E-T-A®
Circuit Protection & Control

PowerPlex® User Manual

Volume 2: Hardware Installation

Edition

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Qualified Personnel

The system may only be installed, connected and set up in conjunction with this documentation. Commissioning and operation of a device or system may only be performed by qualified personnel. Within the context of the safety notes in this documentation, qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Safety Instructions

Please follow the installation and adjustment instructions outlined in this manual carefully. Nonobservance may result in serious damage to the product or to your installation. E-T-A will not accept liability or warranty claims for issues caused by incorrect installation or handling by the customer or a third party.

About This Manual

The PowerPlex manual is intended for the professional boat electrician who wants to install and configure the E-T-A PowerPlex system for controlling the boat's electrical equipment.

We have divided the PowerPlex manual into three volumes to make handbook reading easy for you. You don't need to carry a bulky handbook around with you when working on the PowerPlex system. Depending on what you set out to do, whether you want to install the Powerplex hardware or rather define the system parameters using the Configuration Software, just consult the volume that describes the particular issue you are interested in.

Volume 1 **PowerPlex: System Description**

Here you find a general system overview, a description of the PowerPlex system architecture and a detailed explanation about the function of each PowerPlex system component. The Appendix contains background information which you may be interested in in connection with the principles of the PowerPlex system. It gives you a short introduction into CAN networking, and provides the technical data sheets of the main components, such as PowerPlex modules and circuit breakers.

Volume 2 **PowerPlex: Hardware Installation and Maintenance**

Volume 2 of the PowerPlex Manual Box gives you step-by-step instructions on how to install the system. Here you find out where and how to mount the DC Power Modules and the Panel Modules, how to wire them up, and how to connect the appliances and equipment you wish to control. The final chapter summarizes the installation instructions and provides you with a Quick Installation Guide.

Volume 3 **PowerPlex: System Setup and Configuration**

Volume 3 describes the PowerPlex Configuration Software and gives you step-by-step instructions on how to set up your PowerPlex system once the hardware has been properly installed. We take you through all the dialog boxes and menus of the software and create a configuration example. This example configuration shall be loaded into the PowerPlex hardware and tested. A separate chapter is dedicated to special PowerPlex functions that allow you to create a highly sophisticated CAN bus based control system for the boat's entire electrical equipment.

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Conventions and Symbols Used in This Manual

Bold	Menu names and items, text you must select in the PowerPlex configuration software, such as menu items, buttons, and commands.
Italics	Words and characters you see on the screen when you are working with the PowerPlex configuration software. In some cases, italics are used to emphasize a new term or an important fact.
Numbered lists	indicate sequential steps for completing a procedure.
Note	Notes are displayed on a grey background.
Important	Information that is critical for successful application and understanding of the product is displayed on a pale blue background.
→	indicates the progression of menu choices you should select in the graphical user interface (GUI), such as File→Print

The symbols used throughout this manual have the following meanings:

Caution
In this situation, you might do something that could result in equipment damage or loss of data.

Warning
You are in a situation that could cause bodily injury. Before you work on any equipment, you must be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents.

Empty page for your notes:

1. Introduction

For a general description of the PowerPlex System and background information on CAN bus networks, please consult Volume 1 of the PowerPlex manual, "PowerPlex: System Description".

This manual contains installation and connection procedures for the hardware of the PowerPlex system. It tells you

- how to mount the PowerPlex modules
- how to connect the devices to be controlled by the PowerPlex system
- how to interconnect the individual modules of a PowerPlex system and integrate them in a CAN bus arrangement
- how to connect the PowerPlex system to the power supply
- how to connect the PowerPlex system to the computer running the configuration software
- how to replace a faulty PowerPlex module

You find a **quick installation guide** at the end of this manual.

2. E-T-A Scope of Delivery

Please check the equipment you have received to make sure that the delivery is complete. To install and set up a new PowerPlex system you will need the following hardware components.

E-T-A scope of delivery

- one or more PowerPlex modules (e.g., DC Power Module, Panel Module, Touch-PC), inclusive of miniature circuit breakers type 1610 for 8 A and 25 A power outputs.
- CAN-USB converter cable, inclusive of driver software
  (cable with 9-pin D-SUB plug connector or RJ-45 (male) at one end and USB connector at the other).
- 9-pin D-SUB socket connector (female) to connect the CAN-USB converter to the CAN bus network and/or RJ-45 adapter cable to connect male 9-pin D-SUB connector into RJ-45 socket of the module.

In addition you are going to need CAN bus cables to connect the hardware modules to the bus. A number of manufacturers provide these standard cables. For information on typical cable characteristics, please consult section 6.1 of this manual.

3. PowerPlex Module Types: DC Power Module and Panel Module

You will probably have ordered and received two different types of PowerPlex modules:

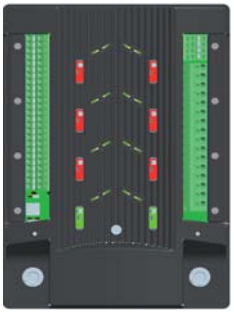
- Panel Modules
- DC Power Modules

Unless requested otherwise, all modules will be delivered complete with their snap-on covers mounted and all miniature circuit breakers fitted. The circuit breakers provide enhanced load protection against overload and short circuits.

3.1 How to Distinguish One from the Other

Design and size of both module types are absolutely identical. But you can easily distinguish one module type from the other by looking at their circuit breakers.

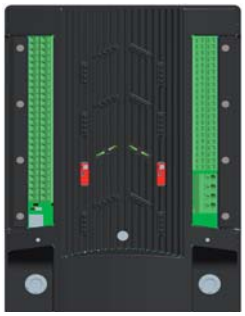
DC Power Module



A total of 8 mcbs:

6x 10 A (red) for 8 A loads,
2x 30 A (green) for 25 A loads

Panel Module



A total of 2 mcbs:

2 x 10 A (red) for 8 A loads

Figure 1: DC Power and Panel Modules: How to distinguish one from the other

Note:

One PowerPlex system may comprise up to 30 PowerPlex modules of mixed types.

3.2 Miniature Circuit Breakers in PowerPlex Modules

Depending on the maximum rated current of the module's power outputs, the modules are equipped with miniature circuit breakers of different current ratings.

DC Power Module **Panel Module**

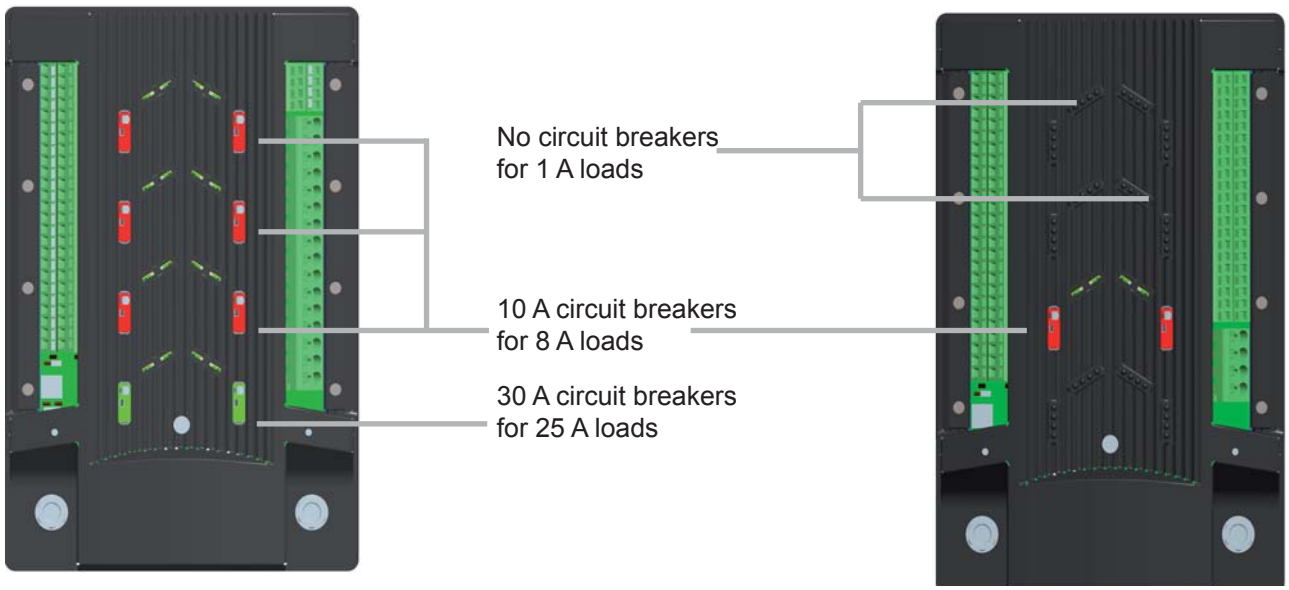


Figure 2: Miniature circuit breakers type 1610 in PowerPlex modules

3.3 Circuit Breaker Identification on the Modules

To be able to clearly identify the circuit breakers inserted in the module and assigned to a particular power output, these circuit breakers are numbered.

DC Power Module

The circuit breakers for the 8 A loads are numbered from 1 to 8 as shown below. The circuit breakers for the two 25 A loads are numbered from 1 to 2.

Panel Module

On the Panel Module, only the higher rated 8 A power outputs are equipped with circuit breakers. No circuit breakers for the 1 A loads.

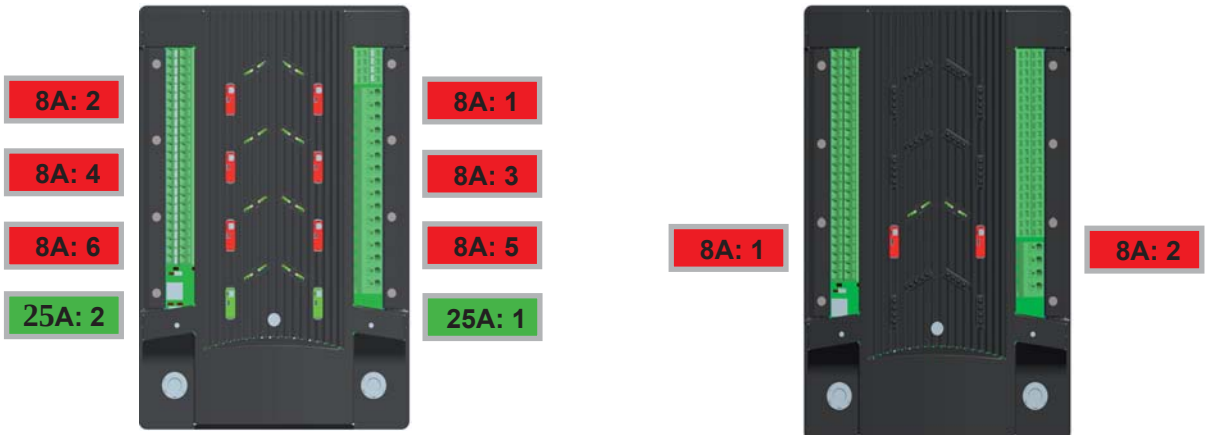


Figure 3: Circuit breaker identification on the modules

4. How to Install the PowerPlex Modules

4.1 Recommended Module Location

DC Power Module: in the vicinity of the loads to be controlled (pumps, motors, ..

Panel Module: near the control panel in the helm area

Important:

- Allow sufficient space for heat dissipation.
- Be sure not to install the modules in confined spaces.

Figure 4 illustrates a typical distribution of DC Power and Panel Modules. Here, the higher switching capacity of the DC Power Modules is applied in the anchor winch area, for bilge pumps and the shower/WC area of the accommodation rooms, just to give you an example.

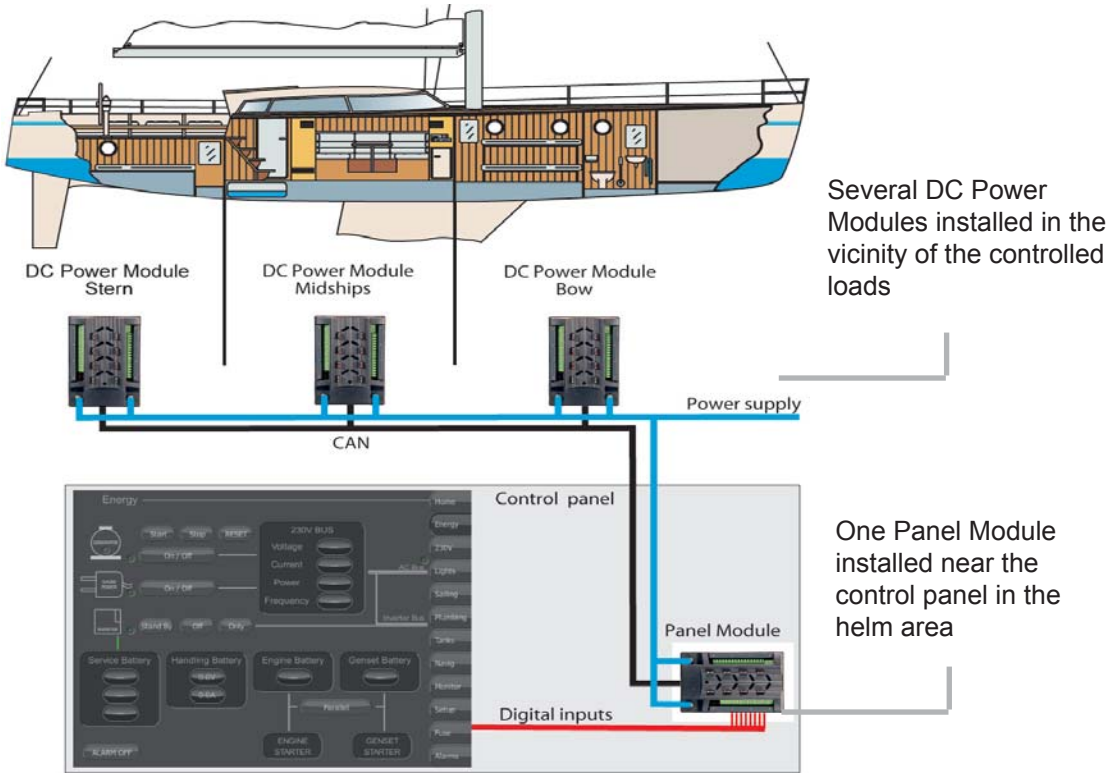


Figure 4: Typical placement of DC Power and Panel Modules

4.2 Noting the Module Serial Numbers

Before you actually mount the PowerPlex modules, we recommend you make a note of all serial numbers and keep a list of which module with which serial number you mount where.

You find the serial number label on the module body, underneath the bottom face. So, to see the serial number, remove the module's snap-on cover by clicking the cover's bottom handle towards you and then pulling off the cover. The serial number comprises 7 digits preceded by the letter D or P indicating the module type.

Later on, when you are going to configure and define the modules' role in the CAN network, you will have to make the association between serial number, CAN bus address and mounting position on the boat.

We recommend using the CAN bus address labels 1 to 30 provided and fix them to the upper right corner of the module covers to keep track of module identification. For details on the recommended circuit and address labels, please consult the module data sheets.

Figure 5: Labelling the CAN bus address on the module

4.3 Mounting the Module

PowerPlex modules are intended for wall-mounting. Use the wall mounting bracket provided to fix the module to the wall.

Figure 6: Wall mounting bracket

Figure 7: Location of module fixing screw

Step	Action
1	Mark the position for the wall mounting bracket and drill and plug the wall.
2	Fix the wall mounting bracket with the screws included in the delivery.
3	Slide the module onto the bracket and fix it by inserting and tightening the screw in the lower part of the module.

Note:

Protection class IP22 requires that the PowerPlex module is mounted vertically with the M8 power supply terminals facing down (→ Figure 8).

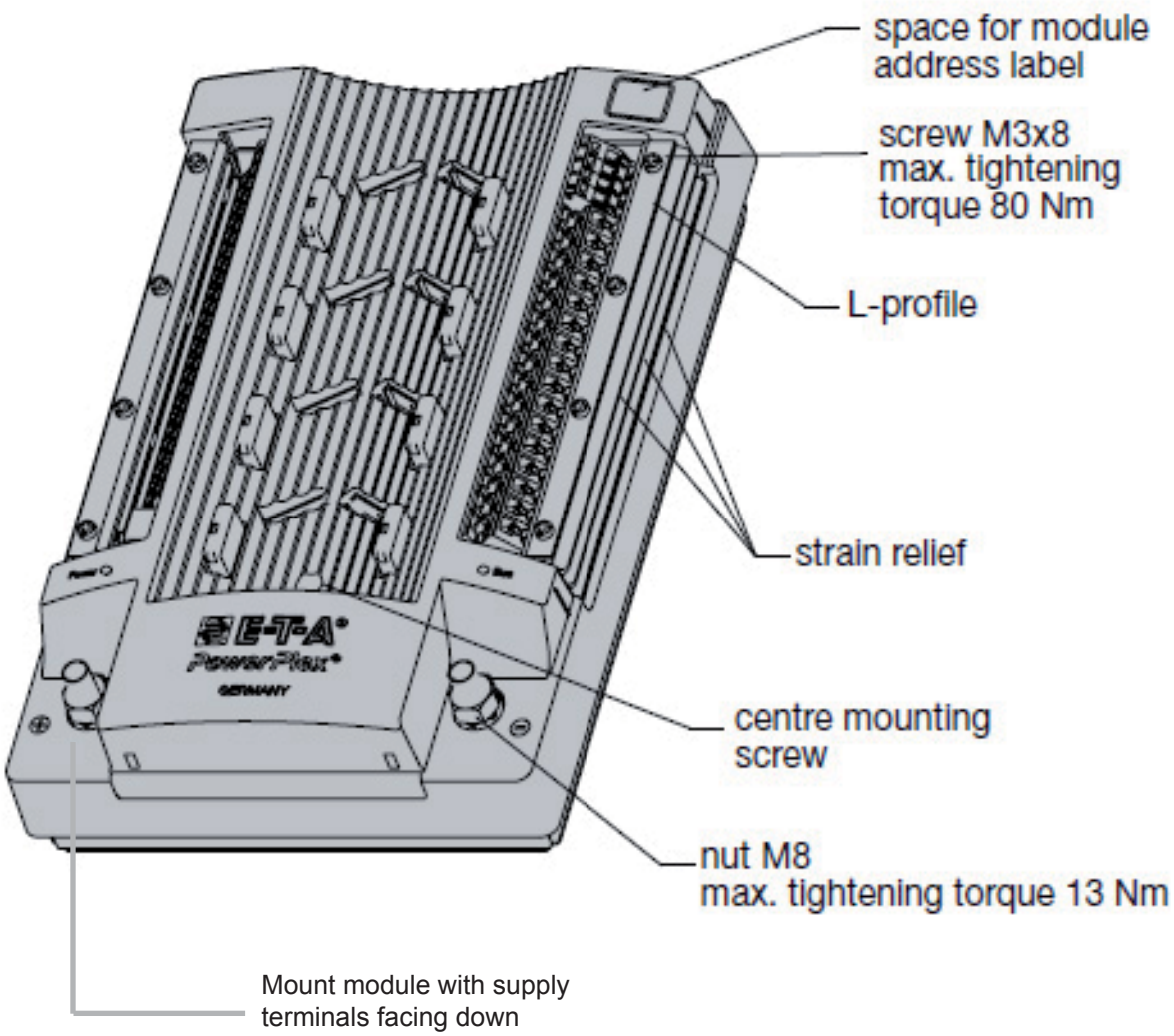


Figure 8: PowerPlex module, mounted vertically

5. How to Connect the Input / Output Devices

Important:

To avoid accidental short circuits, make sure that the module is disconnected from the power supply before you make any connections.

Step	Action
1	Remove the snap-on cover to gain access to the terminals: place a finger in the recessed grip located on the cover's bottom edge, and push the cover upwards a little and then take it off.
2	Remove the strain reliefs, which also serve as seals.
3	Connect the cables of all input / output devices to the corresponding cage clamp terminals. (→ sections 5.1 and 5.2 for more details on the available I/O terminals and interfaces of the DC Power Module and the Panel Module, respectively).
4	Connect the CAN-H and CAN-L cables (→ chapter 7“).
5	Refit the strain reliefs/rubber seals, insert the end brackets and tighten the screws.
6	Connect the module to the voltage supply, observing correct polarity. (→ chapter 8**).**

Note:

Inductive loads, such as motors, require a freewheeling diode at the module's power output in order to suppress flyback, i.e. sudden voltage spikes generated across inductive loads when they are switched off.

5.1 DC Power Module: Terminal Blocks

The terminal block on the module's left comprises 25 double-level terminals for cage clamp connection for 1.5 mm² cables. They are labelled as follows:

Pin	Bottom Terminal Row 1.5 mm²	Top Terminal Row 1.5 mm²
	8 signal outputs 24V (Lx) + 0V return (LR)	8 **S**witch inputs 24V (Sx) + 0V return (SR)
1 2 3 3 . . . 16	L1 LR L2 LR L3 LR ... L8 LR	S1 SR S2 SR S3 SR ... S8 SR
	2 Analog inputs: 0...10V (Ax) + 0V return (AR)	2 Analog inputs: 0...10V (Ax) + 0V return (AR)
17 18 19 20	A1 AR A2 AR	A3 AR A4 AR
	RS232 serial interface (currently not used)	RS232 serial interface (currently not used)
21 22	GND	TX RX
	3 CAN Bus cable terminals (Low, High, Shield) to previous module	3 CAN Bus cable terminals (Low, High, Shield) to next module
23 24 25	CL CH CS	CL CH CS

Table 1: DC Power Module: Terminal designation of left-hand terminal block

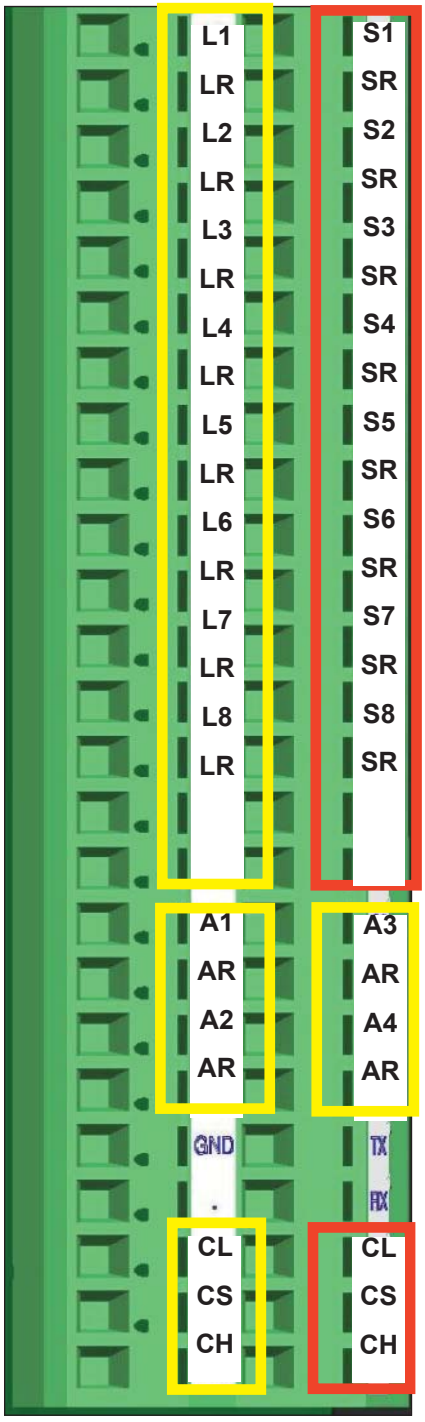
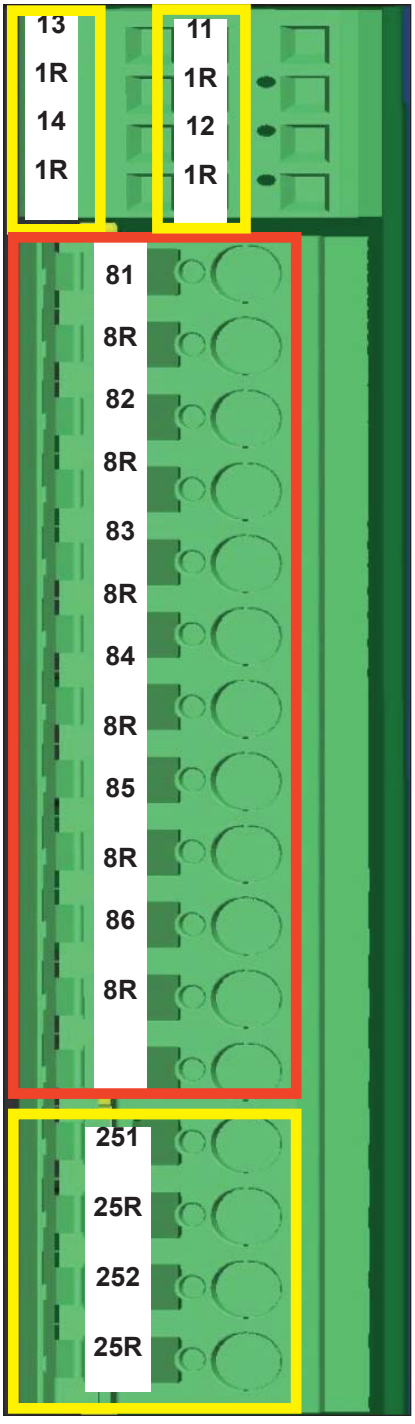


Figure 9: DC Power Module: Terminal block on the left, without snap-on cover

The terminal block on the module's right comprises 4 double-level terminals for 1.5 mm² cables and 16 single-level terminals for 4 mm² cables, both for cage clamp connection. They are labelled as follows:



Pin	Top Terminal Row 1.5 mm²	Bottom Terminal Row 1.5 mm²
	2 Power outputs 1 A 24V (1x) + 0V return (1R)	2 Power outputs 1 A 24V (1x) + 0V return (1R)
1 2 3 4	13 1R 14 1R	11 1R 12 1R

Pin	Single Terminal Row 4 mm²
	6 Power outputs 8 A 24 V (8x) + 0 V return (8R)
5	81
6	8R
7	82
8	8R
9	83
10	8R
11	84.
12	8R
13	85
14	8R
15	86
16	8R
	2 Power outputs 25 A 24 V (2x) + 0 V return (25R)
17	251
18	25R
19	252
20	25R

Figure 10: DC Power Module: Terminal block on the right, without snap-on cover

- DC Power Module: Terminal designation of right-hand terminal block

5.2 Panel Module: Terminal Blocks

The terminal block on the module's left comprises 26 double-level terminals for cage clamp connection for 1.5 mm² cables. They are labelled as follows:

Pin	Bottom Terminal Row 1.5 mm²	Top Terminal Row 1.5 mm²
	1 0V return line SR + 16 Switch inputs Sx	1 0V return line SR + 16 Switch inputs Sx
1 2 3 4 5 6. . 17	SR S1 S2 S3 S4 S5 ... S15 S16	SR S17 S18 S19 S20 S21 ... S31 S32
	2 Analog inputs: 0...10V (Ax) + 0V return (AR)	2 Analog inputs: 0...10V (Ax) + 0V return (AR)
18 19 20 21	A1 AR A2 AR	A3 AR A4 AR
	RS232 serial interface (currently not used)	RS232 serial interface (currently not used)
22 23	GND	TX RX
	3 CAN Bus cable terminals (Low, High, Shield) to previous module	3 CAN bus cable terminals (Low, High, Shield) to next module
24 25 26	CL CH CS	CL CH CS

Table 2: Panel Module:
Terminal designation of left-hand terminal block

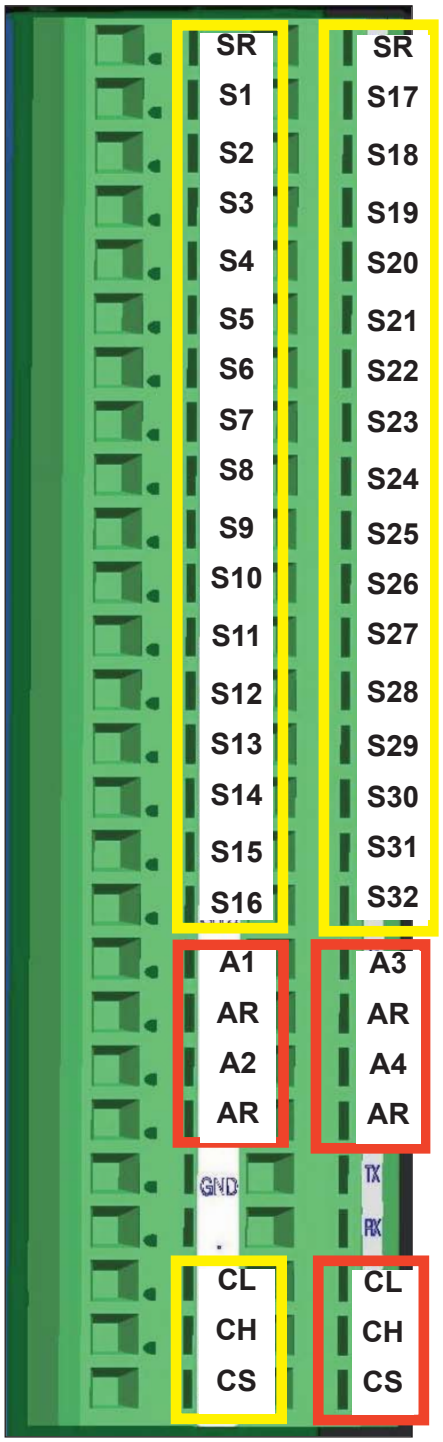


Figure 11: Panel Module:
Terminal block on the left, without snap-on cover

The terminal block on the module's right comprises 21 double-level terminals for 1.5 mm² cables, and 4 single-level terminals for 4.0 mm² cables, both for cage clamp connection. They are labelled as follows:

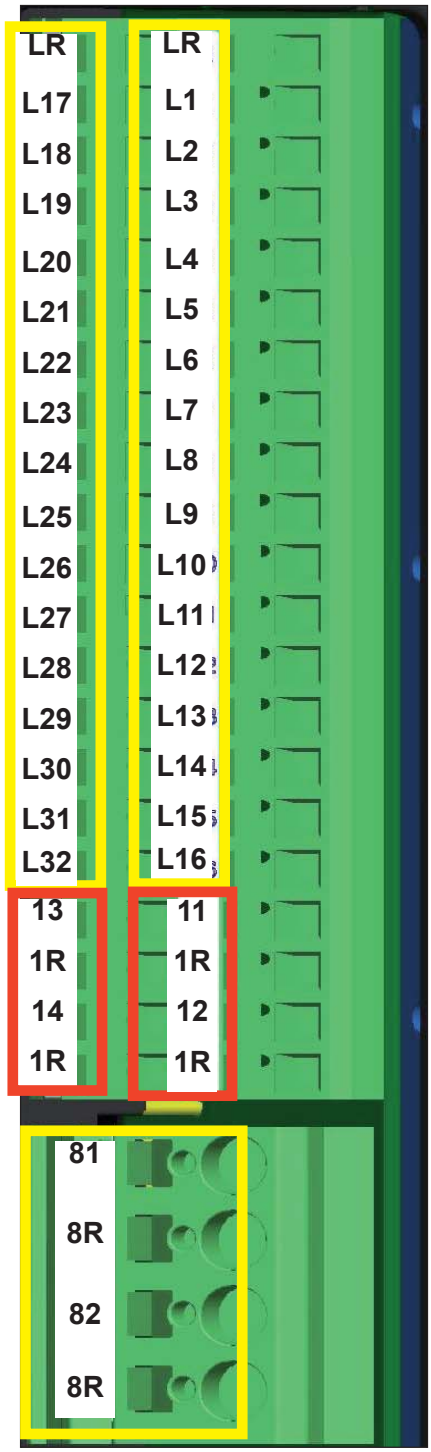


Figure 12: Panel Module:
Terminal block on the right, without snap-on cover

Pin	Top Terminal Row 1.5 mm²	Bottom Terminal Row 1.5 mm²
	1 0V return line LR + 16 signal outputs Lx	1 0V return line LR + 16 signal outputs
1 2 3 4 5 6 . . 17	LR L17 L18 L19 L20 L21 ... L31 L32	LR L1 L2 L3 L4 L5 ... L15 L16
	2 Power outputs 1 A 24V (1x) + 0V return (1R)	2 Power outputs 1 A 24V (1x) + 0V return (1R)
18 19 20 21	13 1R 14 1R	11 1R 12 1R

Pin	Single Terminal Row 4 mm²
	2 Power outputs 8 A 24 V (8x) + 0 V return (8R)
22	81
23	8R
24	82
25	8R

Table 3: Panel Module:
Terminal designation of right-hand terminal block

5.3 Inputs and Outputs of the PowerPlex Modules

I / O	Qty. per Module DC Power / Panel	Description
Output: 8 A max.	6 / 2	• Connection of electrical loads with a maximum permanent current of 8 A • Tolerated inrush current: 40 A max • 10-step PWM dimming, 100 Hz • Programmable overcurrent protection 1 A...8 A and tripping time • Wire break detection • Timing functions
Output: 25 A max.	2 / 0	• Connection of electrical loads with a maximum permanent current of 25 A • Tolerated inrush current: 40 A max • Dimming in 10 steps with 100 Hz PWM • Programmable overcurrent protection 4 A...25 A and tripping time • Wire break detection • Timing functions
Output: 1 A max.	4 / 4	• Connection of electrical loads with a maximum permanent current of 1 A
Signal output	8 / 32	• Connection of loads whose status you wish to monitor and indicate • 5V supply via 150 Ω serial resistor allows direct connection of the LEDs without additional resistors • Outputs can be assigned to optocouplers for AC switching • LED outputs can be dimmed to night mode
Switch input	8 / 32	• Connection to electrical switch contacts • Inputs must be connectd to ground to activate an ON message (ground connection via SR terminal)
Analog input	4 / 4	• AD conversion for analog inputs 0…10 V • Switching function with programmable threshold • Max. voltage: 32 V, range: 0…10 V • 10-bit resolution (10 mV) • Input resistance: 40 kΩ

Table 4: Inputs and outputs of the PowerPlex Modules

5.4 Cage Clamp Terminals

PowerPlex modules offer screwless cage clamp terminals for standard terminal connection. This method of connecting I/O equipment to the control modules, such as pump drives, lamps, motors, switches, pushbuttons, sensors, and so on, requires very little preparation of the wire and no special tools.

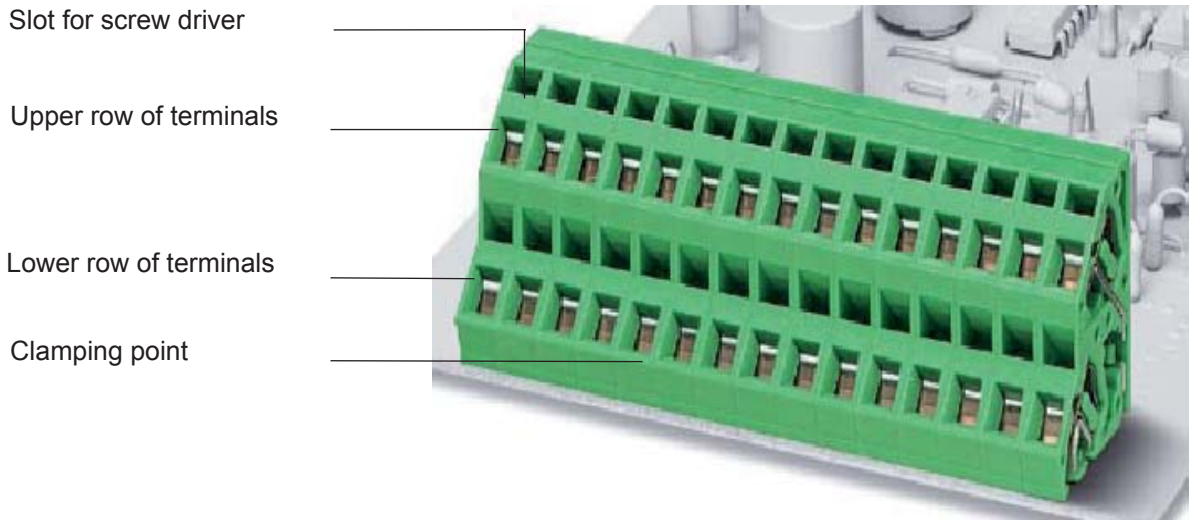


Figure 13: Cage clamp terminal block with two rows of terminals

5.4.1 How to Connect a Conductor to the Cage Clamp Terminal Block

Step	Action
1	Push the screw driver blade into the upper aperture; the spring opens.
2	The screw driver holds the spring open; insert the wire.
3	Remove the screw driver; the spring closes and the wire is securely clamped.

To remove a conductor from a cage clamp terminal slot, simply open the clamp by inserting the screw driver, and pull out the conductor.

Note:

Some of the cage clamp terminal blocks provide only one row of terminals. These single-row terminal blocks are used for the higher-rated outputs of 8 A and 25 A.

6. Input / Output Applications: Examples

6.1 Connecting a Switch to a Switch Input

Connect the switch directly to the Sx and return path SR terminals of the PowerPlex module as shown below.

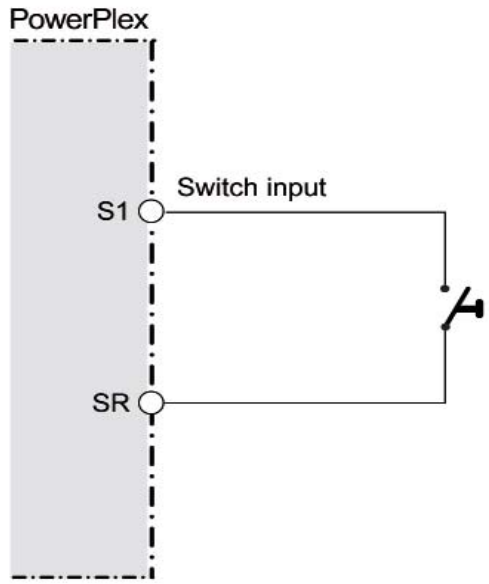


Figure 14: Connecting a switch to a switch input

6.2 Connecting Inductive Loads (Relays, Motors, Coils) to a Power Output

When a strongly inductive load such as an electric motor is switched off, the current cannot drop instantaneously to zero; a spark will jump across the opening contacts due to sudden voltage spikes. To eliminate this flyback voltage, connect a freewheeling diode in parallel to the output terminals.

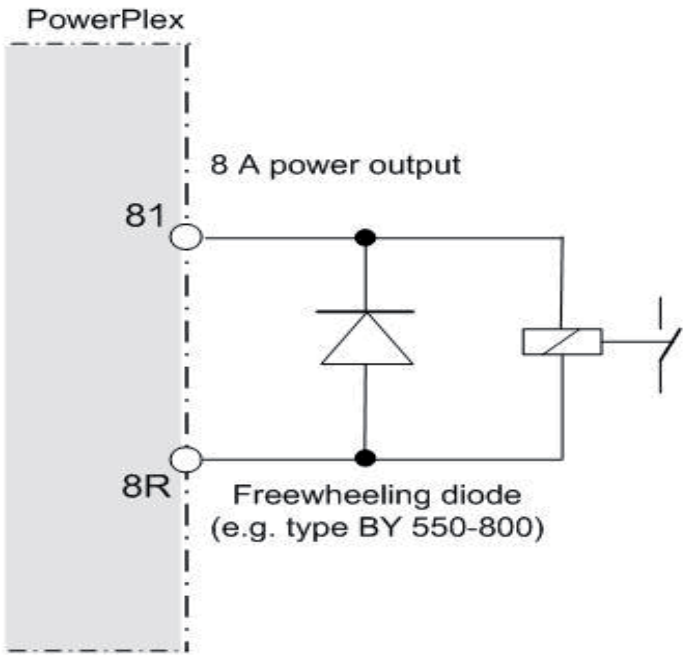


Figure 15: Connecting inductive loads using a freewheeling diode

6.3 Changing a Motor's Rotational Direction Using Two Relays

Using the same method as above, i.e. connecting a freewheeling diode across the power output, you may control two relays by two power outputs, each relay being responsible for one direction of a motor.

Depending on the output signals typically controlled by a Forward / Reverse switch input, one of the two relays is energized and moves the motor into the forward or reverse direction, whichever applies.

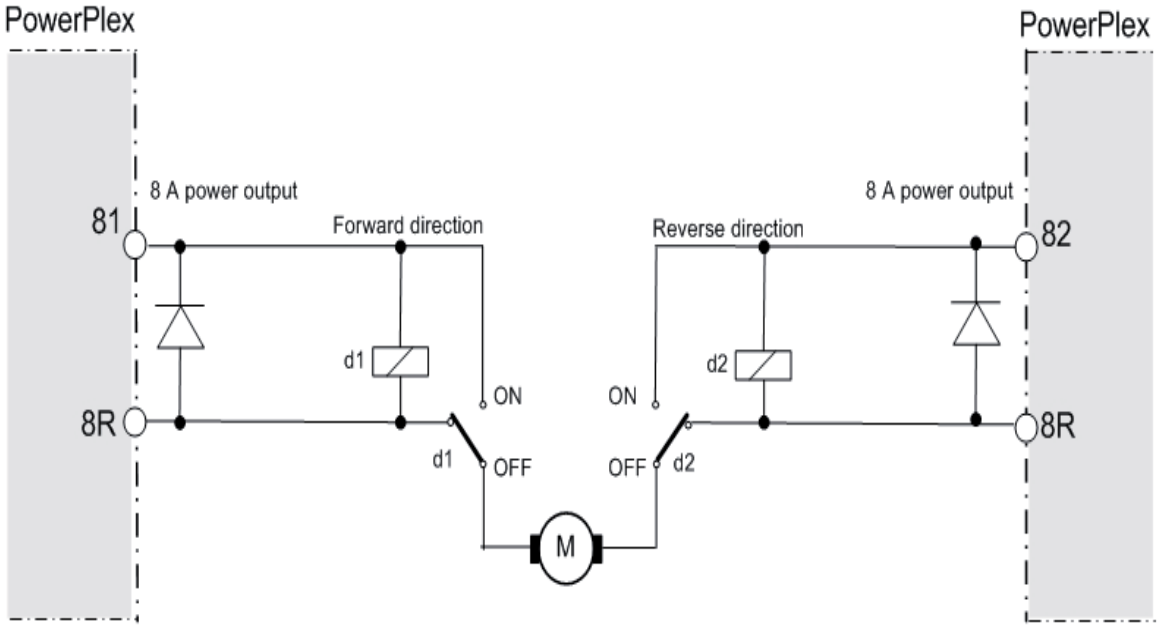


Figure 16: Forward / reverse motor direction using two power outputs, two relays and freewheeling diodes

6.4 Using Signal Outputs for the Switching of Loads

The modules' signal outputs type L1/LR, L2/LR ... are provided with an internal resistance of 150 Ω and a protection diode with 0.5 V forward voltage, both connected in series with the output signal. The ON voltage is 5 V.

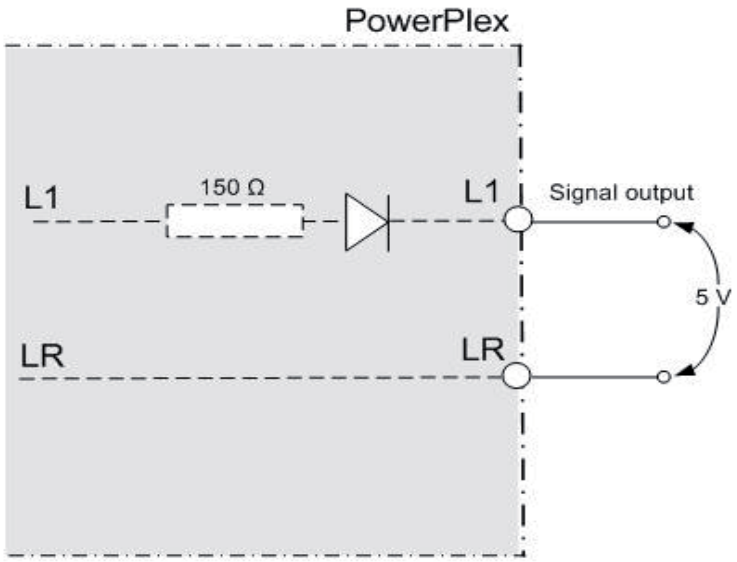


Figure 17: Signal output Lx / LR with internal resistance and protective diode

Being protected by an internal current limiting 150 Ω resistor and a diode, signal outputs, originally intended for signal indication, may also be used for the switching of loads. To provide the necessary electrical isolation, connect an opto-decoupled relay across the output and use this relay for direct load control.

The Phoenix Contact relay type PLC-OSC-5DC/24DC/2ACT (article no. 2980144), for instance, is capable of switching loads with a continuous current rating of 3 A and offers a 2-conductor floating output circuit.

Note:

Make sure to disable the night mode dimming function on those modules whose signal outputs are used for switching loads by means of an optocoupling interface.

6.5 Converting a 0...10V Analog Input to a 0...20 mA Interface

Connecting a 500 Ω resistor across the two analog input terminals Ax and AR converts the 0...10 V voltage interface to a 0...20 mA current loop interface.

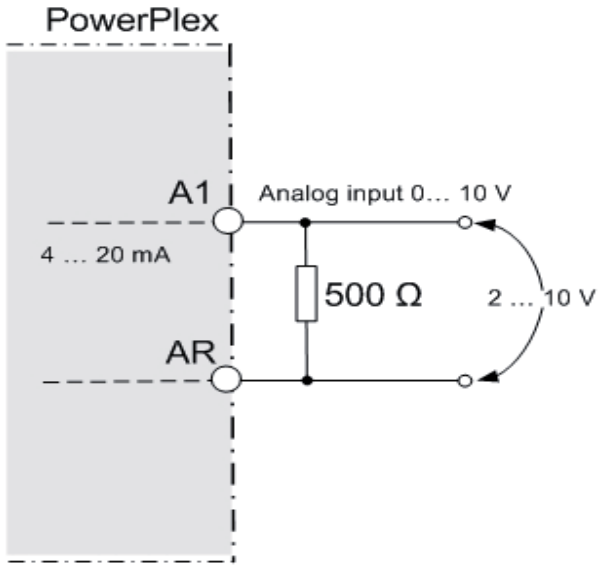


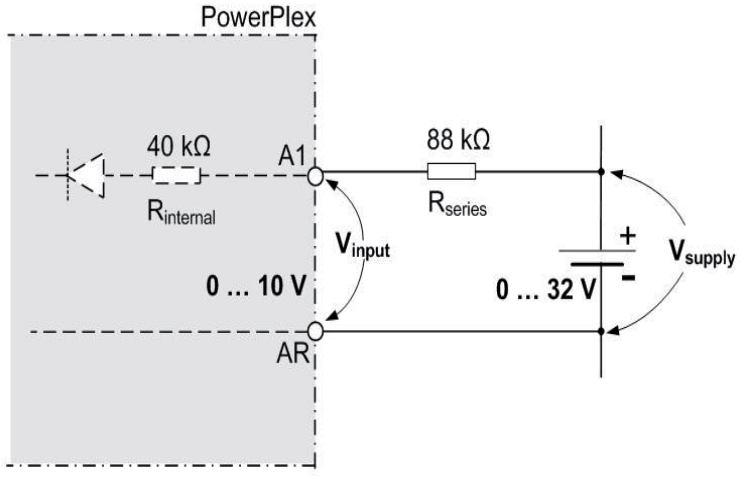
Figure 18: 4 ... 20 mA current loop input using a 500 Ω resistor

6.6 Battery Voltage Monitoring Using Analog Inputs

The operating voltage of the PowerPlex modules ranges from 9 V to 32 V d.c. The system is typically operated at 12 V d.c. or 24 V d.c. You may use the analog inputs of the PowerPlex system for measuring and monitoring the battery that supplies the system voltage.

6.6.1 24 V Systems

To measure and monitor the 24 V battery providing a maximum voltage of 32 Volts, you will have to adjust the analog input circuit so as to make the 10 volt input "see" the maximum 32 volts of the battery. This means that, having a range from 0 to 10 V, the analog input must be capable of measuring a voltage range from 0 ... 32 V. To extend the measuring voltage range, connect an 88 kΩ resistor in series with the analog input as shown in Figure 19.



$$\frac{R_{internal}}{R_{series} + R_{internal}} \times V_{supply} = V_{input}$$

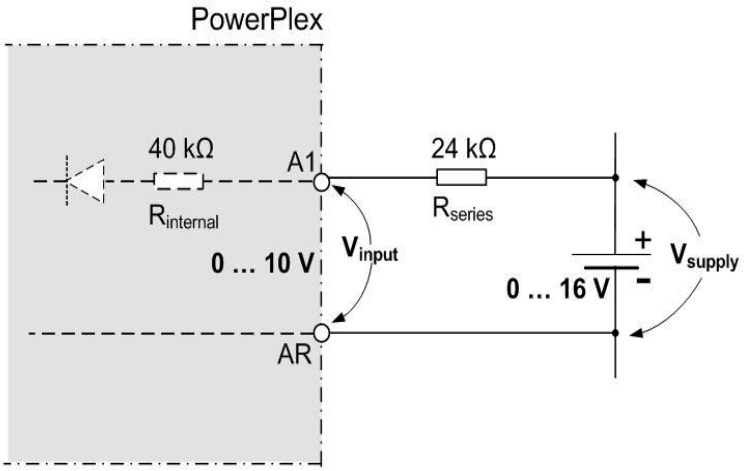
$$\frac{40\ k\Omega}{88\ k\Omega + 40\ k\Omega} \times 32\ V = 10\ V$$

Figure 19: 24 V supply voltage monitoring using an 88 kΩ series resistor

6.6.2 12 V Systems

To measure and monitor the 12 V battery providing a maximum voltage of 16 Volts, you will have to adjust the analog input circuit so as to make the 10 volt analog input "see" the maximum 16 volts of the battery. This means that, having a range from 0 to 10 V, the analog input must be capable of measuring a voltage range from 0 to 16 V.

To extend the measuring voltage range, connect a 24 kΩ resistor in series with the analog input as shown in Figure 20.



$$\frac{R_{internal}}{R_{series} + R_{internal}} \times V_{supply} = V_{input}$$

$$\frac{40\ k\Omega}{24\ k\Omega + 40\ k\Omega} \times 16\ V = 10\ V$$

Figure 20: 12 V supply voltage monitoring using a 24 kΩ series resistor

7. Integrating PowerPlex Modules in a CAN Bus Network

The next step after mounting the PowerPlex modules and connecting the I/O devices to the module terminals is to interlink the individual modules of the PowerPlex system over the CAN bus.

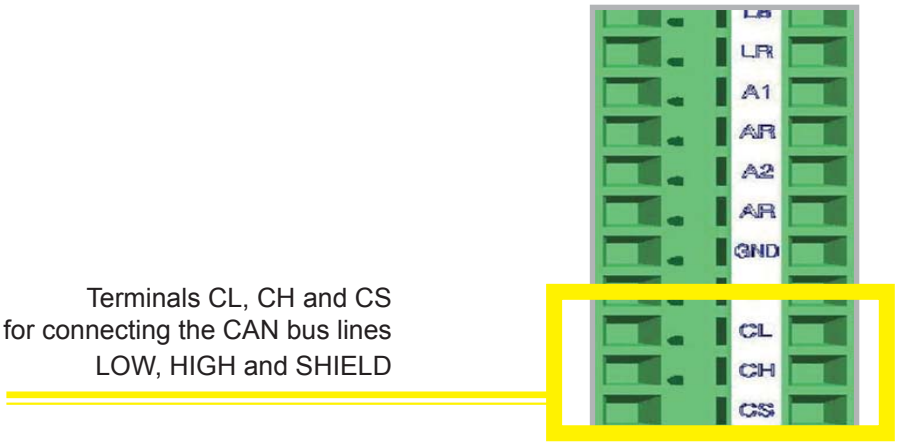


Figure 21: CAN bus terminals on the PowerPlex module

Within your PowerPlex system, you may arrange the two types of PowerPlex modules - the DC Power Module and the Panel Module - in any random order. This means that the Panel Module, of which you will probably install only one, does not require any specific position in the CAN bus system.

To build up the CAN bus network, connect one PowerPlex module to the other - the first module to the second, the second to the third, and so on - by connecting the CAN-H and CAN-L cables to the ingoing and outgoing CAN terminals of the PowerPlex modules (→ Figure 22).

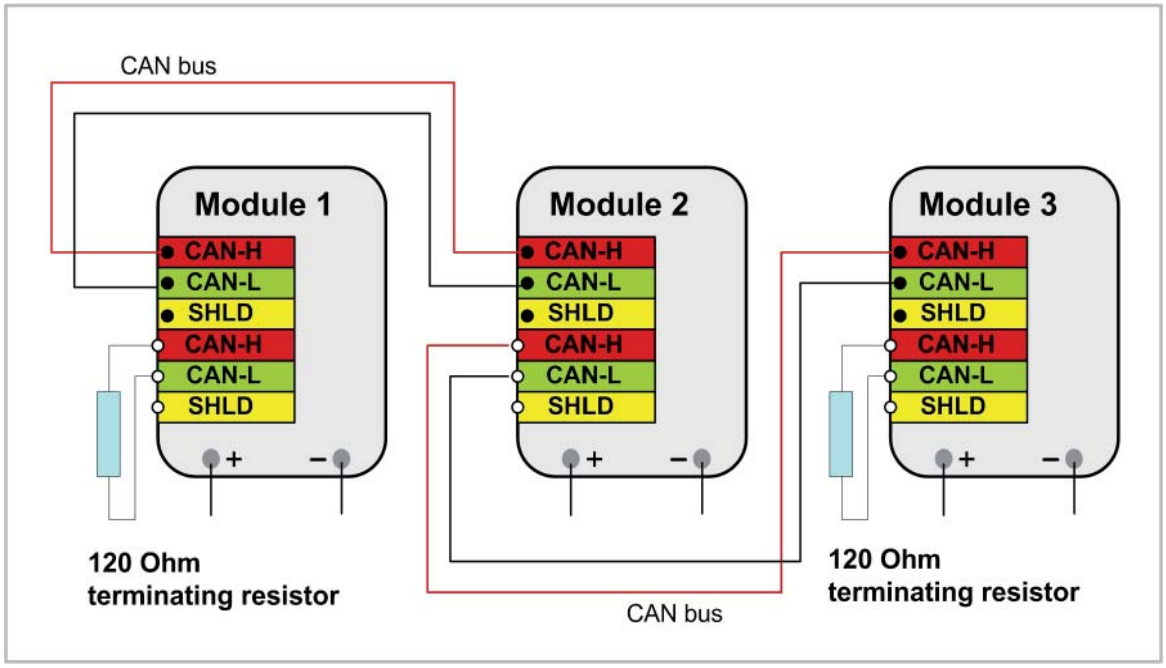


Figure 22: Connecting the PowerPlex modules in the CAN bus system

7.1 CAN Bus Cabling

A typical CAN bus cable is a twisted-pair cable comprising two wires CAN-H and CAN-L and the shield wire SHLD.

Table 6 lists the principal characteristics of the type of CAN bus cable to be used. The following specifications are those of a typical CAN bus cable, type CAN.BUS 1X2X0.50 HOC, as supplied by HELUKABEL (www.helukabel.de).

Mechanical Properties	
Inner conductor diameter	0.97 mm
Conductor nominal cross-sectional area	0.50 mm^2
Conductor material	copper, bare
Conductor class	class 2: stranded
Number of cores	2
Total shielding	CU braid, tinned
Core colours	CAN-High: white (wh) CAN-Low: brown (bn)
Cable external diameter	7.0 mm
Outer sheath colour	violet
Weight	69 kg /km
Min. bending radius	laying: 90 mm static: 48 mm
Operation temperature	-40 °C ... +70 °C
Electrical Properties	
Characteristic impedance	120 Ω
Conductor resistance	37 Ω / km max.
Insulation resistance	1 GΩ / km
Test voltage	1.5 kV
Other General Properties	
Resistance to ambient influences	UV, weather, oil, coolant and microbe resistant
Mechanical resistance	Abrasion and notch resistant, low adhesion
Chemical resistance	Acid and alkali resistant
Thermal resistance	Caloric load: 1.09 MJ / m

Table 5: Characteristics of recommended CAN bus cabling (example: HELUKABEL)

7.2 Terminating Resistor

The first and the last module in this serial CAN bus system are **not** connected to each other by a CAN-H and CAN-L line as the CAN network is of open bus topology; both ends of the CAN bus line must therefore be terminated with one 120 Ohm resistor each. A standard resistor or a plug with internal resistor can be used. Please note that this resistor is not part of the E-T-A PowerPlex delivery scope.

Figure 23: Terminating resistors, conventional and plug-type

Important:

The 120 Ohm resistors terminating the first and the last module of your PowerPlex system are vital for proper system operation.

7.3 Protection Against Interferences

To protect the PowerPlex system against interferences, the module's CAN interfaces offer two terminals for connecting the CAN cable shield.

- Always shield the entire length of the CAN bus cable.
- To prevent ground loops, connect the shield to ground at one end only.

Note:

Some of the cage clamp terminal blocks provide only one row of terminals. These single-row terminal blocks connect the higher-rated outputs of 8 A and 25 A.

8. Connecting PowerPlex to the Power Supply

You have build up your PowerPlex system by connecting the PowerPlex modules to each other using CAN bus cables. Next, connect PowerPlex to the power supply.

PowerPlex works on either DC 12 V or DC 24 V. To feed the d.c. voltage to the PowerPlex system, you can set up either a

- star connection (→ section 7.5), or a
- bus connection (→ section 7.6).

8.1 General Safety Instructions

Make sure that all electrical installations are carried out in compliance with EN ISO 10133 standards.

Always disconnect the battery before you start working on the electrical system.

8.2 Circuit Breaker Protection

We recommend the use of an E-T-A single-pole circuit breaker type 8345 for protecting the power supply secondary side, i.e. the (+) line going from the battery or busbar to the modules. The current rating of this circuit breaker should match the expected total current of all module outputs.

Note:

Use circuit breakers type 8345 rated at 125 A if the demand on the module outputs is likely to reach the maximum level, or if you plan to insert additional loads at a later stage. Install the circuit breakers as close as possible to the battery or busbar..

For detailed technical characteristics of the hydraulic-magnetic circuit breaker, please consult the data sheets in the Appendix of PowerPlex Manual, Volume 1, "System Description", or the download section of our homepage www.e-t-a.com.

8.3 Cable Cross Sections

The required cable cross section of the voltage supply line depends on the maximum rated current that will be transmitted in the PowerPlex system.

Maximum total current	Cross-sectional area
54 A	16 mm^2
72 A	25 mm^2
87 A	35 mm^2
105 A	50 mm^2
135 A	70 mm^2
165 A	95 mm^2
190 A	120 mm^2
220 A	190 mm^2

Table 6: Cable cross sections for different current ratings

Note:

You should use a minimum cable cross section of 50 mm^2 if the demand on the module outputs is likely to reach the maximum level or if you plan to insert additional consumers at a later stage.

8.4 How to Connect the Voltage Supply Cables

Step	Action
1	On the PowerPlex module, remove the snap-on cover for easier access to the M8 stud terminals: place a finger in the recessed grip located on the cover's bottom edge, push the cover upwards a little, and then take it off.
2	Remove the nuts from the two M8 power supply screw terminals.
3	Place the ring connectors over the terminal threads.
4	Refit the nuts and tighten them to a torque of 13 Nm.

8.5 Star Connection

A star connection should be the preferred method of supplying power to the PowerPlex modules. In this type of arrangement, every module connects directly to the battery with its own supply cable.

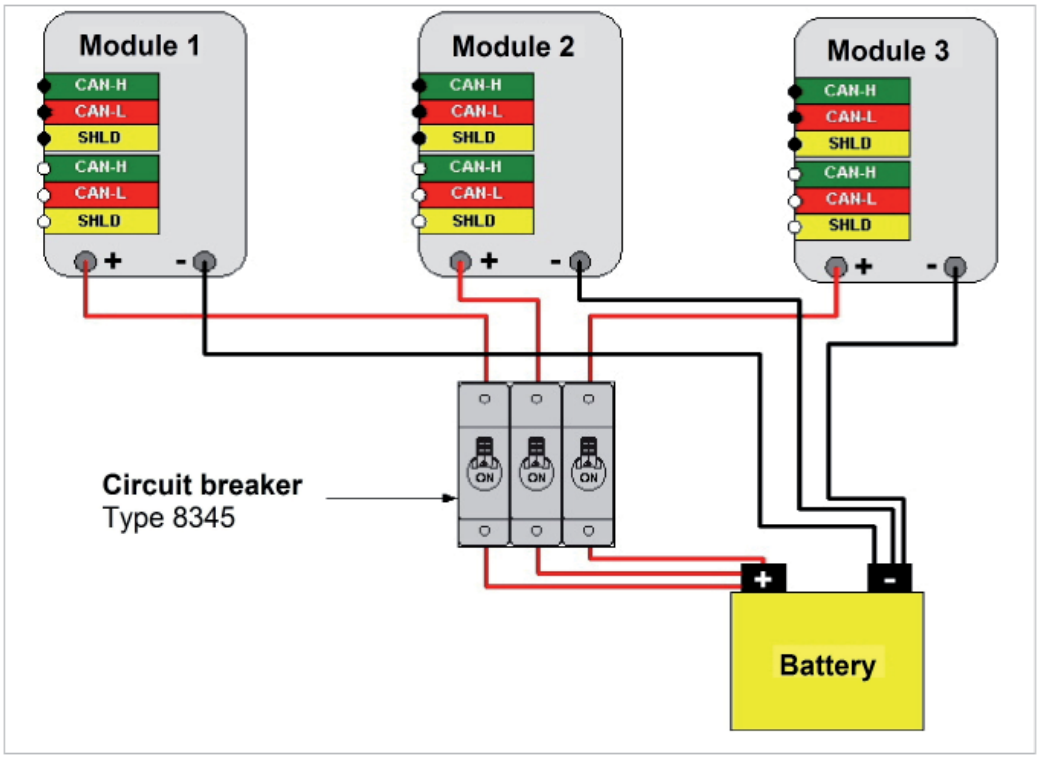


Figure 24: PowerPlex supply arranged as star connection

The (+) cables from the individual PowerPlex modules to the battery must be protected by circuit breakers with a rated current value above and as near as possible to the module's total current.

Important:

Avoid large differences between the lengths of the (+) and (-) cables.

For more detailed information on the required cable cross-sectional areas for different current ratings, please consult Table 7.

8.6 Bus Connection

In this type of supply arrangement, the PowerPlex system is connected to a common bus from which the individual modules are fed. An existing copper busbar or cable can be used for this purpose.

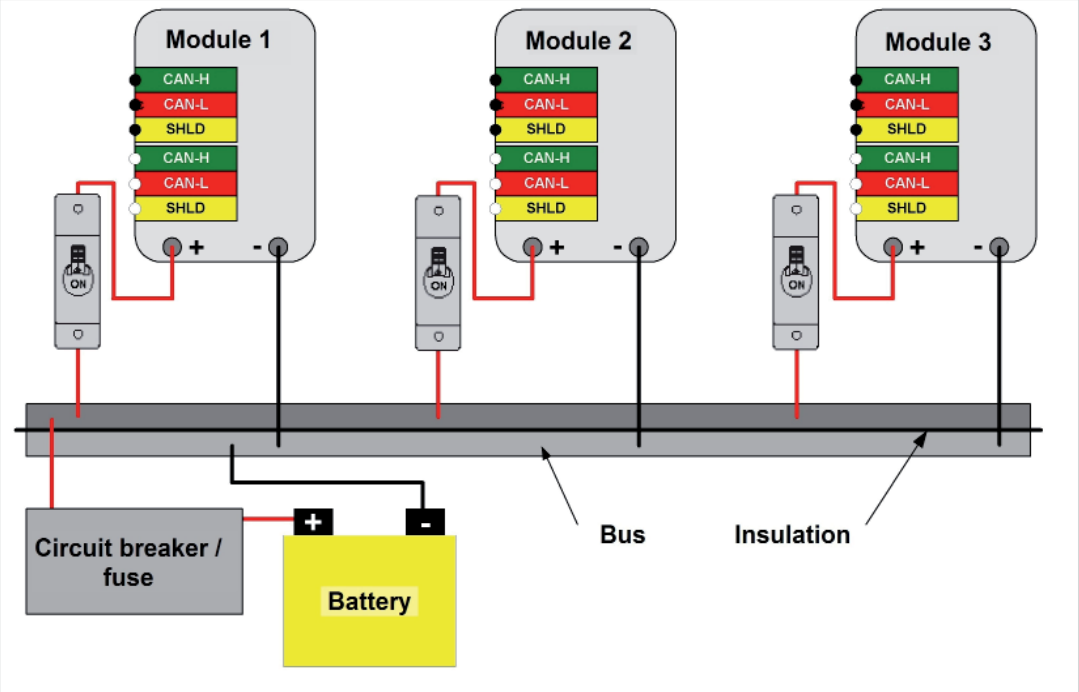


Figure 25: PowerPlex supply arranged as busbar connection

8.6.1 Bus Protection Using Circuit Breakers or Fuses

Overcurrent and short-circuit protection must be provided by using adequately rated circuit breakers or fuses taking into account the maximum total current of all modules:

Max. total current of all outputs	Type of protection
700 A max.	Several circuit breakers of type 8345 connected in parallel
Above 700 A	Fuse of adequate current rating

Table 7: Voltage supply, bus protection using circuit breakers or fuses

Note:

Install circuit breakers or fuses as near as possible to the battery or the central supply.

8.6.2 Making Use of an Existing Copper Busbar

If you feed the supply voltage over an existing copper busbar, connect each module with its own (+) and (-) cable to this bus. Circuit breakers must be installed between the battery and the bus, and between each module and the bus (→ Table 8).

The battery-to-bus and bus-to-module cables must be adequately dimensioned. For detailed information on the cross sections required, please refer to Table 7)

If a connection of the (-) cable to the copper busbar is not practicable, you have no alternative but to lay a suitable cable to the battery.

A ground return over the vessel's hull is not permitted!

8.6.3 Laying a New Cable

If you want to connect the PowerPlex modules to the power supply in a bus-type arrangement, and a copper busbar is not available, then you will have to lay a suitable cable.

Cable	Circuit breaker	Cable cross section
Bus	Maximum total current of all modules (n x I_{max})	See table 7
Between bus and module	Total current of module (I_{max})	See table 7

Table 8: Voltage supply, bus specifications

Note:

Install circuit breakers or fuses as near as possible to the battery or the central supply.

8.7 Power ON / Bus Active Indication on the Module

The semi-transparent snap-on covers for both types of modules are provided with the same LED displays and labelling:

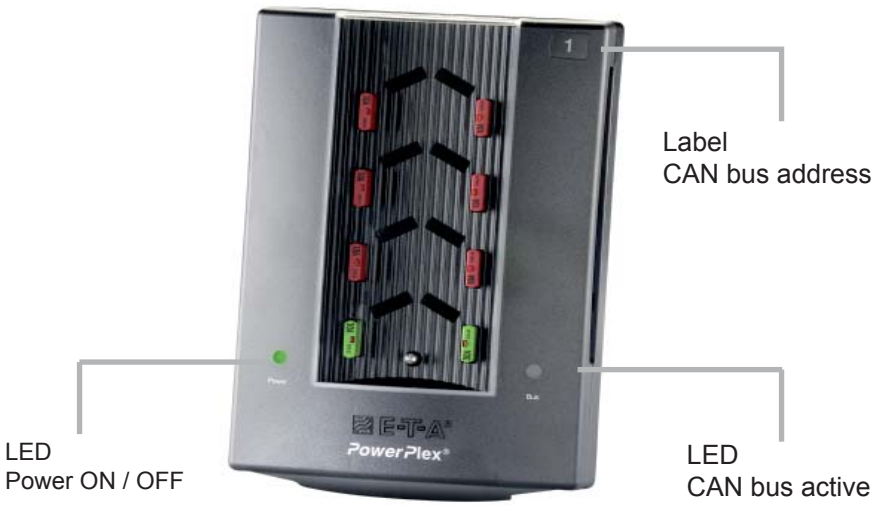


Figure 26: Display elements on the module cover

Display Element	Indication	Meaning	Comment
LED Power ON / OFF	Green slow flashing light LED extinguished	Module is powered up Module is without power	The Power LED blinks at a slower pace than the other indicators in the system. This is normal.
LED CAN bus active	Orange quick flashing light LED extinguished	CAN bus communication in progress No CAN bus communication	
Label CAN bus address	Adhesive label, to be fixed during installation	Module's CAN bus address in the range from 1 to 30	

Table 9: Display elements on the module snap-on cover

Note:

If the flashing frequency of the Power LED is as slow as 3 times per second, or if the Power LED and the BUS LED flash alternately, then the module is in an error state. Try to reconfigure the module by uploading its configuration. If this fails, the module needs to be replaced.

9. Connecting PowerPlex with the Configuration Computer

The installed PowerPlex system - a mixture of DC Power and Panel modules connected to each other over a CAN bus and connected to the power supply - must finally be connected to the computer running the PowerPlex configuration software.

You are going to use the Configuration software to assign bus addresses to the modules, and to define the role and switching response of each module. You will also have to connect your configuration PC whenever you want to modify the system and upload the changes from the computer into the PowerPlex hardware.

To connect your configuration computer to the hardware of the PowerPlex system and the CAN bus, you require the CAN-USB converter cable that is part of our delivery scope (Peak USB-CAN Converter). It establishes a connection between the computer's USB interface and the CAN bus socket of your PowerPlex system hardware.

The CAN-USB converter cable has a USB connector at one end and a 9-pin D-SUB plug connector (male) at the other. A corresponding 9-pin D-SUB socket (female) connector cable must be connected to the PowerPlex module. Both, the CAN-BUS converter and the socket cable, inclusive of the driver software, are part of the E-T-A PowerPlex delivery scope. For more details on these accessory items, please consult the module data sheets in the Appendix of Volume 1 of this manual, "PowerPlex: System Description".

Figure 27: CAN-USB converter (example: PEAK)

You may also use an RJ-45 adapter cable which connects the 9-pin SUB-D male connector of the CAN-USB converter cable directly to the RJ-45 socket of the PowerPlex module.

Note:

For step-by-step instructions on how to configure the characteristics of your PowerPlex system, please consult Volume 3 of this manual, "System Setup and Configuration".

9.1 Connecting the D-SUB Socket Connector to the PowerPlex System

You can choose between two nmethods of connecting the female 9-pin D-SUB connector to the PowerPlex hardware.

- connect the CAN-L and CAN-H conductors of the D-SUB socket (PIN 2 and PIN 7) to the corresponding terminals on the first or the last module of your PowerPlex system

  or

- connect the D-SUB socket between two PowerPlex modules using a junction box connector (one for each conductor)

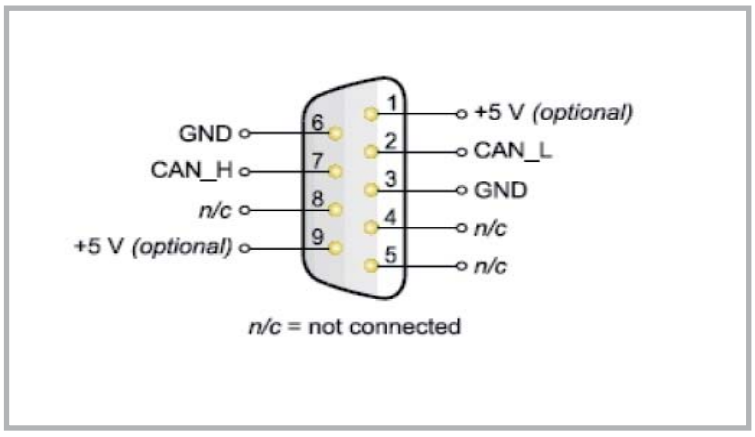


Figure 28: Pin assignment of the D-SUB socket connector

10. Replacing a Defective PowerPlex Module

Step	Action
1	Disconnect the PowerPlex system from the power supply. • Disconnect the battery • or operate the battery main switch.
2	Disconnect all cables from the cage clamp terminals of the defective module (→ section 5.4, for how to remove a conductor from the cage clamp terminal). **Tip:** Reconnection will be a lot easier if you place a wide enough strip of sticky tape across the conductors before disconnecting them from the cage clamp.
3	Remove the module from the wall mount bracket. • Undo the fixing screw in the lower part of the module. • Take the module off.
4	Fit the new module on to the wall mount bracket. • Place the new module on to the bracket. • Fix the new module by tightening the screw in the lower part of the module. **Attention:** The new module must be unconfigured, its CAN address should be 0". Always use brand new, unconfigured modules for replacement.
5	Connect all cables to the cage clamp terminals of the new module. (→ section 5.4, for how to connect a conductor to the cage clamp terminal). Make sure all cables are correctly assigned.
6	Reconnect the PowerPlex system to the power supply.

Note:

There is no need to configure the new module manually; this is done automatically by the neighbouring module which - in addition to its normal role - serves as a backup module (→ Volume 3, "System Setup and Configuration").

11. PowerPlex Hardware - Quick Installation Guide

Step	Action
1	• Make a note of the modules' serial numbers. • Keep a list of all modules, their serial numbers and their point of installation.
2	Choose a suitable location for the installation of the PowerPlex modules. • Allow sufficient space for heat dissipation. • Don't install PowerPlex modules in a confined space or near heaters, motors or windows.
3	Mount the modules on the wall. • Mark the position for the wall mount bracket and drill and plug the wall. • Fix the wall mount bracket with the screws included in the delivery. • Place the module on to the bracket and fix it by screwing in the single screw in the lower part of the module.
4	Connect the cables of the I/O devices (sensors, switches, indicators, lamps, etc.) to the module‘s cage clamp terminals (→ section 5.4).
5	Insert the circuit breakers if the module has not been preassembled. • Use circuit breakers type **1610 30 A** for the protection of the **25 A** load outputs, and circuit breakers type **1610 10 A** for the protection of the **8 A** load outputs. • Make sure to install the circuit breakers in the correct position (vertical plug-in slot for normal operation).
6	Connect the PowerPlex modules to the CAN cable (→ chapter 7).
7	Connect the PowerPlex system to the power supply (→ chapter 8).

12. Index