

# EM-337A-PLI PARALLEL DRIVER FOR 4 ACTUATORS or MOTORS

## 12/24Vdc 4x10A / 4x20A peak

### FEATURES

- synchronized 4 parallel driving
- operates with pulse feedback
- pulse counting PNP or NPN logic
- quadrature pulse counting
- current and temperature limit
- settable drive speed
- 2 or 16kHz pwm frequency
- acceleration and deceleration ramps
- stroke length limitation
- setting with serial interface
- brake ( release ) output
- safety switch input
- RS-485 ( Modbus ) control
- safety reverse function
- A-version replaces earlier versions but A-ver board works only with A-ver. firmware
- firmware ver. A-PLI v1.4 multiparaller feature added. ( param. 27 and 28 )

### APPLICATIONS

- table lifter
- hatch control
- worktop control

### EM-337A-PLI

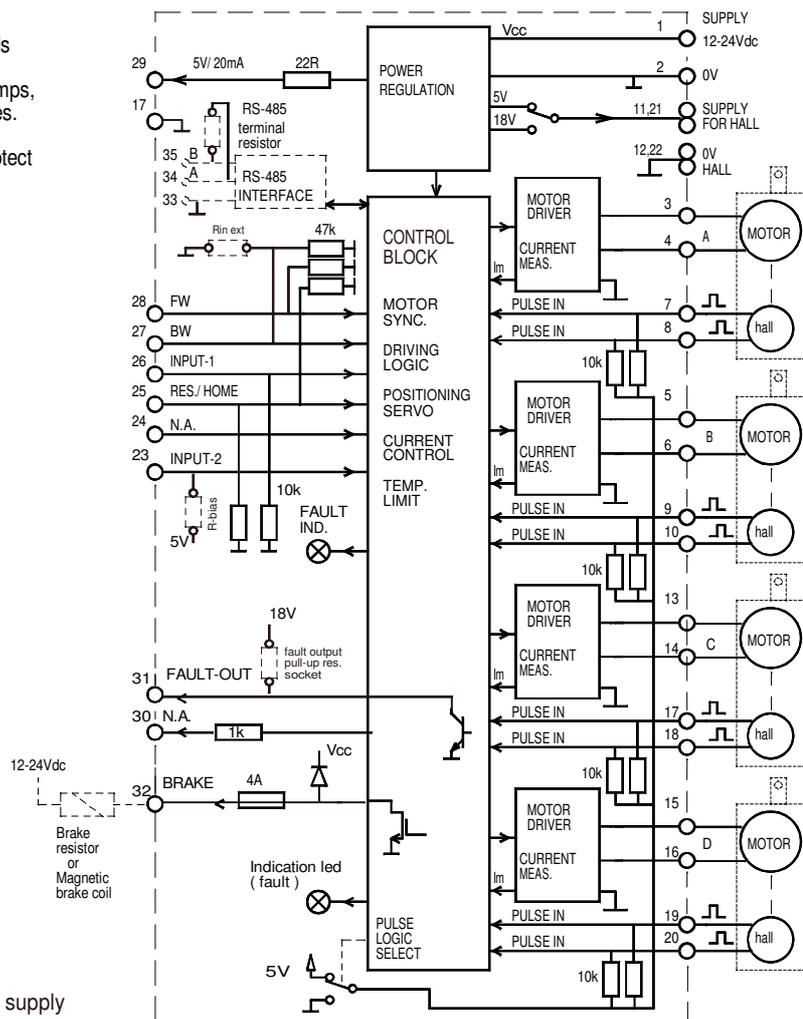
EM-337A-PLI is a parallel synchro controller for 4 DC-motors. The controller has four H-bridge power stages. The driver works with actuators that can offer pulse feedback signal. The control is done with FW / BW commands.

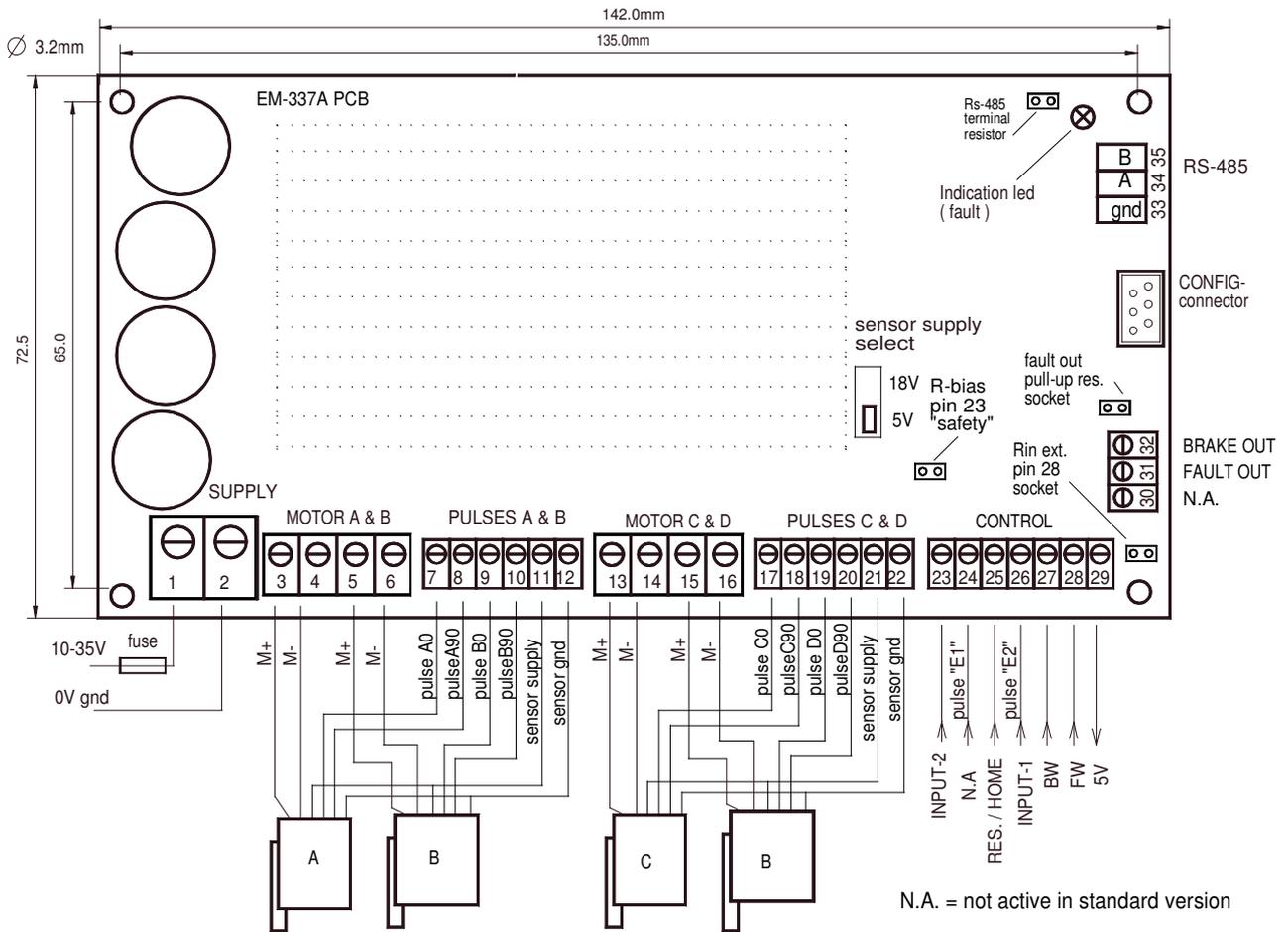
The synchronization control will keep all motors in the same speed and position. If synchronous error exceeds the set difference limit, all motors will be stopped. Device includes adjustable acceleration and deceleration ramps, which produce the smooth starts, stops and direction changes. Load compensation also enables good operation with asymmetric loads. Adjustable current limits can be set to protect motor and mechanics against overcurrent (over sized forces).

### TECHNICAL DATA

Supply voltage 12-24Vdc ( 10-35V )  
 Undervoltage shutdown 8V  
 Overvoltage limit 38V  
 idle current < 20mA  
 Motor current: ( @ 2kHz / 16kHz )  
 4x10A / 4x5A at continuous use  
 4x15A / 4x7A at duty cycle 25%  
 4x20A / 4x8A at duty cycle 10% ( max 5s. )  
 4x25A max. in start  
 Current limit, setting 1-25A  
 Overtemp limit 120°C  
 PWM frequency 2kHz or 16kHz  
 Input control logic levels:  
 "NPN" ON= 0-1V, OFF=4-30V or open  
 "PNP" ON=4-30V, OFF=0-1V or open  
 Control input impedances typ. 47 or 10kohm  
 Pulse input freq. max. 700Hz/ input ch  
 Pulse inputs pull- up/down 10 kohm.  
 Fault out. NPN open coll. max 30V/50mA  
 5V aux. output max 20mA  
 Position out 0-5V ( Rout 1kohm )  
 Brake out NPN max. 4A  
 Supply connectors 4mm<sup>2</sup>  
 Motor/control connectors 2.5/1,5mm<sup>2</sup>  
 Weight 190g  
 Recom. oper. temp ( Ta ) -40..60°C  
 CE Electromagnetic compatibility  
 EN-55022B and EN 61000-6-2/ -4-2...6  
 Dimension and housing options:  
 - Card 142x73x28mm  
 - Installed in DIN-rail base 145x127x50mm  
 - Fibox PC150/60, (180x130x60mm)  
 - Fibox PC175/100 (180x180x100mm) include 300VA supply

EM-337A-PLI BLOCK DIAGRAM





N.A. = not active in standard version

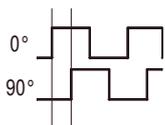
Pulse input E1 and E2 are optional for multiparaller use. For multiparaller use has separate application datasheet

CONNECTION

In the drawing above, a typical connection of the card can be seen. Supply voltage should be 12-35Vdc filtered. Ripple less than 20%. Device has no inbuilt fuse, so use an external fuse, max. value 60A.

NOTICE wrong polarity supply can be damaged device

IMPORTANT.



The phase shift of pulse lines should be about 90 deg. Also the frequency of one pulse sensor should be lower than 700Hz.

NOTICE.

When turned power on first time the led blinking. It is normal. The Homing can be started as guided in page 4

TERMINALS

PULSE SENSOR INPUTS can be set to work in NPN ( pull to gnd ) or PNP ( pull to positive ) mode. The modes are set with parameter 4. The hall switches of motors can be supplied with 18V or with 5V from card. Check the correct voltage from sensor or motor datasheet.

INPUT 1 is a multifunction PNP input, which can be set with parameter 6. It can work as STOP, SPEED-2 activation, or FW END limit.

INPUT 2 is a also multifunction PNP input and this can be set with param. 7. This input can work as SPEED-2 activation or BW end limit input. This input also has a wiring monitor possibility, which support safety switch with resistor. In table beside have some examples R-bias value. NOTICE ! this safety stops works only when run FW direction.

FW and BW are PNP inputs for operating commands. These start running in FW or BW direction.

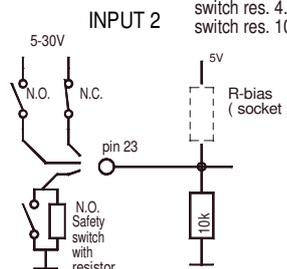
RES. / HOME input is PNP input. Short command resets fault, long command ( >5s ) starts home routine.

FAULT OUTPUT is normally an open NPN output, but if this output want to connect PNP input, then have to install pull up resistor into "fault out res. socket" Recommended value is 2.2kohm Fault output function modes can be set with param. 14

BRAKE OUTPUT is NPN 4A output for releasing magnetic brakes of motors or alternatively for switching brake resistor in overvoltage situation. The function of this output can be set with parameter 8. There load is connected from pin 32 to supply ( pin1 )

Rs-485 This halfduplex serial port. Device can be control and monitor with this bus ( Modbus RTU ) Bus communication has own instructions.

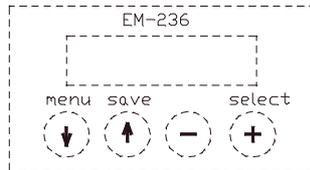
Examples for bias resistor switch res. 1k then R-bias 1k  
switch res. 2.2k then R-bias 1.8k  
switch res. 4.7k then R-bias 3.3k  
switch res. 10k then R-bias 4.7k



## PARAMETER SETTING AND MONITORING

Parameter adjusting can be done with the following EM- interface devices.

- EM-236 is a basic stand alone setting device.
- EM-328 USB-serial converters, which makes it possible to set parameters with a computer that has EmenTool Lite installed.
- EM-326 is a Bluetooth-dongle, which can be used in smart devices with the EmenTool App.



## MONITORABLE VALUES

- 1 fault code, as indication led blink count
- 2 motor A current - 0.1A/digit
- 3 motor B current - 0.1A/digit
- 4 motor C current - 0.1A/digit
- 5 motor D current - 0.1A/digit
- 6 current limit setting 0.1A/digit
- 7 motor A pulse counter value
- 8 motor B pulse counter value
- 9 motor C pulse counter value
- 10 motor D pulse counter value
- 11 channel E pulse counter value
- 12 operating voltagen 0.075V /1digit
- 13 safety edge 0.05V/digit

## INDICATION LED ( number of blinks )

- continuous = homing in progress
- 1 blink = homing failed
  - 2 blinks = overcurrent
  - 3 blinks = no pulses detected
  - 4 blinks = motor position difference too big (synchronisation error)
  - 5 blinks = overvoltage
  - 6 blinks = safety edge wiring failure
  - 7 blinks = Bus ( rs-485 ) timeout

## PARAMETER LIST EM-337A PLI v1.4 (default in brackets)

- 1 Motor output max voltage10-50V / 0-50 ( 0 )  
0-9 = regulation disabled
- 2 Overvoltage 15-60V / 15-60 ( 35 )  
Notice! don't set this higher than max. supply voltage
- 3 PWM frequency 1=2kHz , 2=16kHz ( 1 )
- 4 Motor pulse logic 1=PNP , 2=NPN ( 2 )
- 5 Control mode ( 1 )  
1=continuous ( run as long as command is active )  
2=impulse ( short command starts run )  
3=impulse-2 ( impulse, direction change without stop )
- 6 INPUT-1 ( pin 26 ) function options ( 1 )  
1 stop  
2 speed 2 activation  
3 end limit fw direction ( N.O. )  
4 end limit fw direction ( N.C. )
- 7 INPUT-2 ( pin 23 ) input function options ( 2 )  
1 safety switch input with opening contact ( N.C. )  
2 safety switch input with closing contact ( N.O. )  
3 safety switch input with ( N.O. ) contact and line monitor  
4 speed 2 activation  
5 end limit bw direction ( N.O )  
6 end limit bw direction, ( N.C. )
- 8 Brake output activation ( pin 32 ) ( 0 )  
0= overvoltage  
1 = "run" indication, activates when motors run  
2 = "end" indication, activates if stopped with param 21 or 22
- 9 Motor Speed 20-100% / 20-100 ( 100 )
- 10 Motor Speed-2 20-100%/20-100 ( 60 )
- 11 Current limit FW 0.1-25A / 1-250 ( 100 )
- 12 Current limit BW 0.1-25A / 1-250 ( 100 )
- 13 Start kick options 0-250 ( 0 )  
0=start kick disabled  
1= start kick after homing ( 100ms )  
2 to 255 = start also after I-trip and the param. value defines start kick time as milliseconds
- 14 Fault output modes 1-3 ( 1 )  
1= output activates (= pull down ) if fault detected  
2= output shifting on/off, if homing fault  
3= output shifting on/off in phase with indication led
- 15 Start ramp 0.1-2.5 / 1-25 ( 10 )
- 16 Stop ramp 0.1-2.5 / 1-25 ( 2 )
- 17 Pulse Lost reaction time 0-1s / 0-100 ( 50 )
- 18 Safety reverse run options 1-10s + dir. / 0-30 ( 0 )  
-0= disabled  
-1-10s reversing time both dir.  
-11-20 reversing time 1-10s. enabled only when run FW. dir  
-21-30 reversing time 1-10s. enabled only when run BW dir.
- \* 19 Load compensation 0-255 / 0-255 ( 0 )
- 20 Synchronisation strength 1-50 / 1-50 ( 15 )
- 21 REV. direction End limit 0-65000p ( 5 )
- 22 FW. direction End limit 0-65000p ( 384 )
- 23 Slow down before REV end. 0-65000 ( 50 )
- 24 Slow down before FW. end 0-65000 ( 50 )
- 25 Serial line configuration, speed, parity, and number of stop bits ( 1 )  
1 =9600bps 8N1 5 =19200bps 8N1  
2 =9600bps 8N2 6 =19200bps 8N2  
3 =9600bps 8E1 7 =19200bps 8E1  
4 =9600bps 8O1 8 =19200bps 8O1
- \* 26 Modbus address 1-247
- \* 27 Number of motors 2-4  
2= A and B ( C and D disabled )  
3= A, B and C ( D disabled )  
4 = all in use A,B,C and B
- \* 28 Multiparallel Mode  
0 = Multiparallel Disabled ( terminals 24 and 26 normal use )  
1 = Multiparallel Enabled ( terminals 24 and 26 work as pulse input )

\* Parameter 19 "load compensation" default set = 0, at heavy load you try set this paramet to value 8-10

\* Parameter 26 is modbus address and if bus is in use, then every has to be own address.

\* Parameter 27 defines the number of motors of driver, see in example. the param. 27 is = 2 in driver-3, because this one has only two motors. In drivers-1 and -2 param. 27 is = 4, because all 4 channel are in use.

\* Parameter 28 enables multiparallel function

**HOMING CYCLE ( position counter reset )**

At the start of the use the pulse counters of the device has to reset. In some situations the device might lose the position information, for example when it's moved manually while the power is off. In the cases the position counter must be reset again with homing routine. During homing the motors run at speed-2.

**START THE HOMING CYCLE**

The homing routine is activated with HOME input with 5s command or it can be started with 10 second simultaneously command with FW and BW inputs. After starting, the ind. led on card turn on. Same time the motors starts to run in BW direction until they meet their end points. If only one motor reaches mechanical end, then start homing routine again so many times that all motors reach mechanical end.

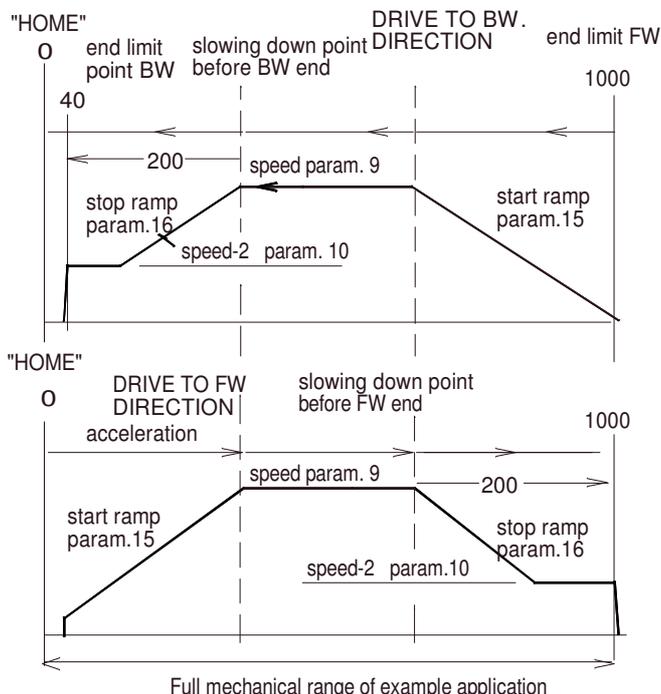
Notice ! don't stop the homing until led has turned off  
keep command on until 2 second after motors has stopped.  
Notice If indication led stay blinking then homing is failed - try again

**TROUBLE SHOOTING AT HOMING**

- A: motor run only about second and ind. led blinking
  - check parameter 4
  - check pulse sensor voltage
  - pulse sensor phasing wrong = wrong counting direction swap the pulse wires
  - motor run wrong direction = swap motor wires
- B: motor not run at all:
  - current limit is too low, check parameters 11 and 12
  - motor or system is mechanically stuck
- C: The homing works, but into the wrong direction, then swap the motor wires and also swap the pulse sensor wires.

**FAULT RESETING**

Current limit and pulse lost faults can be reset with short command for RES/HOME input. or with new BW or FW command. Difference limit and homing fail errors need to reset by doing "homing" routine. Overvoltage and Overtemp. errors will be reset automatically when error situation disappear.



**END LIMITS**

After the succesful homing the device is ready for normal use. The settable end limits of this card are based on internal position counter. There can be set BW and FW direction stop points and also slowing down points for both direction. At slowing down points motors will slowing down to speed -2. Pictures above shows function both direction. In pictures has used default values of end limit and slowing down parameters.

**START KICK**

This routine can be given after homing or I-trip. It means that motors starts short time with full power to release possible mechanical stuck. This configured with param. 13

**MOTOR OUTPUT MA. VOLTGE ( speed regulating )**

This function regulates motor speed so that changes of supply voltage will not affect the motor speed. This is enabled and adjusted with parameter 1. For example, if supply voltage varies 25-32V, then you can set this parameter to value 24V. which means that motor output 100% =24V. If this function is disabled ( param. <10 ) then 100% output is = supply voltage

**OVERVOLTAGE ( brake output use with external brake resistor )**

Brake output can be used to limit overvoltage. Brake resistor connect pin 32 to supply. The brake output activated if supply exceed param. 2 value. Param. 8 has to be set = 0  
NOTICE ! If voltage rises 1V higher than param. 2 then driver powerstage set to freewheel.  
NOTICE! don't set param 2 higher than supply voltage max.

**PWM FREQUENCY**

Driver has two option for pwm frequency 2 or 16kHz, with 2kHz power stage has lower losses and it can give more output current. But 2kHz can also generate whistling voice, this can be avoided with selecting 16kHz frequency.

**SPEED**

Driver has two speed setting parameter 9 and 10. The speed-1 is normally in use The speed-2 is enabled in homing, and in slowing down area when approaching end point. Speed-2 can be also enabled with input-1 or input -2. and with parameter 6 and 7.

**CURRENT LIMIT ( torque limit )**

All motor has own current limit measuring, if current of another motor exceeds the current limit, then both motor will shut down. Overcurrent shut down is disabled during start ramp, but the current limitation is always active and it protects against overtorque. Current can be set separately for FW and BW direction with parameter 11 and 12.

**START AND STOP RAMPS**

ramps smooths start and speed changing. These are set with parameter 15 and 16

**PULSE LOST REACTION TIME**

Parameter 17 defines delay time for pulse lost shutdown. If some of motors don't give pulses then all motors stopped Default value for reaction time is 0.8s

**SAFETY "REVERSE" FUNCTION**

This function reversing motors automatically if one or all meets obstacle. With parameter 18 can be set the direction when function is enabled and also how long time motor reversing. This function trigs on from current limit or with safety switch command.  
NOTICE ! safety switch inputs trigs this function only to when system run FW direction

**LOAD COMPENSATION ( torque at low speed )**

If the motor seems feeble when using a slow speed ( speed-2 ) its endurance can be improved with compensation parameter 19. Slowly increase the parameter's value for example by 10 units and make loading test, repeat this until you get torque enough for low speed. However, setting a too high value will make the motor twitch.

**SYNCHRO STRENGTH**

This parameter 20. defines how strong synchronisation is between motors. The bigger value means stronger synchronisation, which means that motors follow stronger to each other, but too big value could generate twitching.  
DIFFERENCE LIMIT ( unsynchronous. shutdown )

If position difference between motors increase over 50 pulses, then all motors shutdown. Recovery from this situation need "homing"

**SAFETY SWITCH MONITORING ( input-2 )**

Safety switch has usually monitor resistor, which has used to monitoring the condition of safety switch wires. Input-2 has possibility to monitoring this line when "safety switch" option has selected with parameter. Line fault will be detect with fault output. Wiring drawing on page 2