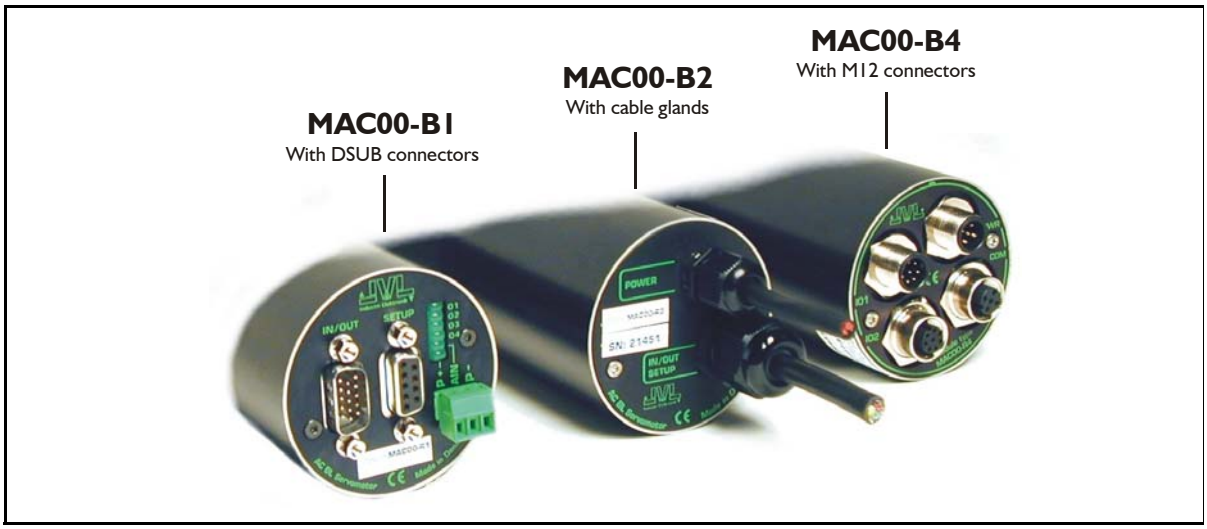
4.2 Expansion Module MAC00-B1/B2/B4



4.2.1 Expansion modules MAC00-B1, B2 and B4 — overall description

The expansion modules MAC00-B1, B2 and B4 can be mounted in all the standard MAC motors up to MAC800. These modules are among the simplest and lowest cost modules in the product range. The modules contain no intelligence (microprocessor).
The MAC00-B1, B2 or B4 expansion module offers an industrial interface that mates with the standard MAC motor and offers a number of feature enhancements, including:

- Different kinds of connectors for more reliability (compared to the basic motor itself).
- Full RS232 protocol support for use with standard serial cable.
- Full RS485 protocol support for multipoint communication up to 100m.
- Sourcing (PNP) outputs for status signals O1 and O2 instead of sinking (NPN).
- Only MAC00-B1: LEDs to indicate: O1, O2 output status. Zero switch (analogue input) status and Input power status.
- Only MAC00-B2 and B4: Dual supply. The main supply can be removed but the control circuitry is kept active and position data and communication are still functional.

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
- Simple velocity or torque control via +/-10V input.
- Machine adjustment/setup by sending RS232 or RS485 commands.

The B1, B2 and B4 are equivalent except for the following hardware differences:

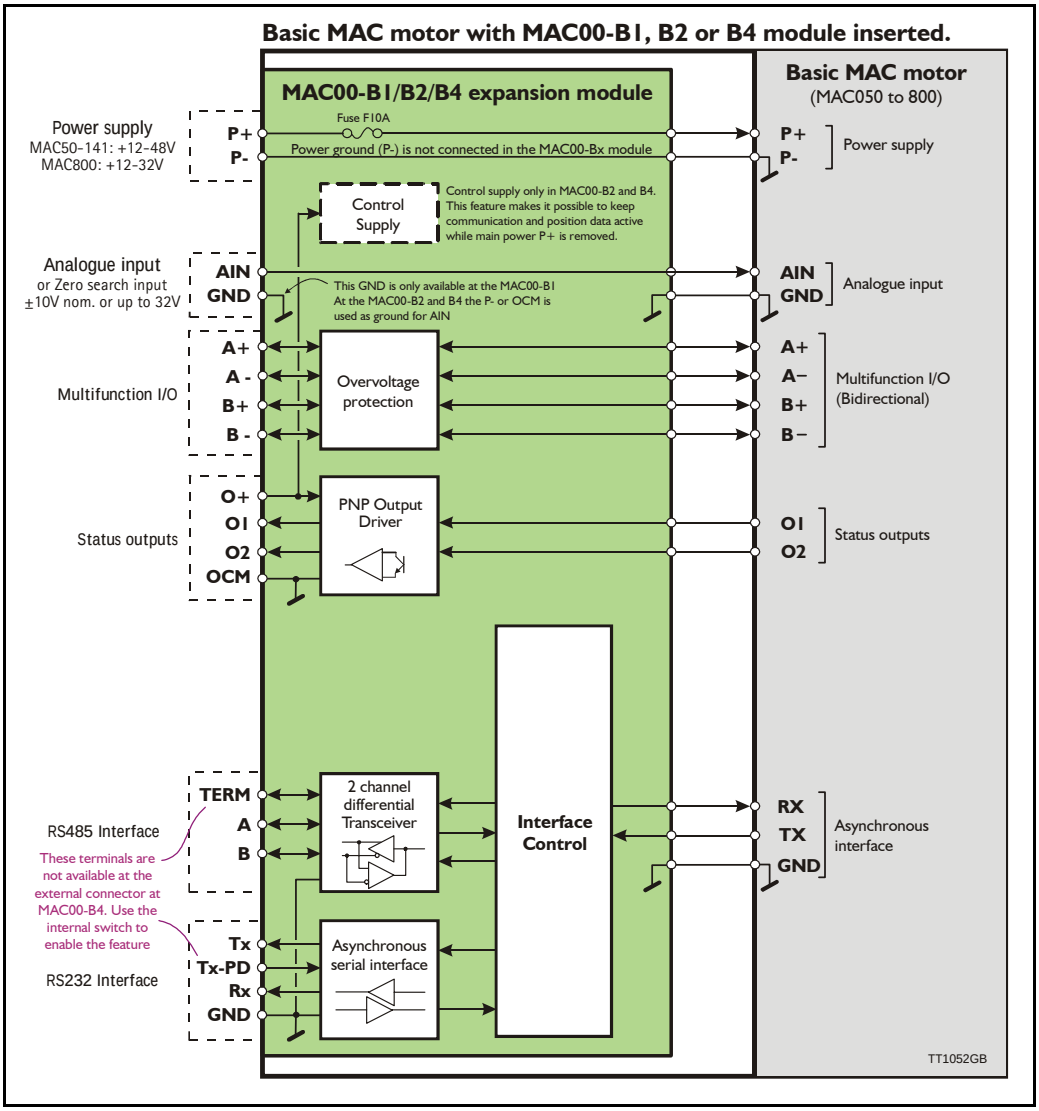
Type	Protection Class	Connectors			Dual Supply
		I/O and interface	Power supply	LEDs at I/O	
MAC00-B1	IP42	DSUB 9 pole	3 pole Phoenix	Yes	No
MAC00-B2	IP67/IP65*	Cable glands	Cable glands	No	Yes
MAC00-B4	IP67/IP65*	M12	M12	No	Yes

Note*: IP65 on MAC400-800

4.2 Expansion Module MAC00-B1/B2/B4

4.2.2 General hardware aspects

All internal and external main connections can be seen in the illustration below. Please note that a few features are only available in MAC00-B4 and partly in B2.



4.2.3 General hardware description

The MAC00-B1, B2 and B4 modules offer the following external connections.

- **Power supply (P+/P-)**
  These terminals are used for the main supply of the motor. A voltage between +12 and 48VDC (MAC50-141) and +12-32VDC (MAC400-800) must be connected.
- **Analogue input (AIN)**
  The analogue input is used either as an analogue input or digital input. When used as an analogue input, it can control velocity, torque or position depending on which mode is set for motor operation. When used for digital input, 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 *General Analogue input (AIN) description when using MAC00-Bx, page 121*.
  (continued)

4.2 Expansion Module MAC00-B1/B2/B4

- **Multifunction I/O (A+,A- , B+and B-)**
  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 111* and *General description: "General description: "Multifunction I/O" when using a Bx module, page 124*
  - Pulse outputs - for functional description please refer to *Multifunction I/O used as pulse outputs, page 112* and
  - RS422 interface - for functional description please refer to *Multifunction I/O general description, page 110*.

  Important !:
  Remember to configure "I/O type" as "Pulse Input" in MacTalk if none of the 4 terminals A+, A-, B+ and B- 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.

- **Status outputs (O1, O2, O+, and OCM)**
  The status outputs O1 and O2 (PNP outputs) indicate the actual status of the MAC motor.
  O1 This output functions as an "In Position" or "at velocity" output depending on which operating mode is selected. The position interval can be set up using the MacTalk program.
  O2 This output is normally passive but if an unrecoverable error occurs, it will be activated to indicate that normal operation of the motor has been interrupted and no further operation is possible until a reset or power down has been made.

- **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 357* for further details.

4.2 Expansion Module MAC00-B1/B2/B4

4.2.4 General power supply description

The power supply must be connected to the terminals marked P+ and P-.

MAC50, 95, 140 or 141:

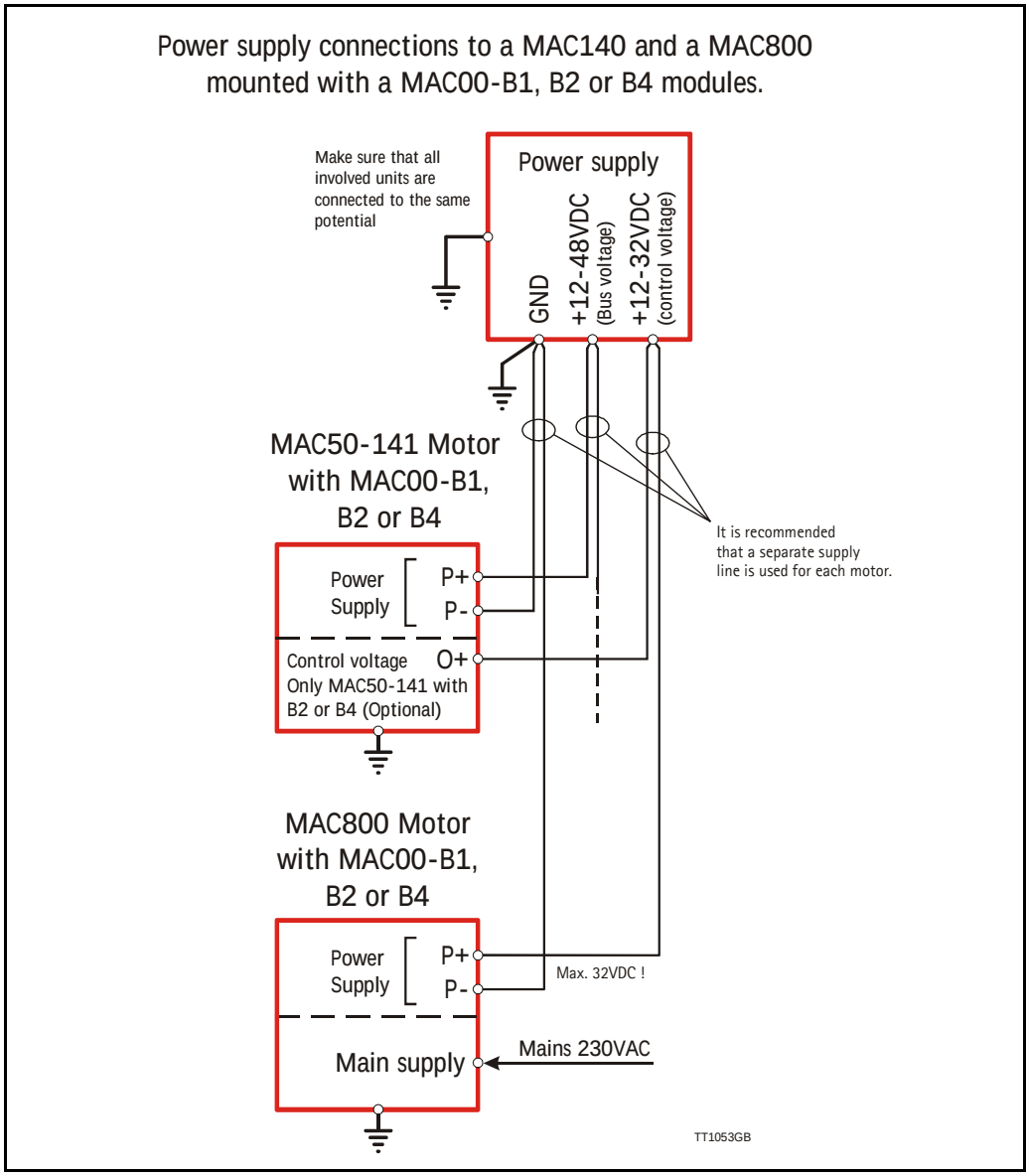
A supply voltage in the range 12VDC to 48VDC can be used. However the maximum speed of the motor (4000 RPM) is based on 48VDC. A lower voltage will decrease the speed/torque performance, and in general it is not recommended to run the motor at more than 2000 RPM if, for example, 24VDC is used as the supply.

Optionally, the MAC00-B2 and B4 modules also offer a control voltage input (O+) which means that the internal control circuitry will be kept powered when the main supply (P+) is removed. See also the description: *Power supply (only MAC050 to 141), page 85*.

MAC400 or 800

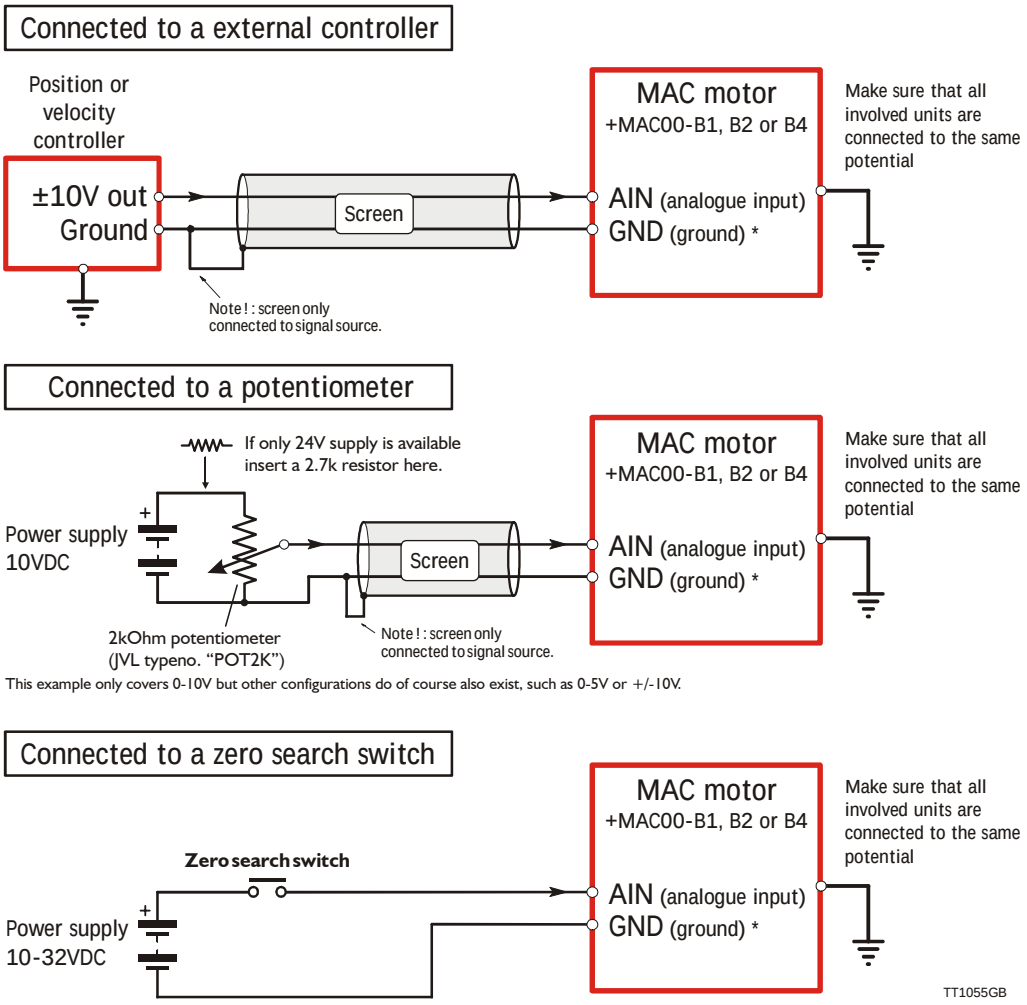
For the MAC400-800, the main supply is 115/230VAC connected at separate terminals. The P+ power supply terminal only serves as a supply to the internal control circuitry. The voltage must stay in the range +12-32VDC. See also the *How to connect the power supply (only MAC800), page 97* or *Power supply circuitry (only MAC800), page 96*.

Power supply connections to a MAC140 and a MAC800 mounted with a MAC00-B1, B2 or B4 modules.



4.2 Expansion Module MAC00-B1/B2/B4

Analogue input connection at the MAC motor mounted with a MAC00-B1, B2 or B4 modules.



*The GND used with the AIN is not equal for all modules. See the specific hardware description of the actual module to make sure that the intended GND terminal is used.

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

4.2.5 General Analogue input (AIN) description when using MAC00-Bx

When a MAC00-B1, B2 or B4 module is mounted in the MAC motor, the analogue input is available in the same manner as in the basic motor itself.

The analogue input 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 input 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 individual chapters for each module type: *General description MAC00-B1, page 126*, *General description MAC00-B2, page 127*, or *General description MAC00-B4, page 129*.

4.2 Expansion Module MAC00-B1/B2/B4

4.2.6 RS232 - General description when using a MAC00-Bx 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.

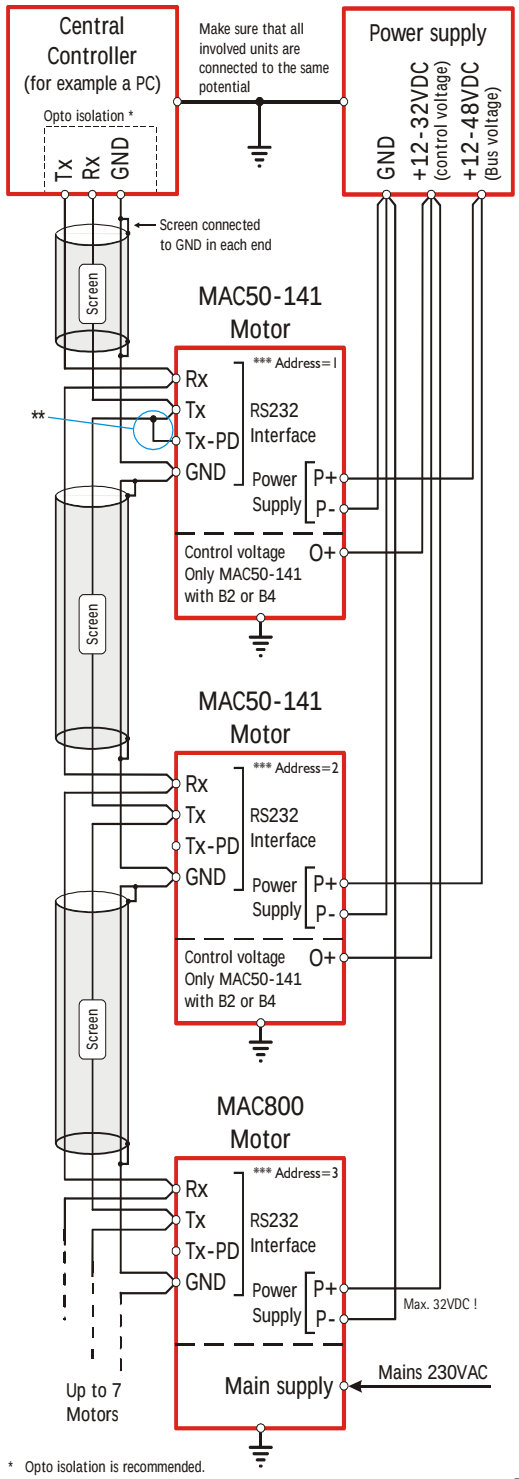
Note: The basic MAC motor does not fully support RS232 since the interface signals are only 5V levels. See also the basic description - Serial interface, page 106.

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

1 Ensure that Tx-PD is connected to TX on one of the units in the system. Note that the B1, B2 and B4 modules all contain a termination resistor which can be activated.
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 Ensure that the supply lines are connected individually in order to minimise the voltage drop between the motors.
6 Master Controller RS485 interface:
If available, it is strongly recommended a type with optical isolation is used.
7 The interface cable length should not exceed 10 metres.

Connectors:
Please read the individual description for the MAC00-B1, B2 or B4 to see the RS232 connector layout.

RS232 network with 2 x MAC140 and 1 x MAC800 mounted with MAC00-B1, B2 or B4 modules.



4.2 Expansion Module MAC00-B1/B2/B4

4.2.7 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.

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.

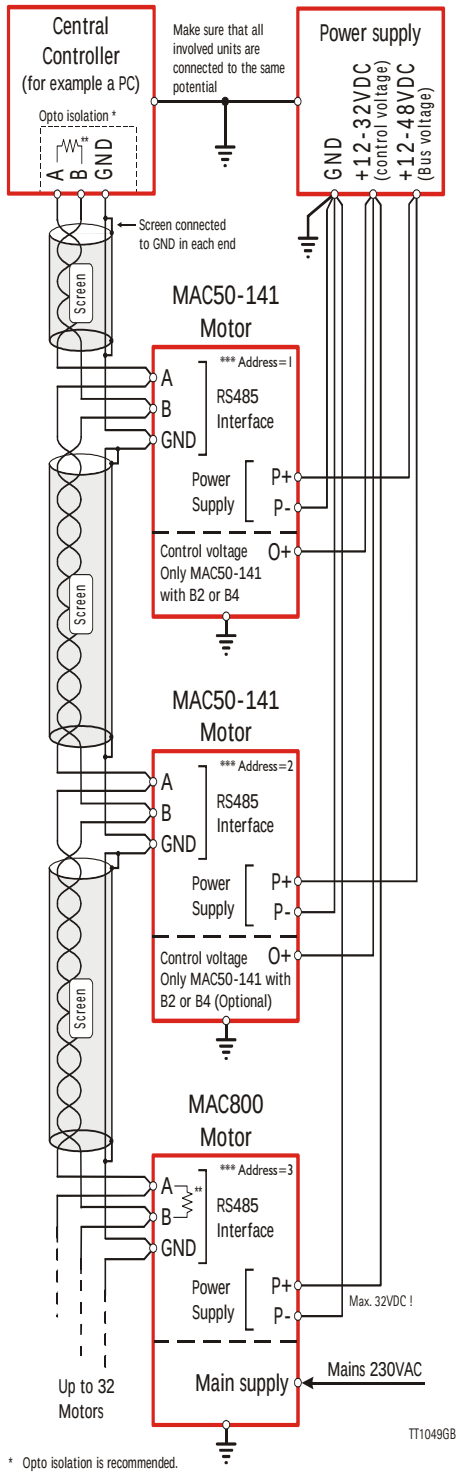
5 The last unit in each end of the network must be terminated. Note that the B1, B2 and B4 modules all contain a termination resistor which can be activated.

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:
Please read the individual description for the MAC00-B1, B2 or B4 to see the connector layout.

RS485 network with 2 x MAC140 and 1 x MAC800 mounted with MAC00-B1, B2 or B4 modules.

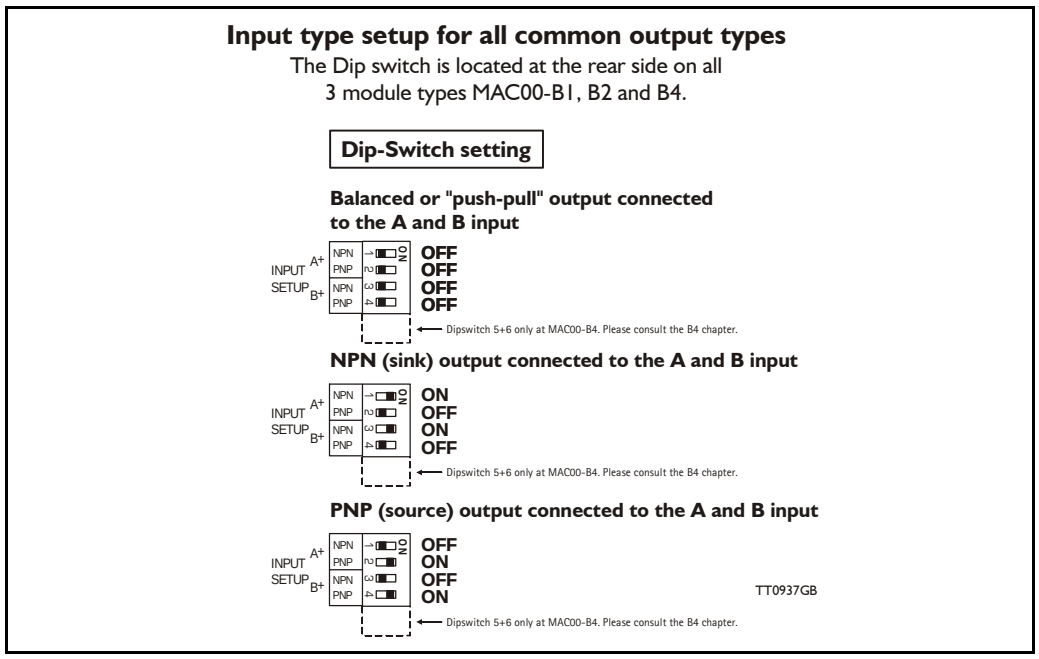


* Opto isolation is recommended.

** The last unit at each end of the line must be terminated. The MAC00-B1, B2 and B4 contain this feature. See the individual module descriptions.

*** Each unit connected must be setup with an address via The MacTalk program. If only one unit is connected no address is needed.

4.2 Expansion Module MAC00-B1/B2/B4

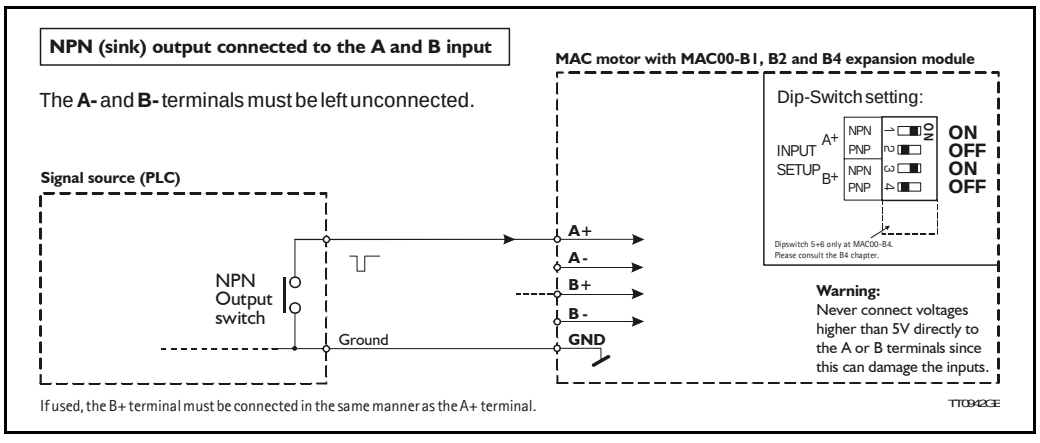


4.2.8 General description: "Multifunction I/O" when using a Bx module

The function of the Multifunction I/O is equal to that of the basic motor with the exception that the B1, B2 or B4 modules 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.

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

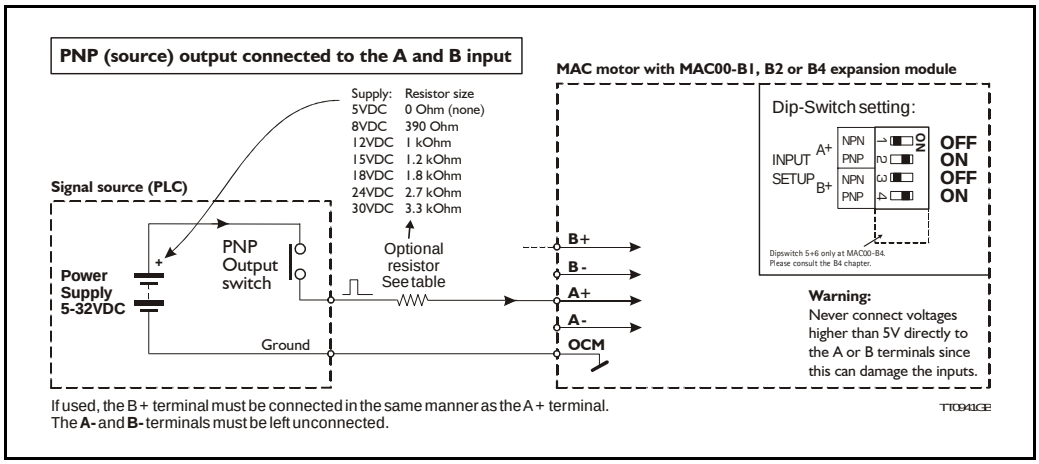
The drawing below shows how to connect an NPN source to the MAC00-B1, B2 or B4 multifunction I/Os. The diagram shows the A channel. The B channel must be connected in the same manner. Ensure that the A- and B- terminals are unconnected in order to maintain proper function.
Warning: Voltages higher than 5V must under no circumstance be connected directly to the input since this will damage the input permanently.



4.2 Expansion Module MAC00-B1/B2/B4

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

The drawing below shows how to connect a PNP source to the MAC00-B1, B2 or B4 multifunction I/Os. The diagram shows the A channel. The B channel must be connected in the same manner.
Ensure that the A- and B- 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.

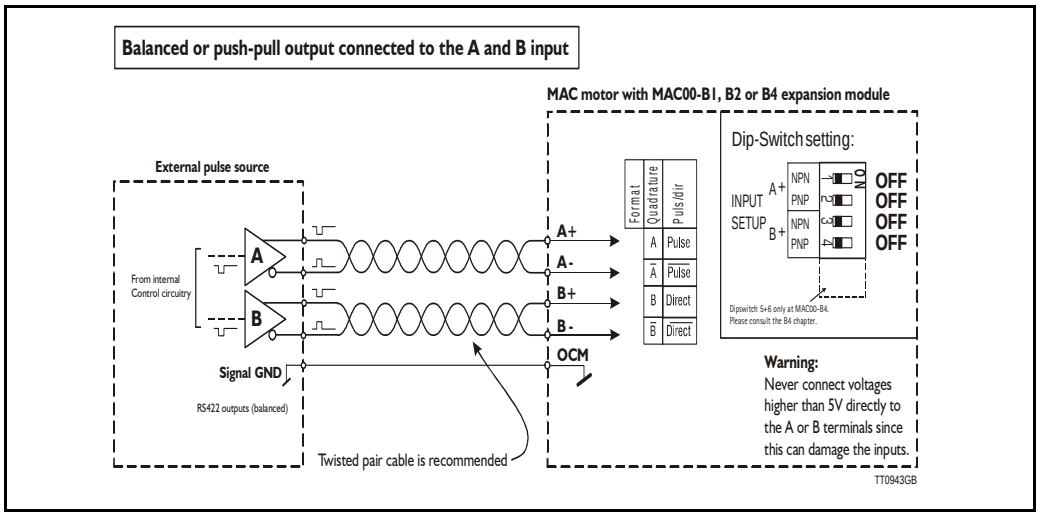


4.2.11 Connecting a balanced/push-pull signal to the Multifunction I/O

The drawing below shows how to connect a balanced or push-pull signal source to the MAC00-B1, B2 or B4 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 (A+/A-) is pulse input and input B (B+/B-) 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.



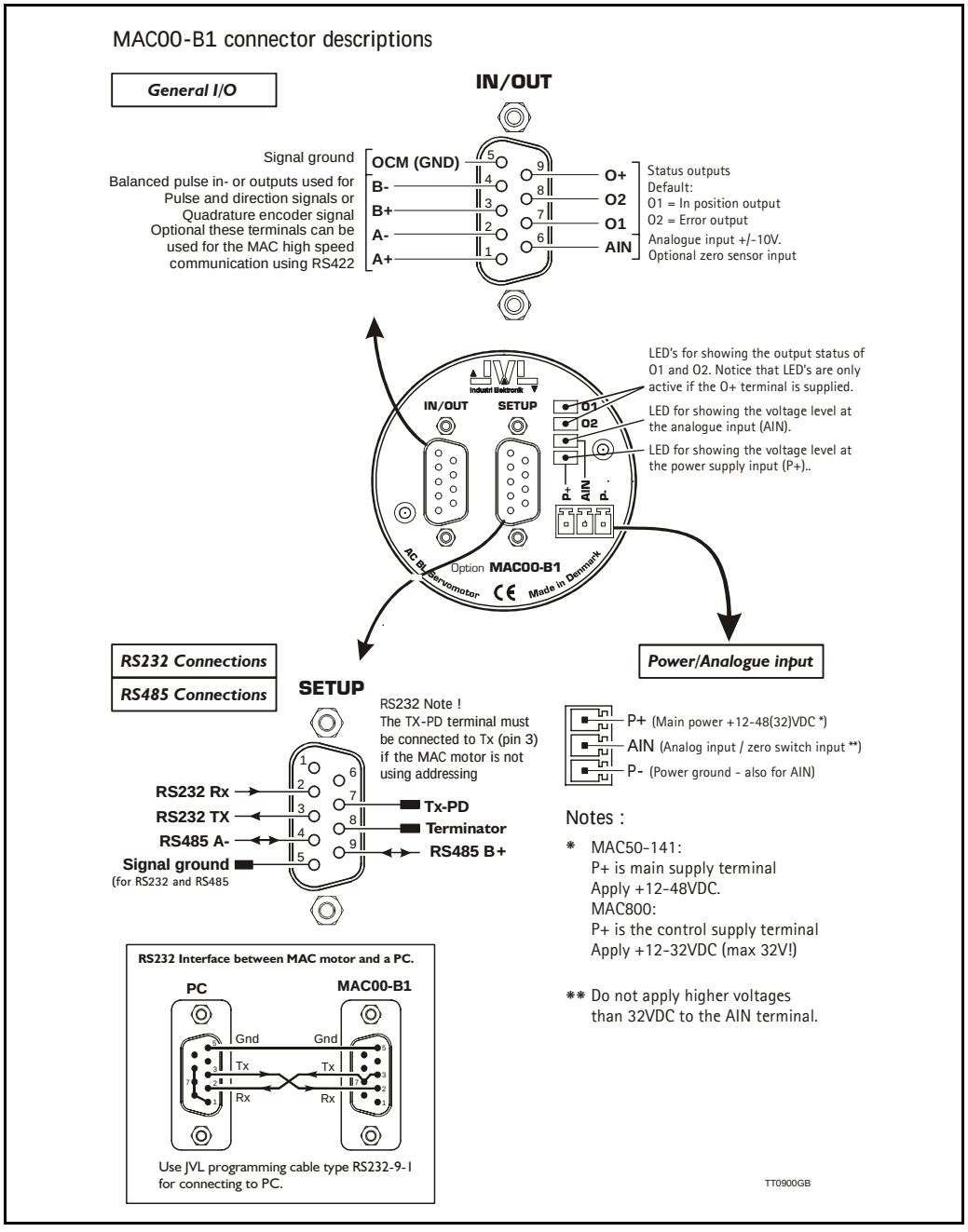
4.2 Expansion Module MAC00-B1/B2/B4

4.2.12 General description MAC00-B1

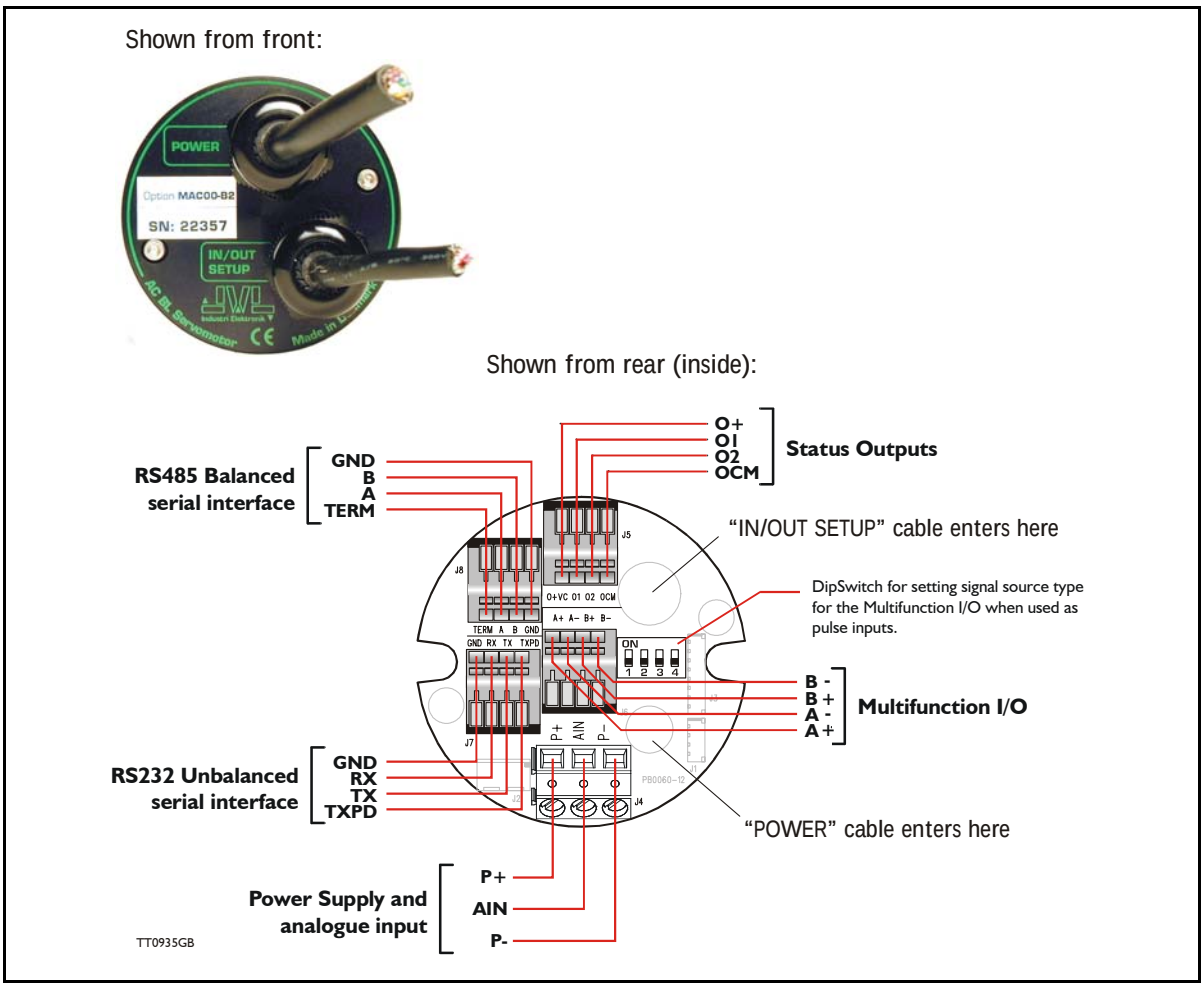
The MAC00-B1 expansion module is an industrial interface that mates with the standard MAC motor and offers a number of feature enhancements, including:

- Standard 9-pin D-SUB connectors for additional reliability.
- Addition of a Zero switch input for locating a mechanical zero point of the actuator when used in position-related modes.
- Plugable screw terminal connector for power supply and Zero switch.
- LEDs to indicate: O1 and O2 output status, Zero switch (analogue input) status. Input power status.
- Full RS232 and RS485 protocol support for use with standard 9-pin DSUB.
- Sourcing (PNP) outputs for status signals O1 and O2 instead of sinking (NPN).

The following illustration shows all the connectors on the MAC00-B1 module.



4.2 Expansion Module MAC00-B1/B2/B4



4.2.13 General description MAC00-B2

The MAC00-B2 expansion module is an industrial interface that mates with the standard MAC motors and offers a number of feature enhancements, including:

- IP67 protection if mounted on basic MAC050-141 motor with the IP67 option, and IP65 on MAC400-600
- Direct cable connection through sealed compression cable glands.
- Addition of a Zero switch input for locating a mechanical zero point of the actuator when used in position-related modes.
- Screw terminals (internal) for all signal lines, power supply and Zero switch.
- Full RS232 protocol support
  Note: The basic MAC motor is only equipped with a low-voltage serial interface that requires the use of the RS232-9-1-MAC option cable which has integrated electronics to boost the voltage levels.
- Full RS485 protocol support for multipoint communication up to 100m.
- Sourcing (PNP) outputs for status signals O1 and O2. The basic MAC motors offers sinking (NPN).

4.2 Expansion Module MAC00-B1/B2/B4

4.2.14 MAC00-B2 option with cables

The 'MAC00-B2' type number designation only covers the basic module without any cables.
If a number is added after the basic type number, for example MAC00-B2-10, this suffix indicates that the module is fitted with 2x10m of cable. One cable is used for the power supply and analogue input, and the other cable covers all the signal lines, i.e. RS232, RS485, status outputs and multifunction I/O. See the following tables.

Power cable (Cable 1) - **Internal connector J4**			
Signal name	**Pin no.**	**Description**	**Wire colour**
P-	3	Power supply ground	White
AIN	2	Analogue input (AIN)	Green
P+	1	Power supply +12-48VDC Nom.	Yellow / Brown

Signal cable (Cable 2) - **Internal connectors J5-8**			
Signal name	**Pin no.**	**Description**	**Wire colour**
O+	J5/1	Status Outputs. Positive supply - Max. 30VDC	Red
O1	J5/2	Status Outputs. Output 1 - PNP(sourcing) max. 25mA	Grey
O2	J5/3	Status Outputs. Output 2 - PNP(sourcing) max. 25mA	Pink
OCM	J5/4	Status Outputs. Output ground	Blue
B-	J6/1	Multifunction I/O. Terminal B-.	Brown/Green
B+	J6/2	Multifunction I/O. Terminal B+. Connect to ground (GND J7/4 or J8/4) if not used ***	White/Green
A-	J6/3	Multifunction I/O. Terminal A-.	Grey/Pink
A+	J6/4	Multifunction I/O. Terminal A+. Connect to ground (GND J7/4 or J8/4) if not used ***	Red/Blue
TXPD *	J7/1	RS232 Interface. Transmit pull-down (Connect to TX if addressing is not used).	Green
TX	J7/2	RS232 Interface. Transmit (Connect to TXPD if addressing is not used).	Yellow
RX	J7/3	RS232 Interface. Receive. Connect to ground if not used.	White
GND	J7/4	RS232 Interface. Ground for RS232	Brown
TERM **	J8/1	RS485 Interface. Terminator. Connect to "A" (J8/2) if MAC motor is the last node on the interface bus. Important: Do not connect if not used.	Purple
A-	J8/2	RS485 Interface. A terminal. Important: Do not connect if not used.	Yellow/Brown
B+	J8/3	RS485 Interface. B terminal Important: Do not connect if not used.	White/Yellow
GND	J8/4	RS485 Interface. Signal ground.	Black
Cable Screen			
The cable-screen is internally connected to motor housing. Externally it must be connected to earth.			

* Connect to the TX terminal if the module is the **only** or the **last** node on the line in order to terminate the line.
** Connect to the A terminal if the module is the **only** or the **last** node on the line in order to terminate the line.
*** Remember to configure "I/O type" as "Pulse Input" in MacTalk if none of the 4 terminals A+, A-, B+ and B- are used (the multifunction I/Os). This must be done to avoid random function of the motor since the multifunction I/Os are defined as "Serial data" by default.

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).

4.2 Expansion Module MAC00-B1/B2/B4

Expansion module MAC00-B4 front plate

IO
Basic I/O's
M12 - 8pin male
connector including:
Multifunction I/O's (A+...)
and O1, O2, GND and
the analogue input AIN

COM1
Communication 1
M12 - 8pin female
connector including:
RS232 and RS485
interface

PWR
Power supply
M12 - 5pin male
connector including:
P+ (primary supply), and O+ (secondary supply) and *P-*

COM2
Communication 2
M12 - 5pin female
connector including:
RS232, RS485

TT1015-02GB

4.2.15 General description MAC00-B4

The MAC00-B4 expansion module is protection class IP67 (MAC050-141) and is basically similar to the B1 and B2 modules except that it offers M12 circular industrial connectors which makes the module flexible and robust.
Additional features are:

- Secondary power supply input which can be used to keep the control core alive during emergency situations
- Dual interface connectors make it easy to daisy chain with other motors at the RS232 or RS485 interface.

4.2.16 Expansion MAC00-B4 hardware description

The MAC00-B4 offers IP67 (MAC050-141) 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 the B2 module with cable glands.

The connector layout:

"PWR" - Power input. M12 - 5pin male connector				
Signal name	**Description**	**Pin no.**	**JVL Cable WI1000-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
O+	Output supply / Control voltage +12-30VDC.	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.				

(Continued next page)

4.2 Expansion Module MAC00-B1/B2/B4

"IO" - Basic I/O's. M12 - 8pin male connector.				
Signal name	**Description**	**Pin no.**	**JVL Cable WI1000-M12 F8T05N**	**Isolation group**
A+	Multifunction I/O terminal A+	1	White	1
A-	Multifunction I/O terminal A-	2	Brown	1
B+	Multifunction I/O terminal B+	3	Green	1
B-	Multifunction I/O terminal B-	4	Yellow	1
O1	Digital output 1 - PNP output	5	Grey	1
O2	Digital output 2 - PNP output	6	Pink	1
OCM	Ground intended to be used together with the other signals in this connector.	7	Blue	1
AIN	Analogue input +/- 10V or used for *Zero search* Use the OCM terminal (pin 7) as ground for the analogue input.	8	Red	1
"COM1" - Communication connector 1. M12 - 8pin female connector.				
Signal name	**Description**	**Pin no.**	**JVL Cable WI1000-M12 M8T05N**	**Isolation group**
	Not used	1	White	
RS232: TX	RS232 interface. Transmit terminal Leave open if unused.	2	Brown	1
RS232: RX	RS232 interface. Receive terminal Leave open if unused.	3	Green	1
GND	Ground intended to be used together with the other signals in this connector,	4	Yellow	1
RS485: B+	RS485 interface. Leave open if unused	5	Grey	1
RS485: A-	RS485 interface. Leave open if unused	6	Pink	1
	Not used	7	Blue	
	Not used	8	Red	
"COM2" - Communication connector 2. M12 - 5pin female connector				
Signal name	**Description**	**Pin no.**	**JVL Cable WI1000M12 M5T05N**	**Isolation group**
RS232 Rx	RS232 interface receive terminal. Leave open if unused	1	Brown	1
RS232 Tx	RS232 interface transmit terminal. Leave open if unused	2	White	1
RS485 B+	RS485 interface. Leave open if unused	3	Blue	1
RS485 A-	RS485 interface. Leave open if unused	4	Black	1
GND	Interface ground (same as main ground).	5	Grey	1

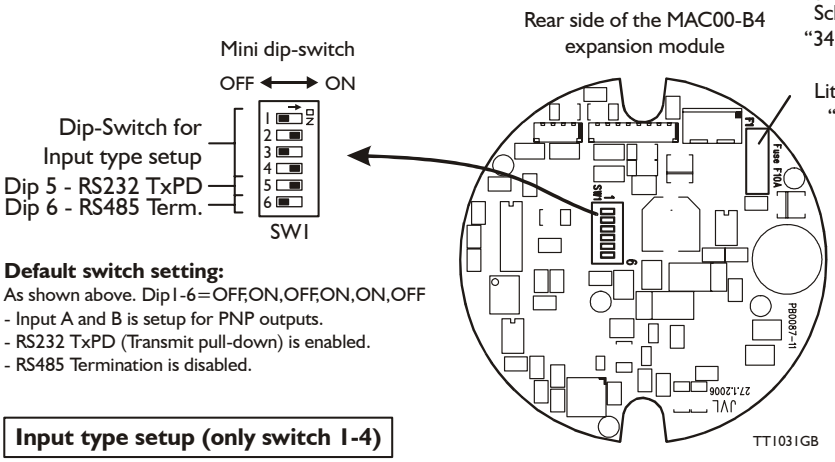
For complete drawings of the M12 cables please see the appendix
Cable drawings, page 396.

4.2 Expansion Module MAC00-B1/B2/B4

4.2.17 MAC00-B4 dip-switch setup

The 6 pole dip-switch is placed on the rear side of the MAC00-B4 module. The following illustration shows how to set up the switch.

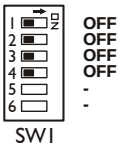
MAC00-B4 Dip switch settings



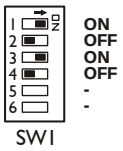
Default switch setting:
As shown above. Dip1-6=OFF,ON,OFF,ON,ON,OFF
- Input A and B is setup for PNP outputs.
- RS232 TxPD (Transmit pull-down) is enabled.
- RS485 Termination is disabled.

Input type setup (only switch 1-4)

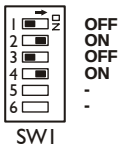
Balanced or "push-pull" output connected to the A and B input



NPN (sink) output connected to the A and B input

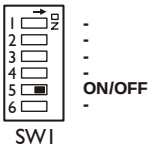


PNP (source) output connected to the A and B input



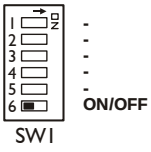
RS232 TxPD setup (only switch 5)

One of the motors connected to an RS232 line must have this switch set to "ON" but only at one !.



RS485 Term. setup (only switch 6)

The last motors connected to an RS485 line must have this switch set to "ON" but only at one !.



4.2 Expansion Module MAC00-B1/B2/B4

4.2.18 Cables for the MAC00-B4

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

MAC00-B4 Connectors				Description	JVL Order no.	Picture
"IO" 8pin Male	"COM1" 8pin Female	"COM2" 5pin Female	"PWR" 5pin Male			
		X		RS232 Interface cable. Connects directly from MAC00-R4 to PC Length: 5m (197 inch)	**RS232-M12-1-5-5**	
			X	Cable (Ø5.5mm) with M12 **female** 5-pin connector loose wire ends 0.35mm² (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** 5-pin connector loose wire ends 0.35mm² (22AWG) and screen. See also type *RS232-M12-1-5-5*.	**WI1000-M12M5T05N**	
		X		Same as above but 20m (787 inch)	**WI1000-M12M5T20N**	
X				Cable with M12 **female** 8-pin connector loose wire ends 0.22mm² (24AWG) and screen. Length: 5m (197 inch)	**WI1000-M12F8T05N**	
X				Same as above but 20m (787 inch)	**WI1000-M12F8T20N**	
	X			Cable with M12 **male** 8-pin connector loose wire ends 0.22mm² (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).