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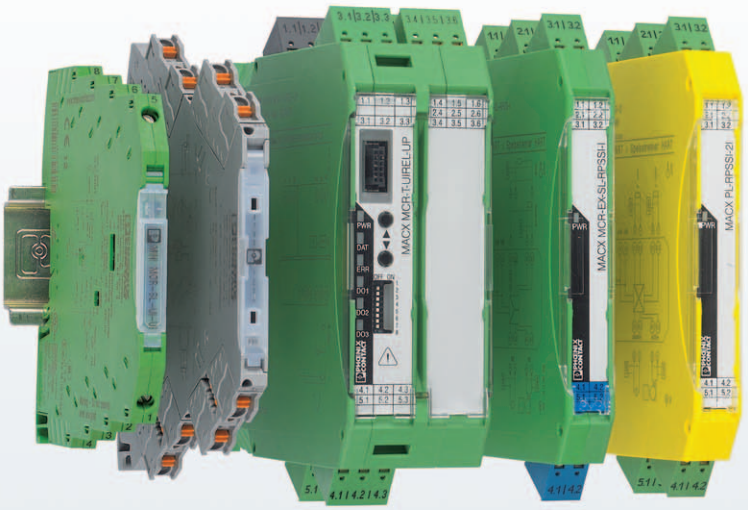


# Power manual for MACX Analog, MACX Analog Ex, MACX PL, MINI Analog, and MINI Analog Pro signal conditioners

User manual

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# User manual

## Power manual for MACX Analog, MACX Analog Ex, MACX PL, MINI Analog, and MINI Analog Pro signal conditioners

2017-02-09

Designation: UM EN Power Manual

Revision: 01

Order No.: —

This user manual is valid for:

| Designation | Order No. |
|---|---|
| MACX Analog MACX MCR-... product range | |
| MACX Analog Ex MACX MCR-EX-... product range | |
| MACX Safety MACX PL-... product range | |
| MINI Analog MINI MCR-... product range | |
| MINI Analog Pro MINI MCR-2-... product range | |
| ME 6,2 TBUS-2 1,5/5-ST-3,81 GN | 2869728 |
| ME 6,2 TBUS-2 1,5/5-ST-3,81 GY | 2695439 |
| MINI-SYS-PS-100-240AC/24DC/1.5 | 2866983 |
| MINI-PS-100-240AC/24DC/1.5/EX | 2866653 |



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# Please observe the following notes

### User group of this manual

The use of products described in this manual is oriented exclusively to:

– Qualified electricians or persons instructed by them, who are familiar with applicable standards and other regulations regarding electrical engineering and, in particular, the relevant safety concepts.
– Qualified application programmers and software engineers, who are familiar with the safety concepts of automation technology and applicable standards.

### Explanation of symbols used and signal words

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety measures that follow this symbol to avoid possible injury or death.

There are three different categories of personal injury that are indicated with a signal word.

**DANGER** This indicates a hazardous situation which, if not avoided, will result in death or serious injury.

**WARNING** This indicates a hazardous situation which, if not avoided, could result in death or serious injury.

**CAUTION** This indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

This symbol together with the signal word **NOTE** and the accompanying text alert the reader to a situation which may cause damage or malfunction to the device, hardware/software, or surrounding property.

This symbol and the accompanying text provide the reader with additional information or refer to detailed sources of information.

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# 1 General notes on the supply of Phoenix Contact signal conditioners

Observe the package slips for the relevant products.

**NOTE:**
When using the DIN rail connector, you may only connect one SELV or PELV circuit to the supply terminals of the modules.

All active signal conditioners from Phoenix Contact can either be supplied directly via terminal blocks on the module or wired individually. Wiring each individual module is very time-consuming and costly, especially when dealing with large quantities of signal conditioners that are mounted side by side on the DIN rail. This is why, depending on the signal conditioners used and the supply options, Phoenix Contact offers the option of supplying a complete standard DIN rail fitted with signal conditioners via a single power terminal block by means of the TBUS DIN rail connector. Time-consuming and error-prone wiring of single wires is therefore eliminated. The supply in the DIN rail connector can be implemented as follows:

- Direct DC supply at any Analog module in the group
- Supply via a power terminal block of the same shape
- Supply via any other MACX Analog, MINI Analog or MINI Analog Pro power terminal block
- Supply via a system power supply with 85 V AC … 264 V AC wide range input

All of the power supply methods for MINI Analog, MINI Analog Pro, and MACX Analog (Ex) modules presented in this user manual are compatible with one another. This means, for example, that as long as the marginal conditions presented in the individual sections are met, a MINI MCR-2-PTB power terminal block can also be used to supply MACX Analog modules. In addition, if these conditions are met, a combination of different product ranges can be mounted on a DIN rail.



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## 1.1 Direct DC supply at any Analog module in the group

This method of supply is particularly suitable when you only need to supply a small number of signal conditioners (around two to eight) and fault monitoring is not required.

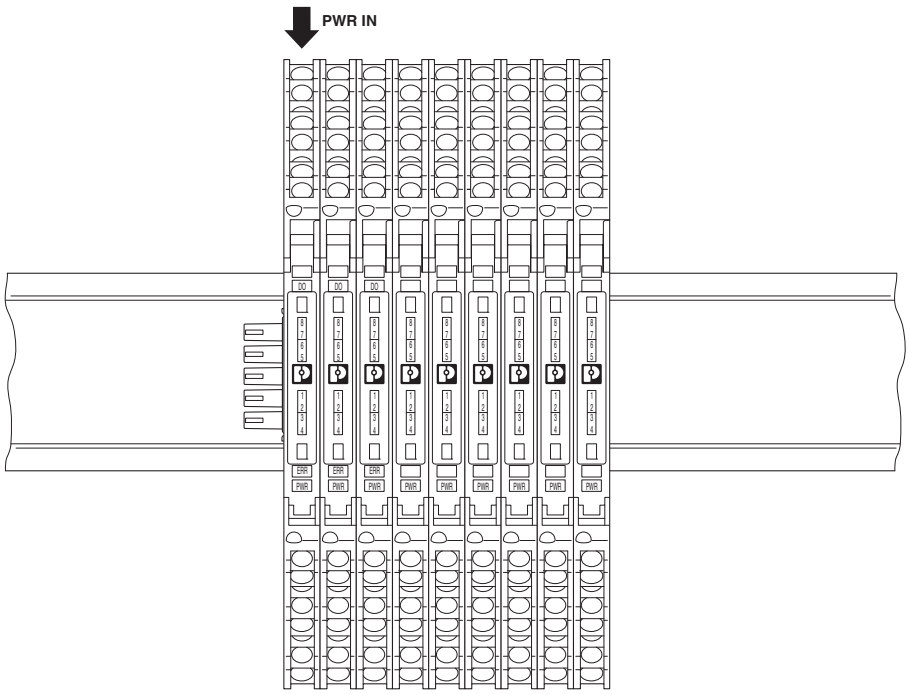


Figure 1-1 Direct supply via any module, e.g., MINI Analog Pro



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## 1.2 Supply via a power terminal block of the same shape

This option is particularly suitable when dealing with larger quantities of signal conditioners mounted side by side, e.g., in new installations. In addition, fault monitoring can be implemented.

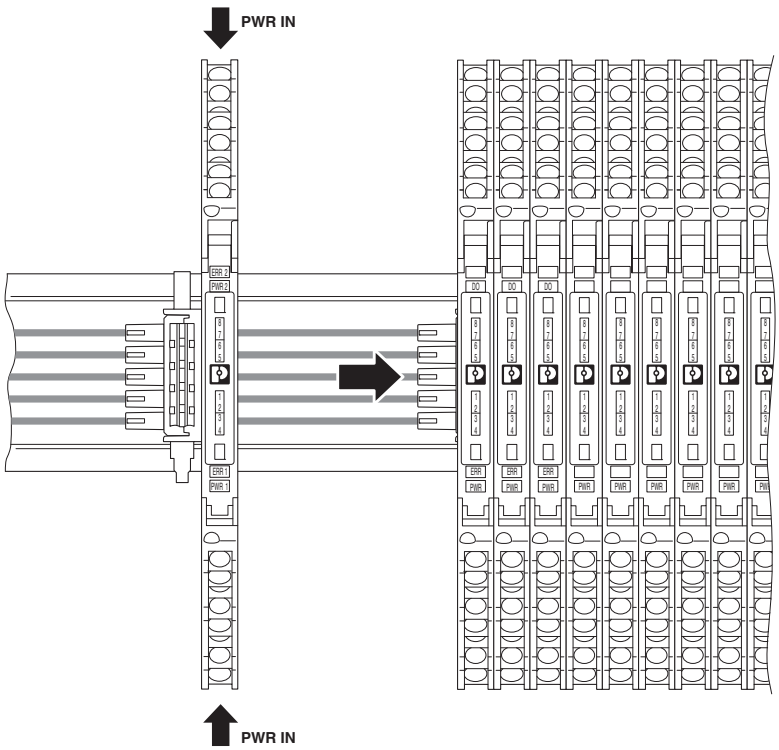


Figure 1-2 Supply via a power terminal block of the same shape



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## 1.3 Supply via any other MACX Analog, MINI Analog or MINI Analog Pro power terminal block

This option is particularly suitable if existing systems need to be extended and newer MINI Analog Pro signal conditioners, for example, are to be installed alongside existing MINI Analog signal conditioners, for example, and it is necessary to use a power terminal block. This option also supports fault monitoring.

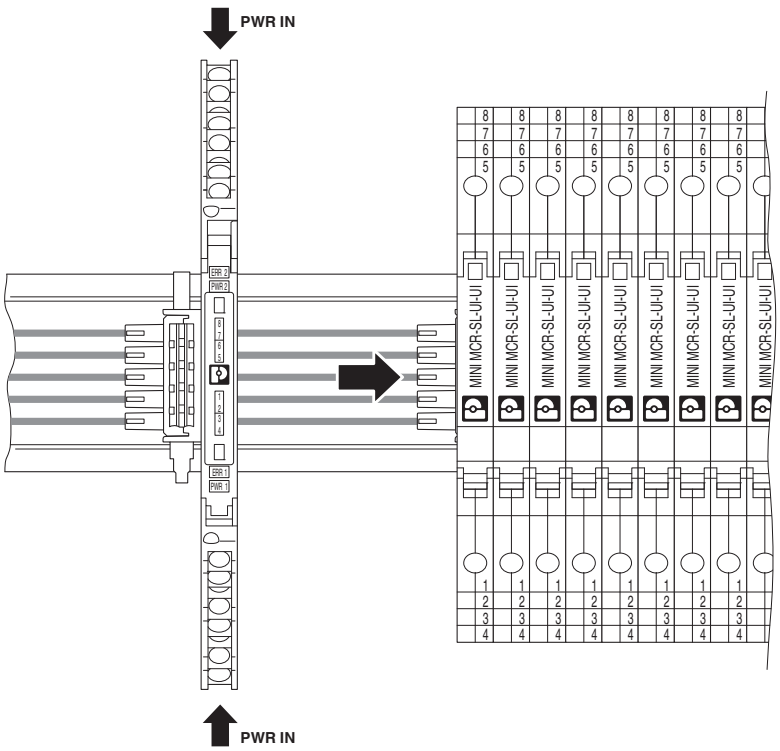


Figure 1-3 Supply via any other MACX Analog, MINI Analog or MINI Analog Pro power terminal block



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## 1.4 Supply via a system power supply with 85 V AC … 264 V AC wide range input

The advantage of this option for supplying the DIN rail connector is that a 24 V DC supply does not have to be available in the control cabinet or control box. For distributed applications in particular, where only 230 V AC is available, this method of supply is the best solution.

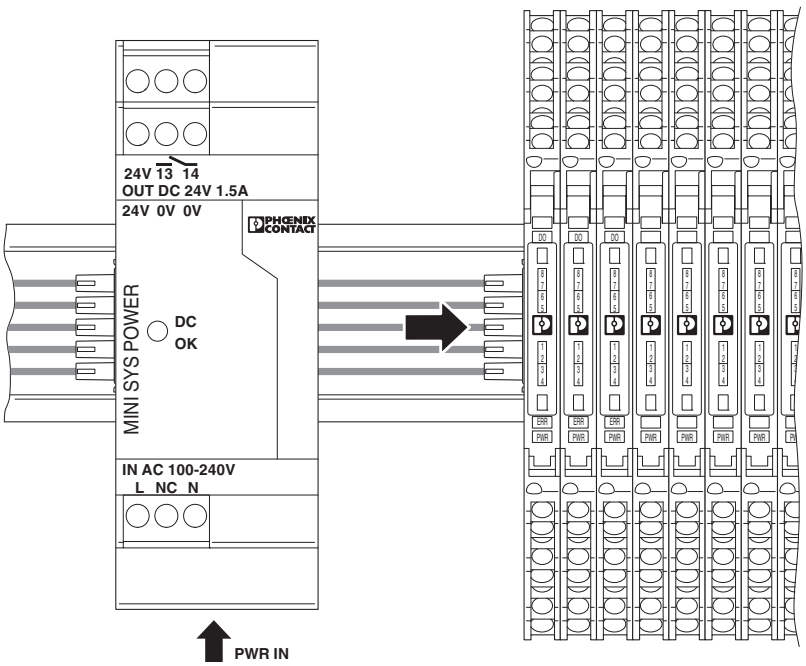


Figure 1-4 Supply via a system power supply with 85 V AC … 264 V AC wide range input



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# 2 Safety notes

You can download the latest documents from phoenixcontact.net/products.

**NOTE:**
When using the DIN rail connector, you may only connect one SELV or PELV circuit to the supply terminals of the modules.

## 2.1 MINI Analog modules

### 2.1.1 Installation notes

The category 3 device is designed for installation in zone 2 potentially explosive areas. It meets the requirements of EN 60079-0:2009 and EN 60079-15:2010.

Installation, operation, and maintenance may only be carried out by qualified electricians. Follow the installation instructions as described. When installing and operating the device, the applicable regulations and safety directives (including national safety directives), as well as generally recognized technical regulations, must be observed. For the safety data, please refer to the package slip and the certificates (conformity assessment and additional approvals where applicable).

Do not open or modify the device. Do not repair the device yourself; replace it with an equivalent device. Repairs may only be carried out by the manufacturer. The manufacturer is not liable for damage resulting from noncompliance.

The IP20 protection (IEC 60529/EN 60529) of the device is intended for use in a clean and dry environment. Do not subject the device to mechanical and/or thermal loads that exceed the specified limits.

The device is not designed for use in atmospheres with a danger of dust explosions.

### 2.1.2 Installation in zone 2

Observe the specified conditions for use in potentially explosive areas. Install the device in suitable approved housing (with IP54 protection, minimum) that meets the requirements of EN 60079-15. Also observe the requirements of EN 60079-14.

Only devices which are designed for operation in Ex zone 2 and are suitable for the conditions at the installation location may be connected to circuits in zone 2.

In potentially explosive areas, snap the device on or off the DIN rail connector and connect or disconnect the cables only when the power is disconnected.

The device must be stopped and immediately removed from the Ex area if it is damaged, was subjected to an impermissible load, stored incorrectly or if it malfunctions.



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## 2.2 MINI Analog Pro modules

### 2.2.1 Installation notes

The category 3 device is designed for installation in zone 2 the potentially explosive areas. It meets the requirements of EN 60079-0:2009 and EN 60079-15:2010.

Installation, operation, and maintenance may only be carried out by qualified electricians. Follow the installation instructions as described. When installing and operating the device, the applicable regulations and safety directives (including national safety directives), as well as generally recognized technical regulations, must be observed. For the safety data, please refer to the package slip and the certificates (conformity assessment and additional approvals where applicable).

During operation of the devices, dangerous contact voltages may be present at the operating elements. Therefore the device may only be parameterized, the cables connected or the module cover opened when the power is disconnected, unless the connected circuits are exclusively SELV or PELV circuits.

Do not open or modify the device. Do not repair the device yourself; replace it with an equivalent device. Repairs may only be carried out by the manufacturer. The manufacturer is not liable for damage resulting from noncompliance.

The IP20 protection (IEC 60529/EN 60529) of the device is intended for use in a clean and dry environment. Do not subject the device to mechanical and/or thermal loads that exceed the specified limits.

The device is not designed for use in atmospheres with a danger of dust explosions.

The device complies with the EMC regulations for industrial areas (EMC class A). When using the device in residential areas, it may cause radio interference.

If the device is not used as described in the documentation, the intended protection may be impaired.

To protect the device against mechanical or electrical damage, install it in suitable housing with an appropriate degree of protection according to IEC 60529.

Provide a switch/circuit breaker close to the device, which is labeled as the disconnecting device for this device.

Provide overcurrent protection ($I \leq 4$ A) within the installation.

The device housing provides basic insulation from neighboring devices for 300 Vrms. If several devices are installed next to each other, this must be taken into account and additional insulation must be installed, if necessary If the neighboring device is equipped with basic insulation, no additional insulation is required.

The voltages present at the input, output, and supply are extra-low voltages (ELV). Depending on the application, hazardous voltage (> 30 V) to ground may occur. Safe electrical isolation from the other connections exists for such cases.

The device must be stopped if it is damaged, was subjected to an impermissible load, stored incorrectly or if it malfunctions.



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### 2.2.2 Installation in zone 2

Observe the specified conditions for use in potentially explosive areas. Install the device in suitable approved housing (with IP54 protection, minimum) that meets the requirements of EN 60079-15. Also observe the requirements of EN 60079-14.

Only devices which are designed for operation in Ex zone 2 and are suitable for the conditions at the installation location may be connected to circuits in zone 2.

In potentially explosive areas, snap the device on or off the DIN rail connector and connect or disconnect the cables only when the power is disconnected.

The device must be stopped and immediately removed from the Ex area if it is damaged, was subjected to an impermissible load, stored incorrectly or if it malfunctions.

## 2.3 MACX Analog (Ex)/MACX PL modules

Please observe the safety regulations of electrical engineering and industrial safety and liability associations.

Disregarding these safety regulations may result in death, serious personal injury or damage to equipment.

The device must be operated in a closed control cabinet.

Before working on the device, disconnect the power.

During operation, parts of electrical switching devices carry hazardous voltages.

In the event of an error, replace the device immediately.

Keep the operating instructions in a safe place.

### 2.3.1 Installation notes

The device is an associated item of equipment (category 1) with “intrinsic safety” protection type and can be installed in zone 2 potentially explosive areas as a category 3 device. It meets the requirements of EN 60079-0:2012, EN 60079-11:2012, and EN 60079-15:2010 and IEC 60079-0 ed. 6.0, IEC 60079-11 ed. 6.0, and IEC 60079-15 ed. 4.0.

Installation, operation, and maintenance may only be carried out by qualified electricians. Follow the installation instructions as described. When installing and operating the device, the applicable regulations and safety directives (including national safety directives), as well as general technical regulations, must be observed. For the safety data, please refer to the package slip and certificates (EC-type examination certificate and additional approvals where applicable).

Do not open or modify the device. Do not repair the device yourself; replace it with an equivalent device. Repairs may only be carried out by the manufacturer. The manufacturer is not liable for damage resulting from noncompliance.

The IP20 protection (IEC 60529/EN 60529) of the device is intended for use in a clean and dry environment. Do not subject the device to mechanical and/or thermal loads that exceed the specified limits.

The device complies with the EMC regulations for industrial areas (EMC class A). When using the device in residential areas, it may cause radio interference.



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### 2.3.2 Intrinsic safety

The device is approved for intrinsically safe (Ex i) circuits up to zone 0 (gas) and zone 20 (dust) in the Ex area. Observe the safety values for intrinsically safe equipment and the connecting cables during connection (IEC/EN 60079-14); the values specified in these installation notes and the EC-type examination certificate must be observed.

When carrying out measurements on the intrinsically safe side, observe the relevant regulations regarding the connection of intrinsically safe equipment. In intrinsically safe circuits, only use measuring devices that are approved for these circuits.

If the device has been used in non-intrinsically safe circuits, it must not be used again in intrinsically safe circuits. The device must be clearly labeled as non-intrinsically safe.

### 2.3.3 Installation in the Ex area (zone 2)

Observe the specified conditions for use in potentially explosive areas. Install the device in suitable approved housing (with IP54 protection, minimum) that meets the requirements of EN 60079-15. Also observe the requirements of EN 60079-14.

In zone 2, only connect and disconnect cables when the power is disconnected.

In potentially explosive areas, snap the device on or off the DIN rail connector and connect or disconnect the cables only when the power is disconnected.

The device must be stopped and immediately removed from the Ex area if it is damaged, was subjected to an impermissible load, stored incorrectly or if it malfunctions.

### 2.3.4 Areas with a danger of dust explosions

The device is not designed for installation in zone 22.

If, however, you wish to use the device in zone 22, it must be installed in housing that complies with IEC/EN 60079-31. In doing so, observe the maximum surface temperatures. Observe the requirements of IEC/EN 60079-14.

Connection to the intrinsically safe circuit in areas with a danger of dust explosions (zone 20, 21 or 22) is only permitted if the equipment connected to this circuit is approved for this zone (e.g., category 1D, 2D or 3D).

### 2.3.5 Safety-related applications (SIL)

When using the device in safety-related applications, observe the instructions in the data sheet at phoenixcontact.net/products as the requirements may differ for safety-related functions.



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## 2.4 System power supplies

To ensure that the device is operated safely and all functions can be used, please read these instructions carefully. For additional information, please refer to the corresponding data sheet at phoenixcontact.net/products.

Installation, startup, and maintenance may only be carried out by qualified personnel. The relevant country-specific safety and accident prevention regulations, as well as general technical regulations, must be observed. For the safety data, please refer to the package slip and the certificates.

Prior to startup, in particular make sure that:

- Mains connection is performed correctly and protection against electric shock ensured.
- The device can be switched off outside the power supply according to the regulations in EN 60950 (e.g., by line protection on the primary side).
- The protective conductor is connected.
- All supply lines and down conductors have sufficient protection and are dimensioned accordingly for the current flow.
- Installation is carried out in accordance with the following instructions.
- During operation the following mechanical and thermal limits must not be exceeded.
- The device may not be opened or modified. Do not repair the device yourself; replace it with an equivalent device. Repairs may only be carried out by the manufacturer. The manufacturer is not liable for damage resulting from noncompliance.
- The device must be stopped and immediately removed from the Ex area if it is damaged, was subjected to an impermissible load, stored incorrectly or if it malfunctions.



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# 3 Supply options for MINI Analog

MINI Analog signal conditioners usually require a 24 V DC (19.2 V DC … 30 V DC) supply. In addition to supplying individual modules via the corresponding terminal blocks on the device, various methods for supplying power to several modules in the MINI Analog product range can be implemented using the DIN rail connector (ME 6,2 TBUS-2 1,5/5-ST-3,81 GN, Order No. 2869728). It is supplied with 24 V DC and supplies all connected signal conditioners. This eliminates the need for time-consuming and costly single wiring.

When there are only a few modules mounted side by side, the ideal solution is to supply the DIN rail connector directly and therefore the connected modules via a signal conditioner, see Section 3.1 on page 19. One way to supply several modules, with or without short-circuit and cable break detection (see Section 3.4 on page 30), is to use MINI MCR-SL-PTB… devices, see Section 3.2 on page 22. These devices also support redundant supply, if required. If a particularly large number of MINI Analog modules need to be supplied via the DIN rail connector, the MACX MCR-PTB… power and fault monitoring module offers sufficient reserves, see Section 5.2 on page 50.

If there is no 24 V DC supply, the devices from the MINI Power Supply series introduced in Section 3.3 on page 28 are used. They are suitable for connection to 230 V AC and are specifically tailored to the requirements of measurement and control technology. They can also be used in potentially explosive areas.

**NOTE: Risk of damage to equipment**
Never connect the supply voltage directly to the DIN rail connector.

## 3.1 Direct supply via a MINI Analog signal conditioner

In the case of direct supply, all modules connected to the TBUS DIN rail connector are supplied via the supply at a signal conditioner. Please note that the maximum total current consumption of $I_{max}$ = 400 mA must not be exceeded and the maximum number of modules is therefore restricted to a few devices. The maximum number of devices can be calculated using the formula below. For the respective current consumption of the individual signal conditioners, please refer to specifications on the Phoenix Contact homepage, in the package slips or the data sheets.

$$n_{modules} = \frac{I_{max}}{I_N} = \frac{400\ mA}{I_N}$$

$$I_N = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + \ldots$$



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A 500 mA fuse should be connected upstream as protection. In addition, you must make sure that with the 24 V DC supply used the fuse will definitely trip in the event of an error.

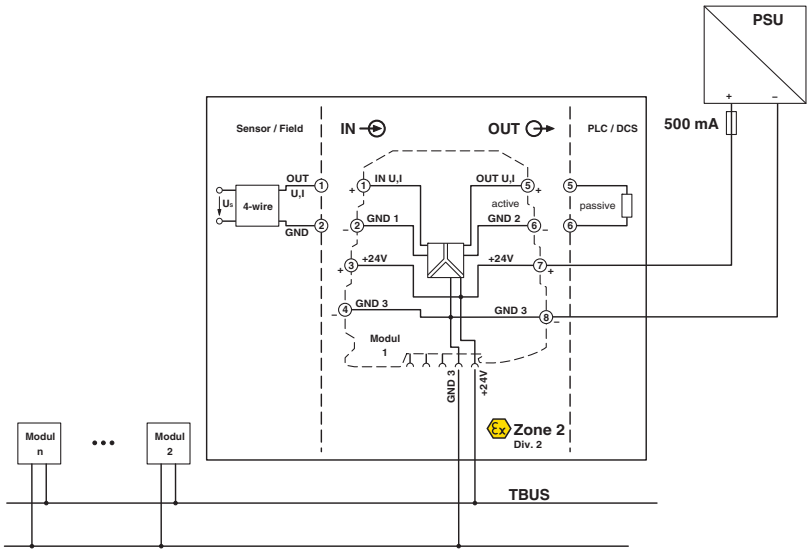


Figure 3-1 Direct supply via a MINI Analog signal conditioner

**Example for direct supply via a module**

Five MINI MCR-SL-PT100-UI-200-NC temperature transducers (Order No. 2864370) and three MINI MCR-SL-UI-UI-NC configurable signal conditioners (Order No. 2864150), with 4 mA … 20 mA current output, are to be supplied at an operating voltage of 24 V DC.

First determine the current consumption of the modules from the package slips. For the temperature transducers it is 21 mA per module and for the configurable transducers it is 19 mA at the desired current output.

Then determine the maximum total current consumption of all eight modules.

$$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$$

$$I = 5 * 19\ mA + 3 * 21\ mA = 158\ mA < 400\ mA$$

The total current consumption of 158 mA is less than the maximum permissible current for supply via a module. The fuse to be connected upstream of the supply signal conditioner should have a nominal current of 500 mA. To ensure that the fuse definitely trips in the event of a short circuit, the 24 V DC supply in this example is provided by a QUINT-PS/ 1AC/24DC/ 3,5 (Order No. 2866747). The structure is shown in Figure 3-2 on page 21. The wiring is as shown in Figure 3-1 on page 20.



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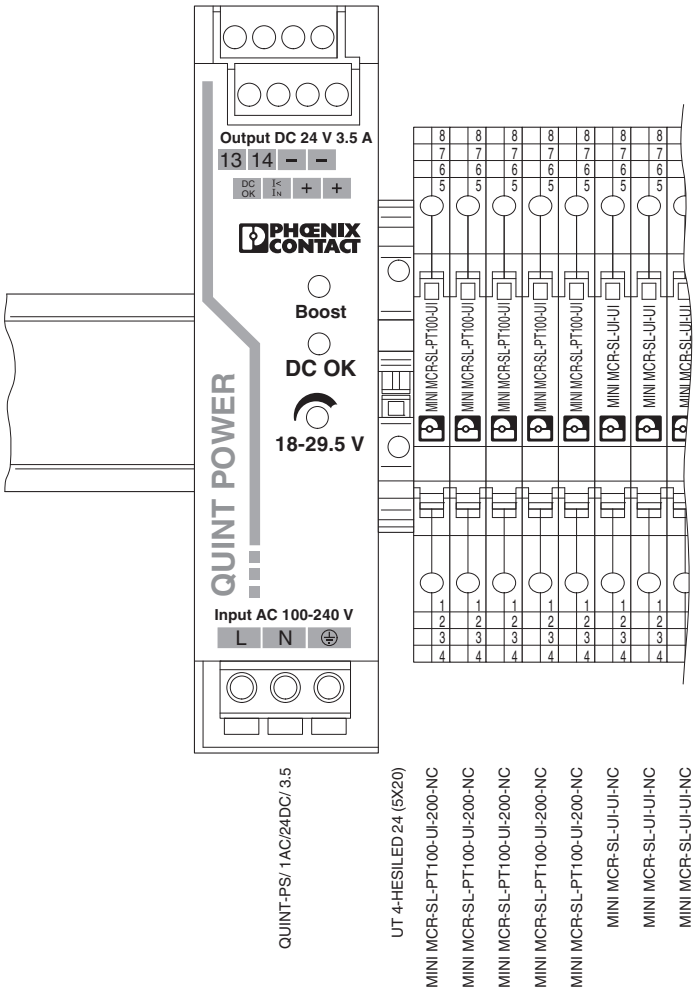


Figure 3-2 Example for direct supply via a module

In addition to the low maximum number of modules, another disadvantage of this method of supply is that fault monitoring is not possible. However, this function is provided by the method of supply described in the next section.



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## 3.2 Supply via MINI MCR-SL-PTB... power terminal blocks

MINI MCR-SL-PTB… power terminal blocks are particularly suitable for supplying power to MINI Analog modules. They are available in the familiar 6.2 mm housing and integrate seamlessly into the MINI Analog range. Redundant supply is supported. The decoupling of power supplies used for supply is ensured by the diodes integrated in the module. In addition, it is possible to extend mechanical redundancy by using two power terminal blocks. A 2.5 A fuse should be used to protect the power terminal block(s). It is important to make sure here that tripping is guaranteed in the event of a short circuit by the power supply/supplies used. You can calculate the maximum number of modules, regardless of whether you are using one or two MINI MCR-SL-PTB… modules, with the aid of the product documents using the formula below.

$$n_{modules} = \frac{I_{max}}{I_N} = \frac{2\ A\ (4\ A)}{I_N}$$

$$I_N = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$$

**Recommended fuse for power terminal block:**
Fuse according to IEC 60127-2/V
Nominal current: 2.5 A
Characteristic: slow-blow
(e.g., Wickmann 5 x 20 mm/No. 195 - glass fuse)



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### 3.2.1 Supply via a MINI MCR-SL-PTB… power terminal block

In the case of supply via the power terminal block, all MINI Analog modules connected via the TBUS DIN rail connector are supplied. Both supply inputs can be supplied by one power supply, see Figure 3-3 on page 23, or redundant supply by means of two different power supplies is implemented, see Figure 3-4 on page 23. It is important here that both supply circuits have separate protection. In this way a maximum current of 2 A can be fed into the DIN rail connector.

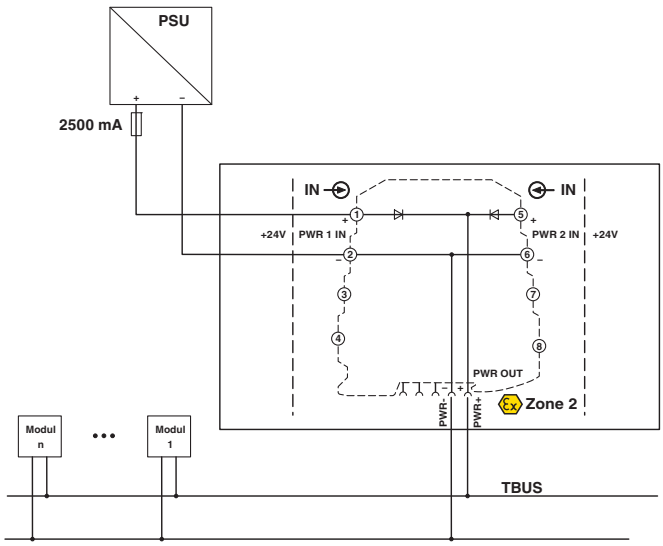


Figure 3-3 Supply by means of one power supply

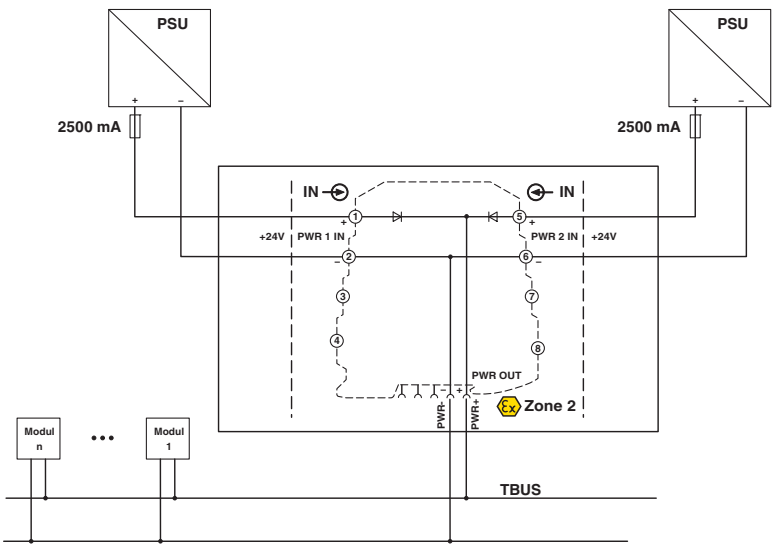


Figure 3-4 Supply by means of redundant power supply



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### Example for supply via a MINI MCR-SL-PTB… power terminal block

32 MINI MCR-RTD-UI-NC temperature transducers (Order No. 2902849), 10 MINI MCR-SL-UI-UI-NC configurable signal conditioners (Order No. 2864150), with 4 mA … 20 mA current output, and 40 MINI MCR-SL-UI-F frequency transducers (Order No. 2864082) are to be supplied at an operating voltage of 24 V DC.

First determine the current consumption of the modules from the package slips. For the temperature transducers it is 27 mA per module and for the configurable transducers it is 21 mA at the desired current output. The frequency transducers require 10 mA each.

Then determine the maximum total current consumption of all 82 modules.

$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$

$I = 32 * 27\ mA + 10 * 21\ mA + 40 * 10\ mA = 1914\ mA < 2000\ mA$

The total current consumption of 1914 mA is less than the maximum permissible current for supply via the MINI MCR-SL-PTB…. The fuses connected upstream of both power terminal blocks should each have a nominal current of 2.5 A. To ensure that the fuses definitely trip in the event of a short circuit, the 24 V DC supply in this example is provided by QUINT-PS/1AC/24DC/ 3,5 (Order No. 2866747), which provide a short-circuit current of 15 A. The structure is shown in Figure 3-5 on page 25. The wiring is as shown in Figure 3-4 on page 23.



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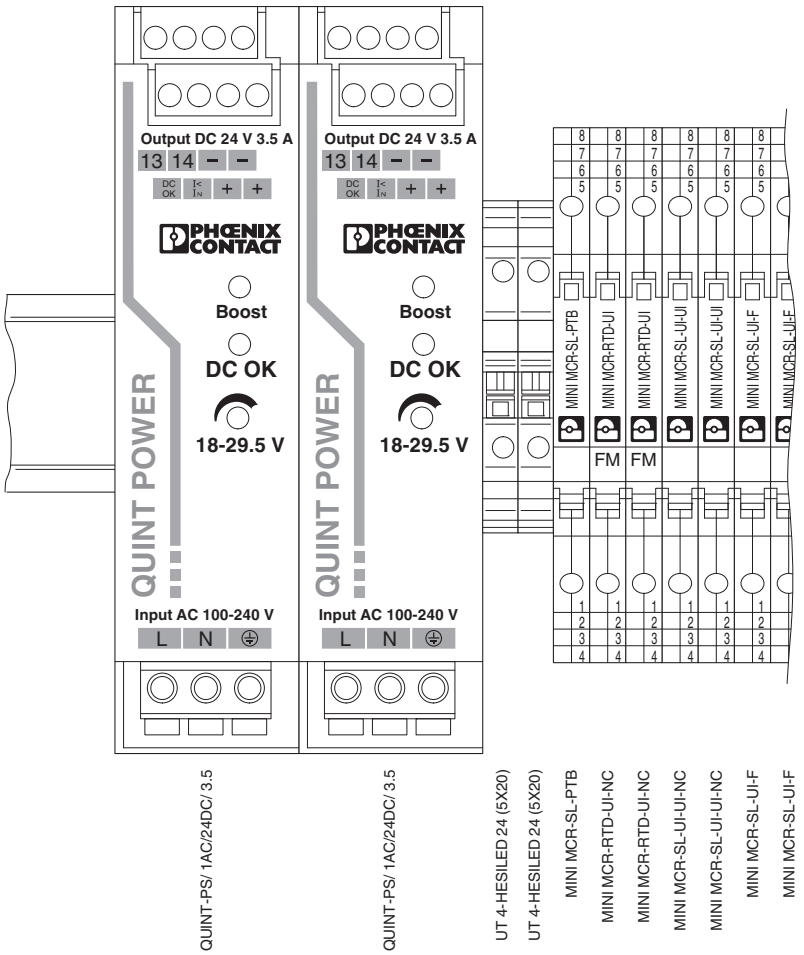


Figure 3-5 Example for supply via a MINI MCR-SL-PTB… power terminal block

The disadvantage here is that in the event that the power terminal block fails, the supply of all signal conditioners is interrupted. However, this can be indicated in this example by means of a N/C contact by using a MINI MCR-SL-FM-RC-NC(-SP) fault monitoring module and the MINI MCR-SL-PTB-FM(-SP) power terminal block, see Section 3.4 on page 30.



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### 3.2.2 Supply via two MINI MCR-SL-PTB... power terminal blocks

If using two MINI MCR-SL-PTB… to supply the connected MINI Analog modules, only one power supply may be connected per power terminal block. Likewise, you should position the two modules at either end of the DIN rail in order to limit the maximum short-circuit current in the event of an error, see Figure 3-6 on page 26. Please also observe the maximum permissible total current here of 2 A if redundant power supply is desired. To increase the total number of signal conditioners, a maximum current of 4 A can be supplied via both power terminal blocks (note, no redundancy). The maximum number of MINI Analog devices is therefore equivalent to the calculation in Section 3.2 on page 22.

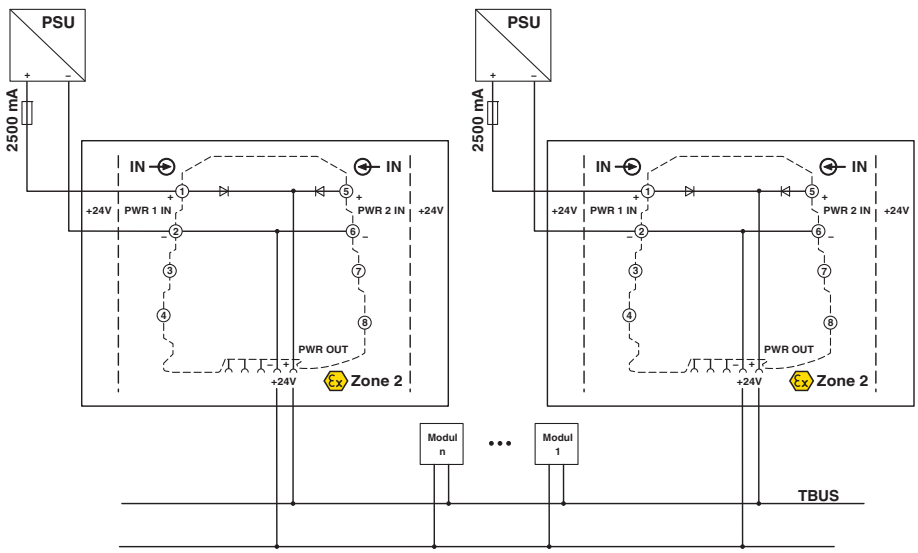


Figure 3-6 Supply via two MINI MCR-SL-PTB... power terminal blocks

**Example for supply via two MINI MCR-SL-PTB... power terminal blocks**

As in the previous example, 32 MINI MCR-RTD-UI-NC temperature transducers (Order No. 2902849), 10 MINI MCR-SL-UI-UI-NC configurable signal conditioners (Order No. 2864150), with 4 mA … 20 mA current output, and 40 MINI MCR-SL-UI-F frequency transducers (Order No. 2864082) are to be supplied redundantly at an operating voltage of 24 V DC.

First determine the current consumption of the modules from the package slips again. For the temperature transducers it is 27 mA per module and for the configurable transducers it is 21 mA at the desired current output. The frequency transducers require 10 mA each.

Then determine the maximum total current consumption of all 82 modules.

$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$

$I = 32 * 27\ mA + 10 * 21\ mA + 40 * 10\ mA = 1914\ mA < 2000\ mA$

The total current consumption of 1914 mA is less than the maximum permissible current for supply via the MINI MCR-SL-PTB…. The fuses connected upstream of both power terminal blocks should each have a nominal current of 2.5 A. To ensure that the fuses definitely trip



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in the event of a short circuit, the 24 V DC supply in this example is provided by QUINT-PS/ 1AC/24DC/ 3.5 (Order No. 2866747), which provide a short-circuit current of 15 A. The structure is shown in Figure 3-7 on page 27. The wiring is as shown in Figure 3-6 on page 26.

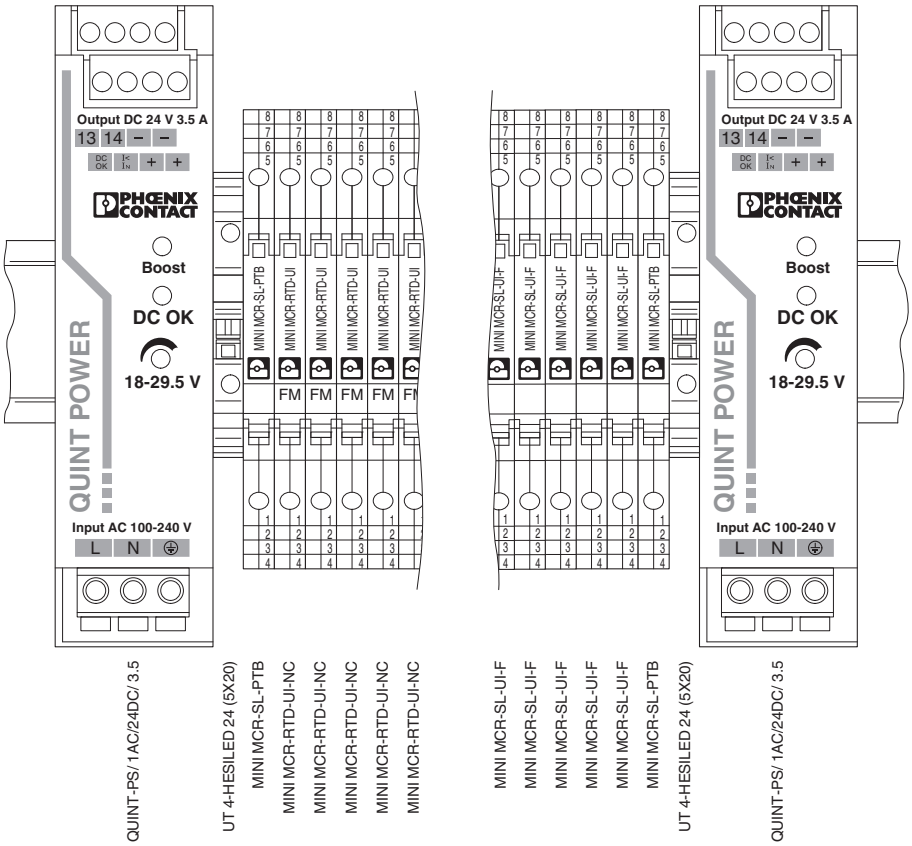


Figure 3-7 Example for supply via two MINI MCR-SL-PTB... power terminal blocks

The failure of either or both of the power terminal blocks can be indicated by means of a N/C contact by using a MINI MCR-SL-FM-RC-NC(-SP) fault monitoring module and the MINI MCR-SL-PTB-FM(-SP) power terminal block.



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## 3.3 Supply via a system power supply

If there is no 24 V DC supply in the control cabinet or terminal box to supply the MINI Analog signal conditioners, you can use a MINI-SYS-PS-100-240AC/24DC/1.5 (Order No. 2866983) or, for potentially explosive areas, a MINI-PS-100-240AC/24DC/1.5/EX (Order No. 2866653). These power supplies, which have been developed specifically for measurement and control technology, enable the signal conditioners to be supplied directly from a 230 V AC supply via the TBUS DIN rail connector. These power supplies are simply snapped onto the TBUS and deliver a maximum current of 1.5 A. For increased performance, up to two MINI-SYS-PS-100-240AC/24DC/1.5 or MINI-PS-100-240AC/24DC/1.5/EX can also be snapped on. This means that a total current of 3 A can be supplied. Please note, however, that redundant supply is not possible for currents greater than 1.5 A. A 6 A, 10 A or 16 A characteristic B circuit breaker should be used to protect the primary side.

Calculate the maximum number of modules with the aid of the relevant package slips using the formula below.

$$n_{modules} = \frac{I_{max}}{I_N} = \frac{1.5\ A\ (3\ A)}{I_N}$$

$$I_N = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$$

**Example for supply via a system power supply**

65 MINI MCR-SL-PT100-UI-200-NC temperature transducers (Order No. 2864370) are to be supplied.

First determine the current consumption of the modules from the package slips. For these temperature transducers it is 21 mA per module.

Then determine the maximum total current consumption of all 65 modules.

$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$

$I = 65 * 21\ mA = 1365\ mA < 1500\ mA$



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The total current consumption of 1365 mA is less than the maximum permissible current for supply via the MINI-SYS-PS-100-240AC/24DC/1.5 or the MINI-PS-100-240AC/24DC/1.5/EX. The structure is shown in Figure 3-8 on page 29.

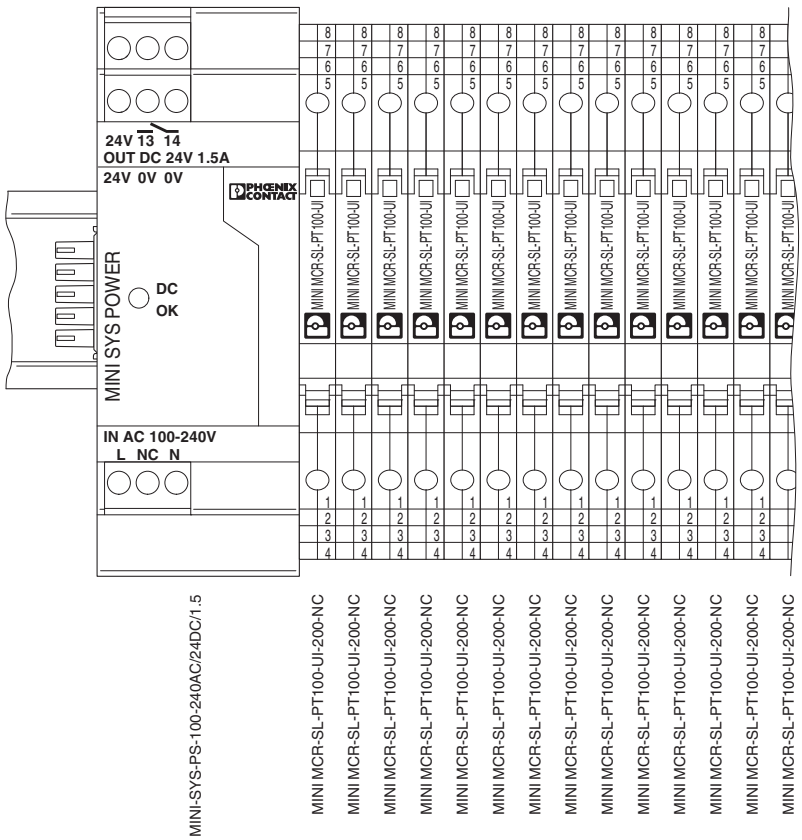


Figure 3-8 Supply via a system power supply



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## 3.4 Monitoring the supply voltage using MINI MCR-SL-FM-RC-… fault monitoring modules

As described in Section 3.2 on page 22, the MINI Analog modules can be supplied with power via a MINI MCR-SL-PTB… power terminal block. If the MINI MCR-SL-PTB-FM… modules (Order No. 2864134) are used, redundancy monitoring of the supply voltage can be configured when using the MINI MCR-SL-FM-RC-… fault monitoring modules (Order No. 2902961). Mount a power terminal block and a fault monitoring module of the same shape side by side without spacing, see Figure 3-9 on page 30.

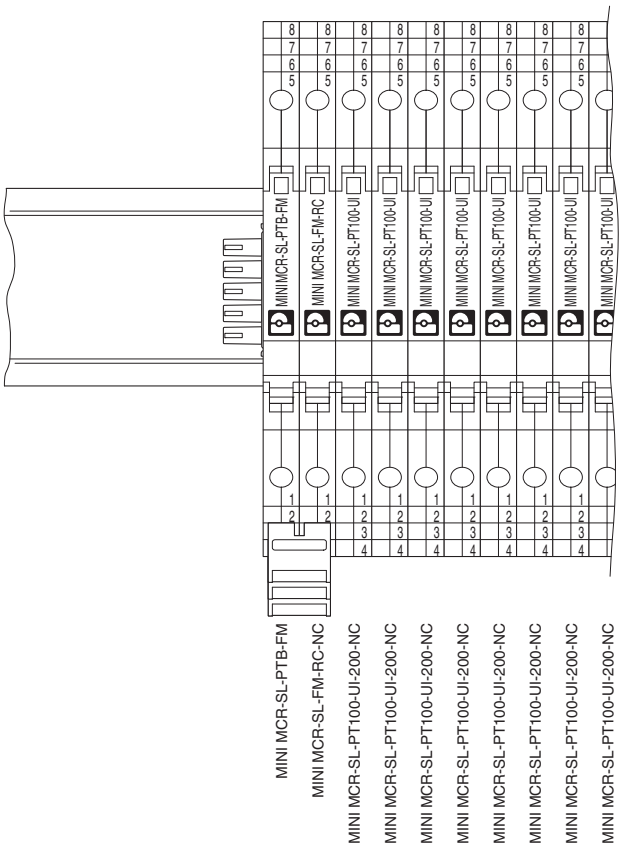


Figure 3-9 Redundancy monitoring of the supply voltage

Then bridge terminal blocks 1 to 4 of the power terminal block with terminal blocks 1 to 4 of the fault monitoring module. Use the FBSR 2-6 jumpers (Order No. 3033715) supplied with the fault monitoring module or normal cables. Now if one of the power supplies fails, this is indicated via a N/C contact. For additional mechanical redundancy, as shown in Section 3.2.2 on page 26, two power terminal blocks and two fault monitoring modules can be used, see Figure 3-10 on page 31. Again only one supply may be connected to each power termi-



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nal block here. In the second fault monitoring module, fault monitoring of external measuring transducers must be deactivated because evaluation can only take place via one module in a group.

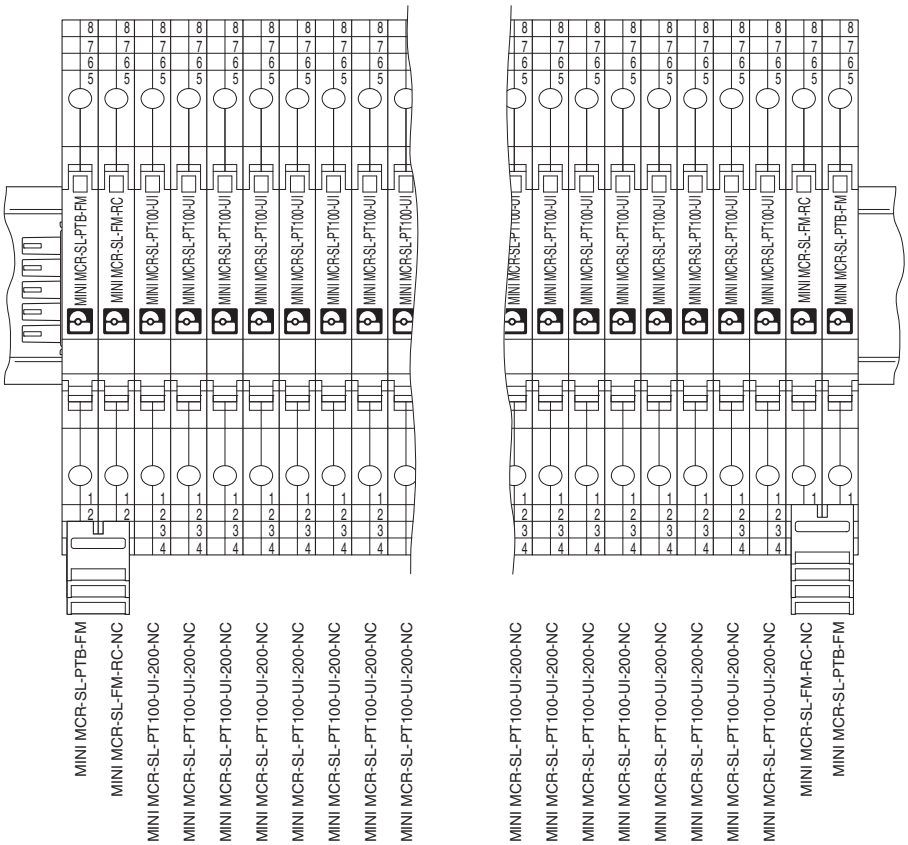


Figure 3-10 Additional mechanical redundancy



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# 4 Supply options for MINI Analog Pro

MINI Analog Pro signal conditioners require a DC supply in the range from 9.6 V ... 30 V. In addition to supplying individual modules via the corresponding terminal blocks on the device, various methods for supplying power to several modules in the MINI Analog Pro product range can be implemented using the DIN rail connector (ME 6,2 TBUS-2 1,5/5-ST-3,81 GN, Order No. 2869728 or ME 6,2 TBUS-2 1,5/5-ST-3,81 GY Order No. 2695439). It supplies all connected signal conditioners. This eliminates the need for time-consuming and costly single wiring.

When there are only a few modules mounted side by side, the ideal solution is to supply the DIN rail connector directly and therefore the connected modules via a signal conditioner, see Section 4.1 on page 33. One way to supply several modules, with additional monitoring for module errors and the supply (see Section 4.4 on page 44), is to use MINI MCR-2-PTB… devices, see Section 4.2 on page 36. These devices also support redundant supply, if required.

If there is no DC supply in the range from 9.6 V ... 30 V, the devices from the MINI Power Supply series introduced in Section 4.3 on page 42 are used. They are suitable for connection to 230 V AC and are specifically tailored to the requirements of measurement and control technology. They can also be used in potentially explosive areas.

**NOTE: Risk of damage to equipment**
Never connect the supply voltage directly to the DIN rail connector.

## 4.1 Direct supply via a MINI Analog Pro signal conditioner

In the case of direct supply, all modules connected to the TBUS DIN rail connector are supplied via the supply at a signal conditioner. Please note that the maximum total current consumption of $I_{max}$ = 400 mA must not be exceeded and the maximum number of modules is therefore restricted to a few devices. The maximum number of devices can be calculated using the formula below. For the respective current consumption of the individual signal conditioners, please refer to specifications on the Phoenix Contact homepage, in the package slips or the data sheets.

$$n_{modules} = \frac{I_{max}}{I_N} = \frac{400\ mA}{I_N}$$

$$I_N = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$$



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A 500 mA fuse should be connected upstream as protection. In addition, you must make sure that with the 24 V DC supply used the fuse will definitely trip in the event of an error.

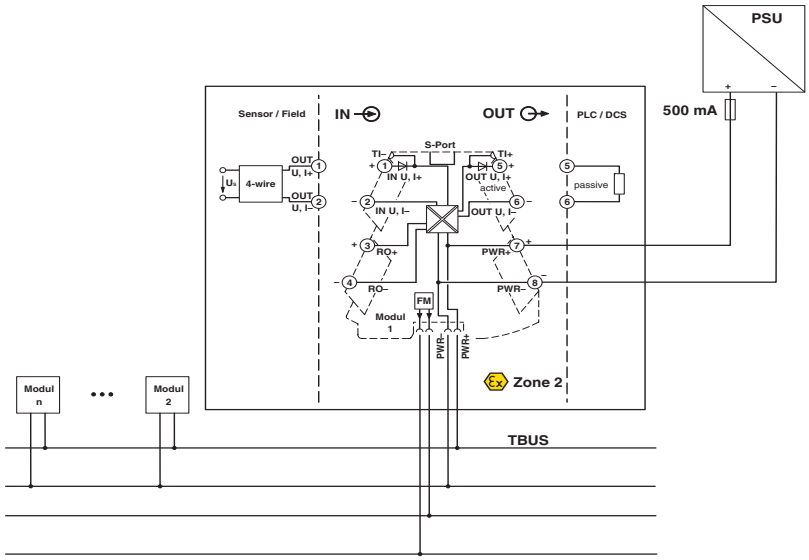


Figure 4-1 Direct supply via a MINI Analog Pro signal conditioner

**Example for direct supply via a module**

Five MINI MCR-2-TC-UI temperature transducers (Order No. 2902055) and three MINI MCR-2-UI-UI configurable signal conditioners (Order No. 2902037), with 4 mA … 20 mA current output, are to be supplied at an operating voltage of 24 V DC.

First determine the current consumption of the modules from the package slips. For the temperature transducers it is 31.5 mA per module and for the configurable transducers it is 25 mA at the desired current output.

Then determine the maximum total current consumption of all eight modules.

$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$

$I = 5 * 31.5\ mA + 3 * 25\ mA = 201\ mA < 400\ mA$

The total current consumption of 201 mA is less than the maximum permissible current for supply via a module. The fuse to be connected upstream of the supply signal conditioner should have a nominal current of 500 mA. To ensure that the fuse definitely trips in the event



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of a short circuit, the 24 V DC supply in this example is provided by a QUINT-PS/ 1AC/24DC/ 3.5 (Order No. 2866747). The structure is shown in Figure 4-2 on page 35. The wiring is as shown in Figure 4-1 on page 34.

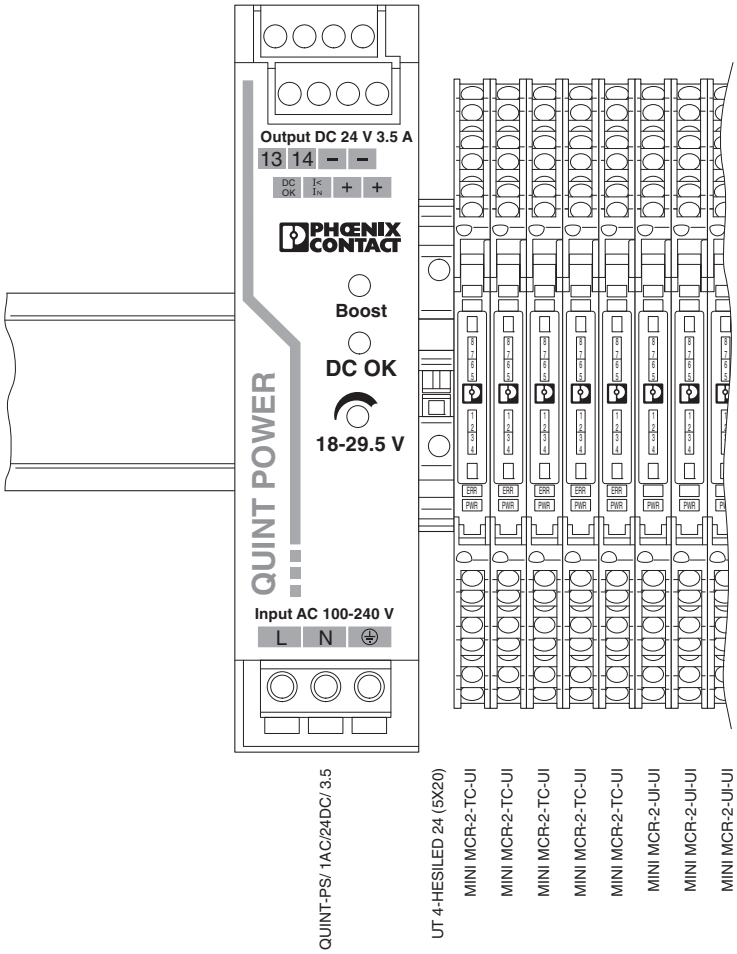


Figure 4-2 Example for direct supply via a module

In addition to the low maximum number of modules, another disadvantage of this method of supply is that fault monitoring is not possible. However, this function is provided by the method of supply described in the next section.



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## 4.2 Supply via a MINI MCR-2-PTB power terminal block

MINI MCR-2-PTB… power terminal blocks are particularly suitable for supplying power to MINI Analog Pro modules. They are available in the familiar 6.2 mm housing and so integrate seamlessly into the MINI Analog Pro range. Redundant supply is supported. The decoupling of power supplies used for supply is ensured by the diodes integrated in the module. In addition, it is possible to extend mechanical redundancy by using two power terminal blocks. A 4 A fuse should be used to protect the power terminal block(s). It is important to make sure here that tripping is guaranteed in the event of a short circuit by the power supply/supplies used. You can calculate the maximum number of modules, regardless of whether you are using one or two MINI MCR-2-PTB… modules, with the aid of the product documents using the formula below.

$$n_{modules} = \frac{I_{max}}{I_N} = \frac{3.2\ A}{I_N}$$

$$I_N = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$$

**Recommended fuse for power terminal block:**
Fuse as per IEC 60127-2/V
Nominal current: 4 A
Characteristic: slow-blow
(e.g., Wickmann 5 x 20 mm/No. 195 - glass fuse)

### 4.2.1 Supply via a MINI MCR-2-PTB… power terminal block

In the case of supply via the power terminal block, all MINI Analog Pro modules connected via the TBUS DIN rail connector are supplied. Both supply inputs can be supplied by one power supply, see Figure 4-3 on page 37, or redundant supply by means of two different power supplies is implemented, see Figure 4-4 on page 37. It is important here that both supply circuits have separate protection. In this way a maximum current of 3.2 A can be fed into the DIN rail connector.



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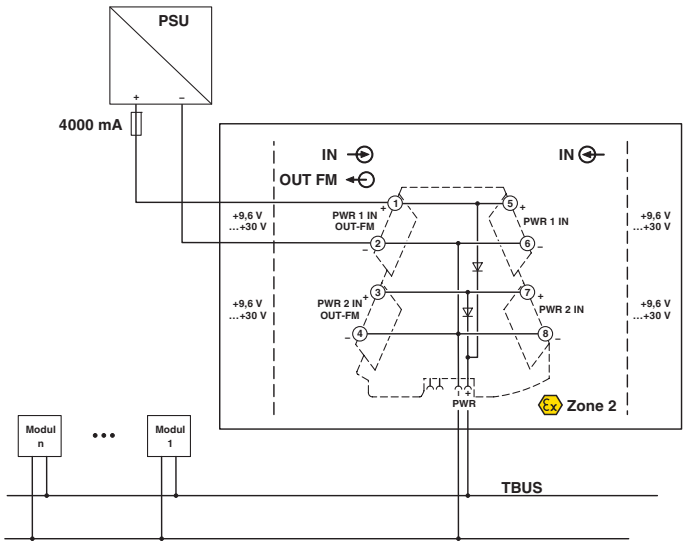


Figure 4-3 Supply by means of one power supply

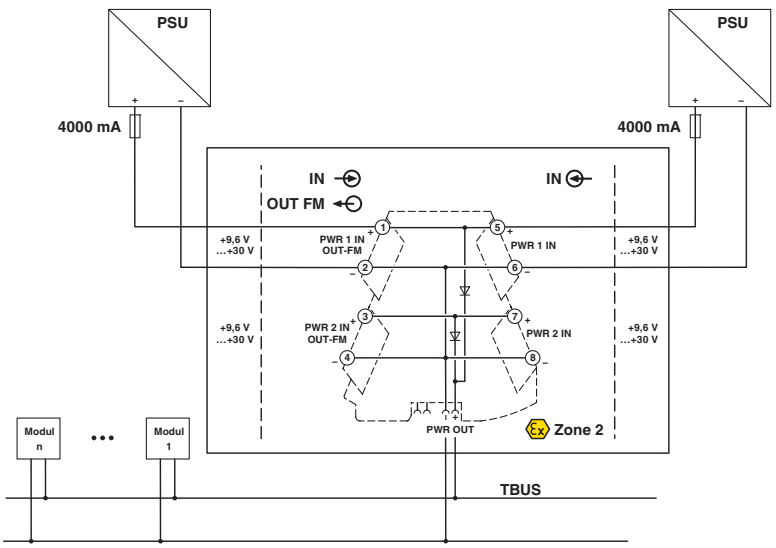


Figure 4-4 Supply by means of redundant power supplies



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### Example for supply via a MINI MCR-2-PTB… power terminal block

32 MINI MCR-2-RTD-UI temperature transducers (Order No. 2902849), 10 MINI MCR-2-UI-UI configurable signal conditioners (Order No. 2902037), with 4 mA … 20 mA current output, and 40 MINI MCR-2-UNI-UI-UIRO universal signal conditioners with switching output (Order No. 2902026) are to be supplied at an operating voltage of 24 V DC.

First determine the current consumption of the modules from the package slips. For the temperature transducers it is 31.5 mA per module and for the configurable transducers it is 25 mA at the desired current output. The universal signal conditioners with switching output require 31.5 mA each.

Then determine the maximum total current consumption of all 82 modules.

$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$

$I = 32 * 31.5\ mA + 10 * 25\ mA + 40 * 31.5\ mA = 2518\ mA < 3200\ mA$

The total current consumption of 2518 mA is less than the maximum permissible current for supply via the MINI MCR-2-PTB…. The fuses connected upstream of both power modules should each have a nominal current of 4000 mA. To ensure that the fuses definitely trip in the event of a short circuit, the 24 V DC supply in this example is provided by QUINT-PS/



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1AC/24DC/ 3.5 (Order No. 2866747), which provide a short-circuit current of 15 A. The structure is shown in Figure 4-5 on page 39. The wiring is as shown in Figure 4-4 on page 37.

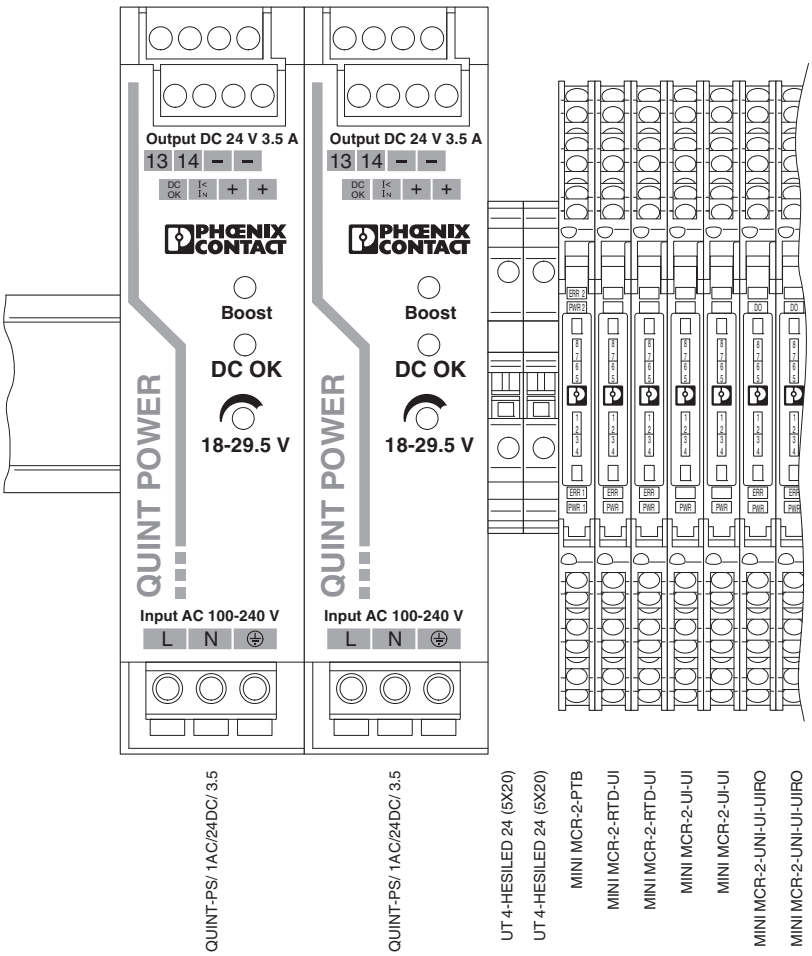


Figure 4-5 Example for supply via a MINI MCR-2-PTB… power terminal block

The disadvantage here is that in the event that the power terminal block fails, the supply of all signal conditioners is interrupted. However, this can be indicated in this example by means of a N/C contact by using a MINI MCR-2-FM-RC fault monitoring module and the MINI MCR-2-PTB power terminal block.



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### 4.2.2 Supply via two MINI MCR-2-PTB... power terminal blocks

If using two MINI MCR-2-PTB… to supply the connected MINI Analog modules, only one power supply may be connected per power terminal block. Likewise, you should position the two modules at either end of the DIN rail in order to limit the maximum short-circuit current in the event of an error, see Figure 4-6 on page 40. Please also observe the maximum permissible total current here of 3.2 A if redundant power supply is desired. To increase the total number of signal conditioners, a maximum current of 6 A can be supplied via both power terminal blocks (note, no redundancy). The maximum number of MINI Analog Pro devices is therefore equivalent to the calculation in Section 4.2 on page 36.

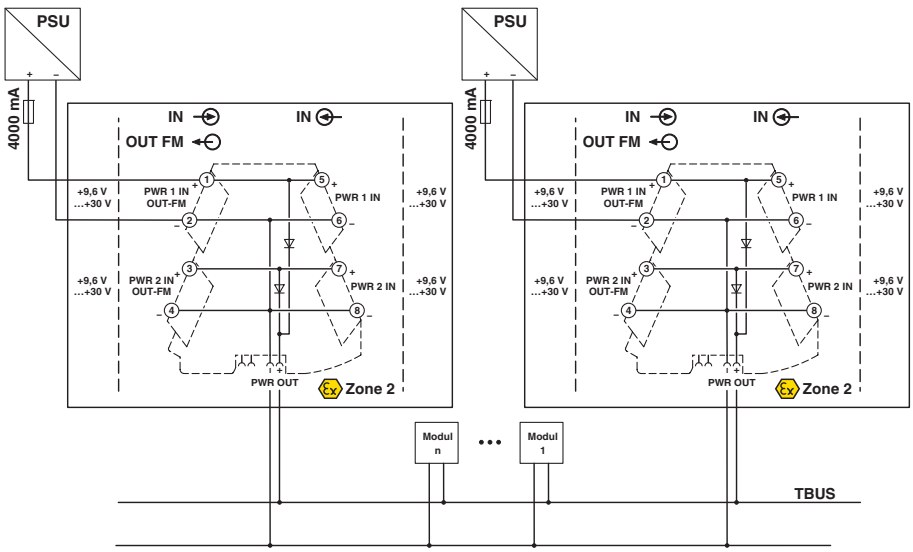


Figure 4-6 Supply via two MINI MCR-2-PTB... power terminal blocks

**Example for supply via two MINI MCR-2-PTB… power terminal blocks**

16 MINI MCR-2-RTD-UI temperature transducers (Order No. 2902049), 10 MINI MCR-2-UI-UI configurable signal conditioners (Order No. 2902037), with 4 mA … 20 mA current output, and 25 MINI MCR-2-UNI-UI-UIRO universal signal conditioners with switching output (Order No. 2902026) are to be supplied redundantly. Only an operating voltage of 12 V DC is available in this example.

First determine the current consumption of the modules from the package slips. For the temperature transducers it is 62.50 mA per module and for the configurable transducers it is 54 mA at the desired current output. The universal signal conditioners with switching output require 62.50 mA each.

Then determine the maximum total current consumption of all 51 modules.
$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$

$I = 16 * 62.5\ mA + 10 * 54\ mA + 25 * 62.5\ mA = 3102\ mA < 3200\ mA$

The total current consumption of 3102.5 mA is less than the maximum permissible current for supply via the MINI MCR-2-PTB…. The fuses connected upstream of both power terminal blocks should each have a nominal current of 4000 mA. To ensure that the fuses definitely trip in the event of a short circuit, the 12 V DC supply in this example is provided by



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QUINT-PS/ 1AC/12DC/15 power supplies (Order No. 2866718), which provide a short-circuit current of 90 A. The structure is shown in Figure 4-7 on page 41. The wiring is as shown in Figure 4-6 on page 40.

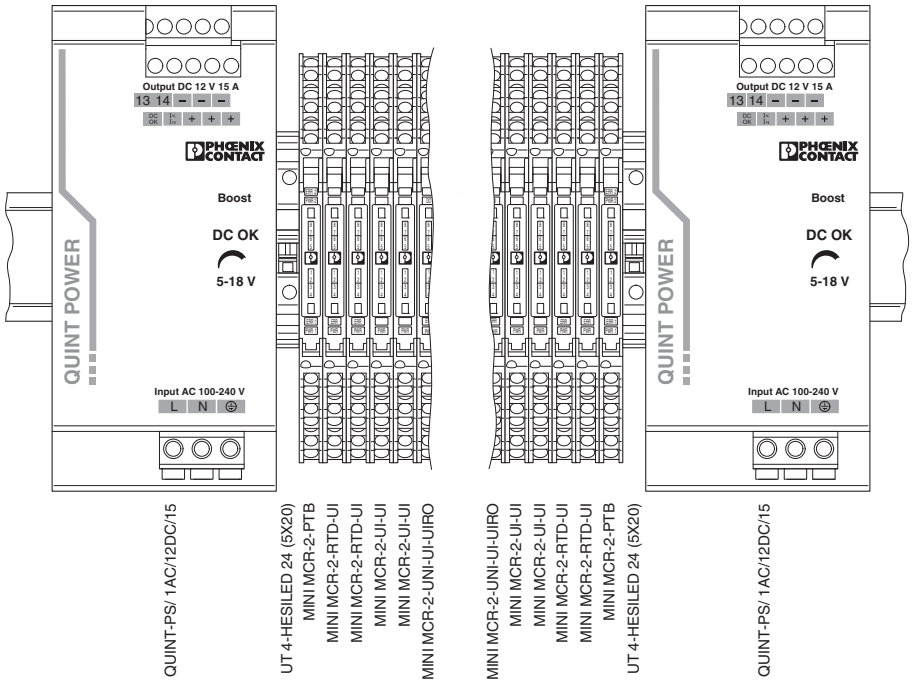


Figure 4-7 Example for supply via two MINI MCR-2-PTB… power terminal blocks

The disadvantage here is that in the event that the power terminal block fails, the supply of all signal conditioners is interrupted. However, this can be indicated in this example by means of a N/C contact by using a MINI MCR-2-FM-RC fault monitoring module and the MINI MCR-2-PTB power terminal block.



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## 4.3 Supply via system power supply

If there is no 24 V DC supply in the control cabinet or terminal box to supply the MINI Analog Pro signal conditioners, you can use a MINI-SYS-PS-100-240AC/24DC/1.5 (Order No. 2866983) or, for potentially explosive areas, a MINI-PS-100-240AC/24DC/1.5/EX (Order No. 2866653). These power supplies, which have been developed specifically for measurement and control technology, enable the signal conditioners to be supplied directly from a 230 V AC supply via the TBUS DIN rail connector. These power supplies are simply snapped onto the TBUS and deliver a maximum current of 1.5 A. For increased performance, up to two MINI-SYS-PS-100-240AC/24DC/1.5 or MINI-PS-100-240AC/24DC/1.5/EX can also be snapped on. This means that a total current of 3 A can be supplied. Please note, however, that redundant supply is not possible for currents greater than 1.5 A. A 6 A, 10 A or 16 A characteristic B circuit breaker should be used to protect the primary side.

Calculate the maximum number of modules with the aid of the relevant package slips using the formula below.

$$n_{modules} = \frac{I_{max}}{I_N} = \frac{1.5\ A\ (3\ A)}{I_N}$$

$$I_N = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$$

40 MINI MCR-2-TC-UI temperature transducers (Order No. 2902055) are to be supplied.

First determine the current consumption of the modules from the package slips. For these temperature transducers it is 32.5 mA per module.

Then determine the maximum total current consumption of all 40 modules.
$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$

$I = 40 * 32.5\ mA = 1300\ mA < 1500\ mA$



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The total current consumption of 1300 mA is less than the maximum permissible current for supply via the MINI-SYS-PS-100-240AC/24DC/1.5 or the MINI-PS-100-240AC/24DC/1.5/EX. The structure is shown in Figure 4-8 on page 43.

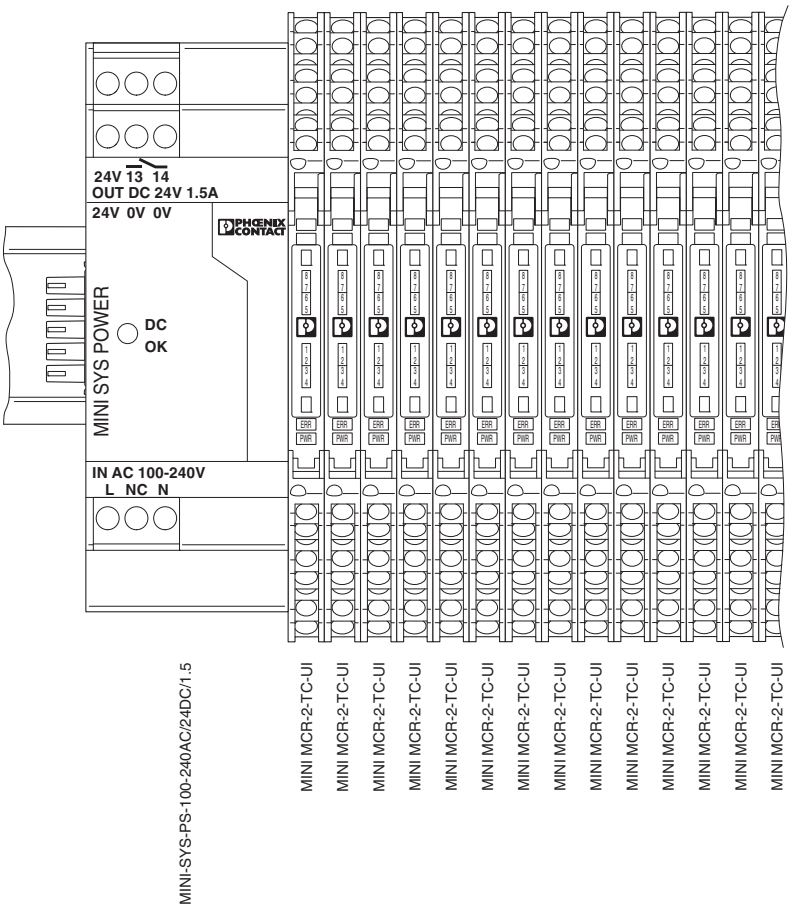


Figure 4-8 Supply via system power supply



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## 4.4 Monitoring the supply voltage using MINI MCR-2-FM-RC-… fault monitoring modules

As described in Section 4.2 on page 36, the MINI Analog Pro modules can be supplied with power via a MINI MCR-2-PTB… power terminal block (Order No. 2902066). Redundancy monitoring of the supply voltage can be configured when using the MINI MCR-2-FM-RC-… fault monitoring modules (Order No. 2904504). Mount a power terminal block and a fault monitoring module of the same shape side by side without spacing, see Figure 4-9 on page 44.

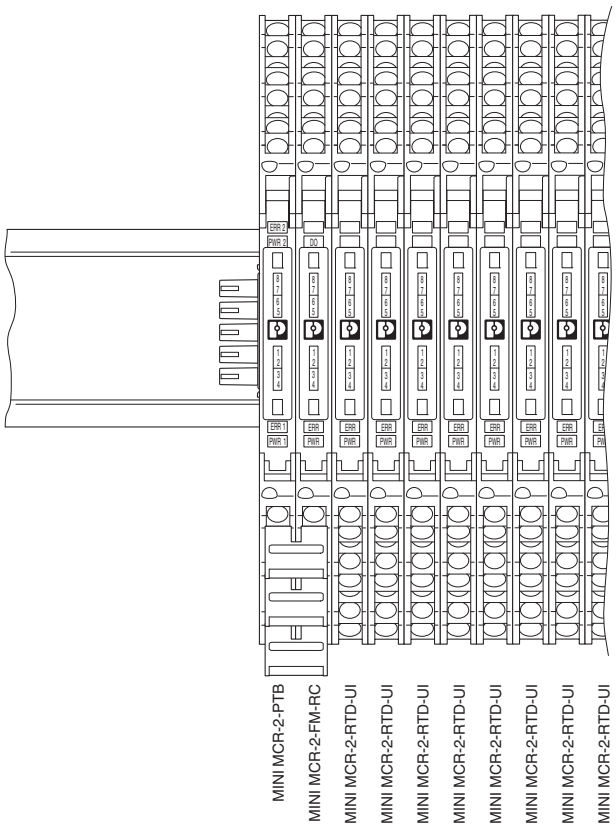


Figure 4-9 Redundancy monitoring of the supply voltage

Then bridge terminal blocks 1 to 4 of the power terminal block with terminal blocks 1 to 4 of the fault monitoring module. Use the FBSR 2-6 jumpers (Order No. 3033715) supplied with the fault monitoring module or normal cables. Now if one of the power supplies fails, this is indicated via a N/C contact. For additional mechanical redundancy, as shown in Section 4.2.2 on page 40, two power terminal blocks and two fault monitoring modules can be used, see Figure 4-10 on page 45. Again only one supply may be connected to each power terminal block here. In the second fault monitoring module, fault monitoring of external measuring transducers must be deactivated because evaluation can only take place via one module in a group.



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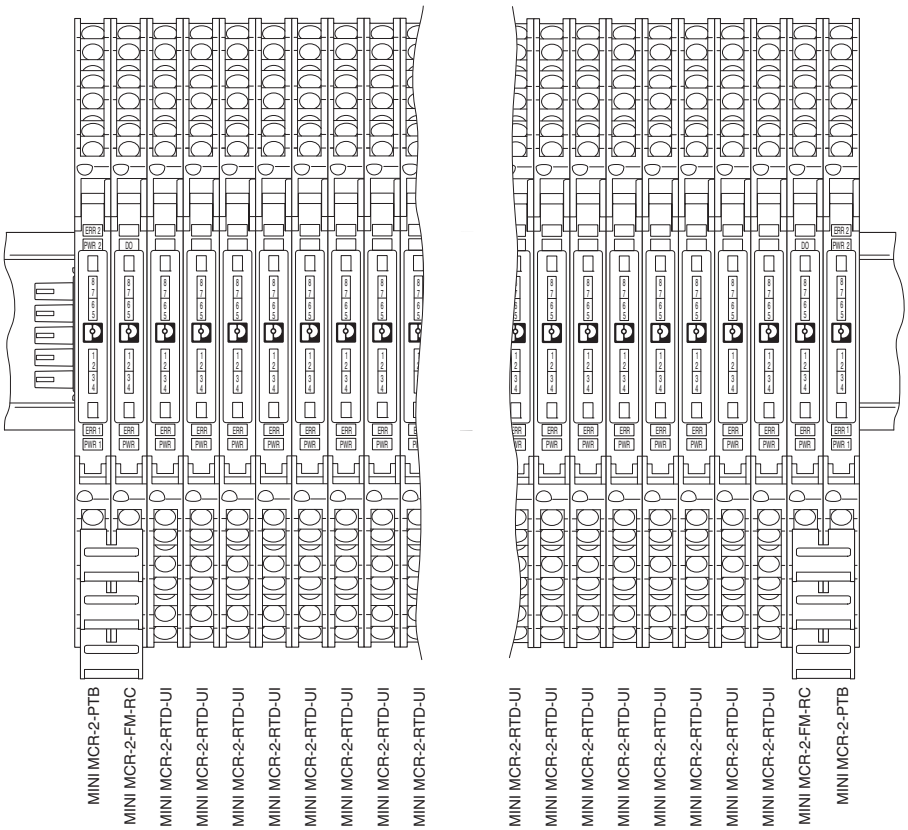


Figure 4-10 Additional mechanical redundancy

## 4.5 Using the MINI MCR-2-V8... gateways

If you are using a MINI Analog Pro V8 gateway (MINI MCR-2-V8...), the gateway is supplied via the MINI Analog Pro signal conditioners. In this case, you have to consider the current consumption of the gateway for each calculation. To illustrate this, the “Example for direct supply via a module” on page 45 is given again with an additional MINI MCR-2-V8-MOD-TCP module.

**Example for direct supply via a module**

Five MINI MCR-2-TC-UI temperature transducers (Order No. 2902055), three MINI MCR-2-UI-UI configurable signal conditioners (Order No. 2902037) and an additional MINI MCR-2-V8-MOD-TCP Modul (Order No. 2905635), with 4 mA … 20 mA current output, are to be supplied at an operating voltage of 24 V DC.

First determine the current consumption of the modules from the package slips. For the temperature transducers it is 31.5 mA per module and for the configurable transducers it is 25 mA at the desired current output. For the Modbus/TCP gateway it is 50 mA at 24 V .



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Then determine the maximum total current consumption of all nine modules.

$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$

$I = 5 * 31.5\ mA + 3 * 25\ mA + 1 * 50\ mA = 282\ mA < 400\ mA$

The total current consumption of 282 mA is less than the maximum permissible current for supply via a module. The fuse to be connected upstream of the supply signal conditioner should have a nominal current of 500 mA. To ensure that the fuse definitely trips in the event of a short circuit, the 24 V DC supply in this example is provided by a QUINT-PS/ 1AC/24DC/ 3.5 (Order No. 2866747). The structure is shown in Figure 4-11 on page 46. The wiring is as shown in Figure 4-1 on page 34.

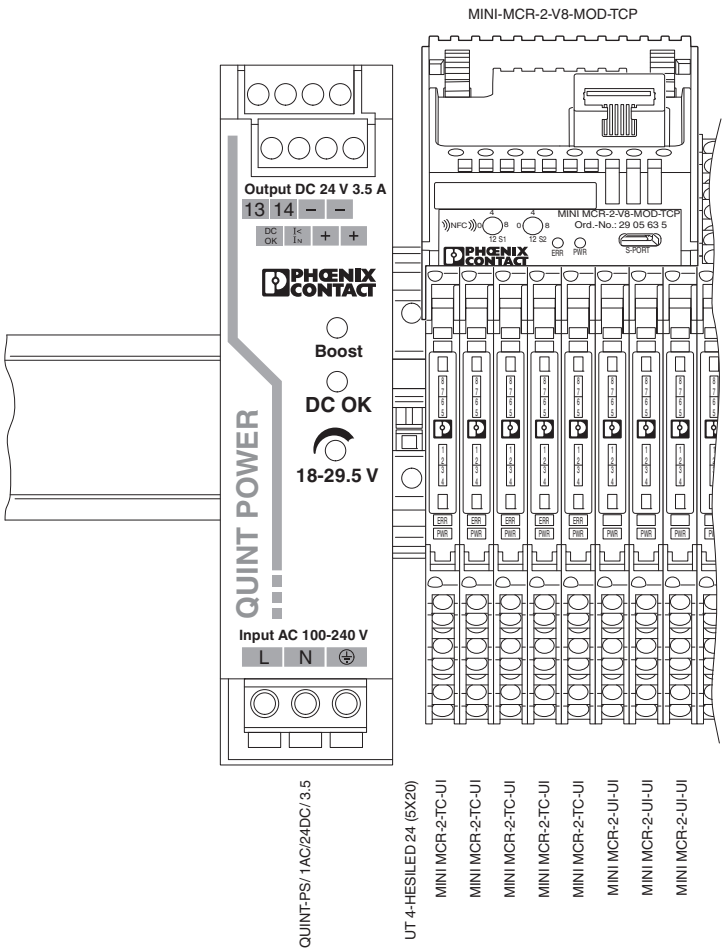


Figure 4-11 Example for direct supply via a module

In addition to the low maximum number of modules, another disadvantage of this method of supply is that fault monitoring is not possible. However, this function is provided by the method of supply described in the next section.



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# 5 Supply options for MACX Analog (Ex)/MACX PL

MACX Analog (Ex) and MACX PL signal conditioners, which are compatible with the DIN rail connector, require a 24 V DC supply. MACX Analog (Ex) and MACX PL modules are also available with an extended supply voltage range of 24 V ... 230 V AC/DC. However, these modules are only ever supplied individually via the terminal blocks on the device and are not suitable for supply by means of the TBUS DIN rail connector. When supplying individual devices directly via the terminal blocks, various methods for supplying power to several modules in the MACX Analog (Ex) and MACX PL product range can be implemented using the DIN rail connector (ME 6,2 TBUS-2 1,5/5-ST-3,81 GN, Order No. 2869728). It is supplied with 24 V DC and supplies all connected signal conditioners. This eliminates the need for time-consuming and costly single wiring.

When there are only a few modules mounted side by side, the ideal solution is to supply the DIN rail connector directly and therefore the connected modules via a signal conditioner, see Section 5.1 on page 47. One way to supply several modules, with short-circuit and cable break detection, is to use MACX MCR-PTB… and TC-MACX-MCR-PTB devices, see Section 5.2 on page 50. These devices also support redundant supply, if required.

If there is no 24 V DC supply, the devices from the MINI Power Supply series introduced in Section 5.3 on page 60 are used. They are suitable for connection to 230 V AC and are specifically tailored to the requirements of measurement and control technology. They can also be used in potentially explosive areas.

**NOTE: Risk of damage to equipment**
Never connect the supply voltage directly to the DIN rail connector.

## 5.1 Direct supply via a MACX Analog (Ex) or MACX PL signal conditioner

In the case of direct supply, all modules connected to the TBUS DIN rail connector are supplied via the supply at a signal conditioner. Please note that the maximum total current consumption of $I_{max}$ = 400 mA must not be exceeded and the maximum number of modules is therefore restricted to a few devices. The maximum number of devices can be calculated using the formula below. For the respective current consumption of the individual signal conditioners, please refer to specifications on the Phoenix Contact homepage, in the package slips or the data sheets.

$$n_{modules} = \frac{I_{max}}{I_N} = \frac{400\ mA}{I_N}$$

$$I_N = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$$



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A 500 mA fuse should be connected upstream as protection. In addition, you must make sure that with the 24 V DC supply used the fuse will definitely trip in the event of an error.

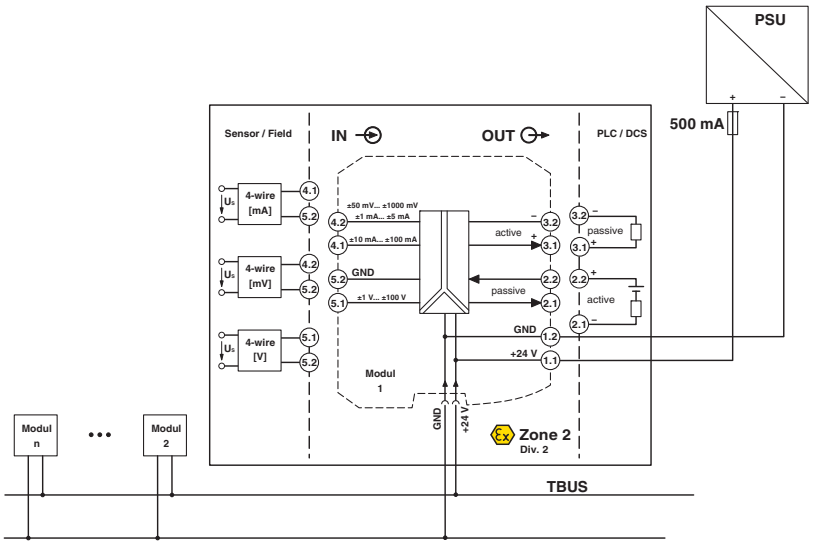


Figure 5-1 Direct supply via a module

**Example for direct supply via a module**

Five MACX MCR-SL-RTD-I temperature transducers (Order No. 2865065) and three MACX MCR-SL-NAM-R NAMUR signal conditioners (Order No. 2865997) are to be supplied at an operating voltage of 24 V DC.

First determine the current consumption of the modules from the package slips. For the temperature transducers it is 40 mA per module and for the NAMUR signal conditioners it is 21 mA at the desired current output.

Then determine the maximum total current consumption of all eight modules.
$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$

$I = 5 * 40\ mA + 3 * 21\ mA = 263\ mA < 400\ mA$

The total current consumption of 263 mA is less than the maximum permissible current for supply via a module. The fuse to be connected upstream of the supply signal conditioner should have a nominal current of 500 mA. To ensure that the fuse definitely trips in the event



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of a short circuit, the 24 V DC supply in this example is provided by a QUINT-PS/ 1AC/24DC/ 3.5 (Order No. 2866747). The structure is shown in Figure 5-2 on page 49. The wiring is as shown in Figure 5-1 on page 48.

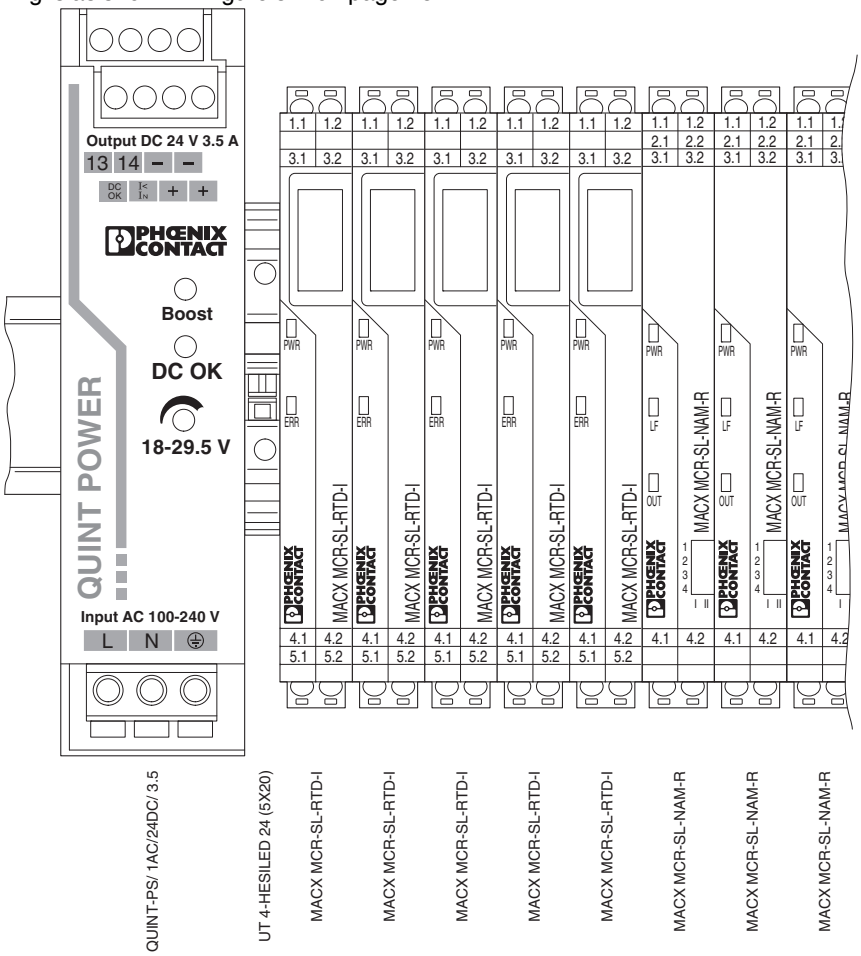


Figure 5-2 Example for direct supply via a module

In addition to the low maximum number of modules, another disadvantage of this method of supply is that short-circuit and cable break detection is not possible. However, this function is provided by the method of supply described in the next section.



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## 5.2 Supply via MACX MCR-PTB... and TC-MACX-MCR-PTB power terminal blocks

MACX MCR-PTB… (Order No. 2865625) and TC-MACX-MCR-PTB (Order No. 2904673) power terminal blocks are particularly suitable for supplying power to MACX Analog modules. This means that a total current of 3.75 A or 2 A can be supplied. Integrated error evaluation is an additional advantage here. An auxiliary supply failure or fuse fault is indicated by a relay contact and displayed via a flashing LED. Redundant supply is supported as an option. The decoupling of power supplies used for supply is ensured by the diodes integrated in the module. In addition, it is possible to extend mechanical redundancy by using two power terminal blocks. Each power terminal block is protected by an integrated 5 A fuse. The TC-MACX-MCR-PTB, on the other hand, does not have an integrated fuse. Here a 2.5 A fuse should be connected upstream of every input. It is important to make sure here that tripping is guaranteed in the event of a short circuit by the power supply/supplies used. You can calculate the maximum number of modules, regardless of whether you are using one or two (TC-)MACX MCR-PTB… modules, with the aid of the product documents using the formula below.

MACX MCR-PTB-...

$$n_{modules} = \frac{I_{max}}{I_N} = \frac{3.75\ A}{I_N}$$

TC-MACX-MCR-PTB

$$n_{modules} = \frac{I_{max}}{I_N} = \frac{2\ A}{I_N}$$

$$I_N = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$$

### 5.2.1 Supply via a MACX MCR-PTB… power terminal block

For supply via a power terminal block, simple supply can be implemented by means of one power supply, see Figure 5-3 on page 50, or redundant supply by means of two different power supplies is implemented, see Figure 5-4 on page 51.

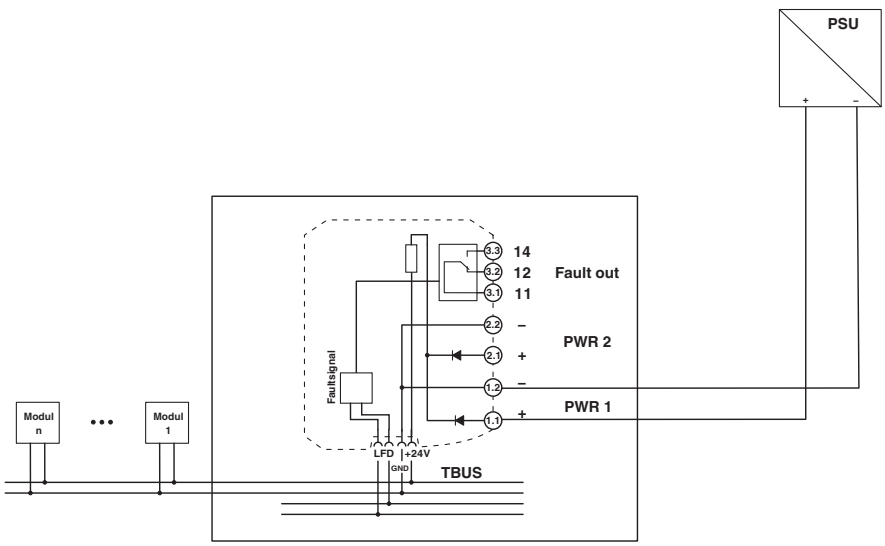


Figure 5-3 Supply by means of one power supply



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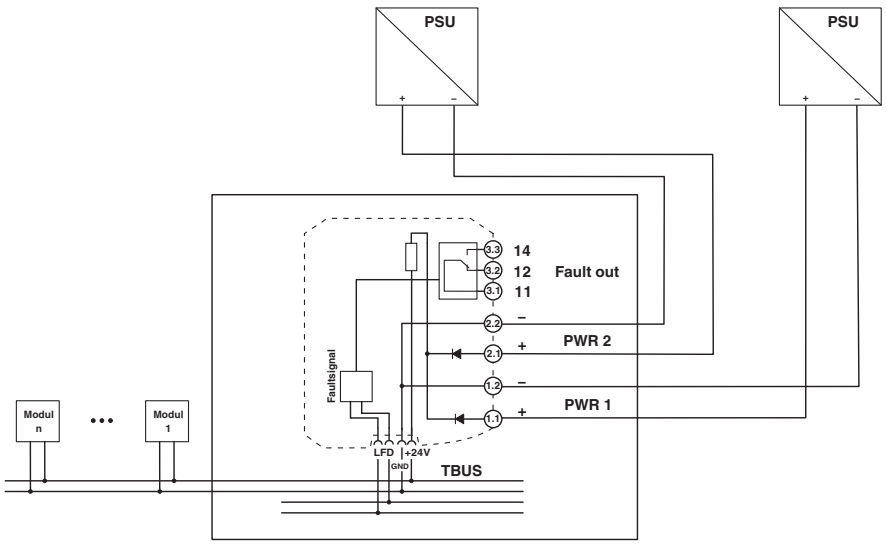


Figure 5-4 Supply by means of redundant power supplies

**Example for supply via a MACX MCR-PTB… power terminal block**

32 MACX MCR-SL-RTD-I temperature transducers (Order No. 2865065), 40 MACX MCR-SL-NAM-R NAMUR signal conditioners (Order No. 2865997), and 26 MACX MCR-EX-SL-RPSSI-I Ex i repeater power supplies (Order No. 2865340) are to be supplied at an operating voltage of 24 V DC.

First determine the current consumption of the modules from the package slips. For the temperature transducers it is 40 mA per module and for the NAMUR signal conditioners it is 21 mA. The intrinsically safe repeater power supplies require 60 mA each.

Then determine the maximum total current consumption of all 98 modules.
$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$

$I = 32 * 40\ mA + 40 * 21\ mA + 26 * 60\ mA = 3680\ mA < 3750\ mA$

The total current consumption of 3680 mA is less than the maximum permissible current for supply via the MACX MCR-PTB…. To ensure that the built-in fuse in the MACX MCR-PTB definitely trips in the event of a short circuit, the 24 V DC supply in this example is provided by QUINT-PS/ 1AC/24DC/ 3.5 power supplies (Order No. 2866747), which provide a short-circuit current of 15 A. The structure is shown in Figure 5-5 on page 52. The wiring is as shown in Figure 5-4 on page 51.



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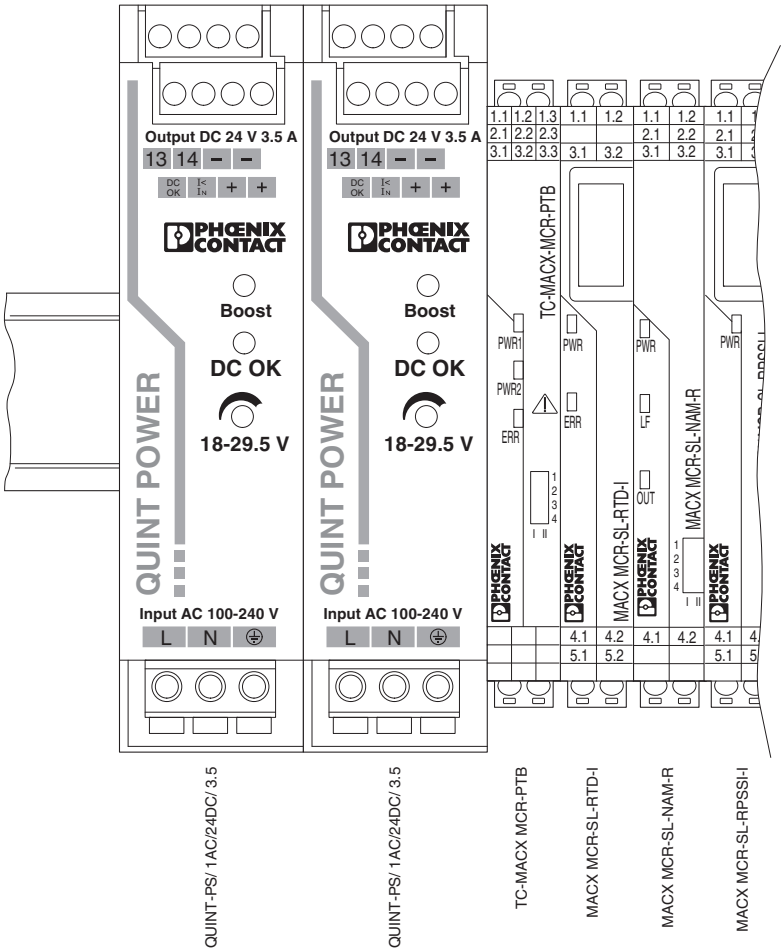


Figure 5-5 Example for supply via a MACX MCR-PTB… power terminal block

The disadvantage here is that in the event that the power terminal block fails, the supply of all signal conditioners is interrupted.



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### 5.2.2 Supply via two MACX MCR-PTB… power terminal blocks

If redundant supply via two MACX MCR-PTB… is desired, the supply for each module must be provided by a separate voltage source, see Figure 5-3 on page 50. Likewise, you should also position the two modules at either end of the DIN rail in order to limit the maximum short-circuit current in the event of an error, see Figure 5-6 on page 54. A maximum current of 3.75 A must not be exceeded here. Redundant supply is thereby ensured. However, to increase the total number of signal conditioners, a maximum current of 6 A can be supplied via both power terminal blocks (note, no redundancy).

#### Example for supply via two MACX MCR-PTB… power terminal blocks

As in the previous example, 32 MACX MCR-SL-RTD-I temperature transducers (Order No. 2865065), 40 MACX MCR-SL-NAM-R NAMUR signal conditioners (Order No. 2865997), and 26 MACX MCR-EX-SL-RPSSI-I Ex i repeater power supplies (Order No. 2865340) are to be supplied redundantly at an operating voltage of 24 V DC.

First determine the current consumption of the modules from the package slips. For the temperature transducers it is 40 mA per module and for the NAMUR signal conditioners it is 21 mA. Likewise, the intrinsically safe repeater power supplies require 60 mA each.

Then determine the maximum total current consumption of all 98 modules.
$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$

$I = 32 * 40\ mA + 40 * 21\ mA + 26 * 60\ mA = 3680\ mA < 3750\ mA$

The total current consumption of 3680 mA is less than the maximum permissible current for supply via the MACX MCR-PTB…. To ensure that the built-in fuse in the MACX MCR-PTB definitely trips in the event of a short circuit, the 24 V DC supply in this example is provided



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by QUINT-PS/ 1AC/24DC/ 3.5 power supplies (Order No. 2866747), which provide a short-circuit current of 15 A. The structure is shown in Figure 5-6 on page 54. The wiring is as shown in Figure 5-3 on page 50.

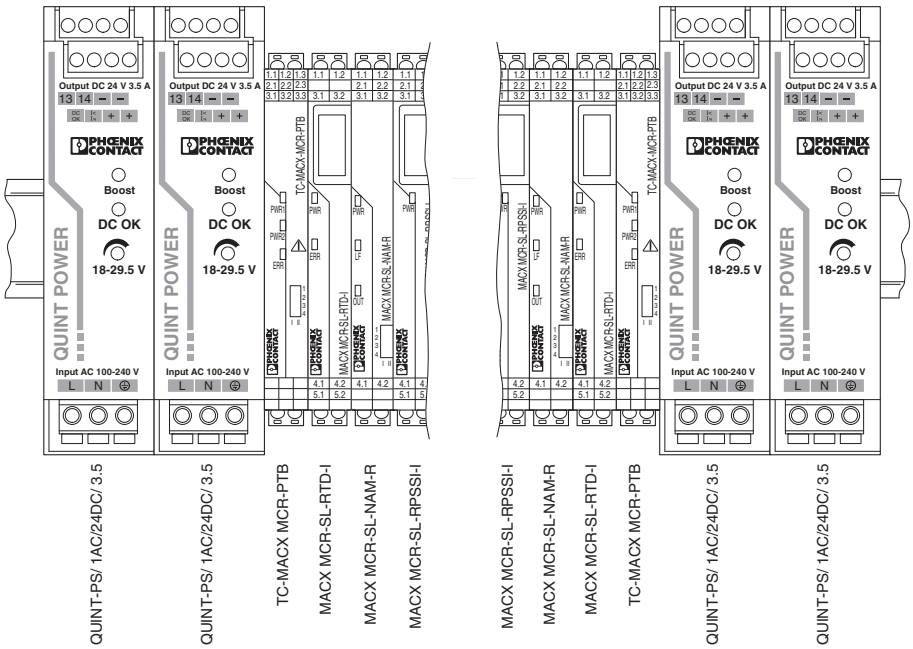


Figure 5-6 Example for supply via two MACX MCR-PTB… power terminal blocks



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### 5.2.3 Supply via a TC-MACX-MCR-PTB power terminal block

You can also use the TC-MACX-MCR-PTB power terminal block (Order No. 2904673) designed for the Termination Carrier to supply the DIN rail connector. However, unlike a standard MACX power terminal block there is no built-in fuse, which means that a suitable fuse must be connected upstream. The maximum output current is limited to 2 A for this device. The TC-MACX-MCR-PTB offers the option of undervoltage monitoring at the input (19.2 V). Simple supply can be implemented by means of one power supply, see Figure 5-7 on page 55, or redundant supply by means of two different power supplies is implemented, see Figure 5-8 on page 56.

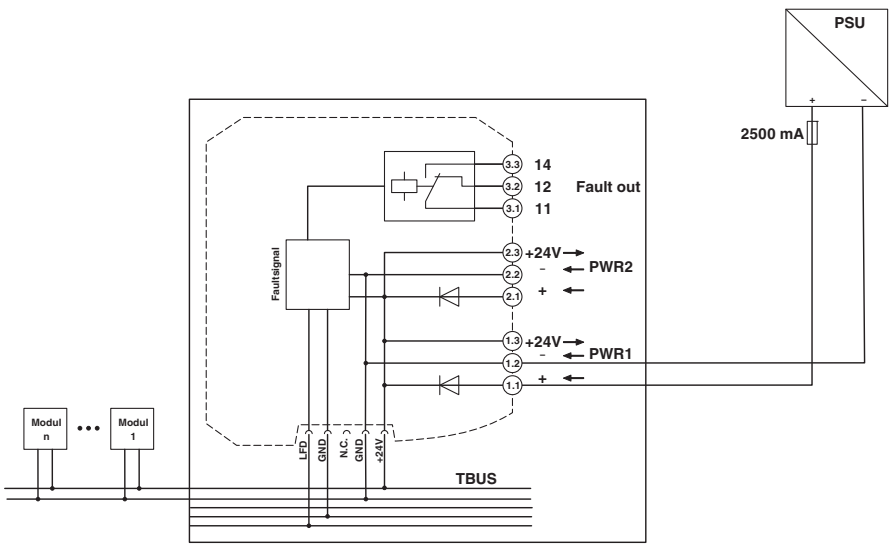


Figure 5-7 Supply by means of one power supply



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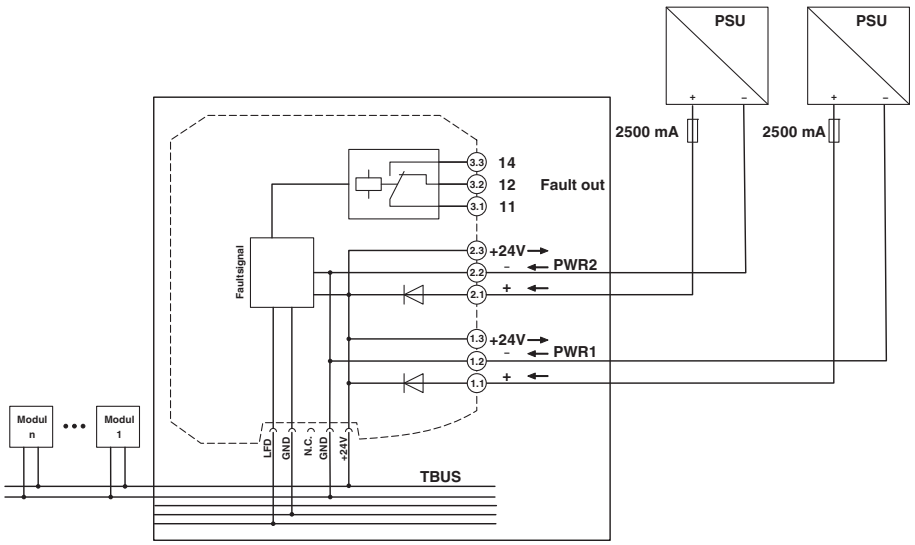


Figure 5-8 Supply by means of redundant power supplies

**Example for supply via a TC-MACX-MCR-PTB power terminal block**

16 MACX MCR-SL-RTD-I temperature transducers (Order No. 2865065), 20 MACX MCR-SL-NAM-R NAMUR signal conditioners (Order No. 2865997), and 13 MACX MCR-EX-SL-RPSSI-I Ex i repeater power supplies (Order No. 2865340) are to be supplied at an operating voltage of 24 V DC.

First determine the current consumption of the modules from the package slips. For the temperature transducers it is 40 mA per module and for the NAMUR signal conditioners it is 21 mA. The intrinsically safe repeater power supplies require 60 mA each.

Then determine the maximum total current consumption of all 49 modules.
$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$

$I = 16 * 40\ mA + 20 * 21\ mA + 13 * 60\ mA = 1840\ mA < 2000\ mA$

The total current consumption of 1840 mA is less than the maximum permissible current for supply via the TC-MACX-MCR-PTB. To ensure that the 2500 mA fuse to be connected upstream of the TC-MACX-MCR-PTB definitely trips in the event of a short circuit, the 24 V DC



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supply in this example is provided by QUINT-PS/ 1AC/24DC/ 3.5 power supplies (Order No. 2866747), which provide a short-circuit current of 15 A. The structure is shown in Figure 5-9 on page 57. The wiring is as shown in Figure 5-8 on page 56.

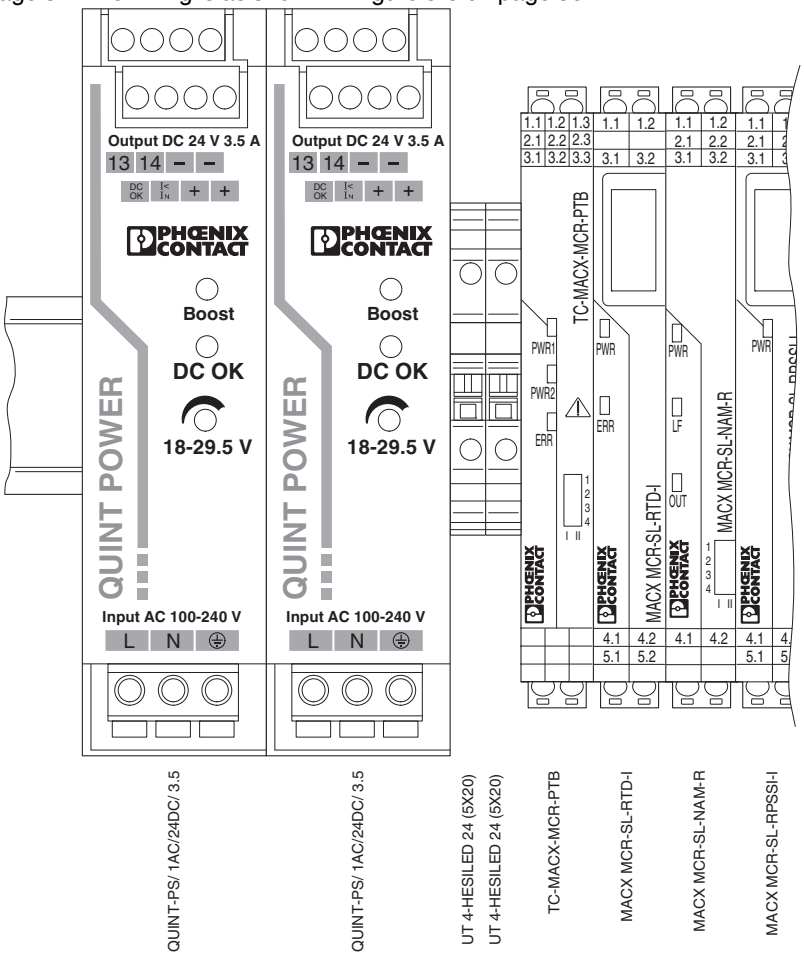


Figure 5-9 Example for supply via a TC-MACX-MCR-PTB power terminal block

The disadvantage here is that in the event that the power terminal block fails, the supply of all signal conditioners is interrupted.



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### 5.2.4 Supply via two TC-MACX-MCR-PTB power terminal blocks

If redundant supply via two TC-MACX MCR-PTB is desired, the supply for each module must be provided by a separate voltage source, see Figure 5-7 on page 55. Likewise, you should position the two modules at either end of the DIN rail in order to limit the maximum short-circuit current in the event of an error, see Figure 5-10 on page 59. A maximum current of 2 A must not be exceeded here. Redundant supply is thereby ensured. However, to increase the total number of signal conditioners, a maximum current of 4 A can be supplied via both power terminal blocks (note, no redundancy).

**Example for supply via two TC-MACX-MCR-PTB power terminal blocks**

16 MACX MCR-SL-RTD-I temperature transducers (Order No. 2865065), 20 MACX MCR-SL-NAM-R NAMUR signal conditioners (Order No. 2865997), and 13 MACX MCR-EX-SL-RPSSI-I Ex i repeater power supplies (Order No. 2865340) are to be supplied redundantly at an operating voltage of 24 V DC.

First determine the current consumption of the modules from the package slips. For the temperature transducers it is 40 mA per module and for the NAMUR signal conditioners it is 21 mA. The intrinsically safe repeater power supplies require 60 mA each.

Then determine the maximum total current consumption of all 49 modules.
$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$

$I = 16 * 40\ mA + 20 * 21\ mA + 13 * 60\ mA = 1840\ mA < 2000\ mA$

The total current consumption of 1840 mA is less than the maximum permissible current for supply via the TC-MACX-MCR-PTB. To ensure that the 2500 mA fuse to be connected upstream of the TC-MACX-MCR-PTB definitely trips in the event of a short circuit, the 24 V DC



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supply in this example is provided by QUINT-PS/ 1AC/24DC/ 3.5 power supplies (Order No. 2866747), which provide a short-circuit current of 15 A. The structure is shown in Figure 5-10 on page 59. The wiring is as shown in Figure 5-8 on page 56.

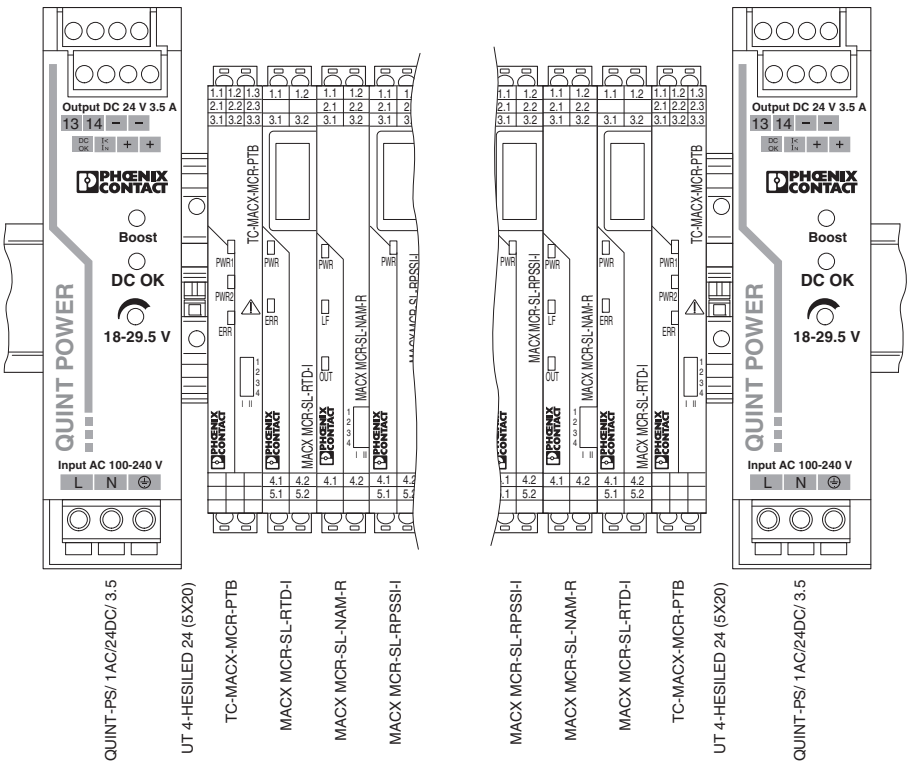


Figure 5-10 Example for supply via two TC-MACX-MCR-PTB power terminal blocks



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## 5.3 Supply via system power supply

If there is no 24 V DC supply in the control cabinet or terminal box to supply the MACX Analog signal conditioners, it is recommended that you use MACX signal conditioners with wide range supply. However, if you wish to avoid time-consuming and costly single wiring, you can use a MINI-SYS-PS-100-240AC/24DC/1.5 (Order No. 2866983) or, for potentially explosive areas, a MINI-PS-100-240AC/24DC/1.5/EX (Order No. 2866653). These power supplies, which have been developed specifically for measurement and control technology, enable the signal conditioners to be supplied directly from a 230 V AC supply via the TBUS DIN rail connector. These power supplies are simply snapped onto the TBUS and deliver a maximum current of 1.5 A. For increased performance, up to two MINI-SYS-PS-100-240AC/24DC/1.5 or MINI-PS-100-240AC/24DC/1.5/EX can also be snapped on. This means that a total current of 3 A can be supplied. Please note, however, that redundant supply is not possible for currents greater than 1.5 A. A 6 A, 10 A or 16 A characteristic B circuit breaker should be used to protect the primary side.

Calculate the maximum number of modules with the aid of the relevant package slips using the formula below.

$$n_{modules} = \frac{I_{max}}{I_N} = \frac{1.5\ A\ (3\ A)}{I_N}$$

$$I_N = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$$



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**Example for supply via a system power supply**

35 MACX MCR-SL-RTD-I temperature transducers (Order No. 2865065) are to be supplied.

First determine the current consumption of the modules from the package slips. For these temperature transducers it is 40 mA per module.

Then determine the maximum total current consumption of all 35 modules.
$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + ...$

$I = 35 * 40\ mA = 1400\ mA < 1500\ mA$

The total current consumption of 1400 mA is less than the maximum permissible current for supply via the MINI-SYS-PS-100-240AC/24DC/1.5 or the MINI-PS-100-240AC/24DC/1.5/EX. The structure is shown in Figure 5-11 on page 61.

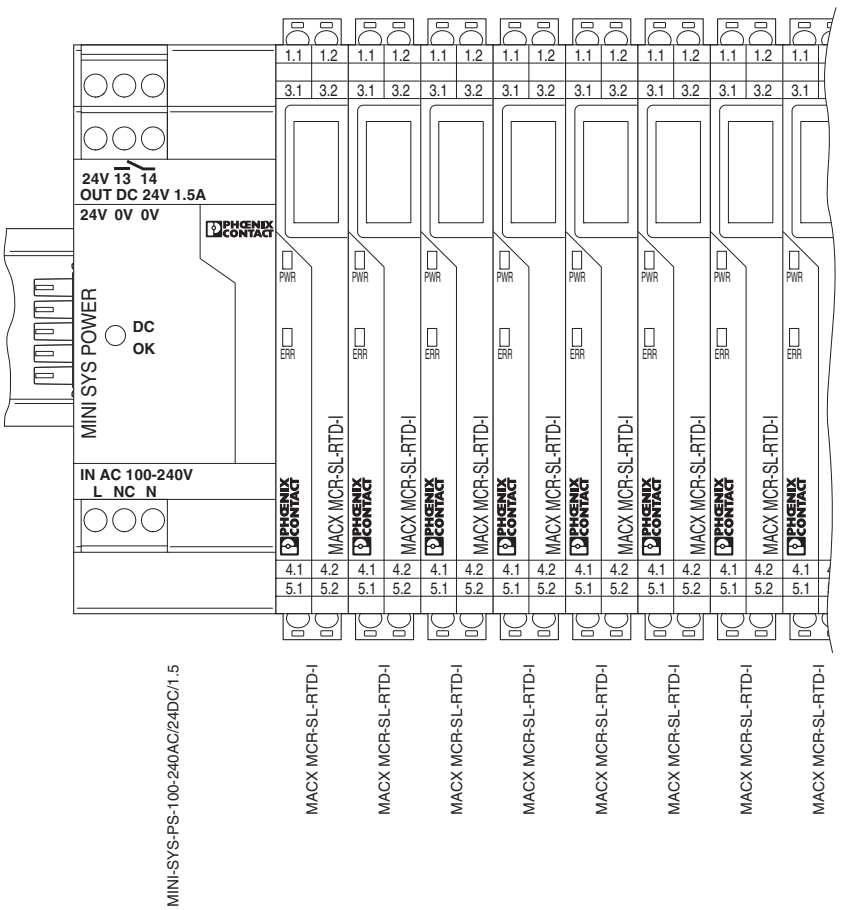


Figure 5-11 Example for supply via a system power supply



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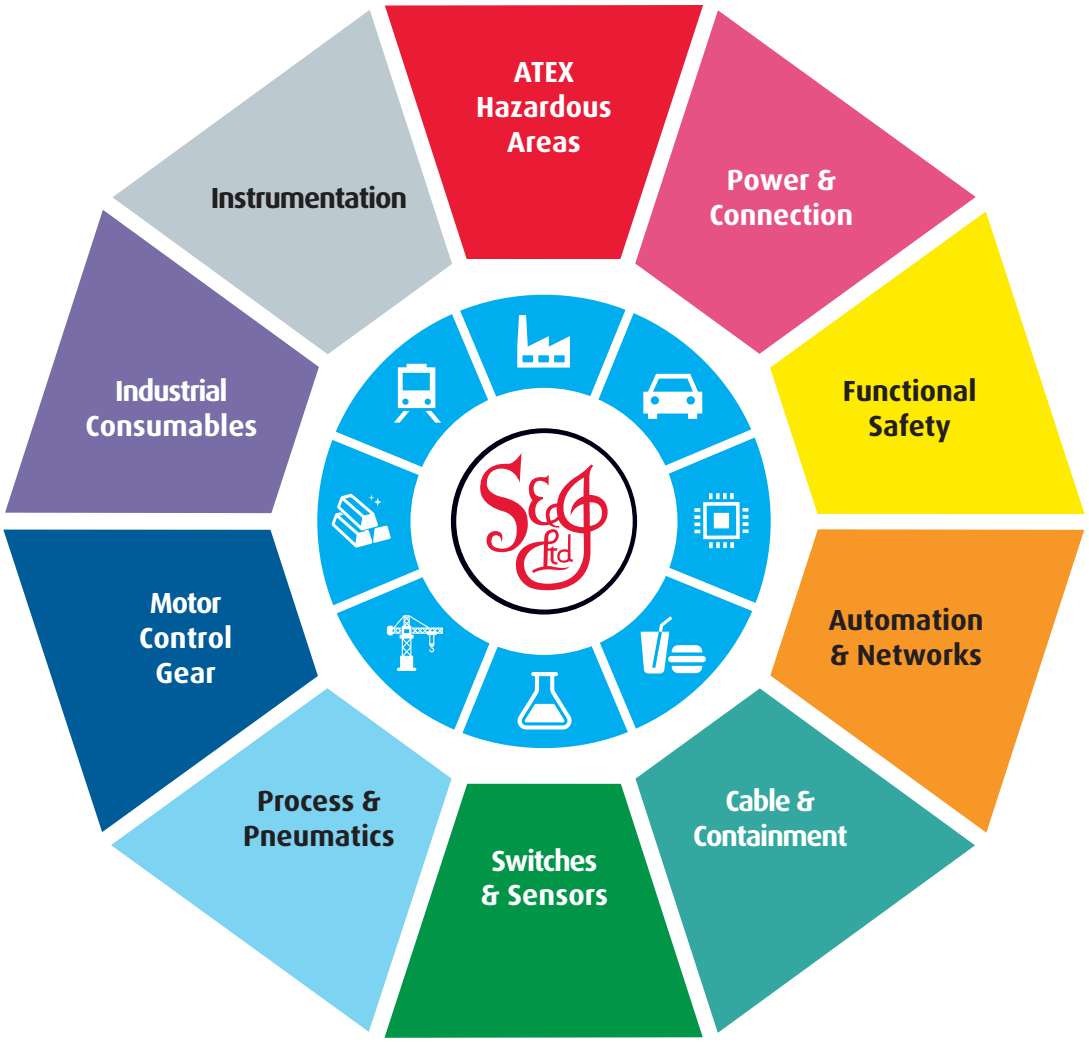


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