SRT / SRAE
SOFTWARE
DOCUMENTATION
SUPER-USER

6. DRIVE BY WIRE

chapter 6

Release : 2.0

REVISIONS DOCUMENT

Release	*Author*	*Date*	*Modifications*
1.0	**M.Mersier**	**04/01/2004**	• **Creation (SRA)**
2.0	**M.Mersier**	**09/15/2006**	• **Update (SRT/SRAE)**

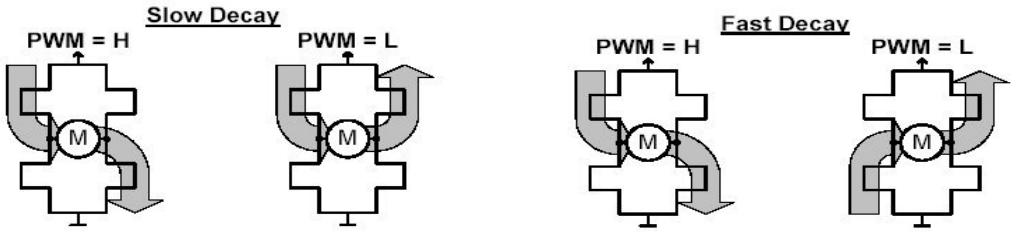
6.1 MOTOR DRIVING

The throttle motor is supplied by a Hbridge driver with a PWM Signal.
The frequency command of the PWM is programmable by **EE.Pmot.Frequence_PMOT (Fmax = 20 kHz),** and the opening direction is programmable by **EE.Pmot.SensOuvHb** This two parameters are only programs at the initialisation of the ECU

The operating mode and the current limitation of the Hbridge driver are programmable :

- The operating mode can be select by the map ***SYSeep. Decay***

Decay	Operating mode
0	Slow DECAY
1	Fast DECAY

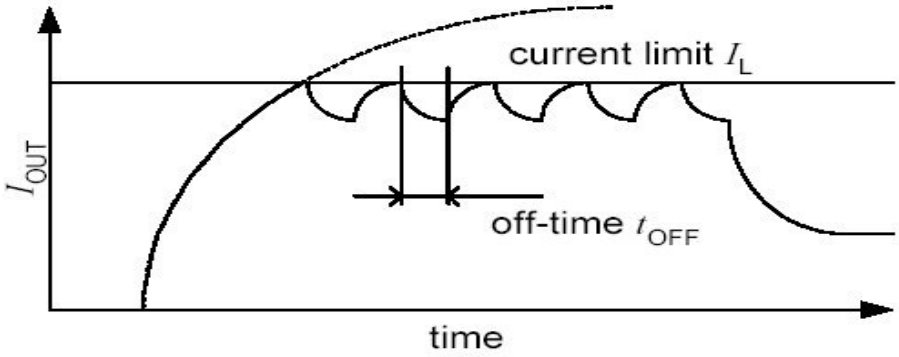


- The current limitation is programmable by **SYSeep.ChopperCurrent**

ChopperCurrent	I (A)
0	4
1	5
2	6
3	7

- During the current limitation , the OFF time is programmable by **SYSeep.ChopperToff**

ChopperToff	Toff (µSec)
0	24
1	43
2	62
3	80



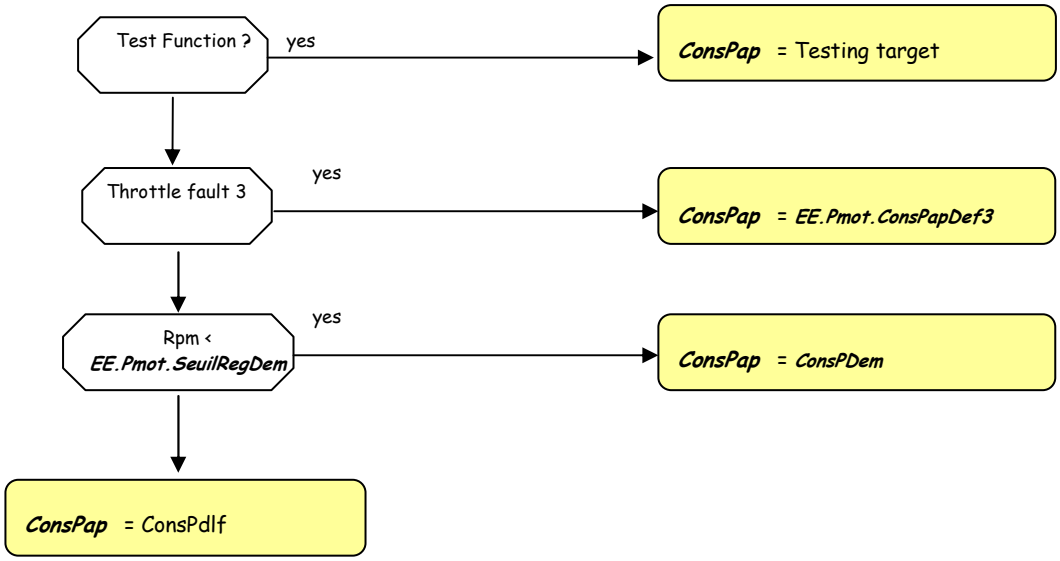
6.2 THROTTLE POSITION CONTROL

6.2.1 TARGET ESTABLISHMENT

The calculation of the target ***ConsPap*** depend on different targets explain below :

Targets	Offset	description
ConsPdlf		Pedal Target filtered
ConsPDem		Pre-opening target
ConsPdlMin		Min pedal Target (auto-adaptation)
Testing Target		Target for testing

The target ***ConsPap*** is determine according to the following way :



6.2.1.1 Pre-opening target

The pre-opening target ***ConsPDem*** is interpolate in the map ***EE.Pmot.TabConsPDem*** function of water temperature and when Rpm is lower than **EE.Pmot.SeuilRegDem** - **EE.Pmot.HystRegDem** .

6.2.1.2 Pedal target

The pedal target ***ConsPdl*** is interpolate in the map ***EE.Pmot.TabConsPdl*** function of pedal position , and is limited at the adaptive min-pedal ***ConPdlMin*** explain below.
The pedal target is filtered using the following formula:

$$ConsPdlf = ConsPdlf + (ConsPdl - ConsPdlf) * EE.Pmot.KfiltConsPdl$$

Where :

- ConsPdlf, ConsPdl in %.
- **EE.Pmot.KfiltCondPdl** no units (between 0 and 1).

6.2.1.3 Auto-adaptation Mini Target

It's necessary to adapt a fix minimal pedal target ***ConsPdlMin*** to maintain correctly the idle rpm..
The adaptation is calculated when the engine is ON and the Rpm is lower than ***EE.Pmot.RegAdaptRal*** and it's stable , and **Co*nsPap*** is between ***ConsPdlMin*** +1° and ***ConsPdlMin*** -1°.

The Rpm is considered stable when the summation ***EcartN*** of the rpm delta since ***E.Pmot.TimerNstab*** mSec is lower than ***EE.Pmot.SEcartNstab***:

When the adaptation conditions are Ok, the difference between Rpm and ***EE.Pmot.RegimeRalenti*** is added in ***EcartRal*** since ***EE.Pmot.TimerNral*** in calibration.
After this time :

- If ***EcartRal*** is > + ***EE.Pmot.SEcartNral***, then ***ConsPdlMin*** = ***ConsPdlMin*** - 0,05%
- If ***EcartRal*** is < – ***EE.Pmot.SEcartNral***, then ***ConsPdlMin*** = ***ConsPdlMin*** + 0,05%

The new value of ***ConsPdlMin*** is limited to a minimum ***EE.Pmot.ButeeMinPapRal*** and to a maximum ***EE.Pmot.ButeeMaxPapRal.***

6.2.1.4 Freeing Target

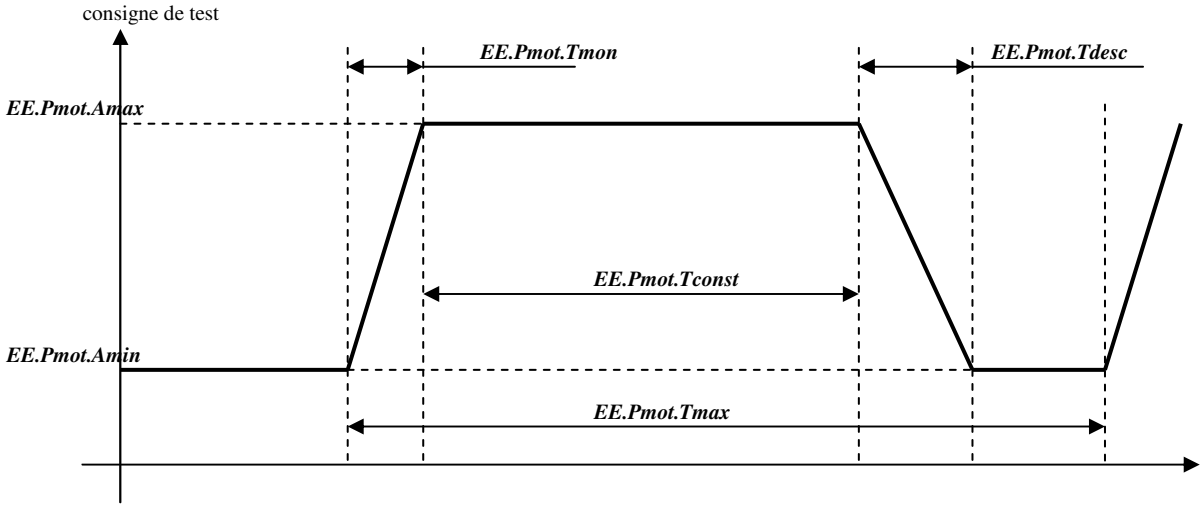
The freeing target ***EE.Pmot.ConsPapDef3*** is applied since ***EE.Pmot.CTErreur3Pap*** 10ms.
When the throttle freeing procedure is active (see $).

6.2.1.5 Testing Target

For a correct calibration of the servo control parameters, a test function can be active by the variable ***ModeTest.*** This function calculate a target like a square signal, a sinusoid , or the pedal position. (ModeTest is write to 0 by software if Rpm is > 0.)

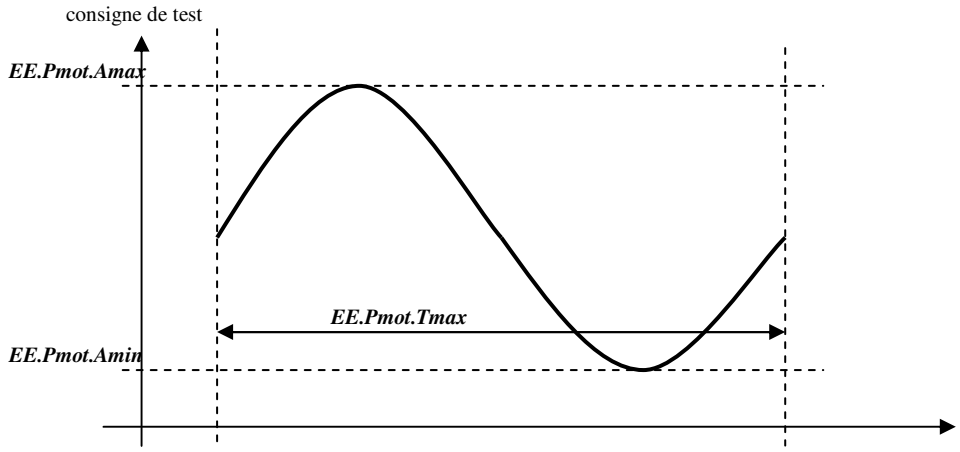
ModeTest	***action***
0	Normal mode
1	Square Signal
2	Sinusoid Signal
3	Pedal Signal

➢ When ***ModeTest*** = 1 , Signal form for ***ConsPap*** :



The period of the square signal is programmable by the map ***EE.Pmot.Tmax*** ,it move between the min value ***EE.Pmot.Amin*** and the max value ***EE.Pmot.Amax*** with the T-ON ***EE.Pmot.Tmon*** and the T-OFF ***EE.Pmot.Tdesc*** . The state is ON during ***EE.Pmot.Tconst***

➢ When ***ModeTest*** = 2, Signal form for ***ConsPap*** :



The period of the sinusoid is programmable by the map ***EE.Pmot.Tmax*** and the signal is moving between the min value ***EE.Pmot.Amin*** and the max value ***EE.Pmot.Amax*** .

- When ***ModeTest*** = 3 , ***ConsPap*** get the value of the pedal target ***ConsPdlf.***
- When ***ModeTest*** = 4 , The Hbridge driver is disable to get the motor Off, This state permit to move the throttle manually.

6.2.2 CONTROL LOOP

6.2.2.1 ERROR CALCULATION

The control loop error , is the difference between the target and the throttle position ***:***

ErreurPap = ConsPap – PapAss

Since a temporisation ***EE.Pmot.TinitPap*** after the initialisation ***ErreurPap*** = 0

6.2.2.2 PROPORTIONAL TERM

The calculation of the proportional term ***CmdP*** is :

CmdP = ErreurPap * EE.Pmot.GainPo when the throttle is opening

or

ErreurPap * EE.Pmot.GainPf when the throttle is closing.

This term is limited between +1000 and –1000.

6.2.2.3 INTEGRAL TERM

The calculation of the integral term ***CmdI*** is :

CmdI32 = *[CmdI (-1) + ErreurPap * EE.Pmot.GainIo]* when the throttle is opening

or

[CmdI (-1) + ErreurPap * EE.Pmot.GainIf] when the throttle is closing

This term is limited between ***EE.Pmot.CmdIMin*** & **Imax**.

CmdI **= CmdI32**

Where :

- **CmdI32** is the last value of the integral term ***CmdI***
- **Imax** = ***EE.Pmot.CmdIMax*** or ***EE.Pmot.CmdIMaxDef3*** when the throttle freeing procedure is active.

6.2.2.4 DERIVE TERM

The calculation of the derive term ***CmdD*** is :

CmdD = (***ErreurPap – ErreurPap(-1)) * EE.Pmot.GainDo*** when the throttle is opening

or

(***ErreurPap – ErreurPap(-1)) * EE.Pmot.GainDf*** when the throttle is closing.

This term is limited between +1000 and –1000.

6.2.2.5 FINAL TERM

The final term ***CmdFin*** is the summation of the three terms discribe upper with a vbatt correction :

CmdFin =[[***CmdP*** + ***CmdI*** + ***CmdD***] * [**12.0** / ***Vbatt***]]/ **1000**

In Slow Decay mode , this term is limited between +1.0 et –1.0
In Fast Decay mode , this term is limited between +1.0 et 0

When ***CmdFin*** < ***EE.Pmot.Sdirback***, the throttle is considered in **CLOSING**. In the other case, the throttle is considered in **OPENING**

A temporisation ***EE.Pmot.Tstopmot*** , is active at every change of the throttle motor direction .

The final term ***CmdFin*** is limited between ***EE.Pmot.CmdMin*** and ***EE.Pmot.CmdMax***

6.2.3 COMMAND RCO ESTABLISHMENT

When the automatic learning of Throttle Min (see chapter "Throttle and Pedal gains, zeros Acquisition" in Client_Configuration.doc) is running :

PmotRCO = RCOButéeMin EE.Pmot.RCOButéeMin

When the automatic learning of Throttle Max (see chapter "Throttle and Pedal gains, zeros Acquisition" in Client_Configuration.doc) is running :

PmotRCO = EE.Pmot.RCOButéeMax

If the timers ***EE.Pmot.TinitPap*** and ***EE.Pmot.Tstopmot*** are finished, and if there is no ***DEFAUTPAPELECT*** information in ***EtatPap*** (see chapter THROTTLE MOTORISED DIAGNOSTIC $6.3).
When the opening direction (**EE.Pmot.SensOuvHb**) is positive

PmotRCO = CmdFin*100

When it's negative

PmotRCO* = - (*CmdFin*100)

If one the timer is > 0 , or if there is a fault in ***EtatPap***

PmotRCO = 0

6.3 THROTTLE MOTORISED DIAGNOSTIC

6.3.1 Analog Inputs Diagnostic

The electric diagnostic and the coherence test between the both throttle inputs and the both pedal inputs are describe in the chapter "Analog Inputs" in INPUTS.DOC.
This defaults flags are positioned in ***EtatPap.***

EtatPap			
Bit 3	**Bit 2**	**Bit 1**	**Bit 0**
DEFAUTPAPCOHER	**DEFAUTPAPELECT**	**DEFAUTPDLCOHER**	**DEFAUTPDLELECT**

- **DEFAUTPDLELECT** = 1 if the both pedal inputs are in default.
- **DEFAUTPDLCOHER** = 1 if the difference between the both pedal inputs are upper than **EE.Pmot.EcartPdl** .
- **DEFAUTPAPELECT** = 1 if the both throttle inputs are in default.
- **DEFAUTPAPCOHER** = 1 if the difference between the both throttle inputs are upper than **EE.Pmot.EcartPap** .

6.3.2 Control Loop Diagnostic

A diagnostic function test the control loop to be sure that the throttle is near the ask target. Since the timing ***EE.Pmot.TinitPap*** this function is inactive and the faults flags are reset to 0.
This defaults flags are positioned in ***EtatPap.***

EtatPap			
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**
---------	**DEFAUTERREUR3**	**DEFAUTERREUR2**	**DEFAUTERREUR1**

- **DEFAUTERREUR1 = 1** if ***ErreurPap > EE.Pmot.SErreur1pPap*** or ***ErreurPap < EE.Pmot.SErreur1nPap*** since ***EE.Pmot.TErreur1Pap*** (important error since a short time)

- **DEFAUTERREUR2 = 1** if ***ErreurPap > EE.Pmot.Serreur2pPap*** or ***ErreurPap < EE.Pmot.Serreur2nPap*** since ***EE.Pmot.Terreur2Pap*** (low error since a long time).

- **DEFAUTERREUR3 = 1** if ***Rpm*** = 0 and ***ErreurPap > EE.Pmot.Serreur3Pap*** since ***EE.Pmot.Terreur3Pap*** (Blocking risk of the throttle).

The third default is has priority in regards of the others defaults.

6.3.3 HBridge Diagnostic

A diagnostic function test the Hbridge driver. This information are read in the Hbridge driver and write in ***DiagHB***

DiagHB			
Bit 3	**Bit 2**	**Bit 1**	**Bit 0**
CO_HB	**Warning**	**PreWarning**	**Error_Flag**
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**
PowerSupply	**1**	**CC_Vbatt**	**CC_Gnd**

- **Error_Flag** **= 1** One default is present.
- **PreWarning** **= 1 :** High temperature pre-alarm of the driver..
- **Warning** **= 1 :** High temperature alarm of the driver.
- **PreWarning+ Warning = 1 :** Very High temperature for the driver .(for internal protection the motor supply is cutoff by the driver)
- **CO_HB** **= 1** : Motor open circuit .
- **CC_Gnd** **= 1** : Ground short circuit upon one of the motor alimentation .
- **CC_ Vbatt** **= 1** : Vbatt short circuit upon one of the motor alimentation, short circuit across the motor.
- **PowerSupply** **= 1 :** Lower alimentation for the motor .(for internal protection the motor supply is cutoff by the driver)
- **Bit 6 is always read to 1** (if no error, DiagHB = 40 hexa)

NOTE: , In case of fault present in EtatPap or DiagHB , speed limiters are applied for injections (EE.Pmot.LimInjPmotand ignitions (EE.Pmot.LimAllPmot) (See Limiters.doc for more details).