MSS54

idle synchronization

1 Idle synchronization:

Due to assembly and manufacturing variations, the leakage air of the individual throttle valves varies. This means that the respective ÿ-
Factor and thus the torque delivered per cylinder; the ÿ factor of the entire bank remains at 1. This uneven cylinder distribution results in uneven running.

By specifically enriching or leaning the mixture of the individual cylinders, the different torques, which result in different segment running times for each cylinder, can be adapted to each other.

This procedure only works within one bank. If the sum of the torque delivered by bank 1 and bank 2 differs when ÿbank = 1, no compensation is possible using injection time corrections, since the lambda control adjusts the injection times changed by LLSYNC when driving. The idle synchronization therefore works bank-selectively and only tries to minimize the running time differences of the cylinders in a bank.

This can lead to different average runtimes for Bank1 and Bank2. If the runtime difference exceeds a specified maximum difference, the synchronization process is stopped.

1.1 ACTIVE CONDITIONS:

Idle synchronization is not only carried out once in the workshop, but works permanently during each engine run. However, the release of the synchronization process is linked to a series of conditions that are summarized in individual condition blocks. In order to achieve the greatest possible flexibility during the application phase or in the field, these condition blocks can be activated or deactivated via a configuration parameter.

Activation conditions for LLSync:

Block 1: detection of the operating point range

Conditions not met:	Bit0 set in llsync_st
Conditions don´t care:	Bit0 in K_LL_AKTIV_CONTROL deleted

Activation condition:

idle operating state

and K_LL_TMOT_MIN ÿ tmot ÿ K_LL_TMOT_MAX
and K_LL_TAN_MIN ÿ tan ÿ K_LL_TAN_MAX
and !B_MD_RF_MIN and | n - llr_nsoll | ÿ K_LL_DN_MAX and v ÿ K_LL_V_MAX

Filling not at minimum stop
in the area around idle speed

Block 2: Lock LLSync when lambda control is inactive
Conditions not met: Bit1 set in llsync_st
Conditions don´t care: Bit1 in K_LL_AKTIV_CONTROL deleted

Activation condition:
Lambda control must be active

Block 3: Considering the influence of tank ventilation
Conditions not met: Bit2 set in llsync_st
Conditions don´t care: Bit2 in K_LL_AKTIV_CONTROL deleted

Activation condition:
tea1_f ÿ K_LL_TEA_MIN and not too strong flushing rate of the TE
tea2_f ÿ K_LL_TEA_MIN
and ! B_TEV_FAILURE no error TE

Block 4: Considering the self-diagnosis of important components
Conditions not met: Bit3 set in llsync_st
Conditions don´t care: Bit3 in K_LL_AKTIV_CONTROL deleted

Activation condition:
no HFM error
and no ZWD error
and no TMOT error
and no TAN error
and no injector error
and no ignition channel error
and no Vanos error

Block 5: Lock LLSync when cat heating is active
Conditions not met: Bit4 set in llsync_st
Conditions don´t care: Bit4 in K_LL_AKTIV_CONTROL deleted

Activation condition:
Cat heating function must be inactive

Block 6: Lock LLSync, for ZW interventions KR/KA
Conditions not met: Bit5 set in llsync_st
Conditions don´t care: Bit5 in K_LL_AKTIV_CONTROL deleted

Activation condition:
no timing retardation from knock control and knock adaptation

Block 7: Lock LLSync when air conditioning compressor is activated

Conditions not met:	Bit6 set in llsync_st
Conditions don´t care:	Bit6 in K_LL_AKTIV_CONTROL deleted

Activation condition:

air conditioning compressor inactive

Block 8: Lock LLSync in case of error in the Egas system

Conditions not met:	Bit7 set in llsync_st
Conditions don´t care:	Bit7 in K_LL_AKTIV_CONTROL deleted

Activation condition:

no Egas emergency program active

In a series tuning, the condition blocks 1, 2, 4, and 8 should be evaluated in any case, ie the corresponding bits in K_LL_AKTIV_CONTROL should be set.

If all activated activation conditions are met, a waiting period of K_LL_SYNC_SPERRZEIT begins, after which a new synchronization process is started. If one of the conditions is no longer met within a synchronization step, the process is immediately aborted and all measured values of the synchronization step are discarded.

1.2 MEASUREMENT:

Provided that the rough running measurement is active, the segment running times of the individual cylinders are added up over K_LL_N_ANZ working cycles.

[ll_tz lu cyl] _ ÿ ÿ ÿ, lu ts_ ÿ ÿll nzyl anz ÿ

Since the summation variables only represent an intermediate result, they are not visible via the MCS.

1.3 CALCULATION:

When the summation of the individual segment runtimes is completed, the sums of the
Individual segment running times divided by K_LL_N_ANZ (simple averaging) and thus an average segment running time per cylinder is determined:

ll_ t_ z[x] ÿ ll_ t_ z[x]/ K_ LL_ N_ NUM

Subsequently, an average bank segment running time is determined for each cylinder bank:

ll t bank 1 = ÿ ll bank 1 ÿ ÿ ll tzi ÿ [ ] / ll bank ÿ 6 cylinder_bank ÿ 3
ÿ i ÿ 0 ÿ

ll t bank 2 = ÿ cfg number of cylinders 1 ÿ ÿ ll tzi [ ] ÿ ll bank ÿ 4 8, cylinder bank ÿ 4
ÿ i ll bank ÿ

The segment running times of each cylinder are now set in relation to the average segment running time of the cylinder bank and stored in the form of a percentage deviation from this in the variable ll_abw[Zylnr - 1]. A positive value means that the segment running time is greater than the average and thus the cylinder is slower, ie that the cylinder torque generated is too low.

1.4 EVALUATION:

An injection time correction is only carried out if the percentage deviations of all segment running times of a cylinder bank are within a tolerance band K_LL_ABW_MAX.

The injection time is corrected using a cylinder-selective offset value ti_ll_z1 to ti_ll_z8, which is incrementally increased or decreased with each synchronization process. These values are saved as adaptation data and are therefore not lost during the follow-up.

The values can be read out, deleted or initialized to any (permissible) values via DS2.

The synchronization process basically runs in the following individual steps.

- Finding the slowest cylinder in a bank

- Calculate a leaning offset ll_ti_dec for the injection time for all other, faster cylinders from the characteristic curve KL_LL_TI_T depending on ll_abw of the slowest cylinder.

- Calculate an enrichment offset ll_ti_inc for the slowest cylinder
  ti_ll_inc = (cylinders per bank - 1) * ll_ti_dec
  This ensures that there are no rounding effects in the calculation and that the total injection time of a cylinder bank is not changed by the LLSync.

- Check whether the synchronization step causes the correction values ti_ll_zx to leave the valid value range K_TI_LL_MIN ÿ ti_ll_zx ÿ K_TI_LL_MAX. If this is the case, the process is aborted and the changes are not adopted.

- Adoption of the injection time changes ll_ti_dec bzx. Ll_ti_inc in the correction values ti_ll_zx

The values of the characteristic curve KL_LL_TI_T for calculating the correction offsets must ensure that the LLSync no longer influences the injection when the engine is sufficiently synchronized. To do this, the deviation must be below a limit (ideally the 1st
An injection time offset of 0µs must be present at the support point in the map. This means that both ll_ti_dec and ll_ti_inc are zero.

1.5 MISCELLANEOUS:

The complete idle synchronization module can be deactivated via the control parameter K_LL_SYNC_CONTROL.

The correction values ti_ll_zx for the injection are pre-initialized with the values from K_LL_TI_FAC[x] after each reset of the adaptation or in the case of a new control unit. This means that design-related, engine-independent differences can be corrected at the factory using data.

1.6 LLSYNC **DATA :**

Description of the variables:

Variable	Meaning
ll_bank	number of cylinders in a bank
ll_ada_anz	Number of synchronization processes performed so far
ll_case	LLSync execution state Initialization - Measurement - Evaluation - Inactive
llsync_st	Status LLSync active - inactive
llsync_st_m	status activation conditions = 0 : all conditions met != 0 : depending on the set bits, the corresponding condition is not fulfilled
ll_t_bank1/2	average segment maturity Bank1 or Bank2
ll_n_anz	Number of currently recorded segments within a sync process
ll_nzyl_anz	Number of segments per sync operation
ll_abw_bank	percentage deviation Bank1 to Bank2
ll_abw[x]	percentage deviation of the cylinder from the bank mean

Description of the application data:

Constant meaning	
K_LL_TI_FAC[x]	factory setting of the injection time correction
K_LL_ABW_MAX max. permissible deviation of a cylinder from the bank mean	
K_LL_SYNC_CONTROL Control parameters for the LLSync	
K_LL_AKTIV_CONTROL Configuration parameters for activation conditions	
K_LL_TAN_MIN min. intake air temperature	
K_LL_TAN_MAX max. intake air temperature	
K_LL_TMOT_MIN min. motor temperature	
K_LL_TMOT_MAX max. motor temperature	
K_LL_V_MAX max. vehicle speed	
K_LL_N_ANZ Number of work cycles per synchronization process	
K_LL_DN_MAX max. speed deviation from the idle target speed	
K_LL_TEA_MIN min. correction factor of the tank ventilation adaptation	
K_LL_SYNC_SPERRZEIT Waiting time until LLSync starts	
KL_LL_TI_T	Correction curve for injection time depending on the deviation of the slowest cylinder.