

4.3 Expansion module MAC00-B41

Only MAC400&800



4.3.1 Expansion module MAC00-B41 — overall description.

The expansion module MAC00-B41 can ONLY be mounted in the MAC400 and newer versions of the MAC800 motor (serial numbers >85000). Please notice that the module CAN NOT be used in the MAC050 to I41 motors. This module is among the simplest and lowest cost modules in the product range. The modules contain no intelligence (microprocessor) meaning that all functionality is controlled via the basic motor. The MAC00-B41 expansion module offers an industrial interface (M12 connectors) and a number of feature enhancements, including:

- Standard M12 connectors for optimum reliability
- Optical isolated communication covering RS232, RS485.
- Full RS232 protocol support for use with standard serial cable.
- Full RS485 protocol support for multipoint communication up to 100m.
- 6 high speed I/O channels that individually can be used as inputs or outputs. Each channel can (when used as output) source up to 300mA.
- Dual supply. The main supply can be removed but the control circuitry is kept active and position data and communication are still functional.
- Standard M12 connectors for optimum reliability

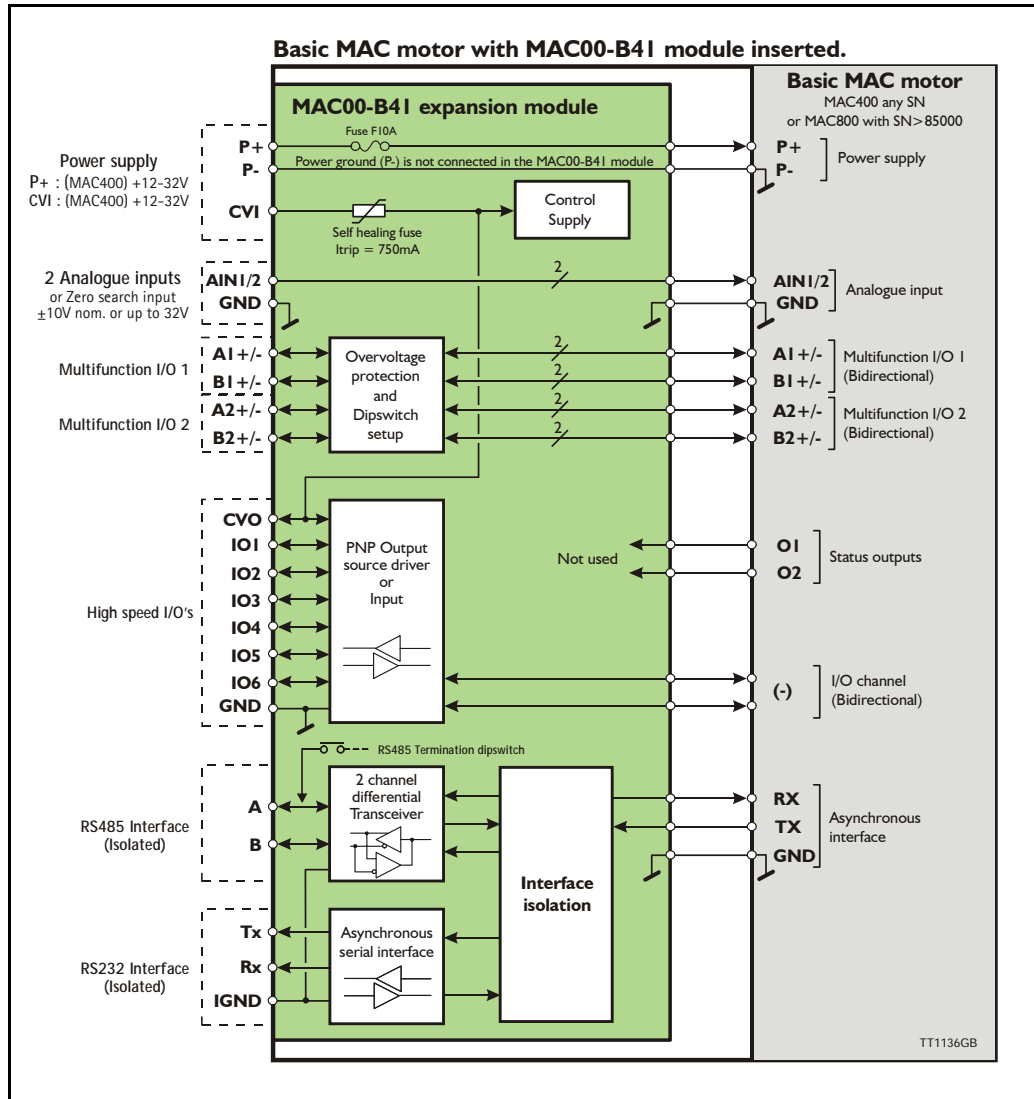
Typical applications for these expansion modules are:

- Closed loop systems with an overall controller involved.
- Replacement for pneumatic cylinders using the “Air Cylinder mode”
- Dispenser systems.
- Machine adjustment/setup by sending RS232 or RS485 commands.
- Standalone PLC with user program stored in the basic motor.

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4.3.2 Overall hardware description

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



4.3.3 General hardware description

The MAC00-B41 module offers the following external connections.

- Power supply (P+/P-/CVI)**
 These terminals are used for the main supply of the motor. A voltage between +12 and 32VDC (MAC400) must be connected.
- Analogue inputs (AIN1 and AIN2)**
 The analogue inputs are used either as analogue input or digital input. The primary analogue input is AIN1. When used as analogue input, it can control velocity, torque or position depending on which mode is set for motor operation. When used for digital inputs, it can be used in position-related modes for the external zero-search sensor. Also in "Air Cylinder Mode" the analogue input is used as a trigger input. For a functional description, please refer to *Analogue input*, page 104. (continued)

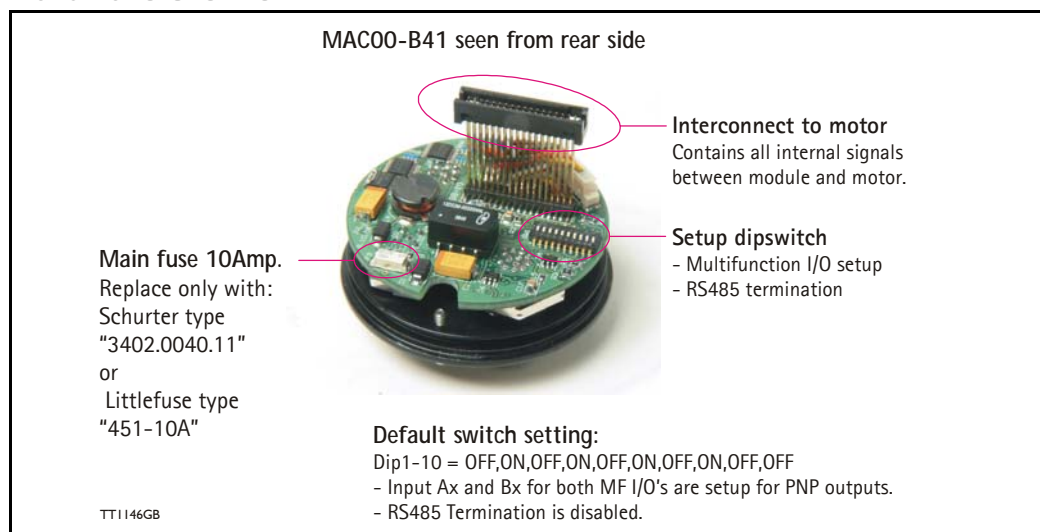
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- **Multifunction I/O 1 and 2 (A1±, B1±, A2± and B2±)**
The functionality of these terminals is the same as for the basic MAC motor. They can be set up in 3 different configurations.
 - Pulse inputs - for functional description please refer to *Multifunction I/O used as pulse inputs, page 107* and *General description: "Multifunction I/O" when using a Bx module, page 120*
 - Pulse outputs - for functional description please refer to *Multifunction I/O used as pulse outputs, page 108* and
 - RS422 interface - for functional description please refer to *Multifunction I/O used as serial communication interface, page 109*.**Important !:**
Remember to configure "I/O type" as "Pulse Input" in MacTalk if none of the 8 terminals A1/2+, A1/2-, B1/2+ and B1/2- is used (the multifunction I/O's). This must be done to avoid random function of the motor since the multifunction I/Os are defined as "Serial data" as default.
- **High speed I/O's (IO1, IO2, IO3, IO4, IO5, IO6, CVO, and GND)**
Each of the high speed IO's can be used as either an input or as an output. The I/O's can be read or set from the serial interface (RS232 or RS485) or they can be operated from the user program stored in the motor.
- **RS485 Interface (A-, B+ and GND)**
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 GND)**
Serial unbalanced interface for connection to a PC or a controller. The protocol is similar to the USB or RS485 interface, which means that 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.

4.3.4 Hardware overview

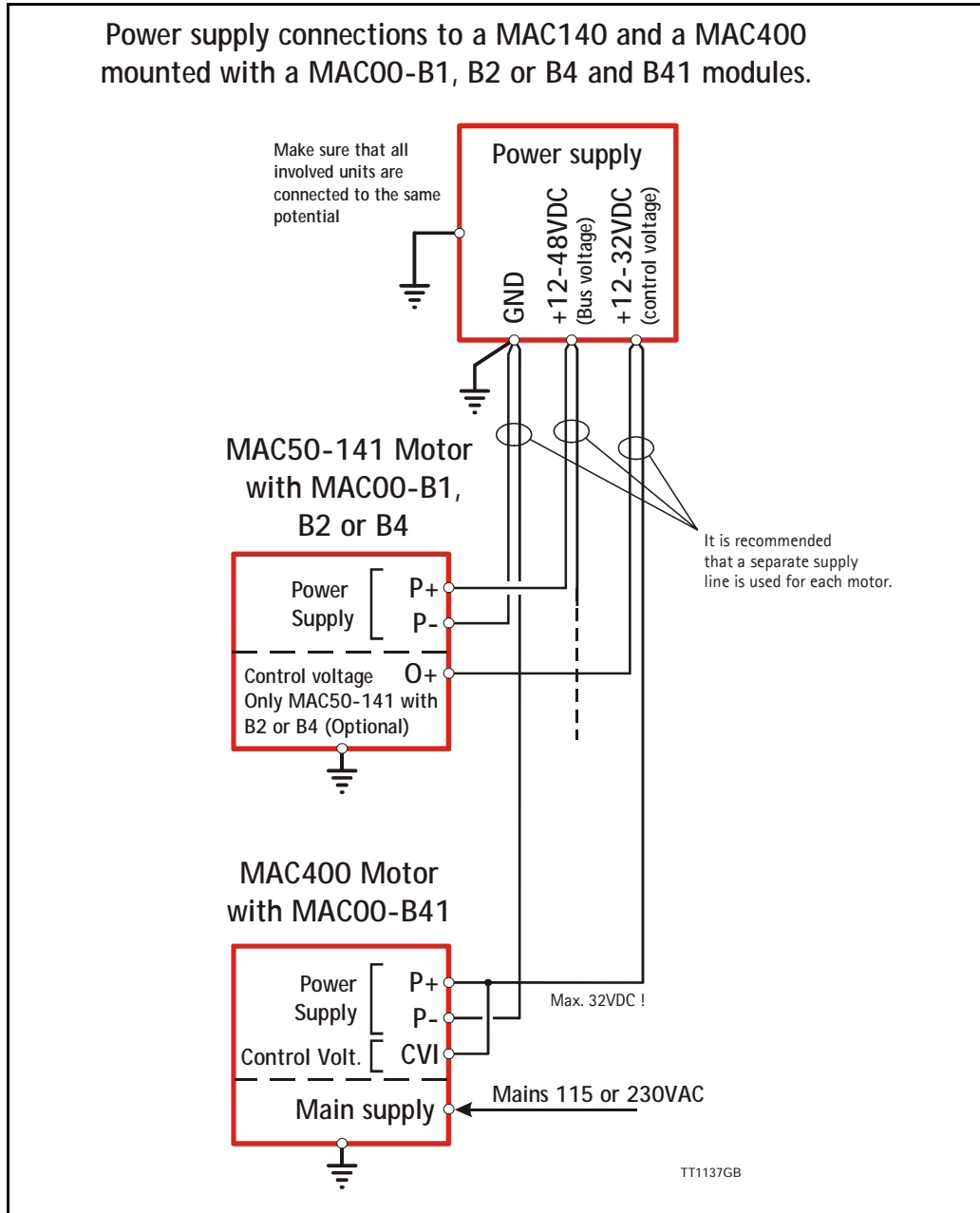


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4.3.5 General power supply description

The MAC00-B41 module can be used in the MAC400 motor and MAC800 motors with serial numbers higher than 85000. The diagram below shows how to connect power to a MAC400 motor mounted with a MAC00-B41.

Please notice that the voltage connected to P+ and/or CVI 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*.

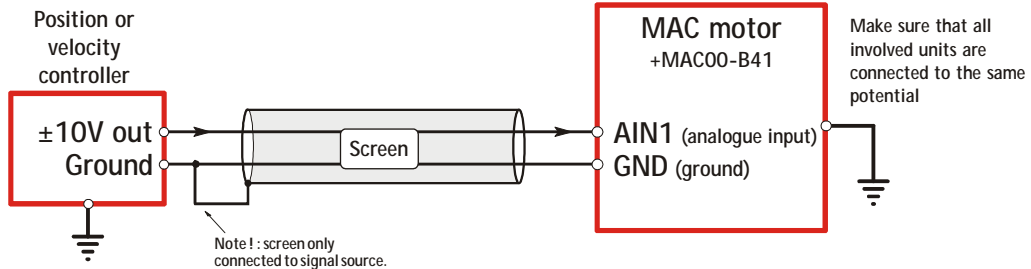


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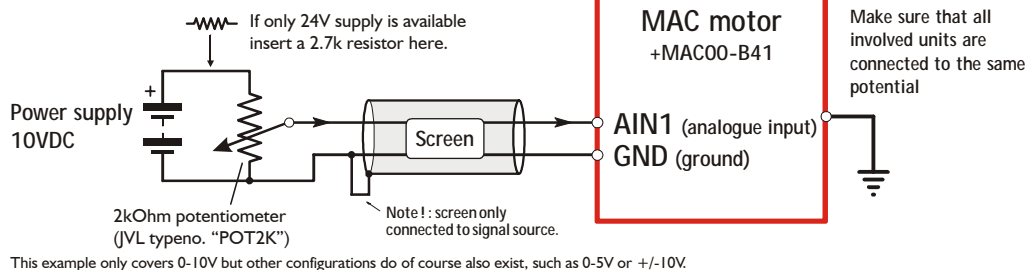
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Analogue input connection at the MAC motor mounted with a MAC00-B41 module.

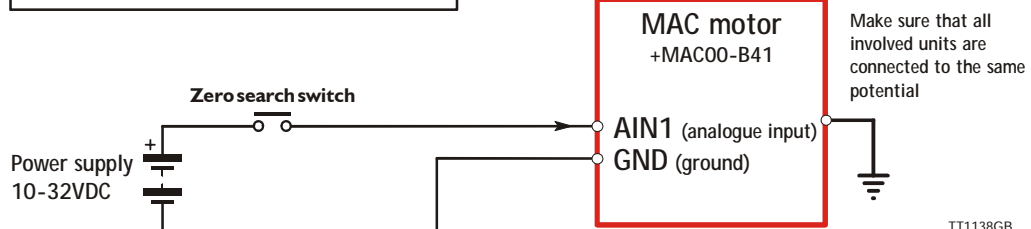
Connected to a external controller



Connected to a potentiometer



Connected to a zero search switch



Note: Do not apply voltages higher than 32V to the analogue input (AIN)

4.3.6 Using the analogue inputs (AIN1 or AIN2).

When a MAC00-B41 module is mounted in the MAC400 motor, the analogue inputs is available in the same manner as in the basic motor itself.

The analogue inputs can be used for several applications and the function of the analogue input is determined by the mode in which the motor is set to operate.

Typically the inputs is used for controlling the velocity, torque or position of the motor but the input is also used as digital input for *Zero search* or in "Air Cylinder Mode" where it is used as trigger input for the movement done by the motor.

For further information concerning physical connections, see the *Expansion MAC00-B41 connector description*, page 143.

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4.3.7 RS232 - General description when using the MAC00-B41 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.

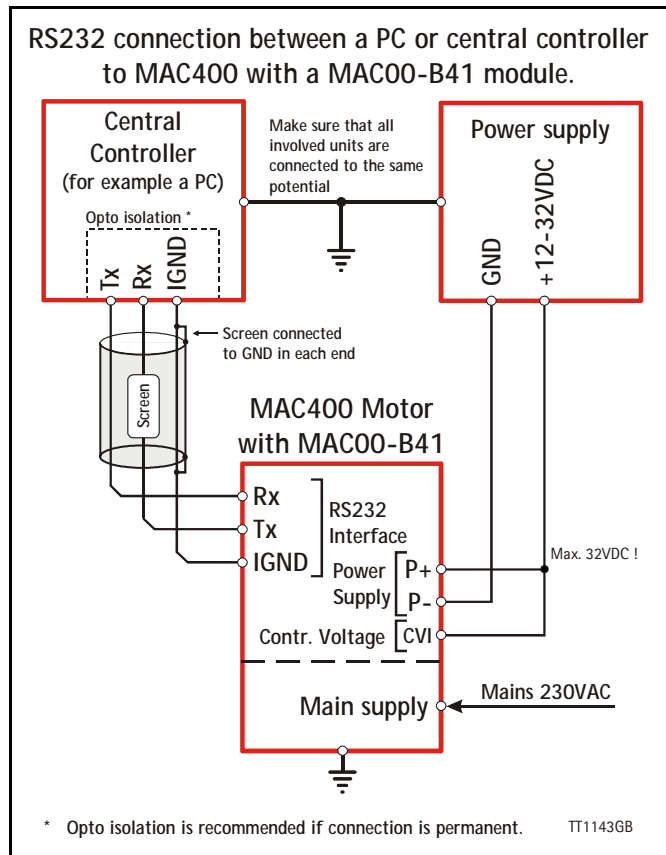
When connecting the RS232 interface to a PC or controller, the following rules must be followed:

- 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 IGND (interface ground) 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*



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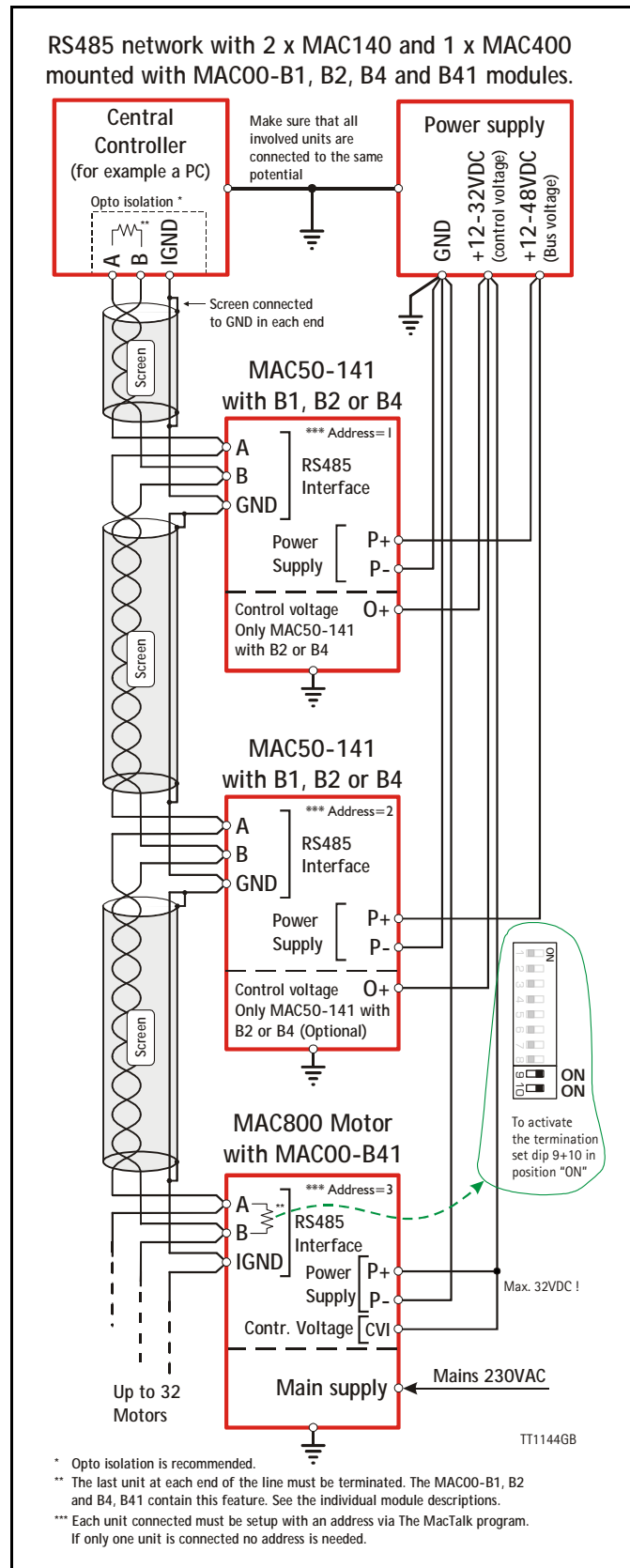
4.3.8 RS485 - General description when using a MAC00-Bx module

The RS485 offers more noise-immune communication compared to the RS232 interface. Up to 32 motors can be connected to the same line. The RS485 interface in the MAC00-B41 module is galvanically isolated. When connecting the RS485 interface to a central controller, the following rules must be followed:

- 1 Use twisted-pair cable
- 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 last unit in each end of the network must be terminated. Note that the B1, B2 and B4, B41 modules all contain a termination resistor which can be activated.
- 6 Ensure that the supply lines are connected individually in order to minimise the voltage drop between the motors.
- 7 Master Controller RS485 interface:
If available, it is strongly recommended a type with optical isolation is used.

Connectors:

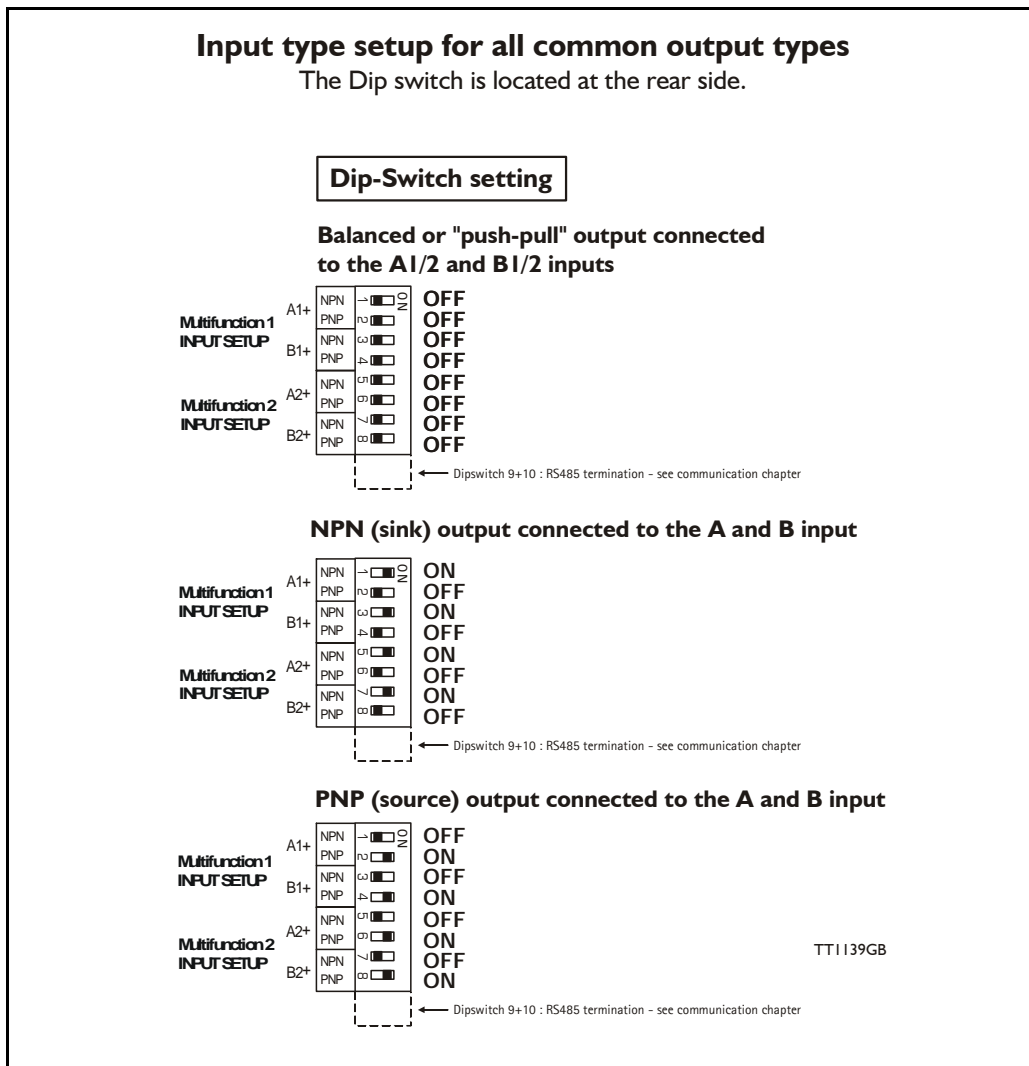
To see the specific connector pin-out please see the chapter *Expansion MAC00-B41 connector description, page 143*. A finished RS485 cable also exist. Please see *Cables for the MAC00-B41, page 145*



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4.3.9 General description: "Multifunction I/O".

The function of the Multifunction I/O is equal to that of the basic motor with the exception that the B4 I module include an overvoltage protection and a dip-switch to set up what kind of signal source feeds the input (if the Multifunction I/O is set up as inputs). The illustration above shows how to set up the Multifunction I/O terminals as balanced/push pull, NPN or PNP input. The illustrations below show examples of connections for each of these signal types.

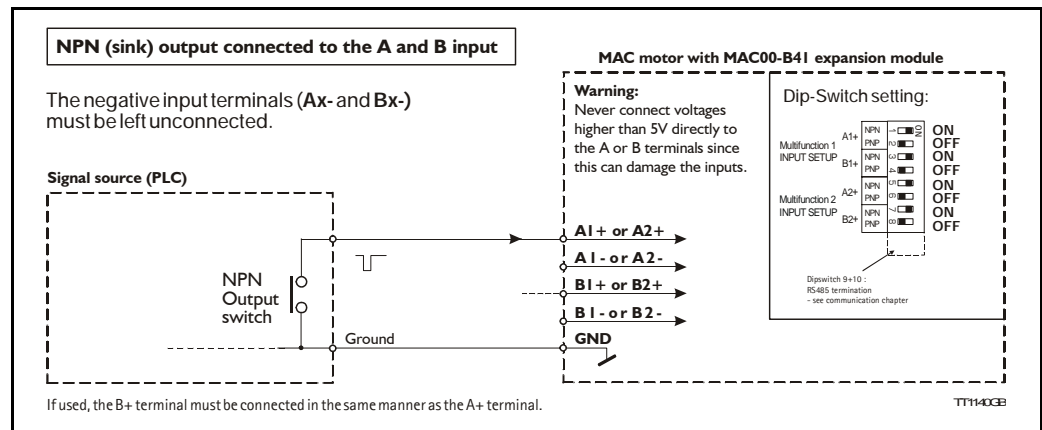
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4.3.10 Connecting an NPN signal source to the Multifunction I/O

The drawing below shows how to connect an NPN source to the MAC00-B41 multifunction I/Os. The diagram shows the A channel. The B channel must be connected in the same manner. Ensure that the Ax- and Bx- terminals are unconnected in order to maintain proper function.

Warning: Voltages higher than 5V must under no circumstance be connected directly to the input since this will damage the input permanently.

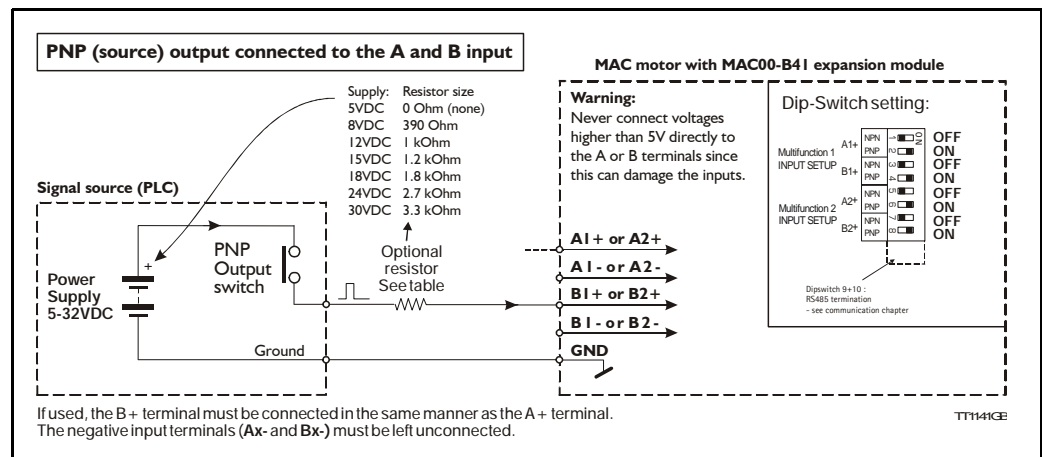


4.3.11 Connecting a PNP signal source to the Multifunction I/O

The drawing below shows how to connect a PNP source to the MAC00-B41 multifunction I/Os. The diagram shows the A channel. The B channel must be connected in the same manner.

Ensure that the Ax- and Bx- terminals are unconnected in order to maintain proper function.

Warning: Voltages higher than 5V must under no circumstance be connected directly to the input since this will damage the input permanently. Use a proper resistor as indicated in the table below.



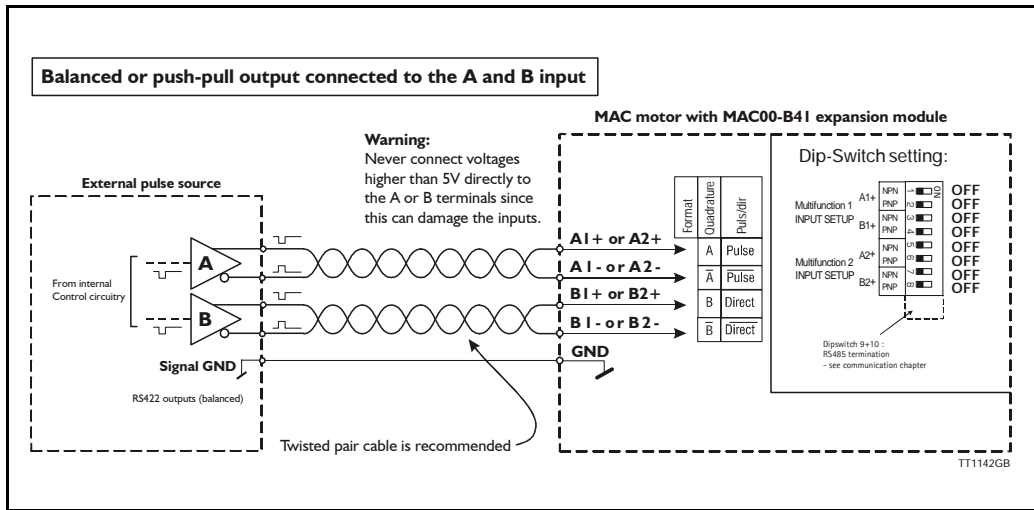
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4.3.12 Connecting a balanced/push-pull signal to the Multifunction I/O

The drawing below shows how to connect a balanced or push-pull signal source to the MAC00-B41 multifunction I/Os. Use twisted-pair cable for the balanced signals in order to ensure noise immunity.

Note: If inputs are used in pulse-direction format input A ($Ax+ / Ax-$) is pulse input and input B ($Bx+ / Bx-$) is direction input.

Warning: Voltages higher than 5V must under no circumstance be connected directly to the input since this will damage the input permanently. Use a proper resistor as indicated in the table below.



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4.3.13 Example - how to use gearmode with MAC00-B41.

The MAC00-B41 module offers a number of I/O possibilities that makes it very convenient to use in Electronic gear applications.

An external encoder with various output configurations can easily be connected to one of the multifunction I/O channels and also signals like Enable/disable motor can be established using one of I/O terminals (I/O1 to I/O6).

The following pages describe in details how to get the wiring sorted and also how to setup the motor in general.

The example will cover:

- Hardware : Connecting the encoder to the MAC00-B41
- Setting up relevant parameters for using gear mode
- Optionally setting up input 1 for enabling/disabling motor operation (enable input)
- Optionally setting up input 2 as a “coupling” input for enabling the motor to follow the encoder or staying stationary at 0 RPM (keeping the position).

Step I

Start by connecting the encoder to the multifunction IO channel I according to the illustration below.

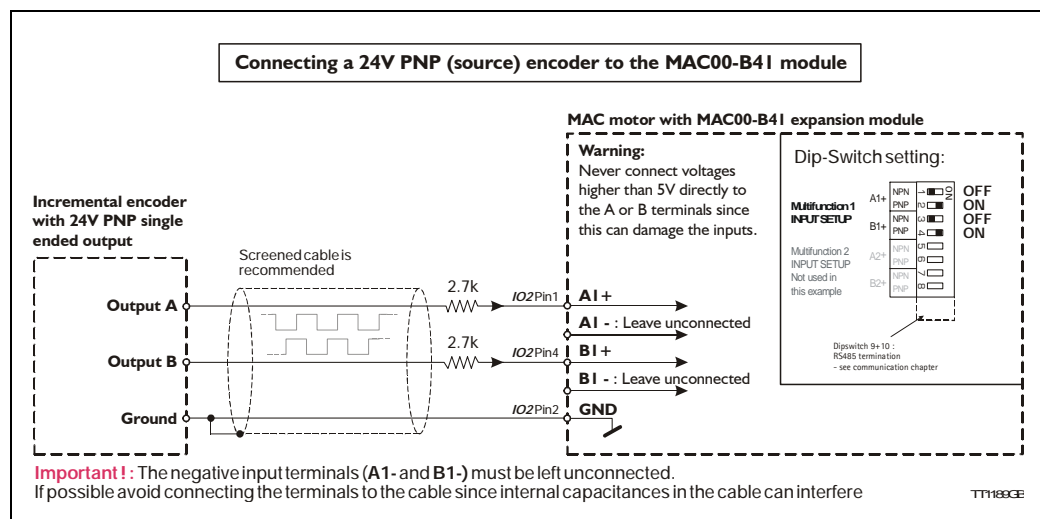
This example is showing an encoder equipped with a 24V PNP (source) output.

A serial resistor must be inserted since the IO channels at the MAC00-B41 is made for handling RS422 levels which means that no more than 5V must be applied. Higher levels will be destructive !.

Remember to set the internal dipswitch correctly in order to setup the module to handle a signal source with a PNP output.

See also *General description: “Multifunction I/O”*, page 136 for configuring the MAC00-B41 to other I/O's formats than the PNP used in this example.

Concerning the physical connector layout of the IO2 connector - please see *Expansion MAC00-B41 connector description*, page 143.



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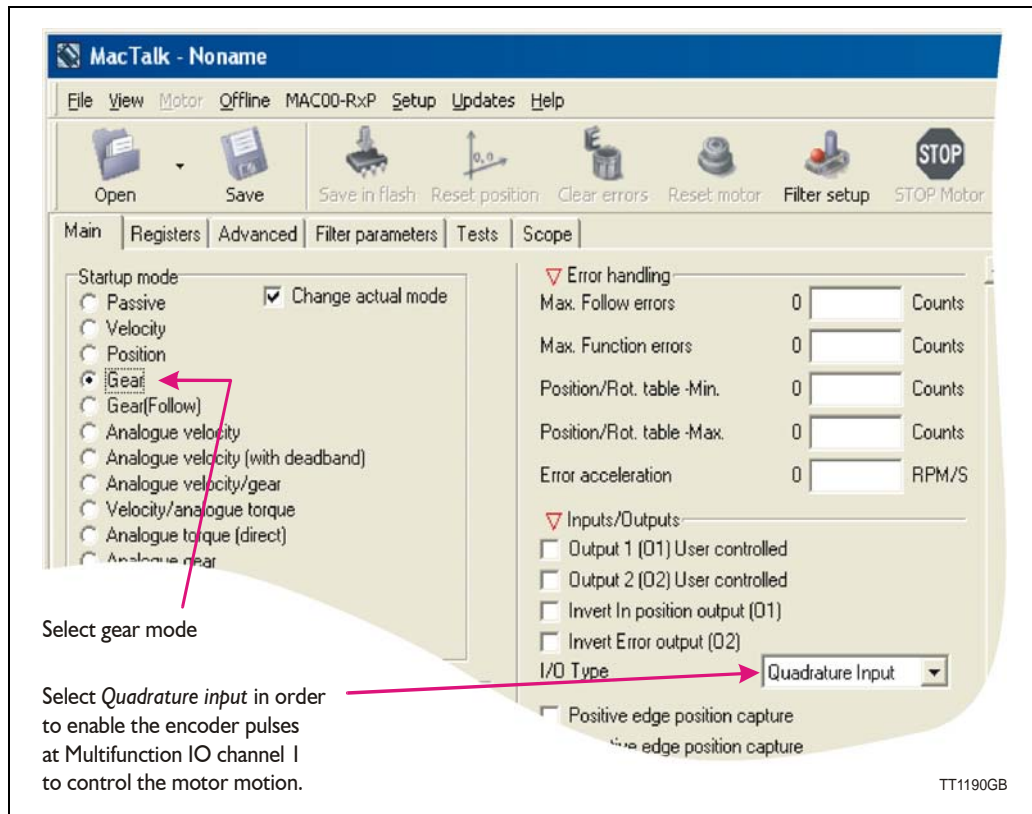
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Step 2

Now the motor need to be setup in gear mode and the Multifunction I/O I must be setup as pulse input in order to accept the applied encoder signal.

This is done in the MacTalk windows software. See illustration below.



The desired gear ratio and other relevant motion parameters may also be necessary to setup. Please see the general gear mode description - *Gear Mode - overall description, page 21*

Now the motor should move accordingly to the connected external encoder using the Gear mode.

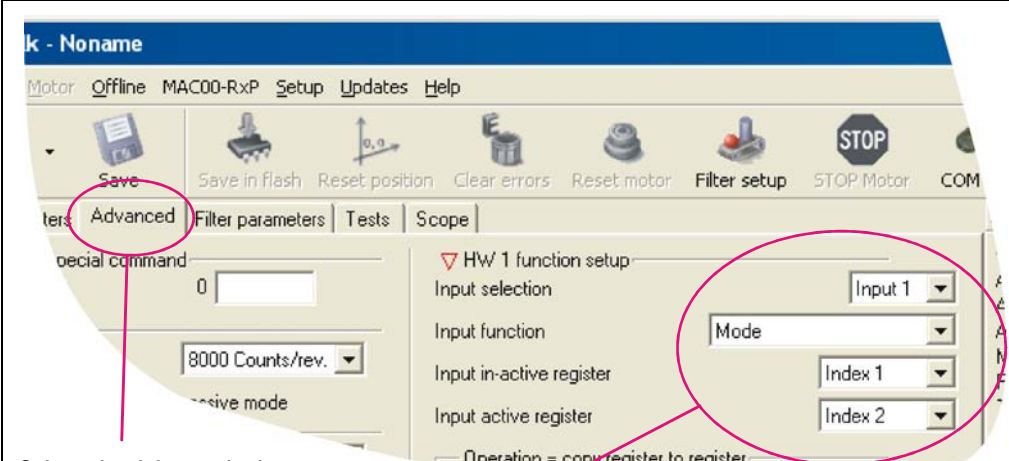
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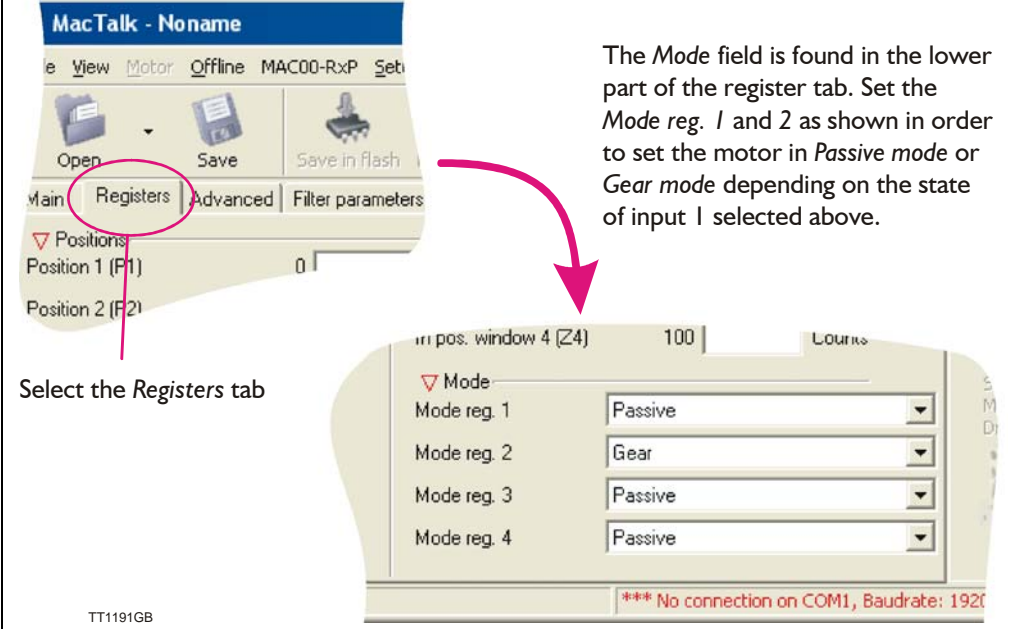
Step 3

Optionally an input can be used for enabling the motor in gear mode or making it passive (current less) which means that the shaft is not kept in position (the shaft is released). The illustration below shows how this setup can be done using the MacTalk program.



Select the *Advanced* tab

Setup as shown
The result will be that input 1 (*IO1*) is used for selecting the motor mode (*Gear* or *Passive* mode). *Index 1* and *Index 2* is referring to the mode registers which are shown below.



Select the *Registers* tab

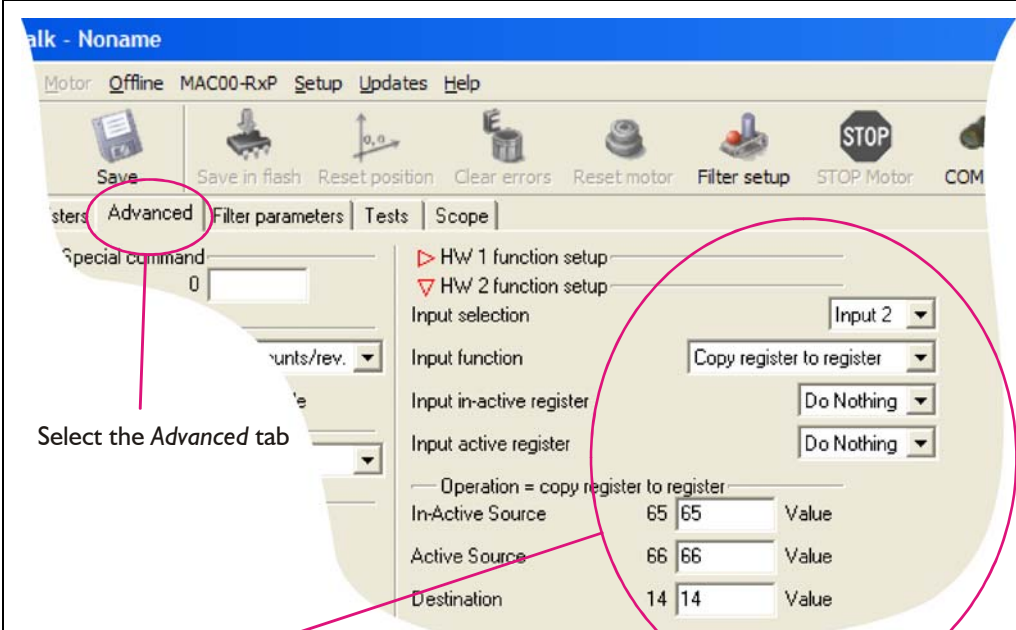
The *Mode* field is found in the lower part of the register tab. Set the *Mode reg. 1* and *2* as shown in order to set the motor in *Passive mode* or *Gear mode* depending on the state of input 1 selected above.

Continued at next page

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Step 4

Optionally an input can be used for enabling motor movement according to the external encoder when the input is active or decelerating the motor to a stationary position when the input is passive. Setup the motor according to the following illustration.

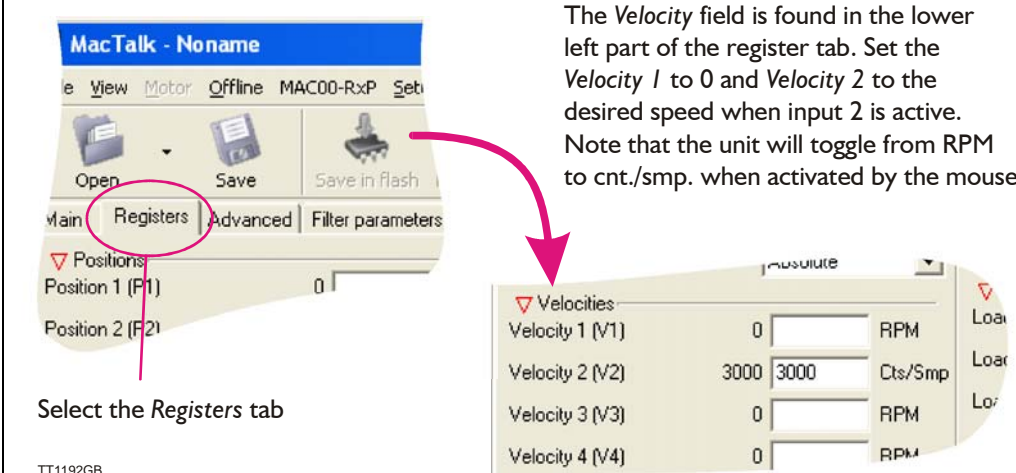


The screenshot shows the 'Advanced' tab in the MacTalk software. The 'Input selection' dropdown is set to 'Input 2'. The 'Input function' dropdown is set to 'Copy register to register'. The 'Input in-active register' and 'Input active register' are both set to 'Do Nothing'. The 'Operation' is set to 'copy register to register'. The 'In-Active Source' is set to 65, 'Active Source' is set to 66, and 'Destination' is set to 14. The unit is set to 'Value'.

Select the *Advanced* tab

Setup as shown

The result will be that input 2 (IO2) is used for setting the motor speed to 0 RPM (stationary position) or any velocity above 0 RPM allowing the motor to move according to the external encoder.



The screenshot shows the 'Registers' tab in the MacTalk software. The 'Velocities' section is expanded, showing four velocity settings:

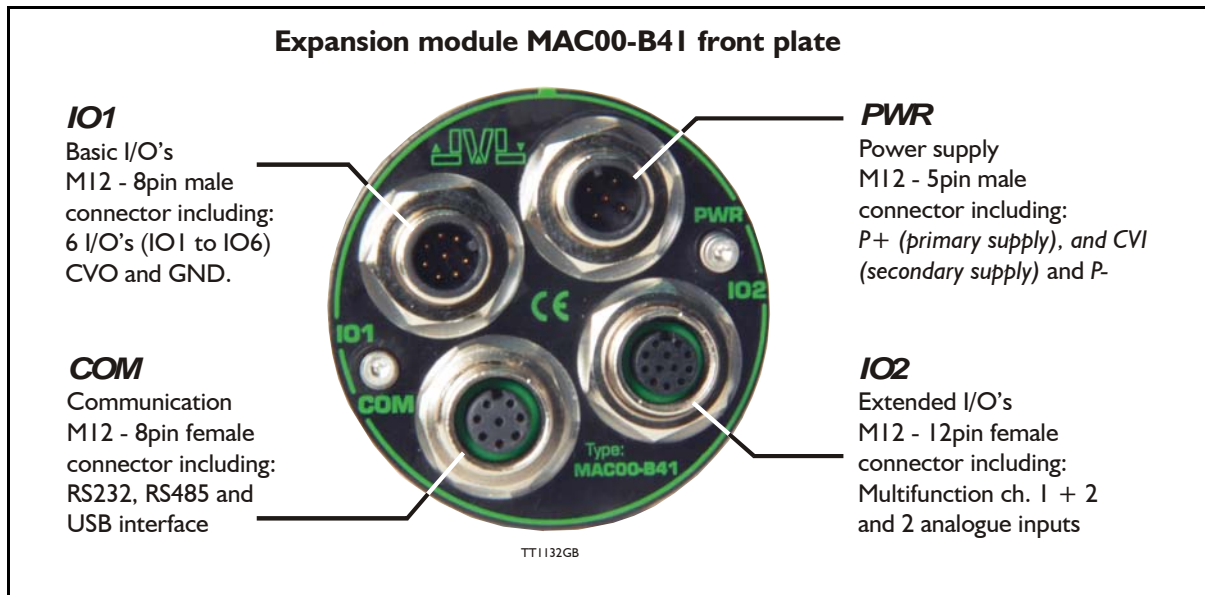
Velocity	Value	Unit
Velocity 1 (V1)	0	RPM
Velocity 2 (V2)	3000	Cts/Smp
Velocity 3 (V3)	0	RPM
Velocity 4 (V4)	0	RPM

Select the *Registers* tab

The *Velocity* field is found in the lower left part of the register tab. Set the *Velocity 1* to 0 and *Velocity 2* to the desired speed when input 2 is active. Note that the unit will toggle from RPM to cnt./smp. when activated by the mouse

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4.3.14 Expansion MAC00-B41 connector description

The MAC00-B41 offers IP65 protection and M12 connectors which makes it ideal for 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
CVI	Control and user output supply +12-30VDC. DO NOT connect >30V to this terminal !	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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"IO1" - Basic I/O's. M12 - 8pin male connector.				
Signal name	Description	Pin no.	JVL Cable W1000-M12 F8T05N	Isolation group (See note)
I/O1	I/O channel 1 - Can be used as input or output	1	White	1
I/O2	I/O channel 2 - Can be used as input or output	2	Brown	1
I/O3	I/O channel 3 - Can be used as input or output	3	Green	1
I/O4	I/O channel 4 - Can be used as input or output	4	Yellow	1
I/O5	I/O channel 5 - Can be used as input or output	5	Grey	1
I/O6	I/O channel 6 - Can be used as input or output	6	Pink	1
CVO	Supply output. Connected internally to the CVI terminal in the PWR connector. DO NOT connect >30V to this terminal !	7	Blue	1
GND	Ground intended to be used together with the other signals in this connector.	8	Red	1
"COM" - Communication connector - M12 - 8pin female connector.				
Signal name	Description	Pin no.	JVL Cable W1000-M12 M8T05N	Isolation group (See note)
USB: D-	USB interface. Negative data terminal	1	White	2
RS232: TX	RS232 interface. Transmit terminal Leave open if unused.	2	Brown	2
RS232: RX	RS232 interface. Receive terminal Leave open if unused.	3	Green	2
IGND	Isolated interface ground to be used together with the other signals in this connector,	4	Yellow	2
RS485: A-	RS485 interface. Leave open if unused	5	Grey	2
RS485: B+	RS485 interface. Leave open if unused	6	Pink	2
USB: D+	USB interface. Positive data terminal	7	Blue	2
USB: VBUS	USB interface. Supply input 5VDC nominal	8	Red	2
"IO2" - I/O connector 2. M12 - 12pin female connector				
Signal name	Description	Pin no.	JVL Cable W1100M12 M12T05N	Isolation group (see note)
A1+	Multifunction I/O1 terminal A1+	1	Brown	1
GND	Ground intended to be used together with the other signals in this connector	2	Blue	1
A1-	Multifunction I/O1 terminal A1-	3	White	1
B1+	Multifunction I/O1 terminal B1+	4	Green	1
A2+	Multifunction I/O2 terminal A2+	5	Pink	1
B1-	Multifunction I/O1 terminal B1-	6	Yellow	1
B2+	Multifunction I/O2 terminal B2+	7	Black	1
A2-	Multifunction I/O2 terminal A2-	8	Grey	1
5VO	5V out - max 100mA	9	Red	1
B2-	Multifunction I/O2 terminal B2-	10	Violet	1
AIN1	Analogue input1 $\pm 10V$ or used for <i>Zero search</i>	11	Grey/pink	1
AIN2	Analogue input2 $\pm 10V$	12	Red/blue	1

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4.3.15 Cables for the MAC00-B41

The following cables equipped with M12 connector can be supplied by JVL.

MAC00-B41 Connectors				Description	JVL Order no.	Picture
"IO1" 8pin male	"IO2" 12pin Female	"COM" 8pin Female	"PWR" 5pin Male			
		X		RS232 Interface cable. Connects directly from MAC00-B41 to a PC Length: 5m (197 inch)	RS232-M12-1-5-8	
		X		RS485 Interface cable. Connects directly from MAC00-B41 to a PC with a RS485 Com. port. Length: 5m (197 inch)	RS485-M12-1-5-8	
		X		USB Interface cable. Connects directly from MAC00-B41 to a PC with a USB Com. port. Length: 5m (197 inch)	USB-M12-1-5-8	(picture coming soon)
			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	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				Cable with M12 female 8pin straight connector, loose ends.	WI1000-M12F8T05N	
X				Same as above but 20m (787 inch)	WI1000-M12F8T20N	
		X		Cable with M12 male 8-pin connector loose wire ends 0.22mm ² (24AWG) and screen. Length: 5m (197 inch)	WI1000-M12M8T05N	
		X		Same as above but 20m (787 inch)	WI1000-M12M8T20N	
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).