PROJECT: MSS54

MODULE: EVT MOMENT REALIZATION

AUTHORIZATION

AUTHOR (ZS-M-57)________________________ DATE __________

APPROVED (ZS-M-57) __________________ DATE __________

APPROVED (EA-E-2) ___________________ DATE __________

Machine Translated by Google

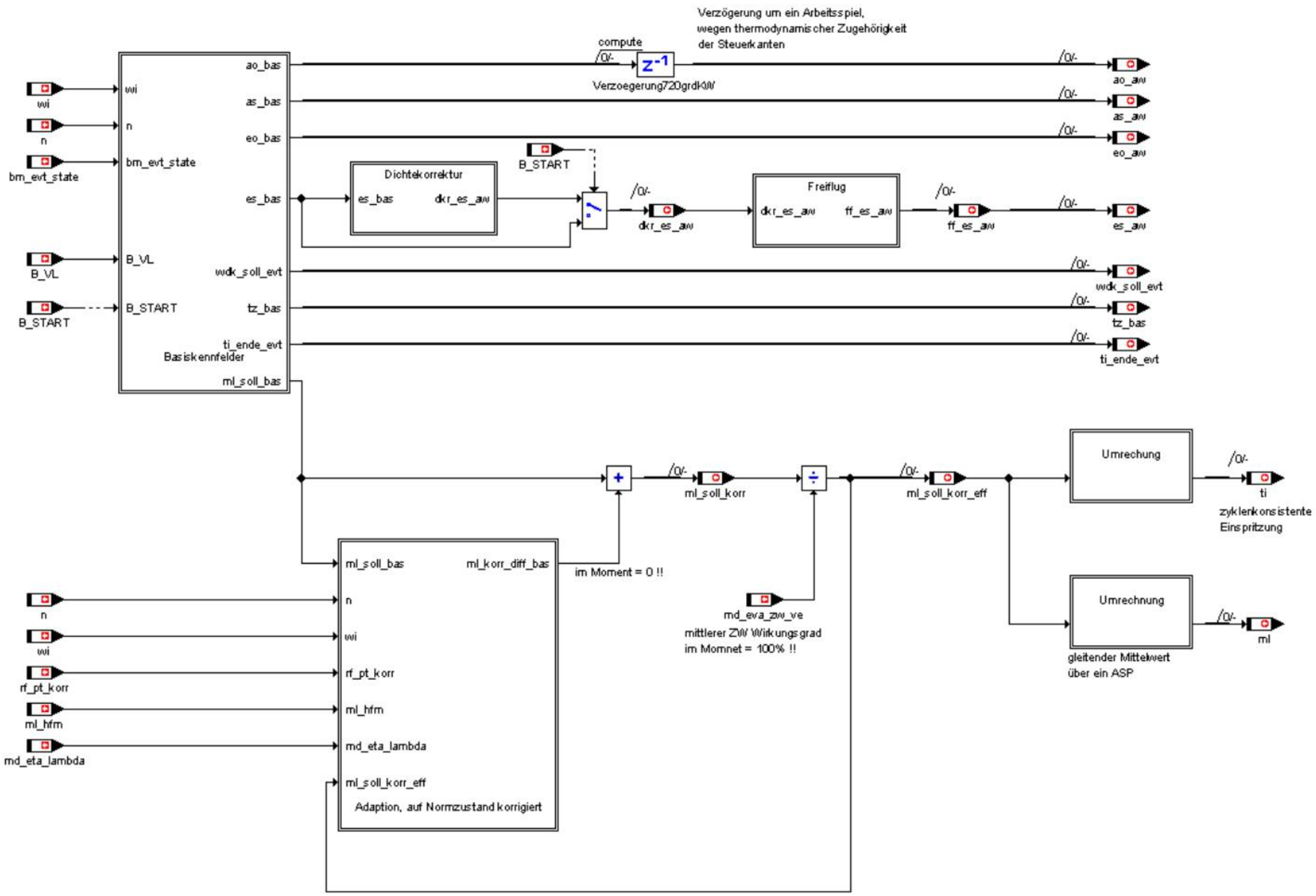
Changes:

version	Date	comment
r310	31.08.2004	First version
r320	27.10.2004	Minihub added
r320	06.11.2004	Conversion of air mass to [mg/l*ASP]
r320	06.11.2004	Pre-bearing angle refers to ES
r330	04.12.2004	Minihub changed from 4V to 3V
r370	27.03.2005	4-stroke braking mode added
r390	25.04.2005	ti_ende and es control edges extended at start of K->KF Density correction calculation changed at start

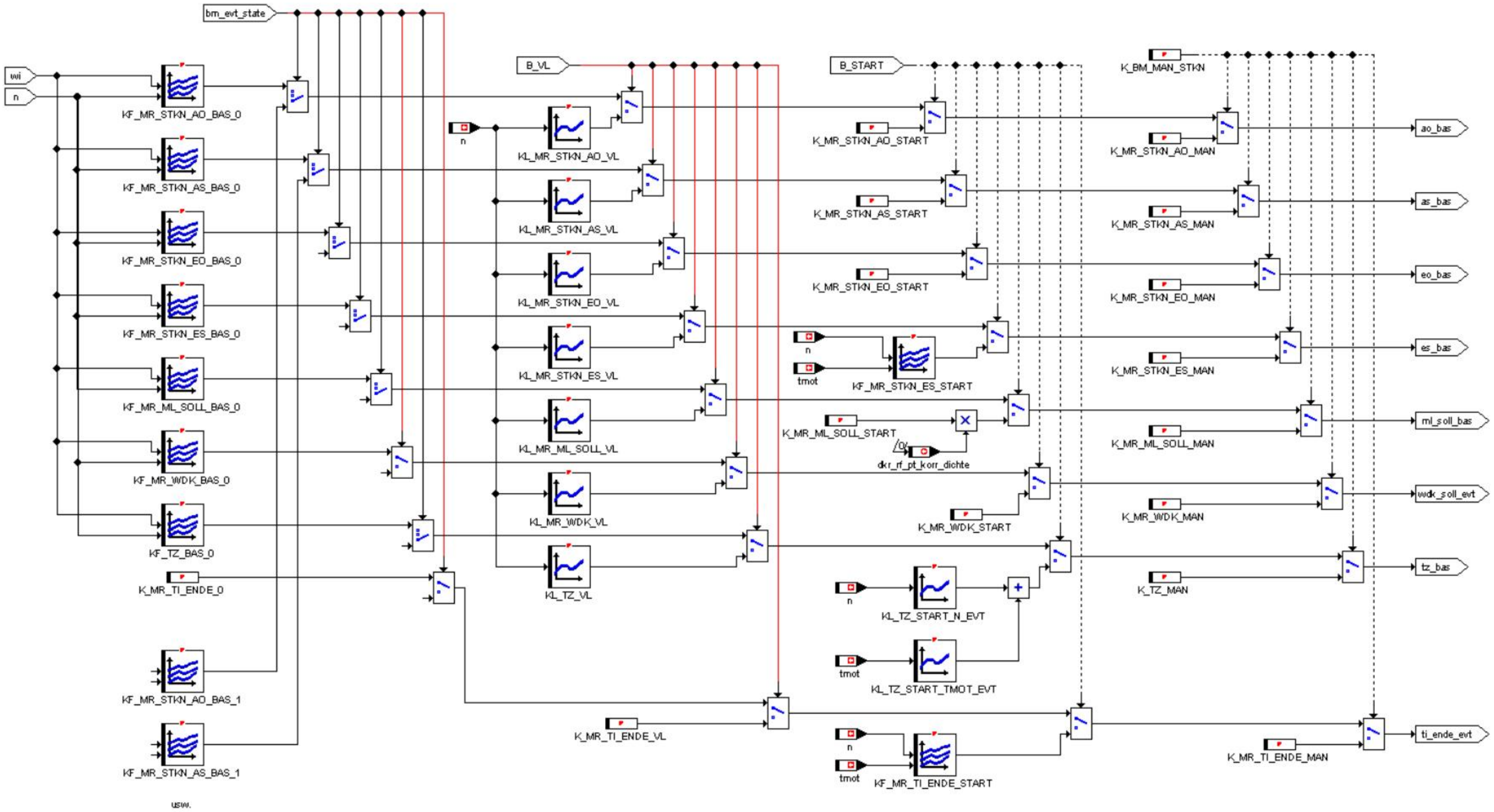
Table of contents

1 FUNCTIONAL DESCRIPTION

1.1 FUNCTIONAL CIRCUIT DIAGRAM (OVERVIEW)



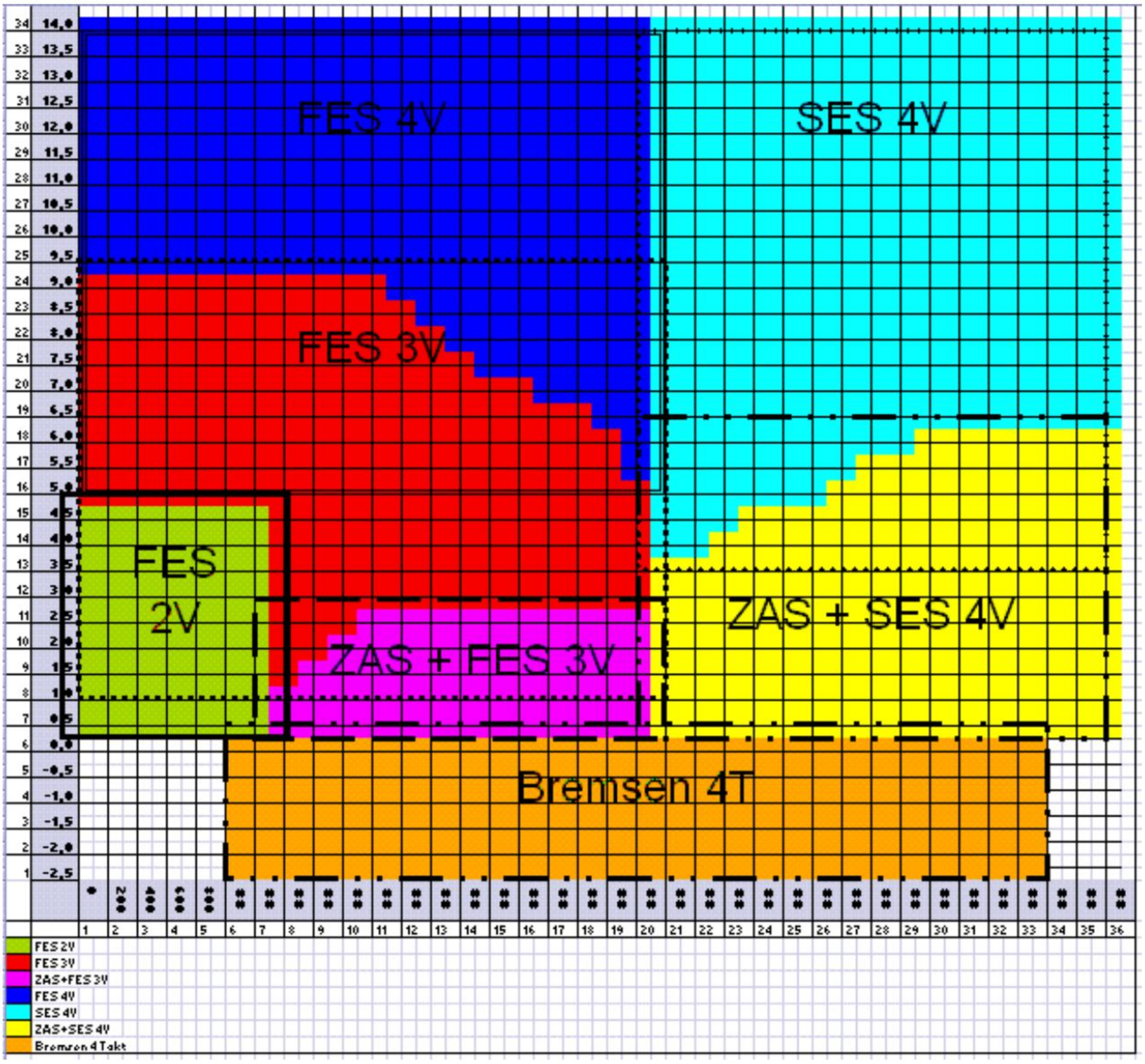
1.2 FUNCTIONAL DIAGRAM BASE CONTROL EDGES



	Department	Date	name	file name
author	ZS-M-57	03.04.04	Frank	1.03

1.3 DESCRIPTION

According to the applicable operating mode **bm_evt_state** (see Operating Mode Manager), the torque realization the basic maps of this operating mode:



At full load **(B_VL =** 1) a basic characteristic set is selected. A separate data set is selected for the start **(B_START =** 1). In addition, a manually entered set of control parameters can be selected using the **B_MAN_STKN** parameter .

The basic control parameter set consists of:

- **eo_bas** (inlet opening control edge in °CA after ignition TDC)
- **as_bas** (exhaust closing control edge in °CA after ignition TDC)
- **es_bas** (intake closing control edge in °CA after ignition TDC)
- **ao_bas** (exhaust opening control edge in °CA after ignition TDC)
- **wdk_soll_evt** (base throttle position in %)
- **tz_bas** (base ignition angle in °CA before ignition TDC)
- **ti_ende_evt** (injection end in °CA before intake closes)
- **ml_soll_bas** (base air mass in mg/l*ASP)

The DISA is kept in the power position in all operating modes except full load. At full load, a speed query NMIN_DISA < n < NMAX_DISA decides whether to switch to the torque position (see Disa.doc).

The control parameters (basic parameters + corrections) are cycle-consistent except for the DISA position and the throttle valve position, ie they belong together for one working cycle of a cylinder (see operating mode manager).

DISA and throttle valve are synchronized as well as possible with the other cycle-synchronous control parameters by speed-dependent control time offsets.
The basic parameters apply stationary at 960 mbar and 20°C.
The characteristic maps are plotted over **wi** and **n .**

1.4 DO NOT APPLY BIT

To ensure that the valve control uses the control edges correctly in every operating mode, a so-called "do not apply bit" **(bm_msk_stkn)** is set by the MSS54 and transmitted via CAN. This bit encodes which control edges are used and which are not.
The bit is encoded as follows:

as2	ao2	as1	ao1	es2	eo2	es1	eo1

For example, in the case of cylinder deactivation, the calculated control edges for cylinders 2 and 3 must not be executed; this bit then contains the value 00000000 (00h) for these cylinders.

state 0 1	cylinder 1	cylinder 2	cylinder 3	cylinder 4
	FFh	00h	00h	FFh
	3Fh / CFh (180ÿ)	00h	00h	3Fh / CFh (180ÿ)
	3Ch / C3h (720ÿ) 3Ch	/ C3h (720ÿ) 3Ch / C3h	(720ÿ) 3Ch / C3h (720ÿ)	
	3Fh / CFh (720ÿ) 3Fh	/ CFh (720ÿ) 3Fh / CFh	(720ÿ) 3Fh / CFh (720ÿ)	
2 3 4, 5,	FFh	FFh	FFh	FFh
13 6	F0h	F0h	F0h	F0h

In addition, the valves can be completely closed in braking mode 4V using the parameter **K_MR_VENTZU_EIN (bm_msk_stkn=0).**

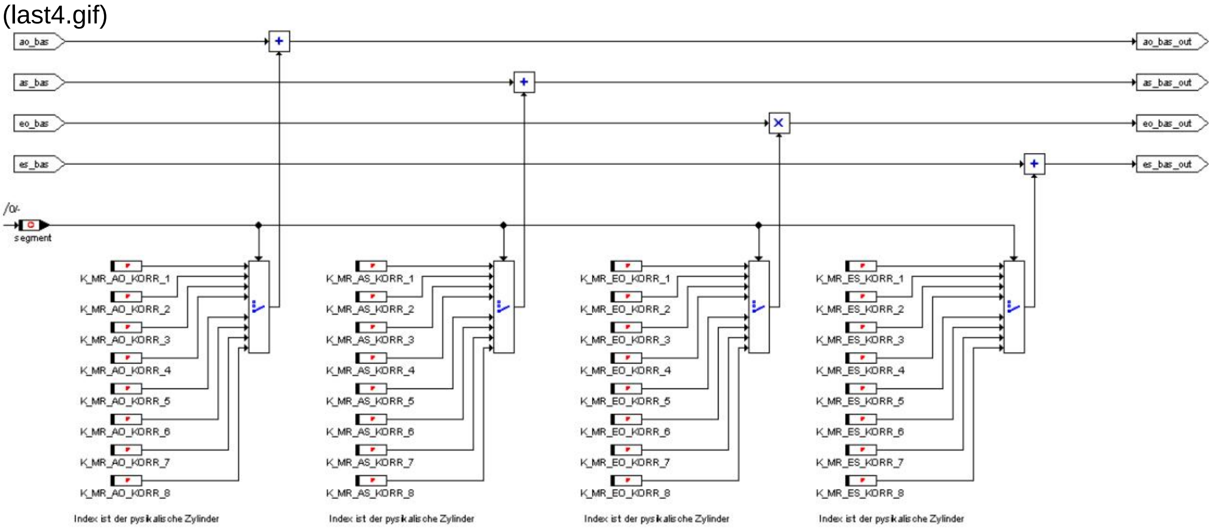
1.5 CYLINDER-INDIVIDUAL CONTROL EDGE CORRECTION

In order to equalize the cylinder filling and the residual gas content of the cylinders, cylinder-specific control edge corrections are required.

Therefore, the 4 control edges (ao_bas, as_bas, eo_bas, es_bas) can be changed with an offset. These offsets, one array each for ao/eo/es, can be set as a manual correction via the application system.

The name of the arrays is:
K_MR_AO_KORR[1..8]
K_MR_AS_KORR[1..8]
K_MR_EO_KORR[1..8]
K_MR_ES_KORR[1..8]
The index of the arrays refers to the physical cylinder. So: Index=1 is for cylinder 1, index 8 for cylinder 8, etc.

(last4.gif)



1.6 INLET CLOSING CORRECTIONS

1.6.1 DENSITY CORRECTION HAS BEEN REPLACED BY DKR !

The ambient pressure and ambient temperature deviating from the standard state are summarized in the factor **rf_pt_korr** and compensated in an inlet closing correction.
With constant **wi** and constant AÖ, AS and EÖ control edges, the inlet closing is converted into an actual volume using a volume characteristic curve **KL_ES_VOLUM .** The density ratio of the actual/target density then leads to a new desired air volume. This is converted back into an inlet closing control edge using the inverse characteristic curve **KL_ES_VOLUM_inv .**

This procedure keeps the load point constant under different ambient conditions and in particular does not change the thermodynamically relevant influencing factors (residual gas, etc.).

At full load and at the highest partial load, the intake closing correction is limited.

1.6.2 ZW-EFFICIENCY CORRECTION (NOT YET IMPLEMENTED!)

Analogously, for timing belt retardation caused by knock control and other functions
the air mass above the intake closing edge is increased to compensate for the drop in torque.

This correction is only applied when the timing belt is retarded, which undesirably reduces the engine torque.

The correction is made using the same characteristics. The torque ratio of actual torque to maximum torque, defined as the ignition angle efficiency, is determined. The drop in torque is compensated by an increase in air mass (reciprocal of the torque ratio of actual torque to maximum torque).

The resulting control parameter sets keep the torque **wi** constant. The intake closing correction reduces the residual gas content at ignition angle retardation by keeping the remaining control edges constant (knock tendency is reduced).

The intake closing correction due to retarded ignition angle leads to a higher air mass. This is added to the air mass path via **md_eva_ve .**

1.7 EXHAUST OPEN DELAY

The burned fuel-air mixture in the cylinder must also be expelled again with the exhaust control edge, which matches the control edges with which the fresh air was taken in. The exhaust opening control edge therefore belongs thermodynamically to the previous working cycle.

However, since the calculation of the control edges always takes place in the same segment, AÖ must be delayed by exactly one working cycle (720 grdKW) in order to then be transmitted to the valve control unit via CAN.

1.8 MINIHUB

The mini-stroke operating mode is used in the lower load range at low speeds and enables quiet operation of the engine.

The amplitude of the control valves is specified by the MSS54, transferred to the dSpace systems via CAN and regulated there. The mini lift is currently only intended for the inlet valves, the outlet valves are operated with full lift in alternating mode (3V) **(mr_minilift_ex =** 0).
The amplitude can be adjusted using the application constant **K_MR_MINILIFT_INT .**
The variable **mr_minilift_int** displays the value of the set valve lift height, which is transferred to the CAN. Due to programming reasons of the dSpace systems, **mr_minilift_int** must be sent to the CAN with a delay of one segment (180grdKW).

1.9 AIR MASS ADAPTATION (NOT YET IMPLEMENTED!)

The aim of air mass adaptation is to compensate for air mass errors in the pre-controlled air mass calculation. A comparison is made between the measured air mass **ml_ist_aw** and the pre-controlled air mass **ml_soll_bas .** The difference is fed to an adaptation map via a PT1 filter.

The actual air mass is determined via HFM (ml) and via the lambda sensor adaptation **(f_ti_a*ml_soll_bas).** The actual air mass determination can be weighted between HFM and lambda sensor adaptation via the characteristic curve **KF_FAK_ML_HFM_LAM .**

adaptation conditions:
- Lambda control is running
- wi below threshold
- B_TL
- Engine warm

ml_korr_diff_bas < threshold; otherwise error detection

ml_korr_diff_bas = 0 !!!
The air mass adaptation is not yet implemented!!! It still needs to be specified in more detail. A separate adaptation map would have to be stored for each operating mode.

1.10 CONVERSION OF ML_SOLL_KORR_EFF INTO INJECTION TIME

The load size **tl** and hence also the injection time **ti** are determined cycle-consistently from **ml_soll_korr_eff** calculated.

The injection time **ti** will be calculated cycle-consistently for each cylinder and each working cycle.

1.11 CONVERSION OF ML_SOLL_KORR_EFF INTO AIR MASS FLOW

The target air mass flow is not required for the basic application. For exhaust gas temperature models or adaptation with the HFM, the target air mass flow can be calculated using the moving average over a working cycle (4 segments with 4 cylinders):

$$ml\,[kg/h] = \sum_{i=\text{Segment number}-(\text{Number of cylinders}-1)}^{\text{segment number}} (ml\_soll\_korr\_eff_i\,[mg/ASP]) * n\,[1/min] * \frac{K\_RF\_STROKEVOLUMEN\,[dm^3]}{cfg\_number\ of\ cylinders} * 0.5*60/10^6$$

The air mass flow is calculated from the moving average of all cylinders. If a cylinder is switched off, the value 0 is used for **ml_soll_korr_effi .** The air mass flow **ml** is output in [kg/h].

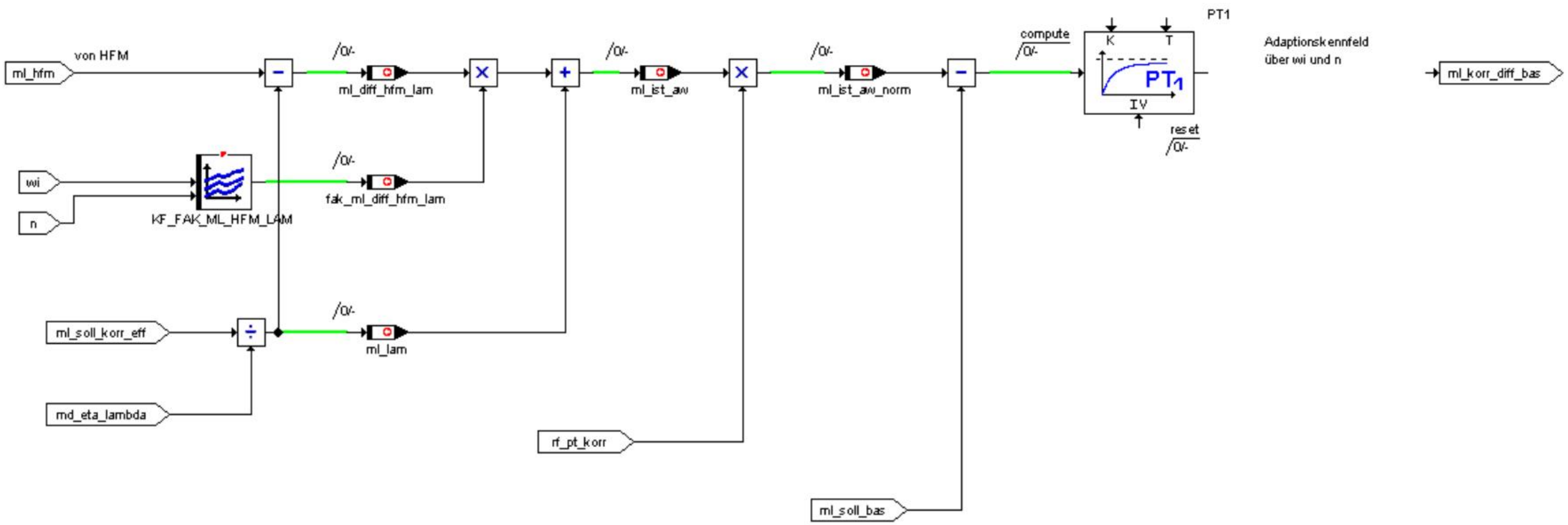
1.12 CONVERSION OF AIR MASS FLOW INTO RELATIVE FILLING

The conversion to rf is calculated using the following formula:

$$rf = \frac{ml}{K\_RF\_STROKE\ VOLUME * K\_RF\_AIR\ DENSITY * 0.5 * n}$$

The relative filling **rf** has the unit [%].

1.13 FUNCTIONAL CIRCUIT DIAGRAM AIR MASS ADAPTATION



2 DATA OF MOMENT REALIZATION

The function is calculated in the angle-synchronous task.

Description of the calculated variables:

ao_aw	Outlet opens, current value, delayed by 720 grdKW Outlet closes, current	uw
as_aw	value Inlet opens, current value Inlet	uw
eo_aw	closes, base Inlet closes, current	uw
es_bas	value (density corrected)	uw
es_aw		uw
ml_soll_bas	Target air mass, basis [mg/l*ASP]	uw
ml_soll_korr	Target air mass, corrected with adaptation Target	uw
ml_soll_korr_eff	air mass, corrected with adaptation and ZW Air mass of	uw
ml_hfm	HFM [kg/h]	uw
ml	Air mass [kg/h] calculated on basic air mass maps uw	
ml_korr_diff_bas	Adapted delta target air mass----------- = 0!!!	uw
ml_diff_hfm_lam	----------------------	
wdk_soll_evt	Target throttle angle in %	uw
tz_bas	base ignition angle	sw
ti_ende_evt	Advance angle possibly related to ignition TDC do not	uw
bm_msk_stkn	apply bit	ub
mr_minilift_int	Amplitude Minihub inlet	ub
mr_minilift_ex	Amplitude mini stroke outlet = 0	ub

Description of the application data:

K_TI_ENDE_x	pre-bearing angle at bm_evt_state=x	uw
K_TI_ENDE_VL	advance angle for full load operation	uw
KF_TI_ENDE_START	advance angle for takeoff	uw/uw/uw
K_TI_ENDE_MAN	advance angle for manual mode	uw
B_MAN_STKN	Switching to manual mode	ub
K_MR_VENTZU_EIN manual closing of the valves only when braking		ub
K_STKN_AO_MAN	Outlet Opens for manual mode	uw
K_STKN_AS_MAN	Outlet Closes for manual mode	uw
K_STKN_EO_MAN	Inlet Opens for manual mode	uw
K_STKN_ES_MAN	Inlet Closes for manual mode	uw
K_ML_SOLL_MAN	Target air mass for manual mode	uw
K_WDK_MAN	throttle angle for manual mode	uw
K_TZ_MAN	ignition angle for manual mode	sw
K_STKN_AO_START	Outlet Opens for Start	uw
K_STKN_AS_START	Exhaust Closes for Start	uw
K_STKN_EO_START	Entrance opens for start	uw
KF_STKN_ES_START	Entrance Closes for Start	uw/uw/uw
K_MR_MINILIFT_INT	Amplitude mini stroke for inlet	ub
K_ML_SOLL_START	Target air mass for takeoff	uw
K_WDK_START	throttle angle for start	uw
KL_TZ_START_N_EVT	ignition angle at start f(n)	uw/bw
KL_TZ_START_TMOT_EVT Ignition angle at start f(tmot)		ub/sw
KL_STKN_AO_VL	Exhaust opens for full load operation	uw/uw
KL_STKN_AS_VL	Exhaust closes for full load operation Intake	uw/uw
KL_STKN_EO_VL	opens for full load operation Intake	uw/uw
KL_STKN_ES_VL	closes for full load operation Target air	uw/uw
KL_ML_SOLL_VL	mass for full load operation Throttle angle	uw/uw
KL_WDK_VL	for full load operation Ignition angle for full load	uw/uw
KL_TZ_VL	operation Conversion inlet closes ->	uw/bw
KL_ES_VOLUM	volume inverse characteristic curve of KL_ES_VOLUM	uw/uw
KL_ES_VOLUM_inv	not applicable!	uw/uw
KF_STKN_AO_BAS_x	Exhaust opens at bm_evt_state=x	uw/uw/uw
KF_STKN_AS_BAS_x	Exhaust closes at bm_evt_state=x Inlet	uw/uw/uw
KF_STKN_EO_BAS_x	opens at bm_evt_state=x Inlet closes	uw/uw/uw
KF_STKN_ES_BAS_x	at bm_evt_state=x Target air mass at	uw/uw/uw
KF_ML_SOLL_BAS_x	bm_evt_state=x Throttle angle at	uw/uw/uw
KF_WDK_BAS_x	bm_evt_state=x Throttle angle at	uw/uw/uw
KL_WDK_BAS_6	bm_evt_state=6 (brakes 4T) uw/uw	
KF_TZ_BAS_x	Base ignition angle at bm_evt_state=x uw/uw/sw	