

MULTIPLE MOTORS CONTROL THROUGH CAN CLM-301

Description

Module used to control two SBS motors (step by step, for the horizontal and vertical movement of the knife) and a brushless (torque, for the turn of the knife) through CAN communication, being able the use of different working ways (asynchronous, synchronous, pulse counting) as well as the control of acceleration and deceleration ramps.

- Allows horizontal synchronized movement of several equipments.
- Allows knife vertical position measurement to control the penetration of it.
- Has inputs and outputs for general purpose



Application

Its principal application is found in the longitudinal cut of heavy machinery in the paper industry: CLM = Motorized, Longitudinal, Cut

Additional Data

- ✓ Synchronism horizontal movement between top and low knife.
- Knifes turning speed control through PMSM motor (permanent magnet synchronous motor).
- Modules addressing through microswitch.
- ✓ SW adapted for graphical visualization of records and change of version through RS232.
- Inputs with supply for extern detectors and differentials encoders.
- ✓ Outputs for devices control
- ✓ Knife penetration auto-adjustment through potentiometer reference.
- ✓ Alarms and devices state signals with led diodes.

I Oldi Hecessary area	155	155	270
Case	135	155	238

Height

Common data

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To govern a longitudinal arm, the CLM-301 module has to control:

Dimensions_{(mm}

Width Length

Weight

(Kg)

- ✓ PMSM motor for knife turn.
- SBS motors for horizontal and vertical movement of the knife.
- ✓ Potentiometer for knife penetration reference.
- Four stages
 1: photoelectric cell for knife diameter calculation.
 2: general purpose.
- Two outputs:
 1: Acts on the electro-valve that presses the top knife against the low one.
 - 2: general purpose.



The CLM-301 control is done through the OPENCAN, hanging from a CANMASTER as many modules as necessary. Each CLM-301 uses 4 gates of the CAN controller, must not overload the line. Each module addressing is done with a micro-switch according to selected code, beginning with the switch of less weight (CODE1).

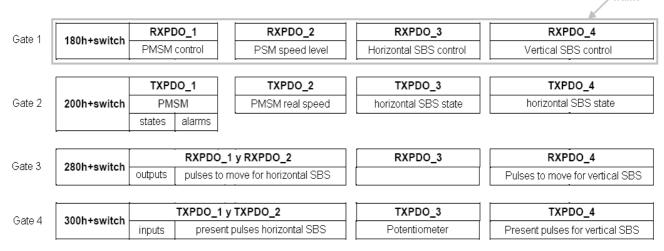
	ON									
	OFF									
8	7	6	5	4	3	2	1			
	A	DD	RE	ss	ING	3				
S١	N.1		С	DC	E	1				
S١	N.2		CODE 2							
S١	N.3		CODE 4							
SI	N.4		С	DC	E	8				
SI	N.5		С	DC	E	16	5			
S١	N.6		CODE			32	2			
S١	N.7		CODE 6			64	L			
SI	N.8		С	DC	E	12	28			

According to standard OPENCAN, the gate definition comes given by...

ID					CRC
OPENCAN Standard + switch		8 by	/tes		

... being switch the addressing to each CLM-301 module.

The gates addresses and the frames composition of the CLM-301 module seen from the CODESYS programming language is the following:



gates 1 and 3 -> transmission for codesys (reception for CLM-301) gates 2 and 4 -> reception for codesys (transmission for CLM-301)

Each CLM-301 module has a glazed window on the upper side of its case for leds visualization. These leds show all devices state, according to following table code.

VISUALIZ.	LED.1	WD (Watch dog) flashing every	y 1 second		
ORDER	LED.2	CAN Communication			FLASHING
	LED.3	RS-232 Reception/Transmission	on		
8 7 6 5	LED.4	PMSM motor.	OFF=STOP	ON=START	FLASHING=ALARM (*)
1 2 3 4	LED.5		OFF=STOP	ON=START	FLASHING=ALARM
LED.	LED.6	Horizontal mov. SBS motor		TOR	QUE
			OFF=LOW	ON=MIDDLE	FLASHING=HIGH
	LED.7		OFF=STOP	ON=START	FLASHING=ALARM
	LED.8	Vertical mov. SBS motor	TORQUE		
	220.0		OFF=LOW	ON=MIDDLE	FLASHING=HIGH

(*) The alarm indicated by the LED4 can have different meanings for a PMSM or a SBS motor. See them detailed in the part of this document that refers to the above mentioned motor.



MOTOR PMSM (brushless / torque)

The control of this motor is done in closed speed loop. Just the first time that the motor starts (after a reset of the CPU), the motor turns in open loop until it founds the position of the "0" angle of the stator poles. Once the motor is positioned it will turn taking as a reference the "0" position of the calculated angle. The configuration values of the PID loops, alarms... are customized by default, being able to modify them from the CODESYS programming language. The control records and the motor visualization are located on the "processmap" and depend on the ID (Switch number).

Switch	Processmap del Codesys (es	scritura en CLM-301)
1	PMSM_01_CONTROL	AT %QW2572: WORD
1	PMSM_01_CONSIGNAVEL	AT %QW2573: WORD
2	PMSM_02_CONTROL	AT %QW2584: WORD
2	PMSM_02_CONSIGNAVEL	AT %QW2585: WORD
3	PMSM_03_CONTROL	AT %QW2596: WORD
5	PMSM_03_CONSIGNAVEL	AT %QW2597: WORD
Switch	Processmap del Codesys (leo	ctura del CLM-301)
1	PMSM_01_ESTADO_ALARMAS	AT %IW2572: WORD
1	PMSM_01_REALVEL	AT %IW2573: WORD
2	PMSM_02_ESTADO_ALARMAS	AT %IW2584: WORD
2	PMSM_02_REALVEL	AT %IW2585: WORD
3	PMSM_03_ESTADO_ALARMAS	AT %IW2596: WORD
3	PMSM_03_REALVEL	AT %IW2597: WORD

The records have the speed "consigna" in encoder impulses/second, which is 2048 pulses/turn. It is possible to accede to the records from the CAN reception and transmission buffer (RXPDO, TXPDO).

		190	h+switch	RXPD	0_1_1		RXPDO_1_2		Registro que contiene la
ristras seess			n+switch	/ control	PMSM		consigna vel PMSM		consigna de velocidad en impulsos/segundo de
egistros acceso ápido PDO									encoder.
bloque CMS del stándar CAN)				TXPD	0_1_1		TXPDO_1_2	[Registro que contiene la
		200	h+switch	PN	ISM	\	velocidad real PMSM		velocidad actual de giro
				estado	alarma	<u>ن</u> ا			en impulsos/segundo de encoder.
						\mathbf{N}		l	
		Est	ado v cont	trol PMSM		Cá	digos alarma PMSM (le	ed 4 display	parpadeando)
	bit	Hex	-			Valor			
	0	1	Marcha			1	Sobrecorriente de pico	rama R	
	1	2	Parada			2	Sobrecorriente de pico	rama S	
	2	4	Carga par	ámetros onl	line	3	Sobrecorriente de pico		
	3	8	Reset alar	mas		4	Sobrecorriente rms ram		
	<u> </u>	•	•			5	Sobrecorriente rms ram		
	I	XPD	O=RECEPC	TION		6	Sobrecorriente rms ran	na T	
	1	[XPD0	O=TRANSN	AISION		7	Alarma módulo de pote	ncia (IGBT)	
						8	Alarma sonda temperat	tura (KTY) A	LARM.> 95°C
						9	Alarma tensión baja de	bus	
						10	Alarma error en la com	unicación CA	AN
						11	Alarma conexión erróne	ea encoder.	

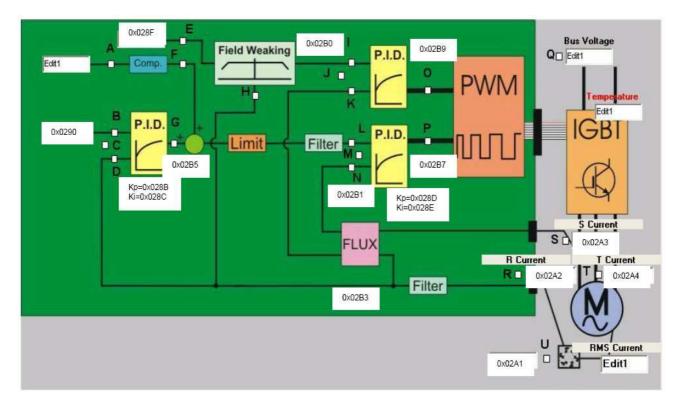


Control loops records configuration

In the CODESYS block, in the MTC-3038 module properties exist the "Editable parameters" flap, where some motor control loops parameters can be modified. They would correspond with slow access record SDO (CMS block of CAN standard), so they are send just once (initial configuration).

REGISTER	COMMENT	FACTOR
Current sensor adjust IR	Registers for IR current measurement adjustment.	
Current sensor adjust IS	Registers for IS current measurement adjustment.	
Note: the IT current measurement is	done matematically	
-	Register for the adjustment of the measurement that the potentiometer gives, which indicates in hundreth the height of the knife	Q12
Reak current limit	Current peak so that alarm goes off. 1000H=5A.	Q12
RMS Current limir	RMS Current so that alarm goes off.	Q12
Maximum speed ramp	Value that a slope generate us if the speed value produces a sudden change or jump.	
Speed filter	Filter in the speed measurement.	
Speed PID	Kp= proportional constant speed loop.	
Speed PID	Ki= integrative constant speed loop.	
Torque PID	Kp= proportional constant speed loop.	
Torque PID	Ki= integrative constant speed loop.	
Magnetizing current reference	Reference of the magnetizing current-	

PMSM module configuration record.



Through RS-232 communication with its respective equipment, the addresses in upper graph can tested.



SBS MOTORS (horizontal movement)

The horizontal movement of the knife is controlled by a SBS motor. This motor can start in synchronous way, starting the upper and lower knife at the same time with the synchronous order. The motor can start doing a torque stopped.

Working ways

Asynchronous

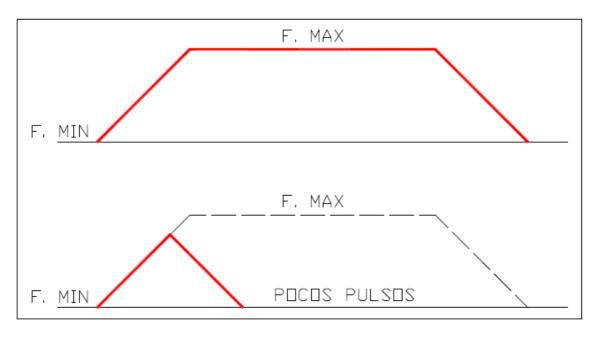
Starts in an individual way with a ramp from a minimum frequency to a maximum. The time of raise is given in tenths of second.

Deceleration

It is only applied in the asynchronous way. Goes from a maximum frequency to a minimum one. The deceleration time is the same as the acceleration time.

Pulses counting

The number of pulses that the knifes want to be moved has to be indicated, the way itself generates the acceleration and deceleration ramp from the maximum and minimum frequency. If there are not many pulses, it is possible that the maximum frequency is not reached.



Synchronous

This way allows starting several motors at the same time (example: pair of knifes upper and lower). Firstly the motors that want to be started are kept with the order "start", when a common signal reach to all the equipments "synchronization order" all of them start at the same time. The stop can also be in synchronous way.

Synchronous way starting process

- Send to the records control of the motors that want to be started, the value "CONTROL_SBS=0x010Eh".
- Verify which state record has located the value "ESTADO_SBS=0x010Eh".
- Send "TRUE" to the system value "MTC3038_SINCRO(BOOL)=TRUE". Motors star at the same time.



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register t (CMS blo standard bit Hex 0 0000 1 0002 2 0004 3 0008 4 0010 5 0020 6 0040 7 0080 8 0100 9 0200 10 0400 11 0800 11 0800 12 1000	o PDO- ock of CAN) h Dire h Torc h Torc h Asyr h Asyr h Asyr h Star h Star h Star h Star h Star	→ 300h+switch tal SBS control ction que 1 (^a) que 2 que with stopped nchronous start nchronous stop t with pulses chronous start S synchronous start b by pulses	Outputs Pulses t TXPI Inputs Present (* ^a) "Multiplexand it is obtained (* ^a) "Multiplexand it is obtained 0 0 Without us 0 1 Minimum t motor 1 0 1 1 Maximum eration (* ^b) The registers "min. frequency" address in the Co SBS1 control bit pp SBSx_CONTRO	to move \$ DO_1 pulses \$ do" control OL (Bits 2 se torque torque torque "control", and slope bdesys. "W 15 and 16 DL (Bits 1	SBS horizo SMS horizo I bit 1 and 2 2 and 1) 0002h 0004h 0006h "max. frequ share the s fultiplexando it is obtain.	ontal ontal	200 bit H 00 10 20 30 40 50 60 70 80 90 100 110 121 132	Dh+sw 000h 002h 002h 004h 008h 010h 020h 040h 020h 040h 020h 040h 000h 00	Vitch Horiz Addre Torqu Torqu Async Decel Async Start Start Start Start Start Reset	Horizonta TXF Horizonta contal SBS s ental	I SBS cont PDO_3 I SBS state state r stopped urt s waiting s turning
bit Hex 0 0000 1 0002 2 0004 3 0008 4 0010 5 0020 6 0040 7 0080 8 0100 9 0200 10 0400 11 0800	No PDO- bock of CAN) Horizon h Dire h Torc h Torc h Asyr h Asyr h Asyr h Star h Star h Star h Star h Star h Star	→ 300h+switch tal SBS control ction que 1 (^a) que 2 que with stopped nchronous start nchronous stop t with pulses chronous start S synchronous start b by pulses	Outputs Pulses t TXPI Inputs Present (* ^a) "Multiplexand it is obtained (* ^a) "Multiplexand it is obtained 0 0 Without us 0 1 Minimum t 0 1 Minimum t 0 1 Nammum eration (* ^b) The registers "min. frequency" address in the Co SBS1 control bit 0 0 Control	to move \$ DO_1 pulses \$ do" control OL (Bits 2 se torque torque torque "control", and slope odesys. "M 15 and 16 OL (Bits 18 ency Hz	SBS horizo SMS horizo I bit 1 and 2 2 and 1) 0002h 0004h 0006h "max. frequ share the s fultiplexando it is obtain.	ontal ontal	200 bit H 00 20 30 40 50 60 70 80 90 100 110 121 132 144	Dh+sw 000h 002h 002h 004h 008h 010h 020h 040h 080h 100h 200h 400h 800h	Vitch Horiz Addre Torqu Torqu Async Decel Async Start Start Start Start Start Reset	Horizonta TXF Horizonta contal SBS s ental	I SBS cont PDO_3 I SBS state state r stopped urt s waiting s turning

(1) Access motor control -> Starting order asynchronous to max. torque	SBS = 0x0016 (hex) = 0000 0000 0001 (hex) = 00000 0000 00000 0001 (hex) = 00000 0000 0000 0000 (hex) = 00000 0000 0000 0000 (hex) = 00000 0000 0000 0000 (hex) = 00000 (hex) = 00000 0000 0000 (hex) = 00000 (hex) = 000000 (hex) = 00000 (hex) = 000000 (hex) = 00000 (hex) = 00000 (hex) = 00000 (hex) = 00000 (hex) = 000000 (hex) = 00000 (hex) = 00000 (hex) = 00000 (hex) = 00000 (hex) = 0000	0110 (bin)
 (2) Access final frequency -> Frequency of 5000hz 	SBS = $0x5388$ (hex) = 01 01 0011 1000 = $0x1388$ (hex)	1000 (bin) 5000 (dec)
(3) Access initial frequency	SBS = 0x8032 (hex) = 10 00 0000 0011 (
 -> Min. frequency of 50hz (4) Access to acceleration slope -> Acceleration slope 100dsg 	= 0x0032 (hex) SBS = 0xC064 (hex) = 1100 0000 0011 - 0x0064 (hex)	0100 (bin)
-> Acceleration slope 100dsg	= 0x0064 (hex)	100 (dec)



SBS MOTORS (vertical movement)

The vertical movement of the knife is controlled by SBS motor. This motor does not have synchronous starting mode. Has automatically photoelectric cell stop, being able to calculate the 0 point of the knife.

Working modes

Asynchronous

Starts in an individual way with a ramp from a minimum frequency to a maximum. The time of raise is given in tenths of second.

Deceleration

It is only applied in the asynchronous way. Goes from a maximum frequency to a minimum one. The deceleration time is the same as the acceleration time.

Pulses counting

The number of pulses that the knifes want to be moved has to be indicated, the way itself generates the acceleration and deceleration ramp from the maximum and minimum frequency. If there are not many pulses, it is possible that the maximum frequency is not reached.

Photocell

The motor starts and remains at the minimal frequency, until stop because of photocell detection.

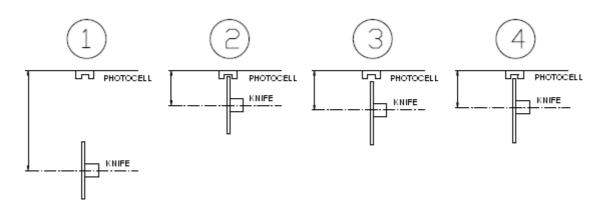
Switch	Codesys Processmap (nome	enclature	e in CLM-301)	
	SBS_01_VERTICAL_CONTROL		AT %QW2575: WORD	The visualization records and
	SBS_01_VERTICAL_FRE_MAX		AT %QW2575: WORD	the motor control are located in
1	SBS_01_VERTICAL_FRE_MIN		AT %QW2575: WORD	the processmap"
	SBS_01_VERTICAL_RAMPA		AT %QW2575: WORD	
	SBS_01_VERTICAL_REF_PULSOS	16 bits	AT %QW2579: WORD	It is possible to accede to the
	SBS_02_VERTICAL_CONTROL		AT %QW2587: WORD	records from CAN reception and
	SBS_02_VERTICAL_FRE_MAX		AT %QW2587: WORD	transmission buffer (RXPDO,
2	SBS_02_VERTICAL_FRE_MIN		AT %QW2587: WORD	TXPDO).
	SBS_02_VERTICAL_RAMPA		AT %QW2587: WORD	
	SBS_02_VERTICAL_REF_PULSOS	16 bits	AT %QW2591: WORD	
Switch	Codesys Processmap (Re	ading of	f CLM-301)	Common register to all modes.
1	SBS_01_VERTICAL_ESTADO		AT %IW2575: WORD	
-	SBS_01_VERTICAL_REAL_PULSOS	16 bits	AT %IW2579: WORD	
2	SBS_02_VERTICAL_ESTADO		AT %IW2587: WORD	
	SBS_02_VERTICAL_REAL_PULSOS	16 bits	AT %IW2591: WORD	



Quick acce	ss register to PDO	180h+switch	RXPDO_4	280h	n+switcl	n RXPDO_4 Horizontal SBS control
	c of standard CAN)	200h+switch	TXPDO_4 Vertical SBS state	300	0h+swite	ch TXPDO_4 Horizontal SBS state
V bit Hex	erticall SBS control	(* ^a) "Multiplexand it is obtained …	do" control bit 1 and 2		H	lorizontal SBS state
0 0000h 1 0002h 2 0004h 3 0008h 4 0010h 5 0020h 6 0040h 7 0080h 8 0100h 9 0200h	Direction Torque 1 Torque 2 Torque with stopped motor Asynchronous start Asynchronous deceleration Asynchronous stop Start with pulses	0 0 Without us 0 1 Minimum 1 0 Average t 1 1 Maximum (* ^b) The registers "min. frequency" address in the Co	torque 0002h orque 0004h	10 20 30 40 50 60 70 80	000h A 002h Tr 004h Tr 008h Tr 010h A 020h D 040h A 080h S	ddress orque1 orque2 orque with motor stopped synchronous start eceleration synchronous stop tart with pulses tart with photocell
10 0400h 11 0800h 12 1000h 13 2000h 14 4000h 15 8000h	Stop by pulses Reset alarm ([*])	SBSx_CONTRO 0 0 0 1 0 1 1 0 1 1	iency HZ	11 0 12 1 13 2 14 4	000h R 000h 000h P	top by pulses eset alarm ower alarm AN alarm

Procedure to measure the knife diameter.

As the work with a photocell is really slow this procedure is done to speed up the work. First of all a quick approximation is done in asynchronous way.



- Raise the knife in asynchronous way and be looking at the input of the photoelectric cell until it detects it, once introduced stop. (*Point2*)
- Lower the knife in asynchronous way until the photocell stops detecting and stop. (Point3)
- Start the knife in photocell way. This way the knife will stop as soon as it detects the photocell, giving a precise adjustment of the same one. (*Point4*)



INPUTS / OUTPUTS

The module has four inputs: one for the photocell and three of general purpose (IN2-IN3-IN4). In the machines where the vertical movement is manual, the inputs IN3-IN4 will be assigned to the raising or descending movement of the knife IN3=KNIFE UP and IN4=KNIFE DOWN.

registers quick access PDO	>	300h+switch	TXPDO_1
(CMS block from CAN standard)	-	Soon+Switch	inputs Present horizontal SBS pulses

The state of the inputs is in the high part of each of the "CODESYS" registers.

Switch	Codesys processmap (CLM-301 writing)									
1	INPUTS_01	AT %IW2576: WORD								
2	INPUTS_02	AT %IW2588: WORD								
3	INPUTS_03	AT %IW2600: WORD								
4	INPUTS_04	AT %IW2612: WORD								
5	INPUTS_05	AT %IW2624: WORD								

F	E	D	С	В	А	9	8	7	6	5	4	3	2	1	0
				↑	↑	↑	↑								
	General Prog.														
	만	notocell													

The module has two outputs: one for the electro-valve and the other for general purpose.

registers quick access PDO (CMS block from CAN standard)

280h+switch	RXPDO_1 and RXPDO_2
20011+5WIICH	outputsPulses to move SBS horizontal

The state of the outputs is in the high part of each of the "CODESYS" registers.

		Switch		Codesys processmap (CLM-301 writing)											
		1	OUTP	UTS_()1		AT	AT %IW2576: WORD							
		2	OUTP	UTS_()2		AT	AT %IW2588: WORD							
		3	OUTP	UTS_()3		AT	AT %IW2600: WORD							
		4	OUTP	UTS_()4		AT	AT %IW2612: WORD							
		5	OUTP	UTS_()5		AT	AT %IW2624: WORD							
	_														
F	E	D	С	В	А	9	8	7	6	5	4	3	2	1	0
General Prog.															
Electro-valve															
It is possible to accede the registers from the CAN reception and transmission buffers.															