TITLE

Calculation of the volumetric efficiency correction

OBJECT OF THE DOCUMENT

This document specifies the calculation of the cylinder fill-up efficiency depending on pressure, engine speed,VVT angle and VVL position.

BACKGROUND HISTORY

Revision	Delivery	Author	Nature of Modification
7-0	MD13	f046779	<IS130624>: AEMS / EAL computational problem during a smooth start HR12DDV <IS130784>: AEMS / Wrong calculation of trapping efficiency <IS130844>: AEMS / Insufficient air filling correction in altitude
6-0	MD12	p080490	<IS129656>: AEMS / Estimated trapping efficiency impact on exhaust richness setpoint
5-0	MD11	p097653	<CR010224>: [IS][AEMS Step2]Issue correction for AE MD11 modules <CR009896>: [AEMS Step2][LPG][Archi]Legacy Migration pour MD11 <IS128079>: AEMS / Wrong air filling model correction with atmospheric pressure and deltaP_GPF
4-0	MD10	a002701	<CR009236>: [AEMS Step1.9][Gasoline]Update of Engine model improvement (part2)
3-0	MD09	p095922	<CR009534>: [IS][A-EMS]Issue correction for AE MD09 modules <IS124783>: AEMS /Wrong constant (Nxx_atm_hpa) used for atmospheric pressure (kpa) related calculation <IS124785>: AEMS /Wrong IGR mass caculation of air filling model
2-0	MD08	a002701	<CR006368> : [A-ems step2][EFE]Engine model improvement <CR006372>: VVT drift learning usage
1-0	MD07.02	p095922	<CR006362>: [A-ems step2][SUPAS]Intake manifold & boost pressure setpoint <CR008239>: Engine filling & Air flow sensor management <IS122176>: AEMS / [MDL]Underflow occurs for the Output variable Vxx_fill_efv_fuel_rat_raw_20ms
0-0	MD06.02	p092015	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration
Rev 35.0	LM55_01	Vuong-son LUONG	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (DMFI04672: [WAMA]: Needed dictionary update for LM55)
Rev 34.0	LM52_01	Rodolphe BOU TAYEH	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (DMFI04008 [LPG]New labels for a specific LPG tuning - Torque management)
Rev 33.0	LM50_01	Bada NDOYE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (DMFI03942: [MXAM]: MXAM rules update for LM50)

			<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (DMFI03944 [Tool]Models conversion into slx format for LM50)
Rev 32.0	LM49	Sarah TALEB	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (DMFI03797 [FLEX]Fill-up correction during transient conditions in Flex Fuel applications)
Rev 31.0	LM47_01	R.IRAQI	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (DMFI03552 [MXAM]: MXAM rules update for LM47) <CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (DMFI03553: [WAMA]: Needed dictionary update for LM47)
Rev 30.0	LM42_01	Hugo DAMANCE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (DMFI02878 [MXAM]: MXAM rules update for LM42)
Rev 29.0	LM41_01	Antoine NAIIM HABIB	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISMET27009 K3: [SPEC]Wrong use of Interp library with shared axis in IN_ASI_IAF_2) <CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (DMFI02746: [Floating]Actual integer data typing to reach one click auto-coding) <CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISMET29395 K4: [SPEC]Evolution of range for coherency in a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 28.0	AEG_39_01	Cheng-Qiang HE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISSUP21633 K3: Issue in model La table Ctp_fill_efy_cor_dyn_amp_rat ne doit pas avoir d'axes partages) <CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (DMFI02368: [Floating]Modification of specification to comply with floating autocoding LM39)
Rev 27.0	AEG_34_01	YOBOUE Konan	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (IS19506 (K2): Ctb_mat2 is not anymore referenced by InAsiIat)
Rev 26.0	LM_XX	KIEFFER Steve	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISMAP18189 : Altitude correction for fill-up model)
Rev 25.0	LM_XX	KIEFFER Steve	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISSUP K2 13588 : Breakpoints shall be given under referenced section in MID) <CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISMAP K3 15074 : Range correction of cmp_n_map_fill_efv_ofs_alco)
Rev 24.0	LM_XX	THOUVENEL Nicolas	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISMET13261 : Modification for dynamic fill-up efficiency computation)
Rev 23.0	LM_XX	THOUVENEL Nicolas	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISMAP 11648 : Dynamic Over fill-up) <CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISMET 12293 : Taking into account of injected fuel flow drift function as Tcarb over F4Rt87x) <CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISMET 12394 : Dictionary to be modified for dissociating variables Vxx_fill_efy_cor_dyn_amp_raw & Vxx_fill_efy_cor_dyn_raw) <CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISMAP 12637 : Basic tuning impossible with ASG_26 (implementation of cylinder deactivation)

			<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISMET 12912 : Modification of logical naming for cartography of cylinder deactivation)
Rev 22.0	LM_XX	BANZET Sebastien	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (DMFI Amont 207 : Cylinder deactivation) <CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (DMFI 833 : [Flex/Gasoline]: Separated management for Flex & Gasoline tuning values #2) <CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISMET 10136 : implementation of intermediate variables for fill-up efficiency calculation) <CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISMET 10468 : Check revision of timer block)
Rev 21.0	LM_XX	THOUVENEL Nicolas	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISMET 09504 : Fill-up and Trapping models correction with taking into account atmospheric pressure)
Rev 20.0	LM_XX	HEBERT	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISMET05853: Modification of Vxx_vvt_fill_efv_cor_fac1 range and resol. Correction of Cmp_vvt_fill_efv_cor_fac1 bounds) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 19.3	LM_XX	THOUVENEL	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Update to ISMET 05742) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 19.2	LM_XX	THOUVENEL	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Correction of resolution of Vxx_fill_efy_cor_dyn) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 19.1	LM_XX	THOUVENEL	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (IS 04502 : ”Missing documentation in a_in_asi_iaf_filupxx_xxx_xx_g_a(19.0)”) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 19.0	LM_XX	THOUVENEL	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Implementation of volumetric correction for Dual VVT (intake, exhaust)) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 18.0	LM_XX	LENOIR	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (ISMAP_2163: Add New calibration Cmp_n_map_cor_dyn_amp, Ctp_fill_efy_cor_dyn_amp_rat, Ctb_fill_efy_cor_dyn_amp, New Input Vxx_amp, Change resolution of Cmp_n_map_cor_dyn_th) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 17.0	LM_XX	LENOIR	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (IS_MAP 420 : Add the ”thermic” factor to correct the fill-up efficiency (figure 4) => New Inputs : Vsx_eng, Vxx_tco=> New internal variables :Vxx_fill_efy_cor_dyn, Vxx_fill_efy_cor_dyn_raw.=> New calibrations : Cmp_n_map_cor_dyn_th, Ctb_n_fill_efy_cor_dyn, Ctb_tco2, Ctp_map_n_ftc, Cxx_fill_efy_cor_dyn_max, Cxx_fill_efy_cor_dyn_min, Nsx_eng_aut) (a_in_asi_iaf_filupxx_xxx_xx_g_a)

Rev 16.0	LM_XX	WALRAVE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (reopening of ISMAP 32 : Resolutions of Cmp_vvt_fill_efv_cor_fac1, Cmp_vvt_fill_efv_cor_fac2, Vxx_vvt_fill_efv_cor_fac1, Vxx_vvt_fill_efv_cor_fac2 has been divided by 256. ranges unchanged) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 15.0	LM_XX	WALRAVE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Alcool settings added offset of fill up efficiency coming form alcoxxx spec as well as specific temperature correction for alcool LPG removed new document model) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 14.0	LM_XX	WALRAVE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Bug correction on VVT parameter. Cmp_vvt_fill_efv_cor_fac1 and fac2 have a new resolution and range. As well as Vxx_vvt_fill_efv_cor_fac1 and fac2. Bloc names changed to respect rules) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 13.0	LM_XX	ALLACH	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Add Shared index Vxb_n in Cmp_vvt_fill_efv_cor_fac1 Cmp_vvt_fill_efv_cor_fac2 Cmp_n_map_fill_efv Cmp_n_map_fill_efv_lpg RSA_BKPT_2D block) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 12.0	LM_XX	WALRAVE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Engine speed IVLD removed. VVT IVLD removed. Slew rate is now before the deadzone on filtered fill-up efficiency. Comments corrected) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 11.0	LM_XX	WALRAVE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Update of the IVLD construction. Added init values. Removed replacement values for inputs Document model modified) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 10.0	LM_XX	WALRAVE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Modification for IS 109 : Library blocks are used instead in the filter block for the throttle command) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 9.0	LM_XX	WALRAVE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (strategy for ON/OFF VVT removed. Vbx_vvt_cart_ti removed) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 8.0	LM_XX	WALRAVE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Coherency done. vvt variables changed into standard types) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 7.0	LM_XX	WALRAVE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (New output Vxx_eng_vol_fill_efy_fil created for throttle command. Deadzone filter + rate limiter) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 6.0	LM_XX	WALRAVE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (RSI on RD8_020: Vxx_vvt_fill_efv_cor_fac2 range, resol and unit modified. Cmp_vvt_fill_efv_cor_fac2 range, resol & unit modified. Several units corrected to be more explicit and standard) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 5.0	LM_XX	PORCHEROT	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Comment and state changed for Vsx_n_vld) (a_in_asi_iaf_filupxx_xxx_xx_g_a)

Rev 4.0	LM_XX	WALRAVE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Bloc "Validity_indicator" modified (two NOT added). Correction of Ctb_mat2 (input variable)) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 3.0	LM_XX	WALRAVE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Validity indicators added. Correction for RSI 63 : resolution of Cmp_vvt_fill_efv_cor_fac1 modified) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 2.1	LM_XX	ADMIN	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Ctb_prs (New max = 20000]), Vxx_in_vvtc_angl (New max = 96 [New unit = DegCrk), Vxx_map (New max = 20000])) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 2.0	LM_XX	WALRAVE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Dictionary update + cartography dimension changed) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 1.1	LM_XX	WALRAVE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Range & resol corrected) (a_in_asi_iaf_filupxx_xxx_xx_g_a)
Rev 1.0	LM_XX	WALRAVE	<CR007978>: [AEMS Step1.9][Gasoline]GE-R migration (Fillup efficiency is now physical (ratio near 1).It includes the effect of temperature that was in a_im_airxx_a5_a) (a_in_asi_iaf_filupxx_xxx_xx_g_a)

Contents

Part I
GENERAL INFORMATION

1 Specification information

ASIL Level	QM
Property	R/N Alliance
Language	Simulink
Level of reuse	No reuse
Calibration ROM	249 bytes
NVM Variables	0 bytes
Variables RAM	229 bytes
Real-Time Context	Sched10ms

2 SIGNALS

2.1 INPUT VARIABLES

Name / Alias		Description	
Name		Description	
Alias			
DataType	Dim	Min - Max	Units
NVM Parameters		Init Value	

Vxx_avg_eng_spd		Average Engine Speed	
Vxx_avg_eng_spd			
single	1*1	[0..16384]	rpm
		double(single(0))	

Vxx_intk_mfld_prs		Manifold pressure value	
Vxx_intk_mfld_prs			
single	1*1	[0..2000]	kPa
		double(single(101.3))	

Vxx_vvt_intk_angl		Actual Intake VTC angle (without learning)	
Vxx_vvt_intk_angl			
single	1*1	[-720..720]	degCrk
		double(single(0))	

Vxx_tq_fuel_typ_rat		Ratio dedicated to the torque management adjustment	
Vxx_tq_fuel_typ_rat			
single	1*1	[0..1]	wu
		double(single(0))	

Vxx_intk_vlv_temp		Intake valve temperature	
Vxx_intk_vlv_temp			
single	1*1	[-50..200]	degC
		double(single(20))	

Vxx_cyl_fill_efy_temp_cor_bifuel		Table of correction of cylinder fill-up efficiency with valve gaz temperature for bifuelol	
Vxx_cyl_fill_efy_temp_cor_bifuel			
single	1*1	[0..2]	wu
		double(single(1))	

Vxx_cyl_fill_efy_bas_bifuel		corrective term of fill up efficiency applied on gazoline settings	
Vxx_cyl_fill_efy_bas_bifuel			
single	1*1	[0..2]	wu
		double(single(0))	

Vxx_eng_cool_temp		Engine outlet coolant temperature	
Vxx_eng_cool_temp			
single	1*1	[-50..200]	degC
		double(single(0))	

Vnx_eng_1st_sta_stt		Engine State (0: Engine stopped, 1: Engine starting, 2: Engine running, 3: Engine wait)	
Vnx_eng_1st_sta_stt			
uint8	1*1	Nnx_eng_stop_stt Nnx_eng_sta_stt Nnx_eng_run_stt Nnx_eng_wait_stt	wu
		Nnx_eng_wait_stt	

Vxx_atm_prs Vxx_atm_prs		Atmospheric pressure	
single	1*1	[40..106.7]	kPa
SHUT_DOWN_MODE RESET_SAFE NOT_RESISTANT_TO_SW_CHANGE SINGLE 101.3 [Not Applicable] YES [Not Applicable]		double(single(101.3))	

Vxx_cyl_fill_efy_vvt_intk_ex_cor Vxx_cyl_fill_efy_vvt_intk_ex_cor		Fill-up efficiency correction for dual VVT (intake, exhaust)	
single	1*1	[-1..1]	wu
		double(single(0))	

Vbx_aj_accel_decl Vbx_aj_accel_decl		Vehicle acceleration flag (0:deceleration, 1:acceleration)	
boolean	1*1	[0..1]	bool
		0	

Vxx_cyl_fill_efy_dyn_cor_accel_t_cst_bifuel Vxx_cyl_fill_efy_dyn_cor_accel_t_cst_bifuel		Thermal time constant for dynamic fill-up efficiency during vehicle acceleration for bifuel	
single	1*1	[0..655.35]	s
		double(single(0))	

Vxx_cyl_fill_efy_dyn_cor_thrml_bifuel Vxx_cyl_fill_efy_dyn_cor_thrml_bifuel		Map of thermic efficiency for power estimate for bifuel	
single	1*1	[0..2]	wu
		double(single(0))	

Vxx_cyl_fill_efy_dyn_cor_atm_prs_bifuel Vxx_cyl_fill_efy_dyn_cor_atm_prs_bifuel		Map of thermic efficiency for power estimate, for a low atmospheric pressure for bifuel	
single	1*1	[0..2]	wu
		double(single(0))	

Vxx_cyl_fill_efy_dyn_l_fill_fac_bifuel		Corrective factor for low fill-up efficiency for bifuel	
Vxx_cyl_fill_efy_dyn_l_fill_fac_bifuel			
single	1*1	[0..2]	wu
		double(single(0))	

Vxx_cyl_fill_efy_dyn_cor_cool_temp_bifuel		bifuel Engine coolant temperature correction	
Vxx_cyl_fill_efy_dyn_cor_cool_temp_bifuel			
single	1*1	[0..1]	wu
		double(single(0))	

Vxx_cyl_fill_efy_dyn_cor_decl_t_cst_bifuel		Thermal time constant for dynamic fill-up efficiency during vehicle deceleration for bifuel	
Vxx_cyl_fill_efy_dyn_cor_decl_t_cst_bifuel			
single	1*1	[0..655.35]	s
		double(single(0))	

Vxx_cyl_fill_efy_vvt_intk_cor_fac_1_bifuel		First coefficient of the parabolic correction of fill-up efficiency for continuous intake VVT for bifuel	
Vxx_cyl_fill_efy_vvt_intk_cor_fac_1_bifuel			
single	1*1	[-0.039063..0.039063]	wu
		double(single(0))	

Vxx_cyl_fill_efy_vvt_intk_cor_fac_2_bifuel		Second coefficient of the parabolic correction of fill-up efficiency for continuous intake VVT for bifuel	
Vxx_cyl_fill_efy_vvt_intk_cor_fac_2_bifuel			
single	1*1	[-0.039063..0.039063]	wu
		double(single(0))	

Vxx_vvl_intk_l_lift_rat		VVL intake low lift ratio 2ms	
Vxx_vvl_intk_l_lift_rat			
single	1*1	[0..1]	wu
		double(single(0))	

Vxx_vvl_intk_l_lift_rat_sp		VVL intake low lift ratio setpoint	
Vxx_vvl_intk_l_lift_rat_sp			
single	1*1	[0..1]	wu
		double(single(0))	

Vxx_vvt_ex_angl_cls		VVT exhaust closing angle	
Vxx_vvt_ex_angl_cls			
single	1*1	[-720..720]	degCrk
		double(single(0))	

Vxx_vvt_intk_angl_cls_l_lift		intake valve closing angle in low lift	
Vxx_vvt_intk_angl_cls_l_lift			
single	1*1	[0..720]	degCrk
		double(single(0))	

Vxx_vvt_intk_angl_cls		VVT intake closing angle	
Vxx_vvt_intk_angl_cls			
single	1*1	[0..720]	degCrk
		double(single(0))	

Vxx_vvt_ex_angl		Actual ExhaustVTC angle (without learning)	
Vxx_vvt_ex_angl			
single	1*1	[-720..720]	degCrk
		double(single(0))	

Vxx_ex_mfld_temp		Exhaust manifold temperature	
Vxx_ex_mfld_temp			
single	1*1	[-50..1050]	degC
		double(single(20))	

Vxx_pft_rel_diff_prs Vxx_pft_rel_diff_prs		Relative difference with regard to the particulate filter pressure difference in vacuum	
single	1*1	[-1000..1000]	kPa
		double(single(0))	

Vxx_ex_mfld_prs Vxx_ex_mfld_prs		Exhaust manifold pressure	
single	1*1	[0..2000]	kPa
		double(single(101.3))	

Vxx_mdl_ref_ex_mfld_prs Vxx_mdl_ref_ex_mfld_prs		Exhaust manifold reference pressure in Steady State	
single	1*1	[0..2000]	kPa
		double(single(101.3))	

Vxx_cyl_fill_mdl_pump_mass_bas_bifuel Vxx_cyl_fill_mdl_pump_mass_bas_bifuel		Basic Cylinder pumped mass estimated by optional air filling model for bifuel	
single	1*1	[0..5000]	mg/str
		double(single(1))	

Vxx_cyl_igr_mass_bifuel Vxx_cyl_igr_mass_bifuel		In-cylinder residual burned gas mass for bifuel	
single	1*1	[0..5000]	mg/str
		double(single(0))	

Vxx_cyl_fill_mdl_ovlp_mass_bifuel Vxx_cyl_fill_mdl_ovlp_mass_bifuel		Basic In-cylinder gas mass during overlap of optional air filling model without exhaust pressure correction for bifuel	
single	1*1	[-5000..5000]	mg/str
		double(single(0))	

2.2 OUTPUT VARIABLES

Name		Description	
Alias			
DataType	Dim	Min - Max	Units
NVM Parameters		Init Value	

Vxx_cyl_fill_efy		Cylinder fill-up efficiency	
Vxx_cyl_fill_efy			
single	1*1	[0..2]	wu
		double(single(1))	

Vxx_cyl_fill_efy_fil		Cylinder fill-up efficiency (filtered for throttle command)	
Vxx_cyl_fill_efy_fil			
single	1*1	[0..2]	wu
		double(single(1))	

Vxx_cyl_fill_efy_intk_mfld_prs_atm_prs_cor		Manifold pressure value corrected from atmospheric pressure	
Vxx_cyl_fill_efy_intk_mfld_prs_atm_prs_cor			
single	1*1	[0..2000]	kPa
		double(single(101.3))	

Vxx_cyl_fill_efy_sp		Cylinder fill-up efficiency taking into account the VVL intake low lift ratio setpoint effect	
Vxx_cyl_fill_efy_sp			
single	1*1	[0..2]	wu
		double(single(1))	

Vxx_cyl_fill_efy_fil_sp		Cylinder fill-up efficiency (filtered for throttle command), taking into account the VVL intake low lift ratio setpoint	
Vxx_cyl_fill_efy_fil_sp			
single	1*1	[0..2]	wu
		double(single(1))	

Vxx_cyl_igr_mass Vxx_cyl_igr_mass		In-cylinder residual burned gas mass	
single	1*1	[0..5000]	mg/str
		double(single(0))	

Vxx_eng_vol_fill_efy Vxx_eng_vol_fill_efy		Cylinder fill-up efficiency	
single	1*1	[0..2]	wu
		double(single(1))	

Vxx_eng_vol_fill_efy_fil Vxx_eng_vol_fill_efy_fil		Cylinder fill-up efficiency (filtered for throttle command)	
single	1*1	[0..2]	wu
		double(single(1))	

Vxx_cyl_fill_trap_efy_opt Vxx_cyl_fill_trap_efy_opt		Trapping efficiency of optinal air filling model	
single	1*1	[0..2]	wu
		double(single(1))	

Vxx_cyl_fill_mdl_ex_mfld_prs_rat_cor Vxx_cyl_fill_mdl_ex_mfld_prs_rat_cor		Corrected exhaust pressure ratio for EVC masse correction of cylin-der filling model	
single	1*1	[0..10]	wu
		double(single(1))	

Vxx_cyl_fill_mdl_intk_mfld_prs_diff_cor Vxx_cyl_fill_mdl_intk_mfld_prs_diff_cor		Corrected differenfial intake manifold pressure for overlap mass cac-ulation	
single	1*1	[-1000..1000]	kPa
		double(single(0))	

2.3 INTERNAL VARIABLES

Name		Description	
Alias			
DataType	Dim	Min - Max	Units
NVM Parameters		Init Value	

Vbt_cyl_fill_trap_area		Boolean vector indicating that engine speed and VVT position could leads to a scavenging area	
Vbt_cyl_fill_trap_area			
boolean	1*2	[0..1]	bool
		[0 0]	

Vxt_cyl_fill_efy		Cylinder fill-up efficiency	
Vxt_cyl_fill_efy			
single	1*2	[0..2]	wu
		double(single([1 1]))	

Vxt_cyl_fill_efy_bas		Cylinder fill-up efficiency without temperature effect (raw calculation)	
Vxt_cyl_fill_efy_bas			
single	1*2	[0..2]	wu
		double(single([1 1]))	

Vxt_cyl_fill_efy_cor_rat		Cylinder fill-up efficiency without temperature effect	
Vxt_cyl_fill_efy_cor_rat			
single	1*2	[0..2]	wu
		double(single([1 1]))	

Vxt_cyl_fill_efy_fil		Cylinder fill-up efficiency (filtered for throttle command)	
Vxt_cyl_fill_efy_fil			
single	1*2	[0..2]	wu
		double(single([1 1]))	

Vxt_cyl_fill_efy_opt		Cylinder fill-up efficiency calulated by optinal air filling model	
Vxt_cyl_fill_efy_opt			
single	1*2	[0..2]	wu
		double(single([1 1]))	

Vxt_cyl_fill_efy_para_mdl		Cylinder fill-up efficiency calulated by parabolic model	
Vxt_cyl_fill_efy_para_mdl			
single	1*2	[0..2]	wu
		double(single([1 1]))	

Vxt_cyl_fill_efy_temp		Temporary result of the 2D carto linked to the number of active cylinders	
Vxt_cyl_fill_efy_temp			
single	1*2	[0..2]	wu
		double(single([0 0]))	

Vxt_cyl_fill_efy_vvt_intk_cor		Fill-up efficiency correction for continuous intake VVT	
Vxt_cyl_fill_efy_vvt_intk_cor			
single	1*2	[-1..1]	wu
		double(single([0 0]))	

Vxt_cyl_fill_efy_vvt_intk_cor_fac_1		First coefficient of the parabolic correction of fill-up efficiency for continuous intake VVT	
Vxt_cyl_fill_efy_vvt_intk_cor_fac_1			
single	1*2	[-0.039063..0.039063]	wu
		double(single([0 0]))	

Vxt_cyl_fill_efy_vvt_intk_cor_fac_2		Second coefficient of the parabolic correction of fill-up efficiency for continuous intake VVT	
Vxt_cyl_fill_efy_vvt_intk_cor_fac_2			
single	1*2	[-0.039063..0.039063]	wu
		double(single([0 0]))	

Vxt_cyl_fill_mdl_ex_vlv_cls_mass_bas_gas Vxt_cyl_fill_mdl_ex_vlv_cls_mass_bas_gas		Basic In-cylinder gas mass at exhaust valve closing of optional air filling model	
single	1*2	[0..5000]	mg/str
		double(single([0 0]))	

Vxt_cyl_fill_mdl_ex_vlv_cls_mass_bas_nomi Vxt_cyl_fill_mdl_ex_vlv_cls_mass_bas_nomi		Basic In-cylinder gas mass at exhaust valve closing of optional air filling model without exhaust pressure correction	
single	1*2	[0..5000]	mg/str

Vxt_cyl_fill_mdl_ex_vlv_cls_mass_gas Vxt_cyl_fill_mdl_ex_vlv_cls_mass_gas		Basic In-cylinder gas mass at exhaust valve closing of optional air filling model without exhaust pressure correction	
single	1*2	[0..5000]	mg/str
		double(single([0 0]))	

Vxt_cyl_fill_mdl_intk_mfld_prs_cor Vxt_cyl_fill_mdl_intk_mfld_prs_cor		Corrected differenfial intake manifold pressure for overlap mass cac-ulation	
single	1*2	[0..2000]	kPa

Vxt_cyl_fill_mdl_ovlp_mass Vxt_cyl_fill_mdl_ovlp_mass		Normalized In-cylinder gas mass during overlap of optional air filling model	
single	1*2	[-5000..5000]	mg/str

Vxt_cyl_fill_mdl_ovlp_mass_bas_gas Vxt_cyl_fill_mdl_ovlp_mass_bas_gas		Basic In-cylinder gas mass during overlap of optional air filling model	
single	1*2	[-5000..5000]	mg/str
		double(single([0 0]))	

Vxt_cyl_fill_mdl_ovlp_mass_bas_nomi		Basic In-cylinder gas mass during overlap of optional air filling model without exhaust pressure correction	
Vxt_cyl_fill_mdl_ovlp_mass_bas_nomi			
single	1*2	[-5000..5000]	mg/str

Vxt_cyl_fill_mdl_ovlp_mass_gas		Normalized In-cylinder gas mass during overlap of optional air filling model	
Vxt_cyl_fill_mdl_ovlp_mass_gas			
single	1*2	[-5000..5000]	mg/str
		double(single([0 0]))	

Vxt_cyl_fill_mdl_pump_mass		Cylinder pumped mass estimated by optional air filling model	
Vxt_cyl_fill_mdl_pump_mass			
single	1*2	[0..5000]	mg/str

Vxt_cyl_fill_mdl_pump_mass_bas		Basic Cylinder pumped mass estimated by optional air filling model	
Vxt_cyl_fill_mdl_pump_mass_bas			
single	1*2	[0..5000]	mg/str

Vxt_cyl_fill_mdl_pump_mass_bas_gas		Basic Cylinder pumped mass estimated by optional air filling model	
Vxt_cyl_fill_mdl_pump_mass_bas_gas			
single	1*2	[0..5000]	mg/str
		double(single([0 0]))	

Vxt_cyl_fill_mdl_tot_mass_bas_gas		Basic In-cylinder total gas mass of optional air filling model	
Vxt_cyl_fill_mdl_tot_mass_bas_gas			
single	1*2	[0..5000]	mg/str
		double(single([0 0]))	

Vxt_cyl_fill_mdl_trap_mass		In-cylinder total trapped gas mass coming from intake valve of optional air filling model	
Vxt_cyl_fill_mdl_trap_mass			
single	1*2	[0..5000]	mg/str

Vxt_cyl_fill_trap_area		Trapping area coefficient	
Vxt_cyl_fill_trap_area			
single	1*2	[0..1]	wu
		double(single([0 0]))	

Vxt_cyl_fill_trap_efy_opt		Trapping efficiency of optinal air filling model	
Vxt_cyl_fill_trap_efy_opt			
single	1*2	[0..2]	wu
		double(single([1 1]))	

Vxt_cyl_fill_trap_efy_opt_raw		Trapping efficiency of optinal air filling model before consolidation with scavenging area	
Vxt_cyl_fill_trap_efy_opt_raw			
single	1*2	[0..1]	wu
		double(single([1 1]))	

Vxt_cyl_igr_mass		In-cylinder residual burned gas mass	
Vxt_cyl_igr_mass			
single	1*2	[0..5000]	mg/str

Vxt_cyl_igr_mass_gas		In-cylinder residual burned gas mass	
Vxt_cyl_igr_mass_gas			
single	1*2	[0..5000]	mg/str
		double(single([0 0]))	

Vxt_vvt_intk_angl_cls_cor		Signal of corrected intake valve closing angle for interpolation of optional air filling model	
Vxt_vvt_intk_angl_cls_cor			
single	1*2	[-60..720]	degCrk

Vxx_cyl_fill_efy_dyn_cor		Thermic correction on fill-up efficiency	
Vxx_cyl_fill_efy_dyn_cor			
single	1*1	[-1..1]	wu
		double(single(0))	

Vxx_cyl_fill_efy_dyn_cor_accel_t_cst		Thermal time constant for dynamic fill-up efficiency during acceleration	
Vxx_cyl_fill_efy_dyn_cor_accel_t_cst			
single	1*1	[0..655.35]	s
		double(single(0))	

Vxx_cyl_fill_efy_dyn_cor_atm_prs_fil		Filtered thermal correction with atmospheric effet on fill-up efficiency	
Vxx_cyl_fill_efy_dyn_cor_atm_prs_fil			
single	1*1	[-1..1]	wu
		double(single(0))	

Vxx_cyl_fill_efy_dyn_cor_atm_prs_fil_para		Filter parameter for fill up efficiency correction	
Vxx_cyl_fill_efy_dyn_cor_atm_prs_fil_para			
single	1*1	[0..1]	wu
		double(single(0))	

Vxx_cyl_fill_efy_dyn_cor_atm_prs_raw		Thermal correction with atmospheric effet on fill-up efficiency	
Vxx_cyl_fill_efy_dyn_cor_atm_prs_raw			
single	1*1	[-1..1]	wu
		double(single(0))	

Vxx_cyl_fill_efy_dyn_cor_cool_temp		Engine coolant temperature correction with bifuel setting adjustment	
Vxx_cyl_fill_efy_dyn_cor_cool_temp			
single	1*1	[-1..1]	wu
		double(single(0))	

Vxx_cyl_fill_efy_dyn_cor_decl_t_cst		Thermal time constant for dynamic fill-up efficiency during deceleration	
Vxx_cyl_fill_efy_dyn_cor_decl_t_cst			
single	1*1	[0..655.35]	s
		double(single(0))	

Vxx_cyl_fill_efy_dyn_cor_l		Corrective factor for low fill-up efficiency with bifuel settings adjustment	
Vxx_cyl_fill_efy_dyn_cor_l			
single	1*1	[0..2]	wu
		double(single(0))	

Vxx_cyl_fill_efy_dyn_cor_raw		thermic correction on fill-up efficiency before coolant factor	
Vxx_cyl_fill_efy_dyn_cor_raw			
single	1*1	[-1..1]	wu
		double(single(0))	

Vxx_cyl_fill_efy_dyn_cor_t_cst		Thermal time constant for dynamic fill-up efficiency	
Vxx_cyl_fill_efy_dyn_cor_t_cst			
single	1*1	[0..655.35]	s
		double(single(0))	

Vxx_cyl_fill_efy_temp_cor		Correction of cylinder fill-up efficiency with valve gaz temperature.	
Vxx_cyl_fill_efy_temp_cor			
single	1*1	[0..2]	wu
		double(single(0))	

Vxx_cyl_fill_mdl_ex_mfld_prs_rat		Modulated exhaust pressure ratio for EVC masse correction of cylinder filling model	
Vxx_cyl_fill_mdl_ex_mfld_prs_rat			
single	1*1	[0..10]	wu

Vxx_cyl_fill_mdl_ex_mfld_prs_rat_bas		Basic exhaust pressure ratio for EVC masse correction of cylinder filling model	
Vxx_cyl_fill_mdl_ex_mfld_prs_rat_bas			
single	1*1	[0..10]	wu

Vxx_cyl_fill_mdl_intk_mfld_prs_cor		Corrected intake manifold pressure by exhaust pressure for overlap mass caculation	
Vxx_cyl_fill_mdl_intk_mfld_prs_cor			
single	1*1	[0..2000]	kPa

Vxx_cyl_fill_mdl_intk_mfld_prs_diff		Modulated differenfial intake manifold pressure for overlap mass caculation	
Vxx_cyl_fill_mdl_intk_mfld_prs_diff			
single	1*1	[-1000..1000]	kPa

Vxx_cyl_fill_mdl_intk_mfld_prs_diff_bas		Basic differenfial intake manifold pressure for overlap mass caculation	
Vxx_cyl_fill_mdl_intk_mfld_prs_diff_bas			
single	1*1	[-1000..1000]	kPa

Vxx_cyl_fill_mdl_mass_cor_fac		Normalization factor of optional air filling model mass caculation	
Vxx_cyl_fill_mdl_mass_cor_fac			
single	1*1	[0..2]	wu

3 PARAMETERS

3.1 CALIBRATIONS

Name		Description	
Alias			
DataType	Dim	Min - Max	Units
X Axis		Y Axis	
Value			

Cbx_cyl_fill_efy_intk_mfld_prs_atm_prs_cor_cho		Boolean to activate manifold air pressure correction as function of altitude	
Cbx_cyl_fill_efy_intk_mfld_prs_atm_prs_cor_cho			
boolean	1*1	[0..1]	bool
0			

Cbx_cyl_fill_efy_opt_cho		Boolean to activate optinal air filling model caculation	
Cbx_cyl_fill_efy_opt_cho			
boolean	1*1	[0..1]	bool
0			

Cbx_cyl_fill_igr_opt_cho		Boolean to activate internal gas mass estimation of optional filling model	
Cbx_cyl_fill_igr_opt_cho			
boolean	1*1	[0..1]	bool
0			

Cnx_cyl_fill_ex_mfld_prs_cor_cho		Exhaust pressure correction choice on cylinder filling model: no correction (0), turbine model based exhaust pressure correction (1), atmospheric pressure and GPF loading based correction (2)	
Cnx_cyl_fill_ex_mfld_prs_cor_cho			
uint8	1*1	[0..2]	wu
0			

Cnx_cyl_nr_conf		Number of cylinders configuration management	
Cnx_cyl_nr_conf			
uint8	1*1	Nnx_cyl_nr_3_conf Nnx_cyl_nr_4_conf Nnx_cyl_nr_6_conf Nnx_cyl_nr_8_conf	wu
4			

Cxb_cyl_fill_efy_dyn_cor_atm_prs_rat		Atmospheric pressure breakpoint	
Cxb_cyl_fill_efy_dyn_cor_atm_prs_rat			
single	1*9	[40..106.7]	kPa
65 70 75 80 85 90 95 100 105			

Cxb_cyl_fill_efy_dyn_cor_eng_spd		Engine speed breakpoints for first order filter time constant computation	
Cxb_cyl_fill_efy_dyn_cor_eng_spd			
single	1*10	[0..16384]	rpm
1000 1500 2000 2500 3000 3500 4000 4500 5000 6000			

Cxb_cyl_fill_efy_dyn_cor_intk_mfld_prs		Pressure breakpoints for first order filter time constant computation	
Cxb_cyl_fill_efy_dyn_cor_intk_mfld_prs			
single	1*6	[0..2000]	kPa
10 30 50 80 100 200			

Cxb_cyl_fill_eng_spd		16 programmable engine speed breakpoints map	
Cxb_cyl_fill_eng_spd			
single	1*16	[0..16384]	rpm
600 750 850 1000 1250 1500 1750 2000 2500 3000 3500 4000 4500 5000 5500 6000			

Cxb_cyl_fill_intk_mfld_prs		16 programmable pressure breakpoints table	
Cxb_cyl_fill_intk_mfld_prs			
single	1*16	[0..2000]	kPa
12 24 36 48 66 84 102 120 138 156 180 204 228 252 276 300			

Cxb_cyl_fill_mdl_ex_mfld_prs_rat_bas		Breakpoint of basic exhaust pressure ratio modulation table	
Cxb_cyl_fill_mdl_ex_mfld_prs_rat_bas			
single	1*16	[0..10]	wu
0 0.33 0.67 1 1.33 1.67 2 2.33 2.67 3 3.33 3.67 4 4.33 4.67 5			

Cxb_cyl_fill_mdl_ex_vlv_cls_angl_cyl_vol		Breakpoint (exhaust vvt position) of cylinder volume map at exhaust valve closing of optional cylinder filling model	
Cxb_cyl_fill_mdl_ex_vlv_cls_angl_cyl_vol			
single	1*16	[-720..720]	degCrk
340 346.6667 353.3333 360 366.6667 373.3333 380 386.6667 393.3333 400 406.6667 413.3333 420 426.6667 433.3333 440			

Cxb_cyl_fill_mdl_intk_mfld_prs_diff_bas		Breakpoint of basic differenfial intake manifold pressure modulation table	
Cxb_cyl_fill_mdl_intk_mfld_prs_diff_bas			
single	1*16	[-1000..1000]	kPa
-100 -86.67 -73.33 -60 -46.67 -33.33 -20 -6.67 6.67 20 33.33 46.67 60 73.33 86.67 100			

Cxb_cyl_fill_mdl_intk_vlv_cls_angl_cyl_vol		Breakpoint (intake vvt position) of cylinder volume map at intake valve closing of optional cylinder filling model	
Cxb_cyl_fill_mdl_intk_vlv_cls_angl_cyl_vol			
single	1*16	[-60..720]	degCrk
460 466.6667 473.3333 480 486.6667 493.3333 500 506.6667 513.3333 520 526.6667 533.3333 540 546.6667 553.3333 560			

Cxb_cyl_fill_mdl_vvt_ex_angl_ovlp_fac		Breakpoint x (intake vvt position) of overlap factor map of optional air filling model	
Cxb_cyl_fill_mdl_vvt_ex_angl_ovlp_fac			
single	1*8	[-720..720]	degCrk
0 10 20 30 40 50 60 61			

Cxb_cyl_fill_mdl_vvt_intk_angl_ovlp_fac		Breakpoint y (exhaust vvt position) of overlap factor map of optional air filling model	
Cxb_cyl_fill_mdl_vvt_intk_angl_ovlp_fac			
single	1*8	[-720..720]	degCrk
0 10 20 30 40 50 60 61			

Cxb_cyl_fill_trap_area_vvt_ex		Exhaust VVT breakpoints which enables to define the scavenging area	
Cxb_cyl_fill_trap_area_vvt_ex			
single	1*8	[-720..720]	degCrk
0 10 20 30 40 50 60 61			

Cxb_cyl_fill_trap_area_vvt_intk		Intake VVT breakpoints which enables to define the scavenging area	
Cxb_cyl_fill_trap_area_vvt_intk			
single	1*8	[-720..720]	degCrk
0 10 20 30 40 50 60 61			

Cxb_eng_cool_temp_2		Engine coolant temperature breakpoints	
Cxb_eng_cool_temp_2			
single	1*9	[-50..200]	degC
-40 -20 -10 0 10 20 40 80 110			

Cxb_intk_mfld_temp_2		table of 9 programable breakpoints of intake manifold temperature	
Cxb_intk_mfld_temp_2			
single	1*9	[-50..200]	degC
-40 -20 0 20 40 50 60 80 120			

Cxm_cyl_fill_efy_bas		Map based on engine speed and intake manifold pressure which give;the basic filling efficiency	
Cxm_cyl_fill_efy_bas			
single	16*16	[0..2]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_efy_bas_vvl_intk_l_lift		Map based on engine speed and intake manifold pressure which give;the basic filling efficiency in VVL low lift	
Cxm_cyl_fill_efy_bas_vvl_intk_l_lift			
single	16*16	[0..2]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_efy_dyn_cor_accel_t_cst		Thermal time constant for dynamic fill-up efficiency during vehicle acceleration	
Cxm_cyl_fill_efy_dyn_cor_accel_t_cst			
single	10*6	[0..655.35]	s
Cxb_cyl_fill_efy_dyn_cor_eng_spd		Cxb_cyl_fill_efy_dyn_cor_intk_mfld_prs	
10*6 matrix			

Cxm_cyl_fill_efy_dyn_cor_atm_prs		Map of thermic efficiency for power estimate, for a low atmospheric pressure	
Cxm_cyl_fill_efy_dyn_cor_atm_prs			
single	16*16	[0..2]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_efy_dyn_cor_decl_t_cst Cxm_cyl_fill_efy_dyn_cor_decl_t_cst		Thermal time constant for dynamic fill-up efficiency during vehicle deceleration	
single	10*6	[0..655.35]	s
Cxb_cyl_fill_efy_dyn_cor_eng_spd		Cxb_cyl_fill_efy_dyn_cor_intk_mfld_prs	
10*6 matrix			

Cxm_cyl_fill_efy_dyn_cor_thrml Cxm_cyl_fill_efy_dyn_cor_thrml		Map of thermic efficiency for power estimate	
single	16*16	[0..2]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_efy_dyn_l_fill_fac Cxm_cyl_fill_efy_dyn_l_fill_fac		Corrective factor for low fill-up efficiency	
single	16*16	[0..2]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_efy_intk_vlv_temp_cor Cxm_cyl_fill_efy_intk_vlv_temp_cor		Correction of cylinder fill-up efficiency as function of valve gaz temperature and manifold pressure	
single	9*16	[0..2]	wu
Cxb_intk_mfld_temp_2		Cxb_cyl_fill_intk_mfld_prs	
9*16 matrix			

Cxm_cyl_fill_efy_vvt_cor_fac_1 Cxm_cyl_fill_efy_vvt_cor_fac_1		Map of first coefficient of the parabolic correction of fill-up efficiency for continuous intake VVT	
single	16*16	[-0.039063..0.039063]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_efy_vvt_cor_fac_1_vvl_intk_l_lift Cxm_cyl_fill_efy_vvt_cor_fac_1_vvl_intk_l_lift		Map of first coefficient of the parabolic corrrection of fill-up efficiency for continuous in VVT with VVL in low lift	
single	16*16	[-0.039063..0.039063]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_efy_vvt_cor_fac_2 Cxm_cyl_fill_efy_vvt_cor_fac_2		Map of second coefficient of the parabolic corrrection of fill-up efficiency for continuous in VVt	
single	16*16	[-0.039063..0.039063]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_efy_vvt_cor_fac_2_vvl_intk_l_lift Cxm_cyl_fill_efy_vvt_cor_fac_2_vvl_intk_l_lift		Map of second coefficient of the parabolic corrrection of fill-up efficiency for continuous in VVT with VVL in low lift	
single	16*16	[-0.039063..0.039063]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_mdl_cor_1 Cxm_cyl_fill_mdl_cor_1		First corrective map of optional cylinder filling model	
single	16*16	[0..2]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_mdl_cor_1_vvl_intk_l_lift Cxm_cyl_fill_mdl_cor_1_vvl_intk_l_lift		First corrective map of optional cylinder filling model with vvl low lift	
single	16*16	[0..2]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_mdl_cor_2		Second corrective map of optional cylinder filling model	
Cxm_cyl_fill_mdl_cor_2			
single	16*16	[-10..10]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_mdl_cor_2_vvl_intk_l_lift		Second corrective map of optinal cylinder filling model with vvl low lift	
Cxm_cyl_fill_mdl_cor_2_vvl_intk_l_lift			
single	16*16	[-10..10]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_mdl_cor_3		Third corrective map of optional cylinder filling model	
Cxm_cyl_fill_mdl_cor_3			
single	16*16	[-10..10]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_mdl_cor_3_vvl_intk_l_lift		Third corrective map of optional cylinder filling model with vvl low lift	
Cxm_cyl_fill_mdl_cor_3_vvl_intk_l_lift			
single	16*16	[-10..10]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_mdl_ex_mfld_prs_rat_cor_fac		Value of exhaust pressure ratio correction table based on engine speed and intake manifold pressure	
Cxm_cyl_fill_mdl_ex_mfld_prs_rat_cor_fac			
single	16*16	[0..10]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_mdl_intk_mfld_prs_diff_cor_fac Cxm_cyl_fill_mdl_intk_mfld_prs_diff_cor_fac		Value of correction talble of differenfial intake manifold pressure based on engine speed and intake manifold pressure	
single	16*16	[0..10]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_mdl_vvt_intk_ex_angl_ovlp_fac Cxm_cyl_fill_mdl_vvt_intk_ex_angl_ovlp_fac		Overlap factor map of optional cylinder filling model	
single	8*8	[-10..10]	wu
Cxb_cyl_fill_mdl_vvt_intk_angl_ovlp_fac		Cxb_cyl_fill_mdl_vvt_ex_angl_ovlp_fac	
8*8 matrix			

Cxm_cyl_fill_mdl_vvt_intk_ex_angl_ovlp_fac_vvl_intk_l_lift Cxm_cyl_fill_mdl_vvt_intk_ex_angl_ovlp_fac_vvl_intk_l_lift		Overlap factor map of optional cylinder filling model with vvl low lift	
single	8*8	[-10..10]	wu
Cxb_cyl_fill_mdl_vvt_intk_angl_ovlp_fac		Cxb_cyl_fill_mdl_vvt_ex_angl_ovlp_fac	
8*8 matrix			

Cxm_cyl_fill_trap_area_eng_spd_intk_mfld_prs Cxm_cyl_fill_trap_area_eng_spd_intk_mfld_prs		Map based on engine speed and corrected intake manifold pressure which enables to define the scavenging area	
single	16*16	[0..1]	wu
Cxb_cyl_fill_eng_spd		Cxb_cyl_fill_intk_mfld_prs	
16*16 matrix			

Cxm_cyl_fill_trap_area_vvt_intk_vvt_ex Cxm_cyl_fill_trap_area_vvt_intk_vvt_ex		Map based on intake VVT and exhaust VVT which enables to define the scavenging area	
single	8*8	[0..1]	wu
Cxb_cyl_fill_trap_area_vvt_intk		Cxb_cyl_fill_trap_area_vvt_ex	
8*8 matrix			

Cxm_cyl_fill_trap_area_vvt_intk_vvt_ex_l_lift Cxm_cyl_fill_trap_area_vvt_intk_vvt_ex_l_lift		Map based on intake VVT and exhaust VVT which enables to define the scavenging area in low lift	
single	8*8	[0..1]	wu
Cxb_cyl_fill_trap_area_vvt_intk		Cxb_cyl_fill_trap_area_vvt_ex	
8*8 matrix			

Cxp_cyl_fill_efy_dyn_cor_atm_prs_rat Cxp_cyl_fill_efy_dyn_cor_atm_prs_rat		Ratio depending of the atmospheric pressure , for the interpolation of dynamic correction	
single	1*9	[0..1]	wu
Cxb_cyl_fill_efy_dyn_cor_atm_prs_rat			
1 1 1 0.8 0.6 0.4 0.2 0 0			

Cxp_cyl_fill_efy_dyn_cor_cool_temp Cxp_cyl_fill_efy_dyn_cor_cool_temp		Engine coolant temperature correction	
single	1*9	[0..1]	wu
Cxb_eng_cool_temp_2			
1 1 1 1 1 1 1 1 1			

Cxp_cyl_fill_efy_dyn_off_dly Cxp_cyl_fill_efy_dyn_off_dly		Inhibition time after start	
single	1*9	[0..655.35]	s
Cxb_eng_cool_temp_2			
0 0 0 0 0 0 0 0 0			

Cxp_cyl_fill_mdl_ex_mfld_prs_rat Cxp_cyl_fill_mdl_ex_mfld_prs_rat		Value of exhaust pressure ratio modulation table	
single	1*16	[0..10]	wu
Cxb_cyl_fill_mdl_ex_mfld_prs_rat_bas			
0 0.33 0.67 1 1.33 1.67 2 2.33 2.67 3 3.33 3.67 4 4.33 4.67 5			

Cxp_cyl_fill_mdl_ex_vlv_cls_angl_cyl_vol Cxp_cyl_fill_mdl_ex_vlv_cls_angl_cyl_vol		Cylinder volume map at exhaust valve closing of optional cylinder filling model	
single	1*16	[0..0.004]	m^3
Cxb_cyl_fill_mdl_ex_vlv_cls_angl_cyl_vol			
5.22e-05 4.35e-05 3.81e-05 3.63e-05 3.81e-05 4.35e-05 5.22e-05 6.42e-05 7.91e-05 9.67e-05 0.0001166 0.0001382 0.0001612 0.0001852 0.0002096 0.000234			

Cxp_cyl_fill_mdl_intk_mfld_prs_diff Cxp_cyl_fill_mdl_intk_mfld_prs_diff		Value of differenfial intake manifold pressure modulation table	
single	1*16	[-1000..1000]	kPa
Cxb_cyl_fill_mdl_intk_mfld_prs_diff_bas			
-100 -86.67 -73.33 -60 -46.67 -33.33 -20 -6.67 6.67 20 33.33 46.67 60 73.33 86.67 100			

Cxp_cyl_fill_mdl_intk_vlv_cls_angl_cor Cxp_cyl_fill_mdl_intk_vlv_cls_angl_cor		Intake valve closing angle corrective map of optional cylinder filling model	
single	1*16	[-60..60]	degCrk
Cxb_cyl_fill_eng_spd			
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			

Cxp_cyl_fill_mdl_intk_vlv_cls_angl_cor_vvl_intk_l_lift Cxp_cyl_fill_mdl_intk_vlv_cls_angl_cor_vvl_intk_l_lift		Intake valve closing angle corrective map of optional cylinder filling model with vvl low lift	
single	1*16	[-60..60]	degCrk
Cxb_cyl_fill_eng_spd			
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			

Cxp_cyl_fill_mdl_intk_vlv_cls_angl_cyl_vol Cxp_cyl_fill_mdl_intk_vlv_cls_angl_cyl_vol		Cylinder volume map at intake valve closing of optional cylinder filling model	
single	1*16	[0..0.004]	m^3
Cxb_cyl_fill_mdl_intk_vlv_cls_angl_cyl_vol			
0.0003034 0.0003242 0.0003435 0.000361 0.0003768 0.0003908 0.0004028 0.000413 0.0004213 0.0004277 0.0004323 0.000435 0.0004359 0.000435 0.0004323 0.0004277			

Cxx_cyl_fill_efy_drv_max		Maximum slope for fill up efficiency.	
Cxx_cyl_fill_efy_drv_max			
single	1*1	[0.0015259..50]	wu
20.0012			

Cxx_cyl_fill_efy_dyn_max		Maximum thermic correction on fill-up efficiency	
Cxx_cyl_fill_efy_dyn_max			
single	1*1	[-1..1]	wu
0.5			

Cxx_cyl_fill_efy_dyn_min		Minimum thermic correction on fill-up efficiency	
Cxx_cyl_fill_efy_dyn_min			
single	1*1	[-1..1]	wu
-0.5			

Cxx_cyl_fill_efy_dz		Fill up efficiency deadzone	
Cxx_cyl_fill_efy_dz			
single	1*1	[-1..1]	wu
0.45776			

Cxx_cyl_fill_efy_vvt_ofs		Offset angle for calculation of VVT fill-up efficiency relative correction	
Cxx_cyl_fill_efy_vvt_ofs			
single	1*1	[-360..360]	DegCrk
0			

Cxx_cyl_fill_trap_area_h_thd		High threshold to detect that scavenging could occur in this area	
Cxx_cyl_fill_trap_area_h_thd			
single	1*1	[0..1]	wu
0.2			

Cxx_cyl_fill_trap_area_l_thd		Low threshold to detect that scavenging could occur in this area	
Cxx_cyl_fill_trap_area_l_thd			
single	1*1	[0..1]	wu
0.1			

Cxx_cyl_fill_trap_efy_dz_l_thd		Lower limit of trapping efficiency deadzone	
Cxx_cyl_fill_trap_efy_dz_l_thd			
single	1*1	[0..1]	wu
0.95			

Cxx_cyl_fill_trap_efy_dz_neg_slop		Negative slop limit of trapping efficiency dead zone switchpe limit of trapping efficiency dead zone switch	
Cxx_cyl_fill_trap_efy_dz_neg_slop			
single	1*1	[-100..0]	wu/s
-0.5			

Cxx_cyl_fill_trap_efy_dz_pos_slop		Positive slope limit of trapping efficiency dead zone switch	
Cxx_cyl_fill_trap_efy_dz_pos_slop			
single	1*1	[0..100]	wu/s
0.5			

Cxx_cyl_vol		Engine capacity displacement	
Cxx_cyl_vol			
single	1*1	[0..0.004]	m^3
0.0016			

Cxx_min_cyl_fill_mdl_ex_mfld_prs_rat_cor		Minimum value for alpha 3 correction factor	
Cxx_min_cyl_fill_mdl_ex_mfld_prs_rat_cor			
single	1*1	[0..10]	wu
0			

3.2 CONSTANTS

Name		Description	
Alias			
DataType	Dim	Value	Units
X Axis		Y Axis	

Nnx_eng_run_stt		Engine in running state	
Nnx_eng_run_stt			
uint8	1*1	2	wu

Nxb_fil_para		Breakpoint used for filter parameter calculation	
Nxb_fil_para			
single	1*9	0 0.125 0.25 0.375 0.5 0.625 0.75 0.875 1	wu

Nxp_fil_para		Table constant used for filter parameter calculation	
Nxp_fil_para			
single	1*9	1 0.8825 0.7788 0.68729 0.60653 0.53526 0.47237 0.41686 0.36788	wu
Nxb_fil_para			

Nxx_atm_kpa		Multiplicative conversion from atm to kPa	
Nxx_atm_kpa			
single	1*1	101.325	wu

Nxx_k_degc		Additive conversion from degKel vin to degCelsius	
Nxx_k_degc			
single	1*1	273.15	degC

Nxx_kilo_bas		Multiplicative conversion from kilo to basic unit (ex: km to m)	
Nxx_kilo_bas			
single	1*1	1000	m

Nxx_wht_pgc_j_kg		Massic perfect gas constant (r in pV=mrT) in J/(kg*K)	
Nxx_wht_pgc_j_kg			
single	1*1	287	J/(kg*K)

4 CONTROL FLOWS

4.1 INPUT TRIGGERS

Name
Comment

Sched10ms_ASXX_MWIN_FLW_filupxxxxg

Part II
FUNCTIONAL DEFINITION

5 STRUCTURE

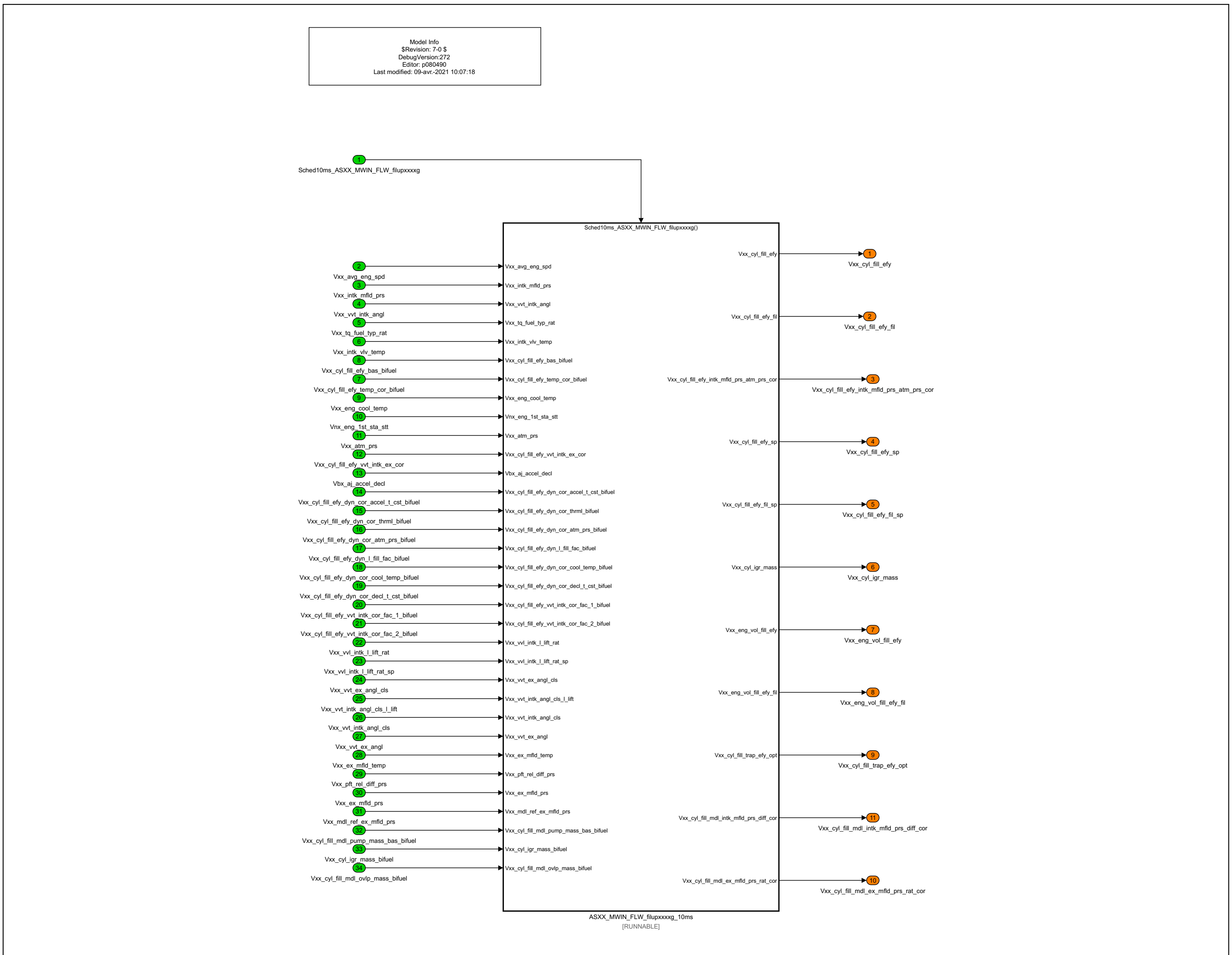

Figure 1: STRUCTURE

6 ASXX_MWIN_FLW_FILUPXXXXG_10MS

Depending on engine camshaft configuration, fill-up efficiency correction can be computed three ways. These configurations are the following ones :
* continuous intake VVT.
* no VVT.
* alcohol fuel

In the first case, basic fill-up efficiency correction is calculated by an interpolation through a (manifold pressure, Engine speed) map. A parabola correction is then added to it.
In the second case fill-up efficiency correction is calculated by an interpolation through a (manifold pressure, Engine speed) map.

For an alcohol running engine, a fill-up efficiency corrector is added to the standard gasoline fillup efficiency map.

Then, an air temperature correction is multiplicated to obtain the final fill-up efficiency
This temperature corrector is a proportion of the gasoline and the alcohol settings depending on alcohol proportion

If a major default is seen (NOK), fillup efficiency is replaced by 1.

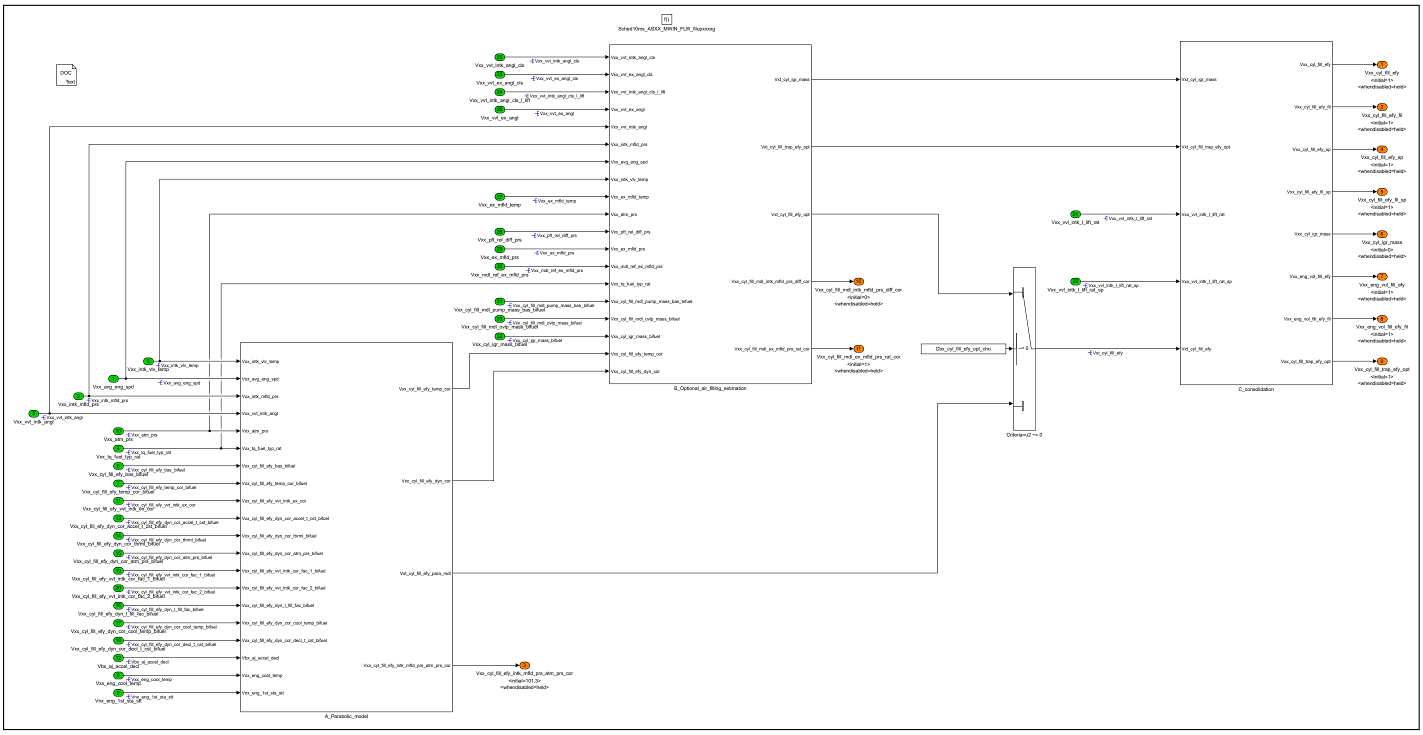

Figure 2: ASXX_MWIN_FLW_FILUPXXXXG_10MS

6.1 A_PARABOLIC_MODEL

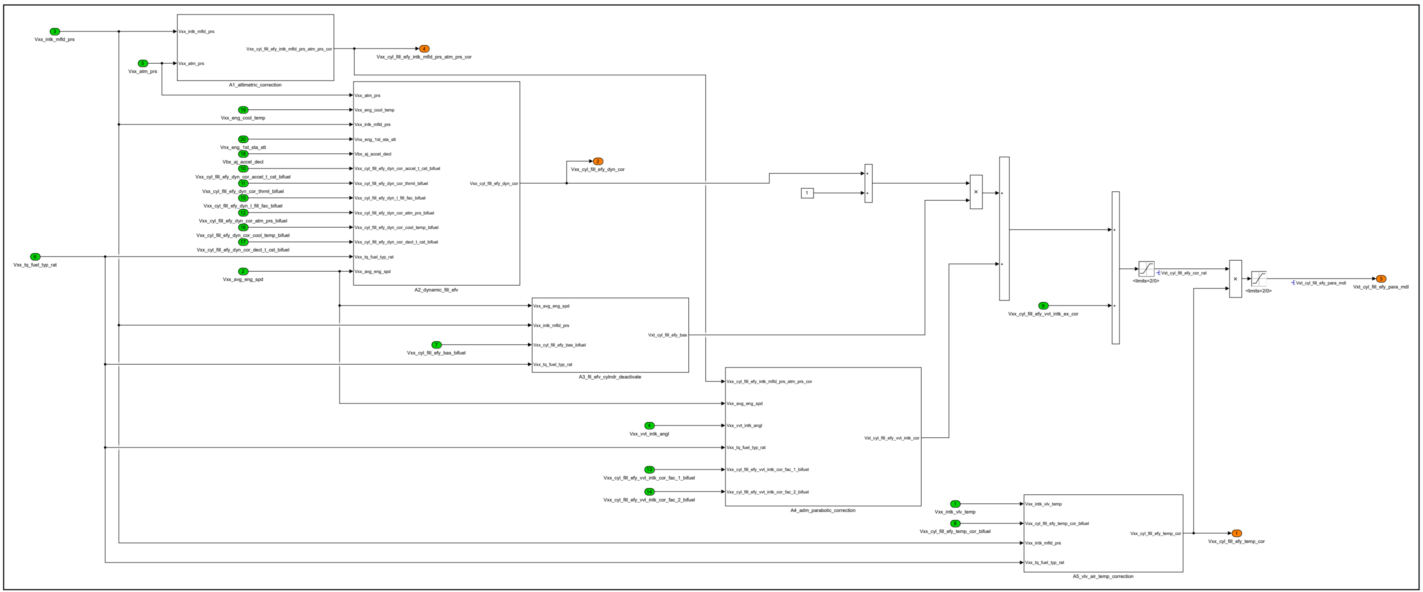

Figure 3: A_PARABOLIC_MODEL

6.1.1 A1_ALTIMETRIC_CORRECTION

For needs of fill-up in altimetric cases, it is necessary to take into account atmospheric pressure and its impact over fill-up phenomenon. Indeed, for altimetric case with, for instance, atmospheric pressure around 800mbar, the exhaust pressure will be lower than for atmospheric pressure around 1000mbar. So it is necessary to take it into account for avoiding errors over fill-up efficiency model.

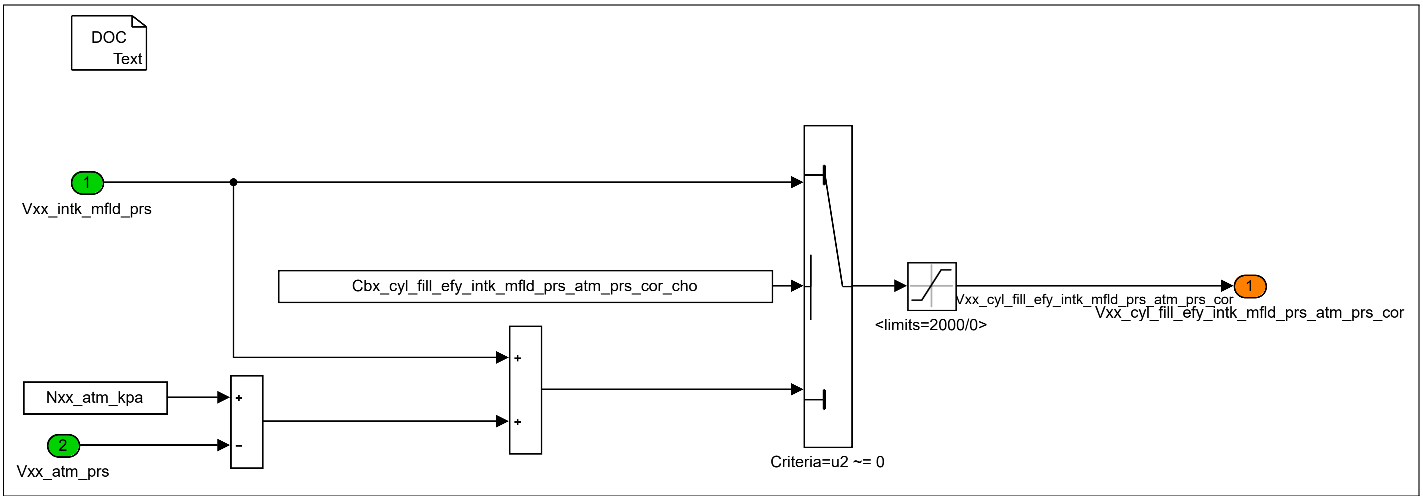

Figure 4: A1_ALTIMETRIC_CORRECTION

6.1.2 A2_DYNAMIC_FILL_EFV

This block computes Vxx_fill_efy_cor_dyn: Thermic correction on fill-up efficiency.
The correction models the variation of the engine fill up efficiency (depending on engine conditions (N, MAP) and of the spent time in full load) and Alcohol settings (adjusted with Vxx_tq_fuel_typ_rat : Ratio dedicated to the torque management adjustment).

The factor is then corrected depending on the water coolant temperature, and inhibited after start during a time depending on the water coolant temperature.

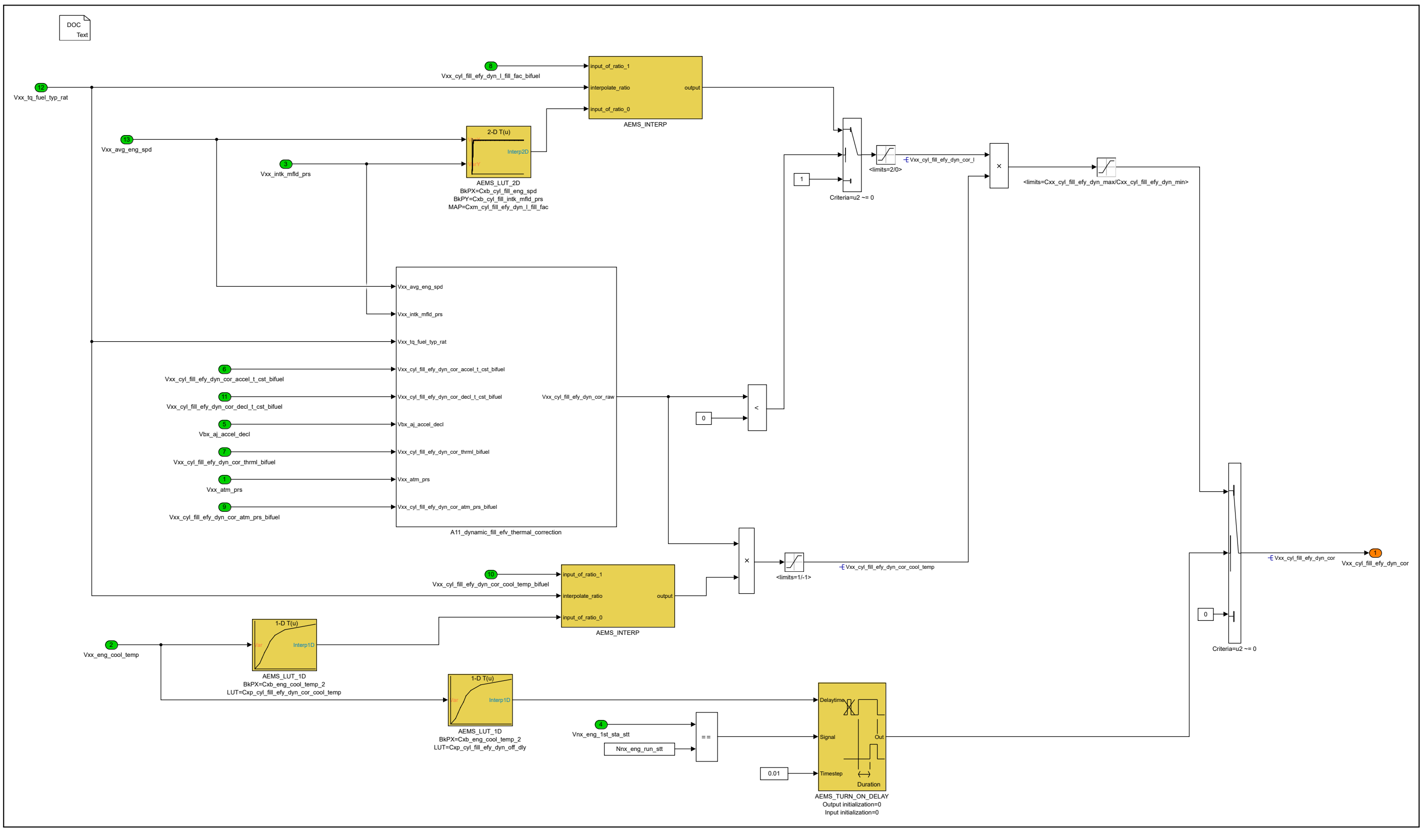

Figure 5: A2_DYNAMIC_FILL_EFV

6.1.2.1 A11_DYNAMIC_FILL_EFV_THERMAL_CORRECTION

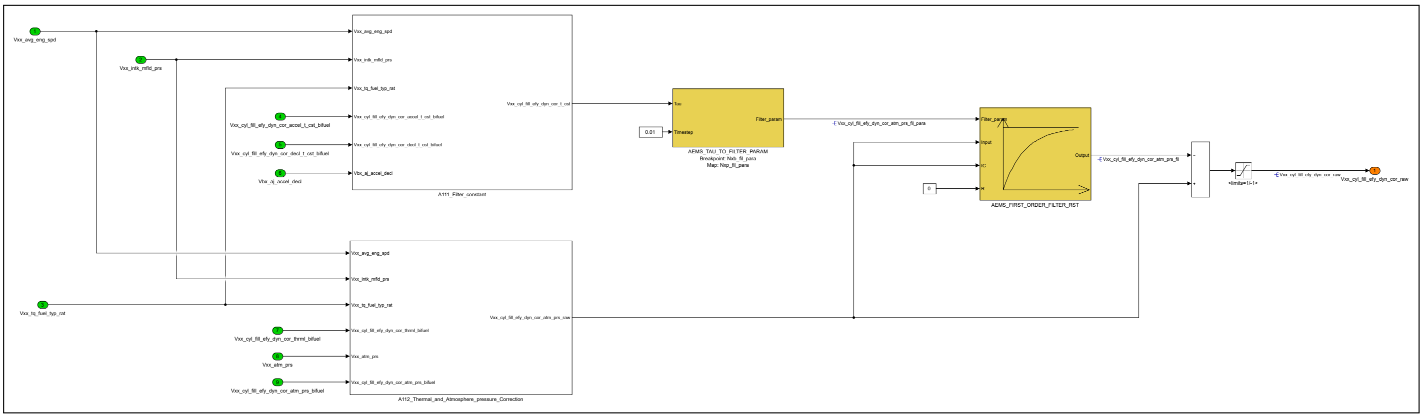

Figure 6: A11_DYNAMIC_FILL_EFV_THERMAL_CORRECTION

6.1.2.1.1 A111_FILTER_CONSTANT

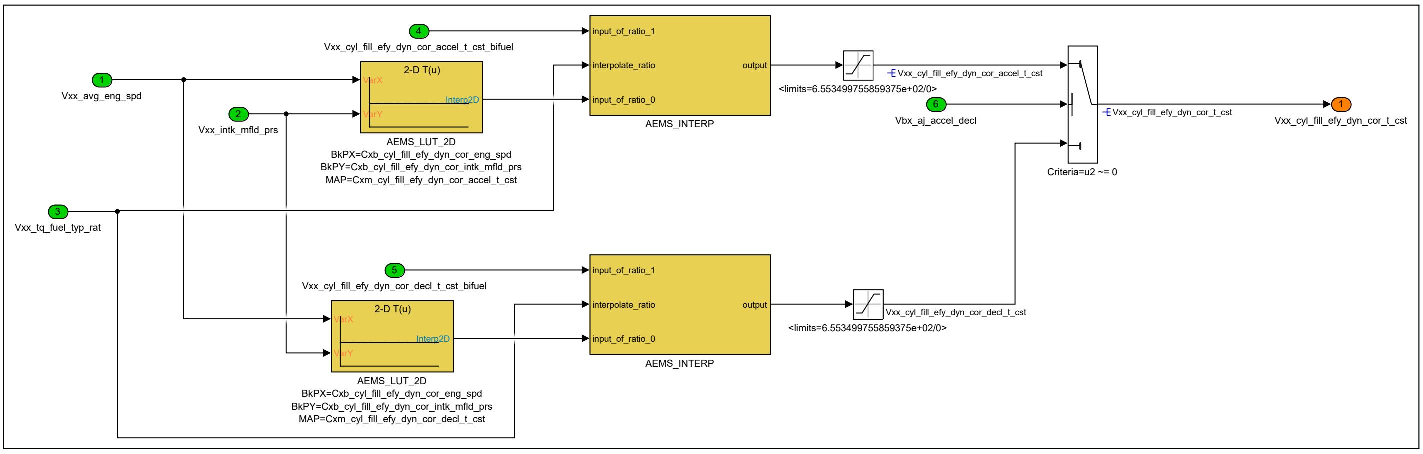

Figure 7: A111_FILTER_CONSTANT

6.1.2.1.2 A112_THERMAL_AND_ATMOSPHERE_PRESSURE_CORRECTION

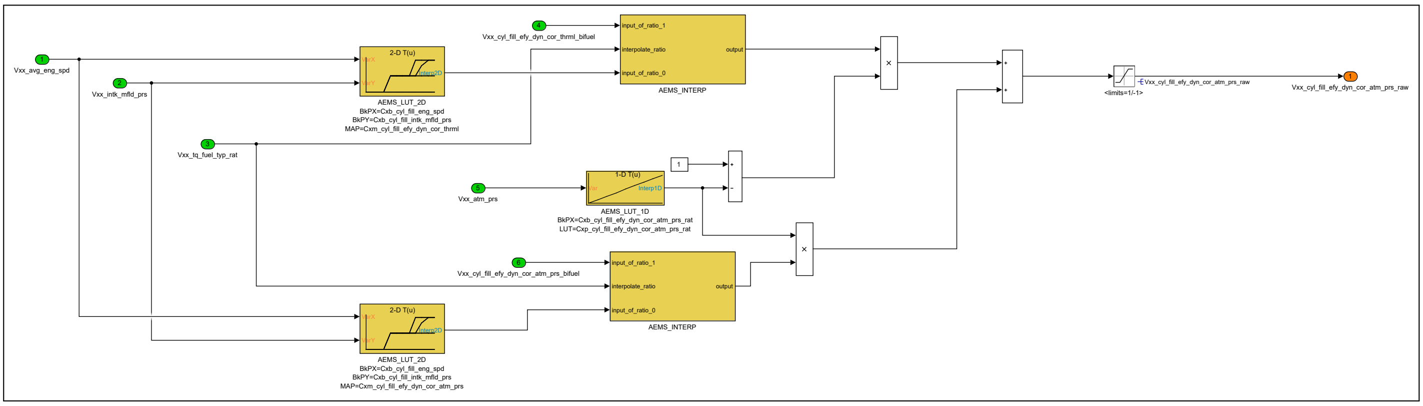

Figure 8: A112_THERMAL_AND_ATMOSPHERE_PRESSURE_CORRECTION

6.1.3 A3_FIL_EFV_CYLNDR_DEACTIVATE

Cartography for all cylinders activated.

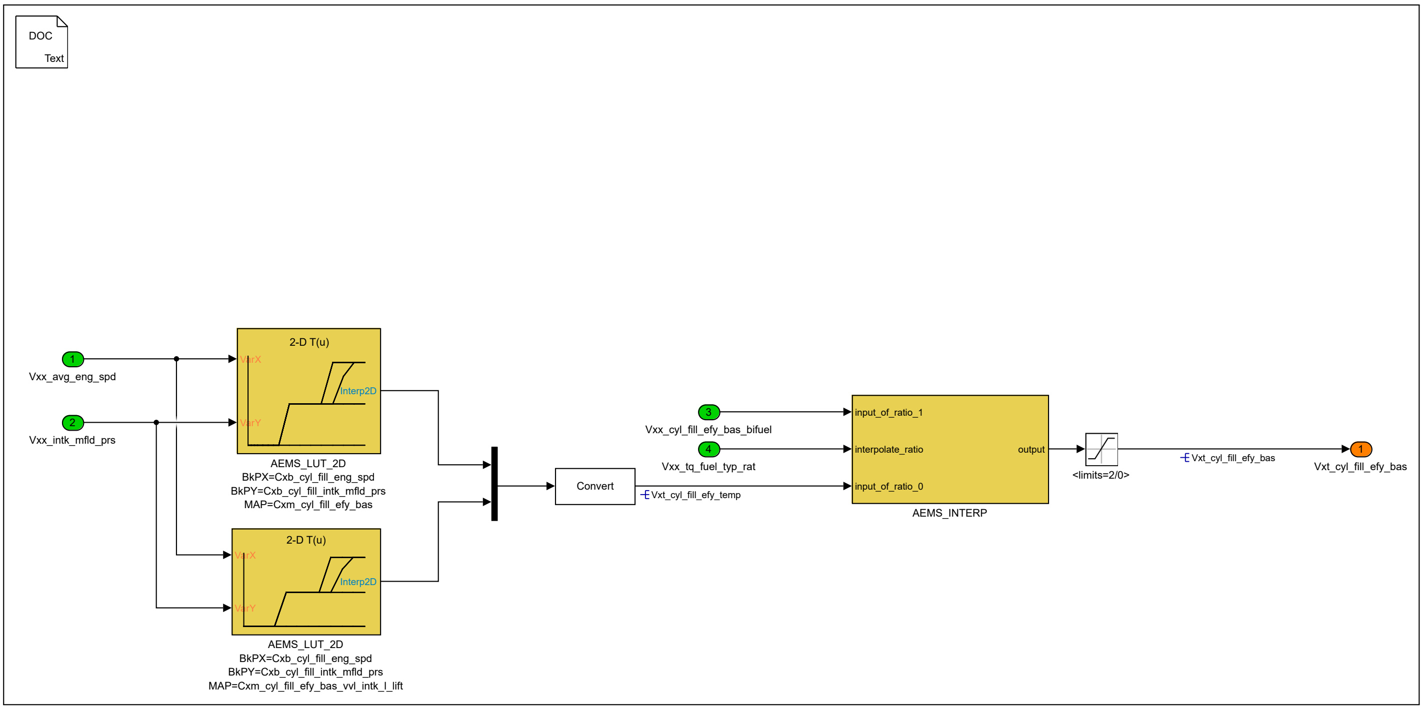

Figure 9: A3_FIL_EFV_CYLNDR_DEACTIVATE

6.1.4 A4_ADM_PARABOLIC_CORRECTION

The parabola correction is calculated as following :

$$Fill\_up\_eff_{corr} = b(P,N)\cdot(Camshaft\_shift - Camshaft\_offset) - a(P,N)\cdot(Camshaft\_shift - Camshaft\_offset)^2$$

$$Fill\_up\_eff_{corr} = b(P,N)\cdot(Camshaft\_shift - Camshaft\_offset) - a(P,N)\cdot(Camshaft\_shift - Camshaft\_offset)^2$$

where *Camshaft_offset* is chosen from two possibilities depending on tuning team choices from a compromise depending on volumetric efficiency computing accuracy versus tests complexity on tests bench :

- On one hand it corresponds to the value of *Camshaft_shift* for which map of basic correction (Cmp_n_map_fill_efy) is tuned. It is preferable to choose to tune this map on a quite central value of camshaft shift to minimise calculation error which depends to square difference between.camshaft shift and this position. The calibration which corresponds to this camshaft shift is Cxx_vvt_fill_efv_cam_ofs.

- On the other hand it correspond to the strategy giving nominal setpoints for intake VVT (see map of references positions from "VVT management" specification in sheet "a_cd_vvtxx_xx ..")
  The reference volumetric efficiency map (Cmp_n_map_fill_efy) is tuned with VVT reference positions from nominal VVT position VVT in hot conditions (see map of references positions from "VVT management" specification in sheet "a_cd_vvtxx_xx ..")

To disable this correction, Cmp_vvt_fill_efv_cor_fac1 and Cmp_vvt_fill_efv_cor_fac2 must be filling with zero.

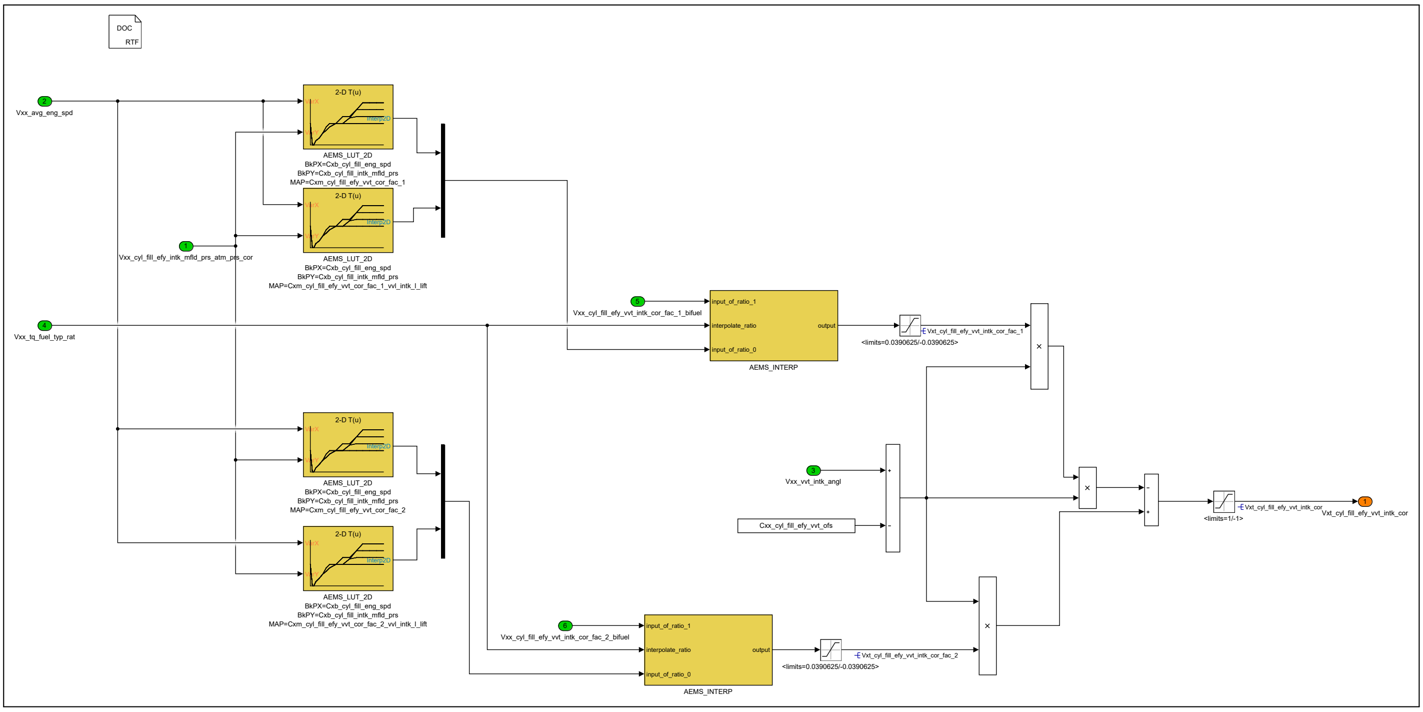

Figure 10: A4_ADM_PARABOLIC_CORRECTION

6.1.5 A5_VLV_AIR_TEMP_CORRECTION

Type your documentation here

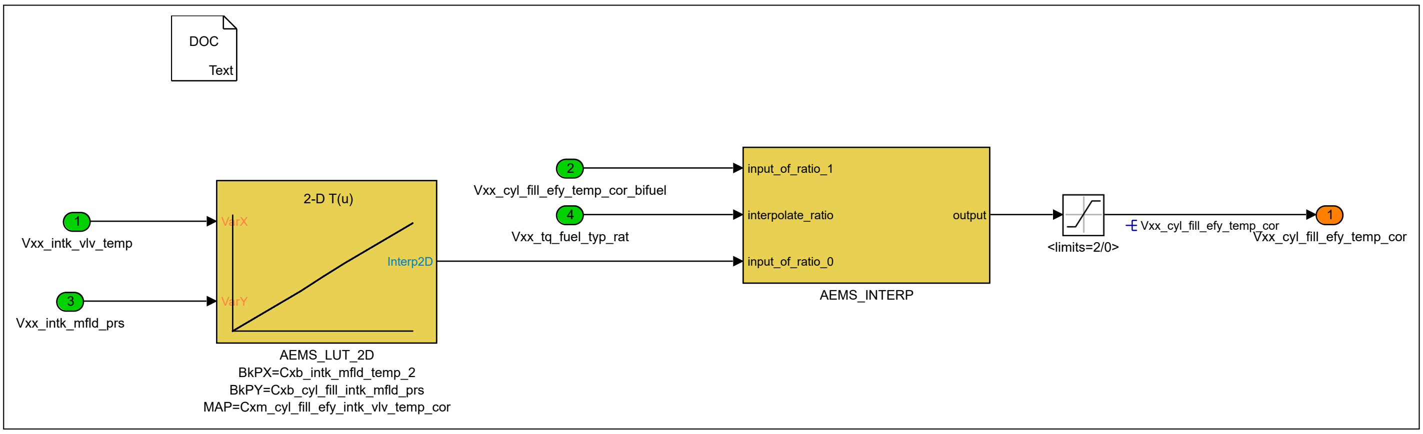

Figure 11: A5_VLV_AIR_TEMP_CORRECTION

6.2 B_OPTIONAL_AIR_FILLING_ESTIMATION

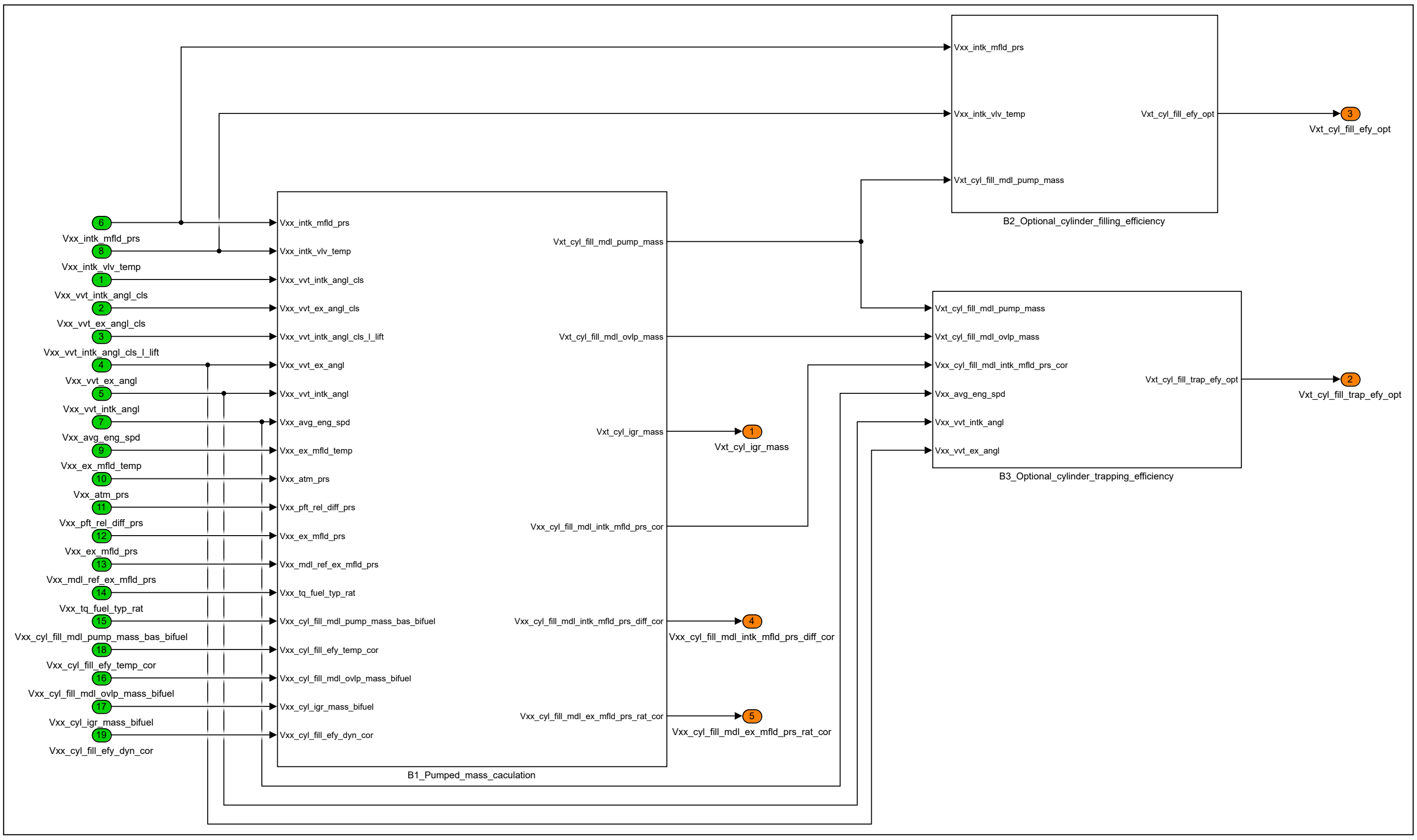

Figure 12: B_OPTIONAL_AIR_FILLING_ESTIMATION

6.2.1 B1_PUMPED_MASS_CACULATION

Basic model

The optional cylinder filling model aiming at modeling the aspired mass from intake pipe m_{asp}^{INT} which is linked to m_{IVC}, the total mass inside the cylinder at IVC (intake valve closing) and m_{asp}^{EXH} the aspirated mass from exhaust, by applying the law of conservation of energy (assuming specific heats are the same for air and burned gas):

$$T_{IVC} * m_{IVC} = T_{INT} * m_{asp}^{INT} + T_{EXH} * m_{asp}^{EXH}$$
$$m_{asp}^{INT} = \frac{T_{IVC}}{T_{INT}} * m_{IVC} - \frac{T_{EXH}}{T_{INT}} * m_{asp}^{EXH}$$

m_{IVC}'s calculation relies on ideal gas law with $P_{IVC} = \alpha_1 P_{INT}$:

$$m_{IVC} = \alpha_1 * \frac{P_{INT} * V_{IVC}}{R * T_{IVC}}$$

m_{asp}^{EXH} is the then combined of two parts: the mass flows from intake to exhaust pipe (scavenging) or from exhaust to intake pipe (back-flow) and the mass trapped at EVC (exhaust valve closing):

$$m_{asp}^{EXH} = m_{ovlp} + m_{EVC}$$

m_{ovlp} represents the mass flow rate across valves using the equations of Barré de Saint-Venant which can be characterized by $\alpha'_2 * \Psi(P_2, P_3, T_2, T_3)$:

$$m_{ovlp} = \alpha'_2 * \Psi(P_2, P_3, T_2, T_3) * \frac{OF}{Ne}$$

m_{EVC} relies also on ideal gas law with $\frac{P_{EVC}}{T_{EVC}} = \frac{\alpha'_3 * P_{EXH}}{T_{EXH}}$:

$$m_{EVC} = \alpha'_3 * \frac{P_{EXH} * V_{EVC}}{R * T_{EXH}}$$

The m_{asp}^{EXH} then becomes:

$$m_{asp}^{EXH} = \alpha'_2 * \Psi(P_2, P_3, T_2, T_3) * \frac{OF}{Ne} + \alpha'_3 * \frac{P_{EXH} * V_{EVC}}{R * T_{EXH}}$$

m_{asp}^{INT} can be deduced as :

$$m_{asp}^{INT} = \alpha_1 * \frac{P_{INT} * V_{IVC}}{R * T_{INT}} - (m_{ovlp} + m_{EVC}) * \frac{T_{EXH}}{T_{INT}}$$
$$m_{asp}^{INT} = m'_{IVC} - (m'_{ovlp} + m'_{EVC})$$

Where:

$$m'_{IVC} = \alpha_1 * \frac{P_{INT} * V_{IVC}}{R * T_{INT}}$$
$$m'_{ovlp} = m_{ovlp} * \frac{T_{EXH}}{T_{INT}}$$
$$m'_{EVC} = m_{EVC} * \frac{T_{EXH}}{T_{INT}}$$

The aspirated mass from intake m_{asp}^{INT} can be solved as:

$$m_{asp}^{INT} = \alpha_1 * \frac{P_{INT} * V_{IVC}}{R * T_{INT}} - \alpha'_2 * \Psi * \frac{OF}{Ne} * \frac{T_{EXH}}{T_{INT}} - \alpha'_3 * \frac{P_{EXH} * V_{EVC}}{R * T_{INT}}$$

As we are not able to have reliable measurement or estimation of P_{EXH}, T_{EXH}, the two variables will be simplified and considered as part of calibration:

$$\alpha_2 = \alpha'_2 * \Psi * \frac{T_{EXH}}{T_{INT}}$$

$$\alpha_3 = \alpha'_3 * \frac{P_{EXH}}{R * T_{INT}}$$

Then the equation of aspirated mass from intake becomes:

$$m_{asp}^{INT} = m'_{ivc} - (m'_{ovlp} + m'_{evc})$$

$$m_{asp}^{INT} = \boxed{\alpha_1(N_e, P_{col}) \frac{P_{INT} V_{IVC}(IVC - \delta_{ivc}(N_e))}{r \cdot T_{INT}}} - \boxed{\left[\alpha_2(N_e, P_{intk}) \cdot \frac{OF(VVT_i, VVT_e)}{N_e} + \alpha_3(N_e, P_{col}) \cdot V_{EVC}(EVC)\right]}$$

Where:
m_{asp}^{INT} : Vxt_cyl_fill_mdl_pump_mass
m'_{IVC} : Vxt_cyl_fill_mdl_tot_mass_bas
m'_{ovlp} : Vxt_cyl_fill_mdl_ovlp_mass_bas
m'_{EVC}: Vxt_cyl_fill_mdl_ex_vlv_cls_mass_bas

Vxt_cyl_fill_mdl_tot_mass_bas: is calculated based on ideal gas equation and then characterized by a basic 2D map (Cxm_cyl_fill_mdl_cor_1/ Cxm_cyl_fill_mdl_cor_1_vvl_intk_l_lift) , law of cylinder volume at IVC (Cxp_cyl_fill_mdl_intk_vlv_cls_angl_cyl_vol) and a supplementary correction of IVC function of engine speed (Cxp_cyl_fill_mdl_intk_vlv_cls_angl_cor/ Cxp_cyl_fill_mdl_intk_vlv_cls_angl_cor_vvl_intk_l_lift)

Vxt_cyl_fill_mdl_ovlp_mass_bas: is calculated by a basic 2D map (Cxm_cyl_fill_mdl_cor_2/ Cxm_cyl_fill_mdl_cor_2_vvl_intk_l_lift) and then an overlap factor map (Cxm_cyl_fill_mdl_vvt_intk_ex_angl_ovlp_fac/Cxm_cyl_fill_mdl_vvt_intk_ex_angl_ovlp_fac_vvl_intk_l_lift)

Vxt_cyl_fill_mdl_ex_vlv_cls_mass_bas: is calculated by a basic 2D map (Cxm_cyl_fill_mdl_cor_3/ Cxm_cyl_fill_mdl_cor_3_vvl_intk_l_lift) and the volume law at EVC (Cxp_cyl_fill_mdl_ex_vlv_cls_angl_cyl_vol)

Volumetric efficiency:

Finally, the aspired mass from intake pipe will be converted to filling efficiency with mean pressure and temperature at intake pipe (Vxt_cyl_fill_efy_opt).

$$\eta_{vol} = m_{asp}^{INT} / \left(\frac{P_{INT} V_{cyl}}{r T_{INT}}\right)$$

IGR mass:

In order to reconstruct m_{ovlp} (**Vxt_cyl_fill_mdl_ovlp_mass**) from m'_{ovlp} (**Vxt_cyl_fill_mdl_ovlp_mass_bas**) and m_{EVC} (**Vxt_cyl_fill_mdl_ex_vlv_cls_mass**) from m'_{EVC} (**Vxt_cyl_fill_mdl_ex_vlv_cls_mass_bas**), a normalization factor (**Vxx_cyl_fill_mdl_mass_cor_fac** - ratio between intake temperature and exhaust temperature) should be used:

$$m_{ovlp} = m'_{ovlp} * \frac{T_{INT}}{T_{EXH}}$$
$$m_{EVC} = m'_{EVC} * \frac{T_{INT}}{T_{EXH}}$$

And the aspirated mass from exhaust m_{asp}^{EXH} which can be also considered as internal burnt gas mass (**Vxt_cyl_igr_mass**) is calculated by:

$$m_{asp}^{EXH} = m_{ovlp} + m_{EVC}$$

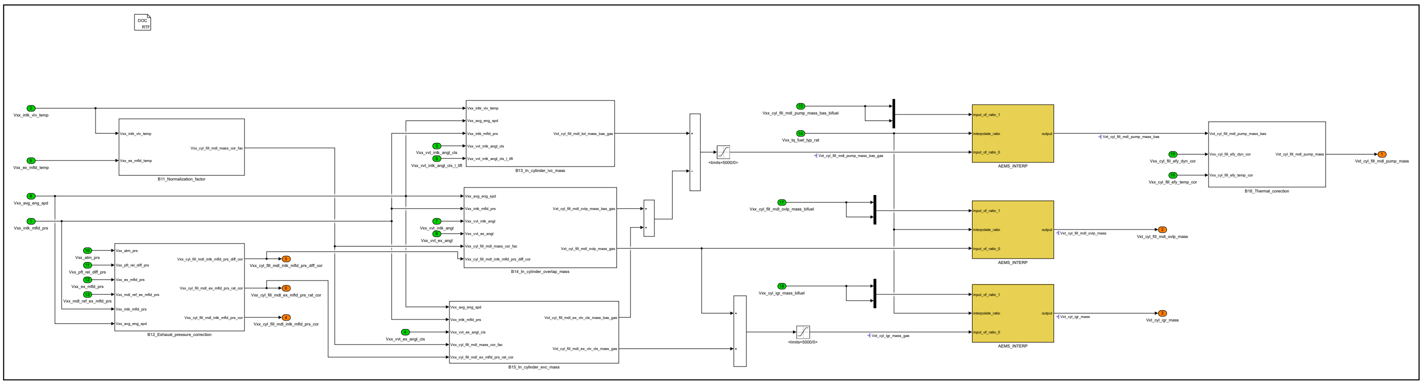

Figure 13: B1_PUMPED_MASS_CACULATION

6.2.1.1 B11_NORMALIZATION_FACTOR

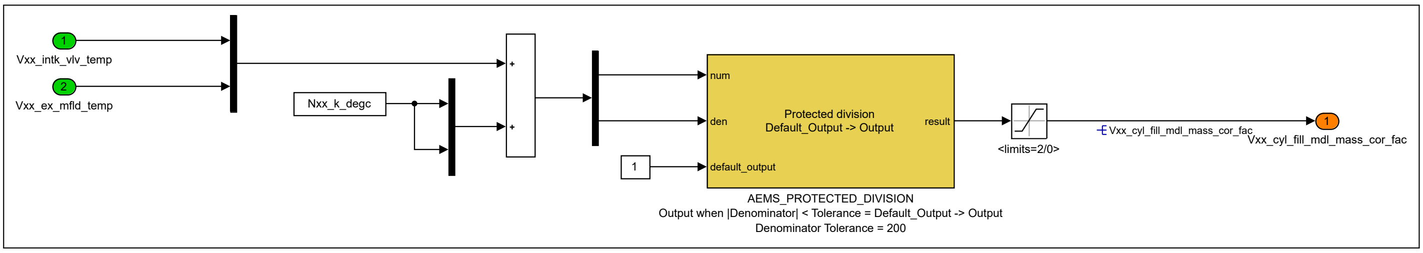

Figure 14: B11_NORMALIZATION_FACTOR

6.2.1.2 B12_EXHAUST_PRESSURE_CORRECTION

Exhaust pressure increase due to GPF loading and transient operations will lead to increased back-flow and residual gas concentration at EVC, and will have a significant impact on the aspirated mass from intake.
As the three alpha tables are calibrated at nominal conditions (nominal exhaust pressure), to adresse the exhaust pressure correction, we are using the turbine model to generate a nominal exhaust pressure P_{EXH}^{nomi} (Vxx_mdl_ref_ex_mfld_prs) based on turbine control setpoints in addition to the exhaust pressure based on real conditions P_{EXH} (Vxx_ex_mfld_prs),. The relativeness between the two pressures enables the intergration of exhaust pressure correction on alpha tables based formulation.

- For the overlap mass part m'_{ovlp} , we take into account the increased backflow (or reduced scavenging) due to increased P_{EXH} (Vxx_ex_mfld_prs), compared to P_{EXH}^{nomi} (Vxx_mdl_ref_ex_mfld_prs), as an intake pressure drop in α_2 which is dictated as well by overlap:

$$\alpha_2(N_e, P_{INT} + P_{EXH}^{nomi} - P_{EXH}) \frac{OF(VVT_i, VVT_e)}{N_e}$$

- For the EVC mass part m'_{EVC}, higher P_{EXH} leads to larger residual concentration at EVC which is considered as proportional to exhaust pressure variation ratio:

$$\alpha_3(N_e, P_{INT}) \cdot V_{EVC} \cdot \frac{P_{EXH}}{P_{EXH}^{nomi}}$$

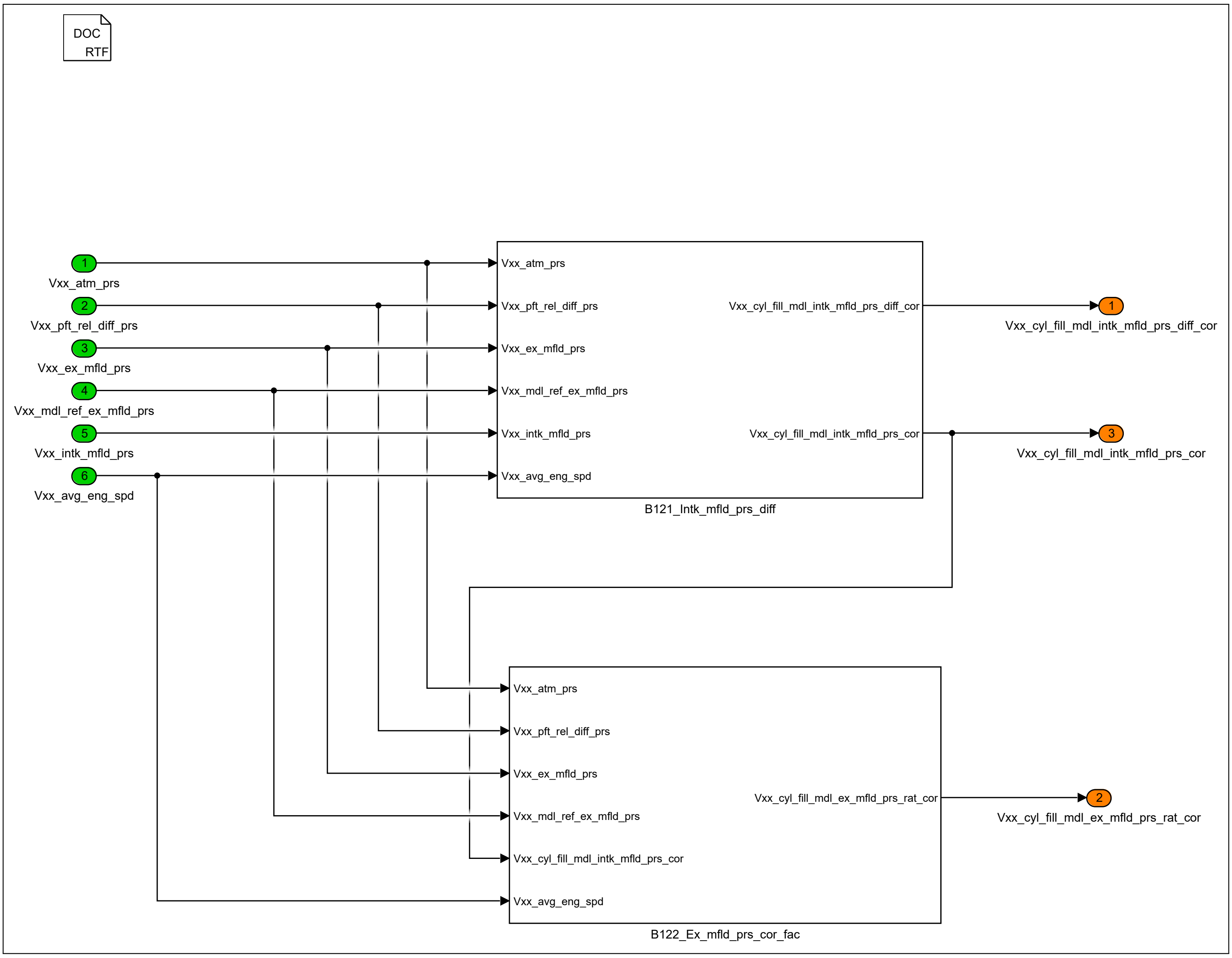

Figure 15: B12_EXHAUST_PRESSURE_CORRECTION

6.2.1.2.1 B121_INTK_MFLD_PRS_DIFF

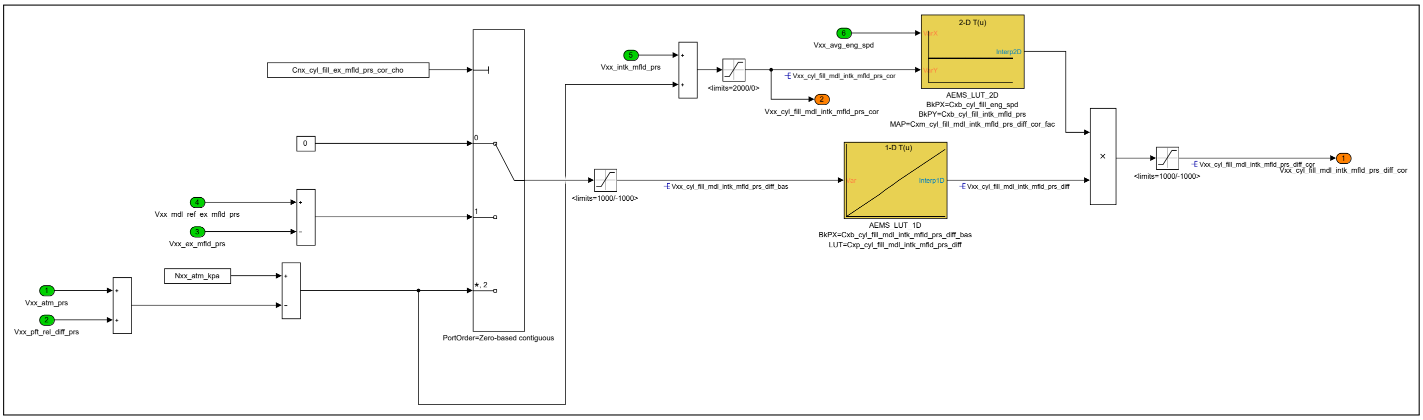

Figure 16: B121_INTK_MFLD_PRS_DIFF

6.2.1.2.2 B122_EX_MFLD_PRS_COR_FAC

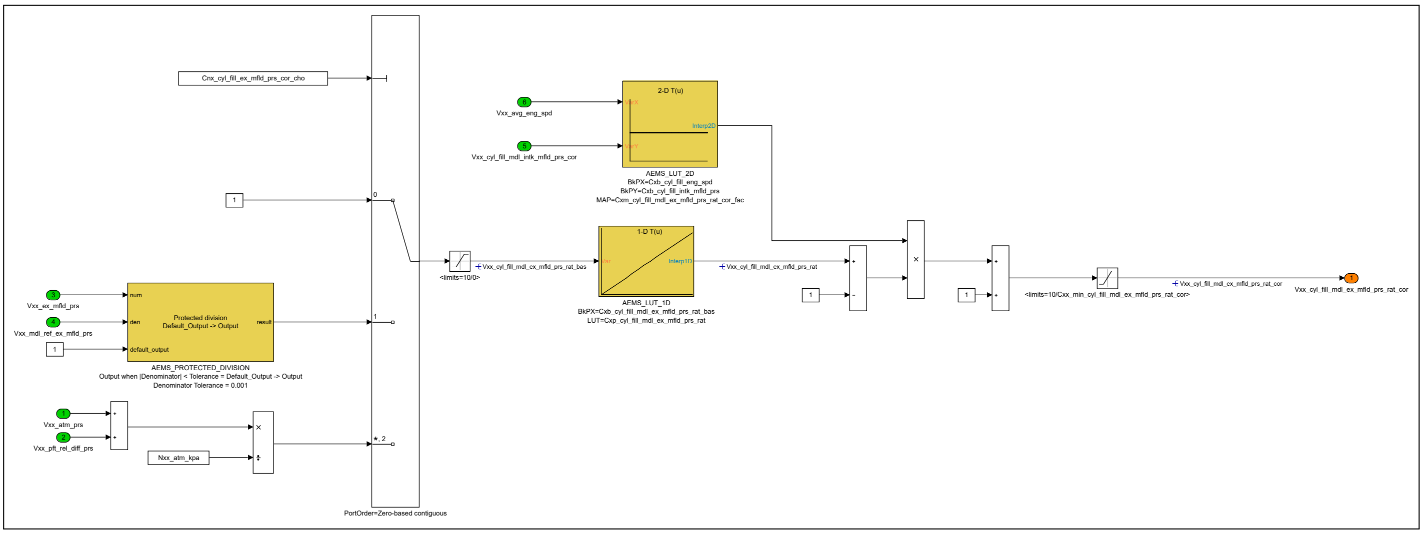

Figure 17: B122_EX_MFLD_PRS_COR_FAC

6.2.1.3 B13_IN_CYLINDER_IVC_MASS

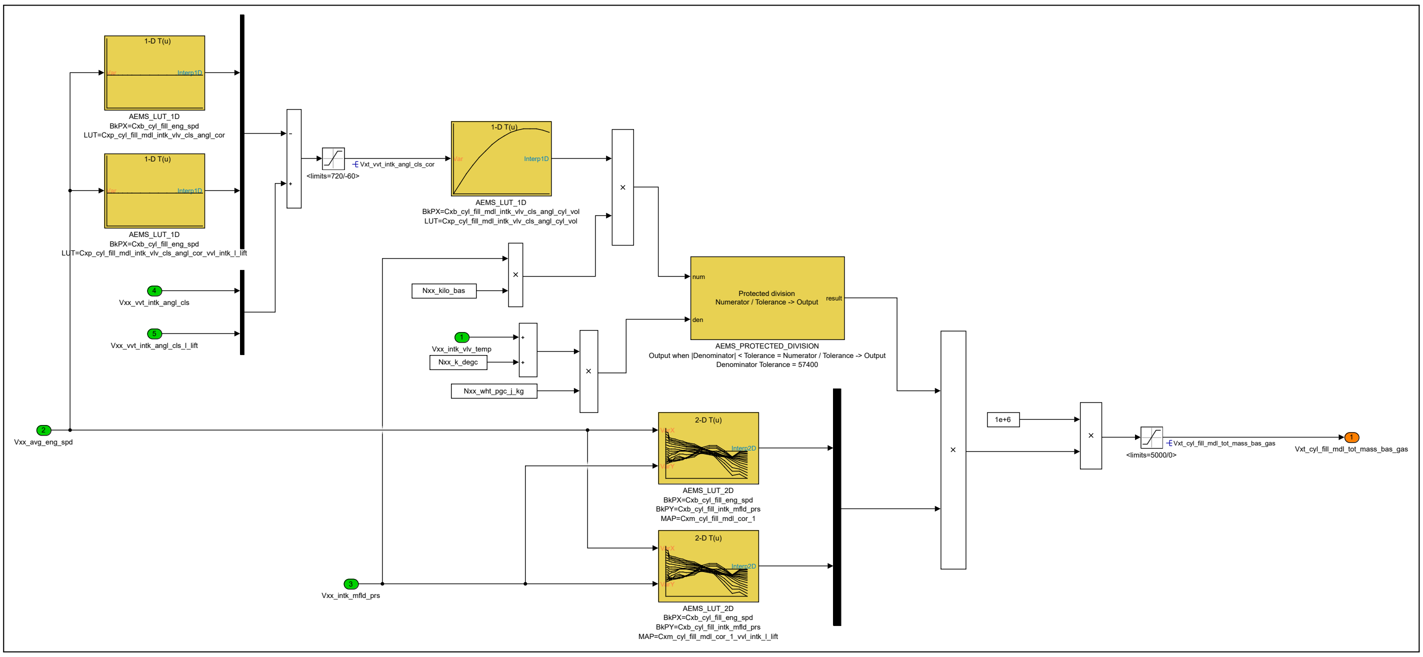

Figure 18: B13_IN_CYLINDER_IVC_MASS

6.2.1.4 B14_IN_CYLINDER_OVERLAP_MASS

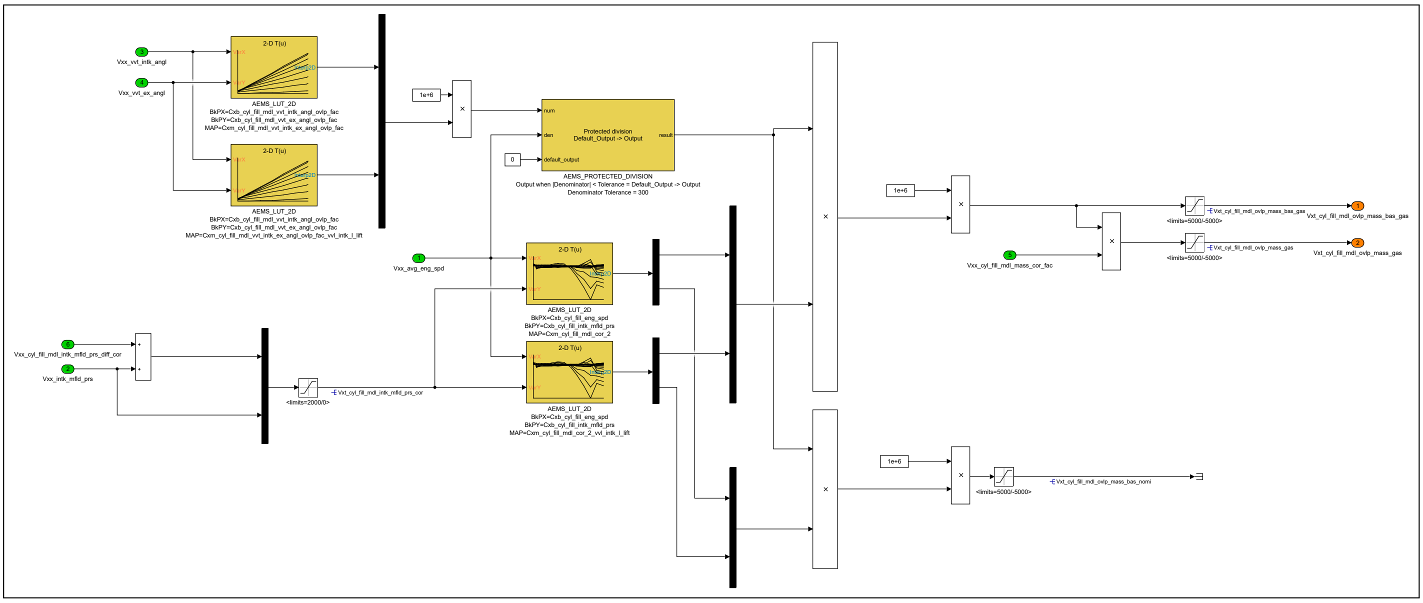

Figure 19: B14_IN_CYLINDER_OVERLAP_MASS

6.2.1.5 B15_IN_CYLINDER_EVC_MASS

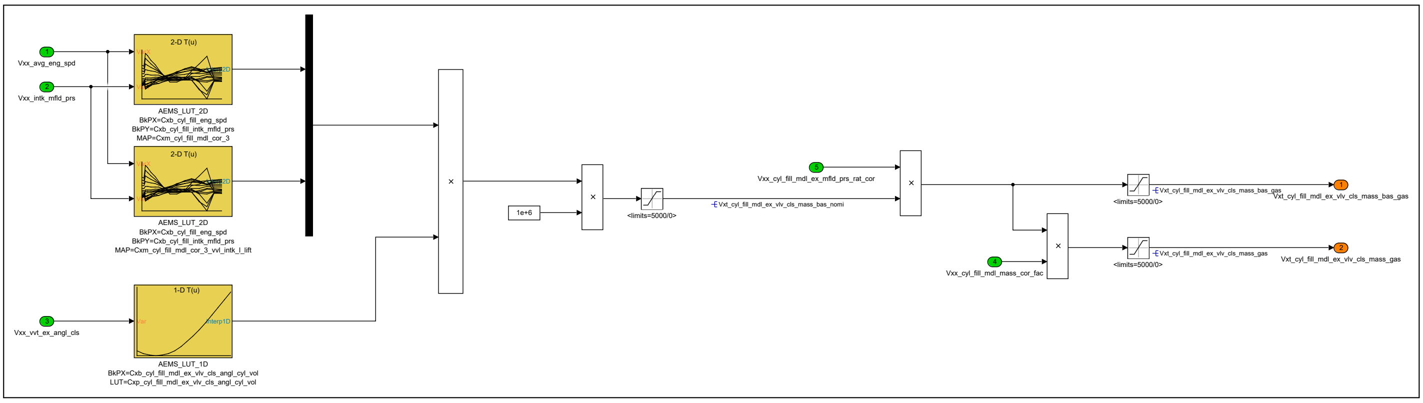

Figure 20: B15_IN_CYLINDER_EVC_MASS

6.2.1.6 B16_THERMAL_CORECTION

The two correction terms rely on the same principle as the legacy filling model, so the existing corrections (Vxx_cyl_fill_efy_temp_cor & Vxx_cyl_fill_efy_dyn_cor) will be reused to correct estimated aspirated mass Vxt_cyl_fill_mdl_pump_mass_bas

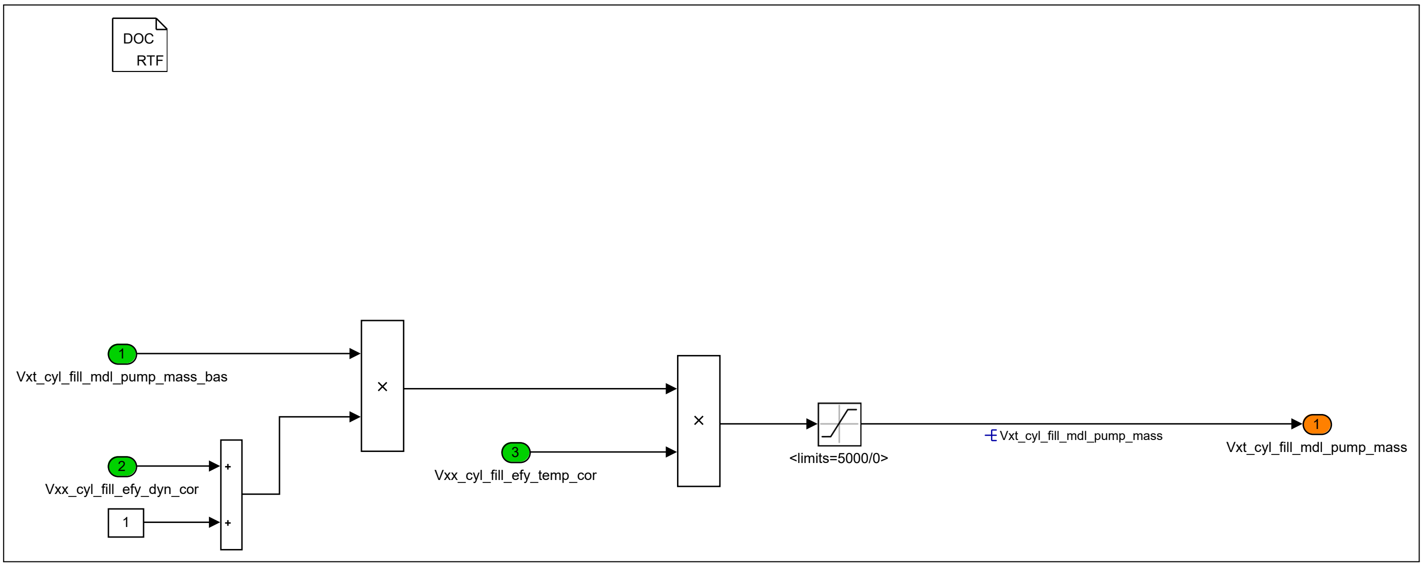

Figure 21: B16_THERMAL_CORECTION

6.2.2 B2_OPTIONAL_CYLINDER_FILLING_EFFICIENCY

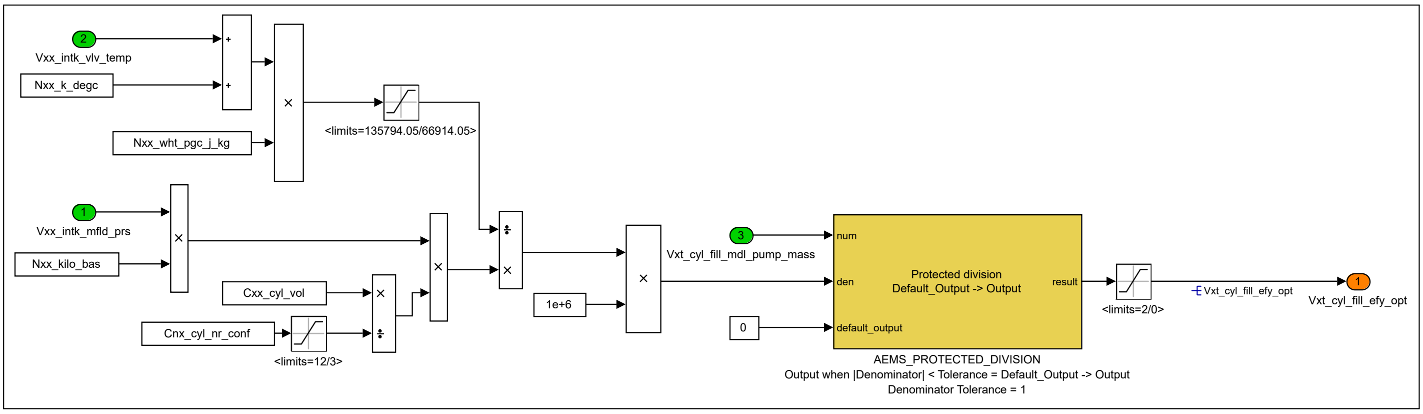

Figure 22: B2_OPTIONAL_CYLINDER_FILLING_EFFICIENCY

6.2.3 B3_OPTIONAL_CYLINDER_TRAPPING_EFFICIENCY

The trapping efficiency (Vxt_cyl_fill_trap_efy_opt) will be calculated as following:

$$m_{trap} = \begin{cases} m_{asp} + m_{ovlp}, m_{ovlp} < 0 \\ m_{asp}, m_{ovlp} \geq 0 \end{cases}$$

$$\eta_{trap} = m_{trap} / m_{asp}$$

In case of scavenging, mass during overlap will flow through from intake valve to exhaust valve, so aspirated mass from intake is not totally trapped in cylinder. Trapped mass (Vxt_cyl_fill_mdl_trap_mass) is calculated with aspirated mass form intake by removing mass during overlap. (Mass during overlap will be negative in the given model)
In case of back-flow, mass during overlap will flow from exhaust valve to intake valve, so aspirated mass from intake can be totally trapped in cylinder.

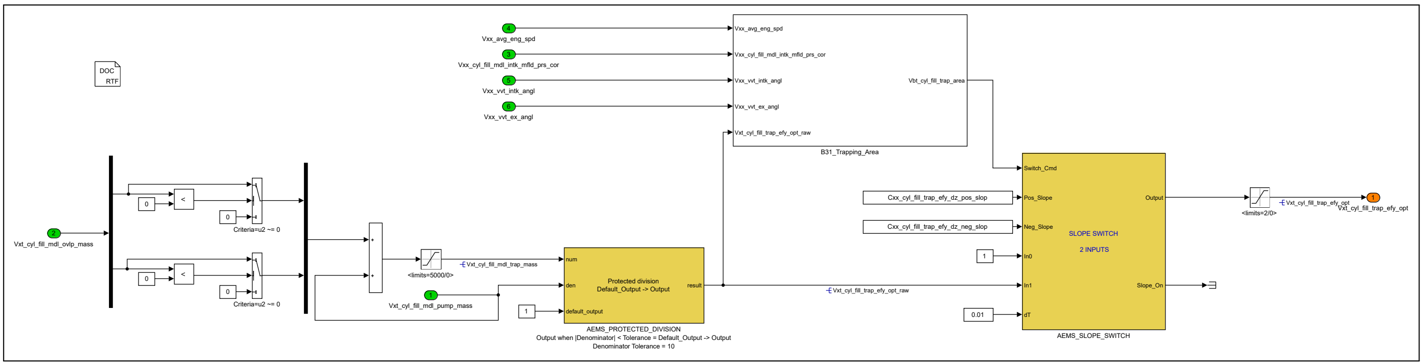

Figure 23: B3_OPTIONAL_CYLINDER_TRAPPING_EFFICIENCY

6.2.3.1 B31_TRAPPING_AREA

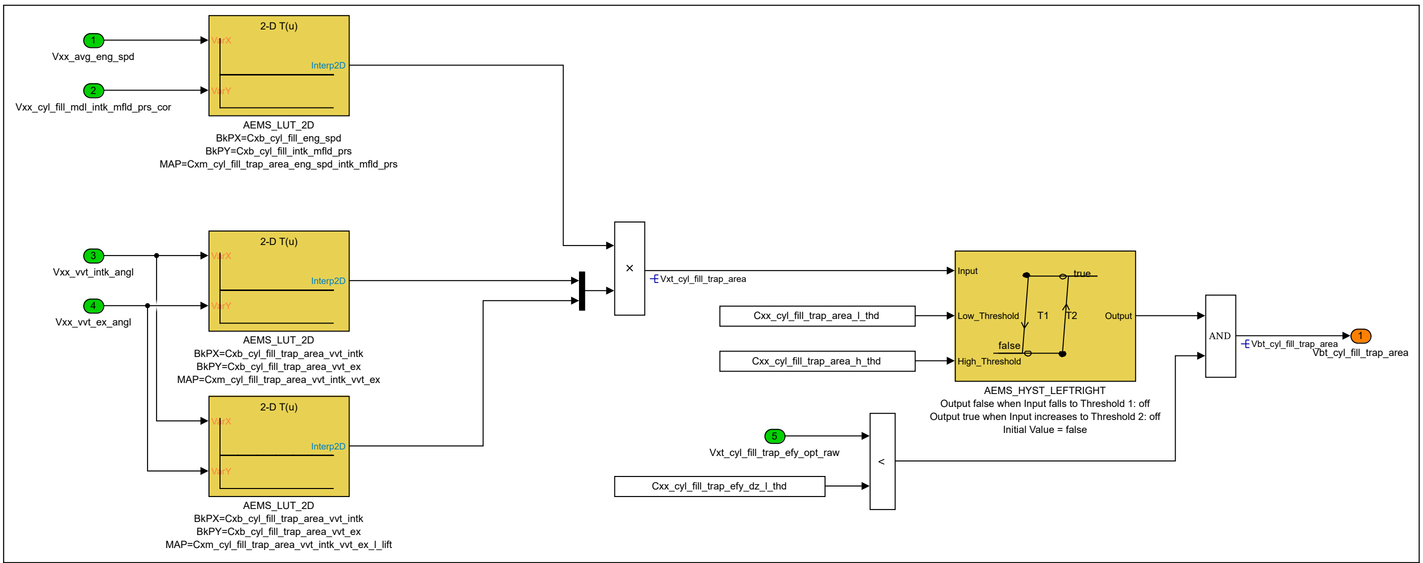

Figure 24: B31_TRAPPING_AREA

6.3 C_CONSOLIDATION

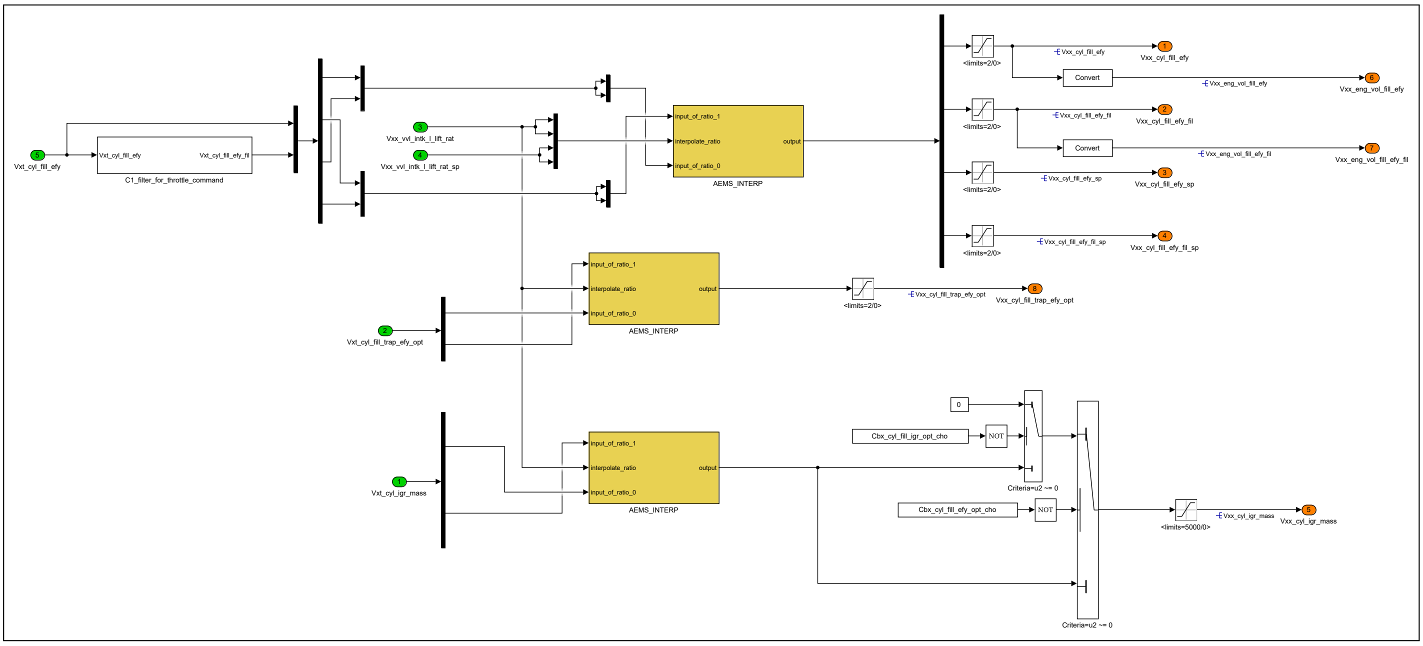

Figure 25: C_CONSOLIDATION

6.3.1 C1_FILTER_FOR_THROTTLE_COMMAND

The engine fill up efficiency goes through a deadzone and also a rate limiter.
This is to avoid too much movement on the throttle command. (Noise on command or oscillations)

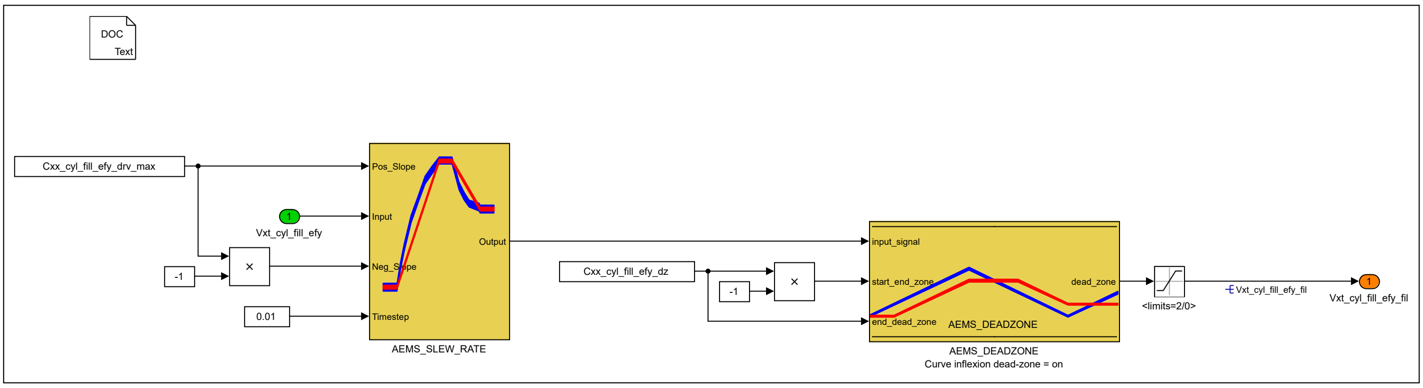

Figure 26: C1_FILTER_FOR_THROTTLE_COMMAND