

4.9 Expansion module MAC00-P4/P5 Only MAC400-3000



4.9.1 Expansion module MAC00-P4 and P5 — overall description.

Important !: please notice that this module will only function in MAC800 motors with a serial number greater than 85000. All MAC400 motors supports this module.

The MAC00-P4 and P5 is an expansion module for the integrated servomotors MAC400 and MAC800. Please notice that the module can NOT be used in the MAC050-141.

The module is intended to be used for control application requiring an analogue 4-20mA interface to a master controller.

The interface is consisting of a 4-20mA input to control the motor position and a 4-20mA output to indicate the actual position. Both offers full galvanic isolation from other electrical circuitries inside the motor and also in between.

An output is also available to indicate if any error has occurred that prevent the motor from doing the intended operation. This output is also galvanic isolated.

If a second motor need to function as a slave the MAC00-P4 and P5 modules also offers this possibility. A high speed communication interface makes it possible to handle a secondary motor configured as "slave" which means that the communication protocol always makes sure that the slave follows the master motor. In case of an error in either the slave or master any further motion is stopped in both motors.

The modules contain no intelligence (microprocessor) meaning that all functions are controlled via the basic motor in which the module is installed.

The MAC00-P4 and P5 expansion modules offers an industrial interface (M12 connectors + Harting) and a number of feature enhancements, including:

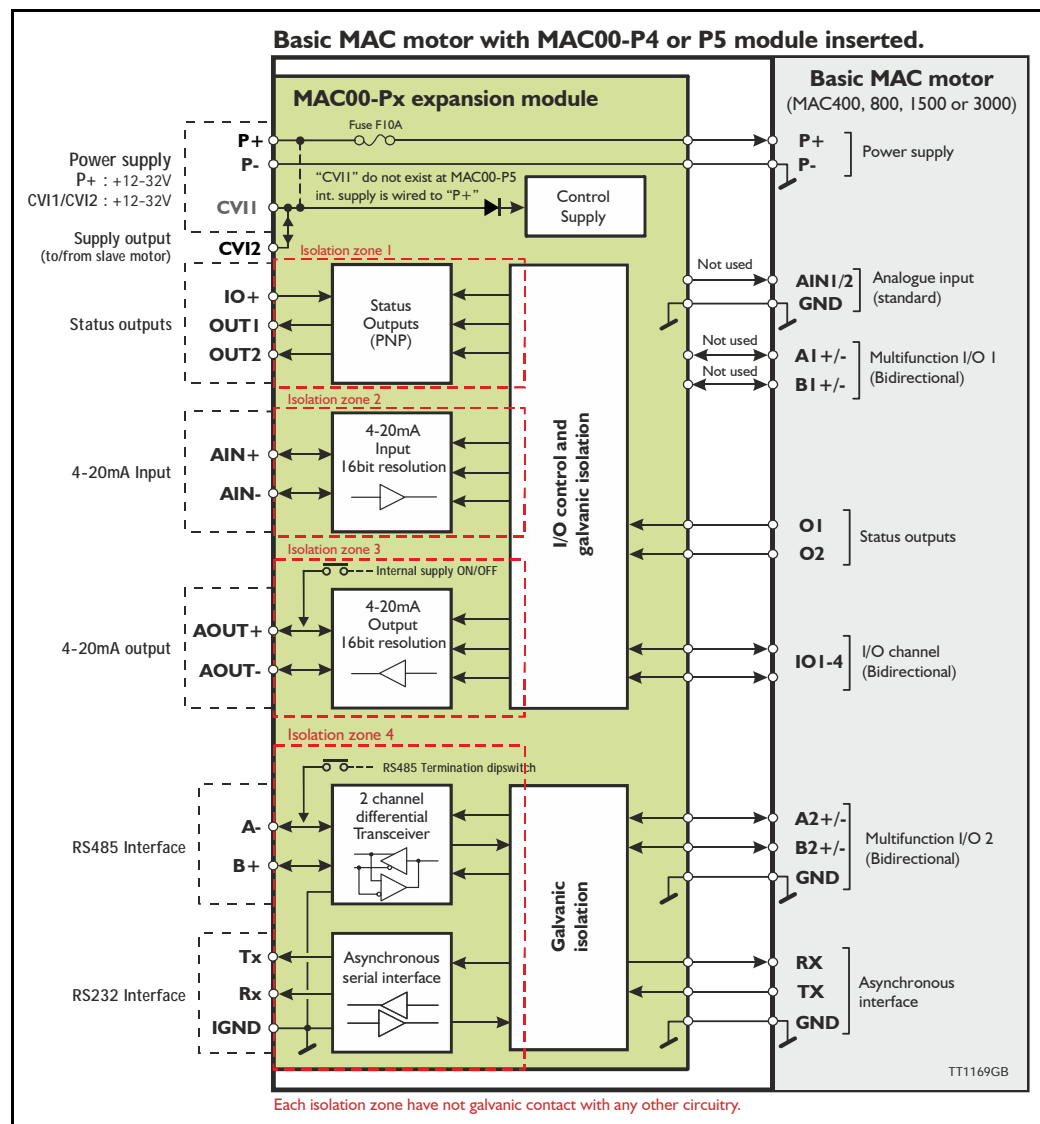
- Standard M12 and Harting connectors for optimum reliability
- 4-20mA analogue input. Resolution 16 bit (65535 steps). Galvanic isolated.
- 4-20mA analogue output. Resolution 16 bit (65535 steps). Galvanic isolated.
- Error output. Galvanic isolated.
- Communication interface to slave motor (includes +24V power to the slave motor)
- Optical isolated communication covering RS232, RS485.
- Full RS232 protocol support for use with standard serial cable.
- RS232 Communication interface to a PC for setup and monitoring use.
- Supply input for the control section in the motor. Is also used to the slave motor if present.

4.9 Expansion module MAC00-P4/P5

Only MAC400-3000

4.9.2 Overall hardware description

All internal and external main connections can be seen in the illustration below.



4.9.3 General hardware description

The MAC00-Px module offers the following external connections.

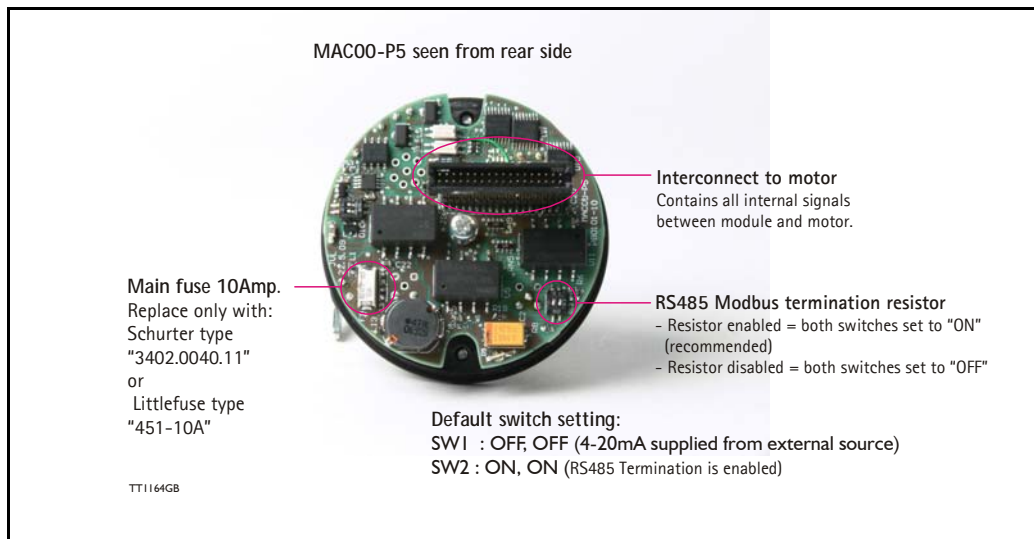
- Power supply (P+/P-/CVI1/CVI2)**
 These terminals are used for the main supply of the motor. A voltage between +12 and 32VDC (MAC400) must be connected to P+ and optionally CVI1 (CVI1 only exist at the MAC00-P4 module). CVI2 is hardwired to CVI1 and is intended to be used for supplying a slave motor or receiving supply from a master motor. This simplifies the cable connections since it is available in the same connector as the RS485 slave communication.
- Status outputs (OUT1, OUT2 and IO+)**
 OUT1 is an error output which indicates when an error exist. OUT2 is for future options. IO+ is the overall supply of the outputs and must be applied with 5-32VDC. The outputs are PNP (source) outputs. The outputs are galvanic isolated from all other terminals and circuits.

4.9 Expansion module MAC00-P4/P5 Only MAC400-3000

- **4-20mA Analogue input (AIN+ and AIN-)**
The analogue input is read by the motor and will typically be used with the motor set in "Analogue to position mode". In this configuration the motor position will follow the analogue input proportional in a user defined working range.
The analogue input has a resolution of 16 bit corresponding to the rang 0 to 20mA divided into 65536 steps. The input is galvanic isolated from all other terminals and circuits.
- **4-20mA Analogue output (AOUT+ and AOUT-)**
The analogue output is monitoring the actual position when the motor is set in "Analogue to position mode". In this configuration the output value will be from 4 to 20mA proportional to the actual motor position in a user defined working range.
The analogue output has a resolution of 16 bit corresponding to the rang 4 to 20mA divided into 65536 steps. The output is galvanic isolated from all other terminals and circuits.
- **RS485 Interface (A-, B+ and IGND)**
Serial balanced interface for connection to a PC or a controller. The protocol is similar to the RS232 or USB interface, which means that all registers/parameters in the motor can be monitored or changed. The RS485 is recommended for longer distances or in noisy environments.
- **RS232 Interface (Rx, Tx and IGND)**
Serial unbalanced interface for connection to a PC or a controller. All registers/parameters in the motor can be monitored or changed. RS232 is not recommended for long distances (> 10m).

The MAC motor uses "binary" communication protocol which makes it possible to access all the internal registers. Please consult *MacTalk communication, page 344* for further details.

4.9.4 Hardware overview

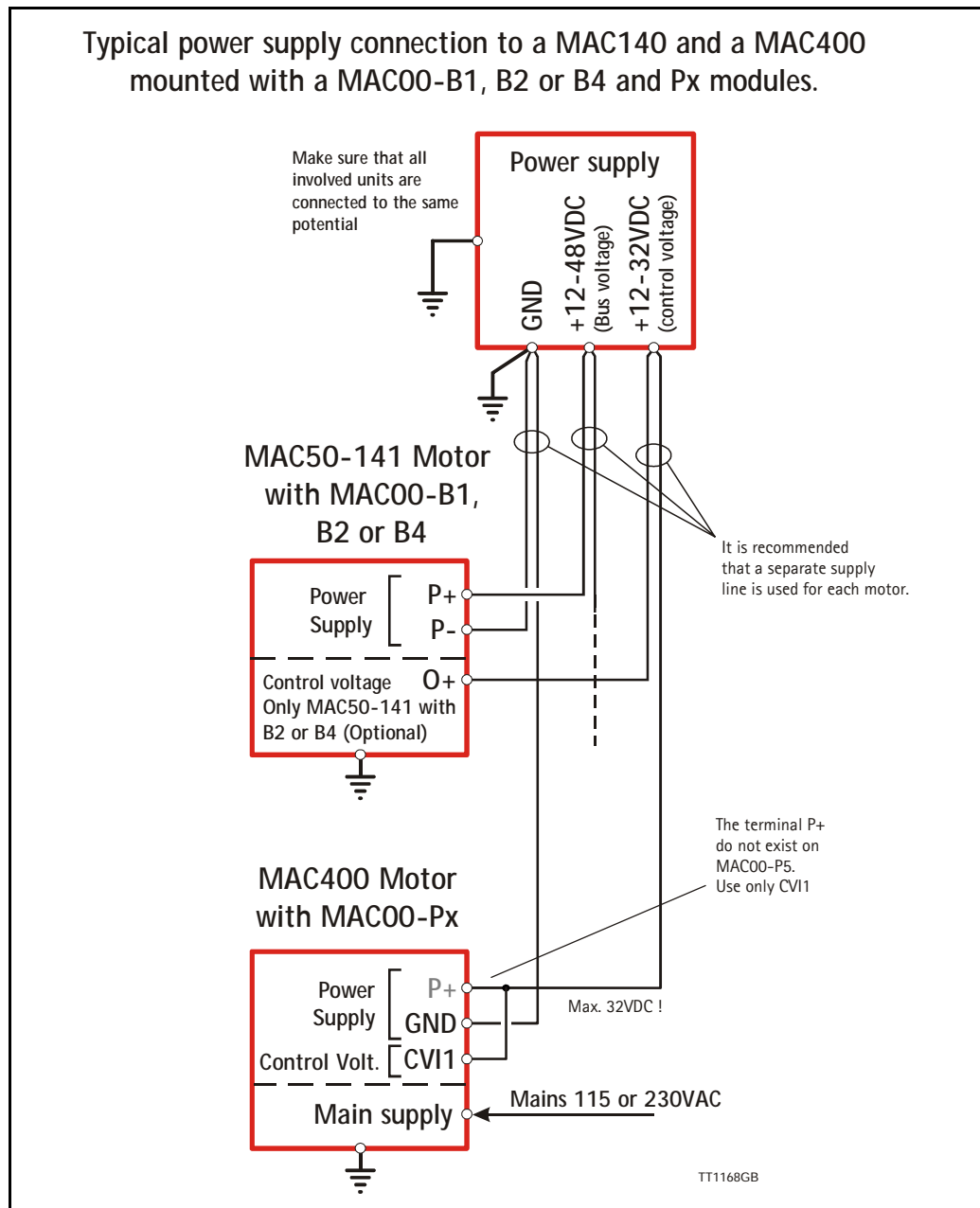


4.9 Expansion module MAC00-P4/P5 Only MAC400-3000

4.9.5 General power supply description

The MAC00-P5 module can only be used in the MAC400 motor. The diagram below shows how to connect power to a MAC400 motor mounted with a MAC00-P5. Please notice that the voltage connected to CV11 and P+ (only -MAC00-P4) must stay in the range +12-32VDC. Precautions must therefore be taken if the system also contains MAC50, 95, 140 or 141 which may require 48VDC in order to reach maximum motor speed.

See also the general power supply description *Power Supply, page 85*.



4.9 Expansion module MAC00-P4/P5 Only MAC400-3000

4.9.6 RS232 - General description when using the MAC00-P4/5 module

The RS232 interface is considered the main interface to the motor when the motor is set up using the MacTalk windows software from a PC or from any kind of controller using a RS232 interface.

Note: The basic MAC motor does not fully support RS232 since the interface signals are only 5V levels. See also the basic description - Serial interface, page 103.

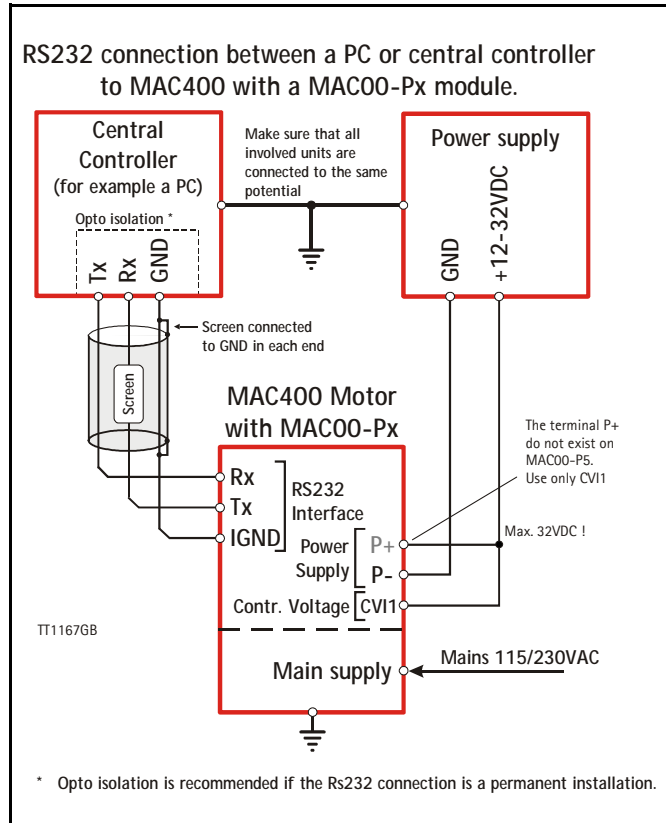
When connecting the RS232 interface to a PC or controller, the following rules must be followed:

- 1 Only one motor can be connected at the interface line. Use the RS485 if multiple units have to be connected at the same time.
- 2 Use screened cable.
- 3 Ensure that GND is also connected.
- 4 Ensure that all units have a proper connection to safety ground (earth) in order to refer to the same potential.
- 5 The RS232 interface cable length should not exceed 10 metres.

Connectors:

To see the specific connector pin-out please see the chapter *Expansion MAC00-B41 connector description, page 143*.

A finished RS232 cable also exist. Please see *Cables for the MAC00-B41, page 145*

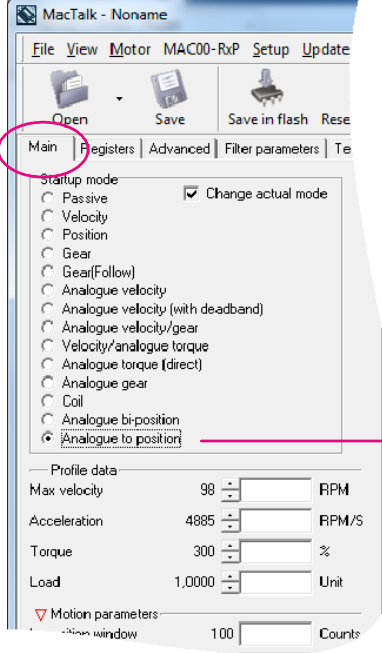


4.9 Expansion module MAC00-P4/P5 Only MAC400-3000

4.9.7 Basic setup of the "Master" motor.

Following steps must be followed

1. Enter the program "MacTalk" version 1.50 or newer.
2. Set the motor in "Analogue to position" mode in order to control the actual motor position by an analogue input.
3. Max velocity, Acceleration, torque etc. must be adjusted for the actual application. This can be done now or at any other time.
4. At the "Advanced" tab select "Paired Master" under Modbus setup.
5. Select AIN3 as analogue input in order to use the 4-20mA input at the MAC00-P4/5 module instead of the default input (AIN1).



MacTalk - Noname

File View Motor MAC00-RxP Setup Update

Open Save Save in flash Rese

Main Registers Advanced Filter parameters Te

Startup mode

Passive Change actual mode

Velocity

Position

Gear

Gear(Follow)

Analogue velocity

Analogue velocity (with deadband)

Analogue velocity/gear

Velocity/analogue torque

Analogue torque (direct)

Analogue gear

Coil

Analogue bi-position

Analogue to position

Profile data

Max velocity 98 RPM

Acceleration 4885 RPM/S

Torque 300 %

Load 1,0000 Unit

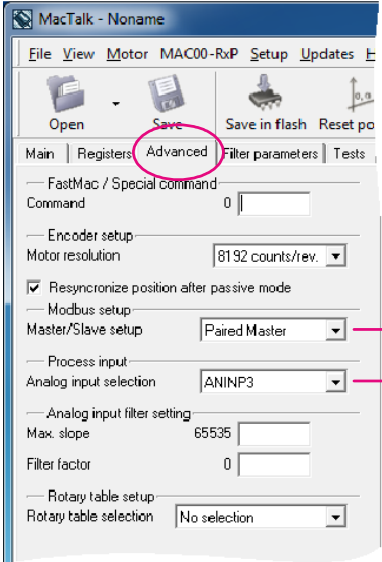
Motion parameters

100 Counts

Setting up the Master motor in MacTalk

Select **Analogue to position** mode.

Setup the desired max velocity and acceleration. Torque and Load may also need a different setting compared to the default setup.



MacTalk - Noname

File View Motor MAC00-RxP Setup Updates

Open Save Save in flash Reset po

Main Registers Advanced Filter parameters Tests

FastMac / Special Command

Command 0

Encoder setup

Motor resolution 8192 counts/rev.

Resynchronize position after passive mode

Modbus setup

Master/Slave setup Paired Master

Process input

Analog input selection ANINP3

Analog input filter setting

Max. slope 65535

Filter factor 0

Rotary table setup

Rotary table selection No selection

Select **Paired Master** in the Modbus setup.

Select **ANINP3** in as process input - this is the 4-20mA input at the P4/5 module.

4.9 Expansion module MAC00-P4/P5 Only MAC400-3000

(Master setup continued)

6. Go to the "Registers" tab and define the desired working range by entering a number in "P2" after following formulars

For linear applications (spindle actuator): $P2 = WR / SP * GR * CPR * 32 / 52428$

Notes:

WR = Working range in mm

SP = Spindle pitch (linear motion per spindle revolution)

GR = Gear ratio between motor and spindle (if any). Set to 1.00 if none

CPR = Counts per motor revolution (MAC400, 1500 and 3000: 8192 CPR / MAC800: 8000 CPR).

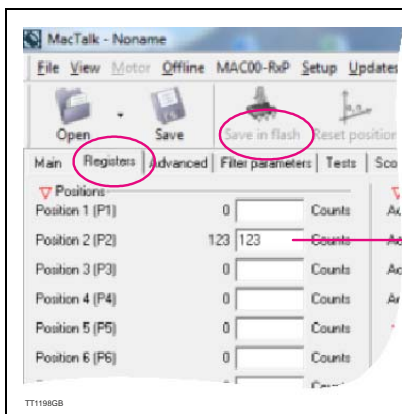
For rotary applications: $P2 = WR / 360 * GR * CPR * 32 / 52428$

Notes:

WR = Working range in degrees

GR = Gear ratio between motor and output shaft (if any) - set to 1.00 if none

CPR = Counts per motor revolution (MAC400, 1500 and 3000: 8192 CPR / MAC800: 8000 CPR).



Setting up the Master motor in MacTalk

The calculated working range constant is typed in here.

Finally remember to «Save in flash» in order to save all the settings permanent in the motor.

4.9.8 Basic setup of the "Slave" motor.

If a second motor with a synchronous movement is needed the MAC00-P4/5 offers the possibility to connect 2 MAC motors in a master/slave configuration.

The 5pin M12 male connector located at the MAC00-P4/5 is the master/slave connector. By connecting the 5 pins in the master motor to the equivalent pins in the slave motor all communication and also 24V supply is taken care of in the slave motor (see supply options at previous page).

Beside these connections only 115/230VAC need to be supplied the slave motor.

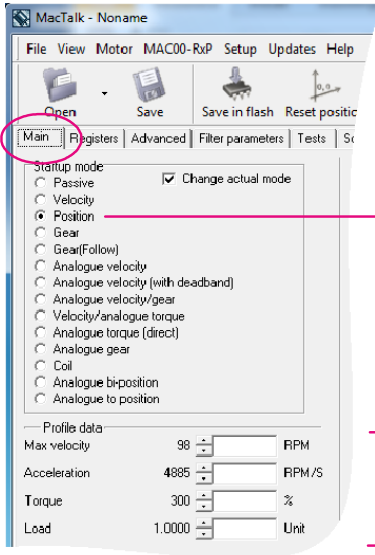
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4.9 Expansion module MAC00-P4/P5 Only MAC400-3000

If a slave motor is connected to the master the slave needs to be setup in order to establish permanent communication with the master motor.

Please following these steps to setup the slave motor

1. Enter the program “MacTalk” version 1.50 or newer.
2. At the “Advanced” tab select “Paired Slave” under Modbus setup.
3. Set the startup mode to “Position”-mode. By doing this the motor will start to follow the position of the master motor.
4. It is recommended to set the “max velocity” and “acceleration” to appropriate high values since they can cause a limitation in the motion of the slave compared to the master.
6. After changing relevant parameters please remember to save the changes permanent in the motor by pressing “Save in flash”.
7. It may be needed to cycle the 24V supply for both motors in order to establish full synchronization between the 2 motors.



MacTalk - Noname

File View Motor MAC00-RxP Setup Updates Help

Open Save Save in flash Reset positio

Main Registers Advanced Filter parameters Tests S

Startup mode

Passive Change actual mode

Velocity

Position

Gear

Gear(Follow)

Analogue velocity

Analogue velocity (with deadband)

Analogue velocity/gear

Velocity/analogue torque

Analogue torque (direct)

Analogue gear

Coil

Analogue biposition

Analogue to position

Profile data

Max velocity 98 RPM

Acceleration 4885 RPM/S

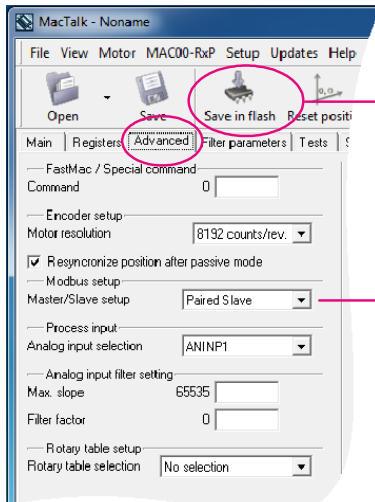
Torque 300 %

Load 1.0000 Unit

Setting up the Slave motor in MacTalk

Select **Position** mode.

Setup the desired max velocity and acceleration. Torque and Load may also need a different setting compared to the default setup.



MacTalk - Noname

File View Motor MAC00-RxP Setup Updates Help

Open Save Save in flash Reset positio

Main Registers Advanced Filter parameters Tests S

FastMac / Special command

Command 0

Encoder setup

Motor resolution 8192 counts/rev.

Resynchronize position after passive mode

Modbus setup

Master/Slave setup Paired Slave

Process input

Analog input selection ANINP1

Analog input filter setting

Max. slope 65535

Filter factor 0

Rotary table setup

Rotary table selection No selection

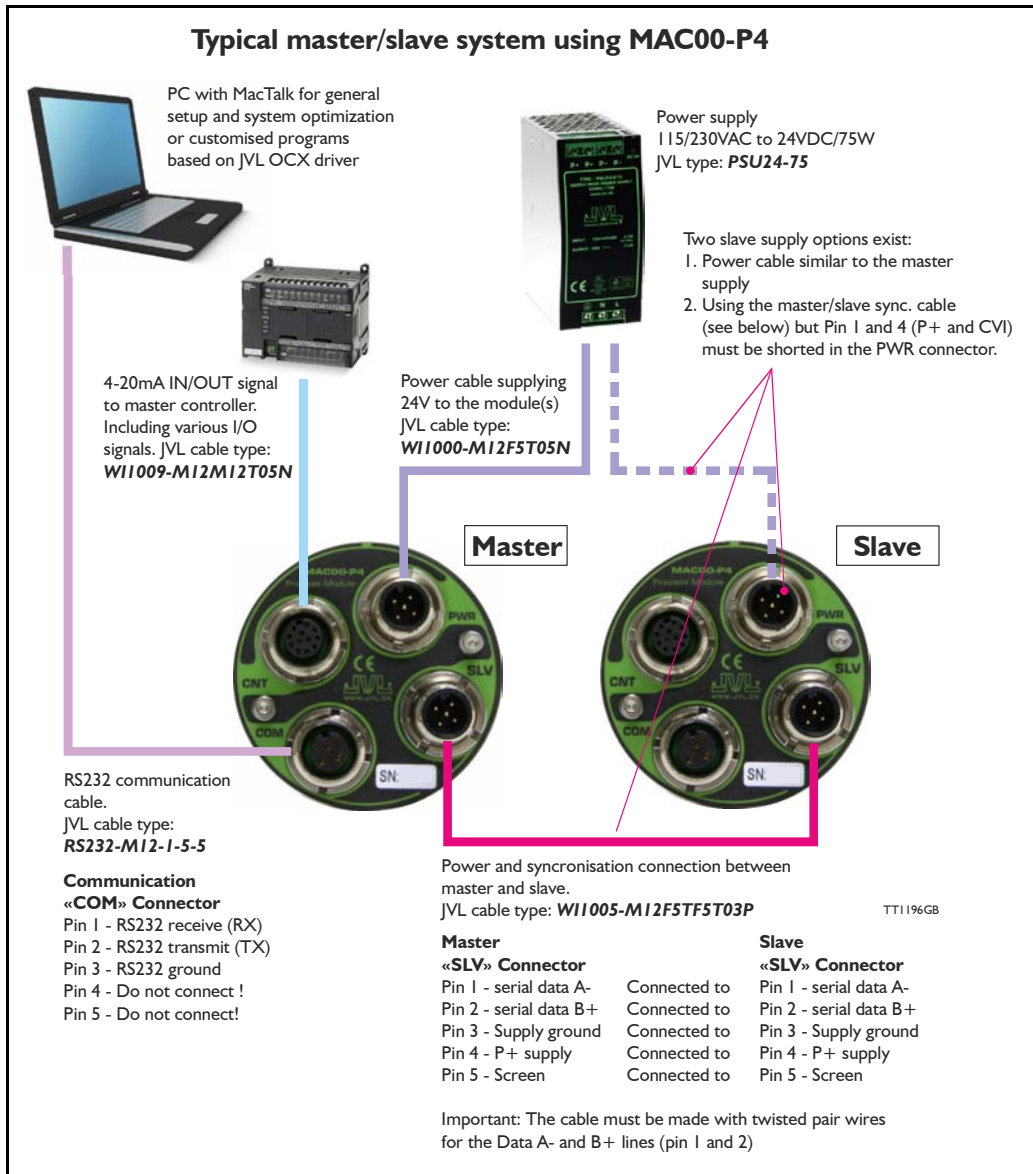
Finalize the setup by pressing the «Save in Flash» button.

Select **Paired Slave** in the Modbus setup.

4.9 Expansion module MAC00-P4/P5 Only MAC400-3000

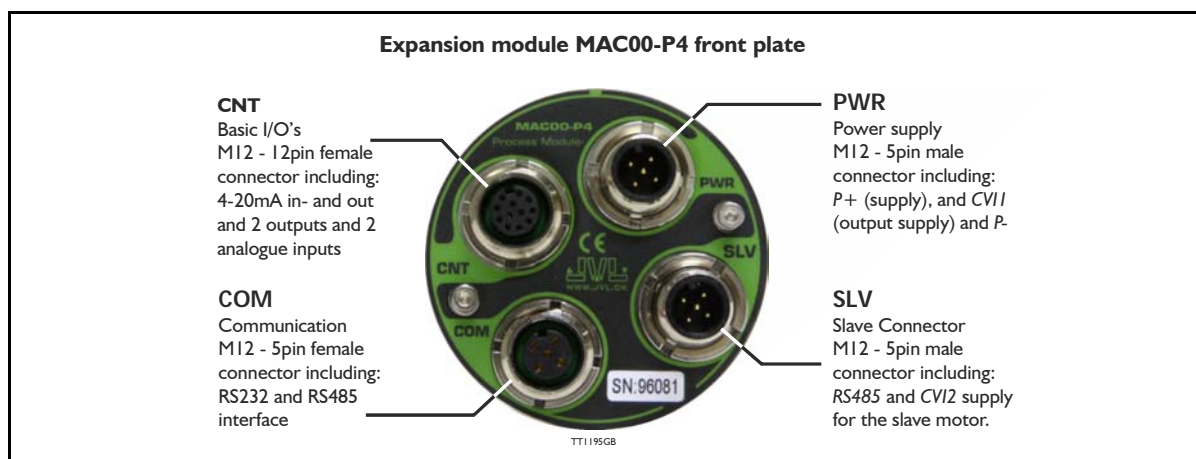
4.9.9 Master/slave application example.

The illustration below shows exactly how 2 motors installed with a MAC00-P4 module can be connected in a master/slave coupling using the cable JVL type: W11005-M12F5TF5T03P which contains an internal supply for the slave and a RS485 connection.



4.9 Expansion module MAC00-P4/P5

Only MAC400-3000



4.9.10 Expansion MAC00-P4 connector description

The MAC00-P4 offers IP65 protection when used at MAC400 or MAC800 and M12 connectors which makes it ideal for process control and automation applications where no additional protection is desired. The M12 connectors offer solid mechanical protection and are easy to unplug compared to modules with cable glands or DSUB connectors.

The connector layout:

"PWR" - Power input. M12 - 5pin male connector				
Signal name	Description	Pin no.	JVL Cable W11000-M12F5T05N	Isolation group
P+	Main supply +12-48VDC. Connect with pin 2 *	1	Brown	1
P+	Main supply +12-48VDC. Connect with pin 1 *	2	White	1
P-	Main supply ground. Connect with pin 5 *	3	Blue	1
CV11	Output supply / Control voltage +12-32VDC.	4	Black	1
P-	Main supply ground. Connect with pin 3 *	5	Grey	1

* Note: P+ and P- are each available at 2 terminals. Make sure that both terminals are connected in order to split the supply current in 2 terminals and thereby avoid an overload of the connector.

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4.9 Expansion module MAC00-P4/P5

Only MAC400-3000

"CNT" - Control I/O. M12 - 12pin female connector				
Signal name	Description	Pin no.	JVL Cable W11009- M12M12T05N	Isolation group
AIN+	4-20mA input. Positive terminal	3	White	2
AIN-	4-20mA input. Negative terminal	1	Brown	2
AOUT1	4-20mA output. Positive terminal. Apply 7 to 24V to this terminal if internal AOUT supply is disabled.	9	Red	3
AOUT2	4-20mA output. Negative terminal.	2	Blue	3
O+	Supply term. to the OUT1 and 2 circuitry. Apply 5 - 32VDC	11	Grey/Pink	1
OUT1	Output 1 - Default : Error output. PNP output.	6	Yellow	1
OUT2	Output 2. PNP output.	4	Green	1
CV1	Control supply input +12-28VDC. Consumption typical 350mA @ 24VDC and 700mA @ 24VDC if a slave motor is connected. At MAC00-P4 the CV1 is hardwired to the CVI terminal (pin 4) at the power connector. At MAC00-P5 the CV1 is not present but CV1 is internally hardwired to P+.	12	Red/Blue	0
P-	Main ground to be used with CV11 and IN2-4.	10	Violet	0
IN2 / AIN1	General digital input and analogue input 1 Notice that analogue input 1 is used for <i>Zero search</i>	5	Pink	0
IN3 / AIN2	General digital input and analogue input 2	8	Grey	0
IN4	General digital input	7	Black	0

* Note: Isolation group indicate which terminals/circuits that a galvanic connected to each other. In other words group 1, 2, 3 and 4 are all fully independantly isolated from each other. Group 0 correspond to the housing of the motor which may also be connected to earth via the 115/230VAC power inlet.

"COM" - Communication connector - M12 - 5pin female connector.				
Signal name	Description	Pin no.	JVL Cable "RS232- M12-1-5-5"	Isolation group (See note)
RS232: RX	RS232 interface. Receive terminal Leave open if unused.	1	Brown	4
RS232: TX	RS232 interface. Transmit terminal Leave open if unused.	2	White	4
IGND	Ground intended to be used together with the other signals in this connector,	3	Blue	4
RS485: A-	RS485 interface. Leave open if unused	4	Black	4
RS485: B+	RS485 interface. Leave open if unused	5	Grey	4

"SLV" - Slave connector - M12 - 5pin male connector				
Signal name	Description	Pin no.	JVL Cable "W11005- M12F5TF5T 03P"	Isolation group (see note)
RS485 A-	RS485 Modbus. Positive terminal	1	1	4
RS485 B+	RS485 Modbus. Negative terminal	4	4	4
CVI2	Supply output (optionally input) +12-28VDC Hardwired internally to CVI1.	2	2	0
GND	Ground to be used with CVI2. This ground is hardwired internally to the main power ground P-.	3	3	0
IGND	Multifunction I/O2 terminal B2+	5	Screen wire	4

4.9 Expansion module MAC00-P4/P5

Only MAC400-3000

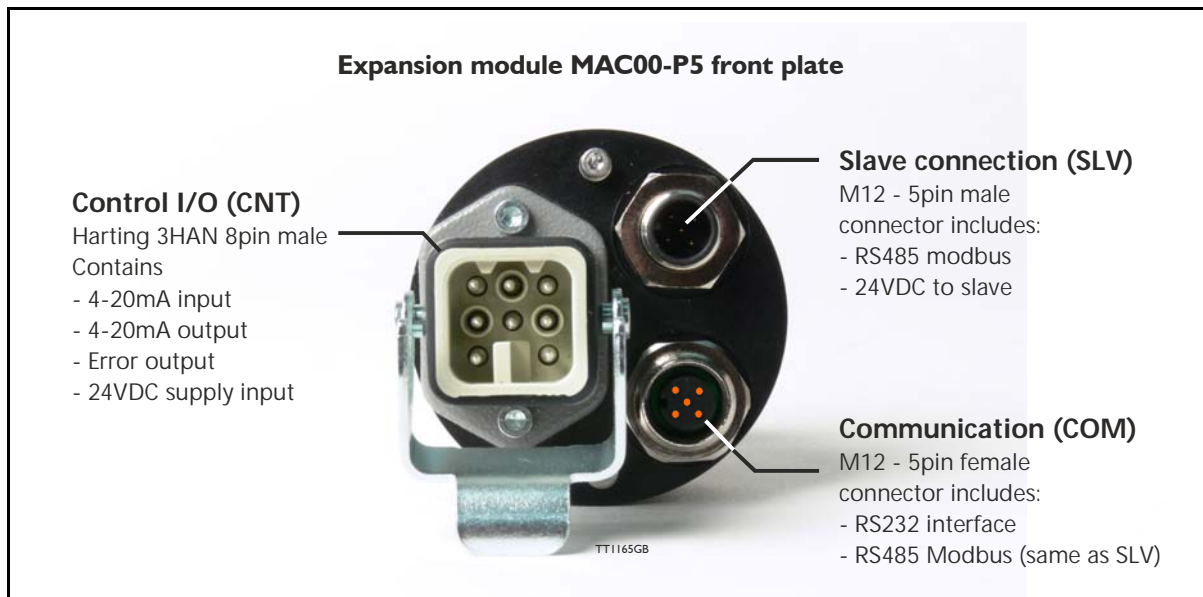
4.9.11 Cables for the MAC00-P4

The following cables equipped with connectors can be supplied by JVL.

MAC00-P4 Connectors				Description	JVL Order no.	Picture
"SLV" 5pin male	"CNT" 12pin Female	"COM" 5pin Female	"PWR" 5pin Male			
		X		RS232 Interface cable. Connects directly from MAC00-P4 to a PC Length: 5m (197 inch)	RS232-M12-1-5-5	
		X		RS485 Interface cable. Connects directly from MAC00-P4 to a PC with a RS485 Com. port. Length: 5m (197 inch)	RS485-M12-1-5-5	
X			X	Cable (Ø5.5mm) with M12 female 5-pin connector loose wire ends 0.35mm ² (22AWG) and foil screen. Length: 5m (197 inch)	WI1000-M12F5T05N	
X			X	Same as above but 20m (787 inch)	WI1000-M12F5T20N	
	X			Cable with M12 male 12 pin straight connector, loose wire ends.	WI1009-M12M12T05N	
	X			Same as above but 20m (787 inch)	WI1009-M12M12T20N	
X				RS485 Interface cable. Connects directly from a master to a slave motor via the SLV connector. Length: 3m (197 inch)	WI1005-M12F5TF5T03P	
Protection caps. Optional if connector is not used to protect from dust / liquids.						
	X	X		IP67 protection cap for M12 female connector.	WI1000-M12FCAP1	
X			X	IP67 protection cap for M12 male connector.	WI1000-M12MCAP1	

Important: Please note that the cables are a standard type. They are not recommended for use in cable chains or where the cable is repeatedly bent. If this is required, use a special robot cable (2D or 3D cable).

4.9 Expansion module MAC00-P4/P5 Only MAC400-3000



4.9.12 Expansion MAC00-P5 connector description

The MAC00-P5 offers IP67 only IP65 on MAC400-800 protection and M12 connectors which makes it ideal for process control and automation applications where no additional protection is desired. The M12 and Harting connectors offer solid mechanical protection and are easy to unplug compared to modules with cable glands or DSUB connectors.

The connector layout:

"CNT" - Control I/O. Harting 3HAN - 8pin male connector				
Signal name	Description	Pin no.	JVL Cable W10xxxxx	Isolation group
AIN+	4-20mA input. Positive terminal	1	Blue	2
AIN-	4-20mA input. Negative terminal	2	Red	2
AOUT+	4-20mA output. Positive terminal. Apply 7 to 24V to this terminal if internal AOUT supply is disabled.	3	Grey	3
AOUT-	4-20mA output. Negative terminal.	4	Yellow	3
O+	Supply term. to the error output. Apply 24VDC	5	Green	1
OUT1	Error output. PNP output.	6	Brown	1
P+ (CVI1)	Control supply input +12-28VDC. Consumption typical 350mA @ 24VDC and 700mA @24VDC if a slave motor is connected. At MAC00-P5 the CVI1 is not present but CVI1 is internally hardware to P+.	7	White	0
P-	Main ground to be used with CVI1 and CVI2	8	Black (y)	0

* Note: Isolation group indicate which terminals/circuits that a galvanic connected to each other. In other words group 1, 2, 3 and 4 are all fully independantly isolated from each other. Group 0 correspond to the housing of the motor which may also be connected to earth via the 115/230VAC power inlet.

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4.9 Expansion module MAC00-P4/P5

Only MAC400-3000

“COM” - Communication connector - M12 - 5pin female connector.				
Signal name	Description	Pin no.	JVL Cable “RS232- M12-1-5-5”	Isolation group (See note)
RS232: TX	RS232 interface. Transmit terminal Leave open if unused.	1	Brown	4
RS232: RX	RS232 interface. Receive terminal Leave open if unused.	2	White	4
IGND	Ground intended to be used together with the other signals in this connector,	3	Blue	4
RS485: A-	RS485 interface. Leave open if unused	4	Black	4
RS485: B+	RS485 interface. Leave open if unused	5	Grey	4
“SLV” - Slave connector - M12 - 5pin male connector				
Signal name	Description	Pin no.	JVL Cable “W11005- M12F5TF5T 03P”	Isolation group (see note)
RS485 A-	RS485 Modbus. Positive terminal	1	1	4
RS485 B+	RS485 Modbus. Negative terminal	4	4	4
CVI2	Supply output (optionally input) +12-28VDC Hardwired internally to CVI1.	2	2	0
GND	Ground to be used with CVI2. This ground is hardwired internally to the main power ground P-.	3	3	0
IGND	Multifunction I/O2 terminal B2+	5	Screen wire	4

4.9 Expansion module MAC00-P4/P5

Only MAC400-3000

4.9.13 Cables for the MAC00-P5

The following cables equipped with connectors can be supplied by JVL.

MAC00-P5 Connectors			Description	JVL Order no.	Picture
"CNT" Harting 8pin male	"COM" M12 con. 5pin Female	"SLV" M12con. 5pin Male			
	X		RS232 Interface cable. Connects directly from MAC00-P5 to a PC Length: 5m (197 inch)	RS232-M12-1-5-5	
		X	RS485 Interface cable. Connects directly from a master to a slave motor. Length: 3m (197 inch)	WI1005-M12F5TF5T03P	
		X	Cable with M12 female 5 pin straight connector, loose ends. Length: 5m (197 inch)	WI1000-M12F5T05N	
		X	Same as above but 20m (787 inch)	WI1000-M12F5T20N	
X			Please contact JVL for further details	-	
Protection caps. Optional if connector is not used to protect from dust / liquids.					
	X		IP67 protection cap for M12 female connector.	WI1000-M12FCAP1	
		X	IP67 protection cap for M12 male connector.	WI1000-M12MCAP1	

Important: Please note that the cables are a standard type. They are not recommended for use in cable chains or where the cable is repeatedly bent. If this is required, use a special robot cable (2D or 3D cable).