Project: MSS54

Module: Exhaust gas temperature

x. exhaust gas temperature

x.1 recording the exhaust gas temperature

The exhaust gas temperature is measured every 100ms using a Pt200 sensor. The measuring voltage is recorded by a 10-bit AD converter. The measurement result is transmitted via a 'PT1-element' (K_TABG_TAU) and converted into a temperature value using characteristic interpolation (KL_TABG_PT200).

x.2 Calculation of the exhaust gas temperature

The analog voltage is available with 10-bit resolution. Due to the low dR/dT of the Pt200
When wired with a 1kÿ resistor, only a resolution of approx. 3.5°C is possible. The filtered value is output with an apparent accuracy of 1°C.

Resolution: 1°
Value range: -55° ... 1250° [0xFFC9 ... 0x04E2]

x.3 replacement value calculation

For diagnosis, a substitute value (tabg_ersatz) is constantly calculated depending on the operating state of the engine.
If the engine is stopped, the intake air tan is used as a stationary replacement value.
The intake air temperature tan + the engine temperature tmot + the offset K_TABG_ERSATZ_TMOT_OFFSET is used as the stationary replacement value for overrun cut-off.
When the engine is running, the stationary replacement value comes from the map KF_TABG_ERSATZ which has as input variables relative filling rf and speed n.
As long as the engine running time is less than K_TABG_ERSATZ_START, this is multiplied by the factor (t_ml_seit_start/K_TABG_ERSATZ_START) in order to simulate the warm-up. In the case of late ignition angles or enrichment, the value from KF_TABG_ERSATZ is corrected in one direction or the other. The correction factors come from the characteristic curves KL_TABG_ERSATZ_TZ (input variable: md_eta_zw_ne) or KL_TABG_ERSATZ_TI (input variable: md_la_ist). Furthermore, the enrichment by the catalytic converter is taken into account with the factor (1/ti_f_kats2).

Finally, the intake air temperature tan is added to the stationary replacement value.
In order to take dynamic influences into account to some extent, the stationary replacement value is filtered with the filter time constant from KL_TABG_ERSATZ_TAU.

x.4 plausibility check

tabg > K_TABG_DIAG_MAX => Short circuit to Ub
or
tabg < K_TABG_DIAG_MIN => Short circuit to ground

If there is no short circuit, the signal is checked for plausibility once per engine run using the calculated substitute value.
The engine must be running during the entire diagnosis and the calculated substitute value must be above the threshold K_TABG_DIAG_THRESHOLD. If this is not the case, the diagnosis is restarted with the complete diagnosis time K_TABG_DIAG_TIME.
If the recorded value, during the diagnosis time, is less than the calculated value by a maximum of K_TABG_DIAG_UNTERHALB and greater than the calculated value by a maximum of K_TABG_DIAG_OBERHALB, the diagnosis for this engine run is concluded as OK. If this is not the case, the sensor is implausible until the next diagnosis in the next engine run and the calculated substitute value is used as tabg.

Entry in the error log under error number 24.

x.5 variables

tabg	exhaust gas temperature
tabg_ed	self-diagnosis exhaust gas temperature sensor
tabg_st	status of the plausibility diagnosis
tabg_diag_time	Maximum allowable diagnostic time
tabg_ersatz	Calculated replacement value
tabg_roh	Recorded raw value

x.6 Applicable quantities of TABG recording

Constants:

K_TABG_TAU	Filter time constant (PT1_Glied) of the measured value acquisition
K_TABG_DIAG_MAX	maximum value for plausibility check
K_TABG_DIAG_MIN	minimum value for plausibility check
K_TABG_ERSATZ_OFFSET_TMOT	Offset + tmot + tan = Stationary replacement value at B_SA
K_TABG_ERSATZ_START	warm-up time replacement temperature
K_TABG_DIAG_SCHWELLE	Plausibility check only if replacement value exceeds threshold
K_TABG_DIAG_UNTERHALB	Maximum deviation of the measured value downwards
K_TABG_DIAG_OBERHALB	Maximum deviation of the measured value upwards
K_TABG_DIAG_TIME	Maximum time period in which the maximum deviation must be adhered to once

characteristics:

KL_TABG_PT200	Conversion of AD value into physical quantity
KL_TABG_ERSATZ_TZ	Correction factor (due to late ignition) of the stationary replacement temperature
KL_TABG_ERSATZ_TI	Correction factor (by lambda) of the stationary replacement temperature
KL_TABG_ERSATZ_TAU	Filter time constant of the replacement value calculation

map:

KF_TABG_ERSATZ	Stationary replacement value if the engine is running and not in overrun

Calculation basis:

1st option: Define the desired temperature and calculate the AD value from it

a) At the appropriate temperature, the resistance value of the NTC (Rnom) from its data sheet.

b) Calculate: $AD\ value\ (10) = \frac{1023}{\frac{1k\Omega}{Rnom} + 1}$

c) Assign AD_Value(10) and temperature in the MCS.

2nd option: Define the desired AD value and calculate the temperature from it

a) Calculate: $R_{nom} = \frac{1k\Omega}{\frac{1023}{AD\ WERT_{(10)}} - 1}$

b) Use Rnom to determine the corresponding temperature from the data sheet.

c) Entry of AD_value(10) and temperature in the MCS.

Determination of the resistance Rnom:

If the Rnom values are not known from the data sheet, they can be calculated.

$Rnom = Ri * R_0 * (1 + 3.8285*10^{-3} * \vartheta + 5.85*10^{-7} * \vartheta^2)$

$Ri = 0.77\Omega$

$R0 = 200\Omega$

ϑ *Selected temperature (in°C)* 0 *C*