4.8   Expansion module MAC00-P5   `Only MAC400&800`

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4.8.1   Expansion module MAC00-P5 — overall description.

The MAC00-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-P5 module 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 functionalety is controlled via the basic motor where the module is inserted.

The MAC00-P5 expansion module 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.

4.8 Expansion module MAC00-P5 | Only MAC400&800 |

4.8.2 Overall hardware description

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

Basic MAC motor with MAC00-P4 or P5 module inserted.
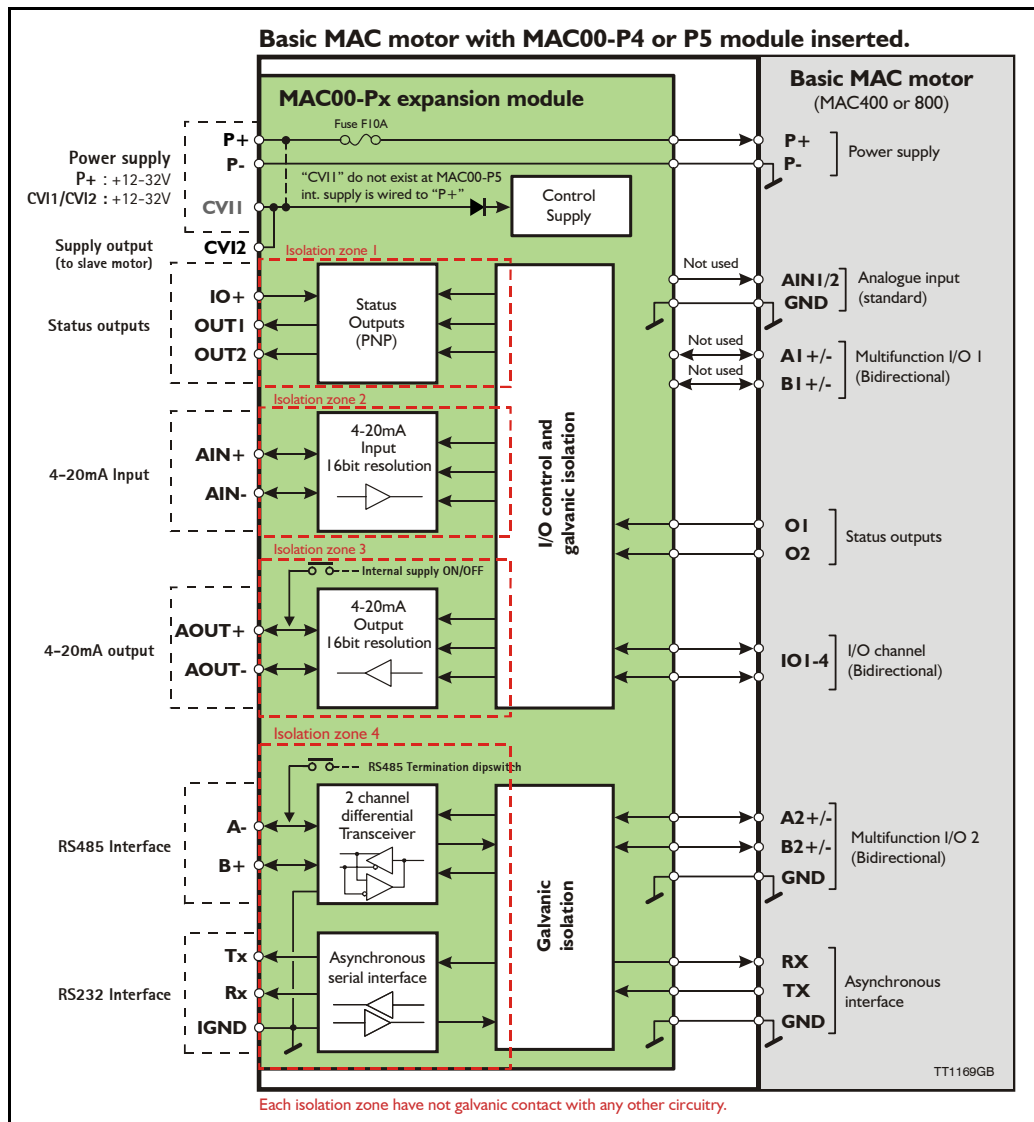
4.8.3 General hardware description

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 if present. 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.
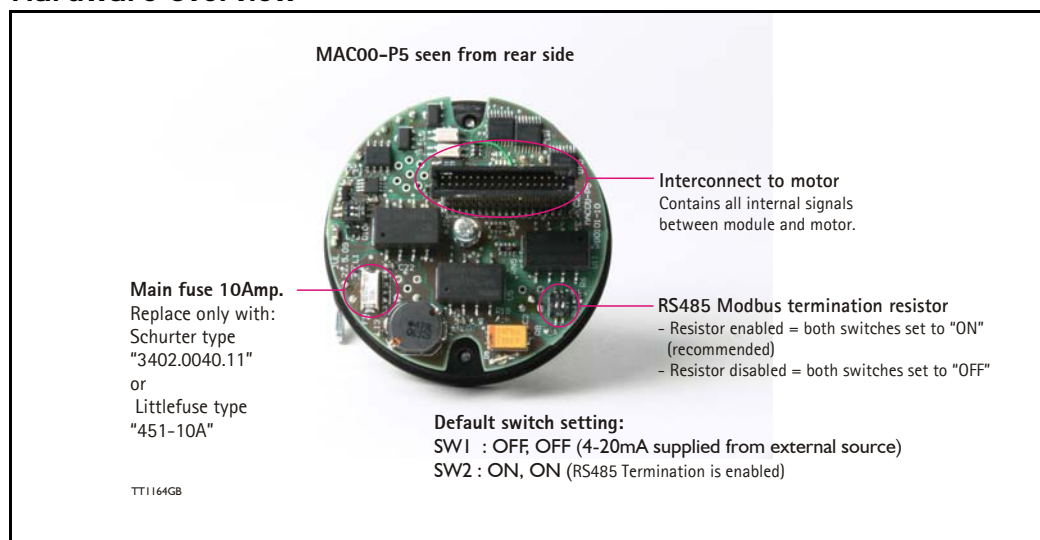
4.8   Expansion module MAC00-P5   **Only MAC400&800**

- **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 281* for further details.

4.8.4   Hardware overview

MAC00-P5 seen from rear side

Interconnect to motor
Contains all internal signals between module and motor.

Main fuse 10Amp.
Replace only with:
Schurter type
"3402.0040.11"
or
Littlefuse type
"451-10A"

RS485 Modbus termination resistor
- Resistor enabled = both switches set to "ON" (recommended)
- Resistor disabled = both switches set to "OFF"

Default switch setting:
SW1 : OFF, OFF (4-20mA supplied from external source)
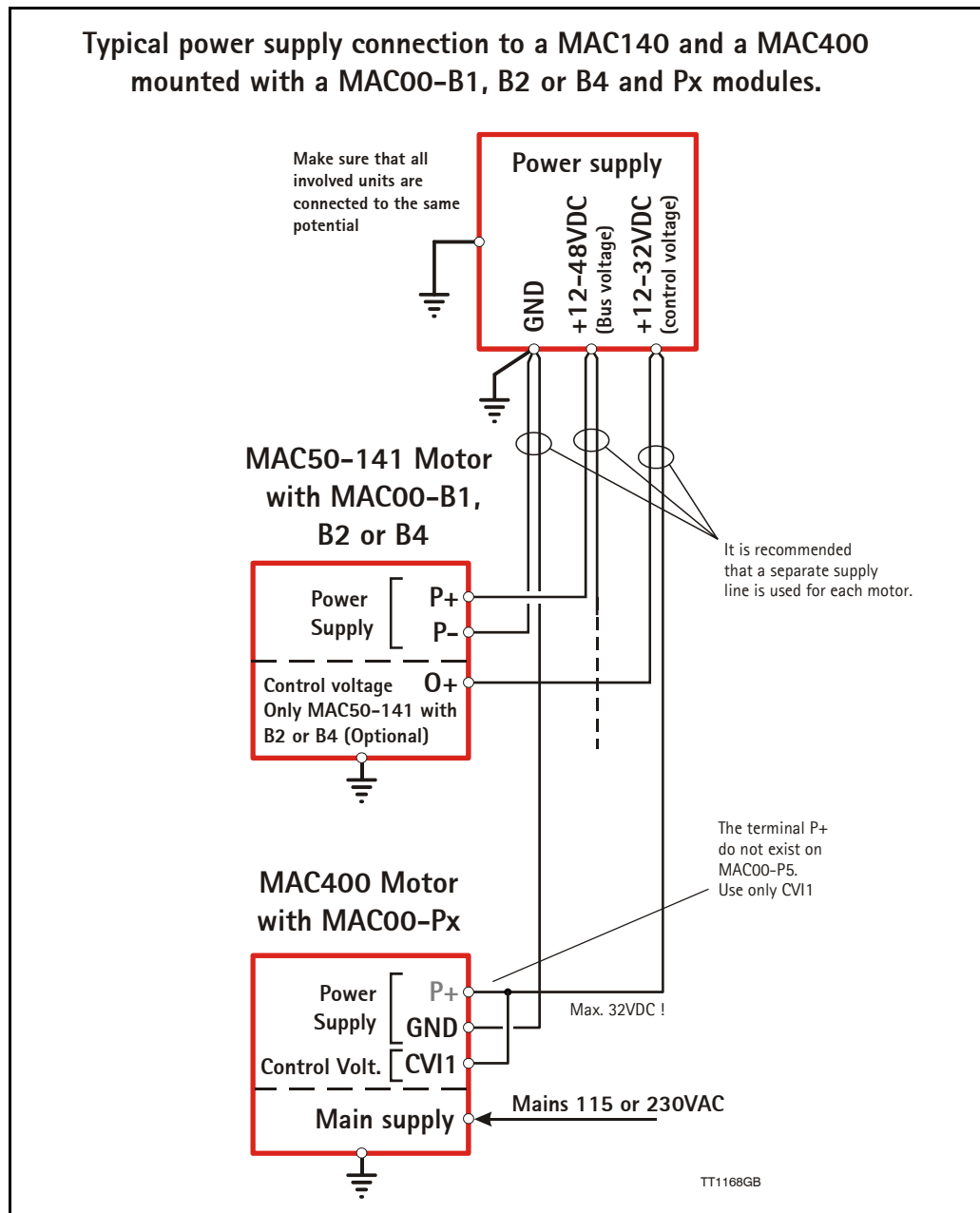SW2 : ON, ON (RS485 Termination is enabled)

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4.8 Expansion module MAC00-P5 | Only MAC400&800

4.8.5 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 CVI1 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 59.*

Typical power supply connection to a MAC140 and a MAC400 mounted with a MAC00-B1, B2 or B4 and Px modules.

Make sure that all involved units are connected to the same potential

Power supply
GND
+12-48VDC (Bus voltage)
+12-32VDC (control voltage)

MAC50-141 Motor with MAC00-B1, B2 or B4

It is recommended that a separate supply line is used for each motor.

Power Supply P+
P-

Control voltage Only MAC50-141 with B2 or B4 (Optional) O+

The terminal P+ do not exist on MAC00-P5. Use only CVI1

MAC400 Motor with MAC00-Px

Power Supply P+
GND

Max. 32VDC !

Control Volt. CVI1

Main supply ← Mains 115 or 230VAC

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4.8.6   RS232 - General description when using the MAC00-P5 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 69.
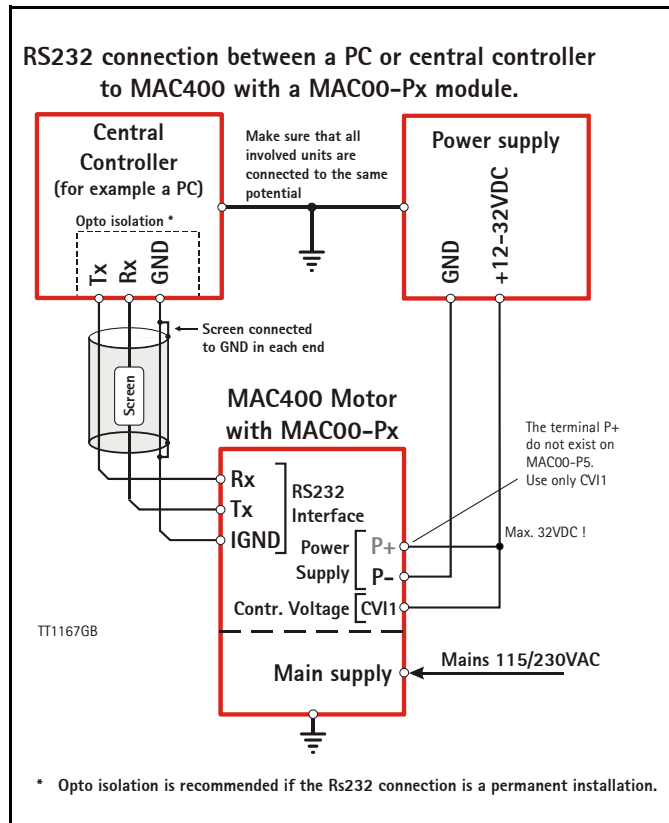
When connecting the RS232 interface to a PC or controller, the following rules must be followed:

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 105.*

A finished RS232 cable also exist. Please see *Cables for the MAC00-B41, page 107*

RS232 connection between a PC or central controller to MAC400 with a MAC00–Px module.

Central Controller (for example a PC)

Opto isolation *

Tx Rx GND

Make sure that all involved units are connected to the same potential

Power supply

GND +12–32VDC

Screen connected to GND in each end

Screen

MAC400 Motor with MAC00–Px

Rx
Tx RS232 Interface
IGND

Power Supply P+
P–

Contr. Voltage CVI1

The terminal P+ do not exist on MAC00-P5. Use only CVI1

Max. 32VDC !

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Main supply ← Mains 115/230VAC

* Opto isolation is recommended if the Rs232 connection is a permanent installation.

4.8.7   Basic setup of the "Master" motor.

Following steps must be followed
1. Enter the program "MacTalk" version 1.47 or newer.
2. At the "Advanced" tab select "Master" under Modbus setup.
3. Also select AIN3 as analogue input in order to use the 4-20mA input at the MAC00-P5 module instead of the default input (AIN1).
4. Press "Save in flash" to save the setting permanent.
5. Go to the "Registers" tab and define the desired working range by entering a number in "P2" after following formular (when using a linear 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)
    CPR = Counts per motor revolution (MAC400: 8192 CPR / MAC800: 8000 CPR)

6. Set the motor in "analogue to position mode" and the motor is now in operation following the 4-20mA input signal etc.

The motor is now capable of moving accoring to the analogue input but topspeed, motor torque, acceleration and other relevant paramters can now be adjusted for the actual application.

4.8.8   Basic setup of the "Slave" motor.

If a second motor with a syncronous movement is needed the MAC00-P5 offers the posibility to connect 2 MAC motors in a master/slave configuration.
The 5pin M12 male connector located at the MAC00-P5 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. Beside these connections only 115/230VAC need to be supplied the slave motor.
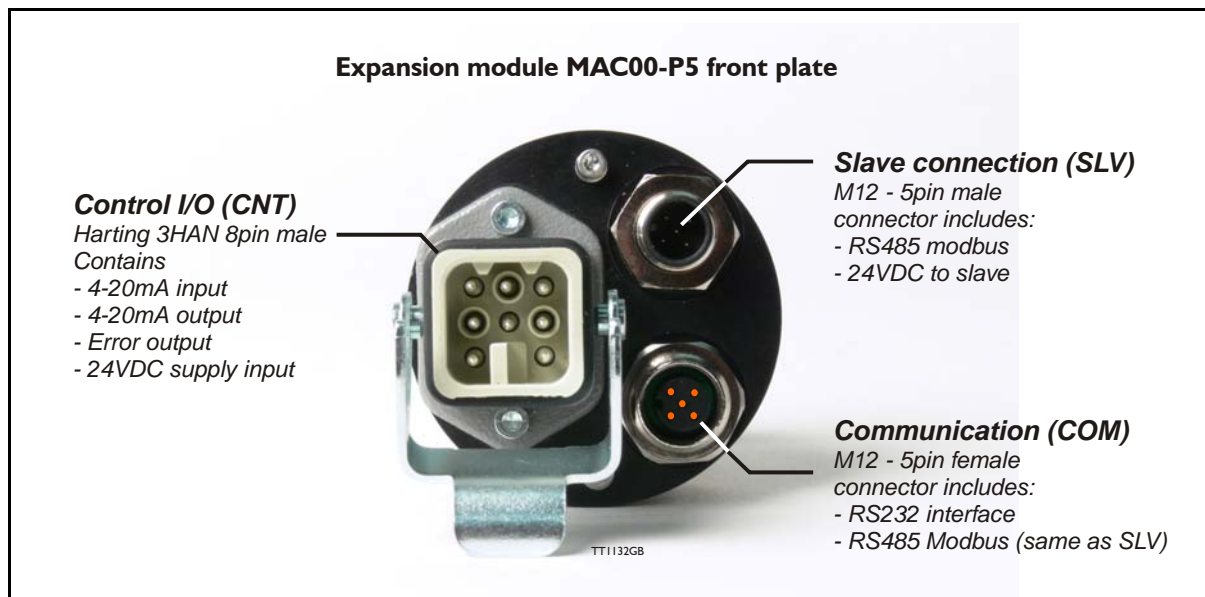
If a slave motor is connected to the master the slave needs to be setup in order to establish permanent communication with the master motor.

Please following these steps to setup the slave motor

1. Enter the program "MacTalk" version 1.47 or newer.
2. At the "Advanced" tab select "Slave" under Modbus setup.
3. Press "Save in flash" to save the setting permanent.
4. Set the startup mode to "Position"-mode. By doing this the motor will start to follow the position of the master motor.
5. 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 syncronization between the 2 motors.

4.8 Expansion module MAC00-P5   **Only MAC400&800**

Expansion module MAC00-P5 front plate

Control I/O (CNT)
Harting 3HAN 8pin male
Contains
- 4-20mA input
- 4-20mA output
- Error output
- 24VDC supply input

Slave connection (SLV)
M12 - 5pin male
connector includes:
- RS485 modbus
- 24VDC to slave

Communication (COM)
M12 - 5pin female
connector includes:
- RS232 interface
- RS485 Modbus (same as SLV)

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4.8.9 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 WI10xxxxx**	**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 ouput.	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 hardwired to P+.	7	Hvid	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.				

4.8 Expansion module MAC00-P5 <small>Only MAC400&800</small>

"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 "WI1005-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/O**2** terminal B2+	5	Screen wire	4

4.8   Expansion module MAC00-P5   `Only MAC400&800`

4.8.10   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).