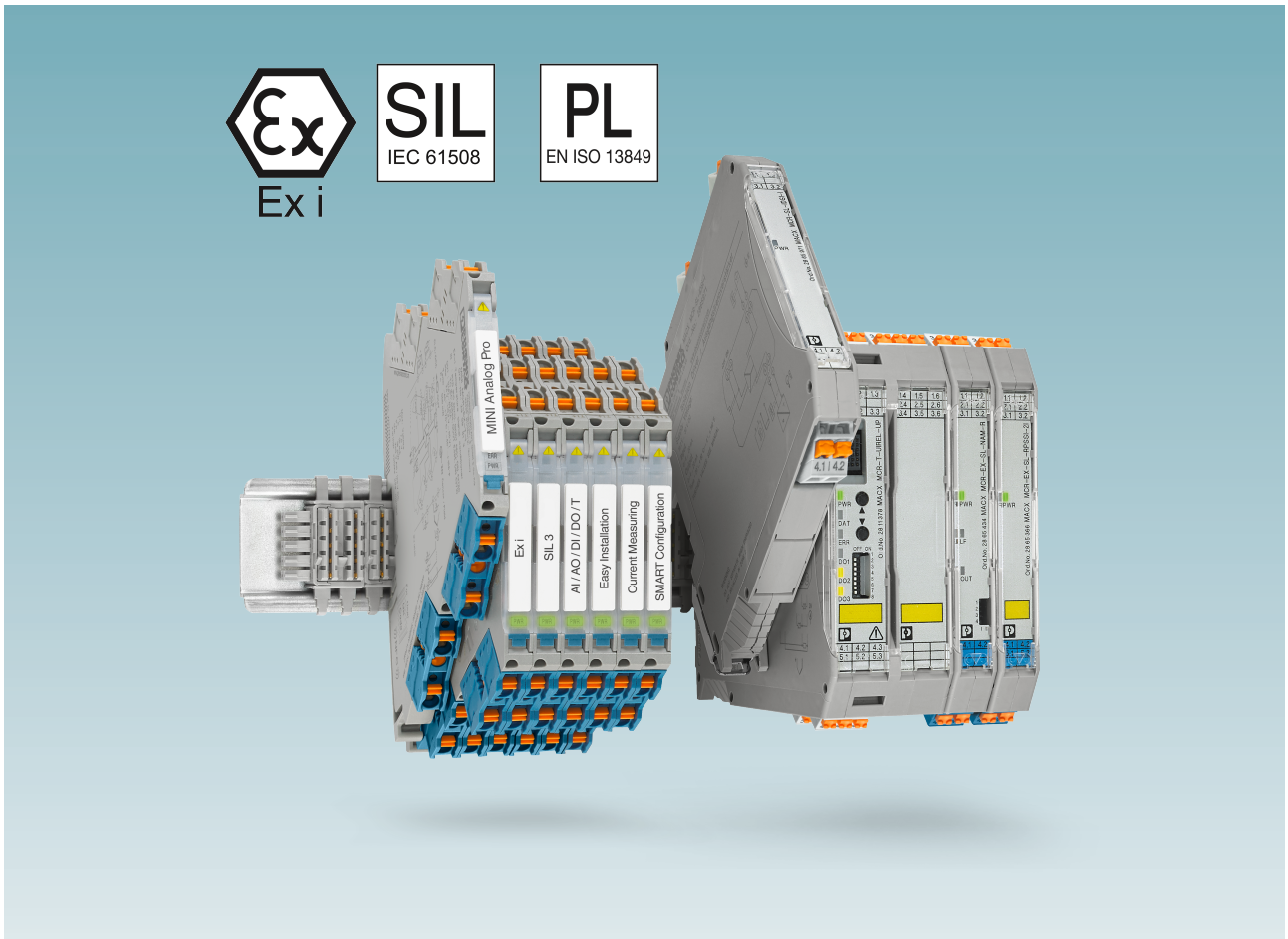

Power manual for signal conditioners and MINI Analog, MINI Analog Pro, MACX Analog measuring transducers

User manual

PHOENIX CONTACT

User manual

Power manual for signal conditioners and MINI Analog, MINI Analog Pro, MACX Analog measuring transducers

UM EN Power Manual, Revision 02 2024-07-29

This manual is valid for:

Designation
MINI Analog MINI MCR-... product family
MINI Analog Pro MINI MCR-2-... product family
MINI Analog Pro MINI MCR-EX... product family
MACX Analog MACX MCR-... product family
MACX Analog Ex MACX MCR-EX... product family

Accessories	**Item No.**
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
ME 17,5 TBUS 1,5/5-ST-3,81 KMGY	2713645
ME 17,5 TBUS	1090049
ME-TBUS-A-MC-1,5-2	1351974
ME-TBUS-A-IMC-1,5-2	1351982
MCR-DP	1430594
QUINT4-SYS-PS/1AC/24DC/2,5/SC	2904614
QUINT4-PS/1AC/24DC/3,8/SC	2904599
TC-MACX-MCR-PTB	2904673

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phoenixcontact.com

Table of contents

1 For your safety

Read this manual carefully and keep it for future reference.

1.1 Identification of warning notes

This symbol indicates hazards that could lead to personal injury.

There are three signal words indicating the severity of a potential injury.

DANGER

Indicates a hazard with a high risk level. If this hazardous situation is not avoided, it will result in death or serious injury.

WARNING

Indicates a hazard with a medium risk level. If this hazardous situation is not avoided, it could result in death or serious injury.

CAUTION

Indicates a hazard with a low risk level. If this hazardous situation is not avoided, it could result in minor or moderate injury.

This symbol together with the **NOTE** signal word warns the reader of actions that might cause property damage or a malfunction.

Here you will find additional information or detailed sources of information.

1.2 Qualification of users

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

– Electrically skilled persons or persons instructed by them. The users must be familiar with the relevant safety concepts of automation technology as well as applicable standards and other regulations.
– Qualified application programmers and software engineers. The users must be familiar with the relevant safety concepts of automation technology as well as applicable standards and other regulations.

1.3 Safety notes

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

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

1.3.1 Installation notes

Installation, operation, and maintenance may only be carried out by qualified electricians. When using the device, observe the installation notes in the data sheet at phoenixcontact.com/products.

1.3.2 Use in potentially explosive areas (zone 2/Ex i)

When using the device in applications in potentially explosive areas, observe the instructions in the data sheet at phoenixcontact.com/products, as the requirements may deviate under these circumstances.

1.3.3 Safety-related applications (SIL)

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

1.3.4 System power supplies

To ensure that the device is operated safely and all functions can be used, read this manual carefully. You will find further information in the corresponding data sheet at phoenixcontact.com/products.

2 General notes on the supply of Phoenix Contact signal conditioners

Observe the corresponding packing slip for the relevant products.

NOTE: Connection notes
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 by means of the TBUS DIN rail connector. Time-consuming and error-prone wiring of single-core wiring is thus eliminated. You can supply the DIN rail connector in the following ways:

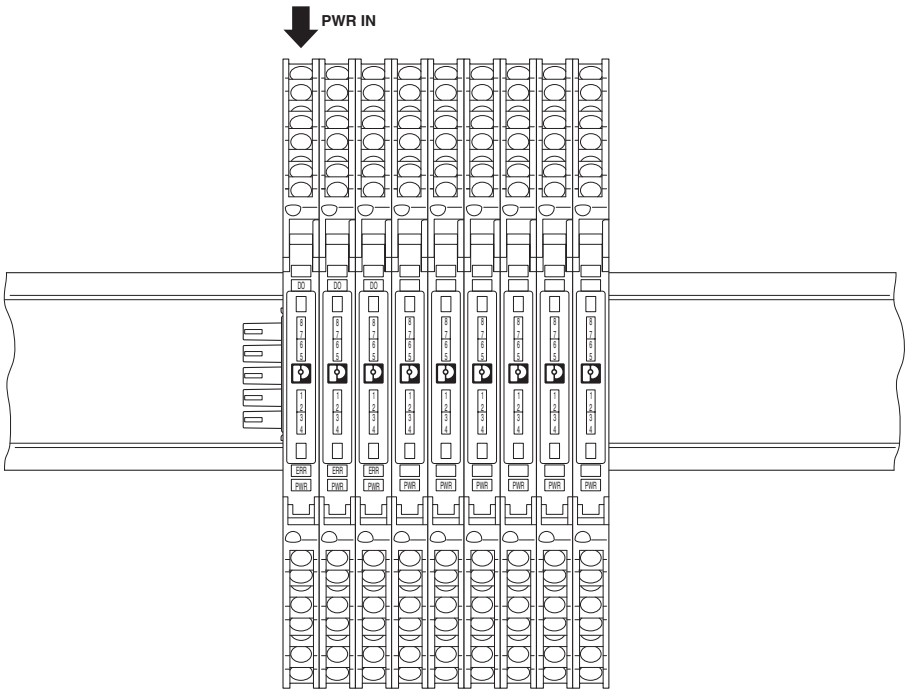
– Direct DC feed-in at any Analog module in the group
– Supply via a power terminal of the same shape
– Supply via any MINI Analog, MINI Analog Pro or MACX Analog power terminal
– Supply via a system power supply with a wide range input of 85 V AC ... 264 V AC

All of the power supply methods for MINI Analog, MINI Analog Pro, and MACX Analog (Ex) modules presented in this 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 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.

2.1 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 (two to eight) and fault monitoring is not required.

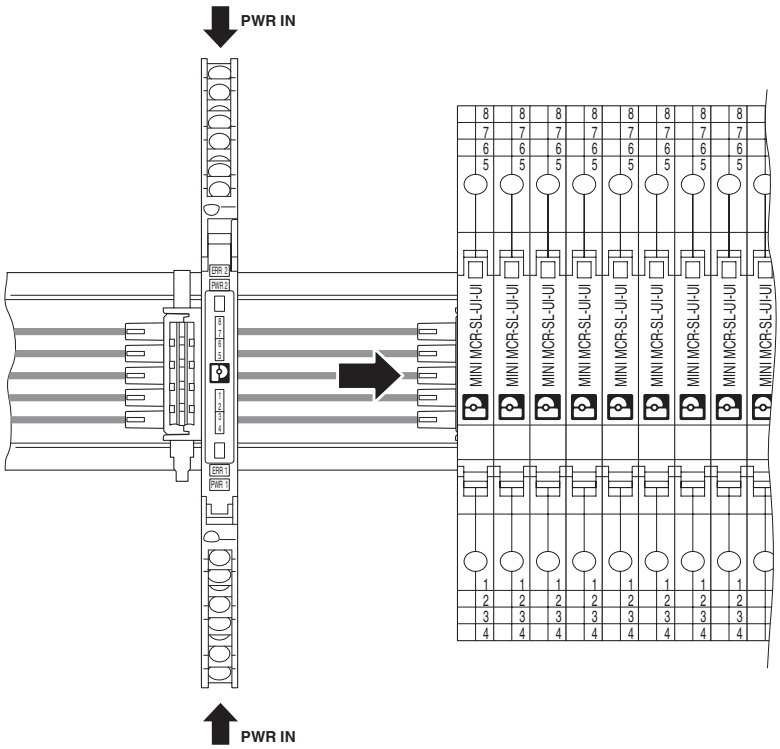
Figure 2-1 Direct supply via any module, e.g., MINI Analog Pro



2.2 Supply via any MINI Analog, MINI Analog Pro or MACX Analog power terminal

This version is particularly suitable if a relatively large number of connected signal conditioners is to be used or existing systems are to be extended and, for example, the newer MINI Analog Pro signal conditioners are to be installed in addition to existing MINI Analog signal conditioners, and the use of a power terminal is required. This option also supports fault monitoring.

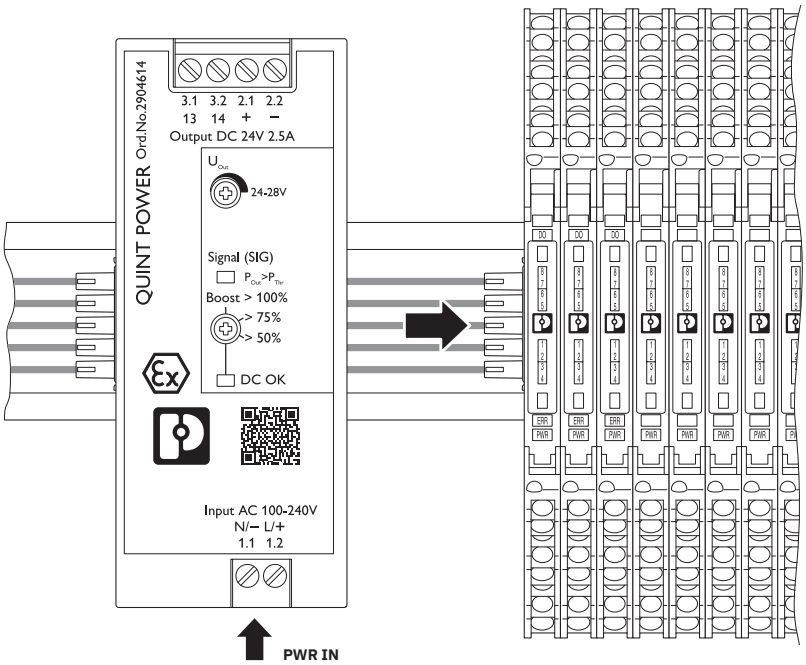
Figure 2-2 Supply via any MINI Analog, MINI Analog Pro or MACX Analog power terminal



2.3 Supply via a system power supply with a wide range input of 85 V AC ... 264 V AC

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 2-3 Supply via a system power supply with a wide range input of 85 V AC ... 264 V AC



3 MINI Analog supply options

The MINI Analog signal conditioners require a supply with 24 V DC (19.2 V DC ... 30 V DC). 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 family can be implemented using a DIN rail connector (ME 6,2 TBUS-2 1,5/5-ST-3,81 GN, item no. 2869728 or ME 6,2 TBUS-21,5/5-ST-3,81 KMGY, item no. 2969401). It is supplied with 24 V DC and supplies all connected signal conditioners. This eliminates the need for time-consuming and costly single-core 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 12. One way to supply several modules, with or without short-circuit and cable break detection (see Section 3.4 on page 22), is to use MINI MCR-SL-PTB... devices (see Section 3.2 on page 14). These devices also support redundant supply. 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 signaling module offers sufficient reserves (see Section 4.2 on page 28).

If there is no 24 V DC supply, the QUINT4-SYS-PS/1AC/24DC/2.5/SC system power supply presented in Section 3.3 on page 20 (item no. 2904614) can be used. It is suitable for connection to 230 V AC and is specifically tailored to the requirements of MCR technology (measurement and control). Use in a potentially explosive area is also possible.

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

3.1 Direct supply via a MINI Analog signal conditioner

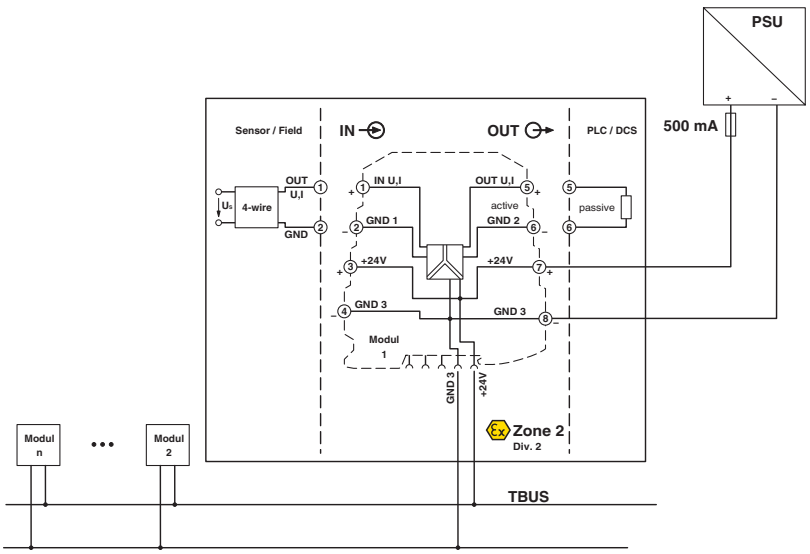
In the case of direct supply, all modules connected to the TBUS DIN rail connector are supplied via the supply at a signal conditioner. Please note that the maximum total current consumption of I_{max} = 400 mA must not be exceeded and the maximum number of modules is therefore restricted to a few devices.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

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

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

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

The goal is to supply five MINI MCR-SL-PT100-UI-200-NC temperature measuring transducers (item no. 2864370) and three configurable MINI MCR-SL-UI-UI-NC signal conditioners (item no. 2864150), with 4 mA ... 20 mA current output at an operating voltage of 24 V DC.

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

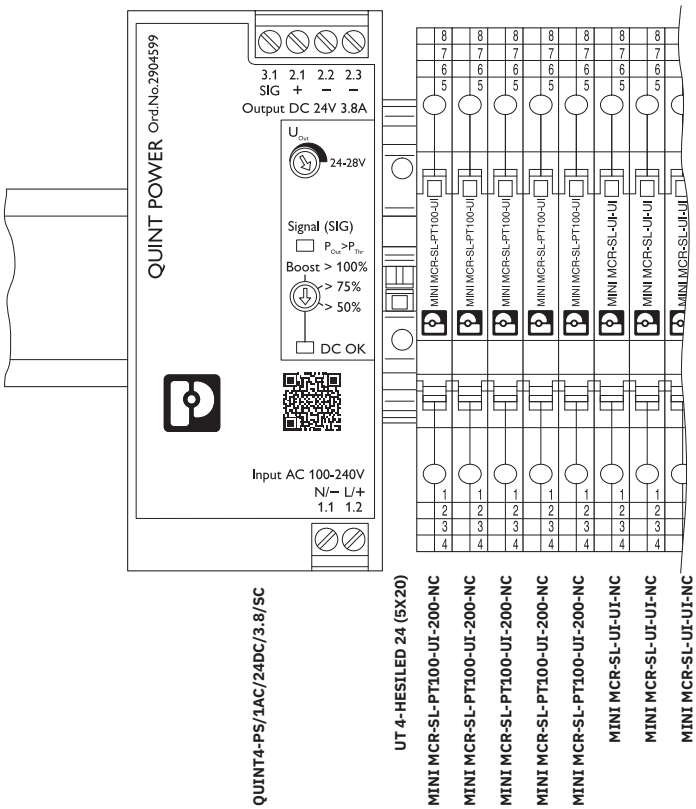
Then determine the maximum total current consumption of all eight modules.

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

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

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 QUINT4-PS/1AC/24DC/3.8/SC (item no. 2904599). The structure is shown in Figure 3-2 on page 13. The wiring is as shown in Figure 3-1 on page 12.

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.

3.2 Supply via MINI MCR-SL-PTB... power terminals

For supplying power to MINI Analog modules, a particularly suitable method involves MINI MCR-SL-PTB... power terminals. They have the familiar 6.2 mm housing and can be seamlessly integrated 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. Moreover, it is possible to extend mechanical redundancy by using two power terminals. A 2.5 A fuse should be used to protect the power terminal(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.

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

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

Recommended fuse for power terminal:
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)

3.2.1 Supply via a MINI MCR-SL-PTB... power terminal

In the case of supply via the power terminal, 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 15, or redundant supply by means of two different power supplies is implemented, see Figure 3-4 on page 16. 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

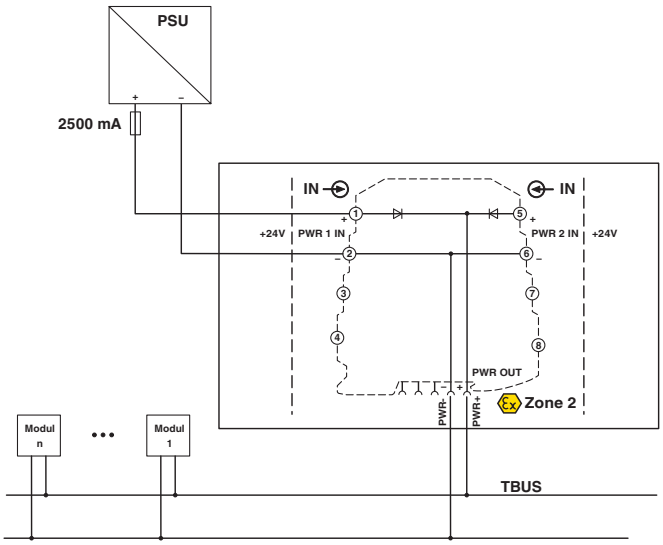
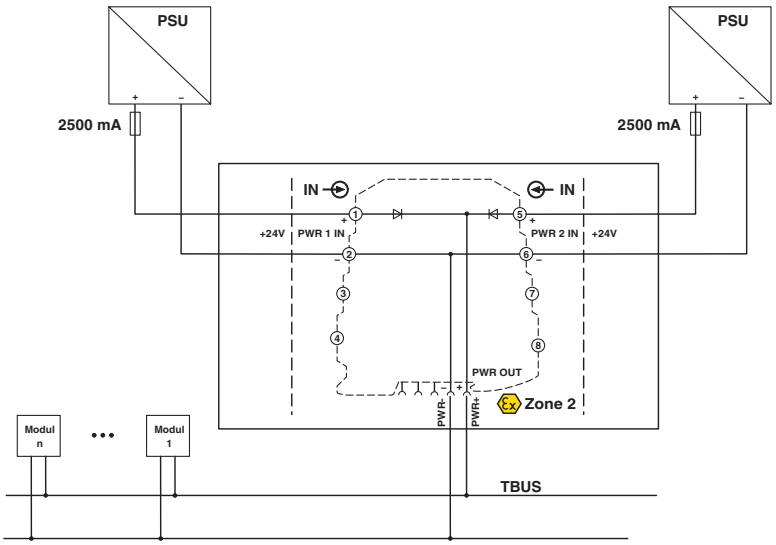


Figure 3-4 Supply by means of redundant power supply



Example for supply via a MINI MCR-SL-PTB... power terminal

The goal is to supply 32 MINI MCR-RTD-UI-NC temperature measuring transducers (item no. 2902849), ten configurable MINI MCR-SL-UI-UI-NC signal conditioners (item no. 2864150), with 4 mA ... 20 mA current output and 40 MINI MCR-SL-UI-F frequency converters (item no. 2864082) at an operating voltage of 24 V DC.

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

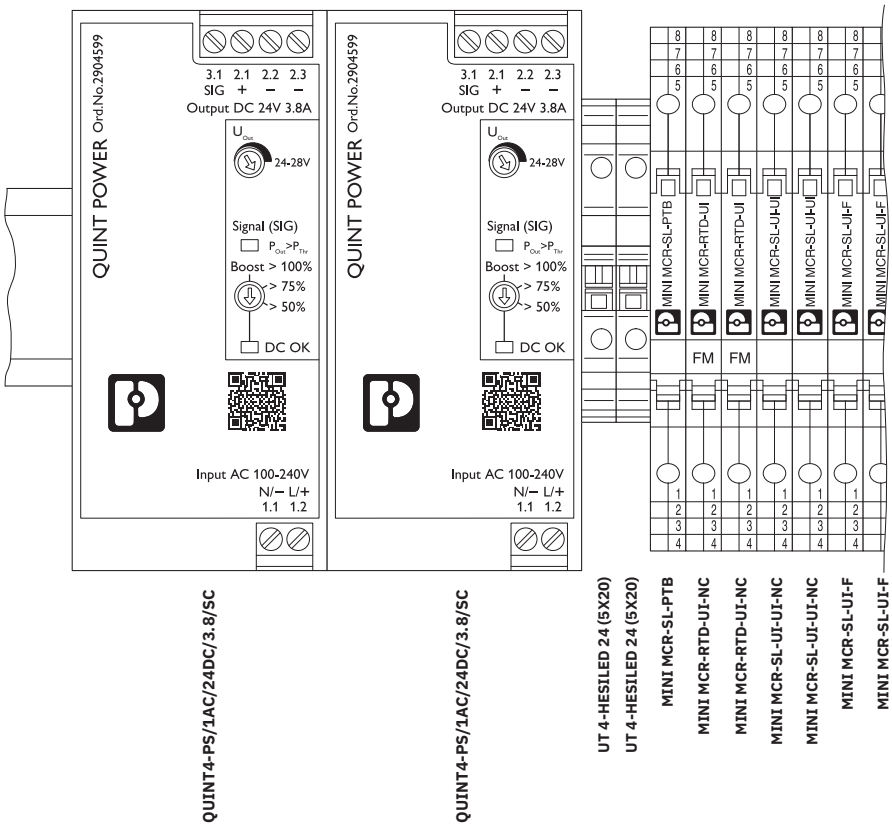
Then determine the maximum total current consumption of all 82 modules.

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

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

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 terminals 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 a QUINT4-PS/1AC/24DC/3.8/SC (item no. 2904599). The structure is shown in Figure 3-5 on page 17. The wiring is as shown in Figure 3-4 on page 16.

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

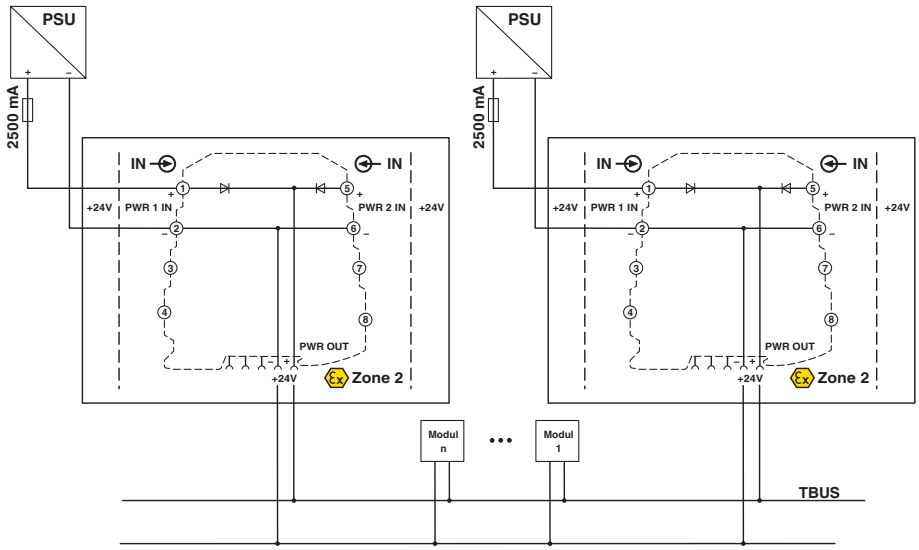


The disadvantage here is that in the event that the power terminal fails, the supply of all signal conditioners is interrupted. However, this can be indicated in this example by means of an N/C contact by using a MINI MCR-SL-FM-RC-NC(-SP) fault signaling module and the MINI MCR-SL-PTB-FM(-SP) power terminal, see Section 3.4 on page 22.

3.2.2 Supply via two MINI MCR-SL-PTB... power terminals

If you are using two MINI MCR-SL-PTB... for supplying the connected MINI Analog modules, you are only allowed to connect one power supply per power terminal. 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 18. 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 terminals (NOTE, no redundancy). The maximum number of MINI Analog devices is therefore equivalent to the calculation in Section 3.2 on page 14.

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



Example for the supply via two MINI MCR-SL-PTB... power terminals

As in the previous example, the goal is to provide a redundant supply to 32 MINI MCR-RTD-UI-NC temperature measuring transducers (item no. 2902849), ten configurable MINI MCR-SL-UI-UI-NC signal conditioners (item no. 2864150), with 4 mA ... 20 mA current output and 40 MINI MCR-SL-UI-F frequency converters (item no. 2864082) at an operating voltage of 24 V DC.

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

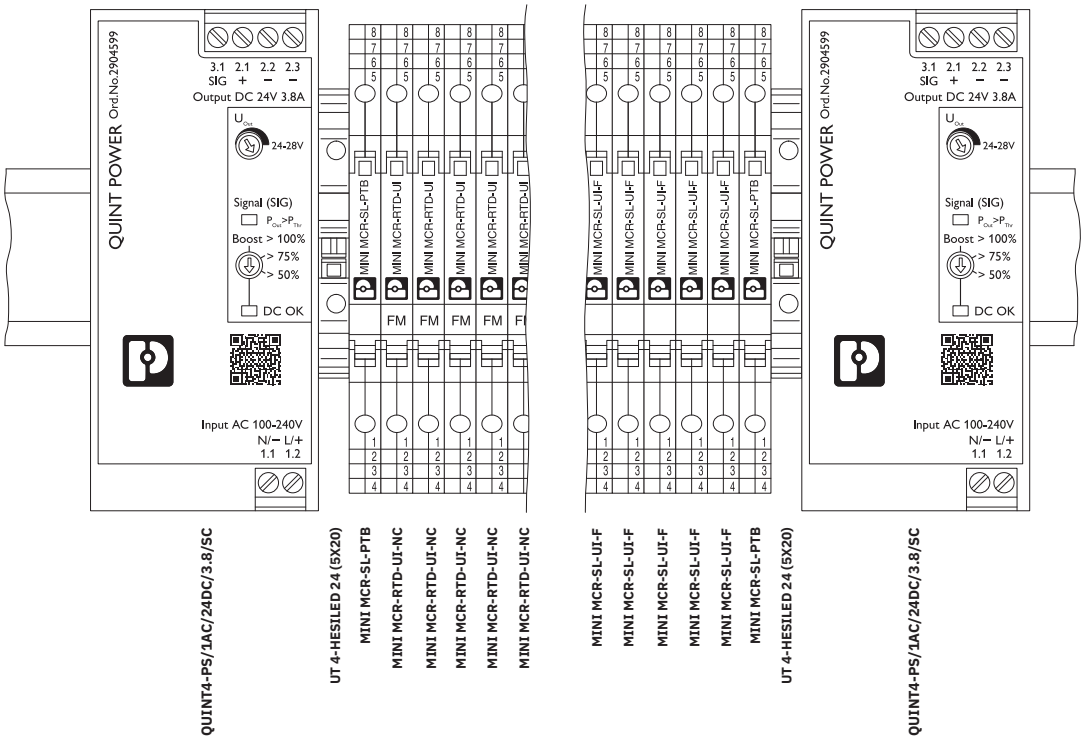
Then determine the maximum total current consumption of all 82 modules.

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

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

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 terminals should each have a nominal current of 2.5 A. In order to ensure the guaranteed tripping of the fuses in the event of a short circuit, the supply with 24 V DC in this example is provided by two QUINT4-PS/1AC/24DC/3.8/SC (item no. 2904599). The structure is shown in Figure 3-7 on page 19. The wiring is as shown in Figure 3-6 on page 18.

Figure 3-7 Example for the supply via two MINI MCR-SL-PTB... power terminals



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

3.3 Supply via a system power supply

If there is no 24 V DC supply in the control cabinet or in the terminal box for supplying the MINI Analog signal conditioners, you can use a QUINT4-SYS-PS/1AC/24DC/2.5/SC (item no. 2904614). 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 2.5 A. To increase performance, up to two QUINT4-SYS-PS/1AC/24DC/2.5/SC can also be snapped on. This means that a total current of 5 A can be supplied. Please note, however, that redundant supply is not possible for currents greater than 2.5 A. A 6 A, 10 A or 16 A characteristic B miniature circuit breaker should be used to protect the primary side.

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

$$n_{modules} = \frac{I_{max}}{I_N} = \frac{1{,}5\ A\ (3\ A)}{I_N}$$

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

Example for supply via a system power supply

The goal is to supply 65 MINI MCR-SL-PT100-UI-200-NC temperature measuring transducers (item no. 2864370).

First determine the current consumption of the modules from the packing slips. For this temperature measuring transducer it is 21 mA per module.

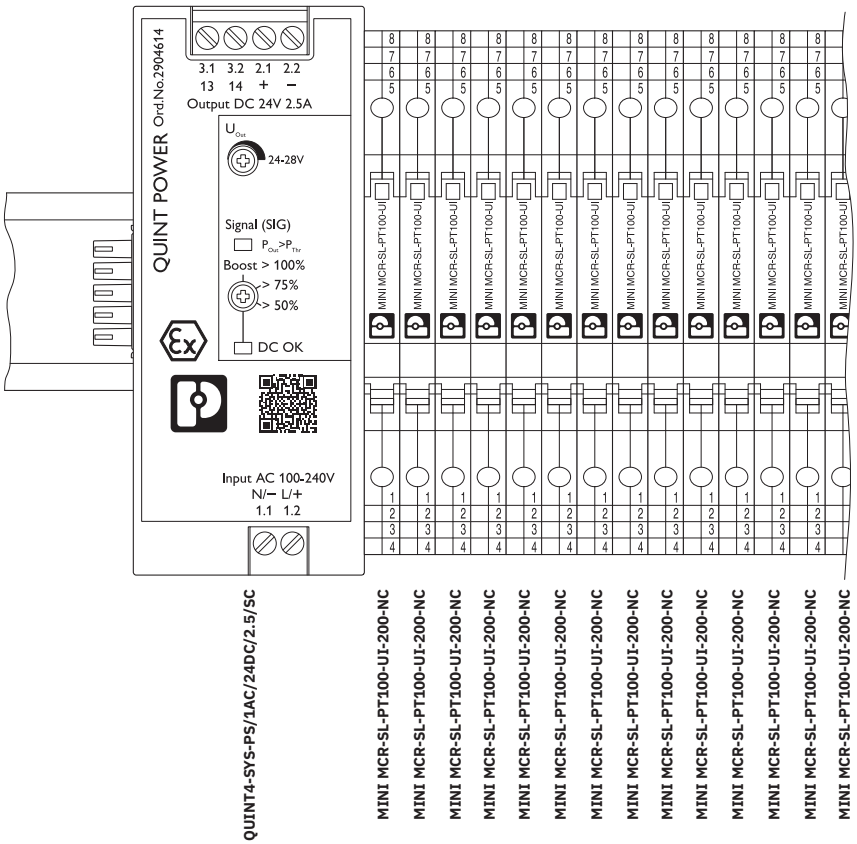
Then determine the maximum total current consumption of all 65 modules.

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

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

The total current consumption of 1365 mA is less than the maximum permissible current for supply via the QUINT4-SYS-PS/1AC/24DC/2.5/SC (item no. 2904614). The structure is shown in Figure 3-8 on page 21.

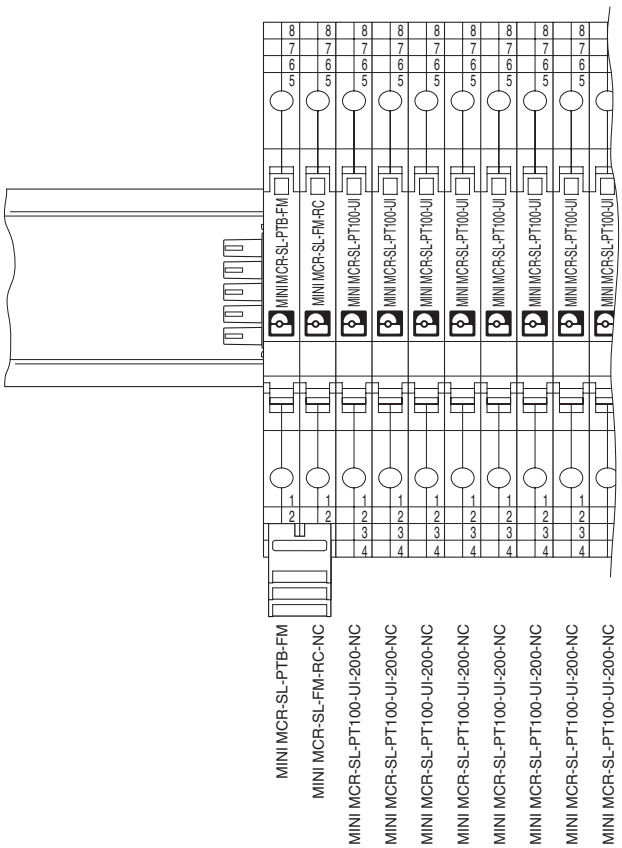
Figure 3-8 Supply via a system power supply



3.4 Monitoring the supply voltage using MINI MCR-SL-FM-RC... fault signaling modules

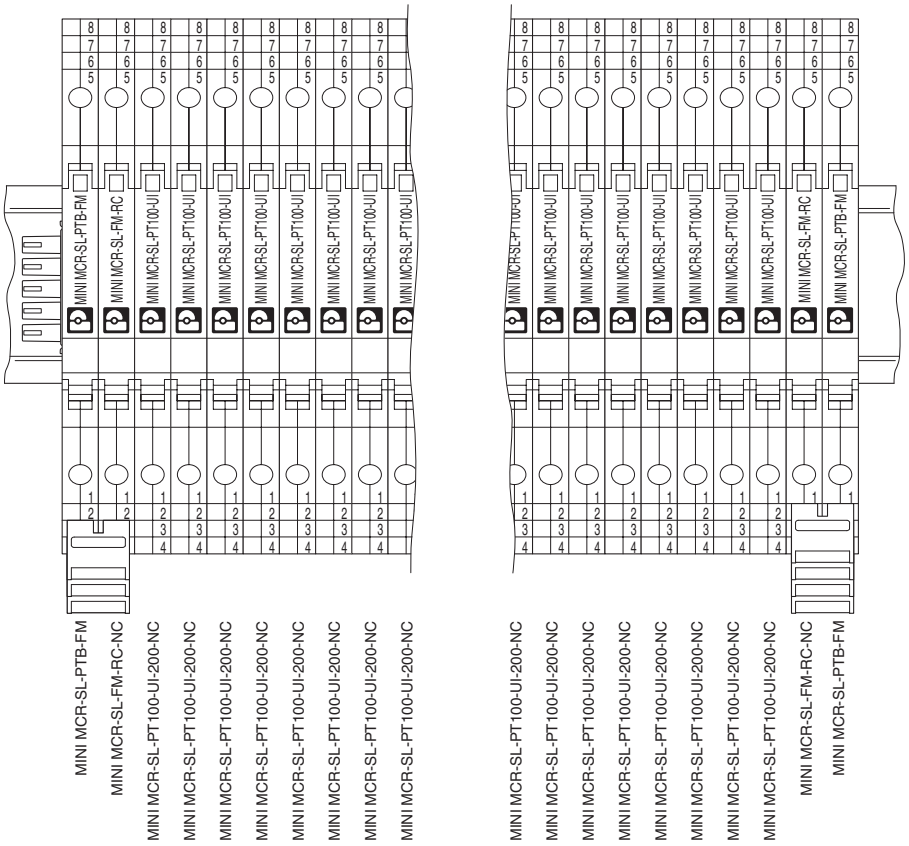
As described in Section 3.2 on page 14, the MINI Analog modules can be supplied with power via a MINI MCR-SL-PTB power terminal. If the MINI MCR-SL-PTB-FM... modules (item no. 2864134) and the MINI MCR-SL-FM-RC... error message modules (item no. 2902961) are used, it is possible to establish redundant monitoring of the supply voltage. Mount a power terminal and a fault signaling module of the same shape side by side without spacing, see Figure 3-9 on page 22.

Figure 3-9 Redundancy monitoring of the supply voltage



Then bridge terminal blocks 1 to 4 of the power terminal with terminals 1 to 4 of the fault signaling module. Use the FBSR 2-6 plug-in bridges supplied with the fault signaling module (plug-in bridge item no. 3033715) or normal cables. Now if one of the power supplies fails, this is indicated via an N/C contact. For additional mechanical redundancy, as shown in Section 3.2.2 on page 18, two power terminals and two fault signaling modules can be used, see Figure 3-10 on page 23. Again only one supply may be connected to each power terminal here. In the second fault signaling 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



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. The MINI Analog Pro versions with intrinsic safety and functional safety require a DC supply in the range between 19.2 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 family can be implemented using the ME 6,2 TBUS-2 1,5/5-ST-3,81 GY DIN rail connector (item no. 2695439). It supplies all connected signal conditioners. This eliminates the need for time-consuming and costly single-core wiring.

When there are only a small number of 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 26. One way to supply several modules, with additional monitoring for module errors and the supply (see Section 4.4 on page 36), is to use MINI MCR-2-PTB... devices (see Section 4.2 on page 28). These devices also support redundant supply.

If the DC supply is not present in the range between 9.6 V ... 30 V, the QUINT4-SYS-PS/1AC/24DC/2.5/SC system power supply presented in Section 4.3 on page 34 (item no. 2904614) can be used. It is suitable for connection to 230 V AC and is specifically tailored to the requirements of measurement and control technology. Use in a potentially explosive area is also possible.

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

4.1 Direct supply via a MINI Analog Pro signal conditioner

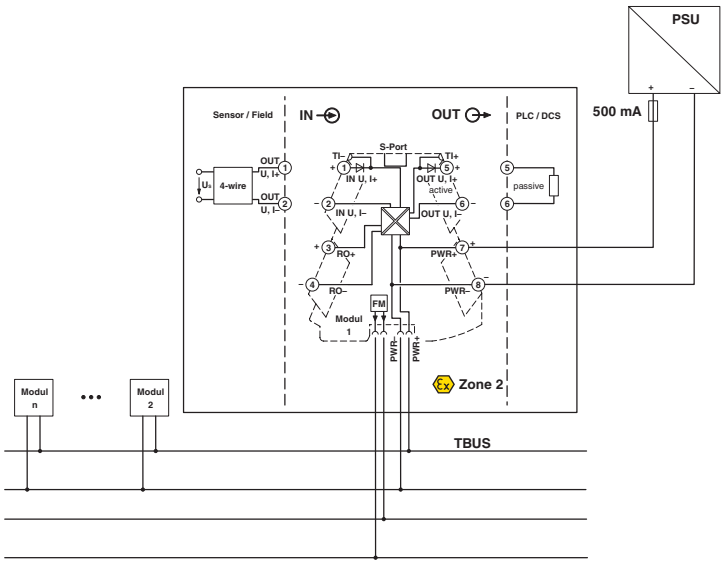
In the case of direct supply, all modules connected to the TBUS DIN rail connector are supplied via the supply at a signal conditioner. Please note that the maximum total current consumption of I_{max} = 400 mA must not be exceeded and the maximum number of modules is therefore restricted to a few devices.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

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

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

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

The goal is to supply five MINI MCR-2-TC-UI temperature measuring transducers (item no. 2902055) and three configurable MINI MCR-2-UI-UI signal conditioners (item no. 2902037), with 4 mA ... 20 mA current output, at an operating voltage of 24 V DC.

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

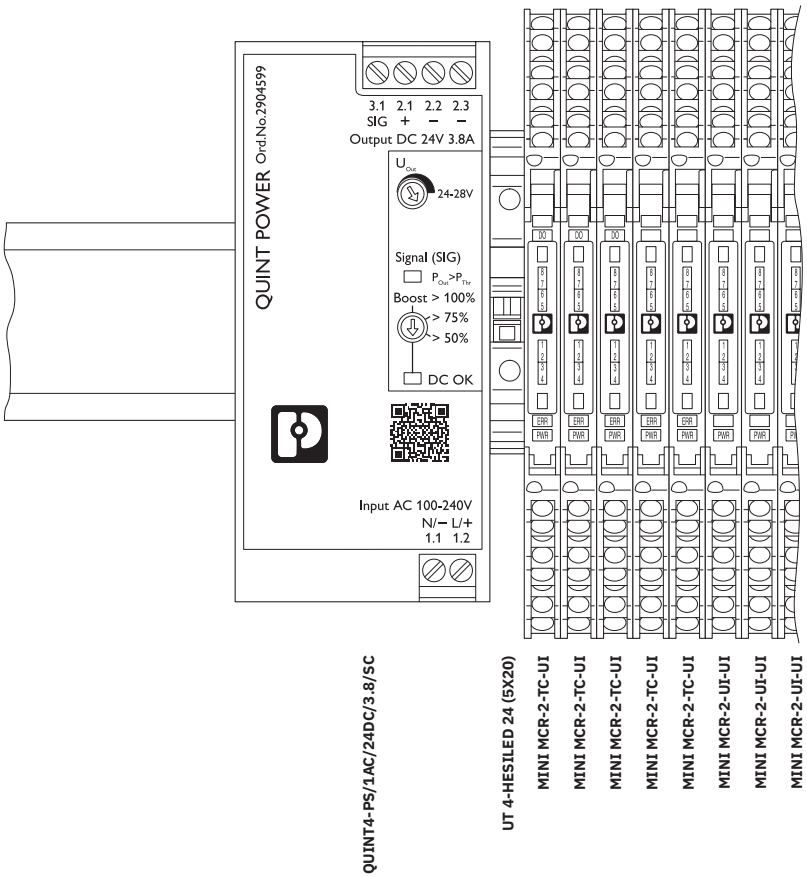
Then determine the maximum total current consumption of all eight modules.

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

$I = 5 * 31{,}5\ mA + 3 * 25\ mA = 201\ mA < 400\ mA$

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 of a short circuit, the 24 V DC supply in this example is provided by a QUINT4-PS/1AC/24DC/3.8/SC (item no. 2904599). The structure is shown in Figure 4-2 on page 27. The wiring is as shown in Figure 4-1 on page 26.

Figure 4-2 Example for direct supply via a module



In addition to the low maximum number of modules, a 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.

4.2 Supply via MINI MCR-2-PTB... power terminal

MINI MCR-2-PTB... power terminals are particularly suitable for supplying power to MINI Analog Pro modules. They have the familiar 6.2 mm housing and can be seamlessly integrated 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. Moreover, it is possible to extend mechanical redundancy by using two power terminals. A 4 A fuse should be used to protect the power terminal(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.

$$n_{modules} = \frac{I_{max}}{I_N} = \frac{3{,}2\ A}{I_N}$$

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

Recommended fuse for power terminal:
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)

4.2.1 MINI MCR-2-PTB... power terminal in combination with intrinsically safe MINI Analog Pro versions

For direct connection of the MINI MCR-2-PTB... power terminal to the intrinsically safe and functionally safe versions of the MINI Analog Pro product family, plug the blind plug provided with the MINI MCR-2-PTB... power terminal into connector position 4 (terminal points 1/2 and 3/4) and 5 of the module. Thus, direct connection is possible.

4.2.2 Supply via a MINI MCR-2-PTB... power terminal

In the case of supply via the power terminal, 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 29, or redundant supply by means of two different power supplies is implemented, see Figure 4-4 on page 29. 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.

For intrinsically safe and functionally safe MINI Analog Pro versions, you must observe Section 4.2.1.

Figure 4-3 Supply by means of one power supply

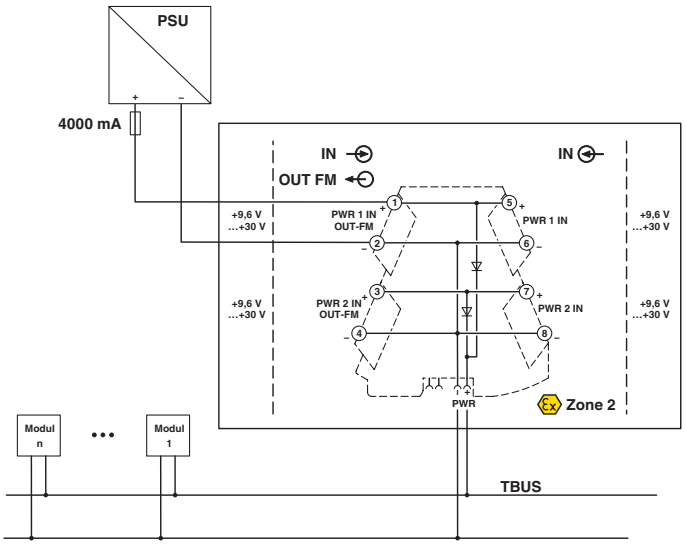
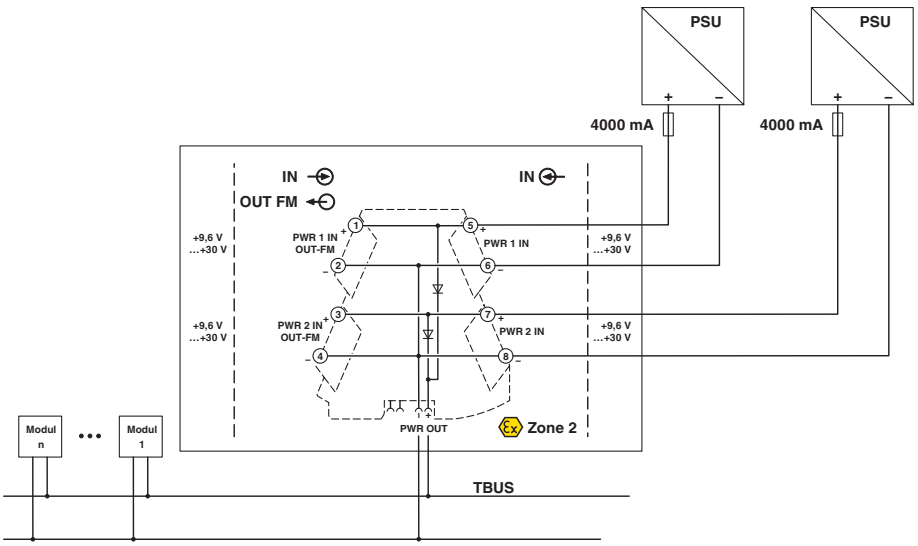


Figure 4-4 Supply by means of redundant power supplies



Example for supply via a MINI MCR-2-PTB... power terminal

The goal is to supply 32 MINI MCR-2-RTD-UI temperature measuring transducers (item no. 2902049), ten configurable MINI MCR-2-UI-UI signal conditioners (item no. 2902037), with 4 mA ... 20 mA current output and 40 universal MINI MCR-2-UNI-UI-UIRO signal conditioners with switching output (item no. 2902026) at an operating voltage of 24 V DC.

First determine the current consumption of the modules from the packing slips. For the temperature measuring 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.

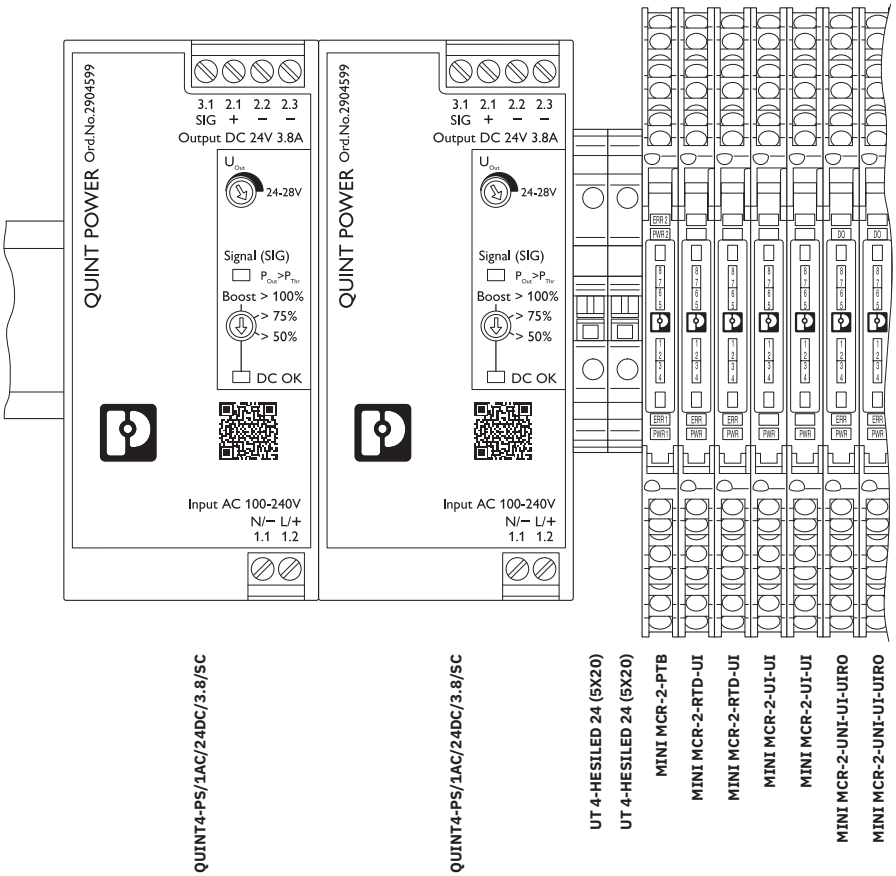
Then determine the maximum total current consumption of all 82 modules.

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

$I = 32 * 31{,}5\ mA + 10 * 25\ mA + 40 * 31{,}5\ mA = 2518\ mA < 3200\ mA$

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 a QUINT4-PS/1AC/24DC/3.8/SC (item no. 2904599). The structure is shown in Figure 4-5 on page 31. The wiring is as shown in Figure 4-4 on page 29.

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

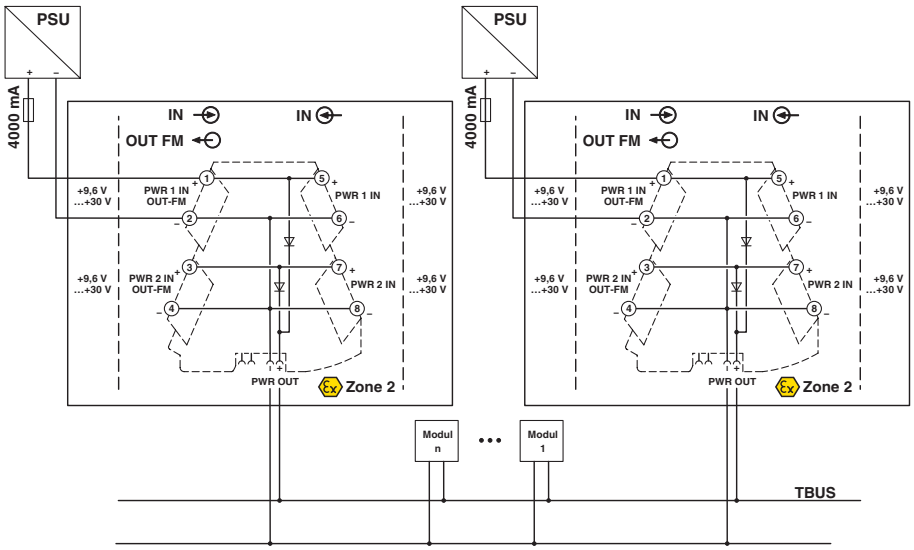


The disadvantage here is that in the event that the power terminal fails, the supply of all signal conditioners is interrupted. However, this can be indicated in this example by means of an N/C contact by using a MINI MCR-2-FM-RC fault signaling module and the MINI MCR-2-PTB power terminal.

4.2.3 Supply via two MINI MCR-2-PTB... power terminals

If you are using two MINI MCR-2-PTB... to supply the connected MINI Analog modules, only one power supply may be connected per power terminal. 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 32. 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 terminals (NOTE, no redundancy). The maximum number of MINI Analog Pro devices is therefore equivalent to the calculation in Section 4.2 on page 28.

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



For intrinsically safe and functionally safe MINI Analog Pro versions, you must observe Section 4.2.1.

Example for the supply via two MINI MCR-2-PTB... power terminals

The goal is to provide a redundant supply to 16 MINI MCR-2-RTD-UI temperature measuring transducers (item no. 2902049), ten configurable MINI MCR-2-UI-UI signal conditioners (item no. 2902037), with 4 mA ... 20 mA current output and 25 universal MINI MCR-2-UNI-UI-UIRO signal conditioners with switching output (item no. 2902026). Only an operating voltage of 12 V DC is available in this example.

First determine the current consumption of the modules from the packing slips. For the temperature measuring 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.

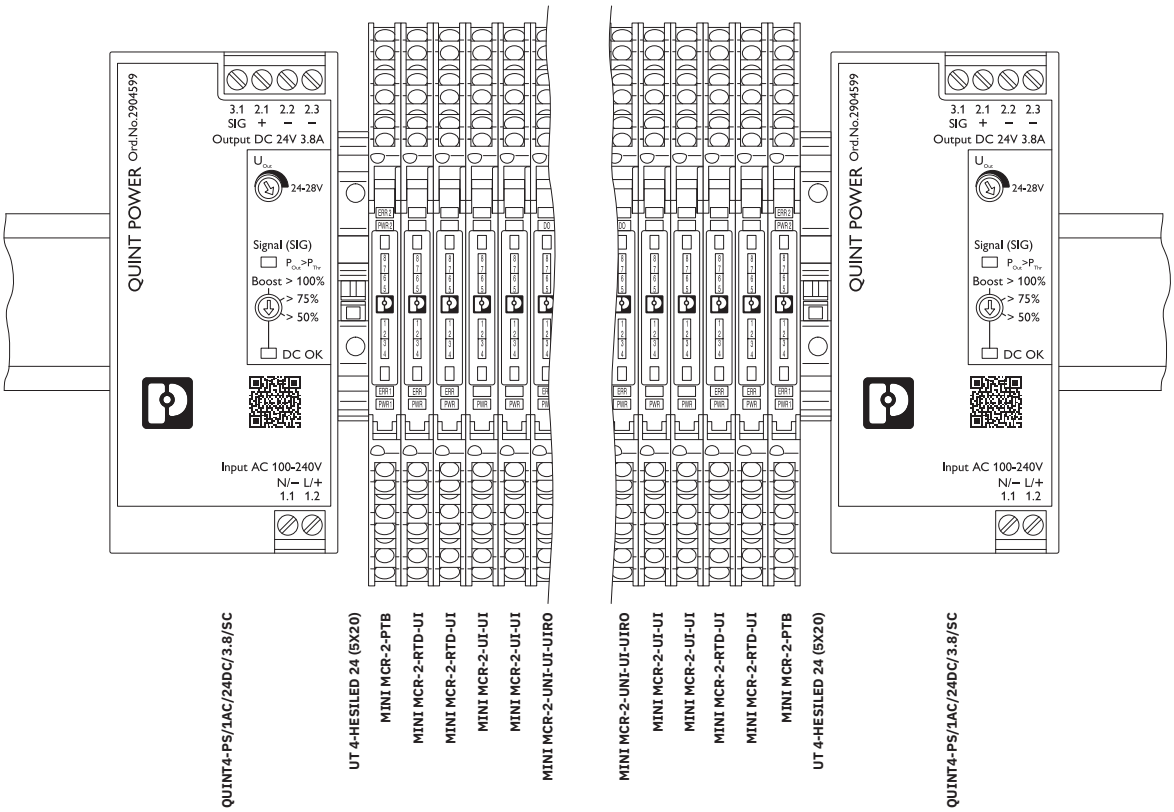
Then determine the maximum total current consumption of all 51 modules.

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

$I = 16 * 62{,}5\ mA + 10 * 54\ mA + 25 * 62{,}5\ mA = 3102{,}5\ mA < 3200\ mA$

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 terminals should each have a nominal current of 4000 mA. In order to ensure the guaranteed tripping of the fuses in the event of a short circuit, the 12 V DC supply is implemented by two QUINT4-PS/1AC/24DC/3.8/SC power supplies in this example (item no. 2904599), which provide a short-circuit current of 90 A. The structure is shown in Figure 4-7 on page 33. The wiring is as shown in Figure 4-6 on page 32.

Figure 4-7 Example for the supply via two MINI MCR-2-PTB... power terminals



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

4.3 Supply via system power supply

If there is no 24 V DC supply in the control cabinet or in the terminal box for supplying the MINI Analog Pro signal conditioners, you can use a QUINT4-SYS-PS/1AC/24DC/2.5/SC (item no. 2904614). 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 2.5 A. To increase performance, up to two QUINT4-SYS-PS/1AC/24DC/2.5/SC (item no. 2904614) can be snapped on. This means that a total current of 5 A can be supplied. Please note, however, that redundant supply is not possible for currents greater than 2.5 A. A 6 A, 10 A or 16 A characteristic B miniature circuit breaker should be used to protect the primary side.

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

$$n_{modules} = \frac{I_{max}}{I_N} = \frac{1{,}5\ A\ (3\ A)}{I_N}$$

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

The goal is to supply 40 MINI MCR-2-TC-UI temperature measuring transducers (item no. 2902055).

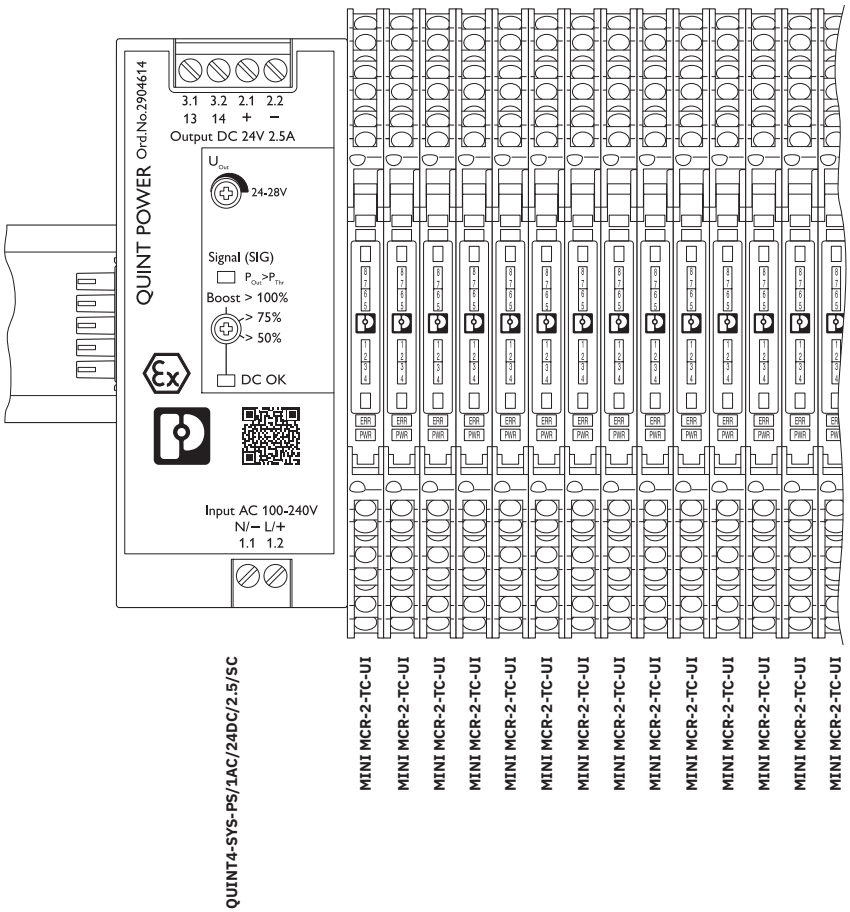
First determine the current consumption of the modules from the packing slips. For this temperature measuring transducer it is 32.5 mA per module.

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

$I = 40 * 32{,}5\ mA = 1300\ mA < 1500\ mA$

The total current consumption of 1300 mA is less than the maximum permissible current for supply via the QUINT4-SYS-PS/1AC/24DC/2.5/SC (item no. 2904614). The structure is shown in Figure 4-8 on page 35.

Figure 4-8 Supply via system power supply.



DANGER: Explosion hazard

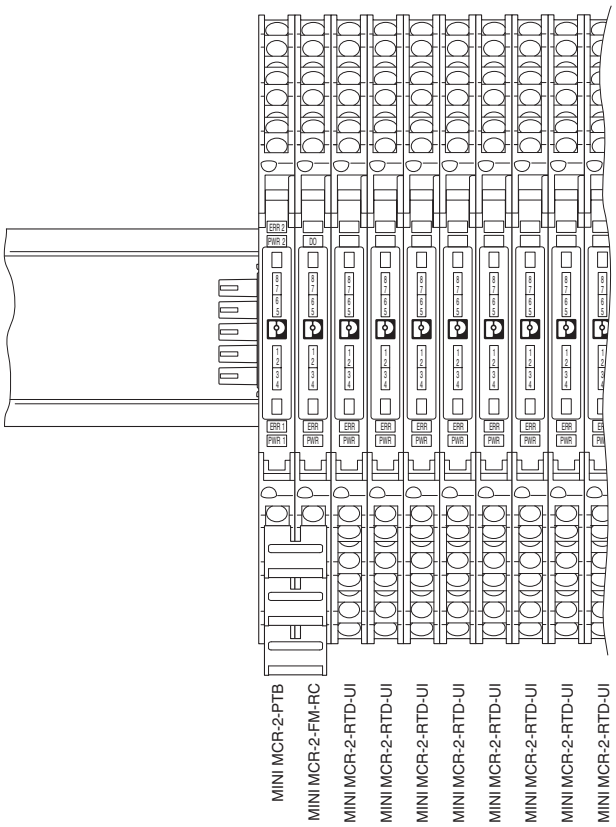
You must observe a 50 mm clearance between the intrinsically safe versions of the MINI Analog Pro product family and the system power supply.

Alternatively, you can install the MCR-DP partition plate (item no. 1430594) between the system power supply and the intrinsically safe versions of the MINI Analog Pro product family. The system power supply can thus be positioned directly adjacent.

4.4 Monitoring the supply voltage using MINI MCR-2-FM-RC-... fault signaling modules

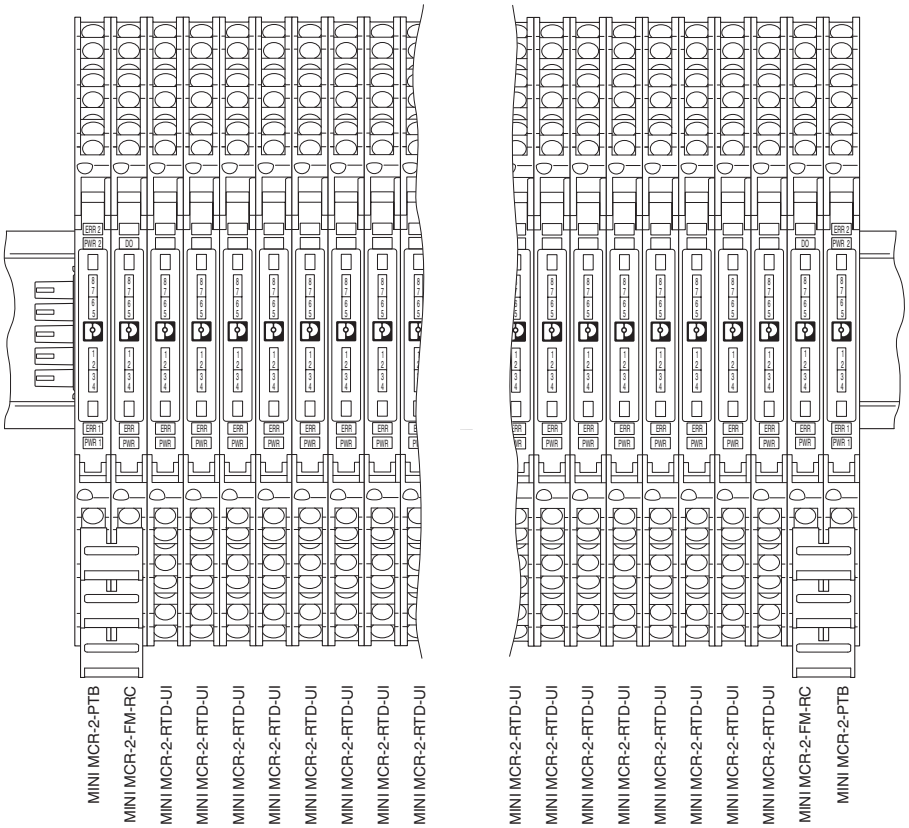
As described in Section 4.2 on page 28, the MINI Analog Pro modules can be supplied with power via a MINI MCR-2-PTB... power terminal (item no. 2902066). By using the MINI MCR-2-FM-RC-... fault signaling modules (item no. 2904504), it is then possible to establish redundancy monitoring of the supply voltage. Mount a power terminal and a fault signaling module of the same shape side by side without spacing, see Figure 4-9 on page 36.

Figure 4-9 Redundancy monitoring of the supply voltage



Then bridge terminal blocks 1 to 4 of the power terminal with terminals 1 to 4 of the fault signaling module. Use the FBSR 2-6 plug-in bridges supplied with the fault signaling module (plug-in bridge item no. 3033715) or normal cables. Now if one of the power supplies fails, this is indicated via an N/C contact. For additional mechanical redundancy, as shown in Section 4.2.3 on page 32, two power terminals and two fault signaling modules can be used, see Figure 4-10 on page 37. Again only one supply may be connected to each power terminal here. In the second fault signaling module, fault monitoring of external measuring transducers must be deactivated because evaluation can only take place via one module in a group.

Figure 4-10 Additional mechanical redundancy



DANGER: Explosion hazard

You must observe a 50 mm clearance between the intrinsically safe versions of the MINI Analog Pro product family and the system power supply.

Alternatively, you can install the MCR-DP partition plate (item no. 1430594) between the system power supply and the intrinsically safe versions of the MINI Analog Pro product family. The system power supply can thus be positioned directly adjacent.

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

If you are using a MINI Analog Pro gateway V8 (MINI MCR-2-V8...), it is supplied via the MINI Analog Pro signal conditioner. This means that you have to take the current consumption of the gateway into consideration in every calculation. To illustrate this, “Example for direct supply via a module” on page 38 is repeated with the MINI MCR-2-V8-MOD-TCP module connected.

Example for direct supply via a module

The goal is to supply five MINI MCR-2-TC-UI-2-TC-UI temperature measuring transducers (item no. 2902055), three configurable MINI MCR-2-UI-UI signal conditioners (item no. 2902037) and also the MINI MCR-2-V8-MOD-TCP module (item no. 2905635), with 4 mA ... 20 mA current output, at an operating voltage of 24 V DC.

First determine the current consumption of the modules from the packing slips. For the temperature measuring 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 24 V 50 mA.

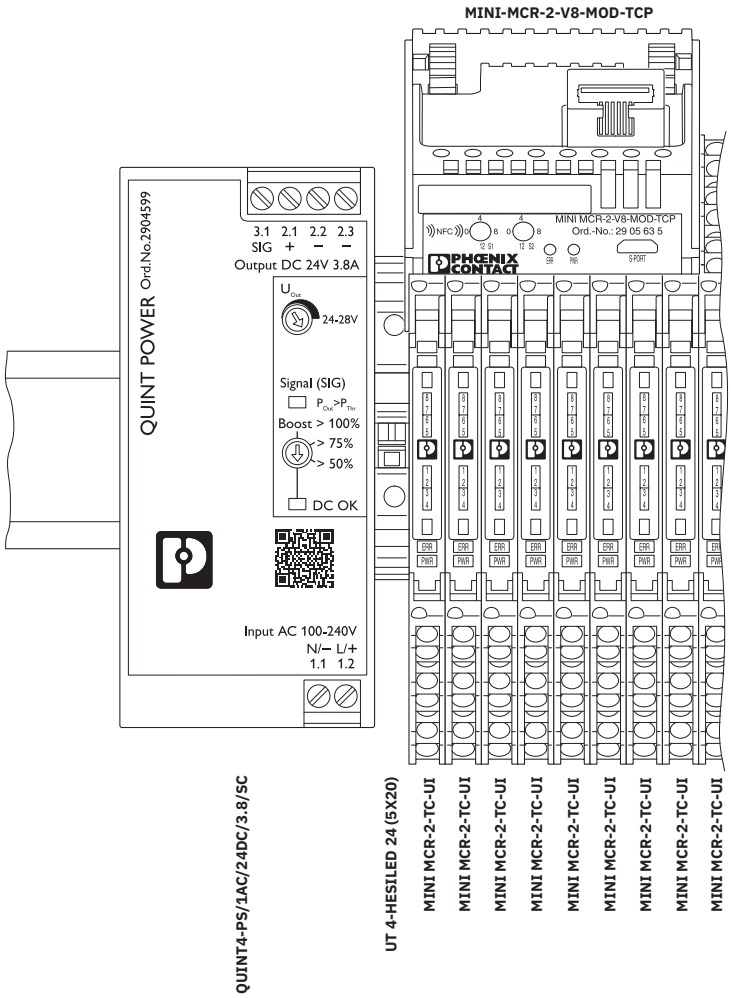
Then determine the maximum total current consumption of all nine modules.

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

$I = 5 * 31{,}5\ mA + 3 * 25\ mA + 1 * 50\ mA = 282\ mA < 400\ mA$

The total current consumption of 331 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 QUINT4-PS/1AC/24DC/3.8/SC (item no. 2904599). The structure is shown in Figure 4-11 on page 39. The wiring is as shown in Figure 4-1 on page 26.

Figure 4-11 Example for direct supply via a module



In addition to the low maximum number of modules, a 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.

DANGER: Explosion hazard

You must observe a 50 mm clearance between the intrinsically safe versions of the MINI Analog Pro product family and the system power supply.

Alternatively, you can install the MCR-DP partition plate (item no. 1430594) between the system power supply and the intrinsically safe versions of the MINI Analog Pro product family. The system power supply can thus be positioned directly adjacent.

5 Supply options for MACX Analog

MACX Analog (Ex) signal conditioners, which are compatible with the DIN rail connector, require a 24 V DC supply. MACX Analog (Ex) 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) product family can be implemented using the DIN rail connector (ME 6,2 TBUS-2 1,5/5-ST-3,81KMGY, item no. 2969401). It is supplied with 24 V DC and supplies all connected signal conditioners. This eliminates the need for time-consuming and costly single-core 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 42. One way to supply several modules, with short-circuit and cable break detection, is to use MACX MCR-PTB... or TC-MACX-MCR-PTB devices, see Section 5.2 on page 44. These devices also support redundant supply.

If there is no 24 V DC supply, the system power supply presented in Section 5.4 on page 51, QUINT4-SYS-PS/1AC/24DC/2.5/SC (item no. 2904614) can be used. It is suitable for connection to 230 V AC and is specifically tailored to the requirements of measurement and control technology. Use in potentially explosive areas is also possible.

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

5.1 Direct supply via a MACX MCR(-EX) signal conditioner

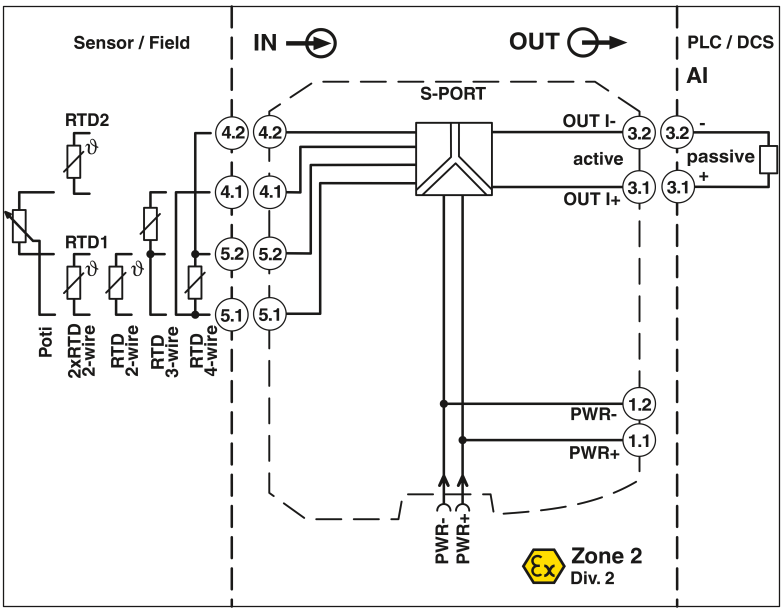
In the case of direct supply, all modules connected to the TBUS DIN rail connector are supplied via the supply at a signal conditioner. Please note that the maximum total current consumption of I_{max} = 400 mA must not be exceeded and the maximum number of modules is therefore restricted to a few devices.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

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

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

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

The goal is to supply five MACX MCR-RTD-I temperature measuring transducers (item no. 1050201) and three NAMUR signal conditioners MACX MCR-SL-NAM-R (item no. 2865997) at an operating voltage of 24 V DC.

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

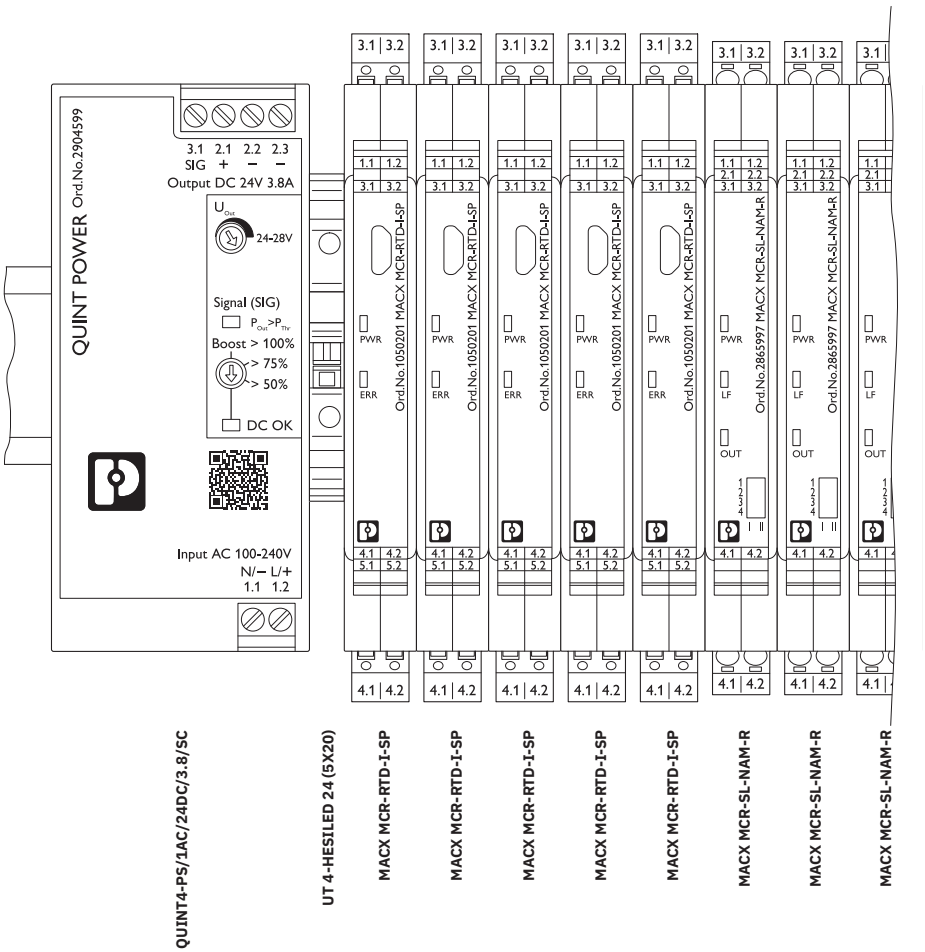
Then determine the maximum total current consumption of all eight modules.

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

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

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 of a short circuit, the 24 V DC supply in this example is provided by a QUINT4-PS/1AC/24DC/3.8/SC (item no. 2904599). The structure is shown in Figure 5-2 on page 43. The wiring is as shown in Figure 5-1 on page 42.

Figure 5-2 Example for direct supply via a module



In addition to the low maximum number of modules, a 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.

5.2 Supply via MACX MCR-PTB... power terminals

For supplying power to MACX Analog modules, a particularly suitable method involves MACX MCR-PTB... power terminals (item no. 2865625). This means that a total current of 3.75 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. Moreover, it is possible to extend mechanical redundancy by using two power terminals. Each power terminal is protected by an integrated 5 A fuse. 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 MACX MCR-PTB... modules, with the aid of the product documents using the formula below.

$$n_{modules} = \frac{I_{max}}{I_N} = \frac{3{,}75\ A}{I_N}$$

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

If a power terminal without an integrated fuse is required, the power terminal (TC-MACX-MCR-PTB, item no. 2904673) can be used. In this case, a corresponding backup fuse must be ensured in the power supply.

5.2.1 Supply via a MACX MCR-PTB... power terminal

For supply via a power terminal, simple supply can be implemented by means of one power supply, see Figure 5-3 on page 45, or redundant supply by means of two different power supplies is implemented, see Figure 5-4 on page 45

Figure 5-3 Supply by means of one power supply

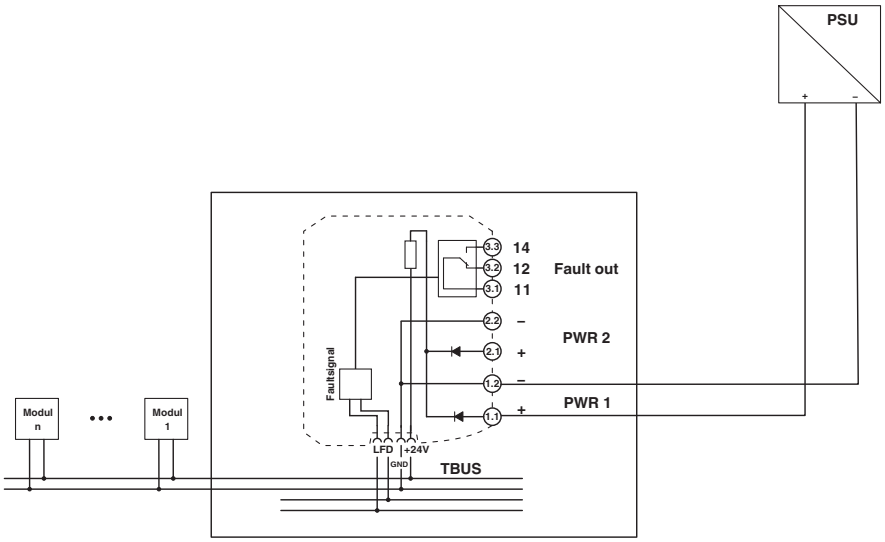
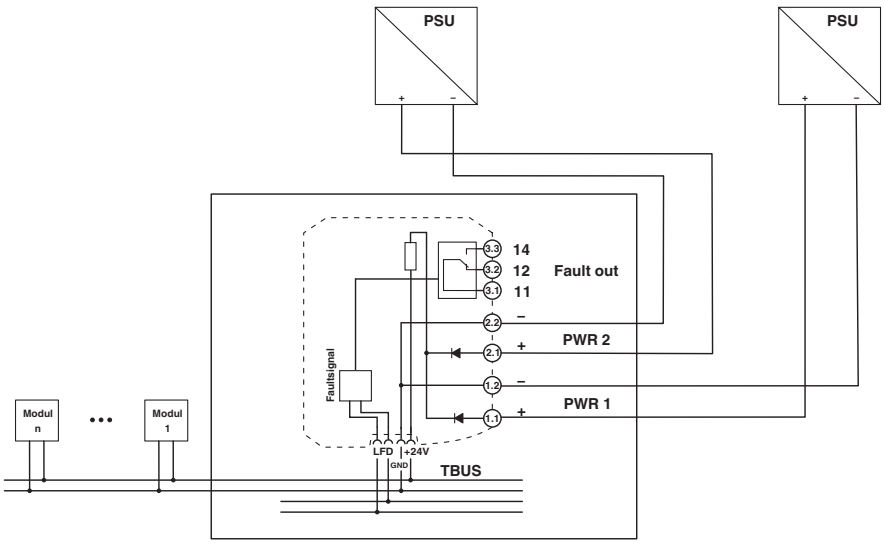


Figure 5-4 Supply by means of redundant power supplies



Example for supply via a MACX MCR-PTB... power terminal

The goal is to supply 32 MACX MCR-RTD-I-SP temperature measuring transducers (item no. 1050201), 40 MACX MCR-SL-NAM-R NAMUR signal conditioners (item no. 2865997) and 20 MACX MCR-SL-RPSSI-I repeater power supplies (item no. 2924207), at an operating voltage of 24 V DC.

First determine the current consumption of the modules from the packing slips. For the temperature measuring transducer, this is 40 mA per module and for the NAMUR signal conditioners, this is 21 mA. The intrinsically safe repeater power supplies require 76 mA each.

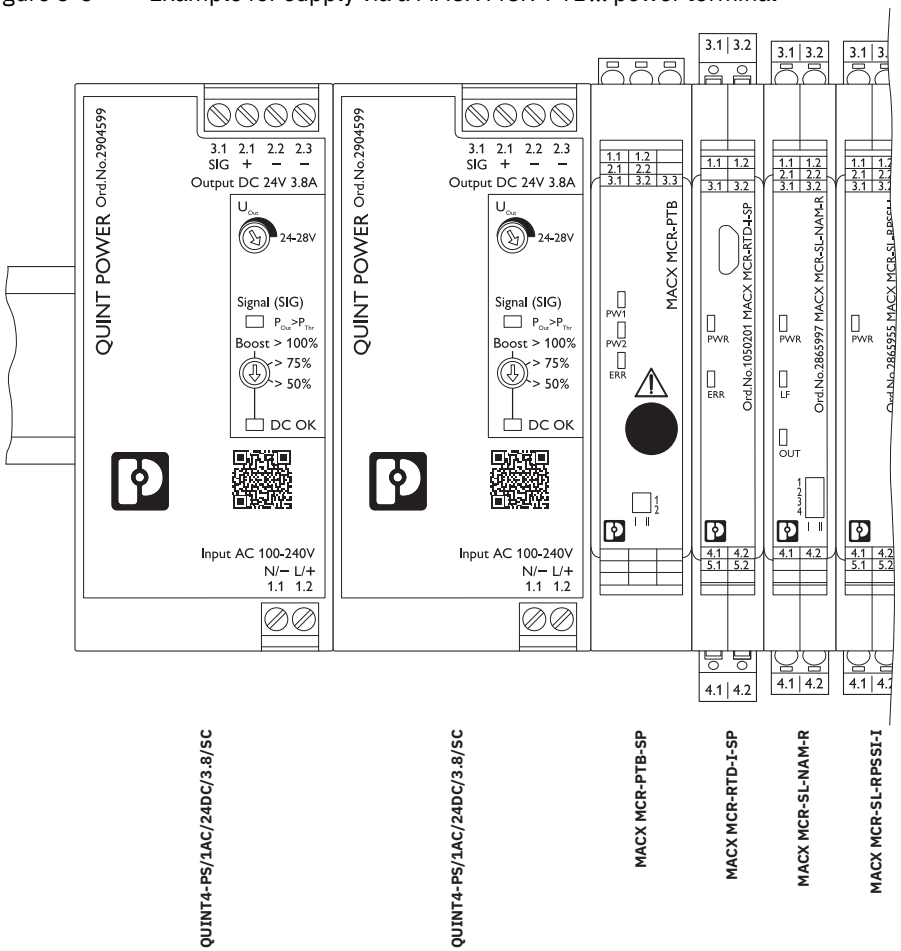
Then determine the maximum total current consumption of all 92 modules.

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

$I = 32 * 40\ mA + 40 * 21\ mA + 20 * 76\ mA = 3640\ mA < 3750\ mA$

The total current consumption of 3640 mA is less than the maximum permissible current for supply via the MACX MCR-PTB.... To ensure that the fuse installed 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 two QUINT4-PS/1AC/24DC/3.8/SC power supplies (item no. 2904599). The structure is shown in Figure 5-5 on page 47. The wiring is as shown in Figure 5-4 on page 45.

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



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

5.2.2 Supply via two MACX MCR-PTB... power terminals

If redundant supply via two MACX MCR-PTB... power terminals is desired, the supply for each module must be provided by a separate voltage source, see Figure 5-3 on page 45. 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 49. 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 terminals (NOTE, no redundancy).

NOTE: Functional limitation
When supplying to the DIN rail connector via two MACX MCR-PTB(-SP) modules, the group error message must be deactivated.

Example for the supply via two MACX MCR-PTB... power terminals

As in the previous example, the goal is to provide a redundant supply to
32 MACX MCR-RTD-I-SP temperature measuring transducers (item no. 1050201),
40 MACX MCR-SL-NAM-R NAMUR signal conditioners (item no. 2865997) and
20 MACX MCR-SL-RPSSI-I repeater power supplies (item no. 2924207), at an operating voltage of 24 V DC.

First determine the current consumption of the modules from the packing slips. For the temperature measuring transducer, this is 40 mA per module and for the NAMUR signal conditioners, this is 21 mA. The intrinsically safe repeater power supplies also require 76 mA each.

Then determine the maximum total current consumption of all 92 modules.

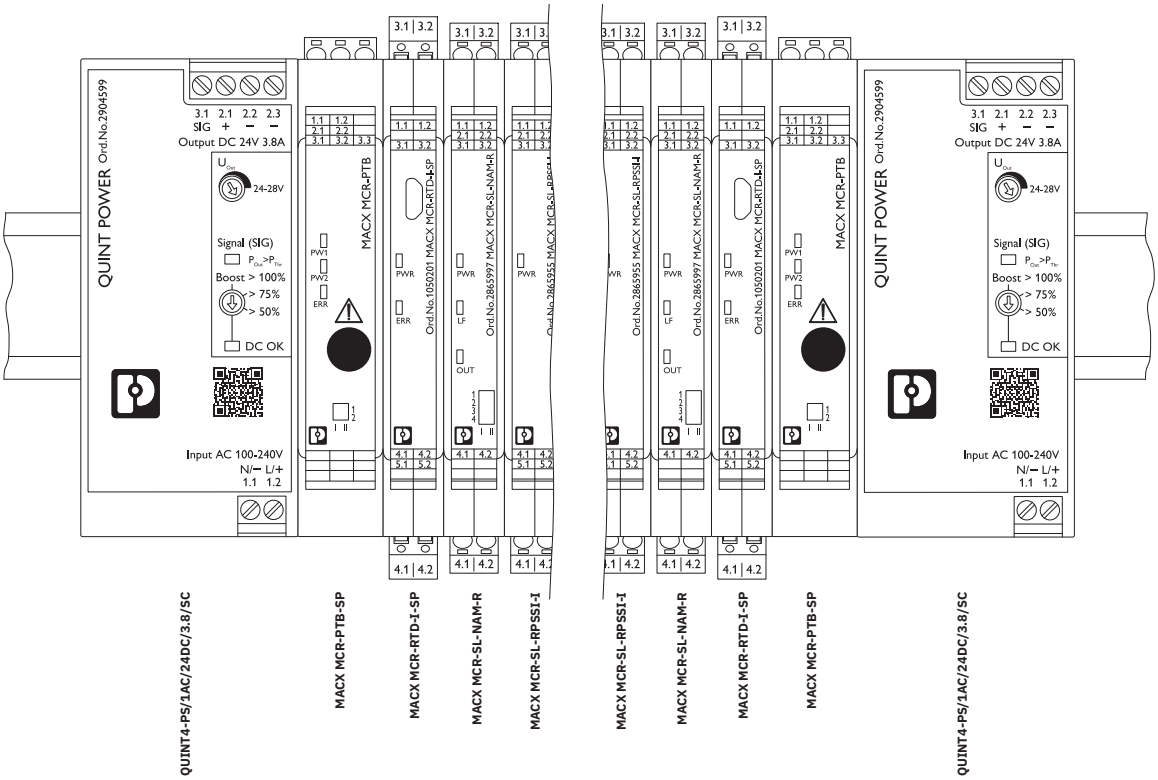
$$I = n_1 * I_{module1} + n_2 * I_{module2} + n_3 * I_{module3} + \ldots$$

$$I = 32 * 40\ mA + 40 * 21\ mA + 20 * 76\ mA = 3640\ mA < 3750\ mA$$

The total current consumption of 3640 mA is less than the maximum permissible current for supply via the MACX MCR-PTB.... To ensure that the fuse installed 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 two QUINT4-PS/1AC/24DC/3.8/SC power supplies (item no. 2904599). The structure is shown in Figure 5-6 on page 49. The wiring is as shown in Figure 5-3 on page 45.

If a power terminal without an integrated fuse is required, the power terminal (TC-MACX-MCR-PTB, item no. 2904673) can be used. In this case, a corresponding backup fuse must be ensured in the power supply.

Figure 5-6 Example for the supply via two MACX MCR-PTB... power terminals

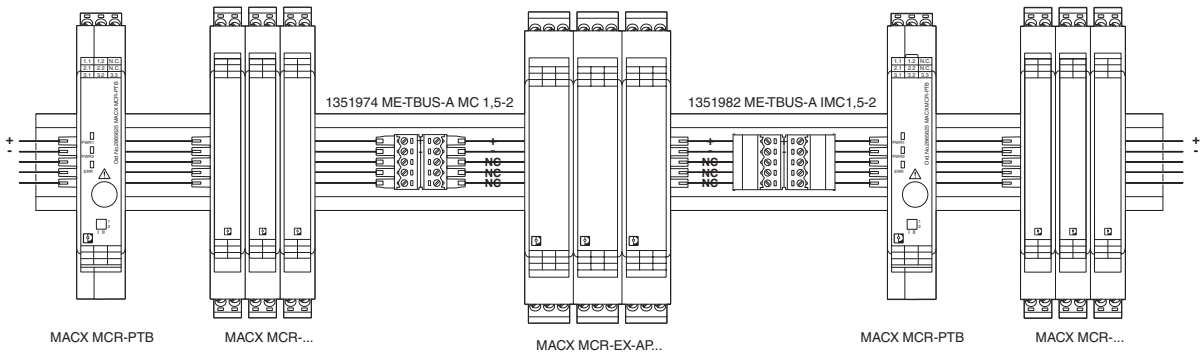


5.3 Supply via MACX MCR(-EX)-AP power module with DIN rail connector

The power and fault signaling module MACX MCR-PTB (item no. 2865625) or MACX MCR-PTB-SP (item no. 2924184) is used to supply the supply voltage to the DIN rail connector.

You also need the ME 17,5 TBUS DIN rail connector (item no. 1090049) and one ME-TBUS-A-MC 1,5-2 each (item no. 1351974) or ME-TBUS-A IMC1,5-2 (item no. 1351982).

Figure 5-7 Example of supply via power module MACX MCR(-EX)-AP with DIN rail connector



The DIN rail connectors ME-TBUS-A-MC 1,5-2 (item no. 1351974) and ME-TBUS-A IMC1,5-2 (item no. 1351982) do not support the transfer of group error messages.

5.4 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 power supply. However, if you want to avoid the complex single-core wiring, you can use a QUINT4-SYS-PS/1AC/24DC/2.5/SC (item no. 2904614). 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 2.5 A. To increase performance, up to two QUINT4-SYS-PS/1AC/24DC/2.5/SC (item no. 2904614) can be snapped on. This means that a total current of 5 A can be supplied. Please note, however, that redundant supply is not possible for currents greater than 2.5 A. A 6 A, 10 A or 16 A characteristic B miniature circuit breaker should be used to protect the primary side.

Calculate the maximum number of modules with the aid of the relevant packing slips using the formula below:

$$n_{modules} = \frac{I_{max}}{I_N} = \frac{1{,}5\ A\ (3\ A)}{I_N}$$

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

Example for supply via a system power supply

The goal is to supply 35 MACX MCR-RTD-I-SP temperature measuring transducers (item no. 1050201).

First determine the current consumption of the modules from the packing slips. For this temperature measuring transducer it is 40 mA per module.

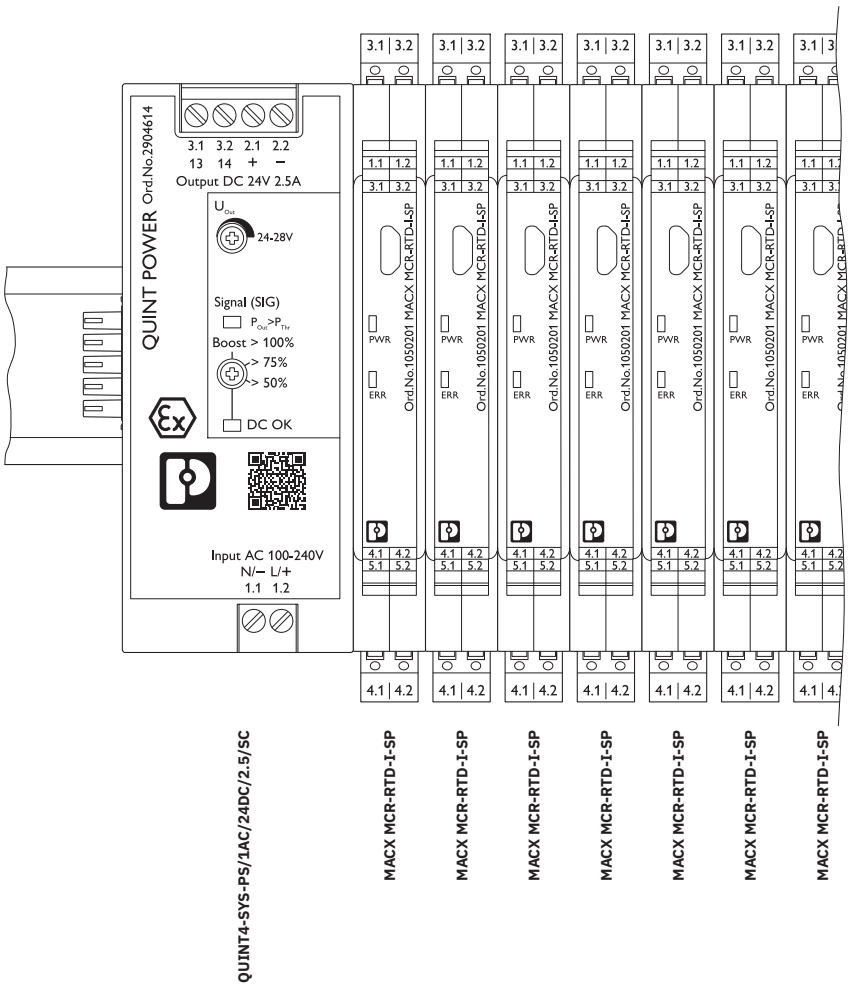
Then determine the maximum total current consumption of the 35 modules.

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

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

The total current consumption of 1400 mA is less than the maximum permissible current for supply via the QUINT4-SYS-PS/1AC/24DC/2.5/SC (item no. 2904614). The structure is shown in Figure 5-8 on page 52.

Figure 5-8 Example for supply via a system power supply



A Appendix for document lists

A 1 List of figures

Section 2

Section 3

Section 4

Section 5

Please observe the following notes

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