature sensor electrical diagnosis					
LF_STATE_DGO_LTS_AIR_SCG [NC_NR_LTS_AIR]	O/V	0... FFH	0... 255	1	-
State of air temperature sensor electrical diagnosis					
LF_STATE_DGO_TLTS_AIR_INTM [NC_NR_TLTS_AIR_ORNG_INTM]	O/V	0... FFH	0... 255	1	-
State of air temperature sensor intermittend diagnosis					
LF_STATE_DGO_TLTS_AIR_ORNG_H [NC_NR_TLTS_AIR_ORNG_INTM]	O/V	0... FFH	0... 255	1	-
State of air temperature sensor out of range diagnosis					
LF_STATE_DGO_TLTS_AIR_ORNG_L [NC_NR_TLTS_AIR_ORNG_INTM]	O/V	0... FFH	0... 255	1	-
State of air temperature sensor out of range diagnosis					
LV_CDN_LTS_AIR_OC [NC_NR_LTS_AIR]	V	0... 1H	0 ...1	1	-
Condition for air temperature sensor electrical diagnosis fulfilled					
LV_CDN_LTS_AIR_SCG [NC_NR_LTS_AIR]	V	0... 1H	0 ...1	1	-
Condition for air temperature sensor electrical diagnosis fulfilled					
LV_CDN_TLTS_AIR_INTM [NC_NR_TLTS_AIR_ORNG_INTM]	V	0... 1H	0 ...1	1	-
Condition for air temperature sensor intermittend diagnosis fulfilled					
LV_CDN_TLTS_AIR_ORNG_H [NC_NR_TLTS_AIR_ORNG_INTM]	V	0... 1H	0 ...1	1	-
Condition for air temperature sensor out of range diagnosis fulfilled					
LV_CDN_TLTS_AIR_ORNG_L [NC_NR_TLTS_AIR_ORNG_INTM]	V	0... 1H	0 ...1	1	-
Condition for air temperature sensor out of range diagnosis fulfilled					
TLTS_AIR_ORNG_INTM_MMV [NC_NR_TLTS_AIR_ORNG_INTM]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Filtered air temperature sensor value for TLTS_AIR_INTM diagnosis					

Input Data

LV_CDN_VB_OBD1 {p. 24053}	LV_INH_ERR_LTS_AIR_OC [NC_NR_LTS_AIR] {p. 1241}	LV_INH_ERR_LTS_AIR_SCG [NC_NR_LTS_AIR] {p. 1241}	LV_INH_ERR_TLTS_AIR_INTM [NC_NR_TLTS_AIR_ORNG_INTM] {p. 1241}
LV_INH_ERR_TLTS_AIR_ORNG_H [NC_NR_TLTS_AIR_ORNG_INTM] {p. 1241}	LV_INH_ERR_TLTS_AIR_ORNG_L [NC_NR_TLTS_AIR_ORNG_INTM] {p. 1241}	LV_TLTS_AIR_INTM_CLR_DIAG {p. 1252}	NC_NR_LTS_AIR {p. 1136}
NC_NR_TLTS_AIR_ORNG_INTM {p. 1136}	TLTS_AIR_ORNG_INTM [NC_NR_TLTS_AIR_ORNG_INTM] {p. 1241}	VP_LTS_AIR [NC_NR_LTS_AIR] {p. 1147}	

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_CRLC_TLTS_AIR_INTM [NC_NR_TLTS_AIR_ORNG_INTM]	V	0... FFFFH	0... 0.999984741211	15.2588e-6	-
Correlation constant for air temperature sensor intermittend diagnosis					
C_TLTS_AIR_DIF_INTM [NC_NR_TLTS_AIR_ORNG_INTM]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Air temperature difference threshold for air temperature sensor intermittend diagnosis					
C_TLTS_AIR_ORNG_H [NC_NR_TLTS_AIR_ORNG_INTM]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Air temperature threshold for air temperature sensor out of range diagnosis					
C_TLTS_AIR_ORNG_L [NC_NR_TLTS_AIR_ORNG_INTM]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Air temperature threshold for air temperature sensor out of range diagnosis					
C_VP_LTS_AIR_OC [NC_NR_LTS_AIR]	V	0... 7FFFH	0... 4.999847412109	152.588e-6	V
Air temperature sensor voltage threshold for air temperature sensor electrical diagnosis					
C_VP_LTS_AIR_SCG [NC_NR_LTS_AIR]	V	0... 7FFFH	0... 4.999847412109	152.588e-6	V
Air temperature sensor voltage threshold for air temperature sensor electrical diagnosis					

General Information

The aim of this specification is the diagnosis of the air temperature sensors.
As output a state variable for each failure symptom is calculated (LF_STATE_xyz).

The air temperature sensor diagnosis consists of three separate parts.

Electrical sensor diagnosis (LTS_AIR_OC / SCG):
The range of the measured sensor voltage is compared to a upper and lower threshold
+ voltage too high => sensor not connected (OC) or short cut to battery
+ voltage too low => short cut to ground (SCG)

Out of range diagnosis (TLTS_AIR_ORNG_H / L):
The range of the measured sensor value is compared to a upper and lower threshold
+ value too high => measured air temperature implausible high (ORNG_H)
+ value too low => measured air temperature implausible low (ORNG_L)

Intermittent diagnosis (TLTS_AIR_INTM):
The gradient of the measured signal is compared to a maximal threshold
+ gradient(difference) too high => implausible value jumps (e.g. contact bouncing on sensor signal)

The number of sensors for the **electrical** diagnosis and the **out of range / intermittent** diagnosis can be configured separately for each diagnosis.
Electrical diagnosis: NC_NR_LTS_AIR
Out of range / intermittent diagnosis: NC_NR_TLTS_ORNG_INTM

If a project uses the ambient air temperature via CAN, only an **out of range / intermittent** diagnosis is necessary.

NC_NR_LTS_AIR will then be smaller than NC_NR_TLTS_ORNG_INTM.

Application Conditions

Initialisation: `RST, IGKON`

Activation: `always`

Deactivation: `never`

Recurrence: `100MS`

Function Description

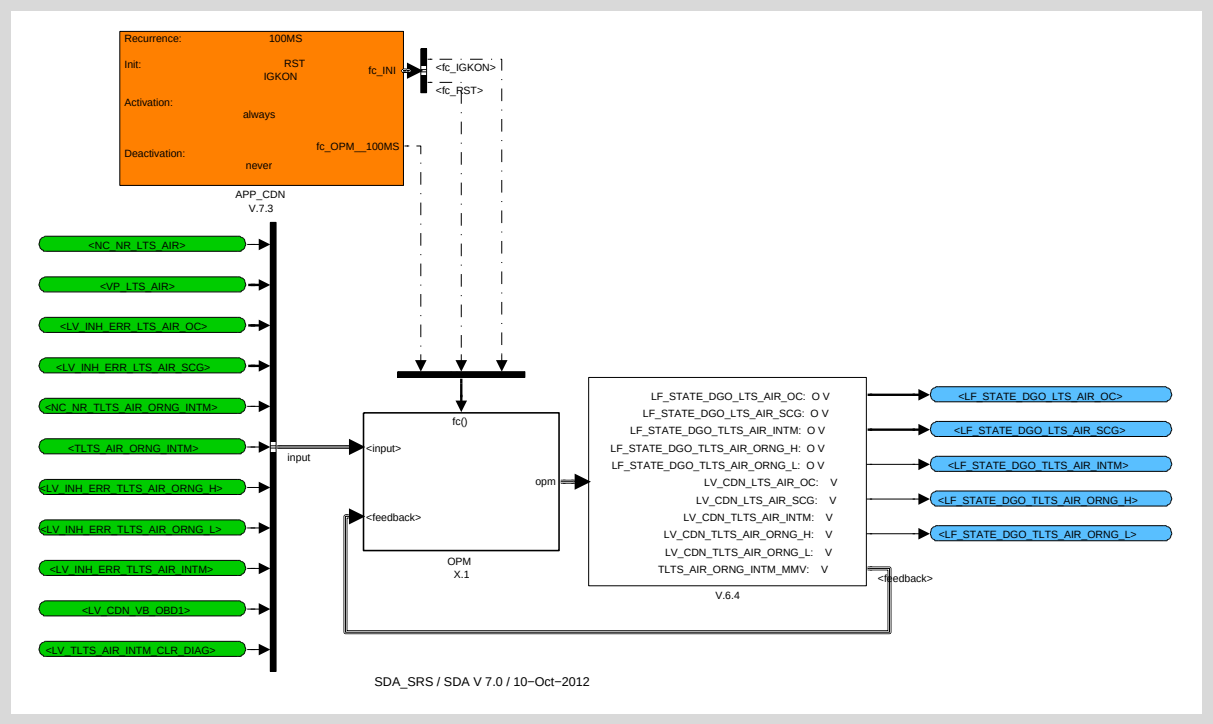

Figure 3.19.1:

3.19.1 Overview of air temperature sensor diagnosis

3.19.1.1 Overview of electrical diagnosis

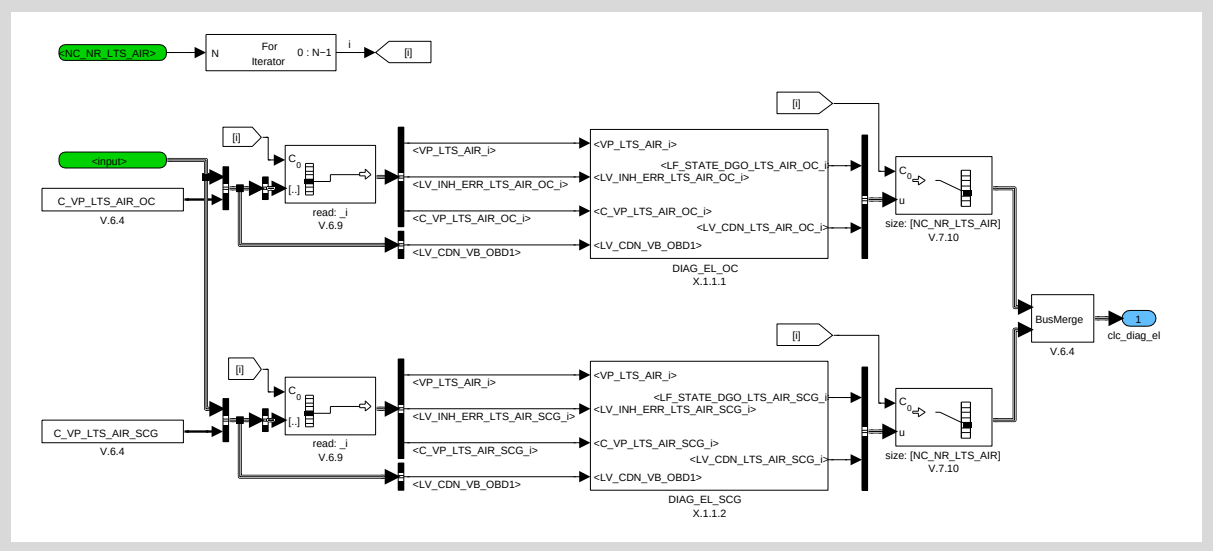

Figure 3.19.2:

3.19.1.1.1 Electrical diagnosis open circuit / shortcut to plus

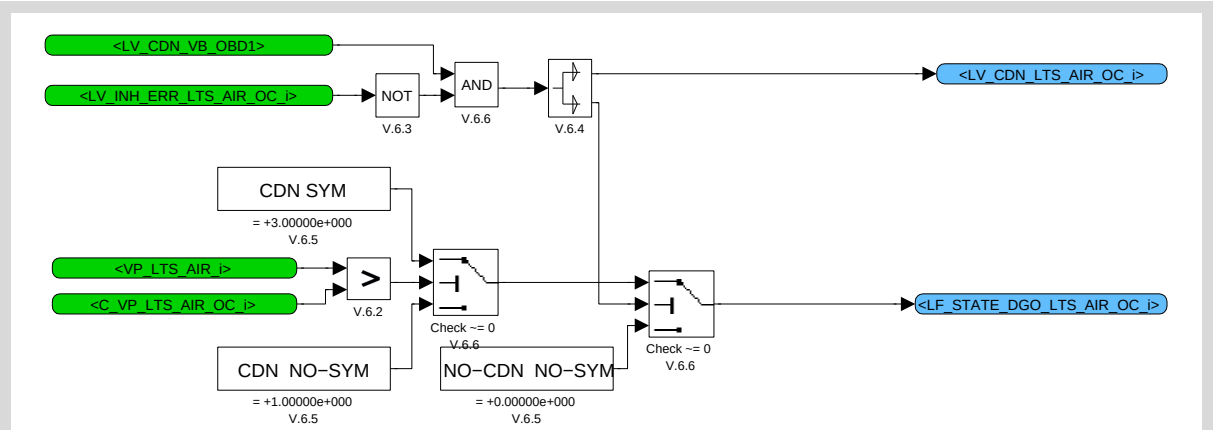

Figure 3.19.3:

3.19.1.1.2 Electrical diagnosis shortcut to ground

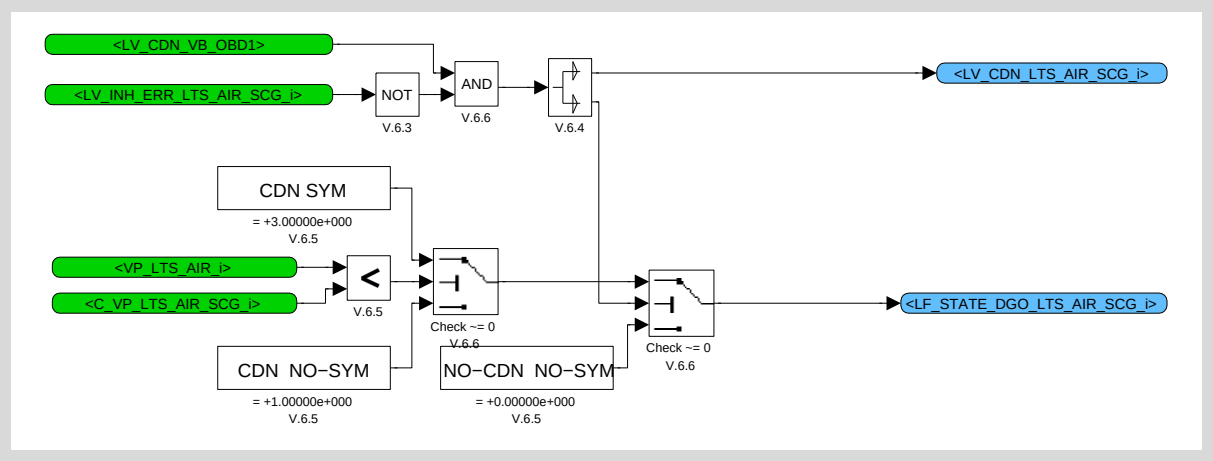

Figure 3.19.4:

3.19.1.2 Overview of out of range and intermittent diagnosis

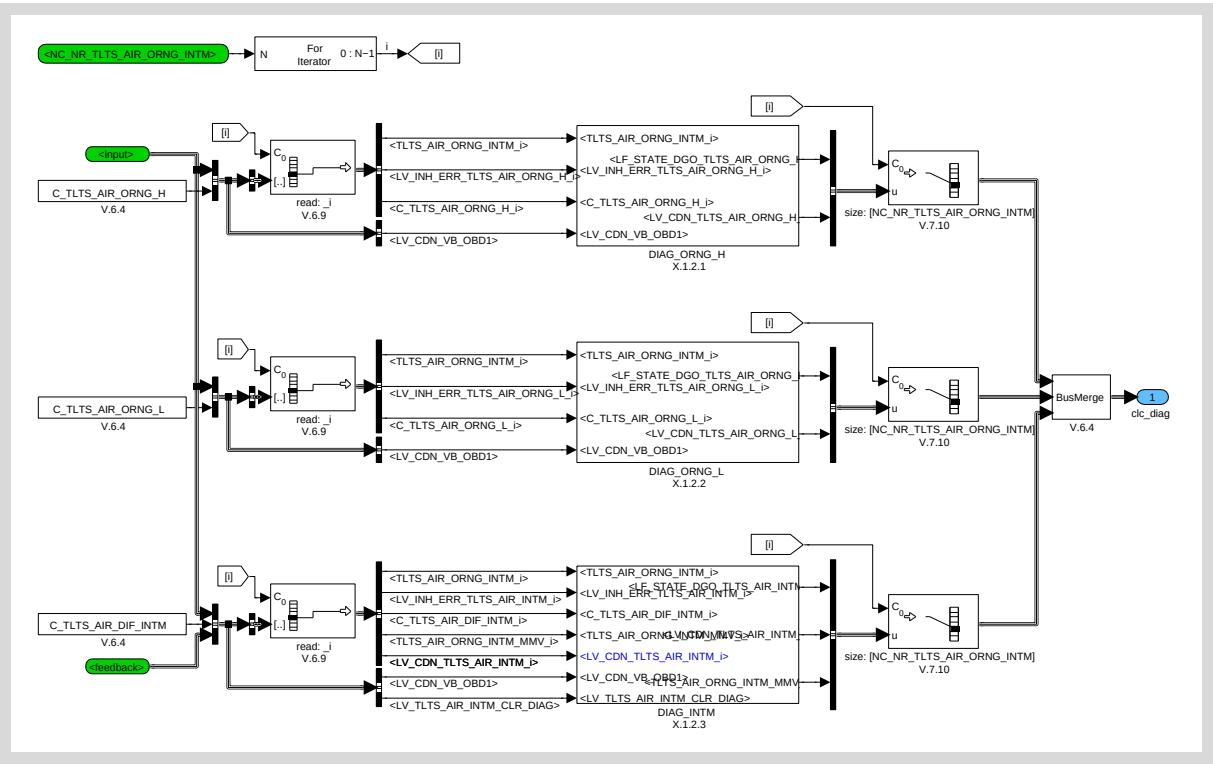

Figure 3.19.5:

3.19.1.2.1 Out of range high diagnosis

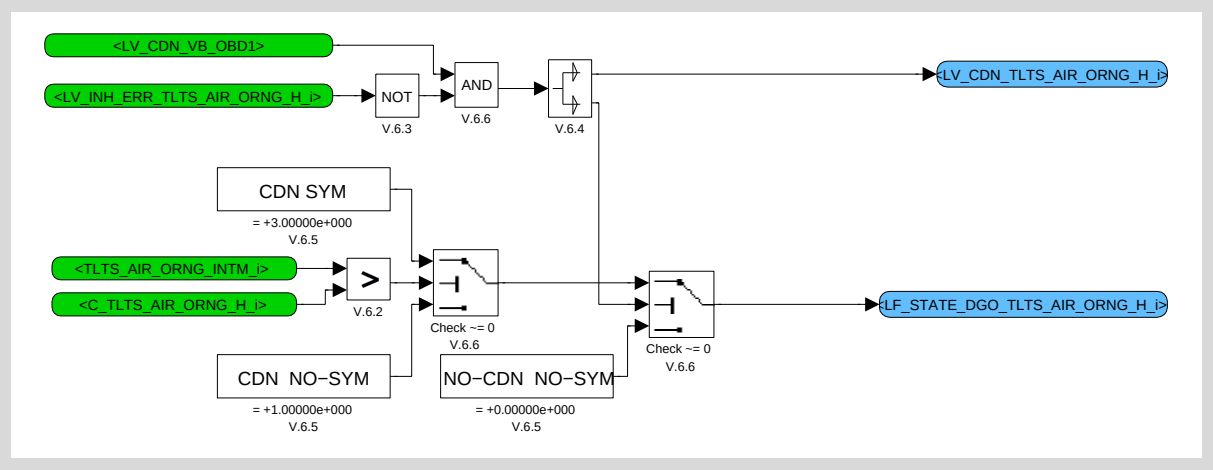

Figure 3.19.6:

3.19.1.2.2 Out of range low diagnosis

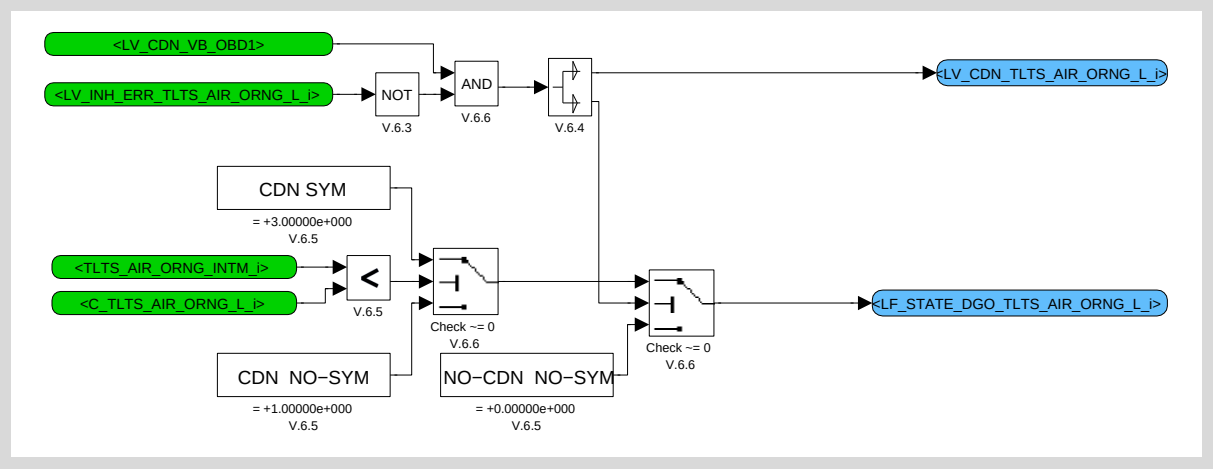

Figure 3.19.7:

3.19.1.2.3 Intermittent diagnosis

3.19.1.2.3.1 Calculation of the condition and filtered air temperature sensor value

Within this subsystem the condition flag for the diagnosis as well as the filtered air temperature sensor value is calculated.
The filter has to be initialized with the latest measured temperature value in case that the condition is 0 as well as in case that the condition turns from 0 to 1.

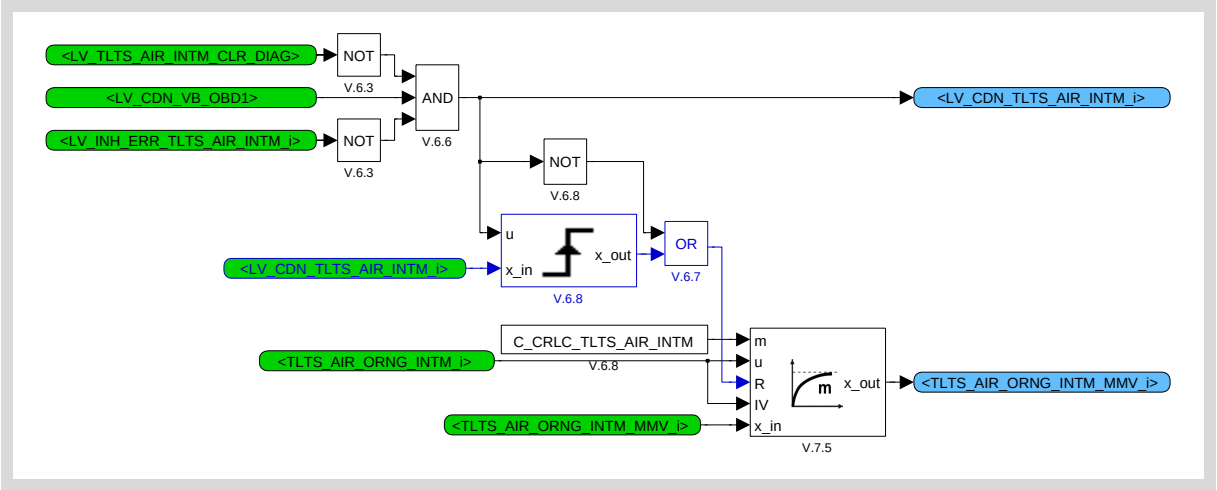

Figure 3.19.8:

3.19.1.2.3.2 Error definition for intermittent diagnosis

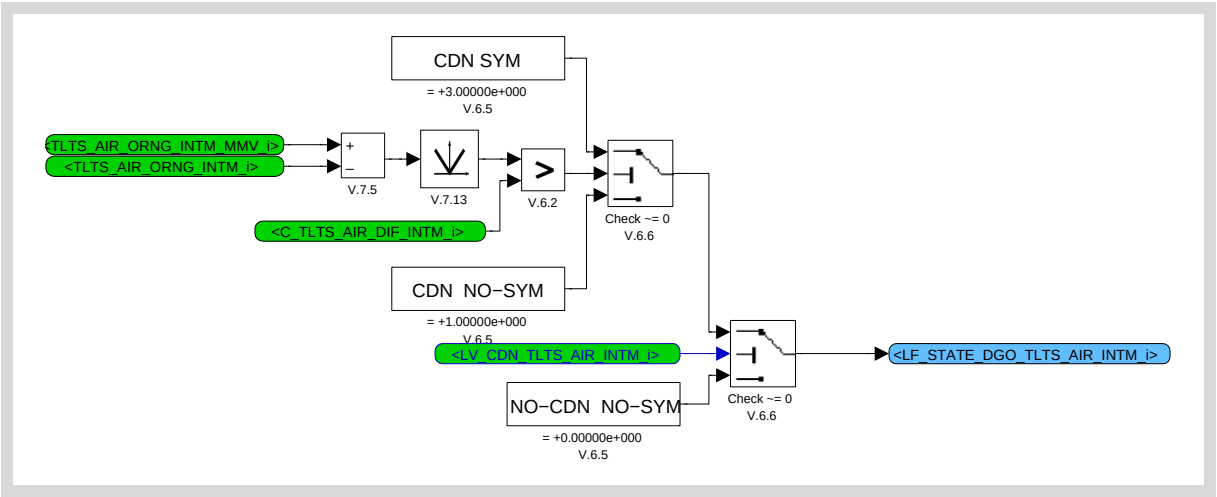

Figure 3.19.9:

3.20 Air temperature sensor diagnosis (ERRM interface)

Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
LV_TLTS_AIR_INTM_CLR_DIAG	O/V	0... 1H	0 ...1	1	-
Clear diagnostic trigger for air temperature sensor intermittend diagnosis					

Input Data

LF_STATE_DGO_LTS_AIR_OC [NC_NR_LTS_AIR] {p. 1245}	LF_STATE_DGO_LTS_AIR_SCG [NC_NR_LTS_AIR] {p. 1245}	LF_STATE_DGO_TLTS_AIR_INTM [NC_NR_TLTS_AIR_ORNG_INTM] {p. 1245}	LF_STATE_DGO_TLTS_AIR_ORNG_H [NC_NR_TLTS_AIR_ORNG_INTM] {p. 1245}
LF_STATE_DGO_TLTS_AIR_ORNG_L [NC_NR_TLTS_AIR_ORNG_INTM] {p. 1245}	NC_NR_LTS_AIR {p. 1136}	NC_NR_TLTS_AIR_ORNG_INTM {p. 1136}	

Configuration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
NC_IDX_ERR_LTS_AIR_OC [NC_NR_LTS_AIR]	O	0... FFFFH	0... 65535	1	-
ERRM diagnosis identifier for air temperature sensor electrical diagnosis					
NC_IDX_ERR_LTS_AIR_SCG [NC_NR_LTS_AIR]	O	0... FFFFH	0... 65535	1	-
ERRM diagnosis identifier for air temperature sensor electrical diagnosis					
NC_IDX_ERR_TLTS_AIR_INTM [NC_NR_TLTS_AIR_ORNG_INTM]	O	0... FFFFH	0... 65535	1	-
ERRM diagnosis identifier for air temperature sensor intermittend diagnosis					
NC_IDX_ERR_TLTS_AIR_ORNG_H [NC_NR_TLTS_AIR_ORNG_INTM]	O	0... FFFFH	0... 65535	1	-
ERRM diagnosis identifier for air temperature sensor out of range diagnosis					
NC_IDX_ERR_TLTS_AIR_ORNG_L [NC_NR_TLTS_AIR_ORNG_INTM]	O	0... FFFFH	0... 65535	1	-
ERRM diagnosis identifier for air temperature sensor out of range diagnosis					

Action Definitions

ACTION_AIRT_ResetDiagTltsIntm(**IN** <PRM_STATE_INI>, **IN** <PRM_NR_CONF>) — **Mode: O**

Action to clear or restart the diagnosis TLTS_AIR_INTM

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_STATE_INI	in	0H 1H	CLR REST	-	-
Type of initialization (Clear: CLR; restart: REST)					
PRM_NR_CONF	in	0... FFH	0... 255	1	-

Additional configuration information for the action (may be not used)

Import actions:

ACTION_ERRM_ResultDiag(**IN** <PRM_IDX_ERR>, **IN** <PRM_STATE_DGO>, **OUT** <PRM_STATE_FIL>)

Error treatment

Diagnostic Identifier	Diagnostic initialization function	NR_CONF	CARB class	OBD DTC
Diagnostic description				
NC_IDX_ERR_LTS_AIR_OC [NC_NR_LTS_AIR]			CC	
ERRM diagnosis identifier for air temperature sensor electrical diagnosis				

Definition of the behavior of the initialization				
ERR-Flag		Reset at ECU Reset	reset at Key ON	Latch error on fail
		YES	YES	NO
ABC	ABC-class	MAX-INC after Failure	No Reset at NEWDC	Init on Condition Loss
	ABC	NO	NO	NO
Description of the implementation				
	prestore FRF	RBM	Similar conditions	
	NO	NO		

Diagnostic Identifier	Diagnostic initialization function	NR_CONF	CARB class	OBD DTC
Diagnostic description				
NC_IDX_ERR_LTS_AIR_SCG [NC_NR_LTS_AIR]			CC	
ERRM diagnosis identifier for air temperature sensor electrical diagnosis				

Definition of the behavior of the initialization				
ERR-Flag		Reset at ECU Reset	reset at Key ON	Latch error on fail
		YES	YES	NO
ABC	ABC-class	MAX-INC after Failure	No Reset at NEWDC	Init on Condition Loss
	ABC	NO	NO	NO
Description of the implementation				
	prestore FRF	RBM	Similar conditions	
	NO	NO		

Diagnostic Identifier	Diagnostic initialization function	NR_CONF	CARB class	OBD DTC
Diagnostic description				
NC_IDX_ERR_TLTS_AIR_ORNG_H [NC_NR_TLTS_AIR_ORNG_INTM]			CC	
ERRM diagnosis identifier for air temperature sensor out of range diagnosis				

Definition of the behavior of the initialization				
ERR-Flag		Reset at ECU Reset	reset at Key ON	Latch error on fail
		YES	YES	NO
ABC	ABC-class	MAX-INC after Failure	No Reset at NEWDC	Init on Condition Loss
	ABC	NO	NO	NO
Description of the implementation				
	prestore FRF	RBM	Similar conditions	
	NO	NO		

Diagnostic Identifier	Diagnostic initialization function	NR_CONF	CARB class	OBD DTC
Diagnostic description				
NC_IDX_ERR_TLTS_AIR_ORNG_L [NC_NR_TLTS_AIR_ORNG_INTM]			CC	
ERRM diagnosis identifier for air temperature sensor out of range diagnosis				

Definition of the behavior of the initialization				
ERR-Flag		Reset at ECU Reset	reset at Key ON	Latch error on fail
		YES	YES	NO
ABC	ABC-class	MAX-INC after Failure	No Reset at NEWDC	Init on Condition Loss
	ABC	NO	NO	NO
Description of the implementation				
	prestore FRF	RBM	Similar conditions	
	NO	NO		

Diagnostic Identifier	Diagnostic initialization function	NR_CONF	CARB class	OBD DTC
Diagnostic description				
NC_IDX_ERR_TLTS_AIR_INTM [NC_NR_TLTS_AIR_ORNG_INTM]	ACTION_AIRT_ResetDiagTltsIntm		CC	
ERRM diagnosis identifier for air temperature sensor intermittend diagnosis				

Definition of the behavior of the initialization				
ERR-Flag		Reset at ECU Reset	reset at Key ON	Latch error on fail
		YES	YES	NO
ABC	ABC-class	MAX-INC after Failure	No Reset at NEWDC	Init on Condition Loss
	ABC	NO	NO	NO
Description of the implementation				

	prestore FRF	RBM	Similar conditions	
	NO	NO		

▶ General Information

This error management interface module is valid for symptom based ERRM

The number of temperature sensors for the electrical diagnosis is defined with: NC_NR_LTS_AIR

The number of temperature sensors for the **out of range** and **intermittend** diagnosis is defined with: NC_NR_TLTS_AIR_ORNG_INTM

3.20.1 Electrical diagnosis

▶ General Information

▶ Application Conditions

Initialisation: **at** reset **and** IGKON:
calculate formula section

Activation: always

Deactivation: never

Recurrence: 100 ms

▶ Function Description

```
% Interface to error management
for i = 0 to  NC_NR_LTS_AIR - 1

ACTION_ERRM_ResultDiag(IN<NC_IDX_ERR_LTS_AIR_OC[i]>,
                                                IN<LF_STATE_DGO_LTS_AIR_OC[i]>)

ACTION_ERRM_ResultDiag(IN<NC_IDX_ERR_LTS_AIR_SCG[i]>,
                                                IN<LF_STATE_DGO_LTS_AIR_SCG[i]>)

endfor
```

3.20.2 Out of range and Intermittend diagnosis

▶ General Information

▶ Application Conditions

Initialisation: **at** reset **and** IGKON:
calculate formula section

Activation: always

Deactivation: never

Recurrence: 100 ms

▶ Function Description

```
% Set handshake flag to clear diagnosis package
LV_TLTS_AIR_INTM_CLR_DIAG = 0;

% Interface to error management
for i = 0 to NC_NR_TLTS_AIR_ORNG_INTM - 1

ACTION_ERRM_ResultDiag(IN<NC_IDX_ERR_TLTS_AIR_ORNG_H[i]>,
                       IN<LF_STATE_DGO_TLTS_AIR_ORNG_H[i]>)

ACTION_ERRM_ResultDiag(IN<NC_IDX_ERR_TLTS_AIR_ORNG_L[i]>,
                       IN<LF_STATE_DGO_TLTS_AIR_ORNG_L[i]>)

ACTION_ERRM_ResultDiag(IN<NC_IDX_ERR_TLTS_AIR_INTM[i]>,
                       IN<LF_STATE_DGO_TLTS_AIR_INTM[i]>)

endfor
```

3.20.3 ACTION_AIRT_ResetDiagTItsIntm

```
if PRM_STATE_INI==CLR
then
% handshake to clear the diagnosis package outside from this module
   LV_TLTS_AIR_INTM_CLR_DIAG = 1;
endif
```

3.21 Air temperature sensor plausibility diagnosis (Appl. Inc.)

Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
LV_INH_ERR_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	O/V	0... 1H	0 ...1	1	-
Inhibition of air temperature sensor plausibility diagnosis					
LV_STATE_TLTS_MDL_UP [NC_NR_TLTS_AIR_PLAUS]	O/V	0... 1H	0 ...1	1	-
Flag that indicates that TLTS_MDL value is updated an can be used for TLTS_AIR_PLAUS diagnosis					
LV_STATE_TLTS_MES_UP [NC_NR_TLTS_AIR_PLAUS]	O/V	0... 1H	0 ...1	1	-
Flag that indicates that TLTS_MES value is updated an can be used for TLTS_AIR_PLAUS diagnosis					
TLTS_AIR_PLAUS_MDL [NC_NR_TLTS_AIR_PLAUS]	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Modeled temperature value for air temperature sensor plausibility diagnosis					
TLTS_AIR_PLAUS_MES [NC_NR_TLTS_AIR_PLAUS]	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Measured temperature value for air temperature sensor plausibility diagnosis					

Input Data

LV_IGK {p. 24082}	NC_NR_TLTS_AIR_PLAUS {p. 1136}	STATE_TAA_ESTIM {p. 1177}	STATE_TLTS_MDL_2 {p. 1156}
TAA_MES {p. 1150}	TLTS_MDL_2 {p. 1156}		

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_TLTS_AIR_PLAUS_MDL_TEST [NC_NR_TLTS_AIR_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Modeled temperature value for testing mode of TLTS_AIR_PLAUS diagnosis					
C_TLTS_AIR_PLAUS_MES_TEST [NC_NR_TLTS_AIR_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Measured temperature value for testing mode of TLTS_AIR_PLAUS diagnosis					
LC_INH_DIAG_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	V	0... 1H	0 ...1	1	-
Logical bit to inhibit air temperature sensor plausibility diagnosis					
LC_STATE_TLTS_MDL_UP_TEST [NC_NR_TLTS_AIR_PLAUS]	V	0... 1H	0 ...1	1	-
Switch for testing mode of flag LV_STATE_TLTS_MDL_UP for TLTS_AIR_PLAUS diagnosis					
LC_STATE_TLTS_MES_UP_TEST [NC_NR_TLTS_AIR_PLAUS]	V	0... 1H	0 ...1	1	-
Switch for testing mode of flag LV_STATE_TLTS_MES_UP for TLTS_AIR_PLAUS diagnosis					
LC_TLTS_AIR_PLAUS_ACT_TEST	V	0... 1H	0 ...1	1	-
Activation of testing mode for air temperature sensor plausibility diagnosis					

Configuration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
NC_FID_ERR_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	O	0... FFFFH	0... 65535	1	-
Run the air temperature sensor plausibility diagnosis					

Import actions:

ACTION_FARM_GetPermission(**IN** <PRM_FID>, **OUT** <PRM_LV_PRMS>)

General Information

This module provides all necessary variables for the air temperature sensor plausibility diagnosis.

The aim of this diagnosis is to check, whether the air temperature sensor signal is plausible or not. Therefore the measured value (TLTS_AIR_PLAUS_MES) is compared to the modelled value (TLTS_AIR_PLAUS_MDL).

In this module the air temperature sensor and its respective model value has to be defined (pair wise).

For testing the switch LC_TLTS_AIR_PLAUS_ACT_TEST can be used to set all parameters manually.

Application Conditions

Initialisation:
```
at  reset:
TLTS_AIR_PLAUS_MDL(TAA)= TLTS_MDL_2
TLTS_AIR_PLAUS_MES(TAA)= TAA_MES
```

Activation: `LV_IGK = 1`

Deactivation: `when activation condition not fulfilled`

Recurrence: `1 s`

Function Description

if LC_TLTS_AIR_PLAUS_ACT_TEST = 0 *// normal operation mode*
then

for i = 0 **to** NC_NR_TLTS_AIR_PLAUS - 1

LV_INH_ERR_TLTS_AIR_PLAUS(i) =
    NOT (**ACTION_FARM_GetPermission**(**IN**<NC_FID_ERR_TLTS_AIR_PLAUS(i)>))
    or LC_INH_DIAG_TLTS_AIR_PLAUS(i)
endfor

TLTS_AIR_PLAUS_MDL(TAA) = TLTS_MDL_2
TLTS_AIR_PLAUS_MES(TAA) = TAA_MES

if STATE_TAA_ESTIM = 2

```
then LV_STATE_TLTS_MES_UP(TAA) = 1
else  LV_STATE_TLTS_MES_UP(TAA) = 0
endif

if STATE_TLTS_MDL_2 = 2
then LV_STATE_TLTS_MDL_UP(TAA) = 1
else  LV_STATE_TLTS_MDL_UP(TAA) = 0
endif


- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
else    // testing mode

for i = 0 to  NC_NR_TLTS_AIR_PLAUS - 1
LV_INH_ERR_TLTS_AIR_PLAUS(i) = 0
TLTS_AIR_PLAUS_MDL(i) = C_TLTS_AIR_PLAUS_MDL_TEST(i)
TLTS_AIR_PLAUS_MES(i) = C_TLTS_AIR_PLAUS_MES_TEST(i)
LV_STATE_TLTS_MDL_UP(i) = LC_STATE_TLTS_MDL_UP_TEST(i)
LV_STATE_TLTS_MES_UP(i) = LC_STATE_TLTS_MES_UP_TEST(i)
endfor
```

3.22 Air temperature sensor plausibility diagnosis

▶ Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
CTR_STAB_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	V	0... FFH	0... 255	1	-
Counter for temperature stability criterion definition					
CTR_SYM_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	V	0... FFH	0... 255	1	-
Counter used for failure filtering of TLTS_AIR_PLAUS diagnosis					
LF_STATE_DGO_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	O/V	0... FFH	0... 255	1	-
State of air temperature sensor plausibility diagnosis					
LV_CDN_DIAG_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	V	0... 1H	0 ...1	1	-
Condition for TLTS_AIR_PLAUS diagnosis fulfilled					
LV_TEMP_DIF_THD_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	V	0... 1H	0 ...1	1	-
Temperature difference of measured and modeled value for symptom calculation above threshold					
LV_TLTS_AIR_PLAUS_ACT [NC_NR_TLTS_AIR_PLAUS]	V	0... 1H	0 ...1	1	-
Air temperature sensor plausibility diagnosis active					
STATE_STAB_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	V	0... FFH	0... 255	1	-
Status of stability for TLTS_AIR_PLAUS diagnosis (0 = Initialisation, 1 = Stability fulfilled, 2 = Stability not fulfilled)					
TEMP_DIF_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Temperature difference of measured and modeled value for symptom calculation					
TEMP_DIF_TLTS_AIR_PLAUS_DC [NC_NR_TLTS_AIR_PLAUS]	V	80... 7FH	-128 ...127	1	°C
Temperature difference of measured and modeled value for symptom calculation at current DC					
TEMP_DIF_TLTS_AIR_PLAUS_TOT_DC [NC_NR_TLTS_AIR_PLAUS]	V/S	80... 7FH	-128 ...127	1	°C
Temperature difference of measured and modeled value for symptom calculation for all DCs					
TEMP_STAB_DIF_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Temperature difference of measured temperature for TLTS_AIR_PLAUS stability check					
TEMP_STAB_MAX_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Maximum measured value for TLTS_AIR plausibility diagnosis					
TEMP_STAB_MIN_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Minimum measured value for TLTS_AIR plausibility diagnosis					

Input Data

LV_CDN_VB_OBD2 {p. 24053}	LV_IGK {p. 24082}	LV_INH_ERR_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS] {p. 1257}	LV_ST_END {p. 7530}
LV_STATE_TLTS_MDL_UP [NC_NR_TLTS_AIR_PLAUS] {p. 1257}	LV_STATE_TLTS_MES_UP [NC_NR_TLTS_AIR_PLAUS] {p. 1257}	LV_TLTS_AIR_PLAUS_CLR_DIAG {p. 1270}	NC_NR_TLTS_AIR_PLAUS {p. 1136}
NC_TLTS_AIR_PLAUS_CONF {p. 1137}	TLTS_AIR_PLAUS_MDL [NC_NR_TLTS_AIR_PLAUS] {p. 1257}	TLTS_AIR_PLAUS_MES [NC_NR_TLTS_AIR_PLAUS] {p. 1257}	

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_CTR_STAB_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	V	0... FFH	0... 255	1	-
Counter for temperature stability criterion definition					
C_CTR_SYM_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	V	0... FFH	0... 255	1	-
Counter used for failure filtering of TLTS_AIR_PLAUS diagnosis					
C_TEMP_DIF_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Temperature difference of measured and modeled value for symptom calculation					
C_TEMP_STAB_DIF_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Temperature difference of measured temperature for TLTS_AIR_PLAUS stability check					

General Information

The aim of this diagnosis is to check, whether the air temperature sensor signal is plausible or not.
Therefore the measured value (TLTS_AIR_PLAUS_MES) is compared to the modeled value (TLTS_AIR_PLAUS_MDL). If the difference between them is bigger than a certain threshold, an error symptom is set.
With NC_TLTS_AIR_PLAUS_CONF = 0 the functionality is not running and all variables are invisible.

For calibration purpose the variable TEMP_DIF_TLTS_AIR_PLAUS_TOT_DC is created which shows the maximum temperature differences over all DC's.

Application Conditions

Initialisation: `RST, IGKON, NVMRES, NVMINI, NVMSTO`

Activation: `NC_TLTS_AIR_PLAUS_CONF==1`

Deactivation: `if activation not true`

Recurrence: `1S`

Function Description

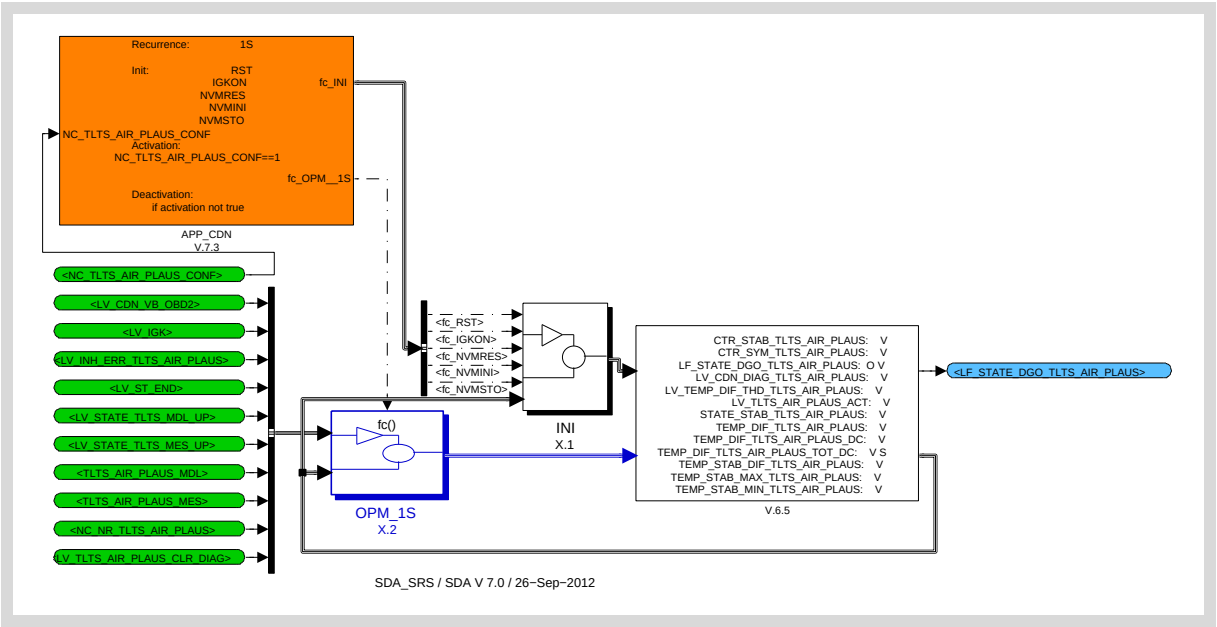

Figure 3.22.1:

3.22.1 Initialization at RST and IGKON

All variables are initialized with zero, except the trailing pointers:
TEMP_STAB_MAX_TLTS_AIR_PLAUS, TEMP_STAB_MIN_TLTS_AIR_PLAUS

3.22.2 Formula section

3.22.2.1 Overview

The actual plausibility diagnosis is started as soon as the activation flag is set.

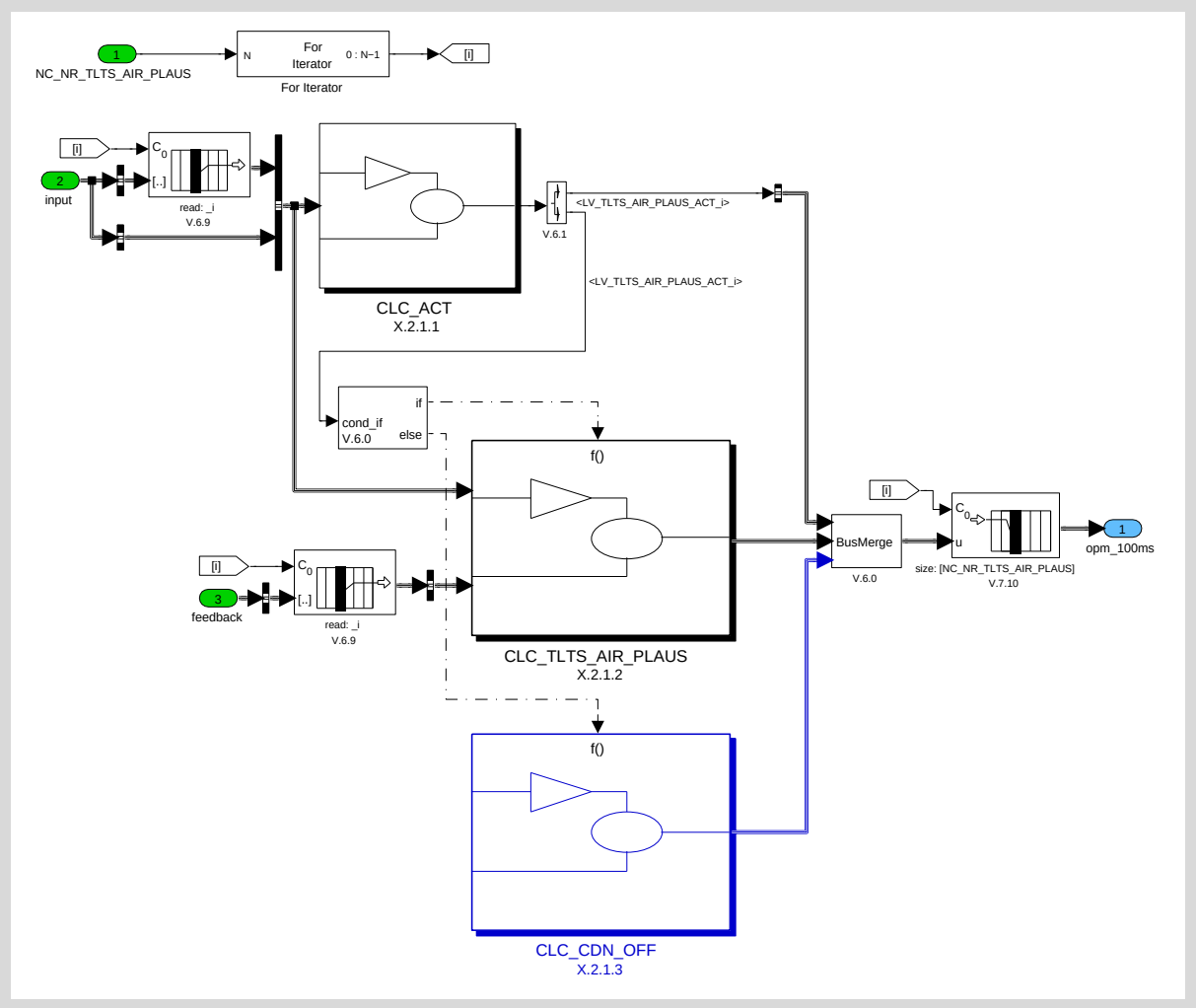

Figure 3.22.2:

3.22.2.1.1 Activation of the diagnosis

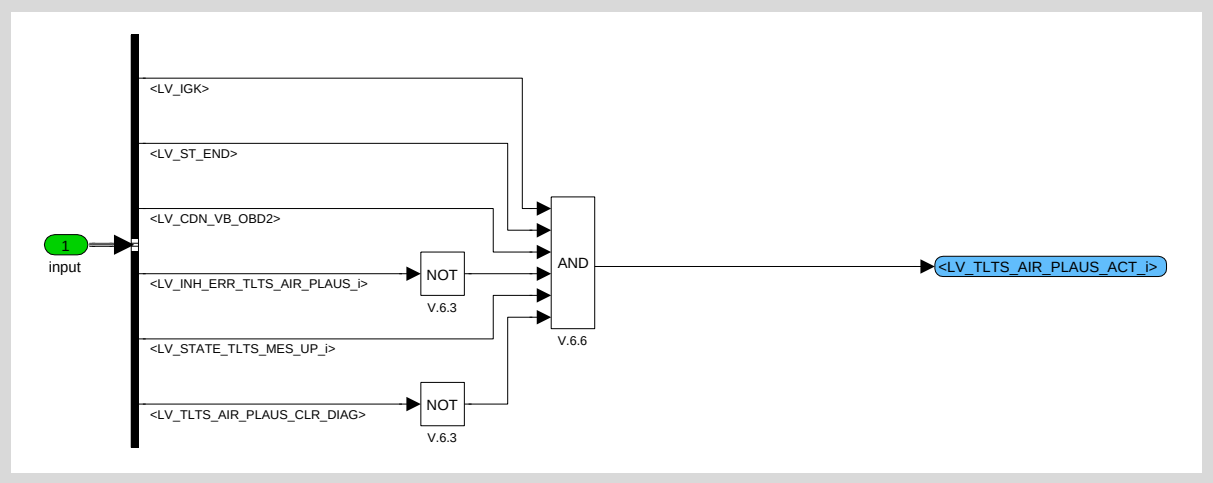

Figure 3.22.3:

3.22.2.1.2 Air temperature sensor plausibility diagnosis

The main part of the diagnosis consists of a continuous stability check of the temperature sensor signal and the comparison of modeled and measured value of temperature.

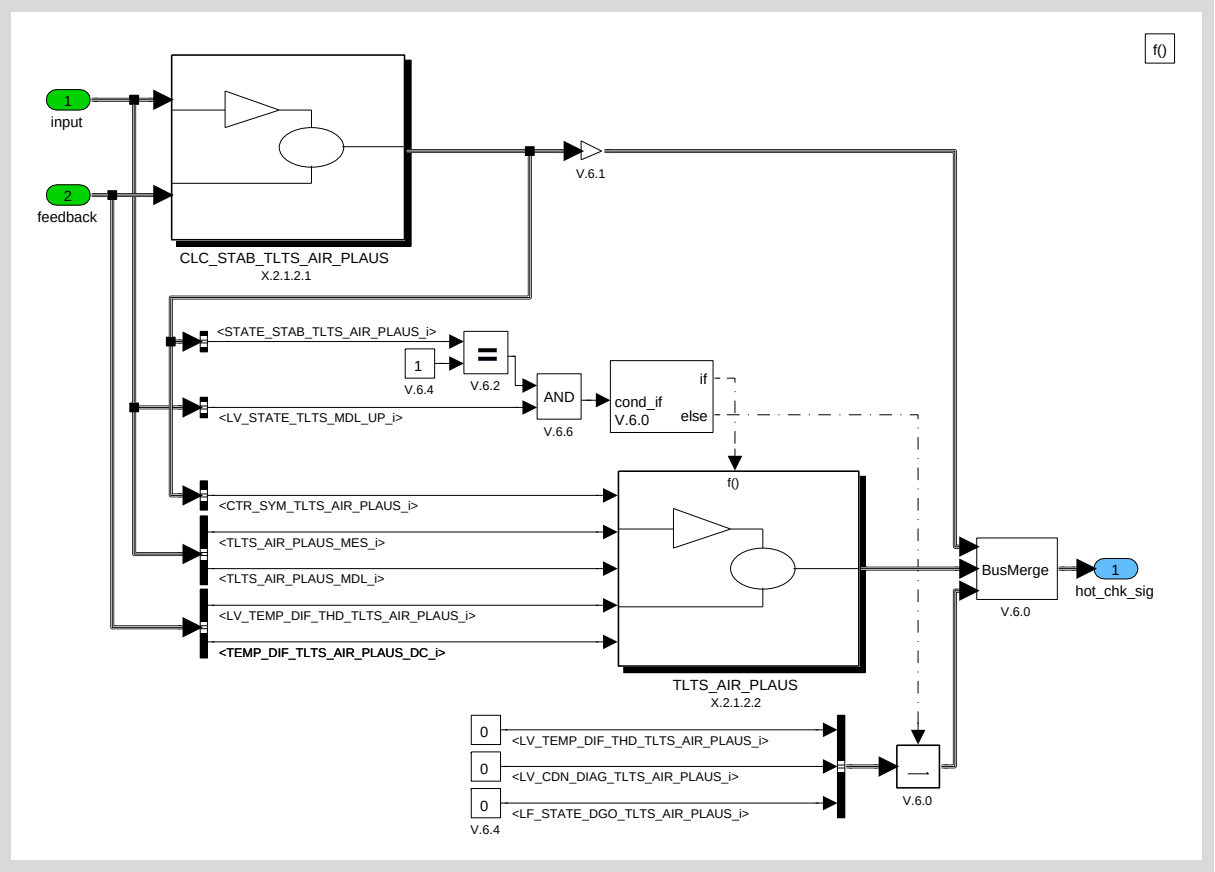

Figure 3.22.4:

3.22.2.1.2.1 stability check of air temperature sensor signal

The air temperature sensor signal is defined as stable, if the difference between minimum and maximum value of temperature is smaller than a defined threshold over a certain period of time.
The state of the stability check is calculated, as this information is needed for the reset of certain variables.

STATE_STAB_TLTS_AIR_PLAUS_I is defined as follows:
- 2 (sensor signal not stabled)
- 1 (sensor signal stable)
- 0 (stability check pending)

3.22.2.1.2.1.1 Calculation of trailing pointers, temperature difference and counter for stability check

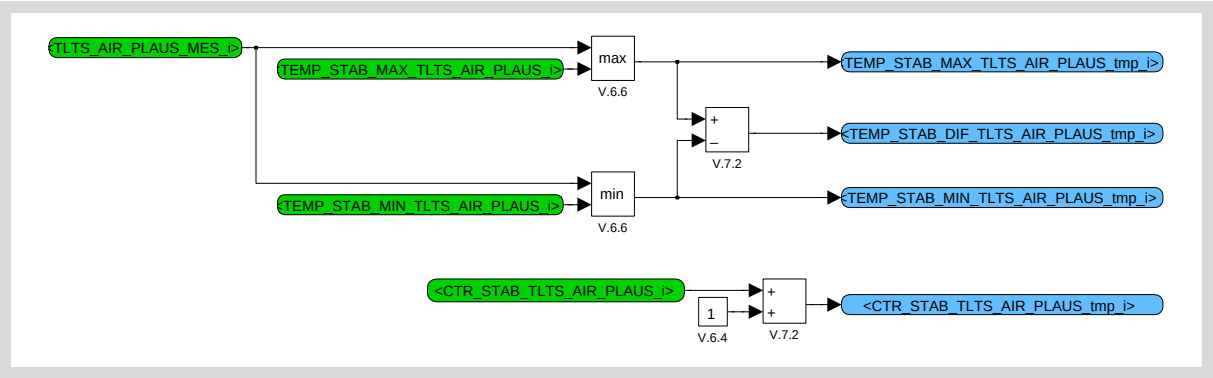

Figure 3.22.5:

3.22.2.1.2.1.2 Calculation of the state of the stability check

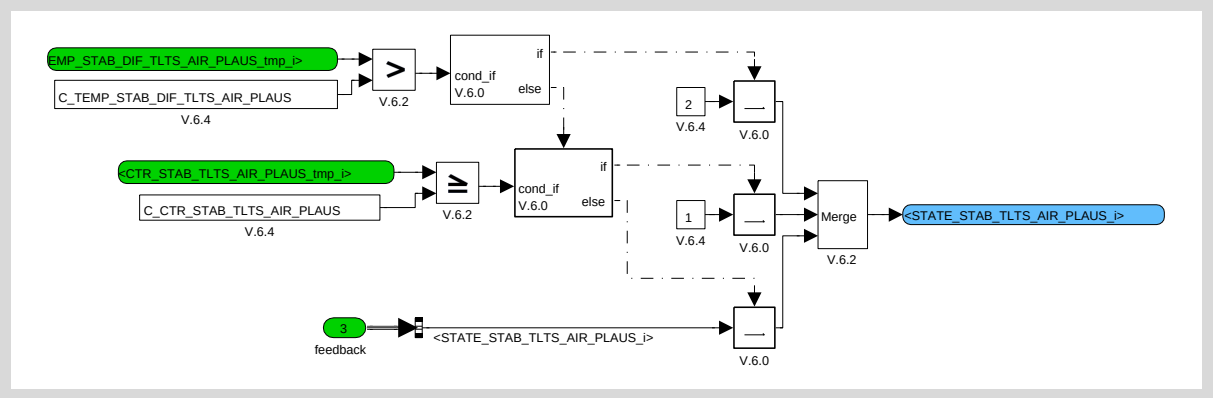

Figure 3.22.6:

3.22.2.1.2.1.3 Reset of variables depending on the state of the stability check

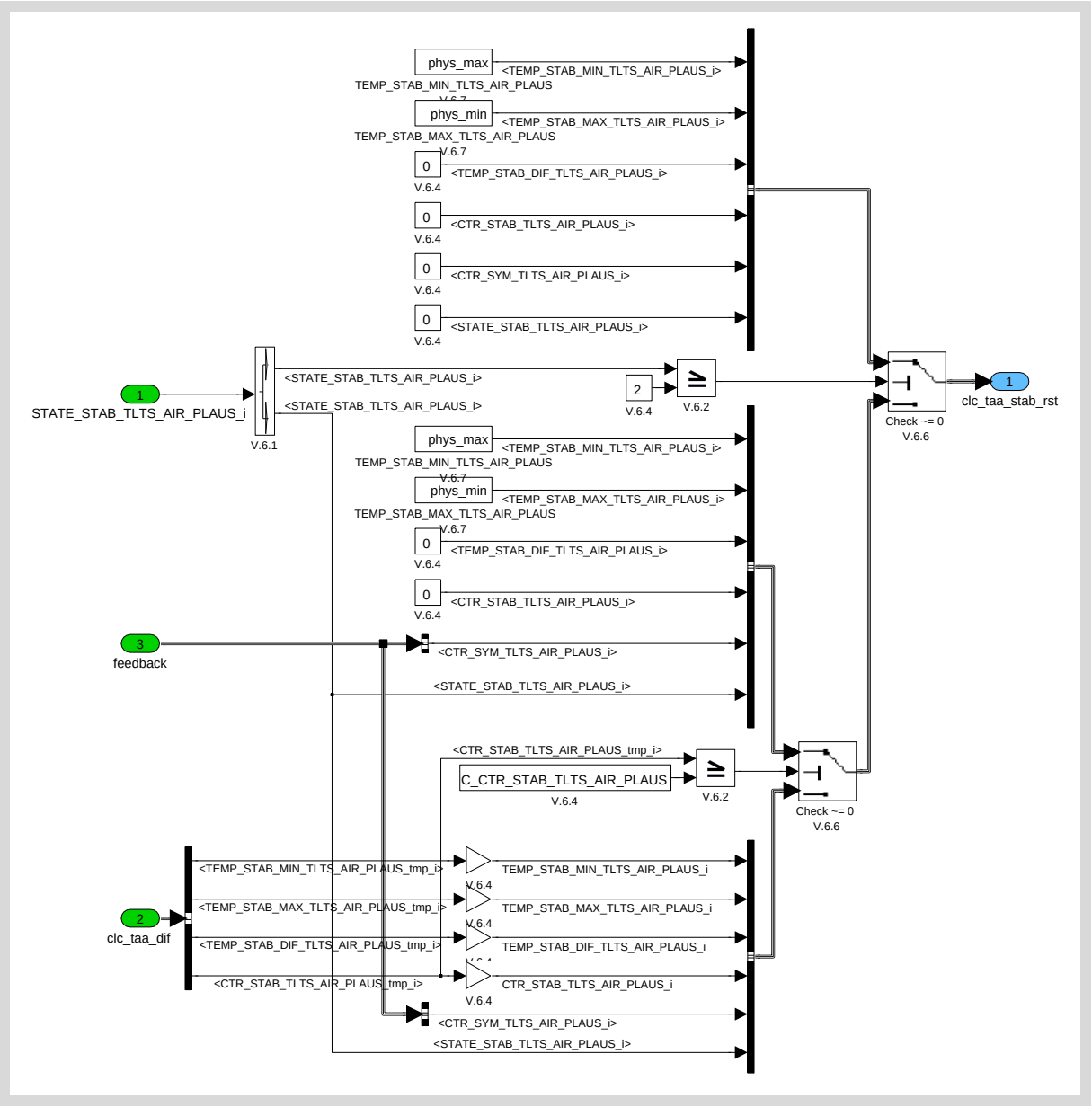

Figure 3.22.7:

3.22.2.1.2.2 Sensor signal plausibility diagnosis

3.22.2.1.2.2.1 Calculation of the temperature difference

In this part, the difference between measured and modeled value is calculated and a flag is set if this difference is above the given threshold.

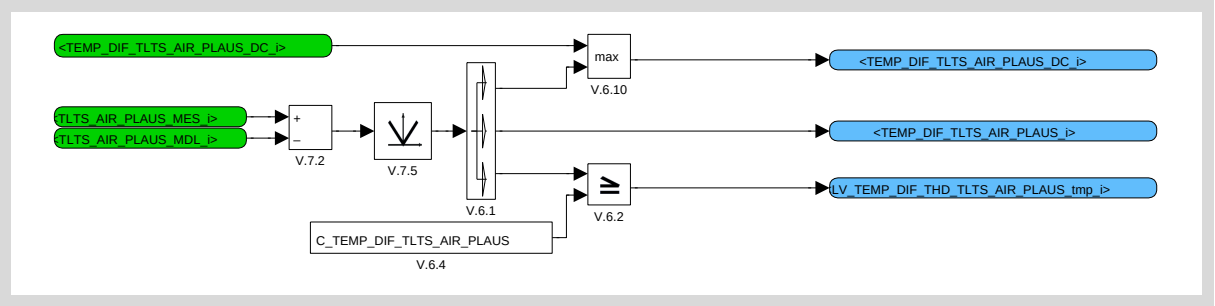

Figure 3.22.8:

3.22.2.1.2.2.2 Determination of the temporary symptom of the diagnosis

Each time the result of the comparison of measured and modeled value of the current recurrence is the same as the result of the last recurrence, the counter is incremented. As soon as the counter reaches the limit, the temporary symptom is refreshed and a condition flag is set for the final error definition.

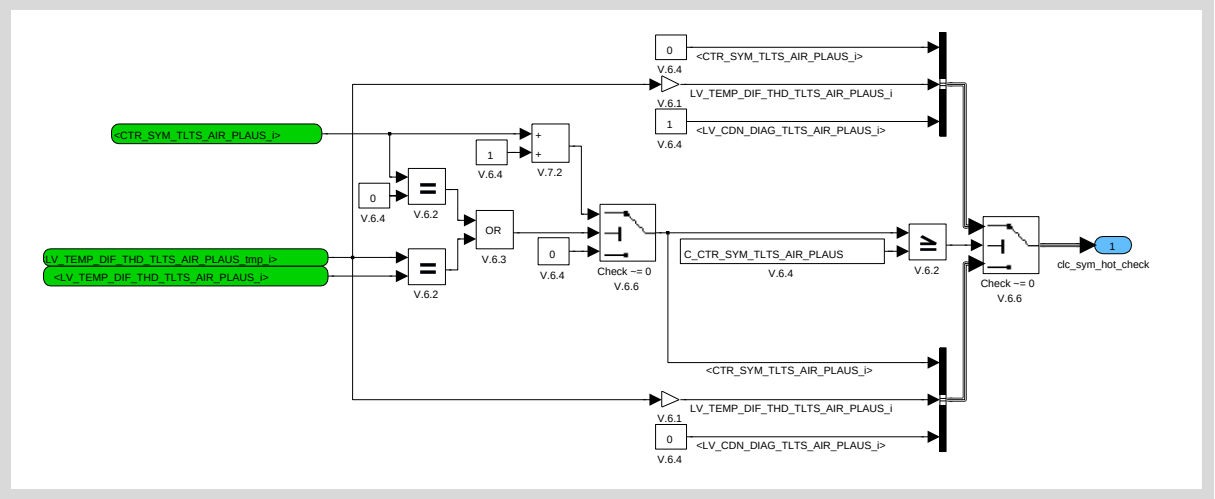

Figure 3.22.9:

3.22.2.1.2.2.3 Calculation of the state of the diagnosis

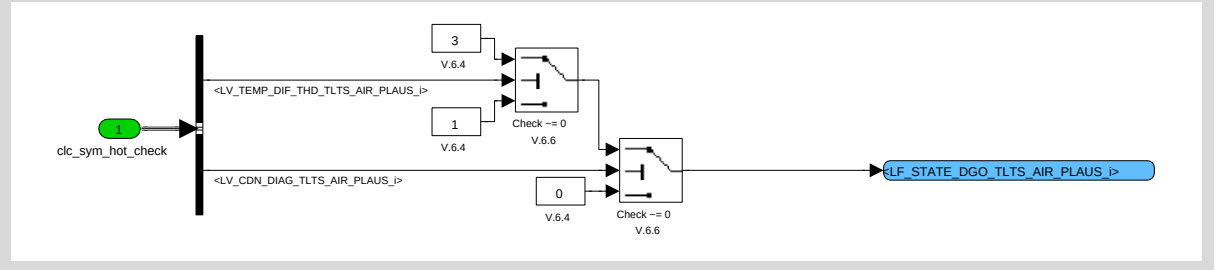

Figure 3.22.10:

3.22.2.1.3 Reset of variables at activation condition off

The variables which are required for diagnosis are reset if the diagnosis is not activated (LV_CDN_DIAG_TLTS_AIR_PLAUS = 0)

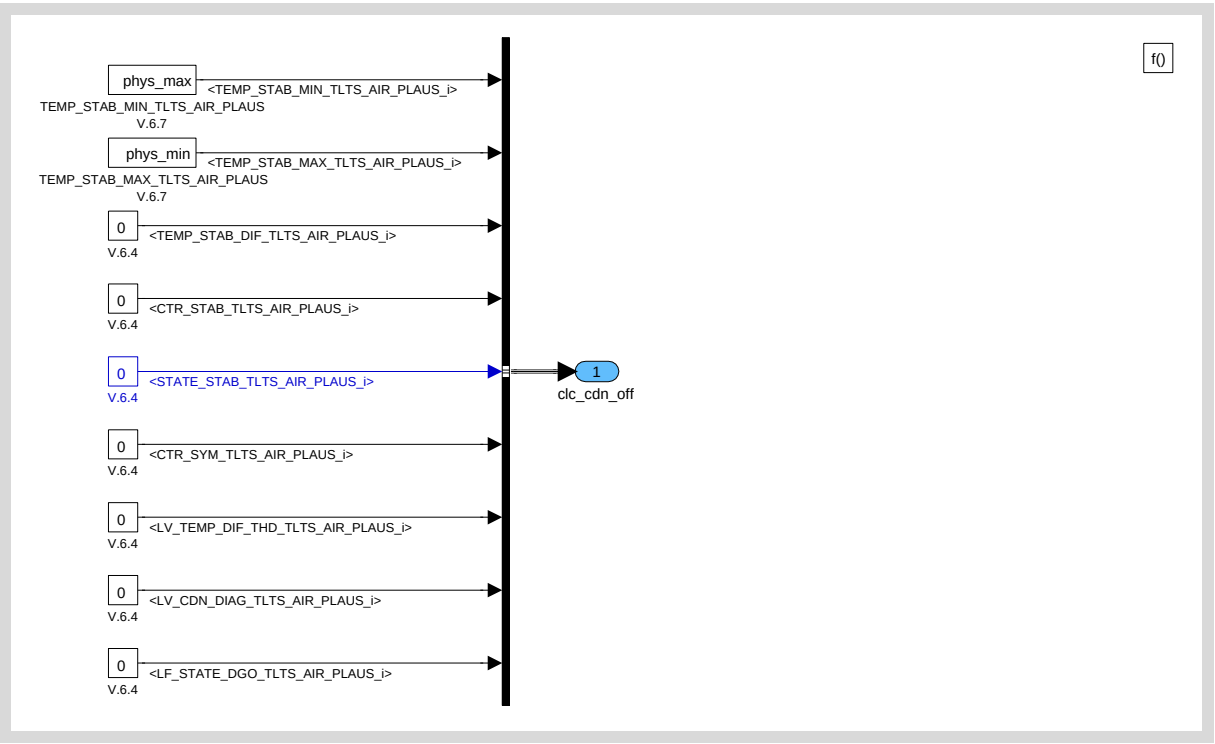

Figure 3.22.11:

3.23 Air temperature sensor plausibility diagnosis (ERRM interface)

Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
LV_TLTS_AIR_PLAUS_CLR_DIAG	O/V	0... 1H	0 ...1	1	-
Clear diagnostic trigger for air temperature sensor plausibility diagnosis					

Input Data

LF_STATE_DGO_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS] {p. 1260}	NC_NR_TLTS_AIR_PLAUS {p. 1136}		

Configuration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
NC_IDX_ERR_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	O	0... FFFFH	0... 65535	1	-
ERRM diagnosis identifier for air temperature sensor plausibility diagnosis					

Action Definitions

ACTION_AIRT_ResetDiagTItsPlaus(IN <PRM_STATE_INI>, **IN** <PRM_NR_CONF>)					**Mode: O**
Action to clear or restart the diagnosis TLTS_AIR_PLAUS					
Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_STATE_INI	in	0H 1H	CLR REST	-	-
Type of initialization (Clear: CLR; restart: REST)					
PRM_NR_CONF	in	0... FFH	0... 255	1	-
Additional configuration information for the action (may be not used)					

Import actions:

ACTION_ERRM_ResultDiag(**IN** <PRM_IDX_ERR>, **IN** <PRM_STATE_DGO>, **OUT** <PRM_STATE_FIL>)

Error treatment

Diagnostic Identifier	Diagnostic initialization function	NR_CONF	CARB class	OBD DTC
Diagnostic description				
NC_IDX_ERR_TLTS_AIR_PLAUS [NC_NR_TLTS_AIR_PLAUS]	ACTION_AIRT_ResetDiagTItsPlaus		CC	
ERRM diagnosis identifier for air temperature sensor plausibility diagnosis				

Definition of the behavior of the initialization				
ERR-Flag		Reset at ECU Reset	reset at Key ON	Latch error on fail
		NO	NO	NO
ABC	ABC-class	MAX-INC after Failure	No Reset at NEWDC	Init on Condition Loss
	NO-FIL	NO	NO	NO
Description of the implementation				
	prestore FRF	RBM	Similar conditions	
	NO	CENTRAL		

▶ General Information

This error management interface module is valid for symptom based ERRM.
The number of temperature sensors for this diagnosis is defined with: NC_NR_TLTS_AIR_PLAUS

▶ Application Conditions

Initialisation: **at** reset **and** IGKON:
all variables set to 0

Activation: always

Deactivation: never

Recurrence: 1 s

▶ Function Description

```
% Set handshake flag to clear diagnosis package
LV_TLTS_AIR_PLAUS_CLR_DIAG = 0;

% Interface to error management
for i = 0 to NC_NR_TLTS_AIR_PLAUS - 1

ACTION_ERRM_ResultDiag(IN<NC_IDX_ERR_TLTS_AIR_PLAUS[i]>,
                       IN<LF_STATE_DGO_TLTS_AIR_PLAUS[i]>)

endfor
```

3.23.1 ACTION_AIRT_ResetDiagTItsPlaus

```
if PRM_STATE_INI==CLR
then
% handshake to clear the diagnosis package outside from this module
   LV_TLTS_AIR_PLAUS_CLR_DIAG = 1;
endif
```

3.24 Intake gas temperature sensor plausibility diagnosis (Appl. Inc.)

Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
LV_DYN_TIG_PLAUS_ACT [NC_NR_TIG_PLAUS]	O/V	0... 1H	0 ...1	1	-
Activation of DYN part of TIG_PLAUS diagnosis					
LV_INH_ERR_TIG_PLAUS [NC_NR_TIG_PLAUS]	O/V	0... 1H	0 ...1	1	-
Inhibition of intake air temperature plausibility diagnosis					
LV_STUCK_TIG_PLAUS_ACT [NC_NR_TIG_PLAUS]	O/V	0... 1H	0 ...1	1	-
Activation of STUCK part of TIG_PLAUS diagnosis					
MFL_INT_STUCK_TIG_PLAUS	O/V	0... FFFFH	0... 65535	1	g
Air mass flow integral for STUCK part of TIG_PLAUS diagnosis					
STATE_HEAT_TIG_PLAUS	O/V	0H 1H 2H	CON DEC INC	-	-
State of heat storage in intake manifold for TIG_PLAUS diagnosis					
TIG_PLAUS_MES [NC_NR_TIG_PLAUS]	O/V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Measured temperature value for intake gas temperature plausibility diagnosis					

Input Data

LV_IGK {p. 24082}	LV_PUC {p. 7530}	MFL_GAS_IM_AIRT {p. 1143}	NC_NR_TIG_PLAUS {p. 1136}
STATE_HEAT_IM {p. 1204}	TIG_IM_MES {p. 1150}		

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_STATE_HEAT_TIG_PLAUS_TEST	V	0H 1H 2H	CON INC DEC	-	-
State of heat storage for testing mode of TIG_PLAUS diagnosis					
C_TIG_PLAUS_MES_TEST [NC_NR_TIG_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Measured temperature value for testing mode of TIG_PLAUS diagnosis					
LC_DYN_TIG_PLAUS_ACT [NC_NR_TIG_PLAUS]	V	0... 1H	0 ...1	1	-
Activation of DYN part of TIG_PLAUS diagnosis					
LC_INH_DIAG_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	0... 1H	0 ...1	1	-
Logical bit to inhibit intake gas temperature sensor plausibility diagnosis					
LC_STUCK_TIG_PLAUS_ACT [NC_NR_TIG_PLAUS]	V	0... 1H	0 ...1	1	-
Activation of STUCK part of TIG_PLAUS diagnosis					
LC_TIG_PLAUS_ACT_TEST	V	0... 1H	0 ...1	1	-
Activation of testing mode for intake gas temperature plausibility diagnosis					

Configuration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
NC_FID_ERR_TIG_PLAUS [NC_NR_TIG_PLAUS]	0	0... FFFFH	0... 65535	1	-
Run the intake gas temperature sensor plausibility diagnosis					

Import actions:

ACTION_ERRM_GetEndDiag(**IN** <PRM_IDX_ERR>, **OUT** <PRM_LV_END_DIAG>)

ACTION_FARM_GetPermission(**IN** <PRM_FID>, **OUT** <PRM_LV_PRMS>)

General Information

This module provides all necessary variables for the intake gas temperature plausibility diagnosis.

The aim of this function is to verify the right dynamic of an air temperature sensor in the intake system under dedicated driving conditions.
As this dynamic only appears when the sensor is closed to the hot engine(intake manifold), the respective air temperature sensors has to be defined at the beginning of the project (NC_NR_TIG_PLAUS).

For testing the switch LC_TIG_PLAUS_ACT_TEST can be used to set all parameters manually.

Application Conditions

Initialisation:
```
at reset:
TIG_PLAUS_MES(IM) = TIG_IM_MES
```

Activation: `LV_IGK = 1`

Deactivation: `when activation condition not fulfilled`

Recurrence: `1s`

Function Description

```
if LC_TIG_PLAUS_ACT_TEST = 0  // normal operation mode
then

for i = 0 to NC_NR_TIG_PLAUS - 1
 if(ACTION_FARM_GetPermission(IN<NC_FID_ERR_TIG_PLAUS(i)>)) and
    LC_INH_DIAG_TIG_PLAUS(i) = 0
 thenLV_INH_ERR_TIG_PLAUS(i) = 0
 else LV_INH_ERR_TIG_PLAUS(i) = 1
 endif

LV_DYN_TIG_PLAUS_ACT(i) = LC_DYN_TIG_PLAUS_ACT(i)
LV_STUCK_TIG_PLAUS_ACT(i) = LC_STUCK_TIG_PLAUS_ACT(i) and
                            NOT (ACTION_ERRM_GetEnd(IN<NC_IDX_ERR_TIG_PLAUS(i)>))
endfor

TIG_PLAUS_MES(IM) = TIG_IM_MES
```

```
if STATE_HEAT_IM = 1
then STATE_HEAT_TIG_PLAUS = 2
elseif STATE_HEAT_IM = 2
then STATE_HEAT_TIG_PLAUS = 1
else
STATE_HEAT_TIG_PLAUS = 0
endif

if LV_PUC = 0
then
  MFL_INT_STUCK_TIG_PLAUS = MFL_INT_STUCK_TIG_PLAUS_{N-1} +
                                          ((MFL_GAS_IM_AIRT / 3600) * 1000)
else
  MFL_INT_STUCK_TIG_PLAUS = MFL_INT_STUCK_TIG_PLAUS_{N-1}
endif

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
else    // testing mode

for i = 0 to NC_NR_TIG_PLAUS - 1
LV_INH_ERR_TIG_PLAUS(i) = 0
LV_DYN_TIG_PLAUS_ACT(i) = LC_DYN_TIG_PLAUS_ACT(i)
LV_STUCK_TIG_PLAUS_ACT(i) = LC_STUCK_TIG_PLAUS_ACT(i)
TIG_PLAUS_MES(i) = C_TIG_PLAUS_MES_TEST(i)
endfor

STATE_HEAT_TIG_PLAUS = C_STATE_HEAT_TIG_PLAUS_TEST
endif
```

3.25 Intake gas temperature sensor plausibility diagnosis

▶ Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
CTR_SYM_DYN_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	0... FFH	0... 255	1	-
Counter used for failure filtering for DYN part of TIG_PLAUS diagnosis					
LF_STATE_DGO_DYN_TIG_PLAUS [NC_NR_TIG_PLAUS]	O/V	0... FFH	0... 255	1	-
State of DYN part of intake gas temperature sensor plausibility diagnosis					
LF_STATE_DGO_STUCK_TIG_PLAUS [NC_NR_TIG_PLAUS]	O/V	0... FFH	0... 255	1	-
State of STUCK part of intake gas temperature sensor plausibility diagnosis					
LF_STATE_DGO_TIG_PLAUS [NC_NR_TIG_PLAUS]	O/V	0... FFH	0... 255	1	-
State of intake gas temperature sensor plausibility diagnosis					
LV_CDN_DIAG_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	0... 1H	0 ...1	1	-
Condition for intake gas temperature plausibility diagnosis					
LV_CDN_DYN_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	0... 1H	0 ...1	1	-
Condition for DYN part of TIG_PLAUS diagnosis					
LV_CDN_STUCK_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	0... 1H	0 ...1	1	-
Condition for STUCK part of TIG_PLAUS diagnosis					
LV_SYM_DYN_TIG_PLAUS_TMP [NC_NR_TIG_PLAUS]	V	0... 1H	0 ...1	1	-
Temporary symptom for DYN part of TIG_PLAUS diagnosis					
LV_SYM_STUCK_TIG_PLAUS_TMP [NC_NR_TIG_PLAUS]	V	0... 1H	0 ...1	1	-
Temporary symptom for STUCK part of TIG_PLAUS diagnosis					
LV_T_RISE_DYN_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	0... 1H	0 ...1	1	-
Rising timer flag for TIG_PLAUS diagnosis					
STATE_DYN_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	0... FFH	0... 255	1	-
STATE of DYN part for TIG_PLAUS diagnosis					
T_DYN_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	0... FFH	0... 255	1	s
Timer for DYN part of TIG_PLAUS diagnosis					
TIG_DIF_DEC_TIG_PLAUS_DC [NC_NR_TIG_PLAUS]	V	80... 7FH	-128 ...127	1	°C
Difference between minimum and maximum value of temperature for DYN part of TIG_PLAUS diagnosis at current DC					
TIG_DIF_DEC_TIG_PLAUS_TOT_DC [NC_NR_TIG_PLAUS]	V/S	80... 7FH	-128 ...127	1	°C
Difference between minimum and maximum value of temperature for DYN part of TIG_PLAUS diagnosis for all DCs					
TIG_DIF_DYN_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Difference between minimum and maximum value of temperature for DYN part of TIG_PLAUS diagnosis					
TIG_DIF_INC_TIG_PLAUS_DC [NC_NR_TIG_PLAUS]	V	80... 7FH	-128 ...127	1	°C
Difference between minimum and maximum value of temperature for DYN part of TIG_PLAUS diagnosis at current DC					
TIG_DIF_INC_TIG_PLAUS_TOT_DC [NC_NR_TIG_PLAUS]	V/S	80... 7FH	-128 ...127	1	°C
Difference between minimum and maximum value of temperature for DYN part of TIG_PLAUS diagnosis for all DCs					
TIG_DIF_STUCK_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Difference of TIG variation for STUCK part of TIG_PLAUS diagnosis					

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
TIG_DIF_STUCK_TIG_PLAUS_TOT_DC [NC_NR_TIG_PLAUS]	V/S	80... 7FH	-128 ...127	1	°C
Difference of TIG variation for STUCK part of TIG_PLAUS diagnosis for all DCs					
TIG_DIF_THD_DYN_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Temperature difference threshold for DYN part of TIG_PLAUS diagnosis					
TIG_MAX_DYN_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Maximum TIG variation value for DYN part of TIG_PLAUS diagnosis					
TIG_MAX_STUCK_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Maximum TIG variation value for STUCK part of TIG_PLAUS diagnosis					
TIG_MIN_DYN_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Minimum TIG variation value for DYN part of TIG_PLAUS diagnosis					
TIG_MIN_STUCK_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Minimum TIG variation value for STUCK part of TIG_PLAUS diagnosis					

Input Data

DIST_DC {p. 26281}	LV_CDN_VB_OBD2 {p. 24053}	LV_DYN_TIG_PLAUS_ACT [NC_NR_TIG_PLAUS] {p. 1272}	LV_IGK {p. 24082}
LV_INH_ERR_TIG_PLAUS [NC_NR_TIG_PLAUS] {p. 1272}	LV_ST_END {p. 7530}	LV_STUCK_TIG_PLAUS_ACT [NC_NR_TIG_PLAUS] {p. 1272}	LV_T_ES_DC_VLD {p. 8333}
LV_T_ES_NOT_AVL_AIRT {p. 1198}	LV_TIG_PLAUS_CLR_DIAG {p. 1287}	MFL_INT_STUCK_TIG_PLAUS {p. 1272}	NC_NR_TIG_PLAUS {p. 1136}
NC_TIG_PLAUS_CONF {p. 1136}	RATE_HEAT_IM_DIF_DC {p. 1204}	STATE_HEAT_TIG_PLAUS {p. 1272}	T_AST_DC {p. 8436}
T_ES_DC {p. 8334}	TAA {p. 1177}	TEMP_HOT_SRC_MMV {p. 1204}	TIG_PLAUS_MES [NC_NR_TIG_PLAUS] {p. 1272}

Calibration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_CTR_SYM_DYN_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	0... FFH	0... 255	1	-
Counter used for failure filtering for DYN part of TIG_PLAUS diagnosis					
C_DIST_MIN_STUCK_TIG_PLAUS	V	0... FFFFFFFFH	0... 429496729500	100	m
Minimum distance for STUCK part of TIG_PLAUS diagnosis					
C_MFL_INT_MIN_STUCK_TIG_PLAUS	V	0... FFFFH	0... 65535	1	g
Air mass flow integral for STUCK part of TIG_PLAUS diagnosis					
C_RATE_HEAT_MIN_TIG_PLAUS	V	0... FFFFH	0... 1310.7	0.02	-
Minimum RATE_HEAT_IM to allow STUCK part of TIG_PLAUS diagnosis					

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
C_T_AST_MIN_STUCK_TIG_PLAUS	V	0... FFFFH	0... 6553.5	0.1	s
Minimum time after start for STUCK part of TIG_PLAUS diagnosis					
C_T_ES_MIN_STUCK_TIG_PLAUS	V	0... FFFFH	0... 65535	1	min
Minimum engine off duration time for STUCK part of TIG_PLAUS diagnosis					
C_T_TIG_DYN_DEC [NC_NR_TIG_PLAUS]	V	0... FFH	0... 255	1	s
Decrement for timer for DYN part of TIG_PLAUS diagnosis					
C_T_TIG_DYN_DEC_MAX [NC_NR_TIG_PLAUS]	V	0... FFH	0... 255	1	s
Maximum time of TIG decrease variation for DYN part of TIG_PLAUS diagnosis					
C_T_TIG_DYN_INC [NC_NR_TIG_PLAUS]	V	0... FFH	0... 255	1	s
Increment for timer for DYN part of TIG_PLAUS diagnosis					
C_T_TIG_DYN_INC_MAX [NC_NR_TIG_PLAUS]	V	0... FFH	0... 255	1	s
Maximum time of TIG increase variation for DYN part of TIG_PLAUS diagnosis					
C_TAA_MIN_STUCK_TIG_PLAUS	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Minimum ambient air temperature for STUCK part of TIG_PLAUS diagnosis					
C_TEMP_HOT_MIN_STUCK_TIG_PLAUS	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Minimum engine temperature to allow STUCK part of TIG_PLAUS diagnosis					
C_TIG_DIF_THD_DEC_DYN_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Temperature difference threshold for DYN part of TIG_PLAUS diagnosis at state 'DEC'					
C_TIG_DIF_THD_INC_DYN_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Temperature difference threshold for DYN part of TIG_PLAUS diagnosis at state 'INC'					
C_TIG_DIF_THD_STUCK_TIG_PLAUS [NC_NR_TIG_PLAUS]	V	8000... 7FFFH	-256... 255.9921875	0.0078125	°C
Difference of TIG variation for STUCK part of TIG_PLAUS diagnosis					

▶ General Information

The aim of this function is to verify the right dynamic of an air temperature sensor in the intake system under dedicated driving conditions.
The module consists of two diagnoses, which are merged to one single failure symptom.

STUCK diagnosis:
This diagnosis is performed only once. Trailing pointers for minimum and maximum temperature are calculated. As soon as the condition flag is set (LV_CDN_STUCK_TIG_PLAUS = 1), the difference between minimum and maximum value is compared to a certain threshold.

DYN diagnosis:
This diagnosis is performed continuously as long as the engine is warm.
An alternating check of increasing and decreasing air temperature is done. Therefore trailing pointers of minimum and maximum values are calculated.
The difference between minimum and maximum value is compared with a certain threshold to calculate the failure symptom. The error symptom is set only, when the same symptom is detected more than counter consecutives times.

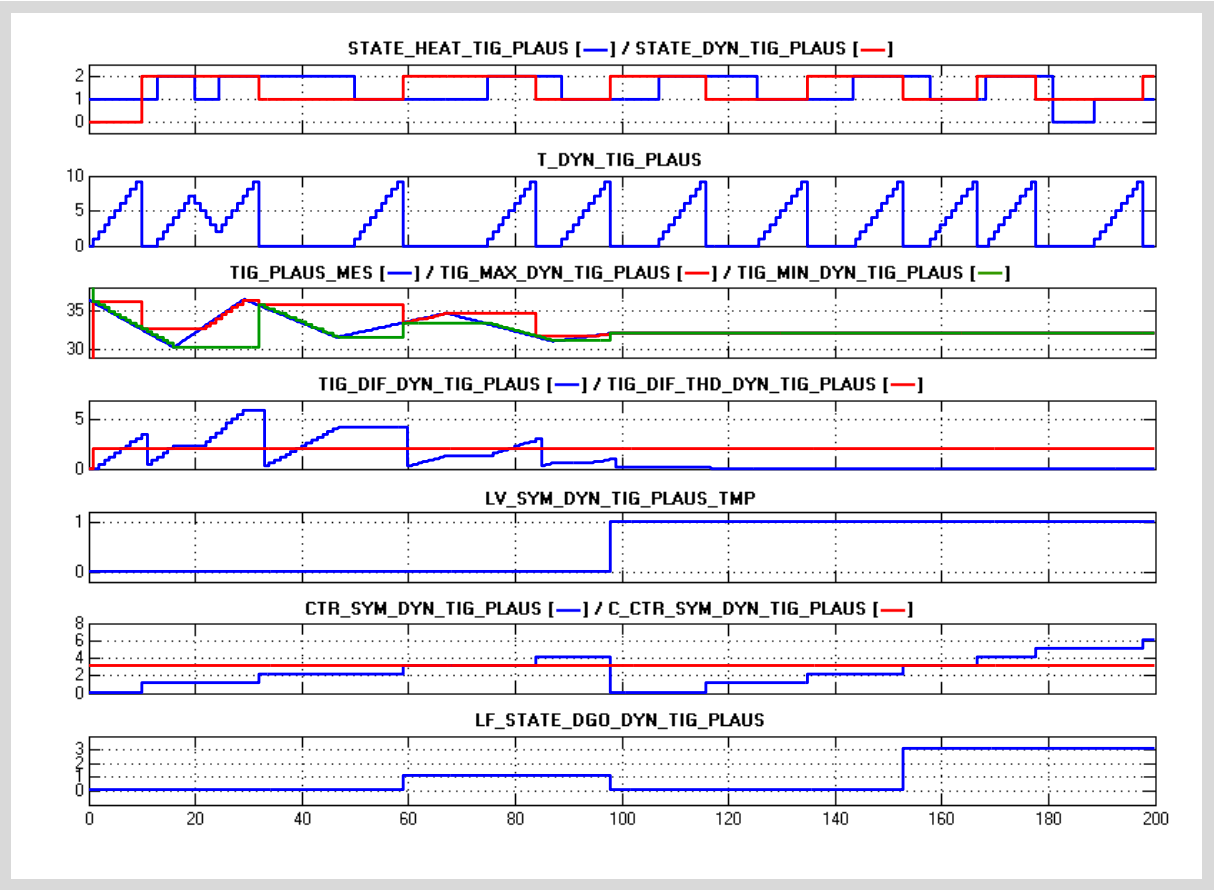

Figure 3.25.1: Overview for DYN diagnosis

For calibration purpose the variables TIG_DIF_INC(DEC)_TIG_PLAUS_TOT_DC, TIG_DIF_STUCK_TIG_PLAUS_TOT_DC are created which show the maximum temperature differences over all DC's.

▶ Application Conditions

Initialisation:	`RST, IGKON, NVMRES, NVMINI, NVMSTO`
Activation:	`LV_IGK`
Deactivation:	`never`
Recurrence:	`1S`

▶ Function Description

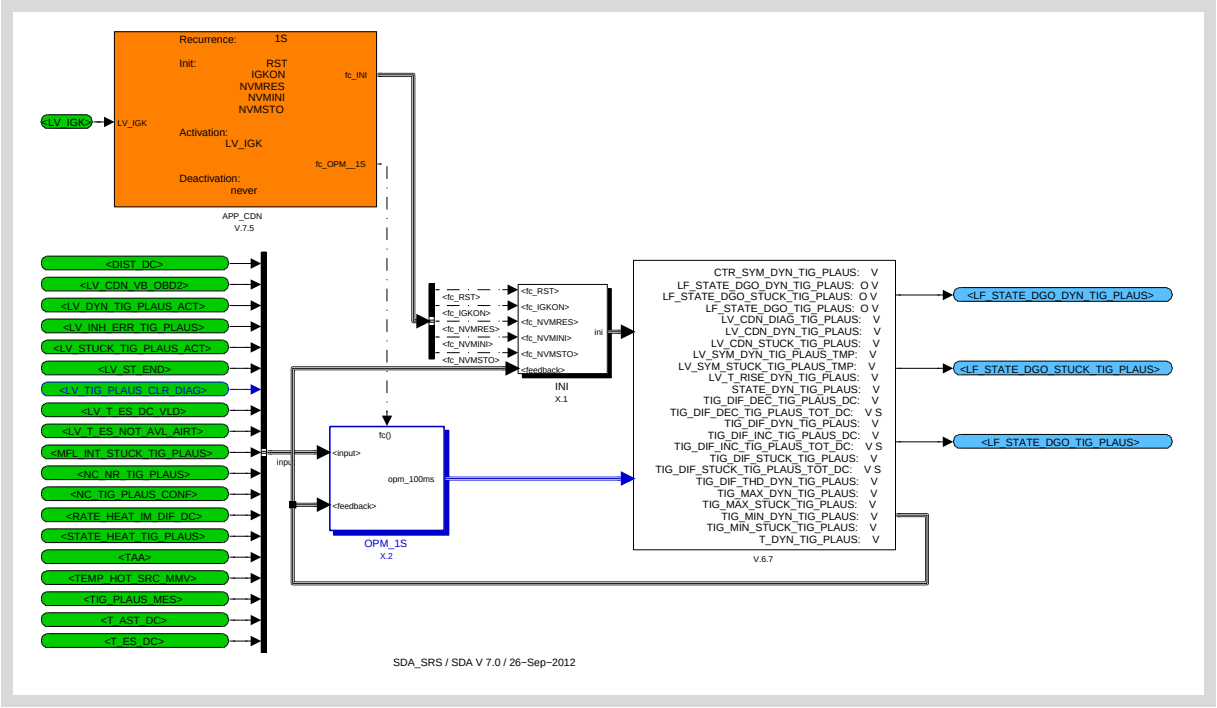

Figure 3.25.2:

3.25.1 Initialization at IGKON and RST

All variables are initialized with zero, except the trailing pointers:
TIG_MIN(MAX)_DYN_TIG_PLAUS(min = phys_max, max = phys_min)
TIG_MIN(MAX)_STUCK_TIG_PLAUS(min = phys_max, max = phys_min)

3.25.2 Formula section

3.25.2.1 Calculation at 1s recurrence

3.25.2.1.1 Overview

3.25.2.1.1.1 Overview of the STUCK part of TIG_PLAUS diagnosis

3.25.2.1.1.1.1 Calculation of the condition for STUCK diagnosis

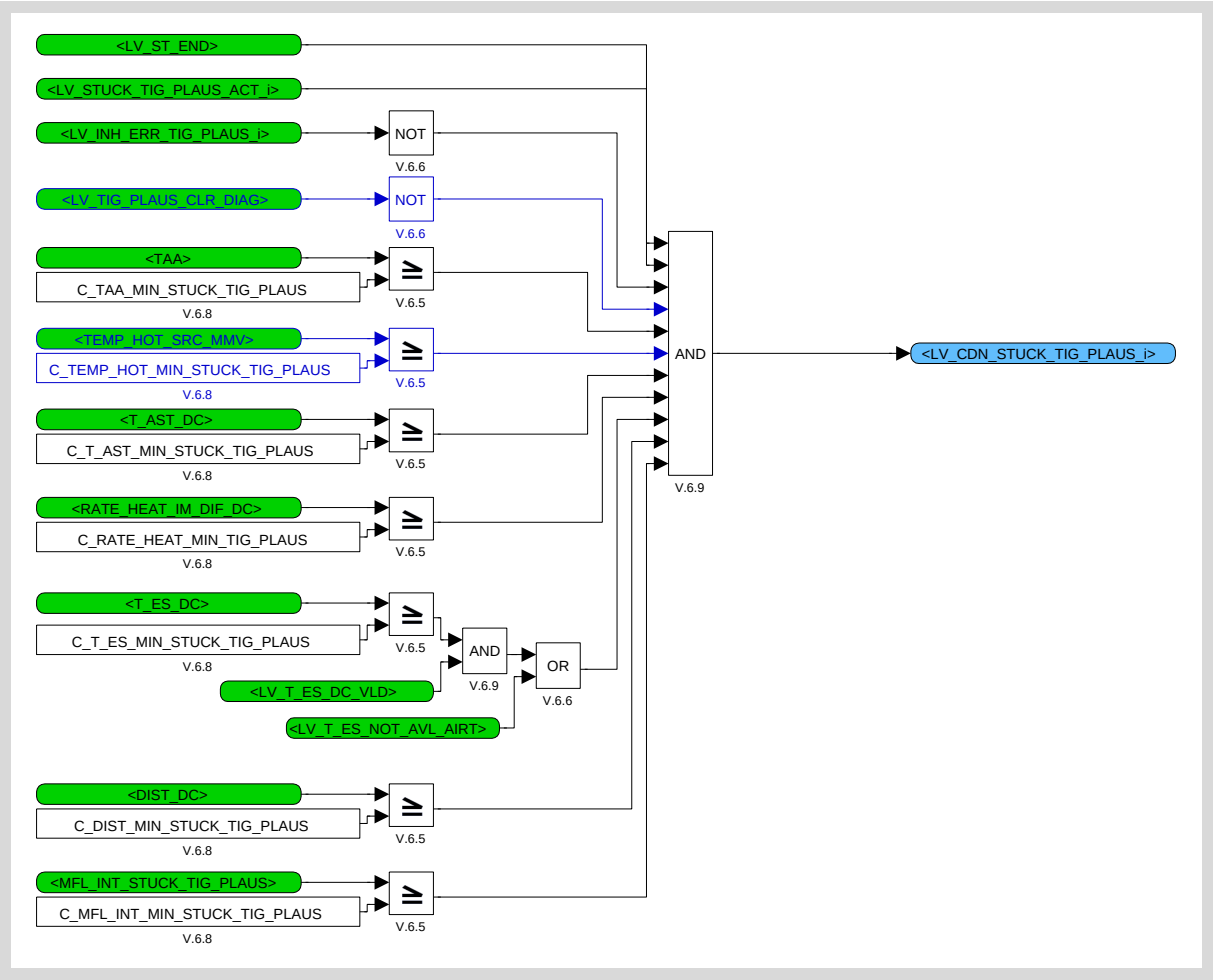

Figure 3.25.3:

3.25.2.1.1.2 Calculation of the symptom for STUCK diagnosis

This diagnosis is performed only once. Trailing pointers for minimum and maximum temperature are calculated. As soon as the condition flag is set (LV_CDN_STUCK_TIG_PLAUS = 1), the difference between minimum and maximum value is compared to a certain threshold.

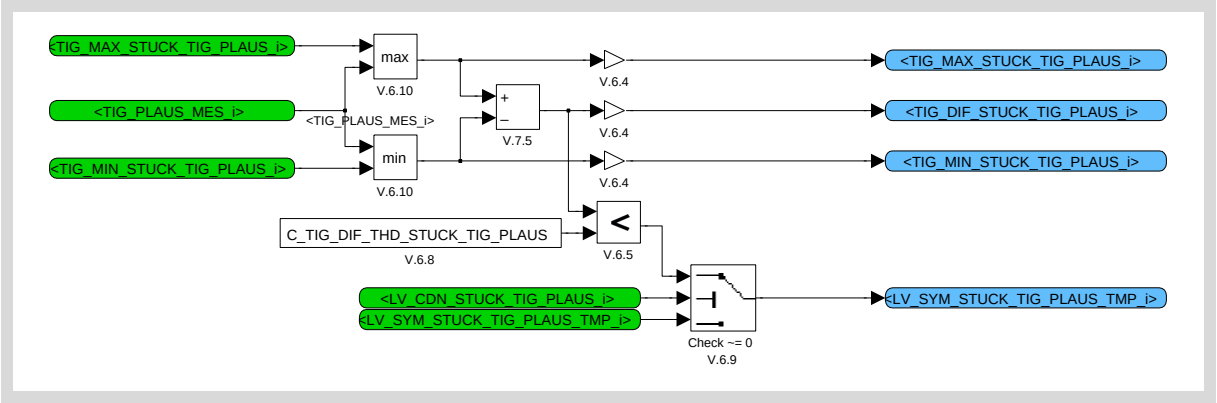

Figure 3.25.4:

3.25.2.1.1.3 Error definition for STUCK part of TIG_PLAUS diagnosis

According to the condition and symptom the state of the STUCK part of TIG_PLAUS diagnosis is set.

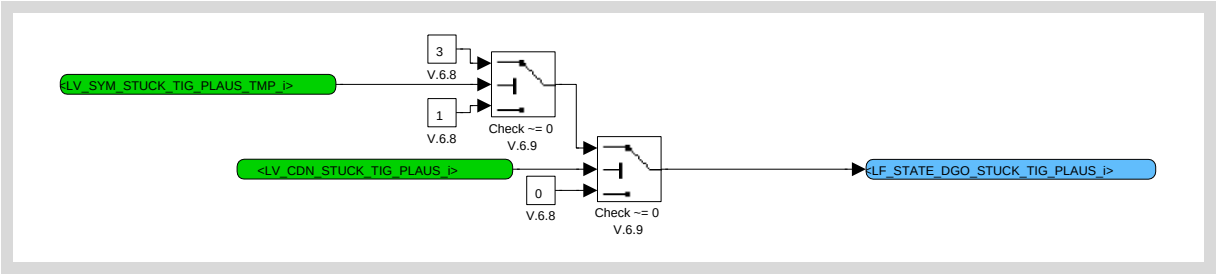

Figure 3.25.5:

3.25.2.1.1.2 Overview of the DYN part of TIG_PLAUS diagnosis

As soon as the conditions are fulfilled the DYN diagnosis is activated. Otherwise the necessary variables are initialized.

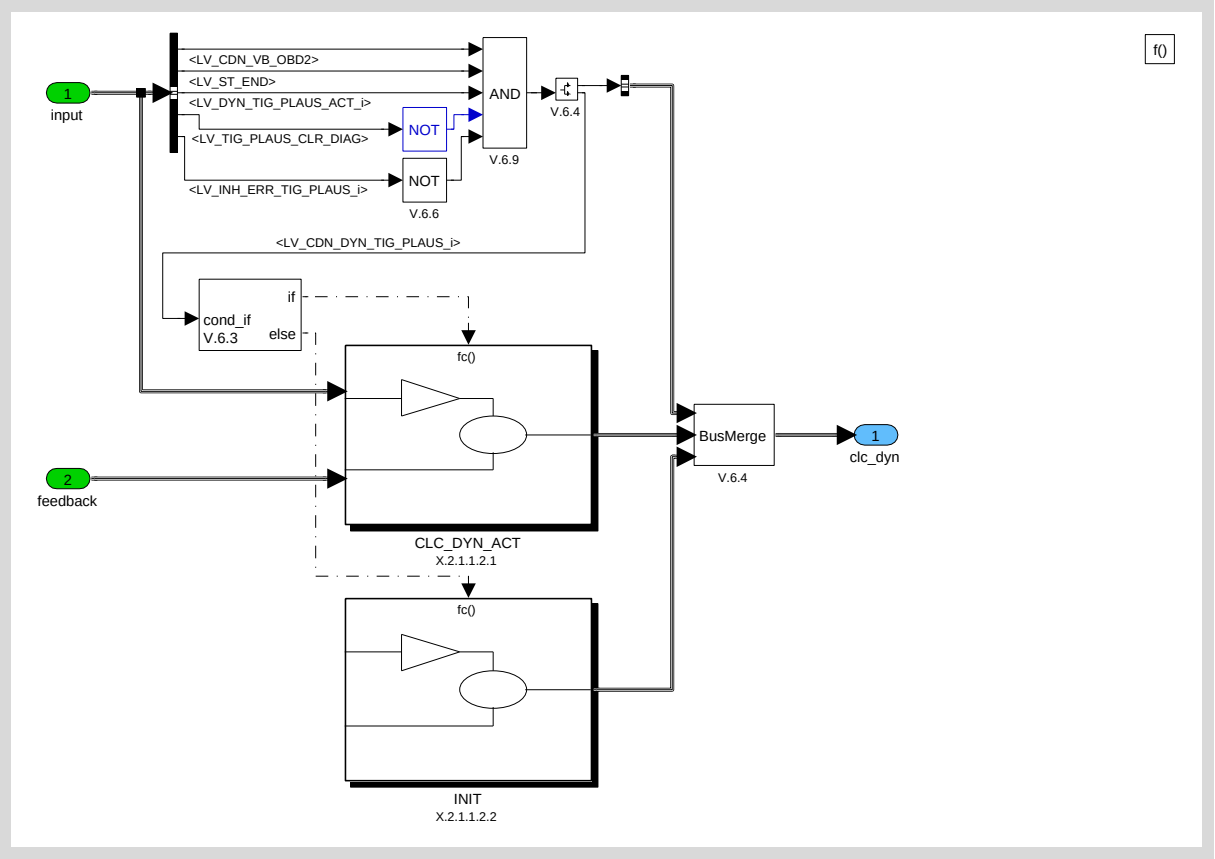

Figure 3.25.6:

3.25.2.1.1.2.1 DYN diagnosis in case of activation condition fulfilled

3.25.2.1.1.2.1.1 Calculation of the timer for DYN diagnosis

The timer is incremented as long as the state of the DYN diagnosis corresponds to the state of the intake manifold heat level.
If the state of the intake manifold heat level(STATE_HEAT_TIG_PLAUS) is different to the currently regarded state of the diagnoses(STATE_DYN_TIG_PLAUS) the counter is decremented with C_T_TIG_DYN_DEC.
With C_T_TIG_DYN_DEC on maximum the counter can be directly reset.

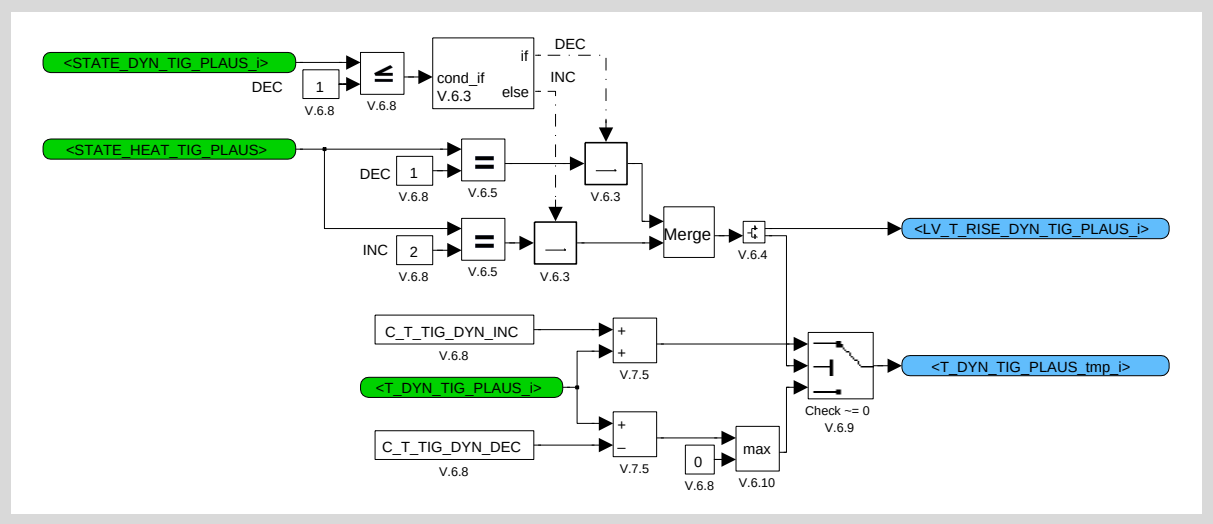

Figure 3.25.7:

3.25.2.1.1.2.1.2 Calculation of trailing pointers, temperature difference and threshold

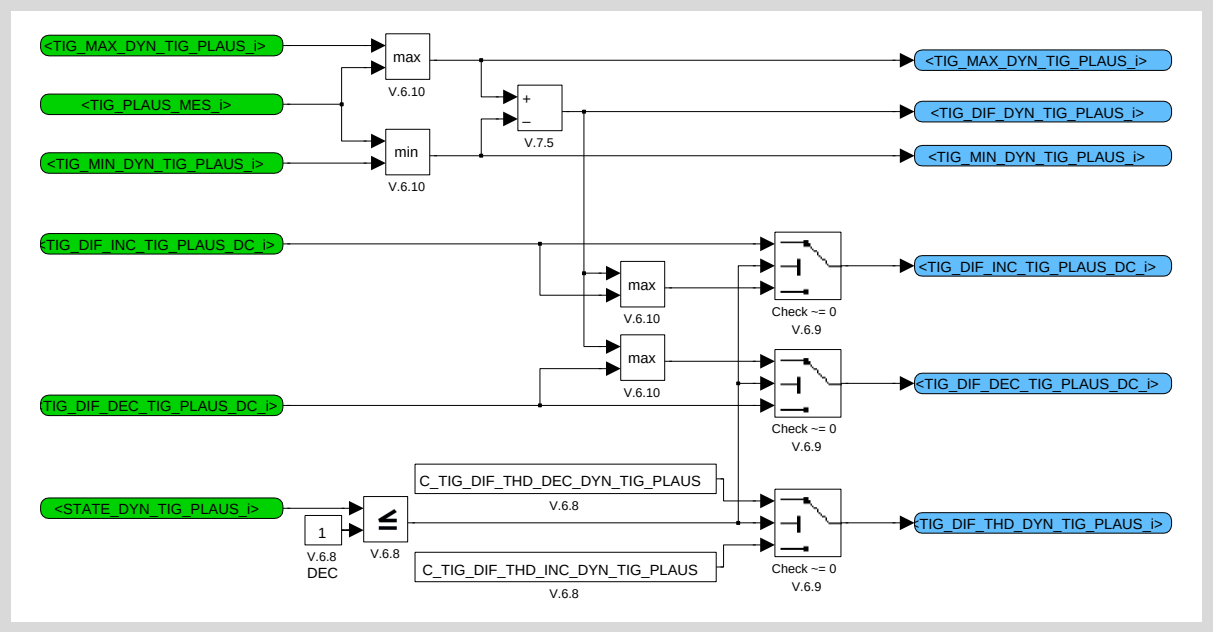

Figure 3.25.8:

3.25.2.1.1.2.1.3 Calculation and debouncing of the symptom for DYN diagnosis

This diagnosis is performed continuously as long as the engine is warm.
An alternating check of increasing and decreasing air temperature is done. Therefore trailing pointers of minimum and maximum values are calculated.

The difference between minimum and maximum value is compared with a certain threshold to calculate the failure symptom. The error symptom is set only, when the same symptom is detected more than counter consecutives times.

3.25.2.1.1.2.1.3.1 Calculation of the symptom for DYN diagnosis

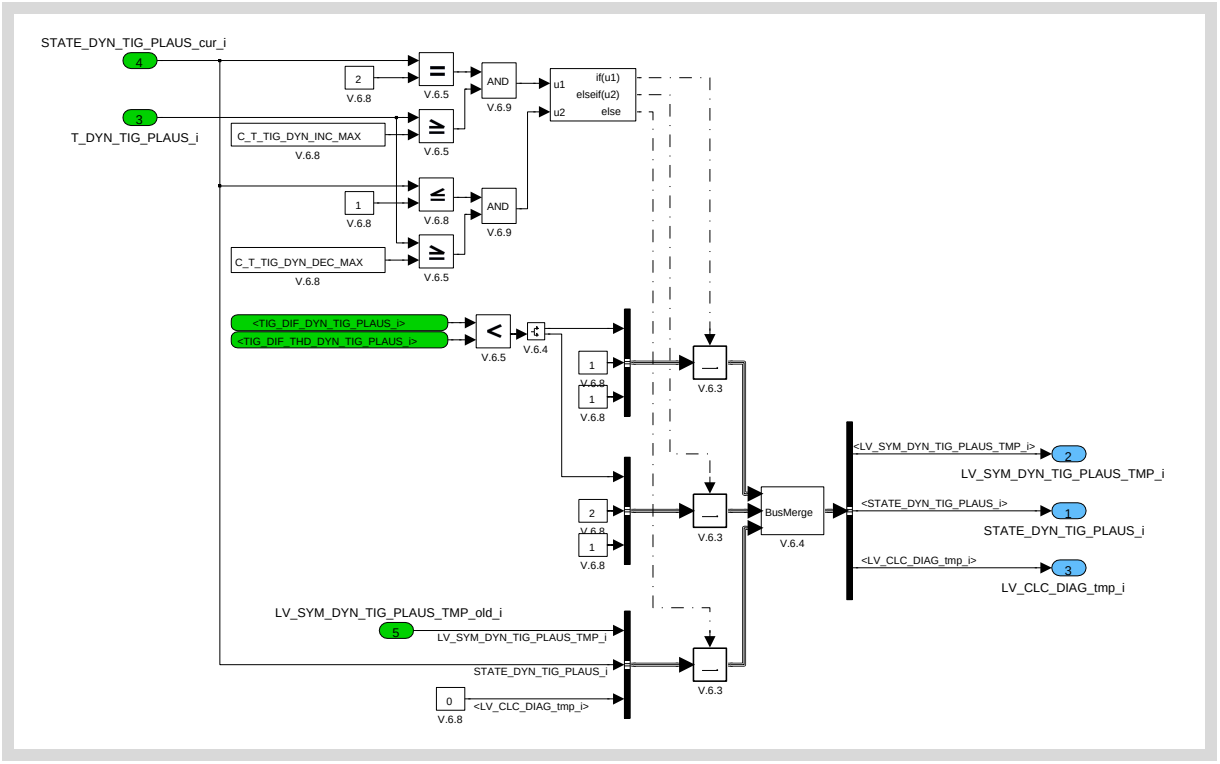

Figure 3.25.9:

3.25.2.1.1.2.1.3.2 Error definition for DYN part of TIG_PLAUS diagnosis

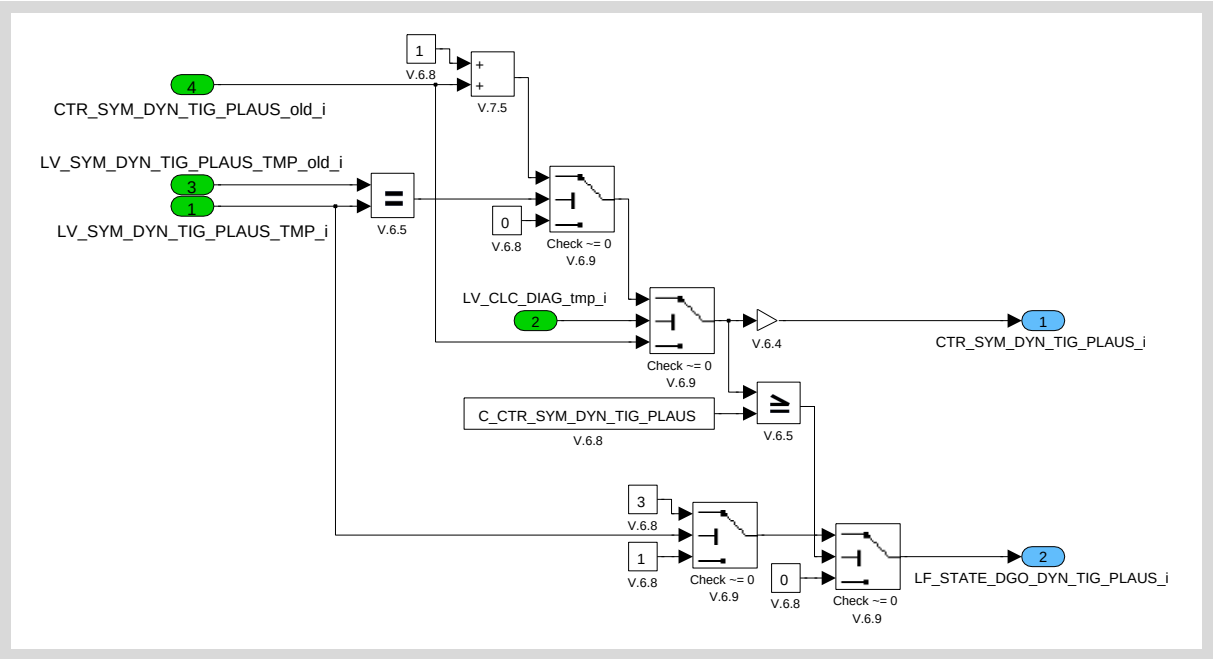

Figure 3.25.10:

3.25.2.1.1.2.1.4 Reinitialization of variables at state change

At every change of the state of the diagnosis, trailing pointers and timer are reset.

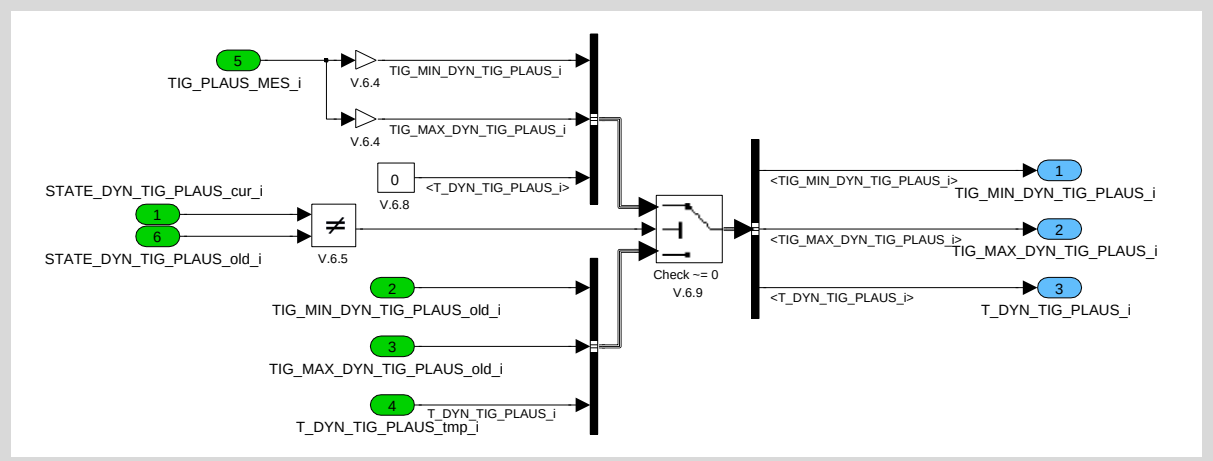

Figure 3.25.11:

3.25.2.1.1.2.2 Initialization of variables in case of activation condition not fulfilled

If the DYN part of the diagnosis is not activated, trailing pointers, timer, counter and state are initialized.

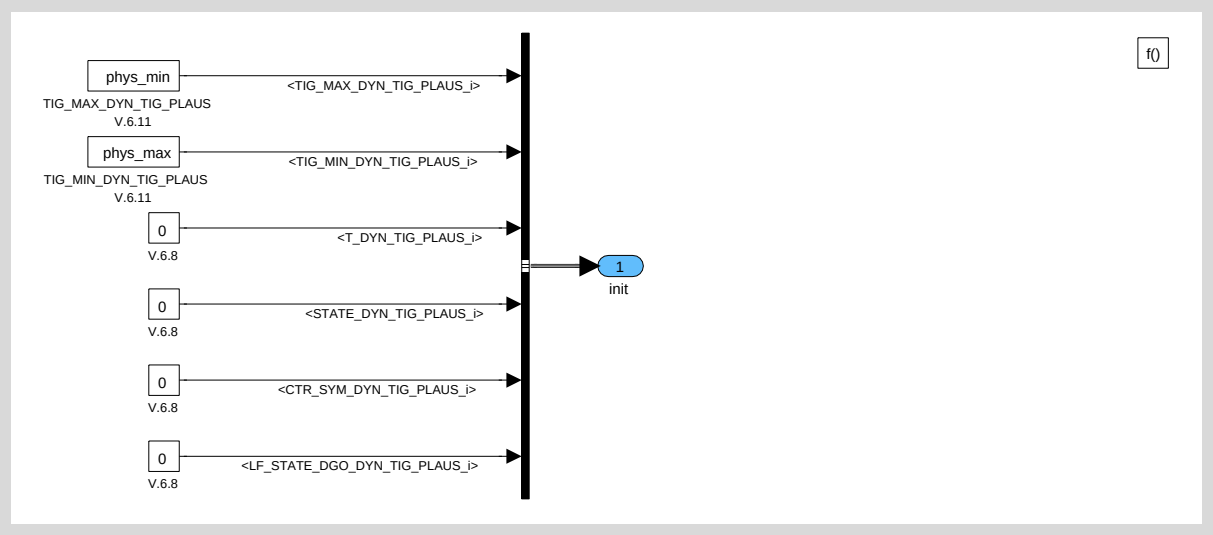

Figure 3.25.12:

3.25.2.1.1.3 Final error definition for TIG_PLAUS diagnosis

According the results of the two parts of the diagnosis (STUCK and DYN), the common state of the diagnosis is set.

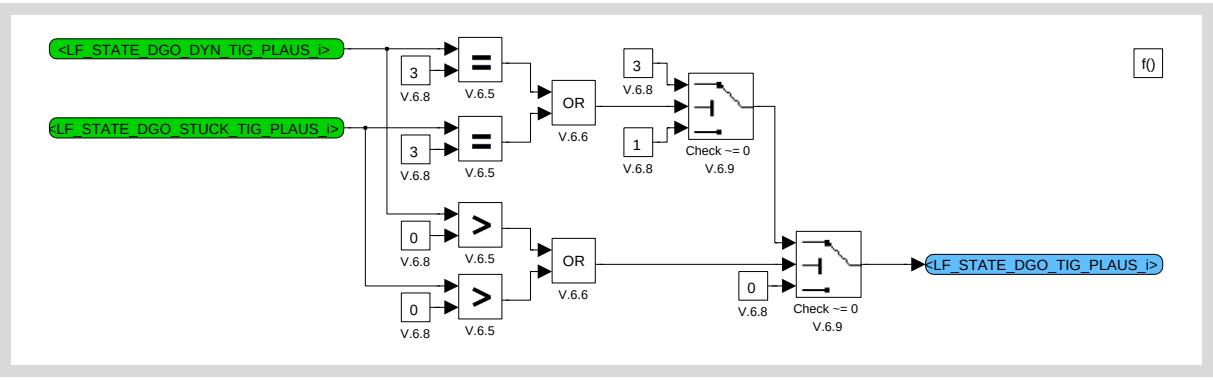

Figure 3.25.13:

3.26 Intake gas temperature sensor plausibility diagnosis (ERRM interface)

Data Definition

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
LV_TIG_PLAUS_CLR_DIAG	O/V	0... 1H	0 ...1	1	-
Clear diagnostic trigger for intake gas temperature sensor plausibility diagnosis					

Input Data

LF_STATE_DGO_TIG_PLAUS [NC_NR_TIG_PLAUS] {p. 1275}	NC_NR_TIG_PLAUS {p. 1136}		

Configuration Data

Name	Mode	Coded Limits	Display Limits	Resolution	Unit
NC_IDX_ERR_TIG_PLAUS [NC_NR_TIG_PLAUS]	O	0... FFFFH	0... 65535	1	-
ERRM diagnosis identifier for intake gas temperature sensor plausibility diagnosis					

Action Definitions

ACTION_AIRT_ResetDiagTigPlaus(**IN** <PRM_STATE_INI>, **IN** <PRM_NR_CONF>)					**Mode: O**
Action to clear or restart the diagnosis TIG_PLAUS					
Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_STATE_INI	in	0H 1H	CLR REST	-	-
Type of initialization (Clear: CLR; restart: REST)					
PRM_NR_CONF	in	0... FFH	0... 255	1	-
Additional configuration information for the action (may be not used)					

Import actions:

ACTION_ERRM_ResultDiag(**IN** <PRM_IDX_ERR>, **IN** <PRM_STATE_DGO>, **OUT** <PRM_STATE_FIL>)

Error treatment

Diagnostic Identifier	Diagnostic initialization function	NR_CONF	CARB class	OBD DTC
Diagnostic description				
NC_IDX_ERR_TIG_PLAUS [NC_NR_TIG_PLAUS]	ACTION_AIRT_ResetDiagTigPlaus		CC	
ERRM diagnosis identifier for intake gas temperature sensor plausibility diagnosis				

Definition of the behavior of the initialization				
ERR-Flag		Reset at ECU Reset	reset at Key ON	Latch error on fail
		NO	NO	NO
ABC	ABC-class	MAX-INC after Failure	No Reset at NEWDC	Init on Condition Loss
	NO-FIL	NO	NO	NO
Description of the implementation				
	prestore FRF	RBM	Similar conditions	
	NO	CENTRAL		

▶ General Information

This error management interface module is valid for symptom based ERRM.
The number of temperature sensors for this diagnosis is defined with: NC_NR_TIG_PLAUS

▶ Application Conditions

Initialisation: `at reset and IGKON: all variables set to 0`

Activation: `always`

Deactivation: `never`

Recurrence: `1 s`

▶ Function Description

```
% Set handshake flag to clear diagnosis package
LV_TIG_PLAUS_CLR_DIAG = 0;

% Interface to error management
for i = 0 to NC_NR_TIG_PLAUS - 1

ACTION_ERRM_ResultDiag(IN<NC_IDX_ERR_TIG_PLAUS[i]>,
                       IN<LF_STATE_DGO_TIG_PLAUS[i]>)

endfor
```

3.26.1 ACTION_AIRT_ResetDiagTigPlaus

```
if PRM_STATE_INI==CLR
then
% handshake to clear the diagnosis package outside from this module
   LV_TIG_PLAUS_CLR_DIAG = 1;
endif
```