PROCESS AUTOMATION

Freelance 2019

Mounting and Installation Instructions
Rack System

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Rack System

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1 System Overview

Figure 1-1 shows the compact control system **Freelance 2000**.

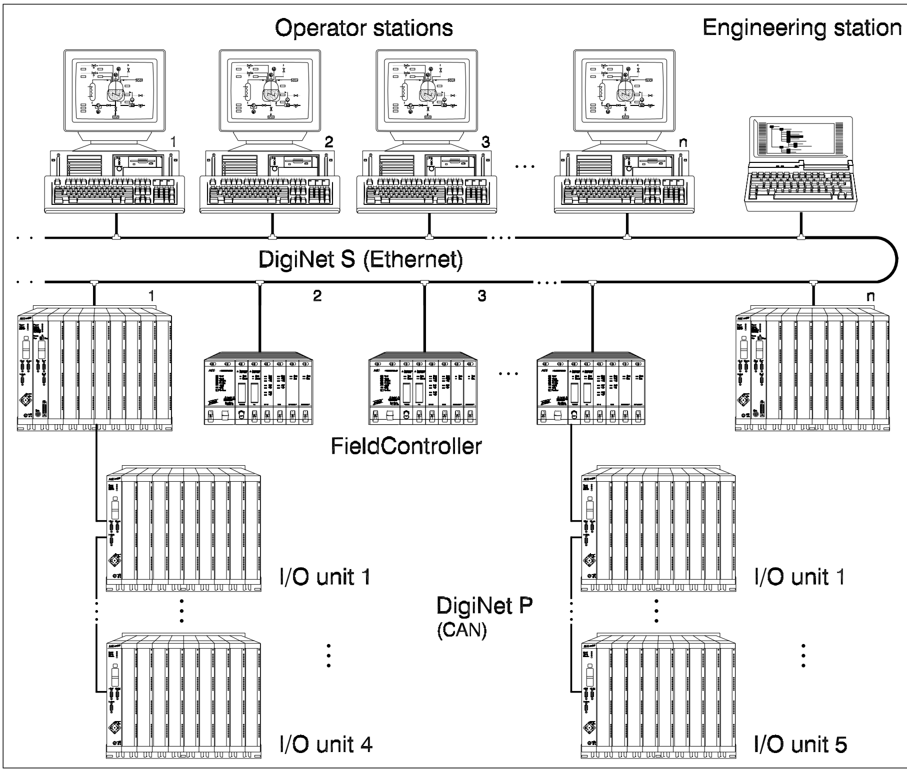


Fig. 1-1 Freelance 2000 system overview

The limitations of the Freelance 2000 system known from the past do no longer exist. The following configurations are now possible (examples):

- one or more engineering station(s),
- ten or more operator stations
- ten or more process stations or FieldControllers, with a maximum of
  - five I/O units per FieldController
  - four I/O units per process station.

System bus **DigiNet S (Ethernet)** links the individual stations and transmits data between the operator stations, the engineering station, the process stations, and the FieldControllers via coaxial or fiber optic cables.

Process station bus **DigiNet P (CAN)** connects a maximum of four I/O units to the central unit and is used to transmit the input/output values from the CPU module to the I/O modules.

Modbus **DigiLink** connects subsystems - e.g. balances, bar code readers, etc. - to the system via the RS485 interface.

The **engineering station** consists of a PC or laptop with MS Windows NT and the software package DigiTool. It is used by the operator for system configuration, documentation, and commissioning. After this has been done it can be disconnected and used for other purposes.

The operator station is usable for configuring and commissioning as well, provided that the engineering software **DigiTool** has been installed here.

The **operator station** is based on a PC with MS Windows NT and the software **DigiVis**. It is recommended to use industrial PCs. Besides a 17" or 21" color monitor, standard keyboard and mouse, components to IP 65 are available on request. A maximum of two printers for message and report printing can be connected.

When the Freelance 2000 system is extended with a FieldController, the connection and handling of local inputs/outputs is possible. The following fieldbuses are available for the FieldController:

- Profibus DP
- Fieldbus Foundation H1 (FFH1)
- Modbus
- CAN

The FieldController acts as a process station, and can run Freelance 2000 I/O units via the CAN fieldbus in the same way as the CPU module of an actual process station.

In addition, the FieldController is designed for running the fieldbus types listed above, and the I/O units connected to this bus. Tools like DigiTool, DigiVis, DigiBatch, etc.. used on the process station for commissioning, configuring, operating, monitoring and archiving can also be used on the FieldController. No external configuration tools are needed for the FieldController or Freelance 2000 system.

The **process station** D-PS in its simplest configuration consists of a central unit.

It can be expanded by max. four I/O units if the eight slots for I/O modules provided by the central unit are not sufficient.

A fully equipped process station with four I/O units accommodates 44 slots for I/O modules.

Process station bus DigiNet P links the central unit with the I/O units.

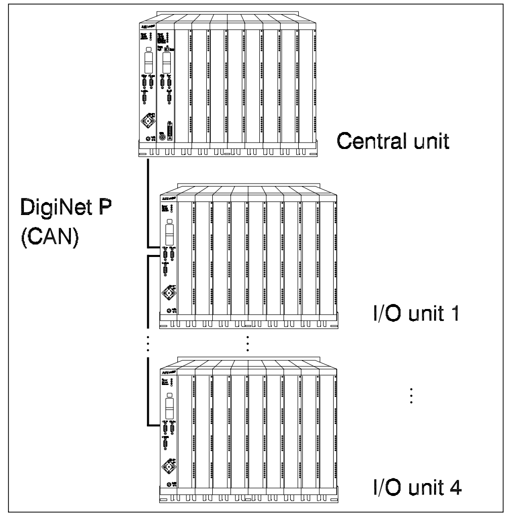


Fig. 1-2 Process station, fully equipped

A single central unit is a process station in its simplest configuration. Figure 1-3 shows the setup of a central unit without power supply, cables and redundant CPU.

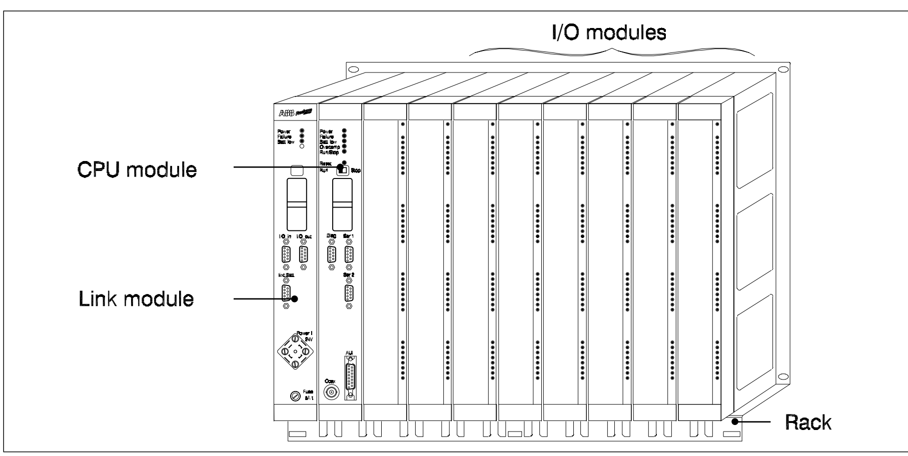


Fig. 1-3 Central unit of a process station

The **central unit** consists of:

- one rack DRA
- one link module DLM
- at least one CPU module DCP
- max. eight I/O modules.

It can also consist of

- one FieldController DFC 02,
- one CAN module DFM 03,
- and one Ethernet module DFE.

Instead of the I/O modules

- a gateway CPU linking the Freelance 2000 system with the Symphony operator level and/or
- a Secondary to increase the availability of Freelance 2000 and/or
- communication modules for connection of intelligent systems via serial interfaces

can be used.

The CPU module of the central unit or the FieldController, respectively, controls the I/O modules via process station bus DigiNet P. Therefore, the I/O units do not require an extra CPU module.

Figure 1-4 shows the setup of an I/O unit.

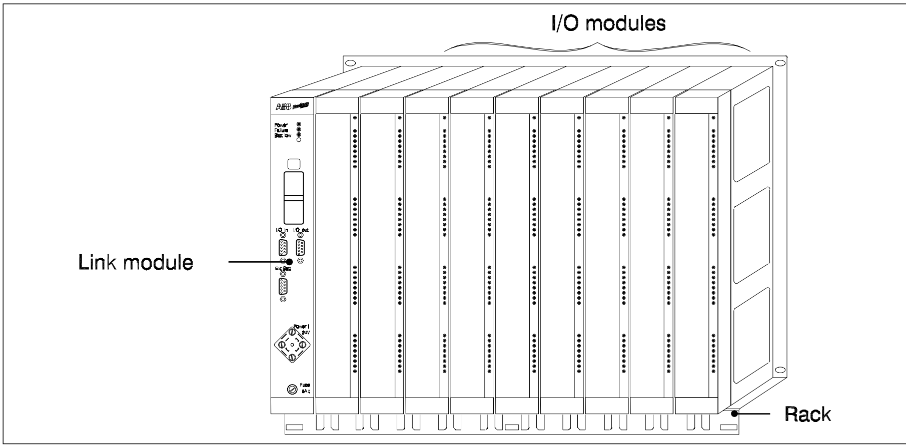


Fig. 1-4 I/O unit

Each **I/O unit** consists of:

- one rack DRA
- one link module DLM
- max. nine I/O modules.

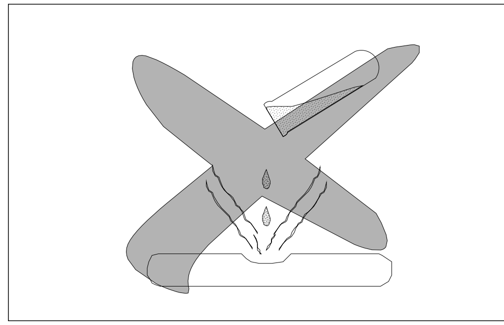
A gateway CPU, a redundant CPU, and/or communication modules can be used instead of the I/O modules.

For details on technical data and system architecture refer to:

- Compact control system Freelance 2000, Catalog No. 04/37 EN
- Compact control system Freelance 2000, System description 50/37-02 EN
- FieldController Mounting and Installation Instructions, 42/37-3151 EN

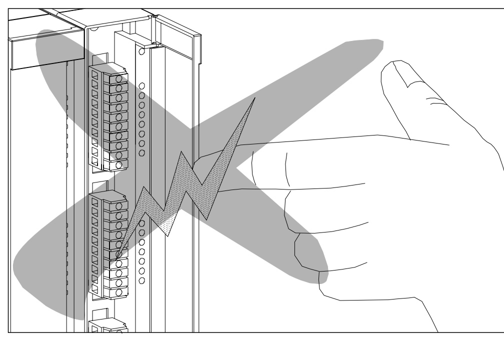
2 Precautions

Do not soil with aggressive or conductive substances.



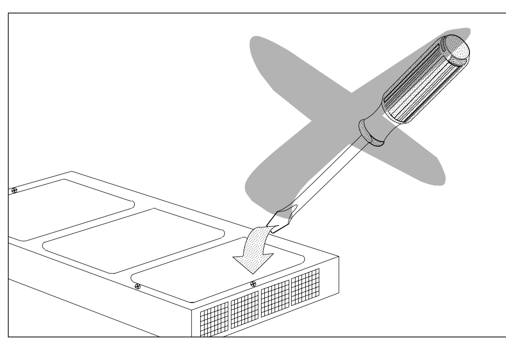
Avoid static discharge to the contacts!

Use a grounded wrist strap or touch the housing to discharge, before.



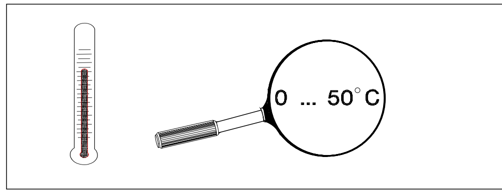
Do not open the modules!

No adjustment inside required.

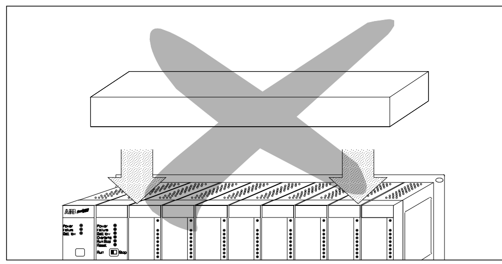


Observe the ambient temperature!

Avoid humidily condensing!
Prior to first commissioning submit the modules to the specified operating temperature for at least 30 minutes and then switch them on.

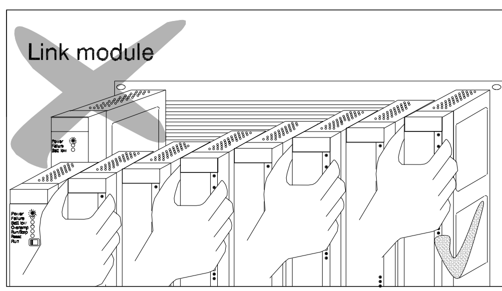


Do not obstruct the air vents!



Do not plug in or pull out the link module when live!

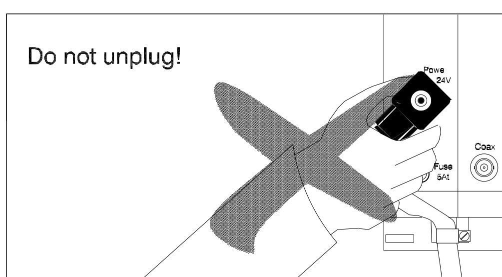
Hot-swapping only permissible for **CPU, communication** and **I/O modules**.



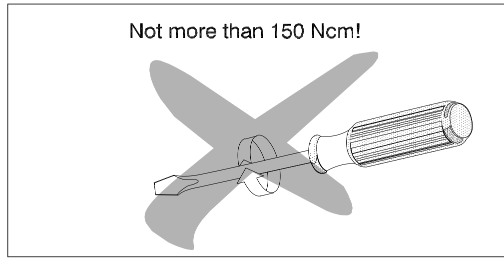
Do not plug in nor disconnect the **mains connector** on the **link module under power.**

Note that unplugging the connectors is no substitute for providing a switch.

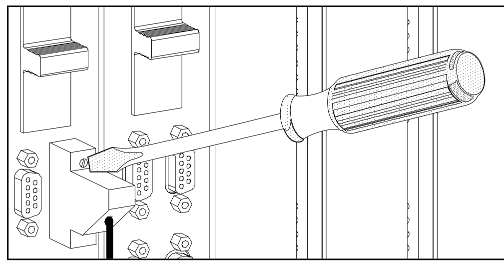
Always provide a switch as specified in Section 4.1.



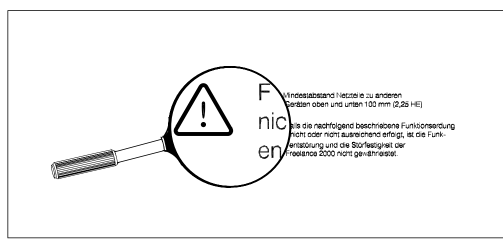
Only **hand-tighten** the module screws!



Screw the **connectors** to the **modules**.



Observe the warnings and cautions!

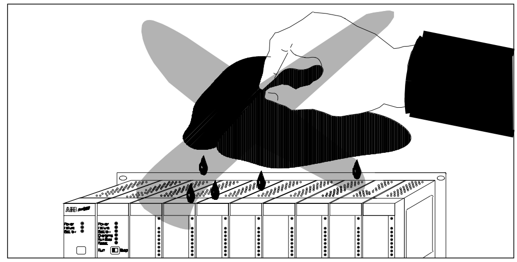


2.1 Routine maintenance and cleaning

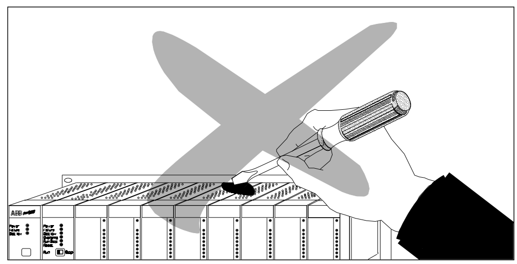
Clean dry !

Do not use moist or wet cloths!

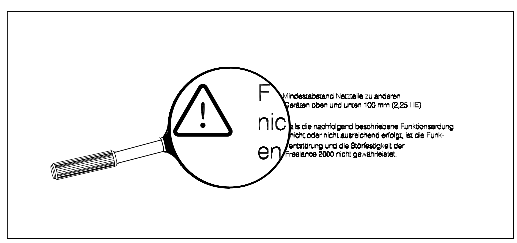
Cleaning interval:
depending on dirt accumulation,
e. g. weekly



Do not use scratchy or sharp-edged tools for cleaning!



Observe the warnings and cautions!



3 Mounting the Process Station

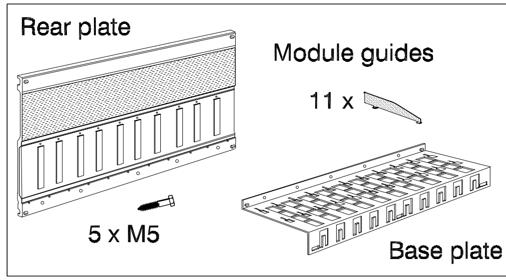
3.1 Mounting the rack

The racks DRA 01, DRA 02, DRA 03 and DRA 04 are delivered as assembly kits and are assembled as seen below (DRA 01 or DRA 02 are shown as an example):

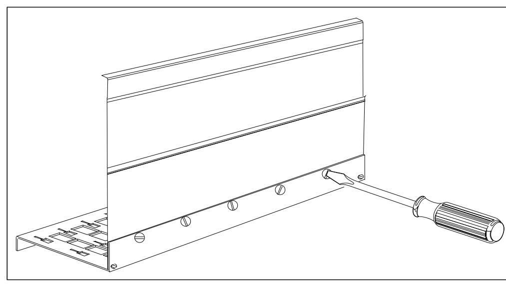
Scope of delivery

11 module guides for **DRA 01,**
11 module guides for **DRA 02**

4 module guides for **DRA 03**
6 module guides for **DRA 04**

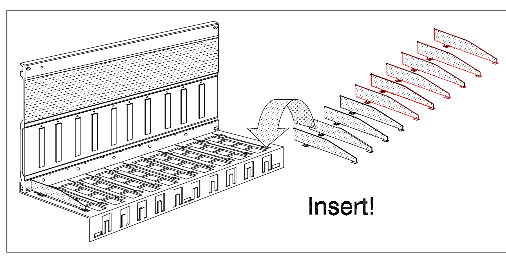


Screw rear plate to base plate.

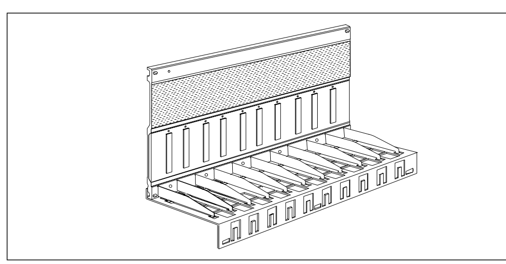


Module guides:

Insert from above.
Push backwards
until the lock snaps in.



Complete !



3.1.1 Dimensions and mounting depth

The racks are designed for 19" rail mounting. Figure 3-1, 3-2 and 3-3 show the DRA 01, DRA 02, DRA 03 and DRA 04 rack dimensions **without modules and without connected cables**.

DRA 01	10 slots	for non-redundant systems
DRA 02	10 slots	for redundant systems
DRA 03	3 slots	for redundant systems
DRA 04	5 slots	for redundant systems

Rack model DRA 01 has been **replaced with model DRA 02**, and is no longer available.

The DRA 01 and DRA 02 racks are 482.6 mm (19") wide. The total height is 341 mm (13.43" or 7.7 HU).

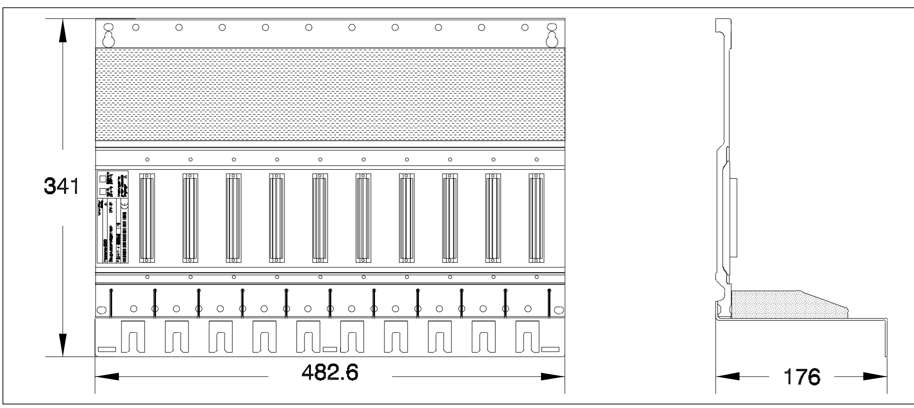


Fig. 3-1 Dimensions of DRA 01 and DRA 02 racks in mm

The rack DRA 03 is 171.8 mm (6.76") wide.

The total height is 341 mm (13.43" or 7.7 HU).

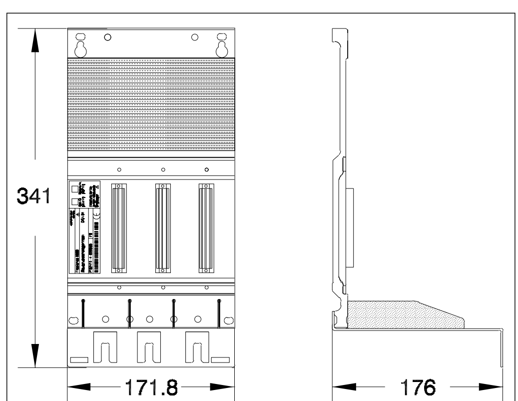


Fig. 3-2 Dimensions of DRA 03 rack in mm

The rack DRA 04 is 260.6 mm (10.26") wide.

The total height is 341 mm (13.43" or 7.7 HU).

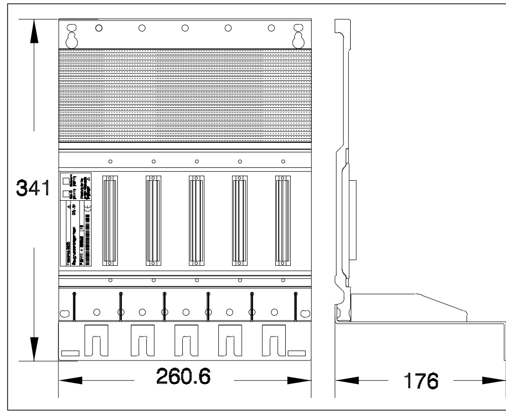


Fig. 3-3 Dimensions of DRA 04 rack in mm

Plugged-in modules and connected cables **increase the depth** of the complete rack to **approx**. **340 mm, when using the NA 00x AUI cable.**

Without the AUI cable the mounting depth is approx. 260 mm.

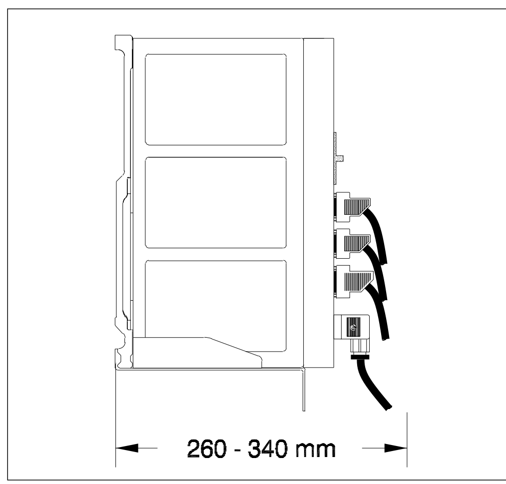


Fig. 3-4 Mounting depth of the rack

3.1.2 Cabinet mounting

Figure 3-5 shows as an example how to mount three racks with three power supplies in a cabinet.

Mount each rack with **four** screws to the cabinet mounting rails set to the back.

Note:

- **Use pan head screws, M6 × 30 .**
- **Weight of fully equipped rack is about 30 kg.**
- **Set mounting rails to back.**
- **All connections at front side.** No swing frame required. No doors at the cabinet back.

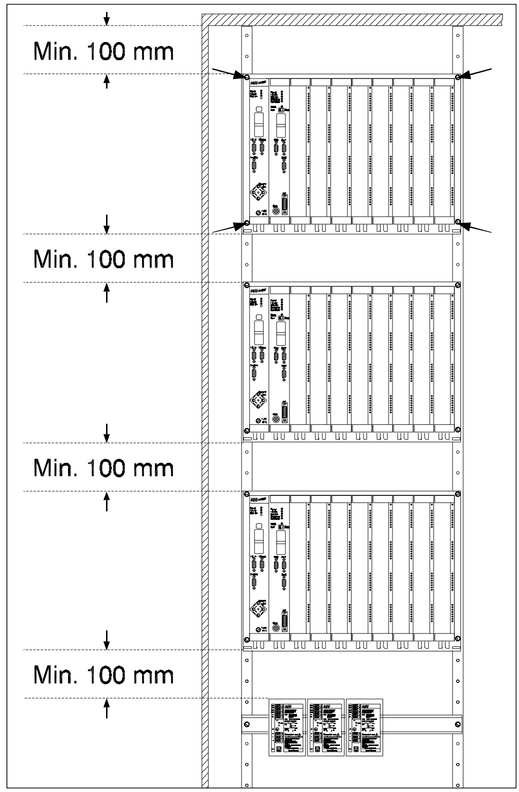


Fig. 3-5 Cabinet mounting

Risk of overheating!

Minimum spacing above and below **100 mm** (2.25 HU).

Maximum temperature at the rack bottom side (air intake): **50 °C**

Keep air vents open.

Do not impair air flow through rack.

Improved air circulation

Figure 3-6 shows the air flow in a cabinet with several racks.

The air flow passes through all racks and is heated while ascending.

As a result the process station mounted at the top of the cabinet only receives the air already heated by the process stations below it.

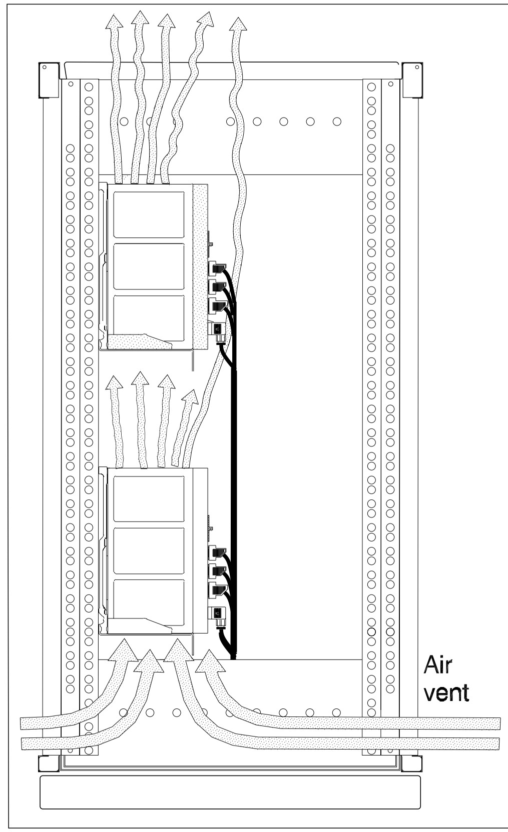


Fig. 3-6 Air flow without air deflectors

This unwanted stack effect can be avoided by using air deflectors DSU 65 (Fig. 3-7).

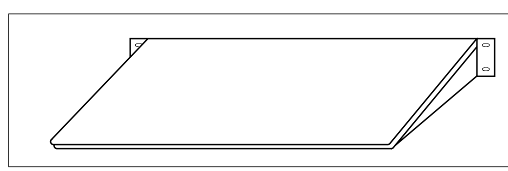


Fig. 3-7 Air deflector DSU 65

Figure 3-8 shows the improved air circulation.

Make sure that the cabinet is provided with the appropriate air inlets and outlets.

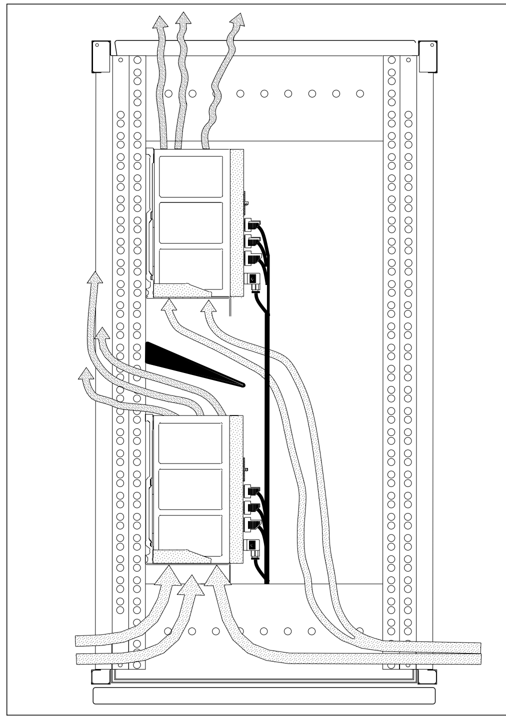


Fig. 3-8 Air flow with air deflectors

3.1.3 Wall mounting

The rack has two holes in its rear plate for wall mounting. **Select** the appropriate **pegs**, depending on the wall material. Fasten with **two 6 × 60 mm** screws.

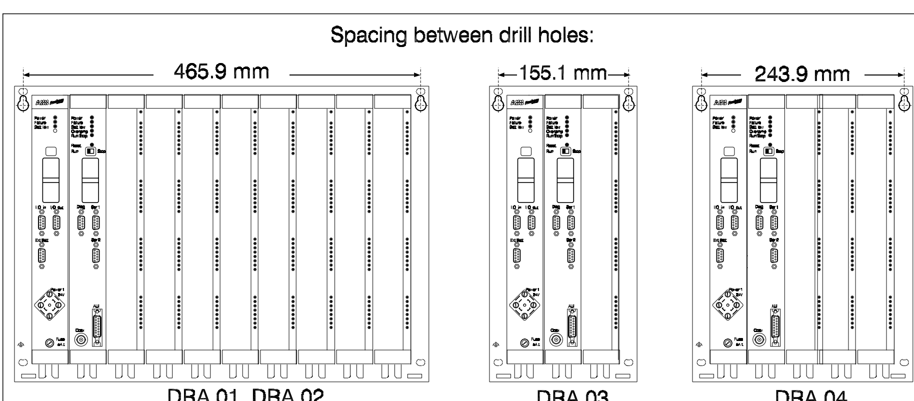


Fig. 3-9 Wall mounting the rack

3.1.4 Grounding the rack

Two kinds of rack grounding are required:

- Safety grounding via the power cable to eliminate the hazard of electrical shocks, for details refer to Section 4.2.1.

- An additional **functional grounding** to drain high-frequency interference from the unit, which is **vital to** RFI suppression and EMI/RFI shielding. Use a **short** grounding conductor with a **big surface**. The grounding point at the rack is marked with the symbol ⏚.

- **Do not connect the ground potential** of the link module power supply and of the I/O modules' external supply **to earth potential**.

If the functional grounding described below is not done or is not sufficient, the **RFI suppression** and **EMI/RFI shielding** of the Freelance 2000 system **cannot be guaranteed**.

For the functional grounding the following must be observed:

- Select **shortest way** to **cabinet potential**
- **Ensure good conductivity.** Use bright metal surfaces without varnish.
- Use a woven wire grounding strap with a total cross sectional area of 16 mm^2, e.g. DSU 485.
- Grounding strap of max. 300 mm.

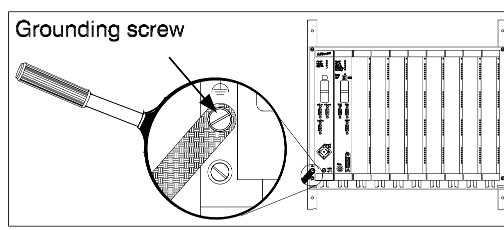


Fig. 3-10 Grounding for cabinet mounting

For wall mounting additionally note:

- Lay grounding rail with big surface close to Freelance 2000.
- Ground rack with shortest possible grounding strap.
- Alternative solution: mount rack on grounded bright metal plate.

Note that the screw connections **do not** provide sufficient contact.

3.2 Mounting the power supply

3.2.1 Dimensions

The illustrations below show the dimensions and mounting depth of the power supplies DPW 01, DPW 02 and DPW 03 in mm. Please note that only power supply DPW 01 is described in the following text. All specifications analogously apply to DPW 02 and DPW 03.

Always **read and observe the documentation delivered with the power supplies**. The units may be different from the illustrations seen in this manual due to further development and model modifications.

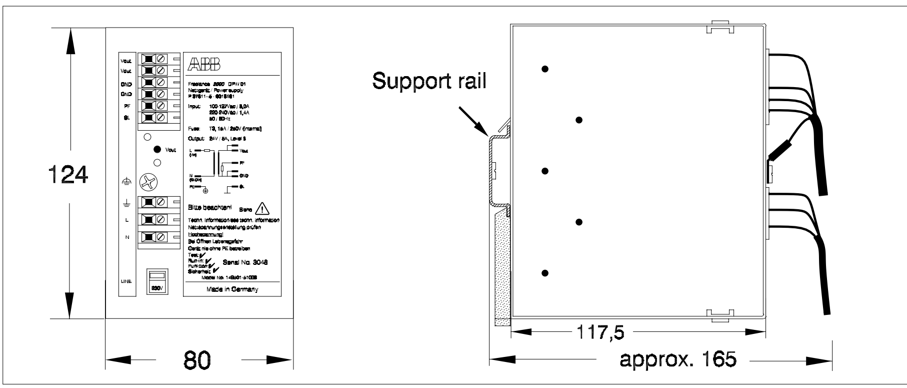


Fig. 3-11 Dimensions and mounting depth of the power supply DPW 01 in mm (115/230 V AC)

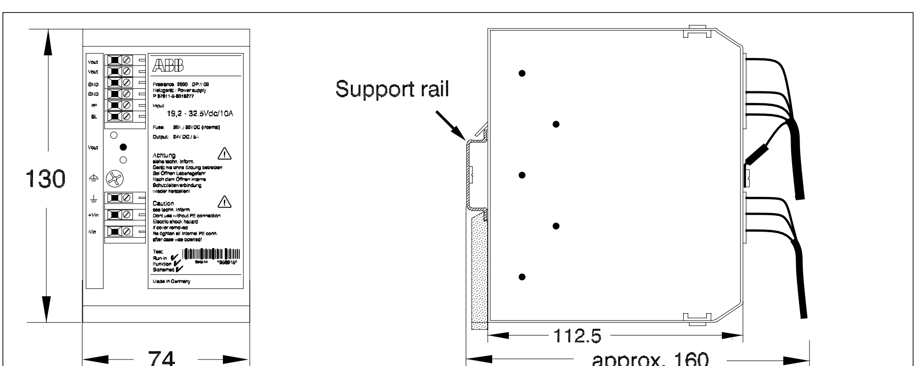


Fig. 3-12 Dimensions and mounting depth of the power supply DPW 02 in mm (24 V DC)

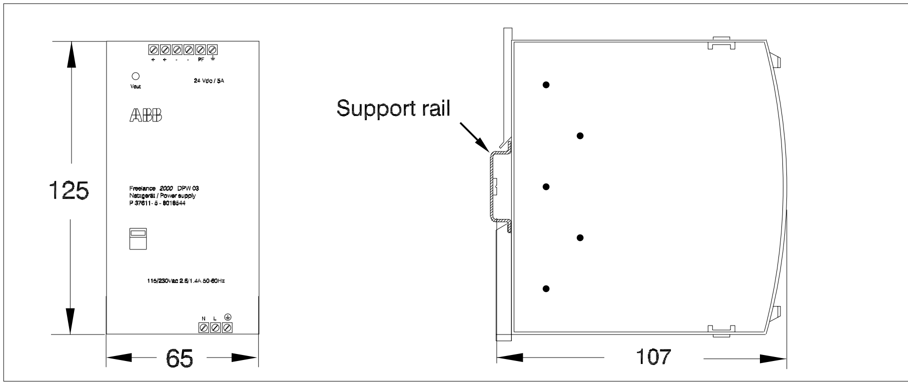
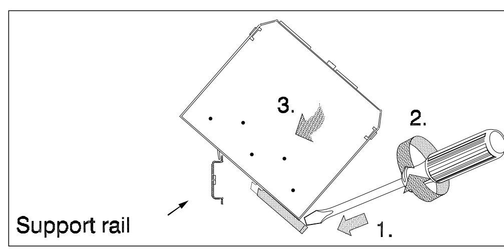


Fig. 3-13 Dimensions and mounting depth of the power supply DPW 03 in mm (115/230 V AC

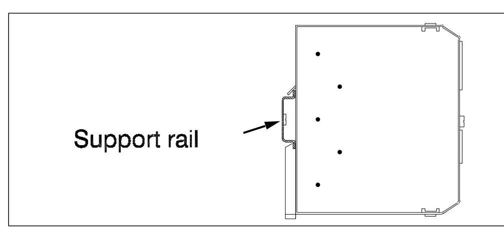
3.2.2 Mounting to a support rail

Proceed as follows to mount the power supply DPW to a support rail:

- Hook power supply on support rail **from above**.
- **Insert screw driver** in slide lock and **turn**.
- Pull down slide lock.



- **Swing down** and **snap in** power supply.
- Pull out screw driver.



If your power supply unit should have a locking mechanism which is different from the one described here, observe the operating instructions delivered with your power supply unit.

Figure 3-14 shows the minimum spacing between power supplies mounted to a support rail TS35/7,5 (EN50 022).

- Minimum mounting depth 150 mm, including cables.
- All connectors accessible from the front.

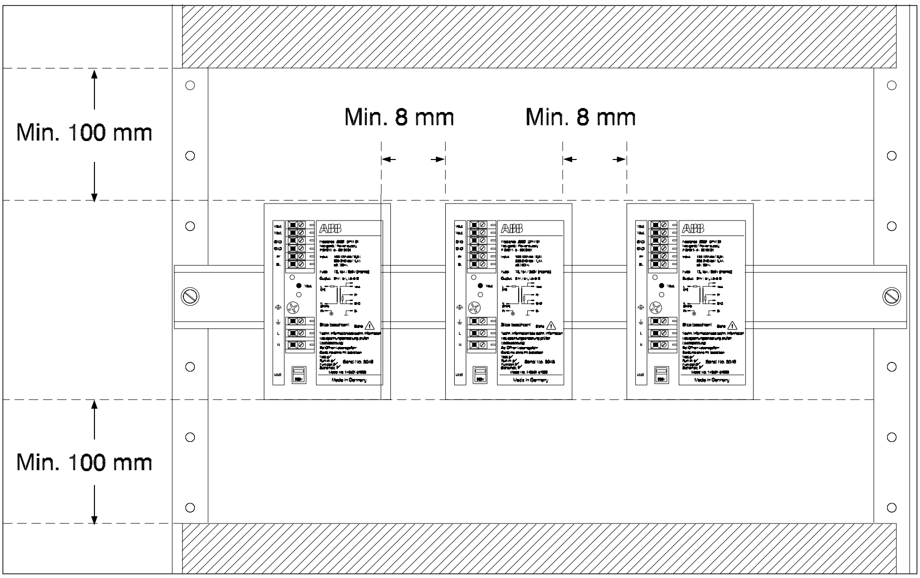


Fig. 3-14 Minimum spacing between power supplies

When mounting the power supplies note the following:

Risk of overheating!
Minimum spacing above and below **100 mm** (2.25 HU) and between power supplies **8 mm.**

Maximum temperature 50 °C
Make sure that good cabinet ventilation is possible.

Keep air vents open.
Do not impair air flow through power supply.

3.2.3 Grounding the power supply

Two kinds of power supply grounding are required:

1. Safety grounding via the power cable to eliminate the hazard of electrical shocks, for details refer to Section 4.2.1.

2. An additional **functional grounding** to drain high-frequency interference from the unit, which is **vital to** RFI suppression and EMI/RFI shielding. Use a **short** grounding conductor with a **big surface**.

3. **Do not connect the GND terminals** (ground potential) of the power supply **to earth potential**.

⚠ If the functional grounding described below is not done or is not sufficient, the **RFI suppression** and **EMI/RFI shielding** of the Freelance 2000 system **cannot be guaranteed**.

The functional grounding has to be done as shown in Figure 3-15. Observe the following instructions:

- Make **shortest possible grounding connection** between **grounding screw** of power supply and **cabinet potential** (e.g. to support rail or grounding point of the rack).

- **Ensure good conductivity.**
  Use bright metal surfaces without varnish.

- **Min. cross-sectional area 4 mm^2.**
  Round conductor (grn-yel).

- **Grounding cord of max. 300 mm.**

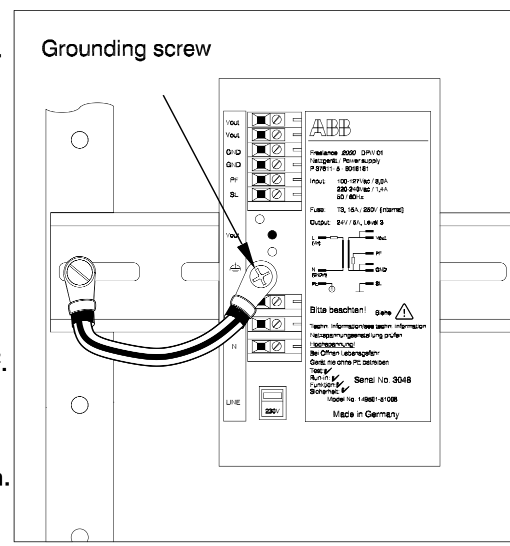


Fig. 3-15 Functional grounding of power supply

3.3 Mounting the modules

3.3.1 Adjusting the link module

The Freelance 2000 system offers a choice of two link modules:

DLM 01: Standard link module
DLM 02: Link module with redundant power supply

The following diagrams show link module DLM 01. The instructions given for adjustment and mounting are analogously valid for DLM 02.

The link modules have a **coding switch** at their **back**, where the **rack number** is adjusted. In the following text this number is referred to as the **rack ID**. The coding switch determines the **data rate** of the DigiNet P in V1 and V2 systems. With system version 3.3 and higher this functionality is performed in the DigiTool by the card module of the link module.

However, this does not apply to the V2-compatible mode of the V3 software. In this case it is recommended to set the coding switch and the card module to the same value.

The coding switch **identifies** the rack as a **central unit** or **first/second/third/fourth I/O unit.**

The coding switch is **accessible from outside** and is adjusted by using a screw driver.

Adjust the r**ack ID before mounting** the module.

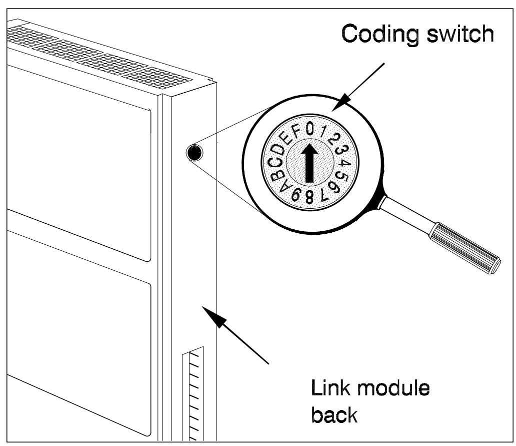
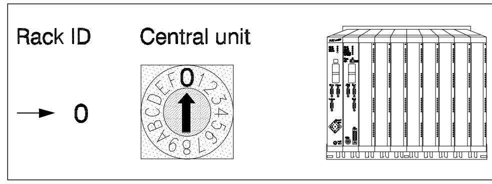


Fig. 3-16 Coding switch of link module

For a **central unit without I/O units always** set the coding switch to position **0**.

Coding switch to position **0**



Standard setting of coding switch

Use the **standard setting** if the total distance between central unit and I/O units is less than 80 m. The CAN bus length is reduced by 2 m for every link module. With this setting the process station bus operates with normal data rate, i.e. 500 kBit/s, in V1 and V2 systems. With version 3.3 or higher the **transmission rate** of the DigiNet P is set using the **DigiTool** configuration software**.**

With transmission rate 500 kBits/s:
Max. cable length = 80 m – number of link modules x 2 m

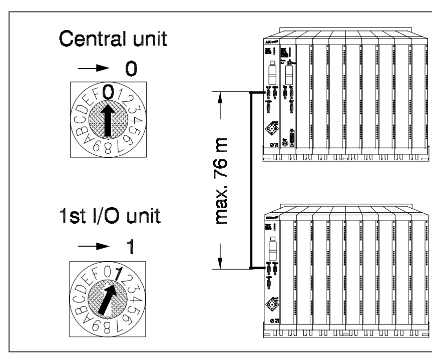
1. **Process station with one I/O unit**

Coding switch positions:

Central unit to **0**

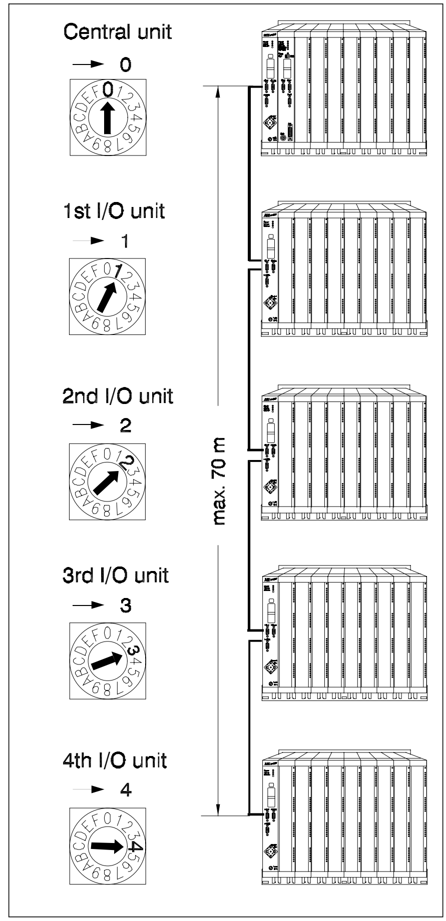
1st I/O unit to **1**

The max. cable length between the central unit and the I/O unit is 76 m (80 m – 2 x 2 m).



Max. distance 76 m.

2. Process station with two and more I/O units



Coding switch positions:

Central unit to **0**

1st I/O unit to **1**

2nd I/O unit to **2**

For Version 3.3 and higher

3rd I/O unit to **3**

4th I/O unit to **4**

The max. cable length between the central unit and the four I/O units is 70 m (80 m – 5 x 2 m).

Max. distance 70 m.

With a transmission rate of 500 kBit/s: Reduce the max. CAN bus cable length by 2 m for every link module .

Coding switch setting for long distances

For distances between central unit and I/O units of **more than 80 m** the **setting for long distances** has to be used. With this setting, the process station bus operates with a reduced data rate of 100 kBit/s. Thus, data transmission to the I/O modules is **five times slower**. In this case, the distance between central unit and I/O units is limited to **max. 400 m**. Note that the max. bus cable length is reduced by 10 m for every link module used.

For cable lengths of more than 80 m the bus cable DSU 07 has to be used. This cable is delivered with two connecting cables. Each of these connecting pieces has a length of 2 m and reduces the max. length of every DSU 07 cable by 10 m. As a result, the max. cable length of every DSU 07 cable is reduced by 20 m.

With version 3.3 or higher the **transmission rate** of the DigiNet P is set using the **DigiTool** configuration software**.**

The following settings are mandatory for V1 and V2 systems. The settings are also recommended for V3 systems that work in the V2-compatible mode. Also make sure that the setting of the link module's card module is identical with the coding switch setting.

With a transmission rate of 100 kbits/s:

Max. cable length = 400 m – number of link modules x 10 m – number of DSU 07 cables x 20 m

1. **Process station with one I/O unit**

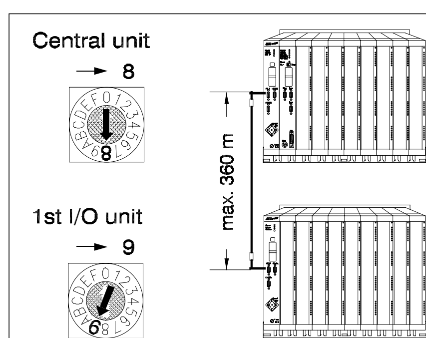
   Coding switch positions:

   Central unit to **8**

   1st I/O unit to **9**

   Reduce the central unit and I/O unit cable length by 10 m, each, and the length of each DSU 07 cable by 20 m.

   (400 m – 2 x 10 m - 20 m)



Max. distance 360 m.

2. Process station with two or more I/O units

Coding switch positions:

Central unit to **8**

1st I/O unit to **9**

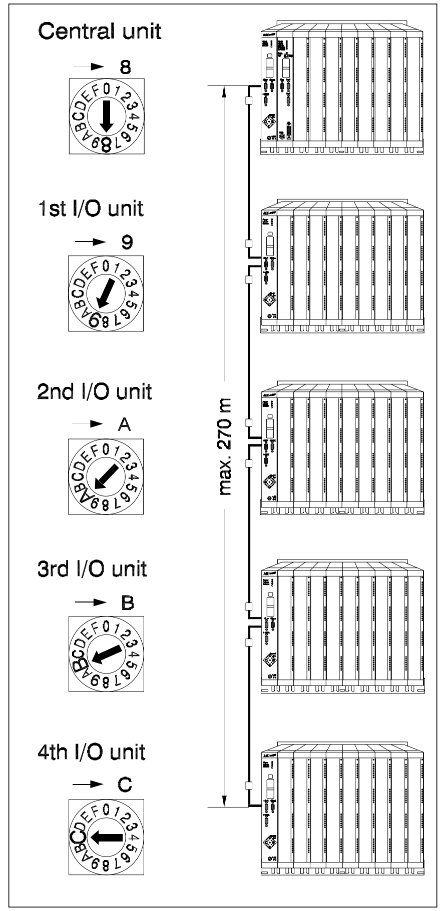
2nd I/O unit to **A**

For Version 3.3 and higher
3rd I/O unit to **3**

4th I/O unit to **4**

Reduce the cable length for the central unit and the four I/O units by 10 m, each, and the length of each DSU 07 cable by 20 m.

(400 m – 5 x 10 m – 4 x 20 m)



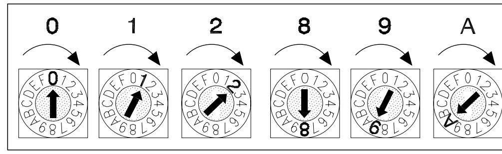
Max. distance 270 m.

With a transmission rate of **100 kBit/s: Reduce the** max. **CAN bus** cable length **by 10 m for every link module** and by another **20 m for every DSU 07 cable.**

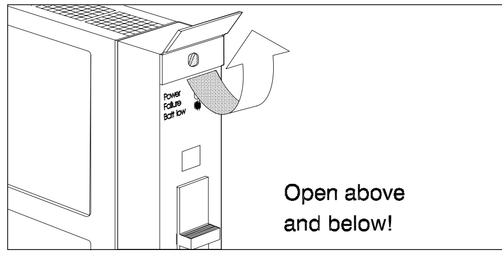
3.3.2 Mounting the link module

Set coding switch as described above.

- For version 1, 2, 3.1 and 3.2 systems **only positions 0, 1, 2, 8, 9, and A are permissible.**
- **For systems of version 3.3 and higher positions 0, 1, 2, 3 and 4 are permissible**

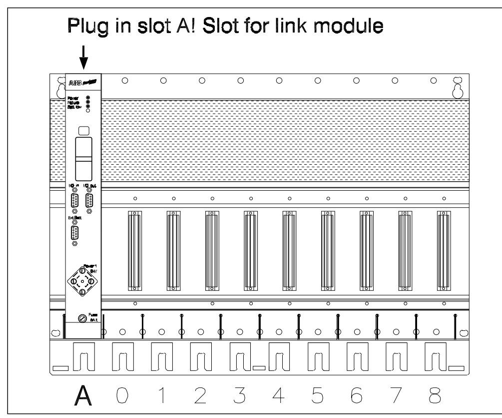


Open **upper** and **lower cover**.



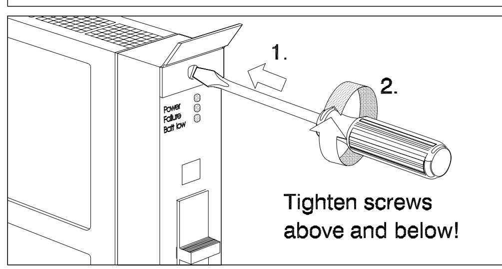
Set module on base plate and **plug in.**

Only slot A permissible (first slot on left-hand side).

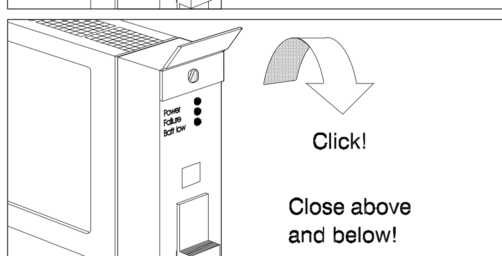


Push in module screws with screw driver and **tighten**. **Turn clockwise**.

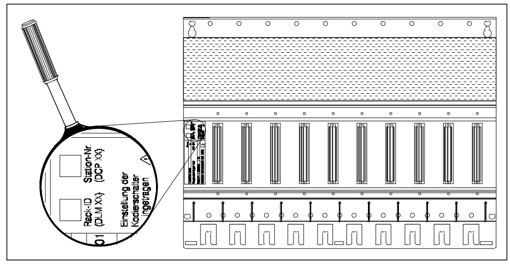
Only hand-tighten the screws.



Close upper and lower cover.



Write the position
of the coding switch
in the **Rack ID** field
on the left hand side of the rack.



3.3.3 Adjusting the CPU modules DCP 02 and DCP 10

The **coding switch** at the back of the CPU module DCP serves for **adjusting** the **IP address** of the process station.

For details on the station number refer to Section 6.1 **Verifying rack ID and station number.**

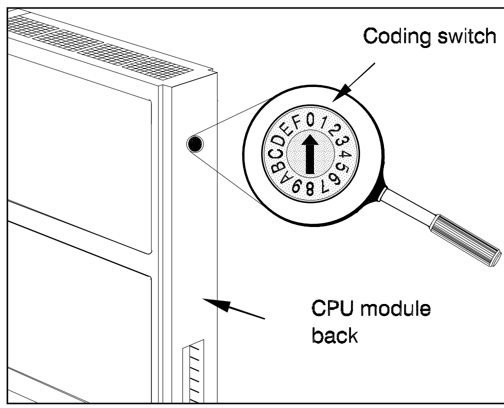


Fig. 3-17 Coding switch for IP address

Use the following flow chart to decide whether you can use the standard station number setting or if it is a special case.

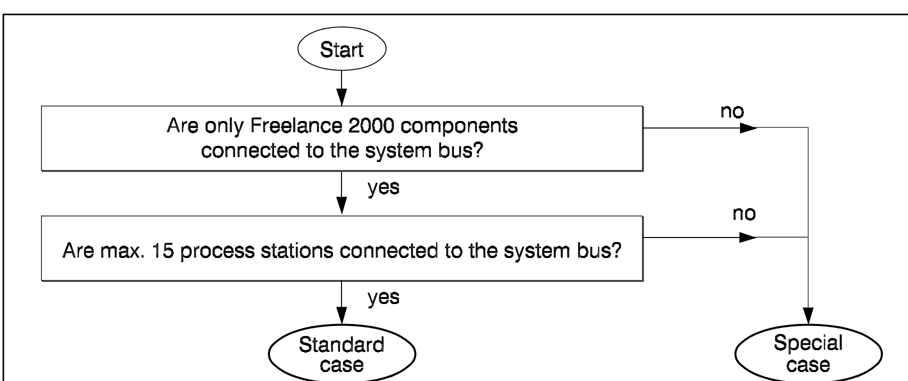


Fig. 3-18 Adjusting the IP address

Standard case

The standard case is valid if:

- **max. 15 process stations** are used on a system bus **and**
- **Freelance 2000 components** are used **exclusively and**
- there is **no connection to other networks.**

Set the coding switch of the first process station to **1** and **increase by one** for each additional process station. From the tenth station on use the characters **A** to **F**. The process station will then work with a standard IP address, of which the last digit is adjusted with the coding switch. Do **not set to 0**.

Several Freelance 2000 systems can be used on one system bus. However, only nodes of the same system can interchange data. **When using more than 10 process stations, data interchange must be configured,** which then takes place via write and read utilities**.**

The clock synchronization works for all process stations connected to DigiNet S.

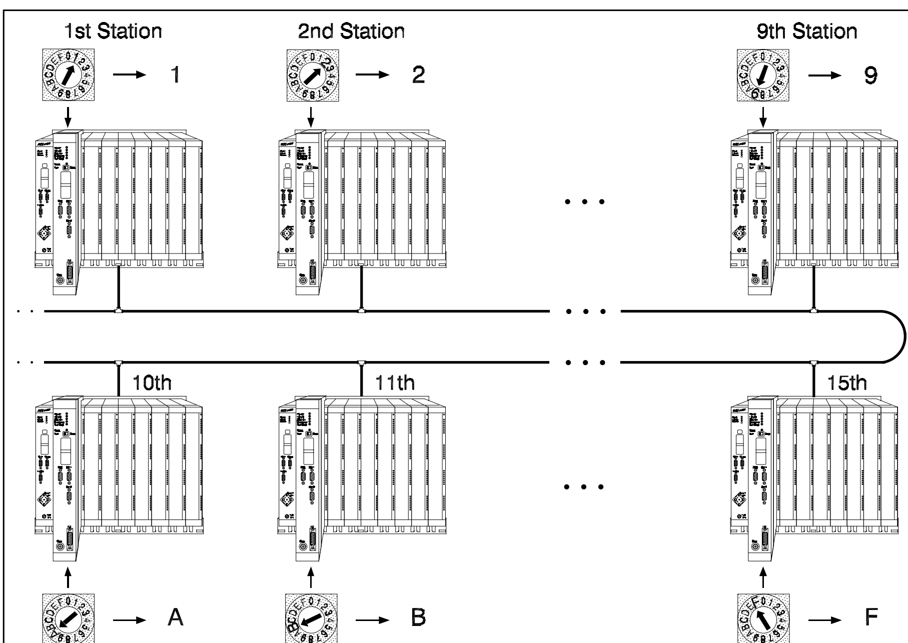


Fig. 3-19 Standard setting

Special case

The special case is valid if **either**

- **other nodes** are used together with Freelance 2000 components (process station, operator station, engineering station) on the same system bus **and/or**
- the system bus has **connections to other networks and/or**
- **more than 15 process stations** are working on the same system bus. (Notice maximum bus load).

Set the coding switches of the CPU modules of all process stations to 0.

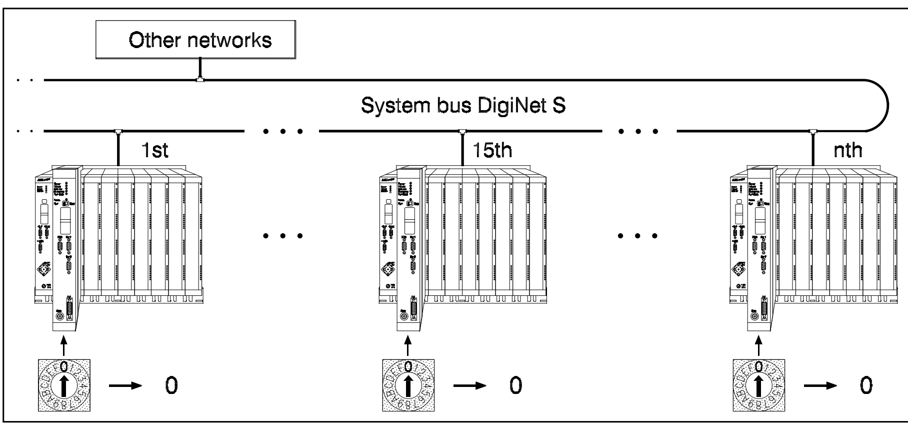
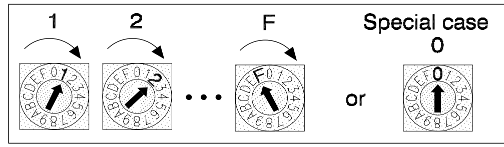


Fig. 3-20 Special setting

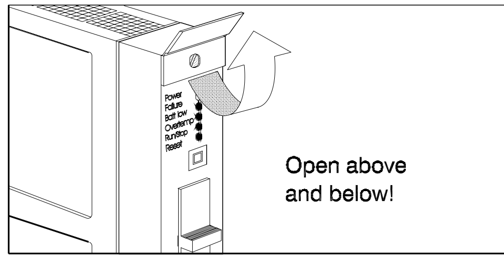
In this case, an individual IP address has to be entered for each station during commissioning (see Section 6.4.4 and 6.4.7). Contact your network administrator for these addresses.

3.3.4 Mounting the CPU modules DCP 02 and DCP 10

Set coding switch
as described above.

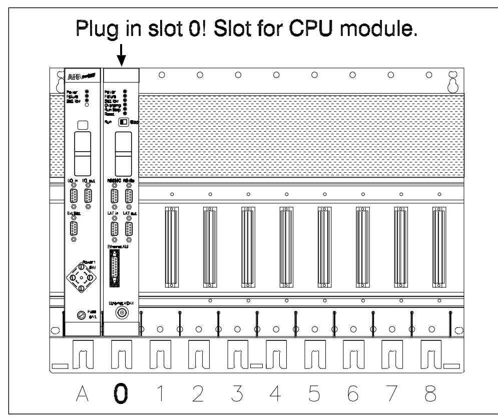


Open covers.



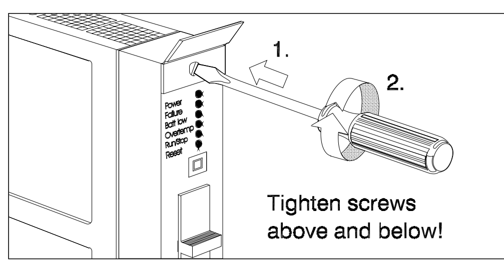
Set module on base plate
and **plug in**.

Only slot 0 permissible
(second from left).

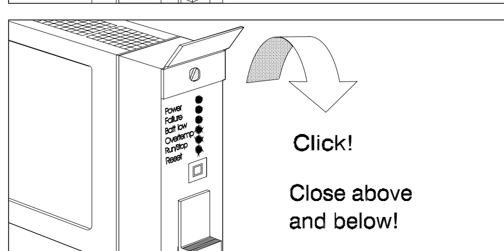


Push in module screws with screw driver and **tighten**.
Turn clockwise.

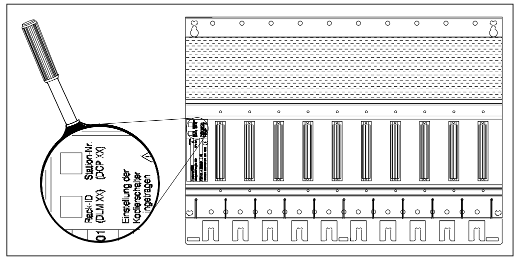
Only hand-tighten the screws.



Close covers.



Write the **position** of the coding switch on the rack in the field **Station-Nr.**

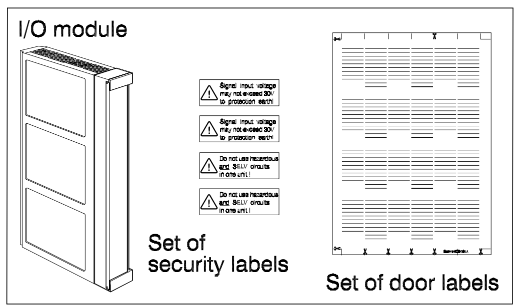


3.3.5 Mounting I/O modules

No adjustment needs to be done at the I/O modules.

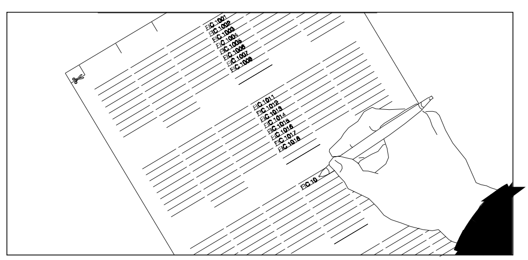
Check scope of delivery:

- I/O module
- Door labels for inside and outside, pack of 3
- Security labels, pack of 4



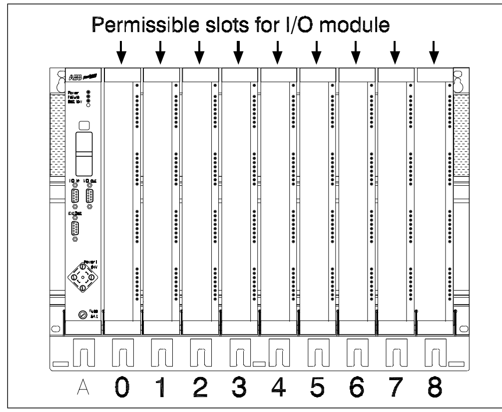
Write tag numbers on door labels.

The labels for the door inside have a serial numbering from 10 to 49 and additional fields for the supply connectors.

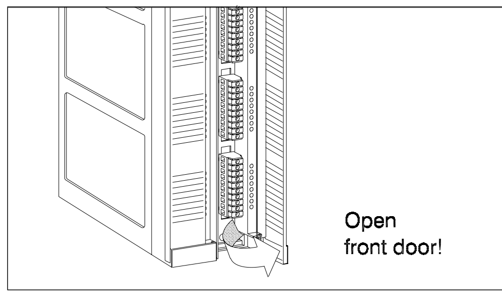


Set module on base plate and **plug in**.

Slots 1 ... 8 in the **central unit** and slots **0 ... 8** in the **I/O units** are permissible.

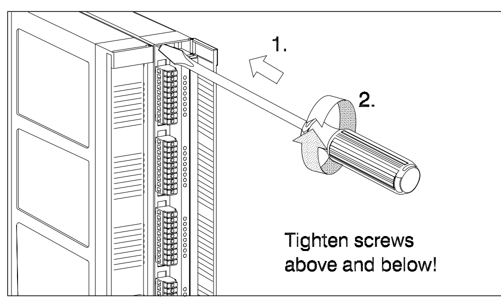


Open front door.



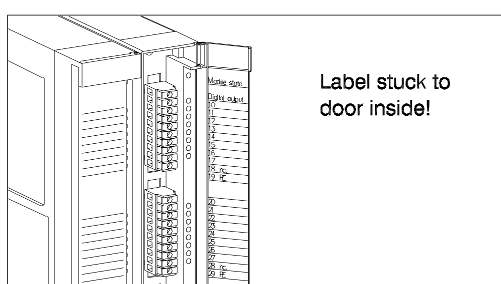
Push in module screws with screw driver and **tighten.**
Turn clockwise.

Only hand-tighten the screws.

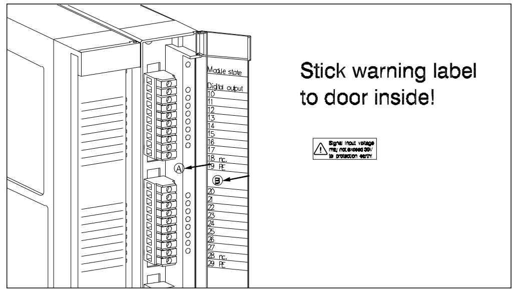


Stick appropriate label to door inside.

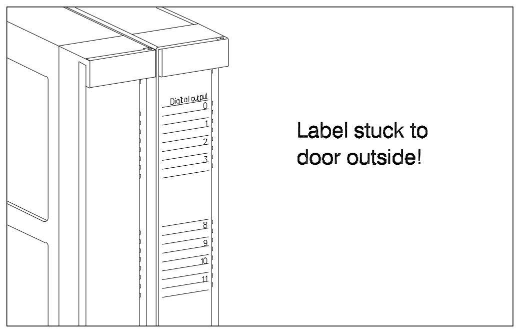
The labels for the door inside have a serial numbering from 10 to 49 and additional fields for the supply connectors.



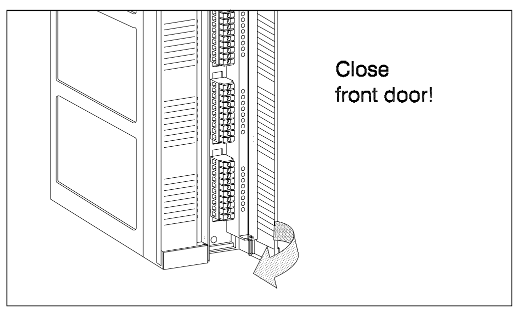
Stick warning and informative labels to door inside when working with hazardous voltages.



Stick appropriate label to door outside.



Close front door.



3.3.6 Adjusting the communication module DCO 01

The **communication module** DCO 01 has a coding switch at its back.

This switch is reserved for future applications and does not require any adjustment for the time being.

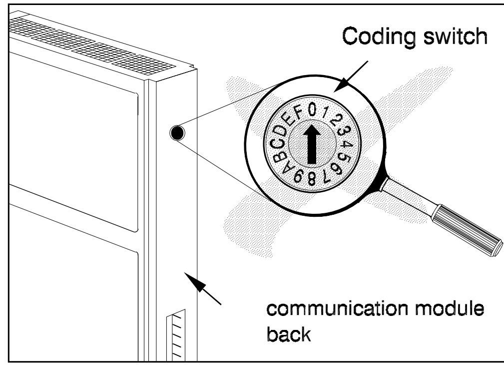


Fig. 3-21 Coding switch of communication module

3.3.7 Mounting the communication module DCO 01

There are no hardware limitations concerning the max. number of communication modules per process station. However, a certain limitation results from the memory requirements per communication channel, which depend upon your project configuration. Typically, around seven channels are available for every process station. The communication module can be mounted either in the central unit or in the I/O units, as required.

Standard case: one communication module per process station

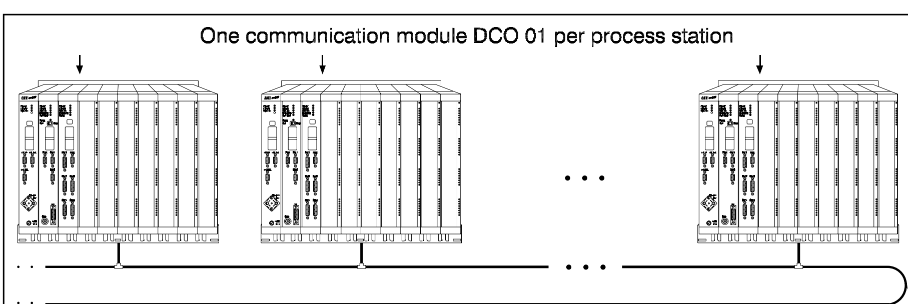
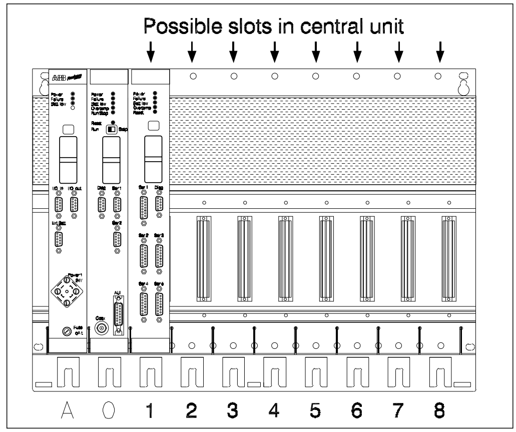


Fig. 3-22 Standard setting for communication module

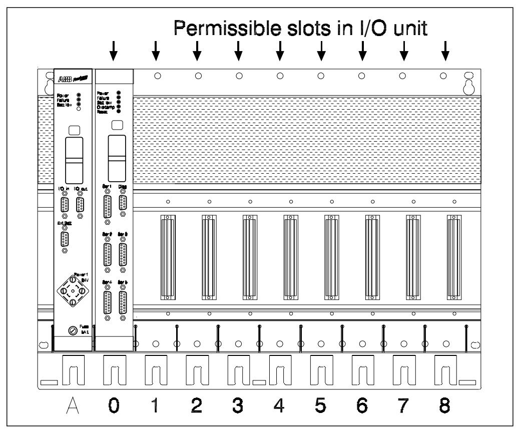
Open covers.

Set module DCO 01 on base plate and **plug in.**

In **central units**
slots 1 to 8 are **permissible.**

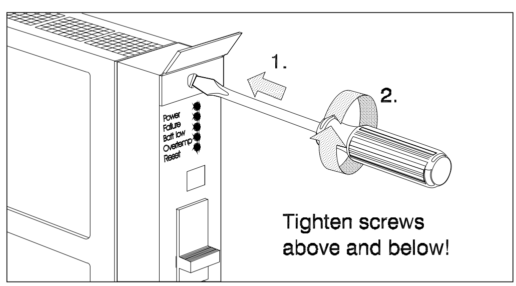


In **I/O units**
slots 0 to 8 are **permissible**.

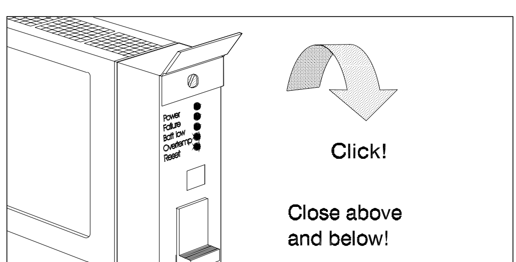


Push in module screws with screw driver and **tighten**.
Turn clockwise.

Only hand-tighten the screws.



Close covers.



3.3.8 Adjusting the gateway CPU for Symphony connection

The CPU module DCP 02 or DCP 10 can be used as a gateway for connection to the supervisory Symphony operator system. Two CPU modules DCP 10 are to be used for redundant connection. The gateway CPU can be plugged in any slot of the central unit or of an I/O unit. The "gateway CPU" function is configured using the DigiTool configuration software.

Set the coding switch at the back of the module as described in section 3.3.3. Make a distinction between the standard and the special case. In the standard case Freelance 2000 system components are used exclusively on the system bus. The number of stations is limited to a maximum of 15. Also, in the standard case the station number of the gateway CPU must be set such that it is different from all other CPUs used in the system.

Fig. 3-23 shows the standard setting of the gateway CPU station number.

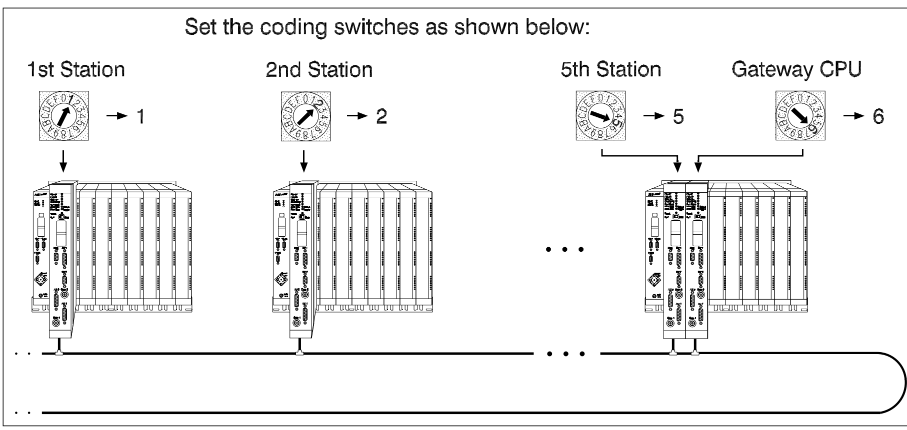


Fig. 3-23 Adjusting the gateway CPU, Symphony

In the special case more than 15 stations and/or non-Freelance 2000 components are used on the same system bus. In this case set the coding switches of all Freelance 2000 stations used on the bus to 0. Figure 3-24 shows a special case where a non-Freelance 2000 component is connected to the system bus.

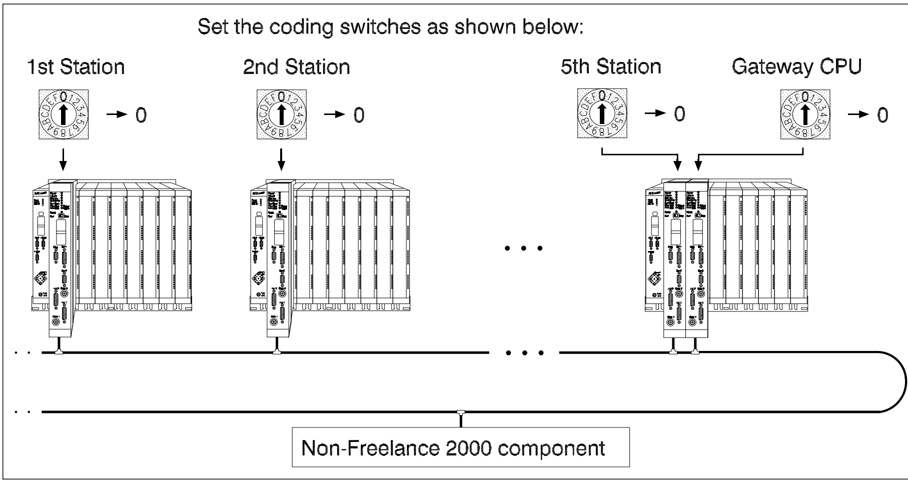


Fig. 3-24 Adjusting the gateway CPU with a non-Freelance 2000 component, Symphony

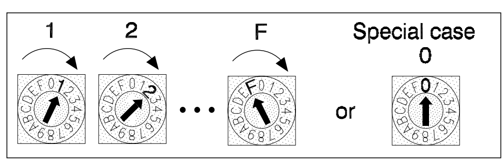
Proceed analogously when installing a redundant gateway. In the standard case you have to make sure that all stations on the system bus have different coding switch positions. In the special case all coding switches have to be set to position 0.

The function of the gateway or CPU is configured using the DigiTool configuration software.

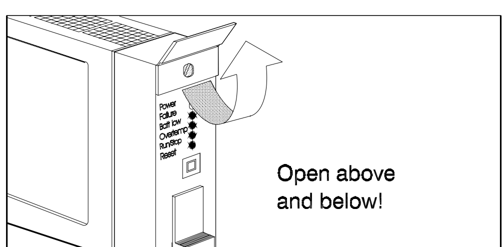
3.3.9 Mounting the gateway CPU for Symphony connection

Set coding switch
as described above.

Standard setting = e.g. 6.



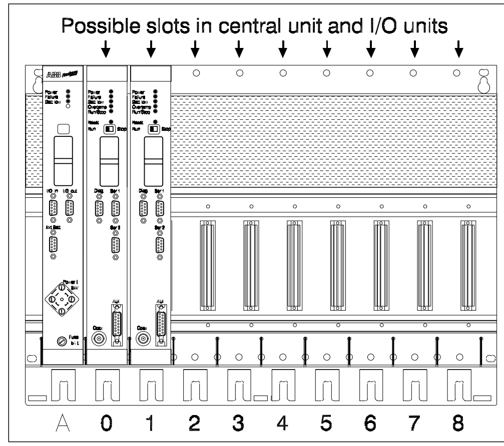
Open covers.



Set module on base plate and **plug in.**

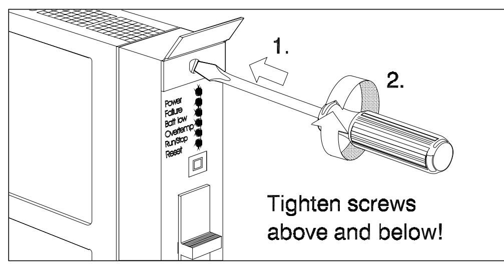
In **central units slots 1 to 8** are **permissible.**

In I/O units slots 0 to 8 are permissible.

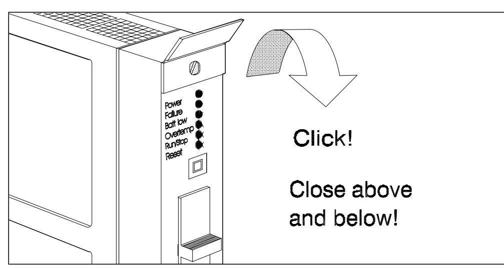


Push in module screws with screw driver and **tighten**.

Turn clockwise. Only hand-tighten the screws.



Close covers.



If no empty slots are available in the Freelance 2000 system, it is also possible to install the gateway CPU in a separate rack. You can, for example, use rack DRA 03.

3.3.10 Adjusting the CPU module for redundant operation

The availability of the Freelance 2000 system can be increased by

- using the link module with redundant power supply DLM 02
- using two CPU modules DCP 10 in redundant mode.

Maximum availability is achieved by combining these two ways. This improves the availability by 480 %. Note that module DCP 02 cannot be used as a Secondary.

Set the coding switch as described in Section 3.3.3. Proceed as described for the standard case with up to 15 CPU modules. For systems with more than 15 CPU modules proceed as described for the special case. It is of no importance whether the CPU module works as a primary, redundant or gateway CPU. In the following descriptions, the first CPU module is referred to as the Primary, whereas the second one is referred to as the Secondary, for a better understanding.

However, the functionality of both CPUs can be changed during operation by a redundancy change-over.

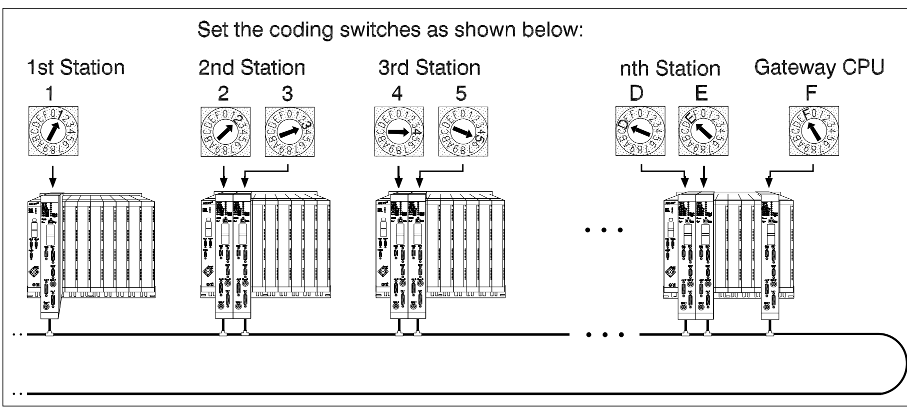


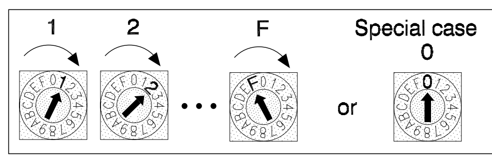
Fig. 3-25 Adjusting the CPU module for redundant operation

When adjusting the coding switch take care that a different IP address is assigned to each CPU module in the system. A second CPU module in the process station is configured in the DigiTool configuration menu to operate as a gateway or Secondary. The following relation exists between the function of the CPU module and the slot:

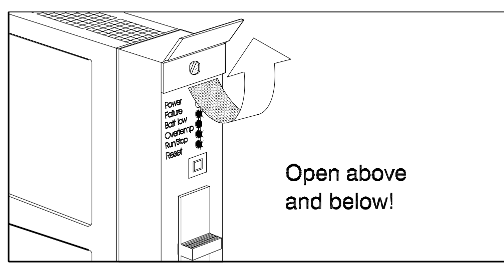
Function	Slot No.	Rack
Primary	0	Central unit, I/O unit
Secondary	1	Central unit
Secondary	0	I/O unit
Gateway	0 / 1 ... 8	Central unit / I/O unit

3.3.11 Mounting the CPU module for redundant operation

Set coding switches of the two modules **to different positions.**

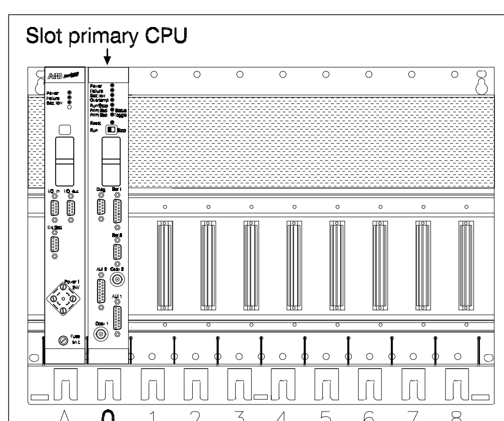


Open upper and lower cover.



Set **Primary** on **base plate** and **plug in.**

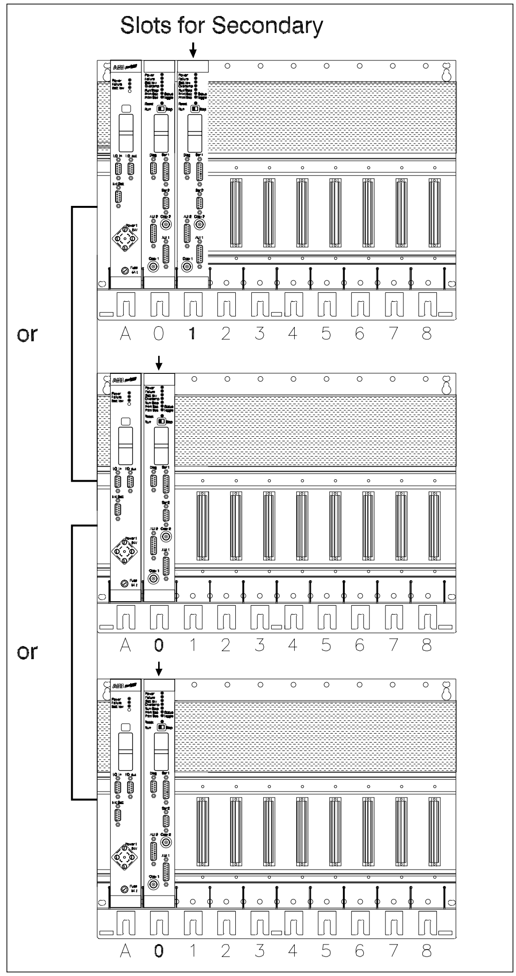
In central units **only slot 0 is permissible**.



Set **Secondary** on **base plate** and **plug in.**

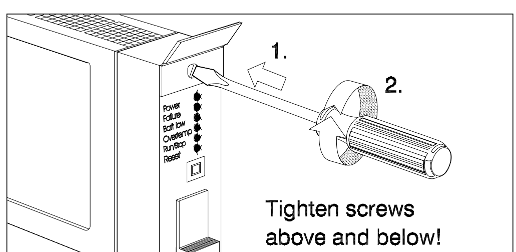
For the Secondary **only slot 1** is permissible in the **central unit** and **only slot 0** is allowed in **I/O units**.

With version 3.3 and higher you can also plug the I/O units into the third or fourth I/O unit.

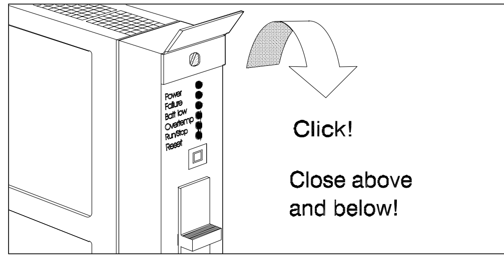


Push in module screws with screw driver and **tighten** clockwise.

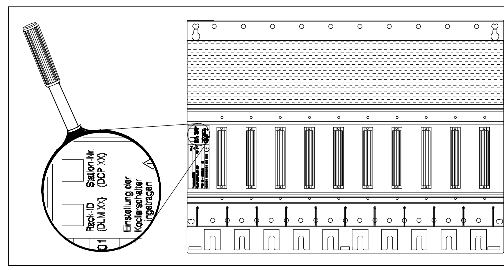
Only hand-tighten the screws.



Close upper and lower cover.



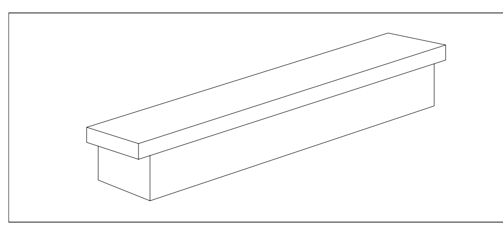
Write the position of the coding switch in the field "Station Nr." of the rack.



3.3.12 Mounting rack slot caps

Cover unused slots with DSU 84 caps.

The caps are not included in the scope of delivery of the rack and have to be ordered separately.



Protect unused slots with caps to avoid static discharge.

3.4 Redundancy

3.4.1 Power supply redundancy

Freelance 2000 Version V2.13 or higher supports power supply redundancy with one link module DLM 02 and two power supplies DPW 01, DPW 02 or DPW 03.

Both power supplies are linked with the appropriate connectors of DLM 02. For further details about connecting the DLM 02 please refer to Section 4.3.

The two power supplies are connected to a sum power supply through link module DLM 02 and then treated equally. The link module monitors the two power supply voltages and generates the power fail signal from the signals delivered by the individual power supplies. If one power supply fails, the DLM 02 makes the required change-over without any power failure of the subsequent system. An LED indicates the defective power supply, while the corresponding alarm is communicated to the CPU module via DigiNet P.

Power supply redundancy with two power supplies in conjunction with link module DLM 02 yields a higher availability than supply through link module DLM 01 and only one power supply.

3.4.2 CPU redundancy with CPU module DCP 10

Freelance 2000 Version V3 or higher supports CPU module redundancy with two CPU modules DCP 10.

Install both CPU modules as described in Section 3.3.4. In the standard case make sure that the coding switches of the CPU modules are set to different positions. With a special case system make sure that all coding switches are set to 0. Refer to Section 3.3.3 for a detailed description of the two cases and the corresponding conditions.

In redundancy mode both CPU modules are connected to the operator level via the DigiNet S system bus.

After power on or restart of the process station, the Primary which controls the process is selected by the software. The second CPU is used as the Secondary in passive mode. The Primary and the Secondary are continuously matched via the redundant system bus DigiNet Sr. If the Primary fails, the Secondary is capable of taking over process control from the Primary immediately.

The functionality "Withdrawing and plugging under power" allows for replacement of a defective module without requiring that the system is switched off.

In addition to automatic change-over in case of failure, the CPU redundancy provides to the user various possibilities of interaction through the configuration software and/or through manual entries via the **Prim/Sec Toggle** switch.

CPU module redundancy with two CPU modules DCP 10 yields an availability which is around 430% higher than with one CPU module DCP 10 or DCP 02.

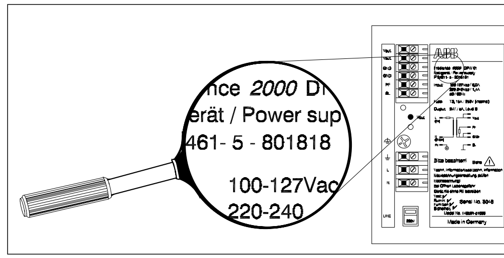
Using redundant power supplies together with redundant CPU modules raises the Freelance 2000 system availability by around 480%.

4 Cabling the Process Station

4.1 Cabling the power supply

4.1.1 Power supply DPW 01 (230 V AC, 115 V AC)

Check the rating plate to see if the **power supply** is a **DPW 01** one for connection to a 230 V AC or 115 V AC mains.

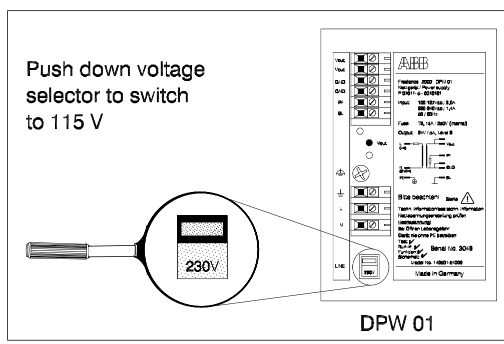


Do not connect power supply DPW 02 with 24 V DC input to a 230 V AC or 115 V AC mains. This will destroy the power supply.

Check the setting of the voltage selector at power supply DPW 01.

Factory setting: 230 V AC.

Set to the **correct mains voltage**.



If the power supply does **not** have a selector switch, it is a DPW 02 with 24 V DC input. **Do not connect power supply DPW 02 to a 230 V AC or 115 V AC mains. This will destroy the power supply.**

Cable the power supply DPW 01 as shown in Figure 4-1. Use the 24 V cable DSU 10 for the power supply output. The 115 V / 230 V mains cable should have a cross-sectional area of at least 0.75 mm².

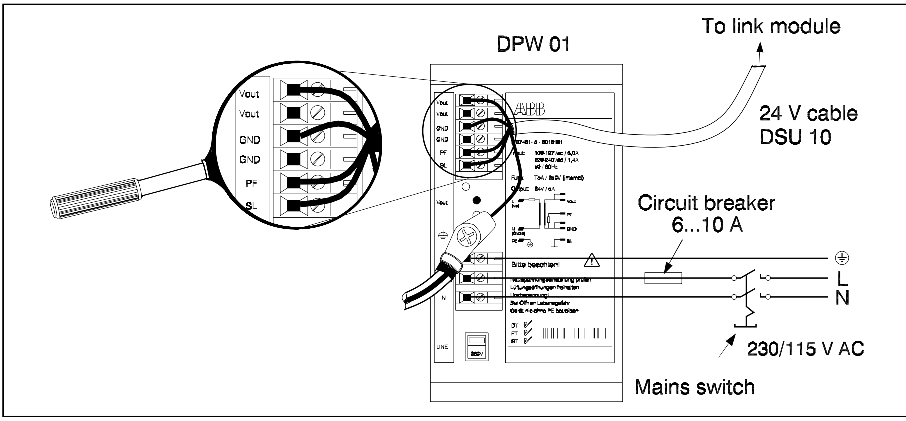


Fig. 4-1 Cabling power supply DPW 01

When installing the power supply DPW 01 observe the following:

- The power supply has **no mains switch**; use a **double-pole** one.
- It is recommended to use a 6 ... 10 A circuit breaker.
- **Do not use** the power supply **without** a protective earth conductor.
- Provide a functional grounding as described in Section 3.2.3.
- Use Freelance 2000 with power supply DPW 01, only, when connecting the system to a 230 V AC or 115 V AC mains.
- Do **not** connect **additional** power consumers.
- **Lay mains cable separately** (not too close to other cables), as shown below.

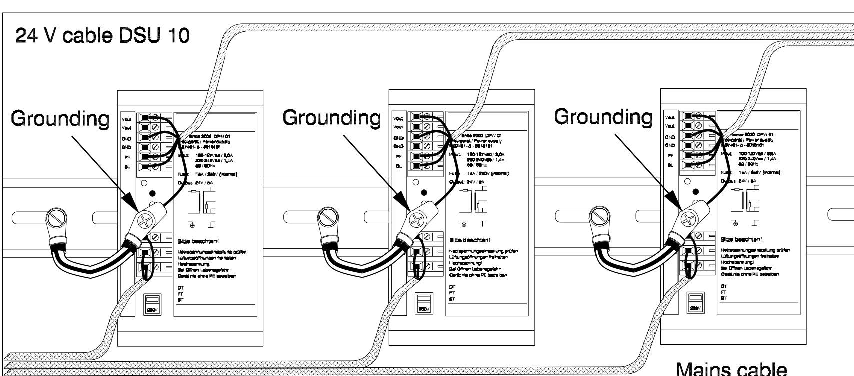
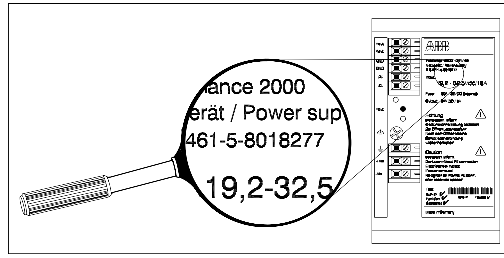


Fig. 4-2 Cabling power supply DPW 01/link module

4.1.2 Power supply DPW 02 (24 V DC)

Check the rating plate to see if the power supply is a DPW 02 one for connection to a 24 V DC mains.



Cable the power supply DPW 02 as shown in Figure 4-3. Use the 24 V cable DSU 10 for the power supply output. The 24 V mains cable should have a cross-sectional area of at least 2.5 mm.²

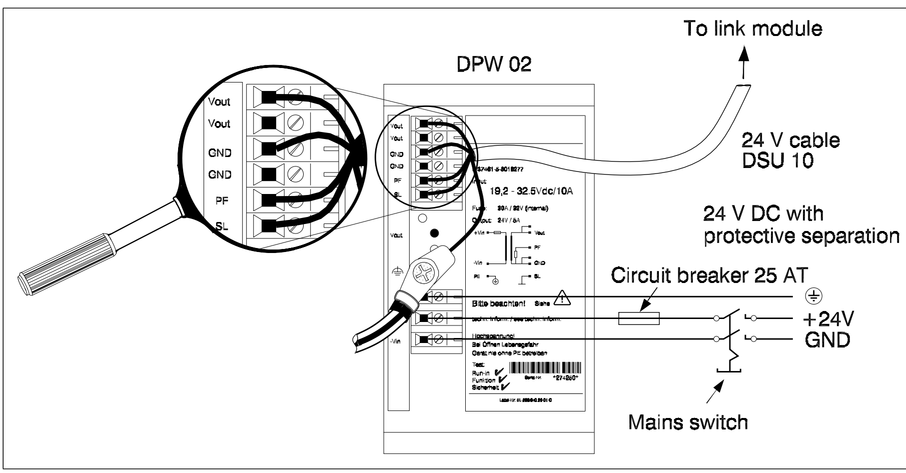


Fig. 4-3 Cabling power supply DPW 02

The input and output of power supply DPW 02 are electrically isolated from each other. However, DPW 02 must not be supplied with any voltage other than the **extra low voltage with protective separation** from other circuits.

When installing the power supply DPW 02 observe the following:

- The power supply has **no mains switch** and must be provided with one.
- It is recommended to use a 25 A T fuse.
- **Do not use** the power supply **without** a protective earth conductor.
- Provide a **functional grounding** as described in Section 3.2.3.
- **Rated voltage 24 V DC**.
  Permissible input voltage range 19.2 ... 32.5 V DC.
- Connection to a **three-phase mains** via a **three-phase bridge rectifier** is **possible**. **However, a protective separation is mandatory.**
- Do **not** connect **additional power consumers**.
- **Lay mains cable separately**, as shown in the figure below.

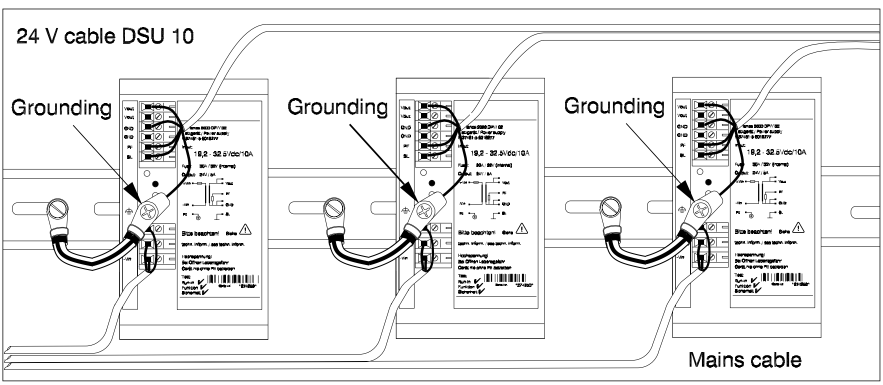


Fig. 4-4 Cabling power supply DPW 02/ link module

- Power supply DPW 02 has a 24 V DC input and output. It provides for electrical isolation between the input and output. Additionally, it suppresses mains noise, acts as a buffer for up to 20 ms in case of power failure, and generates a power-fail signal. Therefore, operation without a power supply is not possible.

Do not use central units and I/O units on a 24 V DC mains without a power supply DPW 02.

The external supplies for the output modules DDO 01 and DAO 01 can be connected directly to a 24 V DC mains. For details see Sections 4.8.9.3 and 4.8.18.3.

4.1.3 Power supply DPW 03 (230 V AC, 115 V AC)

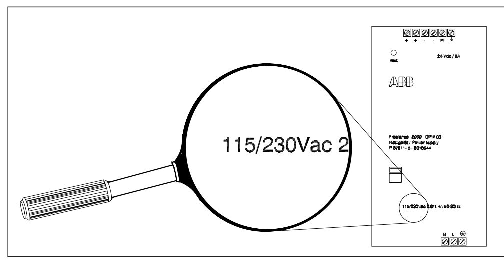
Power supply DPW 03 has the same functions as the DPW 01 model.

However, the two models have slightly different dimensions (see chapter 3.2.1) resulting in differently arranged front panel terminals of the DPW 03 unit.

The same installation instructions given for power supply DPW 01 are valid for power supply DPW 03, taking into account the differences listed above.

In the examples and illustrations given below, power supply DPW 01 is shown, or you will find cross-references to the respective descriptions for the DPW 01. Nevertheless, the examples and illustrations are analogously valid for DPW 03.

Check the rating plate to see if the **power supply** is a **DPW 03** one for connection to a 230 V AC or 115 V AC mains.

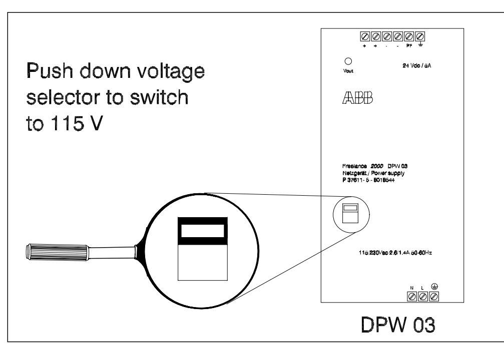


Do not connect power supply DPW 02 with 24 V DC input to a 230 V AC or 115 V AC mains. This will destroy the power supply.

Check the setting of the voltage selector at power supply DPW 03.

Factory setting: 230 V AC.

Set to the **correct mains voltage**.



If the power supply does **not** have a selector switch, it is a DPW 02 with 24 V DC input. **Do not connect power supply DPW 02 to a 230 V AC or 115 V AC mains. This will destroy the power supply.**

Cable the power supply DPW 03 as shown in Figure 4-5. Use the 24 V cable DSU 10 for the power supply output. The 115 V / 230 V mains cable should have a cross-sectional area of at least 0.75 mm².

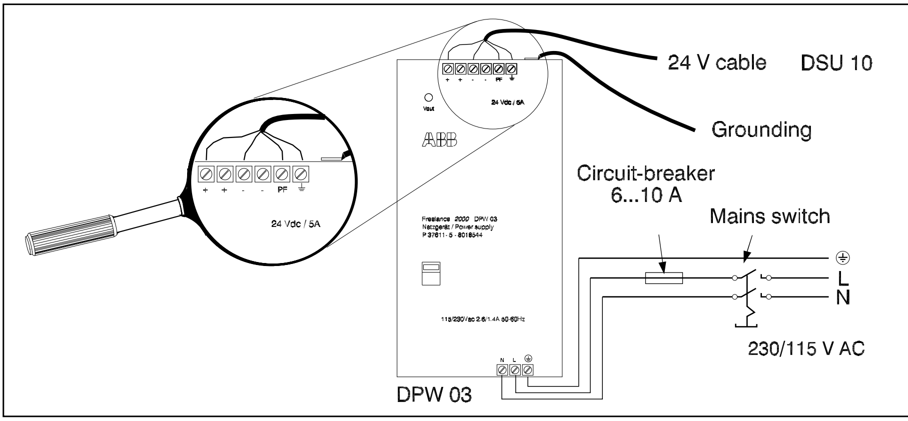


Fig. 4-5 Cabling the power supply DPW 03

When installing the power supply DPW 03 observe the following rules:

- The power supply has **no mains switch**; use a **double-pole** one.
- It is recommended to use a 6 ... 10 A circuit breaker.
- **Do not use** the power supply **without** a protective earth conductor.
- Provide a functional grounding as described in Section 3.2.3.
- Use Freelance 2000 with power supply DPW 03, only, when connecting the system to a 230 V AC or 115 V AC mains.
- Do **not** connect **additional** power consumers.
- **Lay mains cable separately** (not too close to other cables), as shown below.

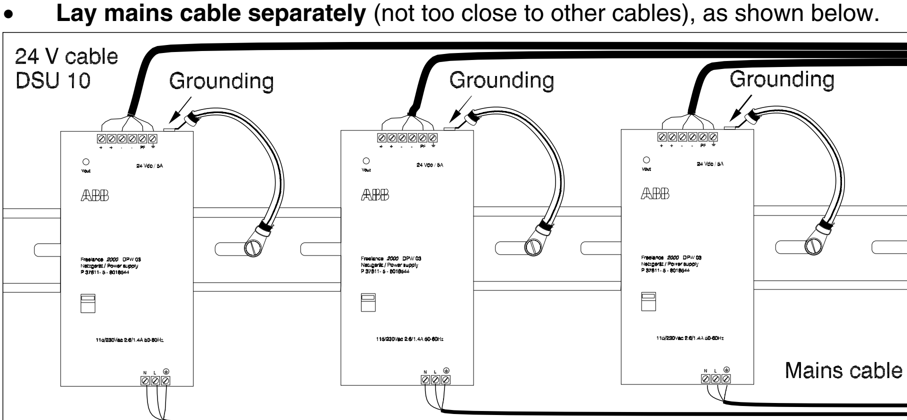


Fig. 4-6 Cabling power supply DPW 03/link module

4.2 Cabling the link module DLM 01

4.2.1 Connecting the power supply

Connect the power supply to the link module DLM 01 and ground the cable shield with a grounding clip as shown in Figure 4-7. Strip off the cable sheath near the clip. Plug the connector of the 24 V cable **DSU 10** to the **Power 24 V** connector of the link module. Refer to Section 13.1.1 for the pin assignment.

Do not plug in or pull out the connector of the 24 V cable when live. Do not connect additional power consumers to the power supply.

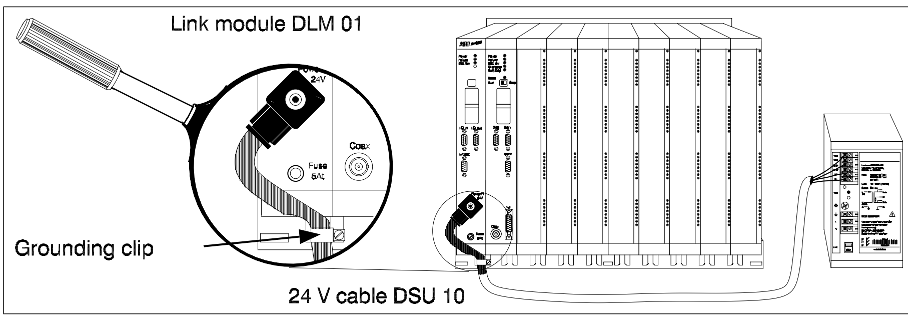


Fig. 4-7 Grounding power supply/link module

- The **RFI suppression** and **EMI/RFI shielding** of the Freelance 2000 system **cannot be guaranteed**
  - if the cable shield is not or not sufficiently grounded
  - if the **GND terminals** (ground potential) of the power supply are **connected to earth**.
- When replacing the module input fuse with a slow-blow one, only **use a type 5A/250V UL** fuse. Otherwise, there is **the risk of a fire**.

4.2.2 Connecting the process station bus

The process station bus is primarily designed for indoor application. The I/O units must be placed in a building if there is the hazard of lightning strokes. A fiber-optic DigiNet S cable should be used for links between buildings.

How the DigiNet P process station bus has to be cabled depends upon the number of used I/O units. The termination DSU 01 are connected to **I/O in** and/or **I/O out** of the **link module**. Use cable DSU 11 for a total distance between central unit and I/O units of less than 80 m. Cable DSU 07, which has a bigger cross-sectional area, is to be used for a total distance of more than 80 m.

Refer to Section 3.3.1 for details about how to determine the maximum cable length.

Note that the distance relevant for selecting the appropriate cable type is not given by the individual cable lengths. Instead, the total distance between the two DigiNet P ends has to be considered. If your current system configuration is based on distances of less than 80 m, but you intend to extend them at a later time, it is recommended to use cable DSU 07. It has a big cross-sectional area of 0.5 mm^2 and is provided with two adapters to the SUB-D connectors.

The two figures below show the structure of cables DSU 11 and DSU 07.

Fig. 4-8 CAN cable DSU 11

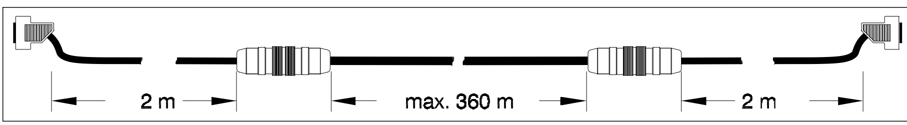


Fig. 4-9 CAN cable DSU 07

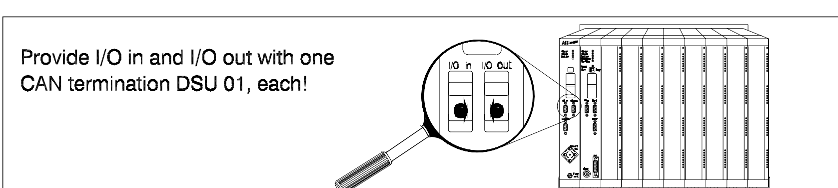
When cabling the process station bus , observe the following rules:

- Always plug the CAN termination DSU 01 to connector **I/O in** of the **first** and connector **I/O out** of the **last** bus node. In case of a single central unit the terminations have to be plugged to **I/O in** and **I/O out** of the central unit.
- Using **no** CAN terminations leads to **malfunctions** of the process station bus.
- Always fasten CAN terminations and CAN cables with screws.
- The CAN cable is sufficiently grounded via the connector.
- The **order** of central unit and I/O units is **arbitrary**.
- To calculate the max. cable length, use the following formula:

500 kBits/s	⇨	l = 80 m –	number of link modules x 2 m
100 kBits/s	⇨	l = 400 m –	number of link modules x 10 m – number of cables DSU 07 x 20 m

For details on the pin assignment of connectors **I/O in** and **I/O out** refer to Section 13.1.1.

1. Process station without I/O units



ess station bus , case 1

2. Process station with one I/O unit

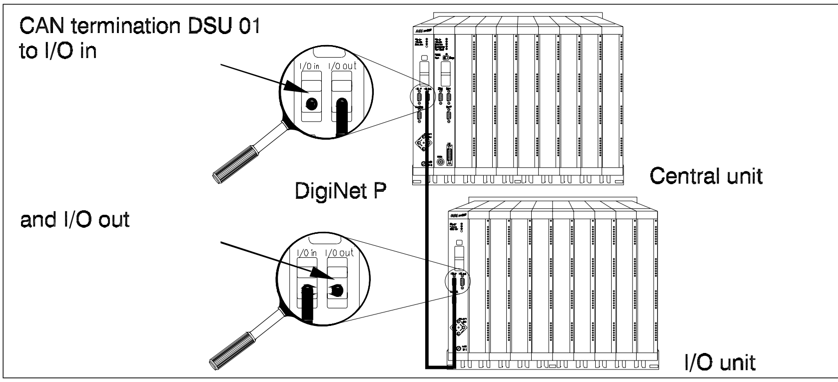


Fig. 4-11 Connecting the process station bus, case 2

3. Process station with two or more I/O units

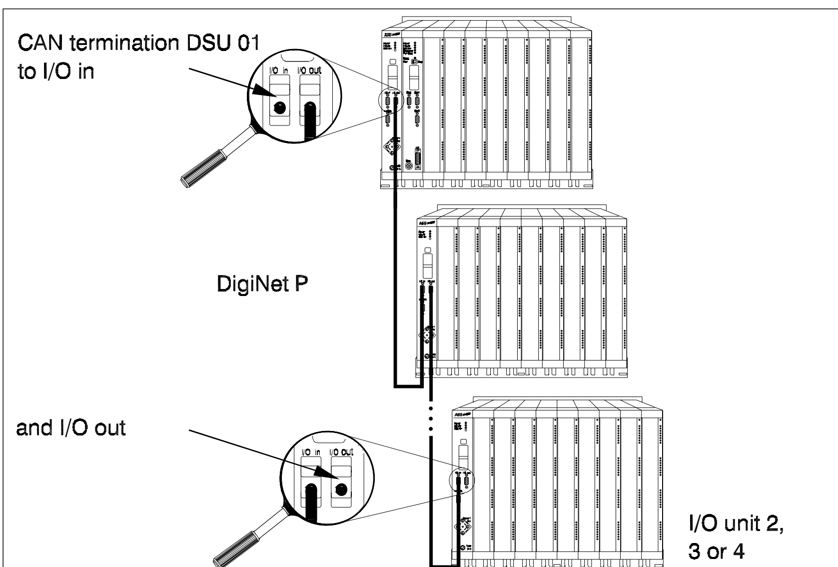


Fig. 4-12 Connecting the process station bus, case 3

4.2.2.1 Scaling process station bus

The DigiNet P process station bus consists of three CAN buses run in parallel. Freelance 2000 makes a distinction between transmission over

- distances up to 80 m at a baud rate of 500 kBit/second
- distances up to 400 m at a baud rate of 100 kBit/second

The total cable length of DigiNet P is calculated as described below:

- for 500 kBit/sek 80 m - 2 m x number of link modules
- for 100 kBit/sek 400 m - 2 m x number of link modules
  - 20 m x number of DSU 07 cables

Example: Central unit and two I/O units, transmission at 500 kBit/sek
Max. length 80 m – 3 x 2 m= 74 m

Within the racks (central unit and I/O unit) the CAN buses are connected to the individual slots as shown in the tables below:

Rack DRA 02

CAN bus	Slot	I/O boards	Primary/Secondary	Gateway CPU
1	A, 0 .. 8	0, 3, 6 [1]	0 ... 8	0 ... 8
2	A, 0 .. 8	1, 4, 7	0 ... 8	0 ... 8
3	A, 0 .. 8	2, 5, 8	0 ... 8	0 ... 8

Rack DRA 03

CAN bus	Slot	I/O boards	Primary/Secondary	Gateway CPU
1	A, 0, 1	0 [1]	0, 1	0, 1
2	A, 0, 1	-	0, 1	0, 1
3	A, 0, 1	-	0, 1	0, 1

[1] Slot 0 only in I/O units

Rack DRA 04

CAN bus	Slot	I/O boards	Primary/Secondary	Gateway CPU
1	A, 0, 1, 2, 3	1	0 ... 3	0 ... 3
2	A, 0, 1, 2, 3	2	0 ... 3	0 ... 3
3	A, 0, 1, 2, 3	0, 3	0 ... 3	0 ... 3

Comment: The gateway CPU does not require CAN communication and, therefore, can be plugged in any of the slots.

Basic cycle times of I/O modules

The table below shows the feasible cycle times for the data transfer from the I/O modules to the process station, which depends on the degree of system expansion and the equipment of the central unit and the corresponding I/O units.

Module type	≤ 5 modules per CAN bus		>5 modules per CAN Bus	
	500 kBaud	100 kBaud	500 kBaud	100 kBaud
Digital modules	2 ms	10 ms	4 ms	20 ms
Analog modules	10 ms	50 ms	20 ms	100 ms

The adjustable cycle time must be equal to or a multiple of the basic cycle time. The maximum cycle time is 500 ms for all modules. The three CAN buses can be configured with different basic cycle times. On the contrary, the same baud rate must be set for all three CAN buses.

4.2.3 Mounting the battery

The battery serves for data buffering of the Freelance 2000 central unit in case of power failure. One internal battery can be installed in the link module and one in the CPU module. Additionally, an external 3.6 V or 24 V battery can be connected. Several ways of battery buffering are possible:

Simple buffering

One battery in the CPU module. **Data is retained** when the CPU module is taken out of the rack.

Redundant buffering

One battery in the link module and one in the CPU module. Both batteries are **working in parallel**. If one battery fails, the other one provides for data retention. The **maximum buffering time** is **doubled**. Both batteries are discharged equally.

If the **CPU module** is **taken out** of the rack, **no data loss** occurs.

External buffering

No batteries in the modules. An external 3.6 V or 24 V battery is connected. If the **CPU module** is **taken out** of the rack, **data is lost** (see Section 4.2.4).

Multiple buffering

In this case both an external 24 V battery (see Section 4.2.4) and an internal battery in the CPU module are used. Benefit: while the CPU module is connected to the rack, **the external 24 V battery provides for buffering**. The battery in the module is not discharged.

If the CPU module is taken out of the rack, the **built-in battery takes over buffering**, and data is retained.

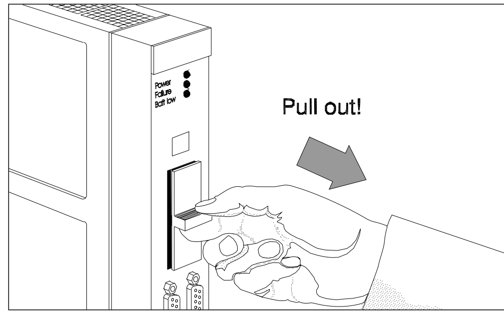
Multiple buffering is useful if already configured CPU modules (spare) are stored outside a rack.

If there are no special requirements, **redundant buffering** should be used.

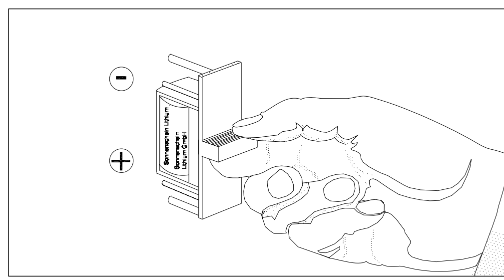
Mounting the battery in a link module

The **buffer battery** DSU 08 is not included in the scope of delivery of the link module and has to be ordered separately.

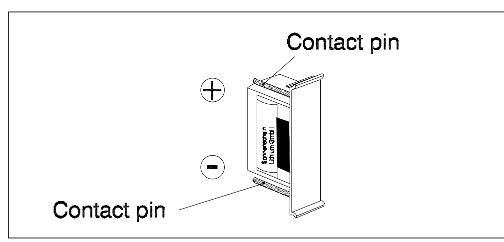
- Pull battery holder out of the link module.



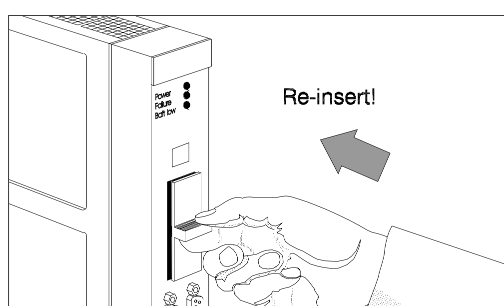
- **Open** the battery holder: slightly press your fingers on the upper and lower edge of the holder.
- **Insert** battery DSU 08
- **Observe the battery polarity**
- Re-assemble battery holder.



- When **inserting** the battery holder make sure the **contact pins** are on the **left hand side**.



- **Re-insert battery holder** in link module and press it in until it **snaps in**.
- Make sure that the battery holder is not canted.



4.2.4 Connecting an external battery

Connecting an external battery is not mandatory. It is only required for external buffering (see Section 4.2.3). Normally, the internal batteries of the CPU and/or the link module provide for data buffering of the process station. However, if you prefer to use external batteries instead of keeping a stock of special Freelance 2000 batteries, this will yield the following benefits:

- Using one big off-the-shelf battery of your choice or a buffered power supply instead of many small batteries.
- Reducing maintenance requirements.

There are two possible ways of external battery buffering:

1. External buffering with a 3.6 V lithium battery

Connect the lithium battery using battery cable **DSU 12**. Cable as shown in the figure below. Several process stations can be connected to the battery, depending on the battery capacity.

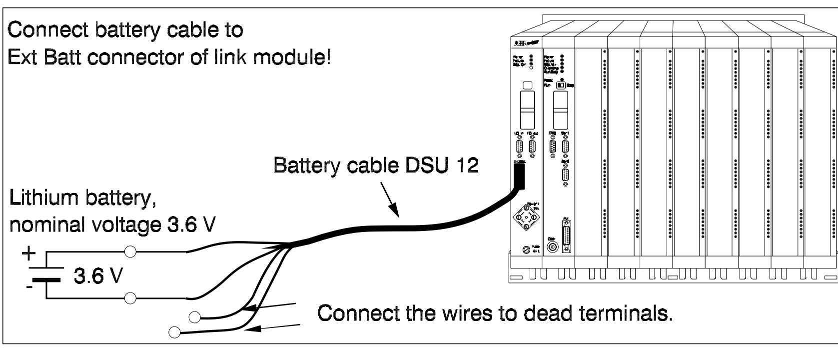


Fig. 4-13 External buffering with a 3.6 V lithium battery

When connecting an external battery, note the following:

- Nominal battery voltage 3.6 V.
- Current consumption at nominal voltage 7 mA.
- Minimum voltage for data retention 2.9 V.
- The input for the 3.6 V lithium battery is protected against damage through accidental application of 24 V DC. However, do not apply 24 V to the 3.6 V input for a longer time.

Refer to Section 13.1.1 for the pin assignment of the **Ext Batt** connector.

2. **External buffering with a 24 V battery (non-rechargeable or rechargeable)**

Connect the 24 V battery using battery cable DSU 12. Cable as shown in the figure below. Several process stations can be connected to the battery, depending on the battery capacity. It is recommended to connect all process stations to a central rechargeable battery which is provided with a charging unit.

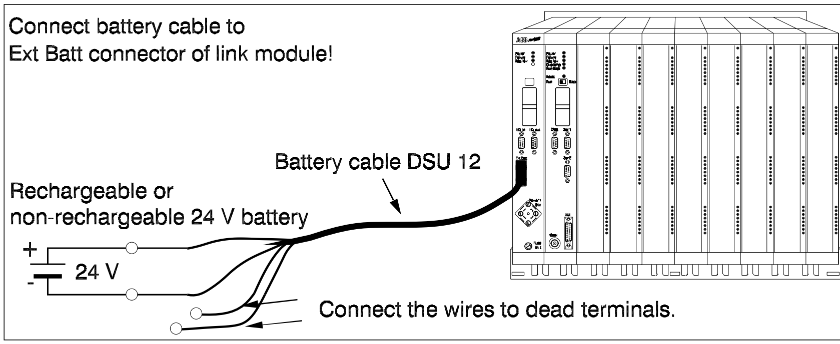


Fig. 4-14 External buffering with a 24 V battery

When connecting the external battery, note the following:

- Nominal voltage 24 V DC. The permissible voltage range is 19 ... 27 V DC.
- Current consumption at nominal voltage 12 mA.

Refer to Section 13.1.1 for the pin assignment of the **Ext Batt** connector.

4.2.5 Cap for unused connector

Leave the cap delivered with the unit on the unused connector if no external battery is connected. The cap is included in the scope of delivery of the module and can also be ordered under the code designation DSU 81.

Cover unused connector with cap to avoid static discharge.

4.3 Cabling the link module DLM 02

Link module DLM 02 offers the possibility to use a redundant power supply. In this case, two power supplies DPW are needed for each process station.

4.3.1 Connecting the power supply

Cable the inputs of the two power supplies as described in Sections 4.1.1 and 4.1.2. The power supply inputs should be supplied via two different current circuits and protected separately. Connect the output of each of the two power supplies to the link module DLM 02 via a 24 V cable DSU 10 as shown in Figure 4-15.

Ground the cable shields using grounding clip DSU 423 or any other appropriate grounding clip. Strip off the outer cable sheath near the clip, before.

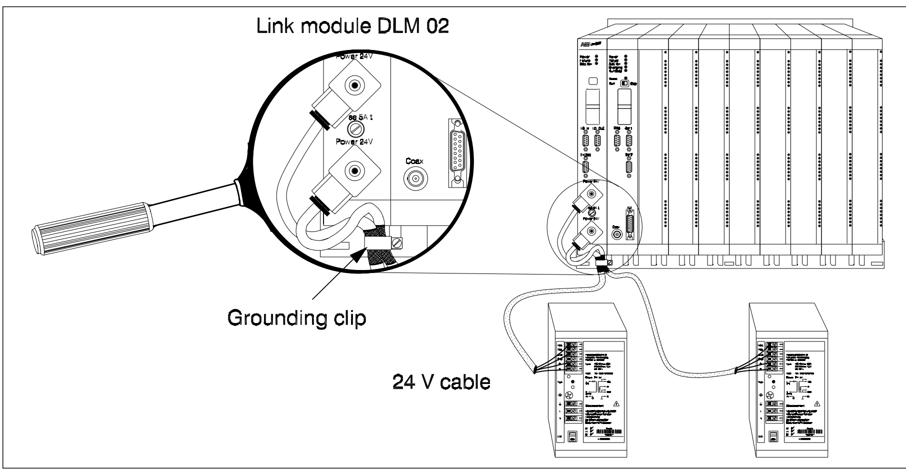


Fig. 4-15 Connecting power supply to DLM 02

- **Do not plug in or pull out the 24 V cable connector when live. Do not connect additional power consumers to the power supplies.**
- The **RFI suppression** and the **EMI/RFI shielding** of the Freelance 2000 system **cannot be guaranteed**
  - if the cable shield is not or not sufficiently grounded,
  - if the **GND terminals** (ground potential) of the power supplies are **connected to earth potential**.
- **When replacing the module input fuse with a slow-blow one, only use a type 5A/250V UL fuse. Otherwise, there is the risk of a fire**.

4.3.2 Connecting process station bus DigiNet P

Connection of process station bus DigiNet P to link module DLM 02 is done in the same way as to link module DLM 01. For details refer to Section 4.2.2.

4.3.3 Mounting the internal battery

Battery installation in link module DLM 02 is done in the same way as in link module DLM 01. For details refer to Section 4.2.3.

4.3.4 Mounting an external battery

An external battery is installed in link module DLM 02 in the same way as in link module DLM 01. For details refer to Section 4.2.4.

4.3.5 Caps for unused connectors

All connectors are delivered with caps. Leave the caps on all unused connectors. Caps for the **Ext Batt** connectors can also be ordered separately under order code DSU 81.

Cover unused connectors with caps to avoid static discharge.

4.4 Cabling the CPU module DCP 02

CPU module DCP 02 has been modified. The new version can be identified through the hardware revision level (HW index 50.00 or higher). The differences were kept as small as possible. In the following text, the modified DCP 02 module (HW index ≥ 50.00) is described. Therefore, the major differences from the previous version are listed in the paragraph below:

The front panel labels have been adapted to those of the more powerful DCP 10 module. The type of cabling, the pin assignments, and the technical features of the interfaces are still the same. As a result, there are no limitations concerning the replacement. Only the positions of the interface connectors and sockets have been changed slightly.

Interface names/labels on the DCP 02 module

Interface (description)	'Old' interface name (HW index < 50.00)	'New' interface name (HW index ≥ 50.00)
Diagnostic interface	RS232C	Diag
RS485 interface	RS485	Ser 1
Lateral communication 1	LAT out	Ser 2
Lateral communiction 2	LAT in	-
Ethernet 10Base2	Ethernet Koax	Coax
Ethernet 10Base5	Ethernet AUI	AUI

4.4.1 Connecting nodes via the Ser 1 interface DigiLink (Modbus)

Subsystems with a Ser 1 interface can be connected to the RS485 interface of the Freelance 2000 CPU module using the Modbus protocol. Note that the RS485 interface is **not** electrically isolated.

The Freelance 2000 process station is supplied with an extra low voltage with protective separation from other circuits. Note that connecting a Modbus node which is not provided with a protective separation may cancel out the protective separation.

The following signals are available with an RS485 connection:

RxTx+:	Combined transmit/receive data (Input/output)	Pin 3
RxTx-:	Combined transmit/receive data (Input/output)	Pin 2
GND:	Ground	Pin 5

Cable the Modbus nodes using the RS485 cable DSU 13. The max. permissible cable length is 1200 m. Cable DSU 13 is deliverable with a max. length of 1000 m (cable reel). Cable lengths of 1000 ... 1200 m are available on request.

Terminate the bus cable at both ends with a 120 Ω resistor and a 0.1 µF ceramic capacitor connected in series. A termination is already integrated in the CPU module and can be switched on or off by a cable bridge in the connector of the RS485 cable. The following cases have to be distinguished:

1. CPU module DCP located at the end of the bus cable

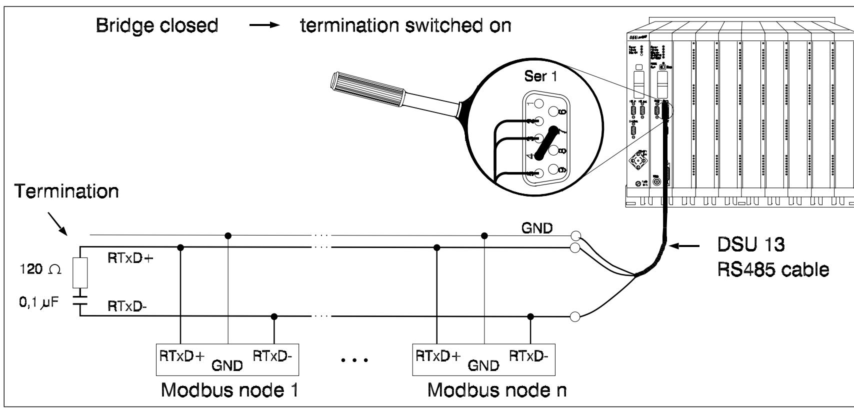


Fig. 4-16 Connecting via RS485 interface, case 1

The cable **bridge between pin 4 and pin 7** of the connector activates the termination of the CPU module. Cable DSU 13 remains unchanged. Cable as shown in the figure. Use a twisted pair cable with a minimum cross-sectional area of 0.25 mm² for the bus. The GND connectors are not needed for field cabling. They are only used for measuring during commissioning, as shown in Fig. 4-71. Note that the offset voltage between GND and the signal lines is lower than ± 7 V. The cable shield is connected to the housing potential of the process station via the connector hood.

2. CPU module is not located at the end of the bus cable

In this case, the CPU module has to be cabled with the other Modbus nodes as seen in Figure 4-17. A termination must be connected to the bus cable at each end. Keep stub cables as short as possible.

In this case the termination integrated in the CPU module must be switched off.

- Open the connector hood of cable DSU 13.
- **Remove** the **bridge** between **pin 4** and p**in 7** (black wire). Insulate or cut off the cable ends.
- Close the connector hood.

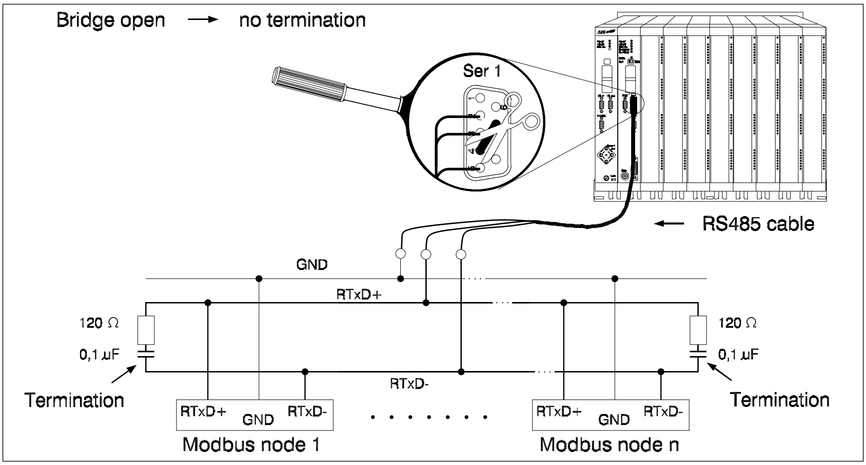


Fig. 4-17 Connecting via RS485 interface, case 2

The RC termination integrated in the CPU module is switched off due to the bridge being removed from the connector. The module can then be connected to the bus in any position, since it does not have an own termination. Keep stub cables to the nodes as short as possible.

Refer to the Section 13.3.1 for a detailed description of the RS485 interface.

4.4.2 Connecting via the Diag interface (RS232C) for diagnosis

The **Diag** interface is reserved for diagnosis and commissioning. This RS232C interface allows you to establish a point-to-point connection to which only one node can be connected. Connecting a diagnostic PC is not mandatory. For details refer to Section 6.4, Diagnosing the process station.

The Freelance 2000 process station is supplied with an extra low voltage with protective separation from other circuits. Note that connecting a diagnostic PC or terminal which is not provided with a protective separation and not battery-powered may cancel out the protective separation.

4.4.2.1 Connecting a radio clock receiver via the Diag (RS232C) interface

Alternatively, a radio clock receiver (see Section 12.2.4) or a GPS satellite radio clock (see Section 12.3.6) can be connected via the **Diag** interface.

The Freelance 2000 process station is supplied with an extra low voltage with protective separation from other circuits. Note that connecting a radio clock receiver or GPS satellite radio clock to the **Diag** interface of the DCP 02 may cancel out the protective separation.

Connecting a PC, laptop or ANSI terminal

When connecting a diagnostic PC, laptop or ANSI terminal cable as shown in Fig. 4-18.

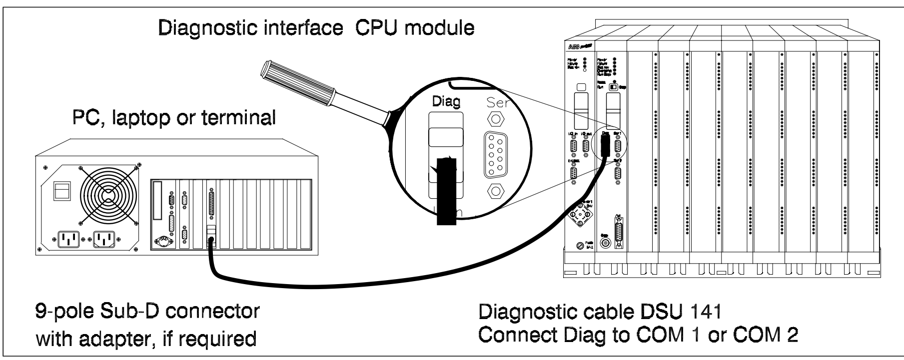


Fig. 4-18 Connecting PC or laptop via Diag interface for diagnosis

Link a serial PC interface (COM1 or COM2) via the diagnostic cable DSU 141 with the **Diag** interface. Fasten both connectors with screws. The diagnostic cable has to be connected to a 9-pin serial PC interface. Use a commercially available 9 to 25 adapter if your PC has a 25-pin interface, only.

Connecting the diagnostic cable is also possible while the system is running (process station is live). **In this case the information given in Section 6.4 must be observed**.

Connecting a PC that is switched off or improperly configured will cause malfunctions of the process station.

4.4.3 Mounting the internal battery

The battery is installed in the CPU module in the same way as in the link module. For details refer to Sections 4.2.3 and 4.2.4.

4.4.4 Caps for unused connectors

In factory, all connectors are protected with caps. Leave these caps on all unused connectors. The caps can also be ordered separately under the following code designations:

DSU 80	for Diag connector
DSU 81	for Ser 1 and Ser 2 connectors
DSU 82	for AUI connector
DSU 83	for Coax connector

Cover unused connectors with caps to avoid static discharge.

4.5 Cabling the CPU module DCP 10

Subsystems which communicate via an RS232C, RS422 or RS485 interface can be connected to the 15-pin connector Ser 1 of the CPU module.

The type of interface is selected by using the appropriate connection cable and is designed for redundant operation. As a result, a user device can be connected according to

- Case 1 to a non-redundant CPU
- Case 2 to a redundant CPU.

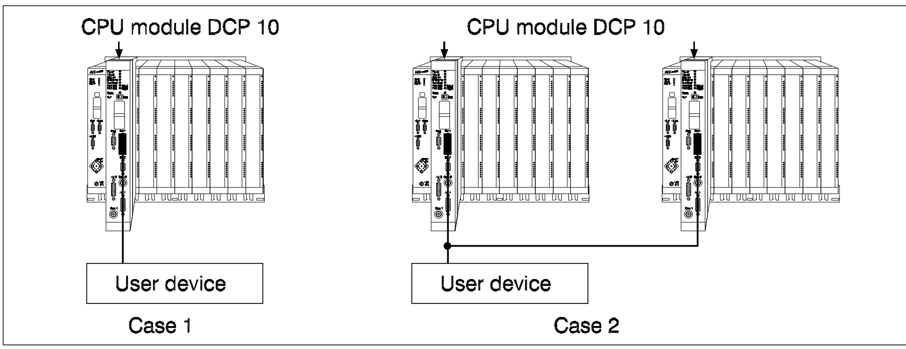


Fig. 4-19 Redundant operation of CPU module DCP 10

At present, the electrically isolated Ser 1 interface supports the Modbus protocol.

4.5.1 Connecting Ser 1 as the RS232C interface

The RS232C interface provides a point-to-point connection. Only one node can be connected to it. When using the CPU module DCP 10 for redundant operation, you can additionally connect the Secondary.

The RS232C interface can, for example, be used for telecontrol. The connected device can exchange data with the process station via modem and/or satellite. The process station can be redundant or non-redundant. Cable as shown symbolically in Fig. 4-19, case 2, when connecting an RS232C device to a redundant system.

If there is no redundancy (case 1), use the RS232C cable DSU 212 to connect the Ser 1 interface. Use RS232C cable DSU 222 to connect the Ser 1 interface if you want to run your RS232C device with a redundant CPU module DCP 10 (case 2).

Fig. 4-20 shows how to cable a non-redundant CPU module DCP 10 with an RS232C device. Connect the signal wires of the DSU 212 cable with the device to be linked. Note that the maximum cable length is 15 m.

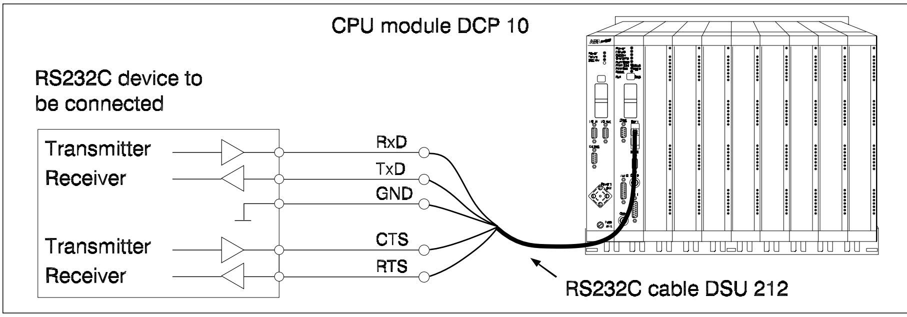


Fig. 4-20 Cabling DCP 10 via an RS232C interface without redundancy

Fig. 4-21 shows how to cable a redundant CPU module DCP 10 with an RS232C device. Connect the signal wires of the DSU 222 cable with the device to be linked. Note that the maximum cable length is 15 m.

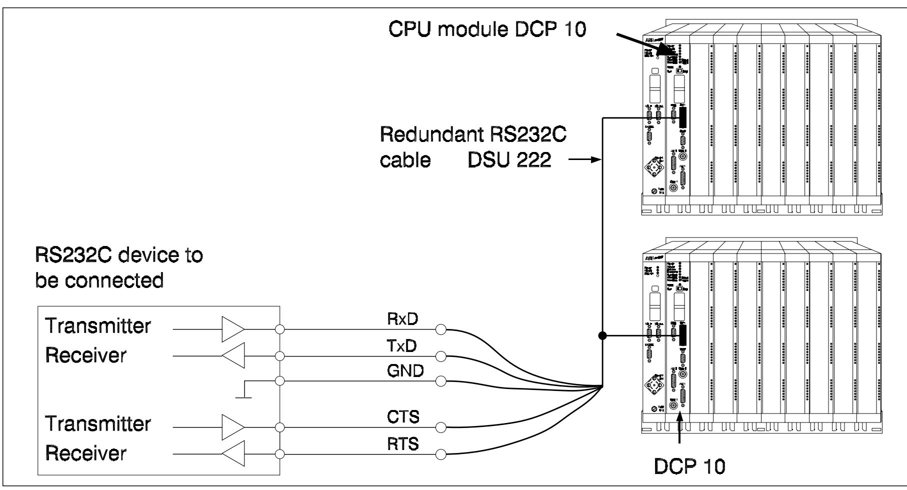


Fig. 4-21 Redundant cabling via RS232C

The following signals are available at the cable on single wires with wire end sleeves:

TxD:	Transmit data	(Output)	Pin 3
RxD:	Receive data	(Input)	Pin 2
GND:	Ground		Pin 5
RTS	Request to send	(Output)	Pin 7
CTS	Clear to send	(Input)	Pin 8

Refer to Section 13.5.1 for the interface and cable terminal assignment.

4.5.2 Connecting Ser 1 as the RS422 interface

The RS422 interface is suitable for bus operation. Several nodes can be connected to this interface. The used protocol ensures that only one device is in transmit mode at the same time. Simultaneous reception of messages by several devices connected to this interface is possible. When using the CPU module DCP 10 for redundant operation, you can additionally connect the Secondary.

Cable as shown symbolically in Fig. 4-19, case 2, when connecting an RS422 device to a redundant system.

The following signals are available with an RS422 connection:

Tx+:	Transmit data	(Output)	Pin 11
Tx-:	Transmit data	(Output)	Pin 12
Rx+:	Receive data	(Input)	Pin 7
Rx-:	Receive data	(Input)	Pin 8
GND:	Ground		Pin 5

With RS422 transmission one pair of wires serves for differentially transmitting the transmit data. A second wire pair transfers the receive data. As a result, the CPU module DCP 10 can simultaneously transmit and receive data (full-duplex operation).

When using the CPU module DCP 10 in non-redundant mode, cable the Ser 1 interface with the RS422 cable DSU 213. The redundant RS422 cable DSU 223 is needed for using an RS422 device with a redundant CPU module DCP 10. The signals listed above are available at the cable on single wires with wire end sleeves. The max. permissible cable length is 1200 m. The max. deliverable length of cables DSU 213 and DSU 223 is 1000 m (cable reel). Cable lengths of 1000 ... 1200 m are available on request.

A distinction has to be made between three cases of cabling:

1. The CPU is non-redundant and installed at the end of the RS422 bus.
2. The CPU is non-redundant and installed in the middle of the RS422 bus.
3. The CPU is redundant.

Case 1

Fig. 4-22 shows how to cable a non-redundant CPU module DCP 10 with an RS422 device. Use cable DSU 213 for this purpose. Connect the signal wires with the device to be linked. Note that both **terminations -** for the receive and for the transmit line - must be **active**. **Bridges 9** and **10** as well as **13** and **14** must be closed.

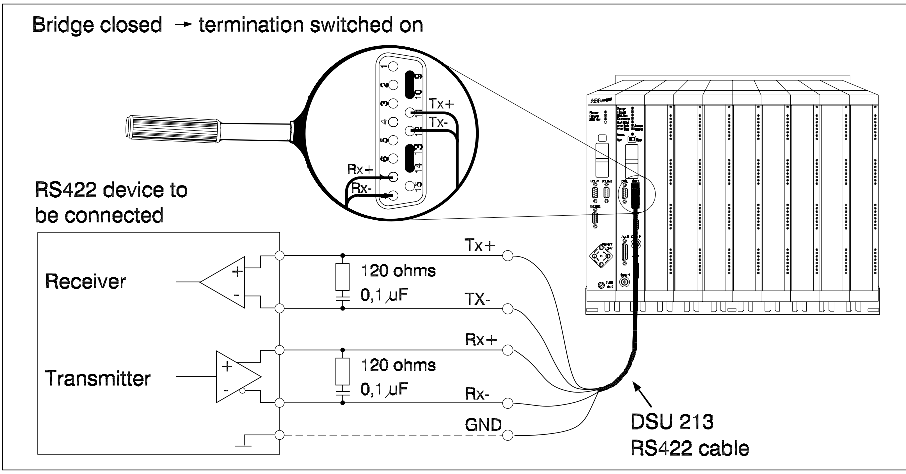


Fig. 4-22 Cabling DCP 10 via RS422 interface, without redundancy

Case 2

Fig. 4-23 shows how to cable a non-redundant CPU module DCP 10 in the middle of the RS422 bus. Note that the **terminations** at **pins 9** and **10** as well as **13** and **14** are **inactive**, i.e. the **bridges** must be **open**.

In this case use either two cables DSU 213, which require some modifications, or cable DSU 223.

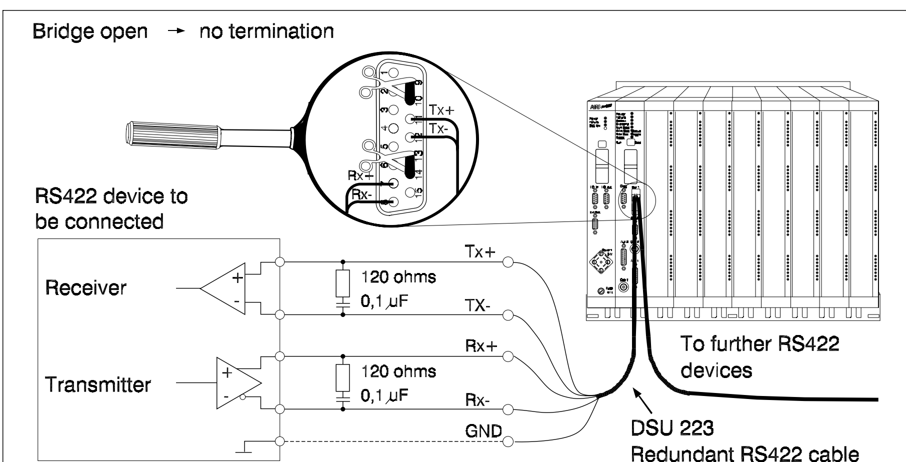


Fig. 4-23 Cabling DCP 10 with RS422 interface without redundancy and termination

Case 3

Fig. 4-24 shows how to cable a redundant system with RS422 devices. The **terminations** of the transmit and receive lines **must be provided externally** at each end of the bus cable. Use a 120 Ω resistor and a 0.1 µF ceramic capacitor connected in series. The terminations of the redundant CPU module must be deactivated. Open on every CPU module the **bridges 9** and **10** as well as **13** and **14** in the **Ser 1** connector.

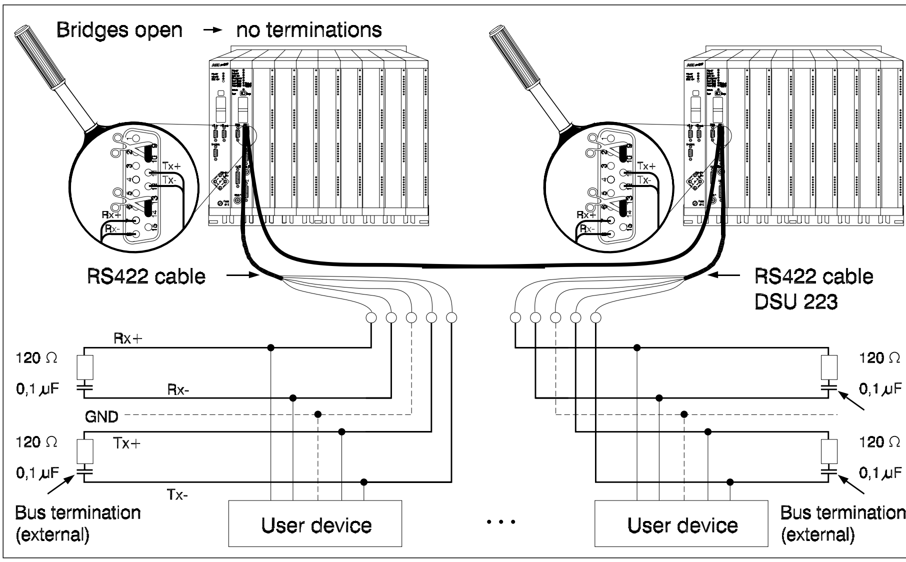


Fig. 4-24 Redundant cabling of DCP 10 via RS422 interface

Refer to Section 13.5.1 for the terminal assignment of the interfaces and the connection cable with the corresponding bridges.

4.5.3 Connecting Ser 1 as an RS485 interface DigiLink (Modbus)

The RS485 interface is suitable for bus operation. Several nodes can be connected to this interface. Only the currently active one of the two redundant CPU modules DCP 10 activates the RS485 interface. The interface of the Secondary remains passive (high-impedance).

The connection in accordance with RS485 provides the following signals which are available on single wires with wire end sleeves.

RxTx+:	Combined transmit/receive data (Input/output)	Pin 7
RxTx-:	Combined transmit/receive data (Input/output))	Pin 8
GND:	Ground	Pin 5

With RS485 transmission one wire pair provides for time-multiplexed, differential transfer of the transmit and receive data. This means that the DCP 10 can either transmit or receive data at the same time (half-duplex operation). Cable the Ser 1 interface with the RS 485 cable DSU 211. The max. permissible cable length is 1200 m. The max. deliverable length of cable DSU 211 is 1000 m (cable reel). Lengths of 1000 ... 1200 m are available on request.

The **RS485 cable DSU 13** is designed for an RS485 connection of CPU module DCP 02. **Do not use** for CPU module **DCP 10**.

Terminate the bus cable at both ends. Use a 120-Ω resistor and a 0.1-µF ceramic capacitor connected in series. A termination of this kind is already integrated in the CPU module DCP 10 and can be activated or deactivated by a cable bridge in the connector of RS485 cable DSU 211. Therefore, a distinction has to be made between the following cases:

1. **The DCP 10 is non-redundant and installed at the end of the bus cable**

   The **bridge between pins 9** and **10** of the connector **activates the termination** in the CPU module DCP 10. The cable DSU 211 remains unchanged.

   Cable the CPU module DCP 10 and the other nodes on the bus as shown in Fig. 4-25. Us a shielded twisted-pair cable, e.g. LiFYCY or LiYCY(TP) with a minimum cross-sectional area of 0.25 mm². The cable shield is put on the housing potential (protective earth) of the process station through the connector hood of the RS485 cable.

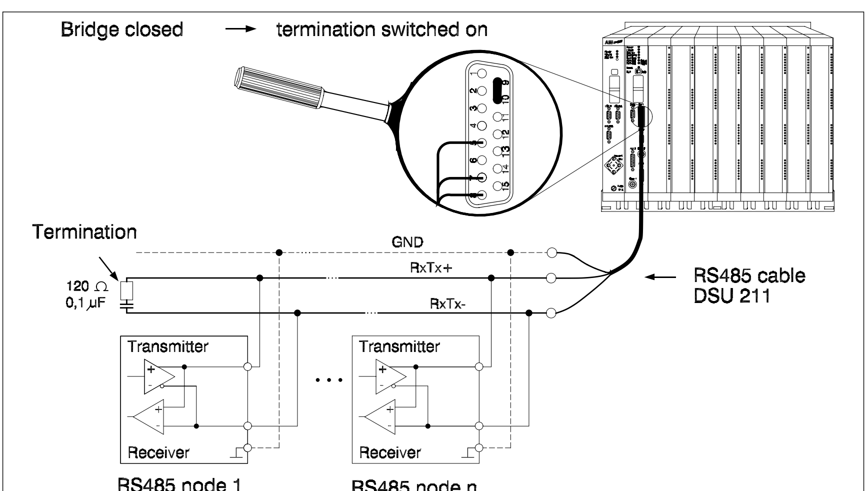


Fig. 4-25 Cabling DCP 10 via RS485 interface, case 1

2. The CPU module DCP 10 is redundant and/or not installed at the end of the bus cable

Cable the CPU module DCP 10 with the other RS485 nodes on the bus as shown in Fig. 4-26. Keep the stubs to the other nodes as short as possible. They should not be longer than 0.2 m. Use cable DSU 221 in redundant systems.

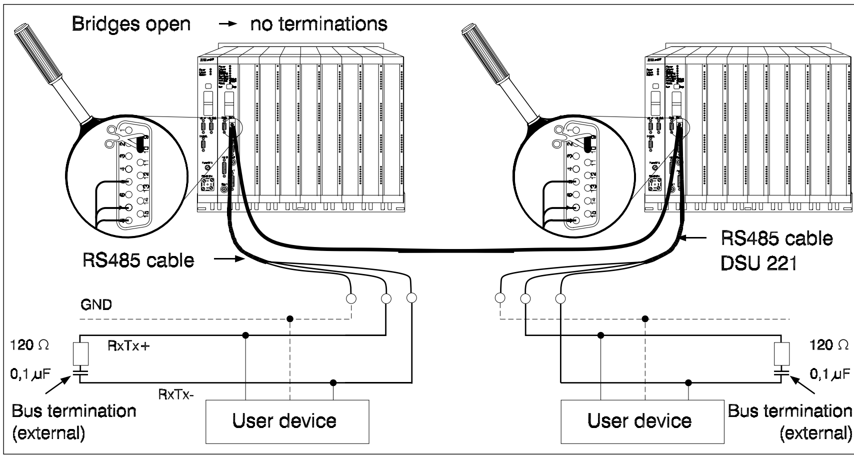


Fig. 4-26 Cabling DCP 10 via RS485 interface, case 2

Provide terminations at both ends of the bus cable. The termination should consist of a 120 Ω resistor and a 0.1 µF ceramic capacitor. Use a bus cable as described in the previous section. Deactivate the termination integrated in the CPU module DCP 10. Proceed as follows:

- Open the connector hood of the RS485 cable DSU 211 or of the cable DSU 221.
- **Remove** the **bridge between pins 9** and **10**. Insulate or cut off short the cable ends.
- Close the connector hood.

Removing the bridge deactivates the termination integrated in the CPU module. Refer to Section 13.5.1 for the terminal assignment of the interfaces and of the connection cable with the corresponding bridges.

Refer to Section 13.3.1 for a description of the RS485 interface. Contrary to the DCP 02, the RS485 interface in the DCP 10 is electrically isolated.

4.5.4 Connecting the diagnostic interface

The Diag interface is reserved for diagnosis and commissioning . Normally, it is not necessary to connect a diagnostic PC. The interface is equivalent to the RS232C interface of the CPU module DCP 02.

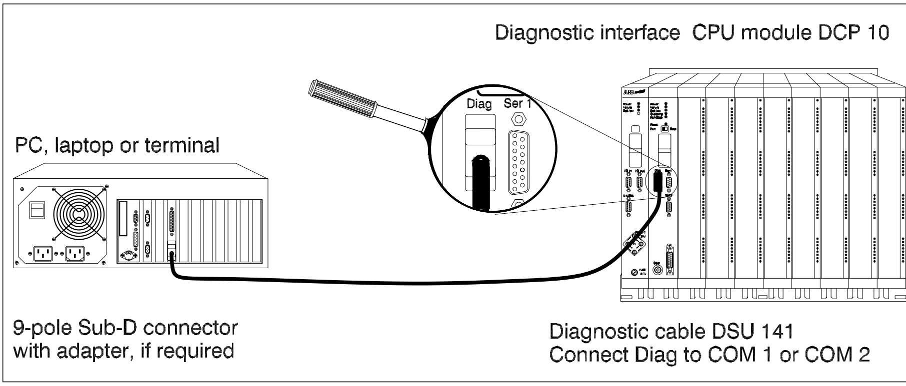


Fig. 4-27 Connecting the Diag interface to a PC or terminal

When connecting a diagnostic PC proceed as described in Section 4.4.1. All information given there is analogously valid for the DCP 10 module. Refer to Section 4.4.2 for details when using a non-redundant process station DCP 10.

⚠ The process station is powered with an extra low voltage with protective separation from other circuits. Note that this protective separation may be canceled out by connecting a diagnostic PC or terminal if it does not have a protective separation from other circuits or is not powered by battery.

4.5.4.1 Connecting a radio clock receiver to the Diag interface

Alternatively, a radio clock receiver or a GPS satellite radio clock can be connected to the Diag interface of the DCP 10. For details refer to Sections 12.2.4 and 12.3.6.

⚠ The Freelance 2000 process station is supplied with an extra low voltage with protective separation from other circuits. Note that connecting a radio clock receiver or GPS satellite radio clock to the Diag interface of the DCP 10 may cancel out the protective separation.

4.5.4.2 Connecting a radio clock receiver to a redundant DCP 10

When connecting a radio clock receiver to a redundant DCP 10 use connection cable DSU 153, as shown in Fig 4-28. For details about how to connect and operate the radio clock receiver refer to Section 12.2.ff.

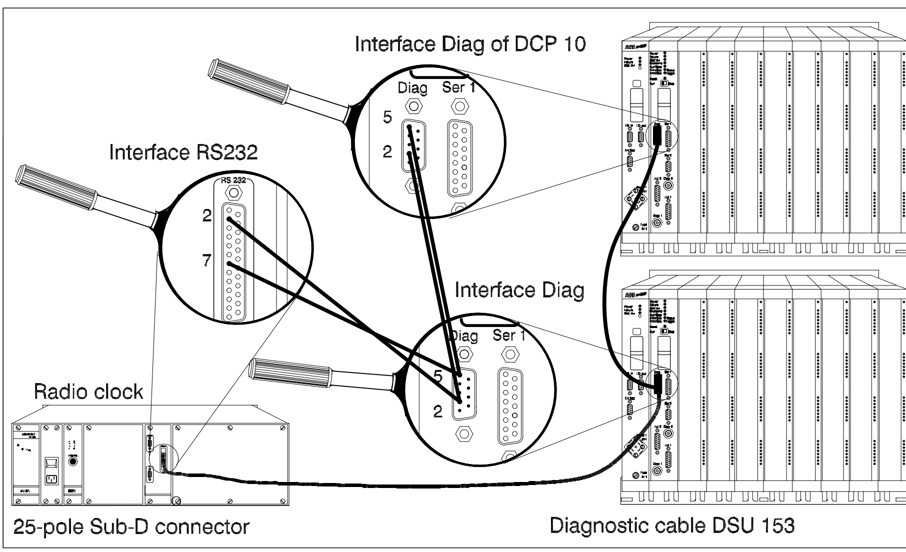


Fig. 4-28 Connecting a radio clock receiver to the Diag interface

⚠ The Freelance 2000 process station is supplied with an extra low voltage with protective separation from other circuits. Note that connecting a radio clock receiver or GPS satellite radio clock to the Diag interface of the DCP 10 may cancel out the protective separation.

4.5.5 Mounting the battery

Battery mounting is done in the same way as for the link module or for CPU module DCP 02. Refer to Sections 4.2.3 and 4.2.4.

4.5.6 Caps for unused connectors

All connectors are provided with protective caps in factory. Leave these caps on all unused connectors. The caps can also be ordered under the following code designations:

DSU 80	for Diag connector
DSU 81	for Ser 2 connector
DSU 82	for Ser 1, AUI 1, and AUI 2 connectors
DSU 83	for Coax 1 and Coax 2 connectors

⚠ **Cover unused connectors with caps to avoid static discharge.**

4.6 Cabling the gateway CPU for Symphony connection

One gateway CPU is needed for connecting each Freelance 2000 system to a supervisory Symphony operator level. Connect the gateway CPU to the DigiNet S system bus (Ethernet) as described in Section 5.8.

A conventional CPU module DCP 02 with hardware index 10 or higher or a CPU module DCP 10 can be used as a gateway CPU. The gateway CPU can be plugged into slots 1 ... 8 of the central unit or slots 0 ... 8 of the I/O unit.

A special gateway software is loaded into the module by the DigiTool configuration program. The gateway software collects and pre-processes the data of a Freelance 2000 system, and then transmits them to the Symphony system.

The RS232C interface is the only gateway CPU interface that can be used for diagnostics. For details refer to Section 4.4.2. **Do not use** any of the other gateway CPU interfaces. Install the battery as described in Section 4.2.3 and 4.2.4 for the CPU module. Cover unused connectors with caps as described in Section 4.4.4 and 4.5.6.

4.7 Cabling a redundant gateway CPU for Symphony connection

The connection to the supervisory Symphony operator level can also be made redundantly. For this purpose, connect two gateway CPUs to the DigiNet S and DigiNet Sr (Ethernet) system buses, as described in Section 5.8.

Exclusively use CPU modules DCP 10 as redundant gateway CPUs. A special gateway software can be downloaded in the module by the DigiTool configuration software. This gateway software collects the data of a Freelance 2000 system, pre-processes the data, and then transmits it to the Symphony system.

For the redundant gateway CPUs, too, there is - besides the DigiNet-S interface - only the **Diag** interface, which is to be used for diagnosis. All other interfaces of the redundant gateway CPUs **cannot** be used. When mounting the battery proceed as described in Sections 4.2.3 and 4.2.4.

Cover unused connectors with caps, as described in Section 4.5.6.

4.8 Cabling the I/O modules

4.8.1 Coding and plugging in the I/O connectors

I/O connectors for connecting the I/O cables to the I/O modules are available in two different colors.

- DSU 491: pack of 4, 10-pin I/O connectors color: black
- DSU 492: pack of 4, 10-pin I/O connectors color: orange
- DSU 493: pack of 4, 15-pin I/O connectors color: black

Use the black I/O connectors DSU 491 and DSU 493 for extra low voltage (24 V) and the orange DSU 492 connector for hazardous voltages.

Extra low voltages	< 42.4 V DC	< 30 V AC
Hazardous voltages	> 42.4 V DC	> 30 V AC

A pack of four I/O connectors is needed for each I/O module. It is not included in the scope of delivery of the I/O module and has to be ordered separately.

- Use **orange** I/O connectors for **hazardous** voltages.
- **Do not apply hazardous voltages and extra low voltages to the same module!**
  Use additional I/O modules.
- Separate **extra low voltages** and **voltages** ≥ **42.4 V** by putting them on **different connectors**!
- **Mark hazardous voltages**!
  Use the warning labels delivered with the system for this purpose!

The package contains the I/O connectors and also the coding elements with four coding pins, each. The coding pins are used for coding the I/O connectors and the corresponding I/O module.

The following modules are provided with **10-pin connectors**:

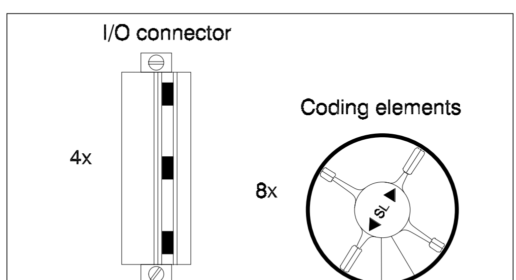
- Digital input modules DDI 01, DDI 02, DDI 03 and DDI 05
- Digital output modules DDO 01, DDO 02, DDO 03 and DDO 04
- Analog input module DAI 01, DAI 02, DAI 03, DAI 04, DAI 05
- Analog output module DAO 01 and DAO 02

The following modules are provided with **15-pin connectors**:

- Digital input module DDI 04
- Frequency input module DFI 01

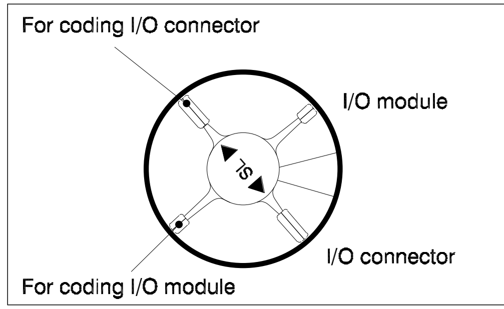
Coding the I/O connectors of an I/O module

Scope of delivery of
I/O connectors DSU 491, DSU 492 or DSU 493.



Each **coding element** contains **four coding pins.**

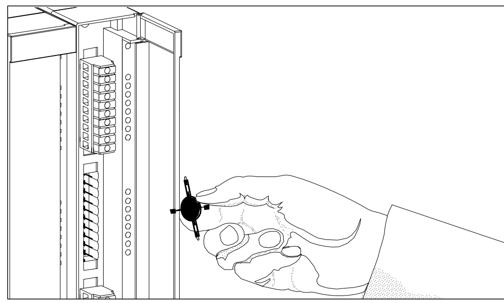
Additional coding pins can be ordered under code designation DSU 661 for 10-pin connectors and DSU 663 for 15-pin connectors.



Connector coding (see next page)

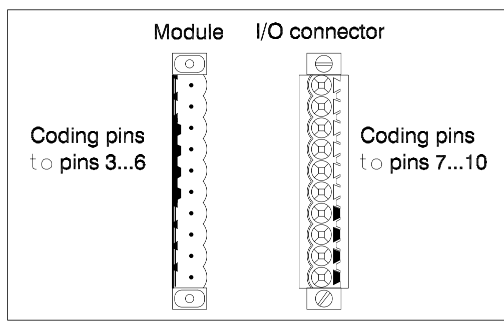
Insert the **thin**, long coding pins in the **I/O connectors** and break off.

Insert the **thick**, short pins in the **module** and break off.

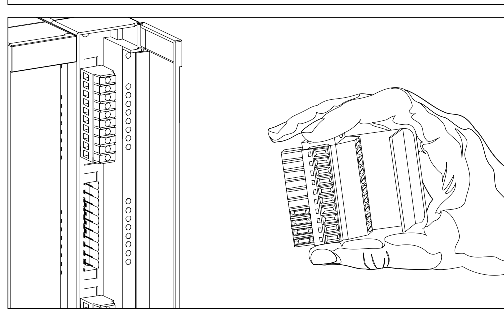


Properly coded connector

with **four pins inserted** in the I/O connector and four in the module.



Plug I/O connector into module and **fasten with screws.**

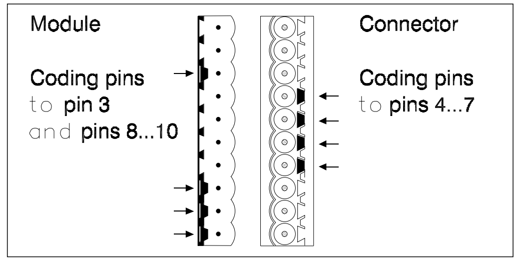


The connectors and modules must be coded to avoid mix-up of the I/O connectors. Mixing up uncoded connectors may lead to serious damage of the I/O module.

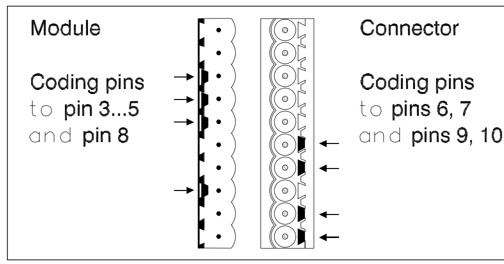
Do not plug in or take out live I/O connectors under hazardous voltage**.**

4.8.1.1 Coding table for the I/O modules with 10-pin connectors

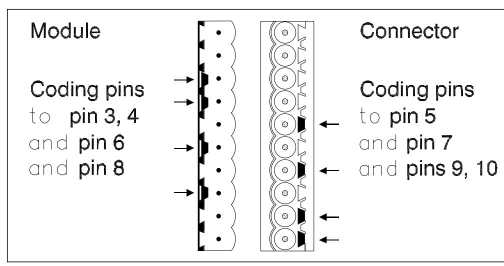
Digital input module DDI 01



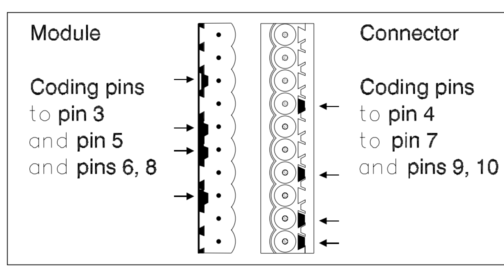
Digital input module DDI 02



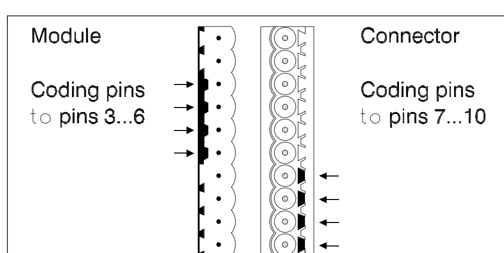
Digital input module DDI 03



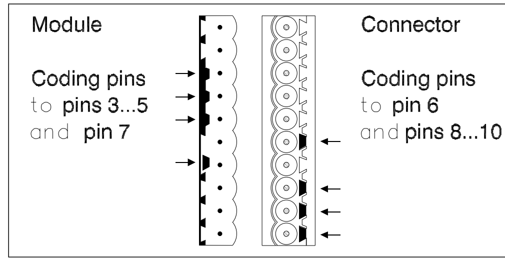
Digital input module DDI 05



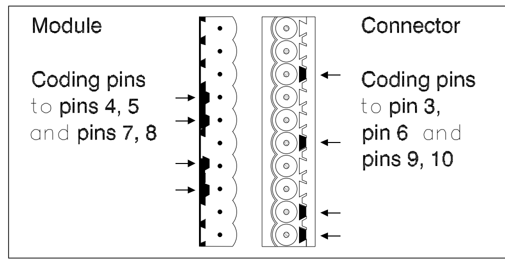
Digital output module DDO 01



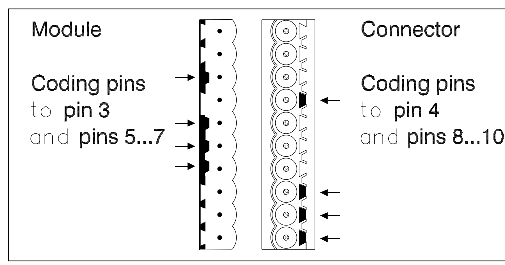
Digital output module DDO 02



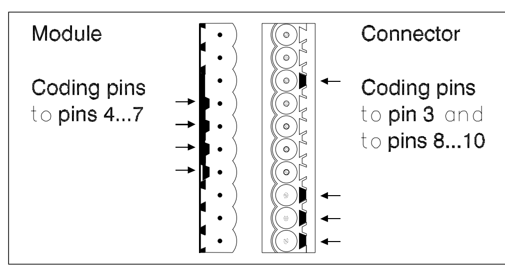
Digital output module DDO 03



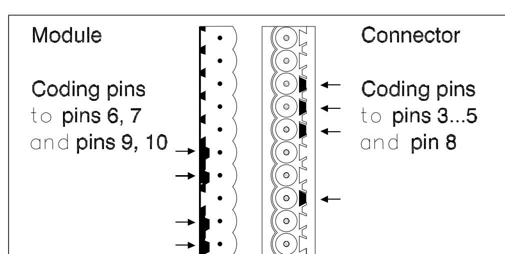
Digital output module DDO 04



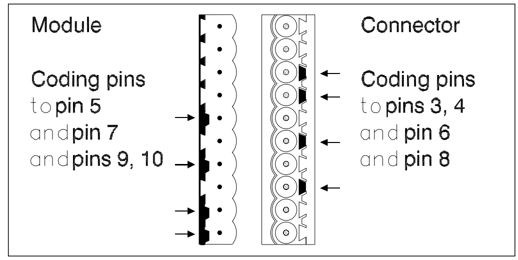
Analog input module DAI 01



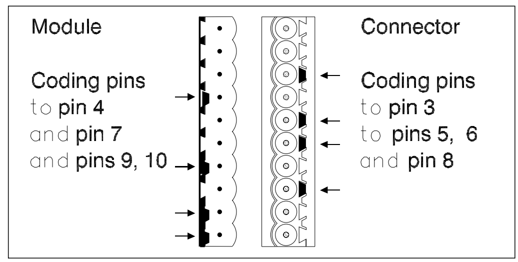
Analog input module DAI 02



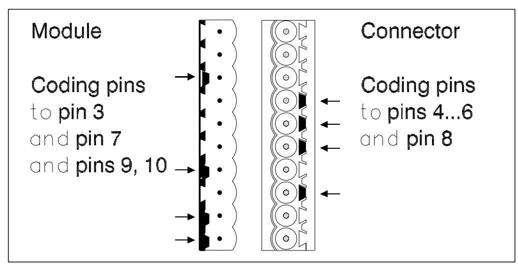
Analog input module DAI 03



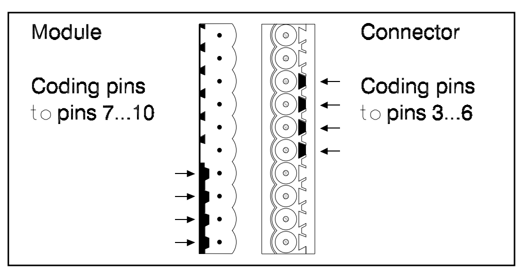
Analog input module DAI 04



Analog input module DAI 05

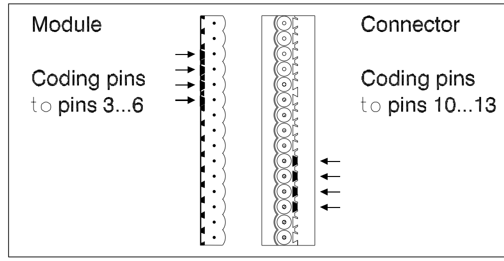


Analog output modules DAO 01 and DAO 02

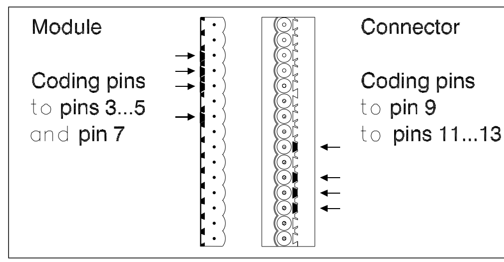


4.8.1.2 Coding table for the I/O modules with 15-pin connectors

Digital input module DDI 04



Frequency input module DFI 01



4.8.2 I/O cables

Unshielded cables

Using unshielded LiYY control cables or individual LiY wires for the Freelance 2000 system is permissible. Unshielded I/O cables meet all EMC requirements, except for IEC 801, Part 5 and IEC 1000-4, Part 4 (surge-impulse).

When using unshielded cables, a larger tolerance range is valid for the DAI 04 module. It is recommended to use shielded I/O cables for this module in any case.

The surge impulse requirements are met by shielded cables. A surge impulse simulates the effects of a lightning stroke near the cable. Installations with a high lightning expectancy always require shielded I/O cables. When using control cables it is recommended to use twisted pairs for the feed and return conductors, especially for analog signals.

Shielded cables

Using shielded I/O control cables such as LiYCY (TP), LifYCY or JY(St)Y is not mandatory, but recommended for:

- installations where **electromagnetic interference** has to be expected,
- installations requiring **lightning protection**,
- installations with **outdoor I/O cables**,
- installations with **I/O cables of more than 200 m.**
- The **DAI 04 module** (Pt100, mV and thermocouples) should always be provided with shielded cables.

Note that the lightning protection measures specified in the relevant standards and regulations applicable in your country must be taken in any case, even if shielded cables are used.

It is recommended to use twisted pair cables, e.g. LiYCY (TP) for the feed and return conductors in order to achieve a better RFI suppression. This is especially important for analog signal transmission. Moreover, the following general rules should be observed:

- Lay signal cables separately from power cables.
- Do not lay cables for analog signal transmission together with cables of digital output modules.

4.8.2.1 Ready-made I/O cables

Ready-made I/O cables (open end cables) can be ordered. The following cable types are available as LiYCY(TP) control cables, shielded twisted-pair, with wire end sleeves at the open end; length as ordered, but max. 2000 m:

	Wires	CSA	End
DSU 431	40	0.14 mm²	
DSU 432	40	0.14 mm²	open, but simply cut off
DSU 441	40	0.5 mm²	
DSU 442	40	0.5 mm²	open, but simply cut off
DSU 451	60	0.14 mm²	
DSU 452	60	0.14 mm²	open, but simply cut off

The cables are terminated with a black 10-pin I/O connector, as seen in Fig. 4-29.

An I/O cable DSU 431, DSU 432, DSU 441 or DSU 442 is needed for each I/O module.

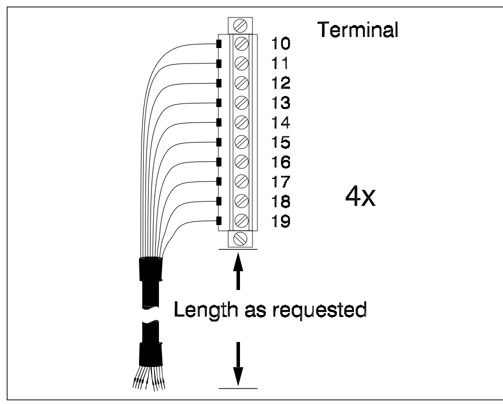


Fig. 4-29 Ready-made I/O cable

The cables are put on a black, 15-pin I/O connector, as shown in Fig. 4-30.

An I/O cable DSU 451 or DSU 452 is needed for each I/O module.

The cables are multi-purpose and, therefore, have 10 or 15 wires. All wires are connected to the I/O connector plug

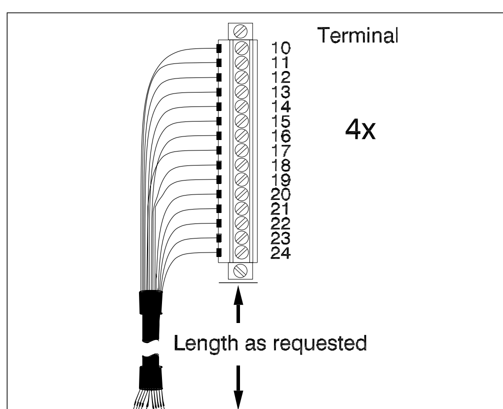


Fig. 4-30 Ready-made I/O cable

If power is to be applied directly to an output module proceed as shown in Fig. 4-31.

Cut off the wires at the last two terminals. Feed power separately via single wires. Use wires with the appropriate cross-sectional area corresponding to the power consumption for power supply.

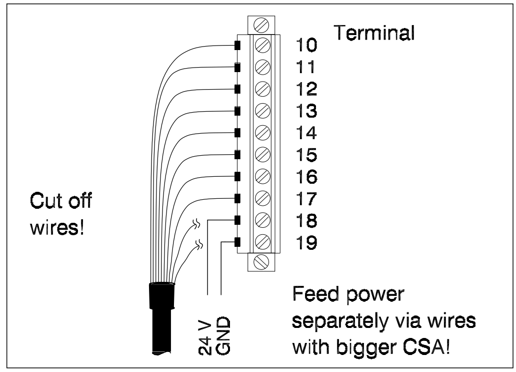


Fig. 4-31 Connecting power supply

Code the I/O connectors with the coding elements delivered with them as described in Section 4.8.1.1 and 4.8.1.2.

4.8.2.2 I/O test cable

It can be useful to link the outputs of a process station with its inputs for testing. This test setup in most cases makes it possible to check the behavior of a user configuration without requiring that the station is actually connected to a process. The ready-made I/O test cable DSU 461 or DSU 462 (different lengths) enables the user to link:

- an analog output module DAO 01 with an analog input module DAI 01 or
- a digital output module DDO 01 with a digital input module DDI 01, as required.

A test and demo process station mounted on a stand and provided with I/O test cables is available on request under code designation DSU 692.

Fig. 4-32 shows how to link an analog output module DAO 01 with an analog input module DAI 01 via the test cable.

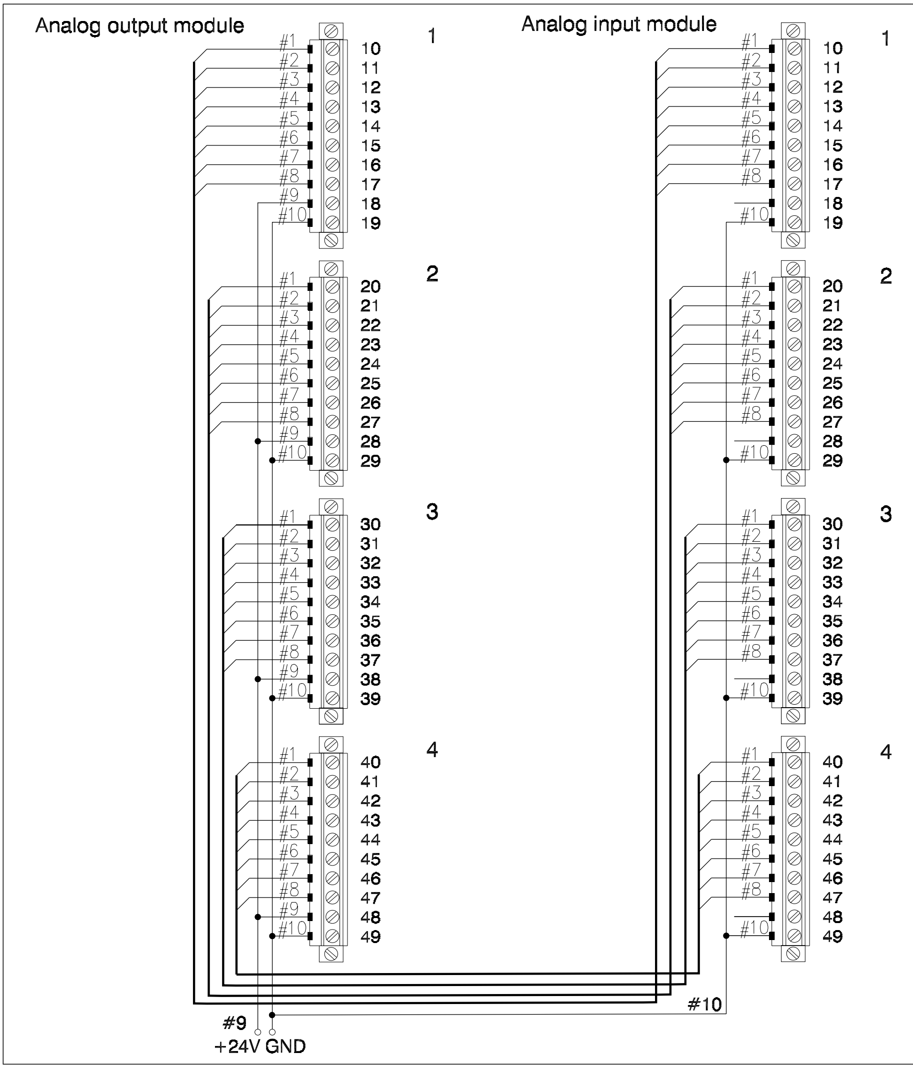


Fig. 4-32 Linking DAO 01 with DAI 01 via I/O test cable

Fig. 4-33 shows how to link a digital output module DDO 01 with a digital input module DDI 01 via the I/O test cable DSU 461 or DSU 462.

Code the I/O connectors with the coding elements delivered with them as described in Section 4.8.1.1 and 4.8.1.2.

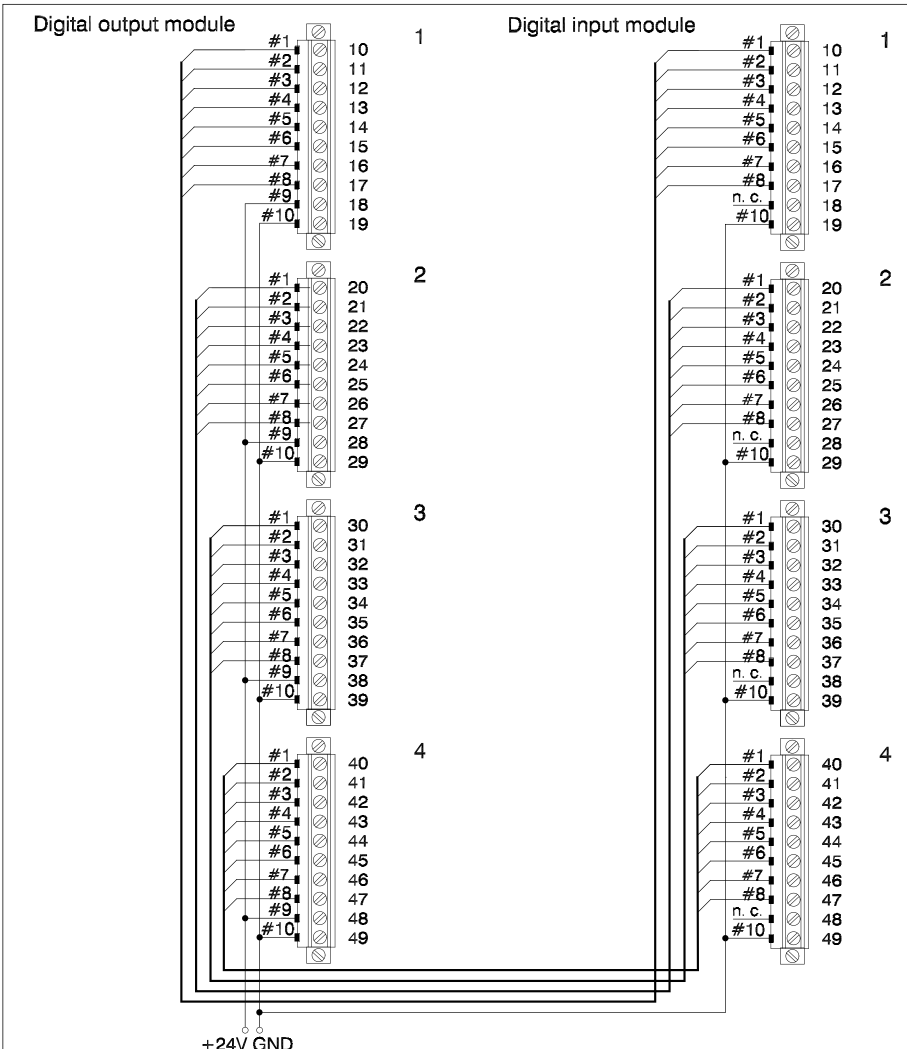


Fig. 4-33 Linking DDO 01 with DDI 01 via I/O test cable

4.8.2.3 Cable cross sectional areas

The required cable cross-sectional area depends upon the cable length and the current. Therefore, selection of the CSA has to be done depending on the respective installation. The cables for external power supply of the output modules should have a bigger cross-sectional area than the I/O lines. When all possible lines (40) are used, single wires with a max. cross-sectional area of 1 mm² can be used.

10-pin terminals with a range of 0.08 ... 2.5 mm²:

Wire size	AWG 28 ... 14
Nominal values to UL, wire size	AWG 26 ... 12
Plug gauge to EN 60947-1/10.91	A 3

15-pin terminals with a range of 0.08 ... 1.5 mm²:

Wire size	AWG 28 ... 16
Nominal values to UL, wire size	AWG 26 ... 12
Plug gauge to EN 60947-1/10.91	A 3

With wire end sleeves:

Wire "f" H07V-K fine wire to DIN 46228, T.1, **type A**: (type A = tube-type, without plastic sleeve)	0.5 ... 2.5 mm²
to DIN 46228, T.2, **type C**: (type C = crimp-type, without insulation sheath)	0.5 ... 2.5 mm²
to DIN 46228, T.3 **type D**: (type D = wire-wrapping, without insulation sheath)	0.5 ... 2.5 mm²
to DIN 46228, T.4, **type E**: (type E = tube type with plastic sleeve)	0.5 ... 1.5 mm²

4.8.2.4 Cable lengths for I/O cables

The maximum permissible I/O cable lengths depend upon the I/O cable cross-sectional area (resistance per unit length). Consider the current to be driven and the permissible voltage drop. Dimension the cable CSA in accordance with your application.

When dimensioning your cables mind the permissible cable lengths of the individual I/O modules described in Section 7.6. The values specified there are typical values. Different lengths can result from the RFI to which the cables are submitted and the way the cables are laid.

4.8.3 Putting on I/O cables

- **To ensure RFI suppression and EMI/RFI shielding** of the system, **do not connect the GND terminals** (ground potential) of the I/O modules **to earth potential**.
- **When applying voltages ≥ 42.4 V to the PE terminals, these terminals must be connected to protective earth ⏚ .**
- **Do not connect or disconnect I/O cables under hazardous voltages (e.g. 230 V) when live.**
- **Separate extra low voltages and voltages ≥ 42.4 V by putting them on different connectors!**
- **Mark hazardous voltages**!
  Use the warning labels delivered with the system for this purpose!

Use **DSU 426 or 427** clips for putting on the cable shield and to achieve strain relief. Put on the cable wires as shown in the diagram.

When putting on **shielded** cables observe the following:

- Lead the **cable shield close to** the I/O connector**.**
- **Strip off** the external cable sheath at the level of the base plate.
- Fasten the cable with the clips in such a way that the braided shield is in **tight contact** with the rack.
- If several cables are fastened with a single clip, make sure that all braided shields are in **tight contact** with the rack.

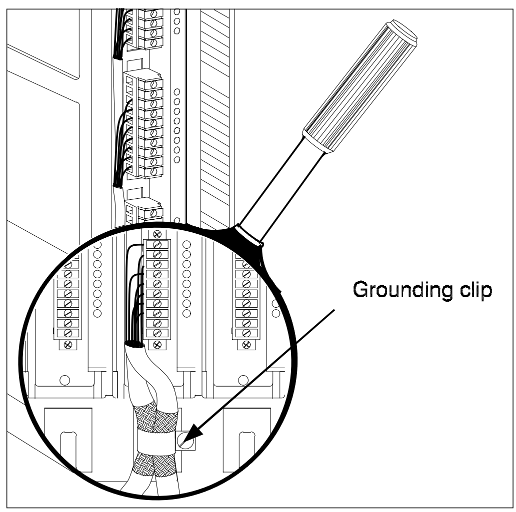


Fig. 4-34 Putting on the I/O cables

This illustration is analogously valid for 15-pin terminals.

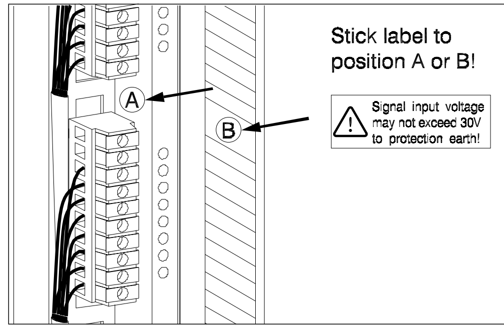
When using shielded I/O cables:

If the cable shield is not put on or not in the way described above, the EMI/RFI shielding specified for a shielded I/O cable cannot be guaranteed**.**

For modules

- DDI 01, DDI 04
- DDO 01, DDO 07,
- DAI 01 ... DAI 05,
- DAO 01, DAO 02 and
- DFI 01

stick the **warning label in accordance with UL** seen in the illustration to either position **A** or **B**.



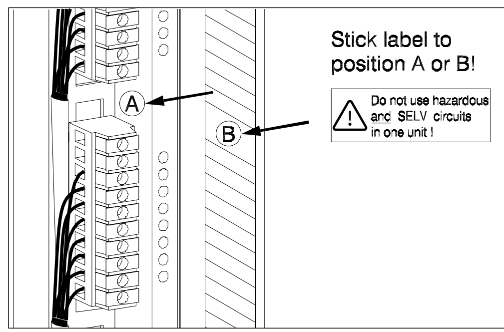
For the modules

- DDI 02, DDI 03 and DDI 05

  and

- DDO 02 ....DDO 06

stick the **warning label in accordance with UL** seen in the illustration to either position **A** or **B**.



4.8.4 Cabling the digital input module DDI 01

The digital input module is designed for connecting digital 24 V DC input signals. The module has 32 inputs. Refer to Section 7.6.6 for the technical data.

4.8.4.1 Terminal assignment of DDI 01

Cable digital input module DDI 01 as shown in Figure 4-35.

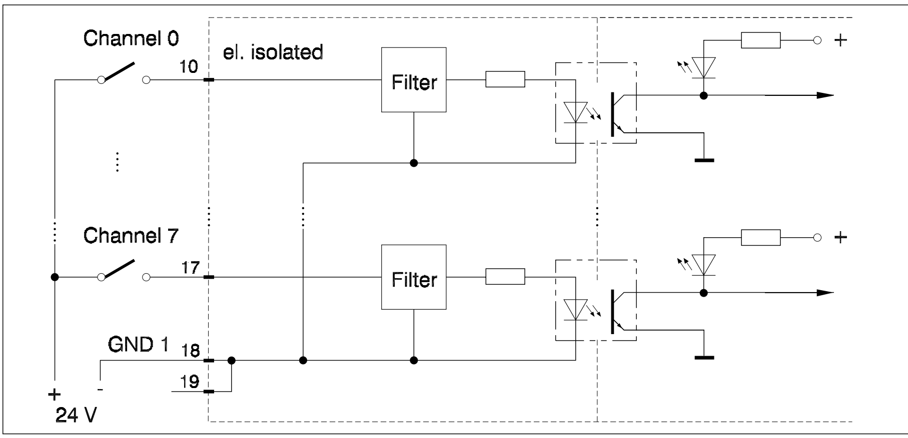
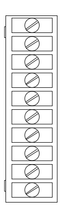


Fig. 4-35 Input circuitry of DDI 01

Figure 4-36 shows the terminal assignment of the digital input module DDI 01. The terminal numbers can be found on the label at the module door inside. The channel assignment can be seen on the label at the door outside.



Connector 1		Connector 2		Connector 3		Connector 4	
Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.
10	0	20	8	30	16	40	24
11	1	21	9	31	17	41	25
12	2	22	10	32	18	42	26
13	3	23	11	33	19	43	27
14	4	24	12	34	20	44	28
15	5	25	13	35	21	45	29
16	6	26	14	36	22	46	30
17	7	27	15	37	23	47	31
18	GND 1	28	GND 2	38	GND 3	48	GND 4
19	GND 1	29	GND 2	39	GND 3	49	GND 4

Fig. 4-36 Terminal assignment of DDI 01

4.8.4.2 Electrical isolation of DDI 01

The DDI 01 module has 32 inputs combined in 4 groups of 8 inputs of the same potential. The four groups are electrical isolated from each other and from the system by opto-couplers, and so are the grounds (GND 1 ... GND 4).

The voltage applied to the **inputs** of the digital input module DDI 01 must be an **extra low voltage with protective separation from other circuits.**

4.8.5 Cabling the digital input module DDI 02

The digital input module DDI 02 is designed for connecting digital DC or AC voltage signals within a voltage range of 24 ... 60 V AC/DC. When connecting the modules in accordance with CSA/UL only apply extra low voltage.

Voltage range for extra low voltage

• DC voltage	max. 42.4 V DC
• AC voltage	max. 30 V AC

The module has 16 inputs with channel-wise electrical isolation. Refer to Section 7.6.7 for the technical data.

4.8.5.1 Terminal assignment of DDI 02

Cable the digital input module DDI 02 as shown in Figure 4-37. When applying a hazardous voltage to DDI 02, you have to provide a double-pole switch for switching off the input voltage.

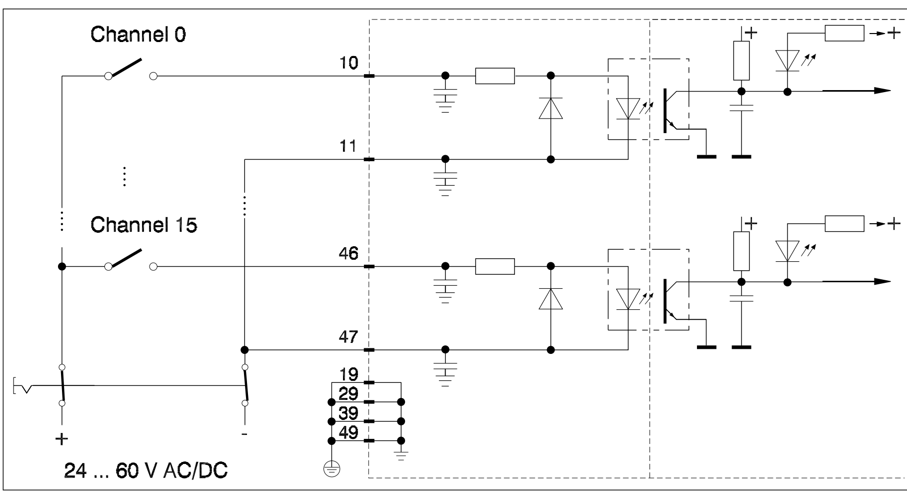


Fig. 4-37 Input circuitry of DDI 02

Terminals 19, 29, 39 and 49 are intended to be used for connecting an additional protective earth conductor. The terminal numbers are found on the label at the module door inside. The channel assignment is shown on the label at the door outside.

Figure 4-38 shows the terminal assignment of the digital input module DDI 02.

Connector 1		Connector 2		Connector 3		Connector 4	
Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.
10	0(+)	20	4(+)	30	8(+)	40	12(+)
11	0 (-)	21	4 (-)	31	8 (-)	41	12 (-)
12	1(+)	22	5(+)	32	9(+)	42	13(+)
13	1 (-)	23	5 (-)	33	9 (-)	43	13 (-)
14	2(+)	24	6(+)	34	10(+)	44	14(+)
15	2 (-)	25	6 (-)	35	10 (-)	45	14 (-)
16	3(+)	26	7(+)	36	11(+)	46	15(+)
17	3 (-)	27	7 (-)	37	11 (-)	47	15 (-)
18	n. c.	28	n. c.	38	n. c.	48	n. c.
19	⏚	29	⏚	39	⏚	49	⏚

Fig. 4-38 Terminal assignment of DDI 02

As the module has a channel-wise electrical isolation, it is possible to connect different current circuits to the module.

Figure 4-39 shows how to connect different current circuits to the digital input module DDI 02. Contrary to DDI 01 this digital input module does not require groups of 8 channels. Any number of channels can be combined in a group.

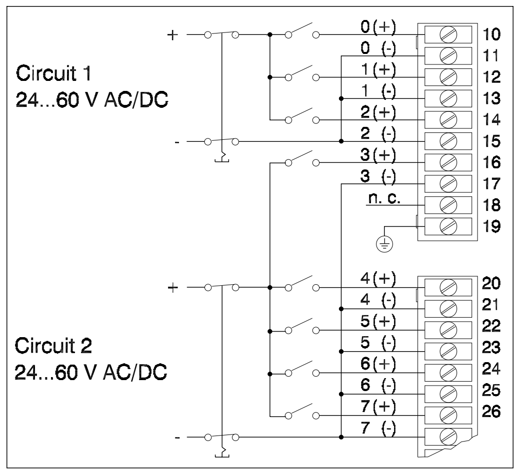


Fig. 4-39 Connecting different current circuits, example

4.8.5.2 Electrical isolation of DDI 02

Digital input module DDI 02 has 16 inputs with channel-wise electrical isolation. There is a protective separation between the I/O channels and the internal current circuits. As a result, hazardous voltages of up to 60 V AC/DC can be applied to the module. Also, a basic isolation between the I/O channels is provided.

- The **max**. permissible operating voltage is **60 V AC/DC**
  To meet the safety requirements in accordance with CSA/UL the max. operating voltage must not exceed 42.4 V DC or 30 V AC.
  1. Always **plug in all of the 4 I/O connectors**, even if not all channels are used.
  2. **Connect protective earth conductors to all of the 4 I/O connectors.**
- The device contains **anti-interference capacitors**. They may be charged, even if the module is not connected to a voltage source.

- **Do not plug in or take out** the I/O connectors **when live**. **Switch off** the **I/O circuit** with a double-pole switch, before.
- **Do not apply hazardous voltages and extra low voltages to the same module!** Use additional I/O modules instead.
- **Do not combine voltages ≥ 42.4 V with the extra low voltage.** Put on separate connector, instead.
- **Mark hazardous voltages!**
  Use the warning labels delivered with the system for this purpose**!**

The rules listed above do not apply to DDI 02 modules supplied with an extra low voltage with protective separation from other circuits.

4.8.6 Cabling the digital input module DDI 03

Digital input module DDI 03 is designed for connecting digital AC voltage signals within a voltage range of 115 ... 230 V AC. The module has 16 inputs with channel-wise electrical isolation. Refer to Section 7.6.8 for the technical data.

4.8.6.1 Terminal assignment of DDI 03

Cable digital input module DDI 03 as shown in Figure 4-40. Provide a double-pole switch for switching off the input voltage.

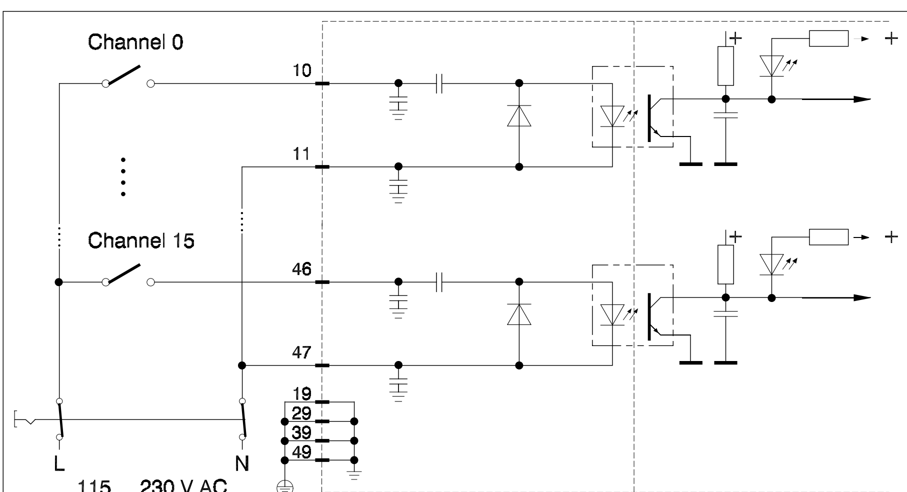
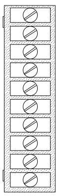


Fig. 4-40 Input circuitry of DDI 03

Figure 4-41 shows the terminal assignment of digital input module DDI 03.



Connector 1		Connector 2		Connector 3		Connector 4	
Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.
10	0 (L)	20	4 (L)	30	8 (L)	40	12 (L)
11	0(N)	21	4(N)	31	8(N)	41	12(N)
12	1 (L)	22	5 (L)	32	9 (L)	42	13 (L)
13	1(N)	23	5(N)	33	9(N)	43	13(N)
14	2 (L)	24	6 (L)	34	10 (L)	44	14 (L)
15	2(N)	25	6(N)	35	10(N)	45	14(N)
16	3 (L)	26	7 (L)	36	11 (L)	46	15 (L)
17	3(N)	27	7(N)	37	11(N)	47	15(N)
18	n. c.	28	n. c.	38	n. c.	48	n. c.
19	⏚	29	⏚	39	⏚	49	⏚

Fig. 4-41 Terminal assignment of DDI 03

Terminals 19, 29, 39 and 49 are intended to be used for connecting an additional protective earth conductor. The terminal numbers can be found on the label at the module door inside. The channel assignment is seen on the label at the door outside. Digital input module DDI 03 has a channel-wise electrical isolation.

If you have to switch all phases of a three-phase AC system, the following choices are provided:

- When using several digital input modules DDI 03: use a separate module for each phase.
- With a single digital input module DDI 03: cable as shown in Figure 4-42. The channels can be assigned to the phases as required.

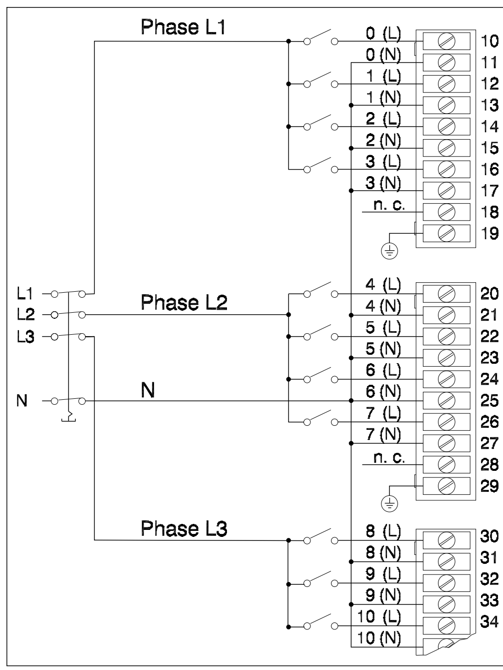


Fig. 4-42 Three-phase connection of DDI 03

4.8.6.2 Electrical isolation of DDI 03

The DDI 03 module has 16 inputs with channel-wise electrical isolation. There is a protective separation between the I/O channels and the internal circuits. Therefore, a max. voltage of 230 V AC can be applied to the module.

A basic isolation with a rated voltage value of 230 V AC between the I/O channels is provided. There is **no** protective separation between I/O channels.

- **Max.** permissible operating voltage **230 V AC**
- **Do not unplug the module and take out of the rack when the I/O connectors are live. Switch off** the **I/O circuits** with an all-pole switch, before.
- Always **plug in all of the 4 I/O connectors**, even if not all channels are used.
- **Connect protective earth conductors to all of the 4 I/O connectors.**
- The device contains **anti-interference capacitors**. They may be charged, even if the module is not connected to a voltage source.
- **Do not plug in or take out the I/O connectors when live. Switch off** the **I/O circuit** with an all-pole switch, before.
- **Do not apply hazardous voltages and extra low voltages to the same module!** Use additional I/O modules instead.
- **Do not combine voltages ≥ 42.4 V with the extra low voltage.** Put on separate connectors, instead.
- **Mark hazardous voltages!**
  Use the warning labels delivered with the system for this purpose **!**

4.8.7 Cabling digital input module DDI 04

DDI 04 is a digital input module with integrated initiator supply, for connection of NAMUR initiators and other digital sensors. This board has 15-pin terminal blocks and is provided with a channel-wise line break detection. The max. voltage range is 30 V DC. The module has two electrically isolated input groups. No separate initiator supplies are needed. The following initiators can be connected directly.

- 2 x 14 inputs for 2- wire NAMUR initiators (to DIN 19234) or
- 2 x 6 inputs for 3-wire or 4-wire initiators or
- 2 x 14 inputs for contact sensing (NO / NC) or
- 2 x 6 inputs for contact sensing (change-over contact) or
- 2 x 14 inputs for acquisition of binary signals (to DIN 19240)

Refer to Section 7.6.9 for the technical data.

4.8.7.1 Terminal assignment of DDI 04

Cable the DDI 04 module as seen in the diagrams below.

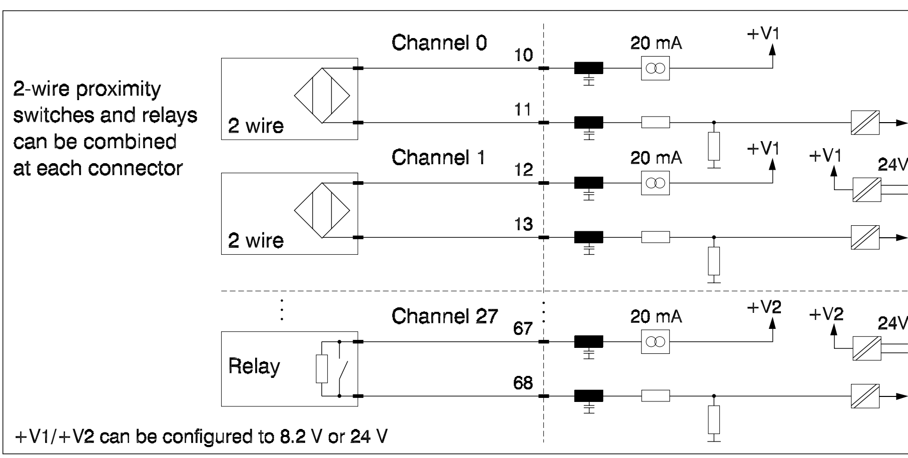


Fig. 4-43 Input circuitry of DDI 04 with 2-wire proximity switches and relays für 2-wire contact sensors (with resistor for cable break detection)

Observe the different terminal functions, depending on the type of sensor connected.

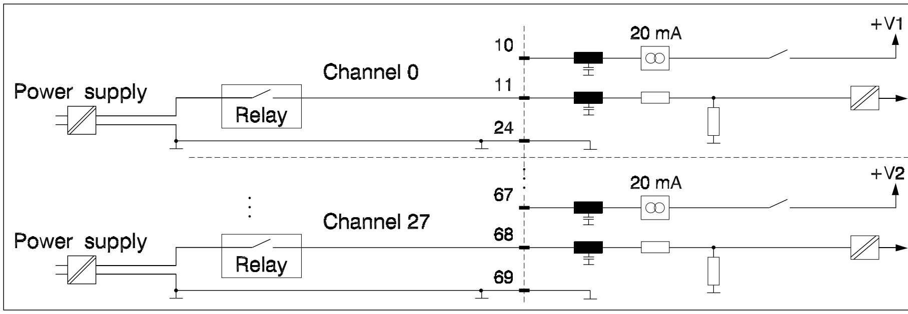


Fig. 4-44 Input circuitry of DDI 04 for binary signal acquisition to DIN 19240

With binary signal acquisition to DIN 19240 all supply terminals (10, 12,...) are switched off group-wise.

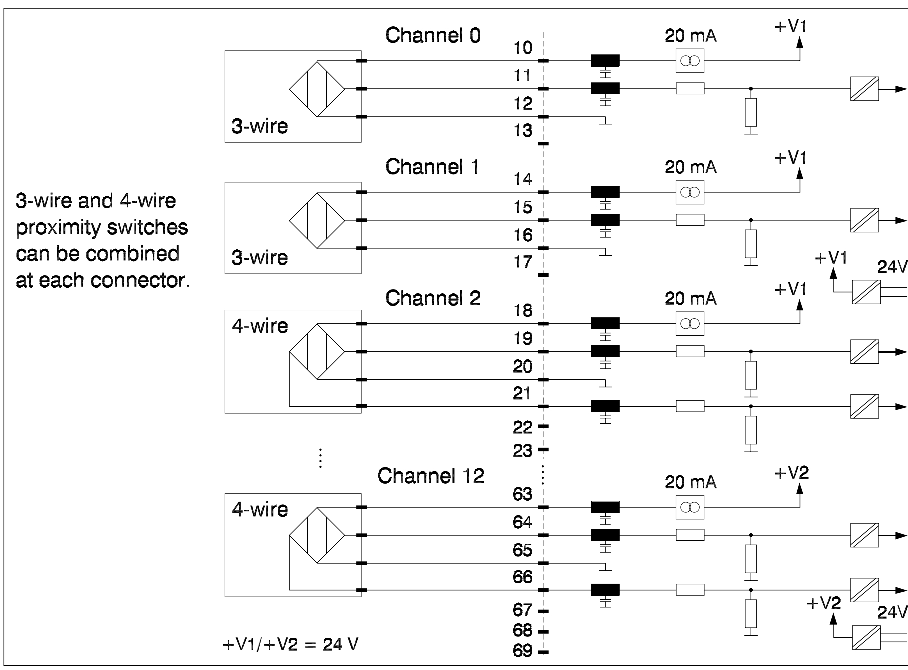
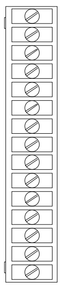


Fig. 4-45 Input circuitry of DDI 04 for 3/4-wire initiators or 3/4-wire proximity switches

The following combinations within one group are permissible:

- 3-wire and 4-wire Proximity switch, relay and change-over contact with 24 V supply voltage
- 2-wire Proximity switch, relay and change-over contact with 8.2 V supply voltage

Figure 4-46 shows the terminal assignment of digital input module DDI 04.



Terminal no.	Channel	Terminal no.	Channel	Terminal no.	Channel	Terminal no.	Channel
10	0 / 0	25	7 / 3	40	14 / 6	55	21 / 9
11	0 / 0	26	7 / 3	41	14 / 6	56	21 / 9
12	1 / 0	27	8 / 3	42	15 / 6	57	22 / 9
13	1 / 0	28	8 / 3	43	15 / 6	58	22 / 9
14	2 / 1	29	9 / 4	44	16 / 7	59	23 / 10
15	2 / 1	30	9 / 4	45	16 / 7	60	23 / 10
16	3 / 1	31	10 / 4	46	17 / 7	61	24 / 10
17	3 / 1	32	10 / 4	47	17 / 7	62	24 / 10
18	4 / 2	33	11 / 5	48	18 / 8	63	25 / 11
19	4 / 2	34	11 / 5	49	18 / 8	64	25 / 11
20	5 / 2	35	12 / 5	50	19 / 8	65	26 / 11
21	5 / 2	36	12 / 5	51	19 / 8	66	26 / 11
22	6 / -	37	13 / -	52	20 / -	67	27 / -
23	6 / -	38	13 / -	53	20 / -	68	27 / -
24	GND 1	39	(24 V EXT) *	54	(GND EXT) *	69	GND 2
Connector 1		Connector 2		Connector 3		Connector 4	

* optional

Fig. 4-46 Terminal assignment of DDI 04

You can find the terminal numbers on the label at the module door inside. The channel numbers represent the number of the channel for 2-wire, 3-wire and 4-wire connections. The assignment of the channels and LEDs can be seen on the label attached to the module door outside.

The LED assignment depends on whether you use the channels for 2-wire, 3-wire or 4-wire initiators. Note that there is not always a 1:1 relation between the LEDs and the terminals.

4.8.7.2 Electrical isolation of DDI 04

The inputs of module DDI 04 are electrically isolated in 2 groups. In each group the channels are combined, depending on the type of connection of their initiators: 14 channels for 2-wire types or 6 channels for 3-wire types. The groups are directly supplied from the module. The voltage available for this purpose (8.2 V for NAMUR initiators, 24 V for digital sensors) has a protective separation from other circuits.

Additionally, there is a protective separation between the I/O channels and the internal circuits. Between the I/O channels within one group, however, there is only a basic isolation and, thus, **no** protective separation.

- **Max.** permissible operating voltage of external supply: **24 V DC ± 25 %** (max. 30 V DC).
- **With internal supply mind the power consumption.**
  Use a maximum of 7 modules in one rack.

4.8.7.3 External power supply for digital input module DDI 04 (on request)

Digital input module DDI 04 can either use an external (with separate order code) or internal power supply for its NAMUR initiators. The nominal voltage of the external power supply is **24 V DC ± 25 %**

The used power supply must have a protective separation from other circuits.

It is recommended to use regulated power supplies for this purpose. When using unregulated power supplies make sure that the supply voltage is always within in the range of 24 V DC ± 25 %, even in case of mains variations. When using three-phase transformers with bridge rectifiers, the RMS value of the voltage must be within the range of 19.2 ... 28 V.

The current consumption of digital input module DDI 04 depends upon the output current of the connected initiators.

The two groups of digital input module DDI 04 are electrically separated internally by using two separate power supplies.

When using the optional external power supply, only one power supply is required.

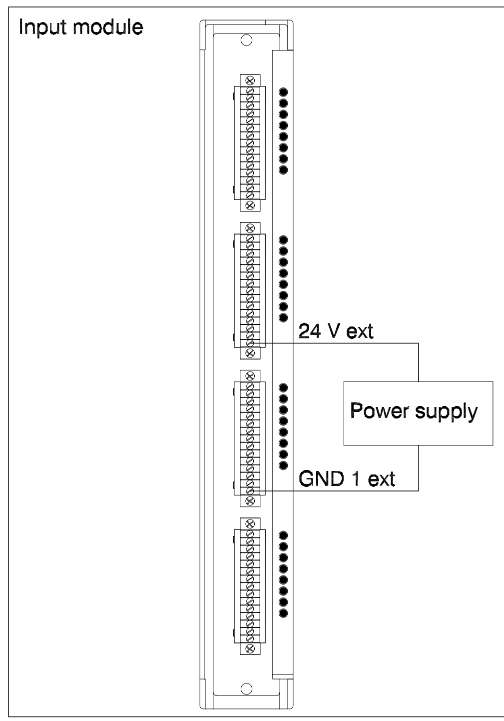


Fig. 4-47 External power supply, single supply voltage

4.8.8 Cabling digital input module DDI 05

DDI 05 is a digital input module for the connection of digital AC voltage signals (voltage range 115 - 230 V AC). The module has 32 inputs, arranged in 4 groups of 8. The groups are electrically isolated from each other. Refer to Section 7.6.10 for the technical data.

4.8.8.1 Terminal assignment of DDI 05

Cable the digital input module DDI 05 as seen in Figure 4-48. Provide a two-pole switch for switching off the input voltage.

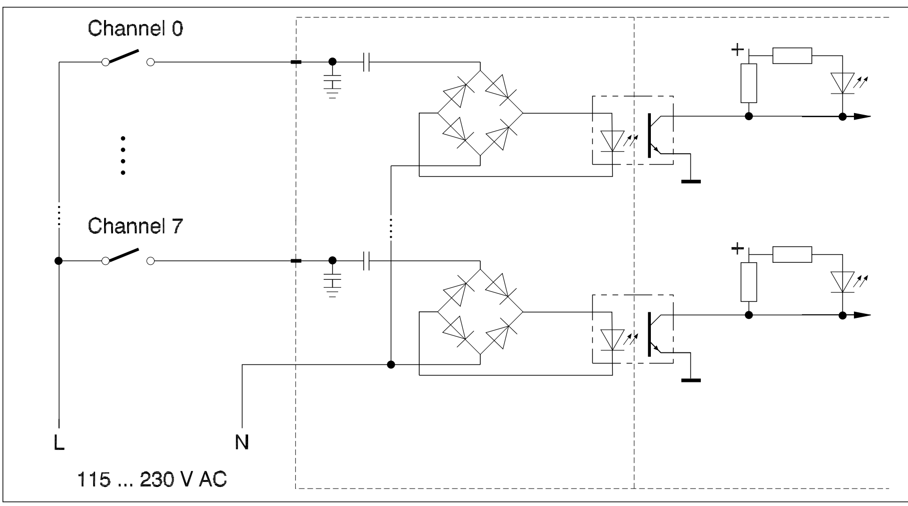
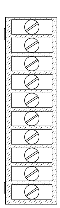


Fig. 4-48 Input circuitry of DDI 05

Figure 4-49 shows the terminal assignment of the digital input module DDI 05.



Connector 1		Connector 2		Connector 3		Connector 4	
Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.
10	1 (L1)	20	9 (L2)	30	17 (L3)	40	25 (L1)
11	2 (L1)	21	10 (L2)	31	18 (L3)	41	26 (L1)
12	3 (L1)	22	11 (L2)	32	19 (L3)	42	27 (L1)
13	4 (L1)	23	12 (L2)	33	20 (L3)	43	28 (L1)
14	5 (L1)	24	13 (L2)	34	21 (L3)	44	29 (L1)
15	6 (L1)	25	14 (L2)	35	22 (L3)	45	30 (L1)
16	7 (L1)	26	15 (L2)	36	23 (L3)	46	31 (L1)
17	8 (L1)	27	16 (L2)	37	24 (L3)	47	32 (L1)
18	(N)	28	(N)	38	(N)	48	(N)
19	⏚	29	⏚	39	⏚	49	⏚

Fig. 4-49 Terminal assignment of DDI 05

Terminals 19, 29, 39 and 49 are dedicated to an additional protecive earth conductor. You can find the terminal numbers on the label at the module door inside. The assignment of the channels can be seen on the label attached to the door outside. DDI 05 has a group-wise electrical isolation.

If you need to switch all three phases of a three-phase current system, there are two possible ways:

- If you are using several digital input modules DDI 05, use a separate module for each phase.
- If you are using only one DDI 05 module, cable it as seen in Figure 4-50. Note that the groups can be assigned to the phases as required.

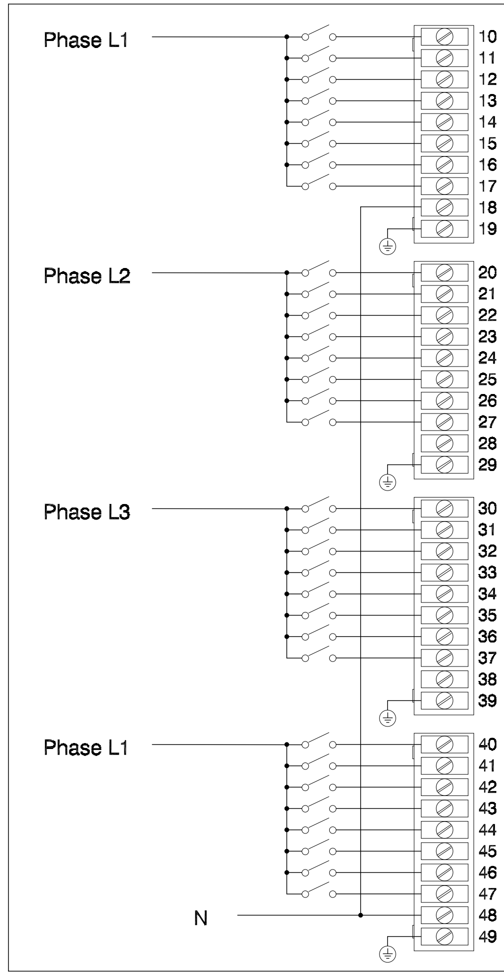


Fig. 4-50 3-phase connection of DDI 05

4.8.8.2 Electrical isolation of DDI 05

The DDI 05 module has 32 inputs arranged in four groups of eight inputs, each. The groups are electrically isolated from each other. There is a protective separation between the I/O channels an the internal circuits. Therefore, a max. voltage of 230 V AC may be applied to the module.

A basic isolation with a rated voltage value of 230 V AC between the I/O channels is provided. There is **no** protective separation between I/O channels.

- **Max.** permissible operating voltage **230 V AC**
- **Do not unplug the module and take out of the rack when the I/O connectors are live. Switch off** the **I/O circuits** with an all-pole switch, before.
- Always **plug in all of the 4 I/O connectors**, even if not all channels are used.
- **Connect protective earth conductors to all of the 4 I/O connectors.**
- The device contains **anti-interference capacitors**. They may be charged, even if the module is not connected to a voltage source.
- **Do not plug in or take out the I/O connectors when live. Switch off** the **I/O circuit** with an all-pole switch, before.
- **Do not apply hazardous voltages and extra low voltages to the same module!** Use additional I/O modules instead.
- **Mark hazardous voltages!**
  Use the warning labels delivered with the system for this purpose **!**

4.8.9 Cabling the digital output module DDO 01

The digital output module DDO 01 accommodates 32 current-sourcing digital DC voltage outputs. The outputs are arranged in 4 electrically isolated groups, each consisting of 2 groups of 4. The output voltage is 24 V DC. The max. output current per channel is 0.5 A. Refer to Section 7.6.11 for the technical data.

4.8.9.1 Terminal assignment of DDO 01

Cable digital output module DDO 01 as shown in Figure 4-51.

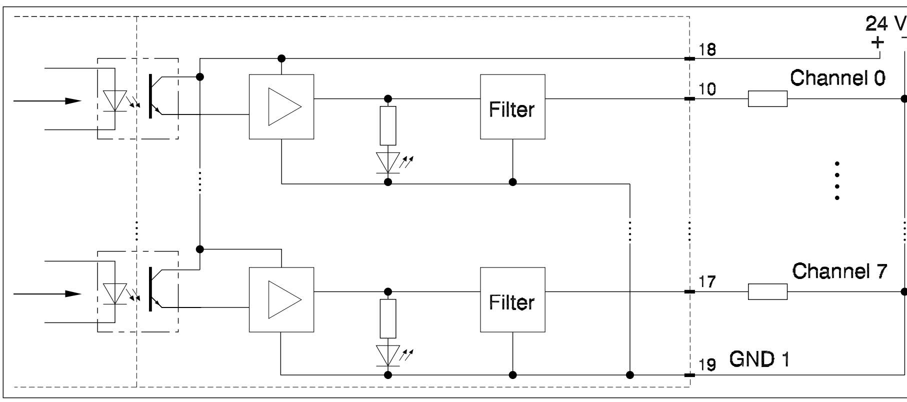
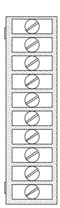


Fig. 4-51 Output circuitry of DDO 01

Figure 4-52 shows the terminal assignment of digital output module DDO 01. The terminal numbers can be found on the label at the module door inside, the channel assignment is shown on the label at the door outside.



Connector 1		Connector 2		Connector 3		Connector 4	
Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.
10	0	20	8	30	16	40	24
11	1	21	9	31	17	41	25
12	2	22	10	32	18	42	26
13	3	23	11	33	19	43	27
14	4	24	12	34	20	44	28
15	5	25	13	35	21	45	29
16	6	26	14	36	22	46	30
17	7	27	15	37	23	47	31
18	24 V	28	24 V	38	24 V	48	24 V
19	GND 1	29	GND 2	39	GND 3	49	GND 4

Fig. 4-52 Terminal assignment of DDO 01

The outputs are protected by contact breaking devices. If a short-circuit occurs, all outputs of a group of 4 which are active at that time are switched off and remain in this state. The outputs can be switched on again in on-line mode using the board function block of the DigiTool software. Additionally, a shorted output can be switched on again in the DigiVis system display. A short-time interruption of the external power supply will also switch on the outputs that have been switched off.

The outputs resist to feedback voltages up to the applied external mains voltage.

Avoid feedback when the external supply voltage is switched off or is lower than the feedback voltage. Otherwise, the module may be damaged.

4.8.9.2 Electrical isolation of DDO 01

The DDO 01 module has 32 outputs combined in groups of eight outputs of the same potential. The four groups are electrically isolated from each other and from the system by opto-couplers, and so are the grounds (GND 1 ... GND 4) and the power connectors. Do not connect the ground potentials to earth potential.

4.8.9.3 External power supply for the digital output module DDO 01

The digital output module DDO 01 needs an external power supply for each of the electrically isolated groups, for powering the outputs. The nominal voltage of the external supply is

24 V DC ± 25 %

It is recommended to use regulated power supplies for this purpose. When using unregulated power supplies make sure that the supply voltage is always within in the range of 24 V DC ± 25 %, even in case of mains variations. When using three-phase transformers with bridge rectifiers, the RMS value of the voltage must be within the range of 19.2 ... 28 V.

The power supply used for this purpose must have a protective separation from other circuits.

The current consumption of digital output module DDO 01 depends upon the output current of the respective outputs. For details refer to Section 7.6.11.

For digital output module DDO 01 the electrical isolation of the channels is preserved by providing electrically isolated supply voltages.

Figure 4-53 shows how **four electrically isolated channel groups** can be powered by four power supplies.

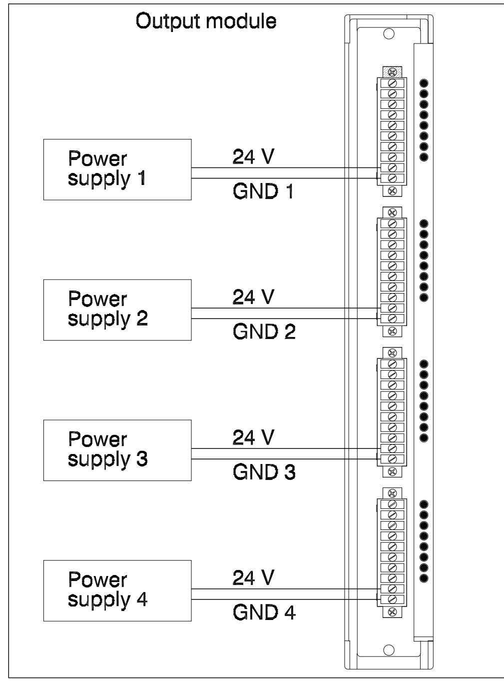


Fig. 4-53 External power supply, individual supply voltages

Figure 4-54 shows how the electrical isolation of the channel groups is neutralized when they are supplied with a **common voltage**.

In this case all **output channels** have the same **reference potential.**

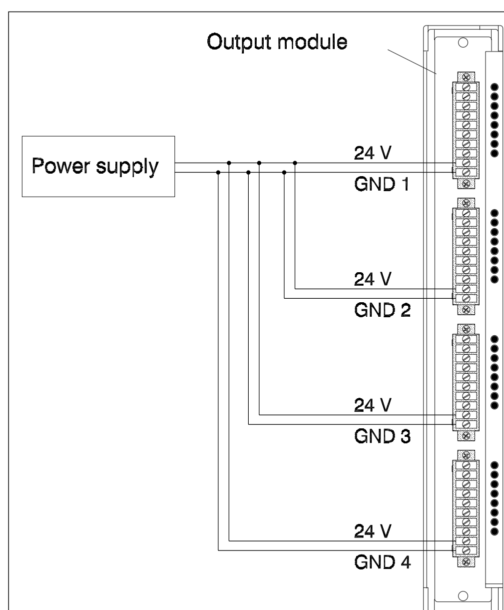


Fig. 4-54 External power supply with a common supply voltage

4.8.9.4 Maximum switching frequency of DDO 01 with inductive loads

The module has an internal demagnetization circuit. Thus, inductive loads can be used without a clamping diode. Observe the maximum switching frequencies shown in the following diagram.

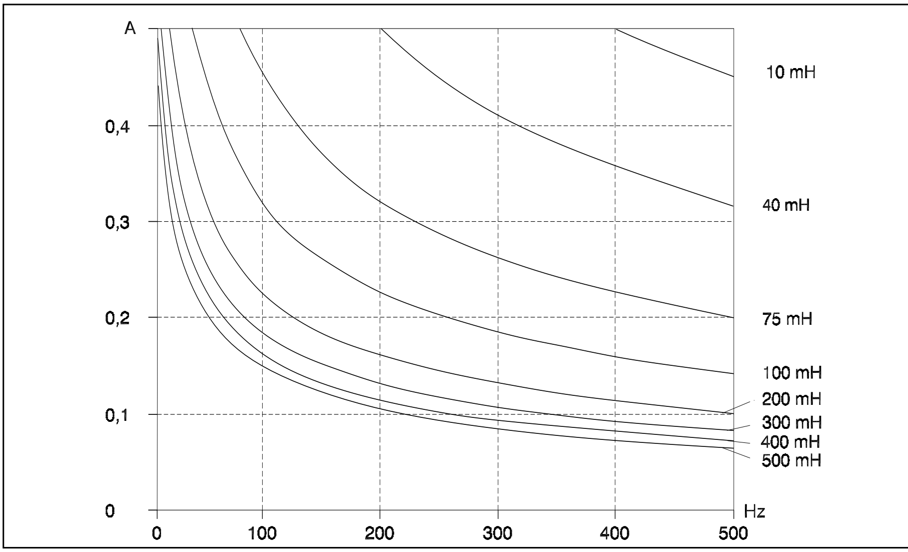


Fig. 4-55 Maximum switching frequencies

Example:

An inductive load of **75 mH** is supplied with **0.4 A.**

How to proceed in the example above:

1. **Read the current** required for your inductive load from the y axis.
2. Draw a **horizontal line** to curve 75 mH.
3. Draw a **vertical line down** from this point. Then you can read the **maximum permissible switching frequency of 125 Hz**.
4. Make sure that this switching frequency is **not exceeded. Configure** your system **accordingly**.

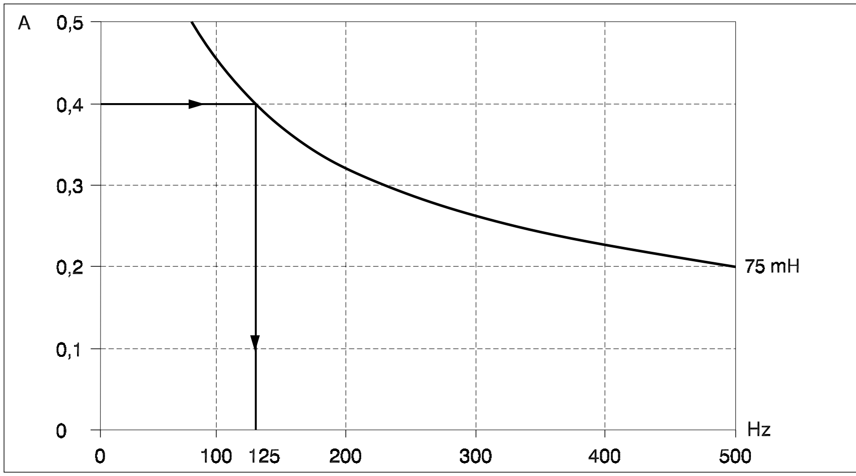


Fig. 4-56 Determination of the permissible switching frequency

4.8.10 Cabling the digital output module DDO 02

The digital output module DDO 02 has 16 relay outputs with channel-wise electrical isolation. The relay outputs are NO (normally open) contacts. The voltage range is from 24 ... 230 V AC/DC. The max. permissible current is 5 A, the minimum current is 100 mA. Note that the minimum current is necessary for self-cleaning of the relay contacts. Operation with lower loads may lead to sticky contacts and, thus, to malfunctions.

Notice the restrictions for DC operation described in Section 4.8.10.3. For inductive loads additionally refer to Section 4.8.10.4. The number of relay operations depends upon the output current. For details refer to the technical data in Section 7.6.12.

When supplying the digital output module DDO 02 with **a hazardous voltage**, a **double-pole switch** for switching off power has to be provided. The relay contacts are unprotected. Therefore, a **circuit breaker should be provided** for contact protection.

4.8.10.1 Terminal assignment of DDO 02

Cable the digital output module DDO 02 as shown in Figure 4-57.

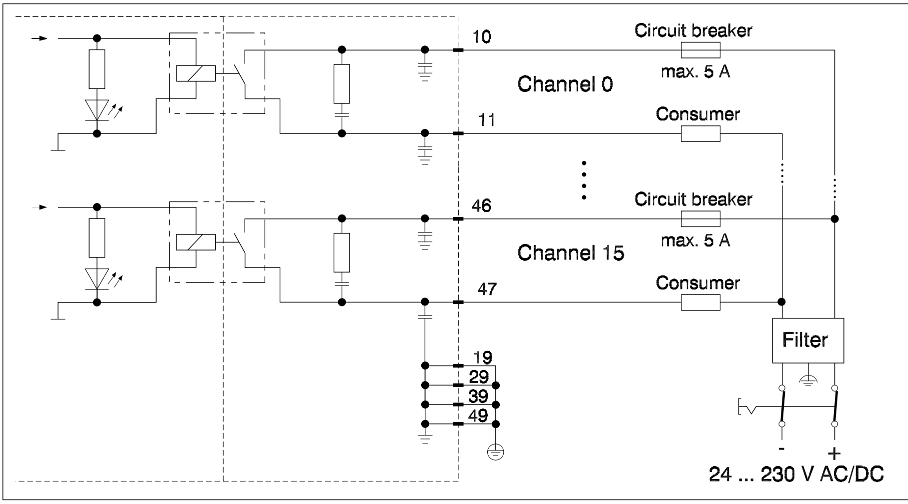


Fig. 4-57 Output circuitry of DDO 02

The switching pulses of the relay outputs may lead to click noise in the connected mains. Using an interference filter is mandatory to achieve RFI suppression to class B. The following interference filters can be used:

- For DC and AC voltages 24 ... 230 V AC/DC: Phoenix-Contact (manufacturer) filter, plastics housing for rail-mounting, 250 V/6 A, ordering code 2783092
- For AC voltage 230 V AC, only: Timonta (manufacturer) filter type FMLB-0151-0610. 250 V/6 A, metal housing for plate mounting

⚠ Use the interference filters mentioned above to **filter the mains input**. Otherwise, **RFI suppression** cannot be guaranteed.

Lay filtered power cables separately from unfiltered ones. If RFI suppression class A (industrial areas) suffices for your applications, it is not necessary to use filters. In this case, however, the relay contacts should not be switched more frequently than every 15 seconds.

If the relay outputs are only loaded with low currents, several channels can be protected by a common circuit breaker as shown in the following diagram. Note that the fuse rating must not be higher than 5 A. Make several groups and protect each of them with a 5 A circuit breaker, if required.

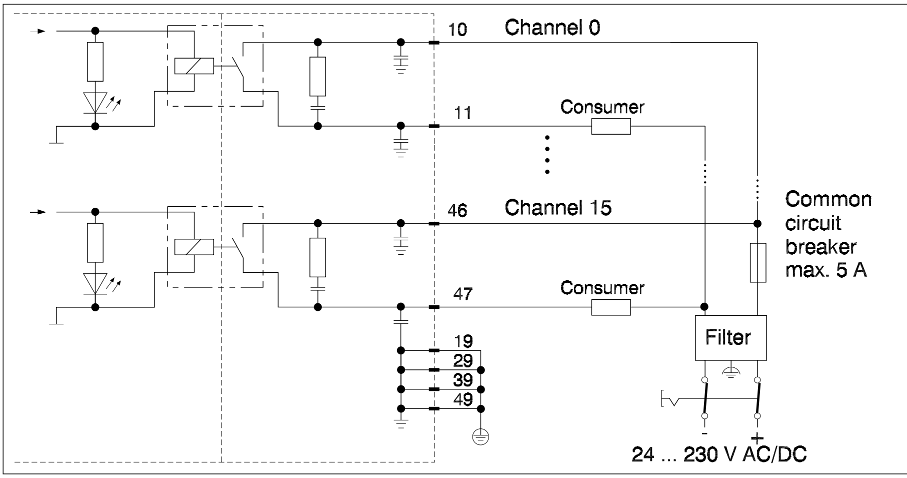
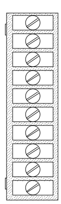


Fig. 4-58 Output circuitry of DDO 02 with common circuit breaker

Figure 4-59 shows the terminal assignment of the digital output module DDO 02.



Connector 1		Connector 2		Connector 3		Connector 4	
Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.
10	0(+)	20	4(+)	30	8(+)	40	12(+)
11	0 (-)	21	4 (-)	31	8 (-)	41	12 (-)
12	1(+)	22	5(+)	32	9(+)	42	13(+)
13	1 (-)	23	5 (-)	33	9 (-)	43	13 (-)
14	2(+)	24	6(+)	34	10(+)	44	14(+)
15	2 (-)	25	6 (-)	35	10 (-)	45	14 (-)
16	3(+)	26	7(+)	36	11(+)	46	15(+)
17	3 (-)	27	7 (-)	37	11 (-)	47	15 (-)
18	n. c.	28	n. c.	38	n. c.	48	n. c.
19	⏚	29	⏚	39	⏚	49	⏚

Fig. 4-59 Terminal assignment of DDO 02

Terminals 19, 29, 39 and 49 are intended to be used for connecting an additional protective earth conductor. The terminal numbers can be found on the label at the module door inside. The channel assignment is shown on the label at the door outside.

It is also possible to connect different current circuits to one module, since the module has a channel-wise electrical isolation. However, you must not connect circuits with extra low voltage and circuits with a hazardous voltage to the same module at the same time.

Fig. 4-60 shows the example of different 24 V circuits connected to a digital output module DDO 02.

Contrary to digital output module DDO 01 this module does not require groups of eight channels. Any number of channels can be combined in a group.

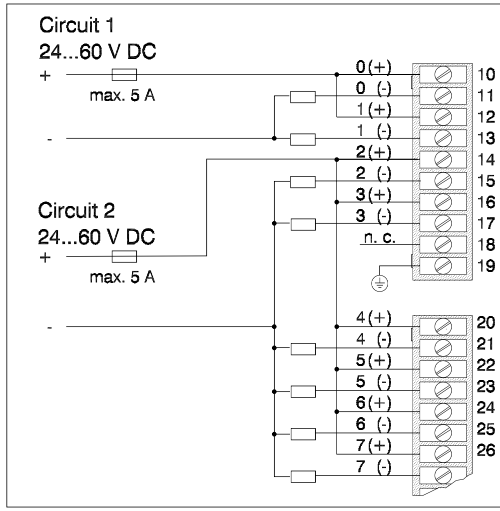


Fig. 4-60 Multiple circuits connected to a DDO 02

Do not connect a 24 V circuit and a 230 V circuit to the same module as shown in 4**-61**.

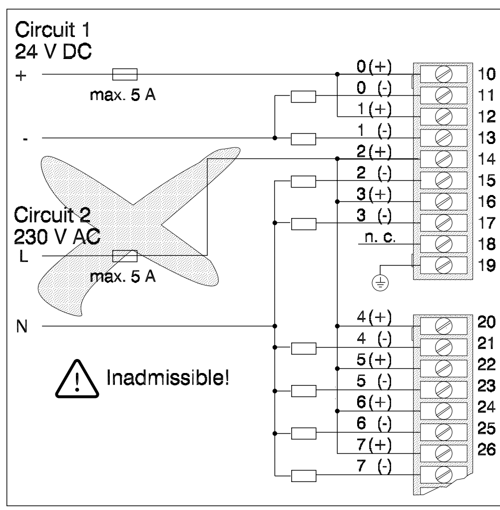


Fig. 4-61 Inadmissible connection of circuits

Do not connect circuits with extra low voltage and hazardous voltages to the same module. Connect to different modules.

If you have to switch all phases of a three-phase AC system, the following choices are possible:

- When using several digital output modules DDO 02: use a separate module for each phase.
- When using only one DDO 02: cable the module as shown in Figure 4-62.

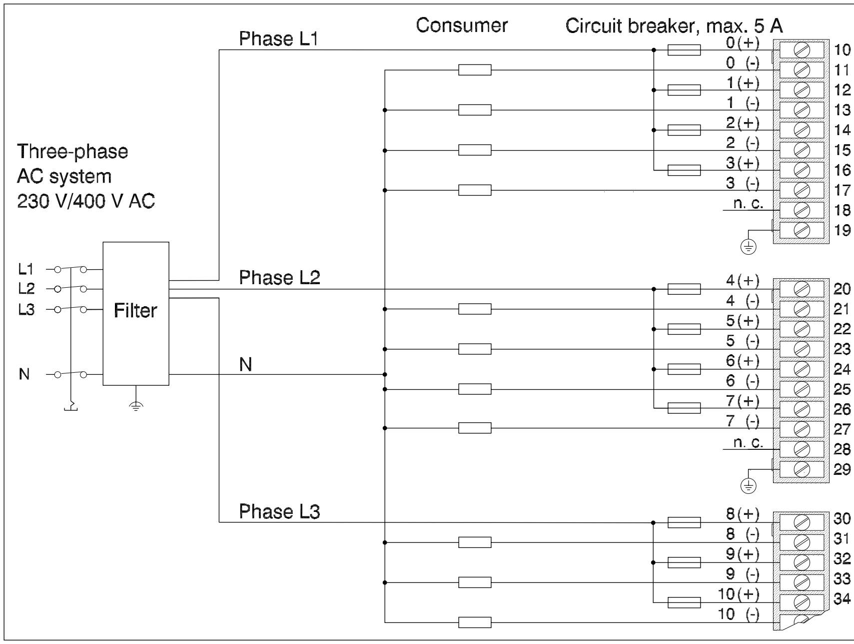


Fig. 4-62 Three-phase connection to DDO 02

The phases can be assigned to any channels.

4.8.10.2 Electrical isolation of DDO 02

The DDO 02 module has 16 relay outputs with channel-wise electrical isolation. There is a protective separation between the I/O channels and the internal circuits. Therefore, hazardous voltages of max. 230 V AC can be applied to the module. A basic isolation with a rated voltage value of 230 V AC/DC between the I/O channels is provided. There is **no** protective separation between I/O channels.

When using the module with **hazardous voltages**, the following rules have to be observed:

- **Max.** perm. operating voltage: **230 V AC/DC** (phase to neutral conductor).
- Do not plug in or take out the I/O connectors when live. **Switch off** the **I/O circuit** with an all-pole switch, before.
- Always **plug in all of the 4 I/O connectors**, even if not all channels are used.
- **Connect protective earth conductors to all of the 4 I/O connectors.**
- The device contains **anti-interference capacitors**. They may be charged, even if the module is not connected to a voltage source.

When supplying the DDO 02 module with an extra low voltage with protective separation from other circuits, the rules listed above are **not** valid.

4.8.10.3 Load limit curves of DDO 02 for DC supply

Observe the load limit curve shown below when supplying the digital output module DDO 02 with a DC voltage. When applying an AC voltage the contact can be loaded with 5 A, independent of the switching voltage. When switching inductive loads, note that the IL reduction factor has to be considered for AC and DC operation, as described in Section 4.8.10.4.

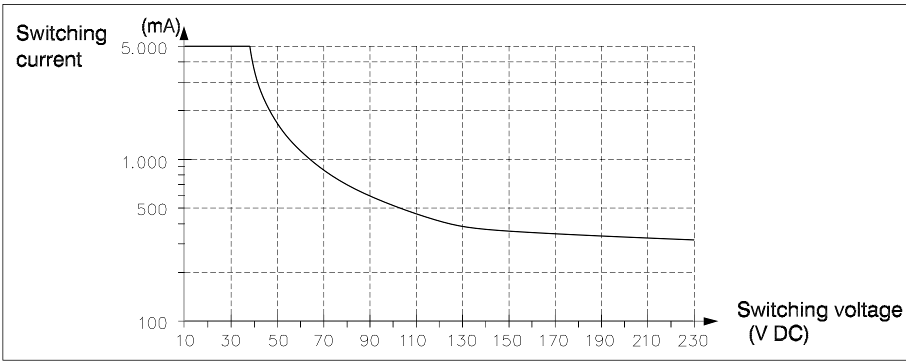


Fig. 4-63 DC voltage load limit curve of DDO 02 for resistive loads

Example

The output of the DDO 02 module is supplied with 60 V DC. Proceed as follows:

1. Read the voltage applied to the output (in this example 60 V DC) from the x axis.
2. Draw a vertical line to the limit curve and then a horizontal line from this point to the y axis.
3. You can read the maximum permissible current of around 1000 mA.
   Additionally consider the reduction factor IL when using inductive loads.

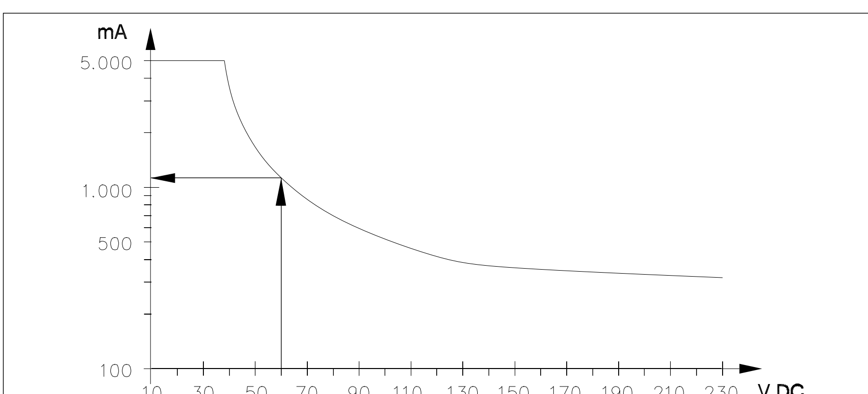


Fig. 4-64 Load limit curve for DC voltage, example

4.8.10.4 DDO 02 reduction factor for inductive loads

A clamping diode or a spark quenching element (spark-quenching capacitor) are needed for inductive loads. Additionally the output current has to be reduced by the IL factor in order to maintain the contact life. This applies to both AC and DC operation.

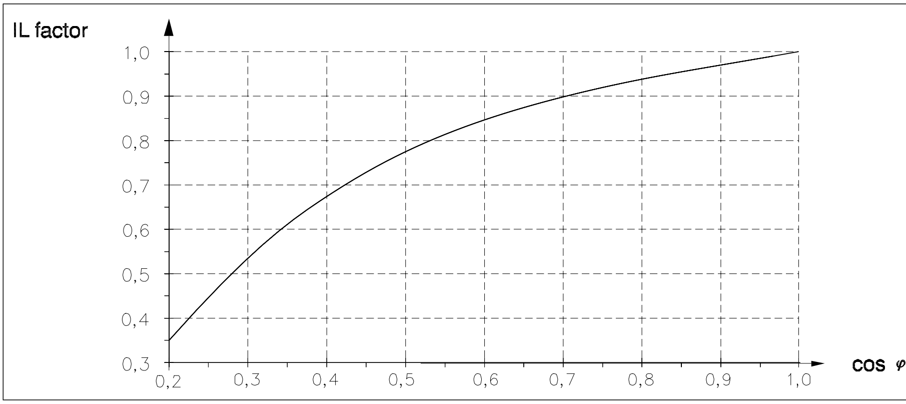


Fig. 4-65 IL reduction factor for inductive loads

Example

An output of the DDO 02 module is operated with an AC voltage and an inductive load with a cos φ of 0.8 is connected to it. Proceed as follows:

1. Read the cos φ generated by the inductive load from the x axis. In this example cos φ = 0.8.
2. Draw a vertical line o the curve and then a horizontal line from this point to the y axis.
3. You can read the reduction factor, here IL = 0.95
   The permissible output current is $I_{inductive} = I_{resistive} \bullet IL$.
   In this example: $I_{inductive} = 5A \bullet 0.95 = 4.75A$

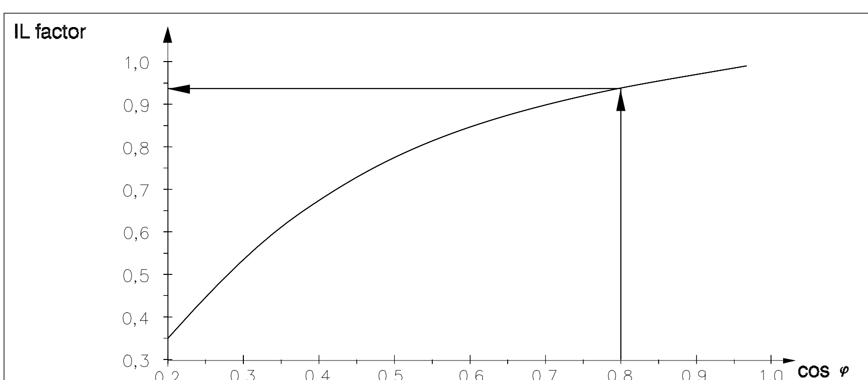


Fig. 4-66 Inductive load, example

4.8.11 Cabling the digital output module DDO 03

The digital output module DDO 03 has 16 relay outputs with channel-wise electrical isolation. The relays are NO (normally open) contacts. The voltage range is 24 ... 60 V AC/DC. The maximum permissible current is 5 A, the minimum current is 100 mA.

DDO 03 reads back its outputs and performs an internal comparison to monitor the relay contacts. If the switching status at the relay output is different from the set point, a system alarm is generated. Moreover, digital output module DDO 03 is capable of recognizing a power failure at the relay contact.

Mind the restrictions for DC operation The information given in Section 4.8.10.3 for the voltage range 24 ... 60 V DC is valid. When using inductive loads additionally refer to Section 4.8.10.4.

4.8.11.1 Terminal assignment of DDO 03

Cable the digital output module DDO 03 as shown in Figure 4-67.

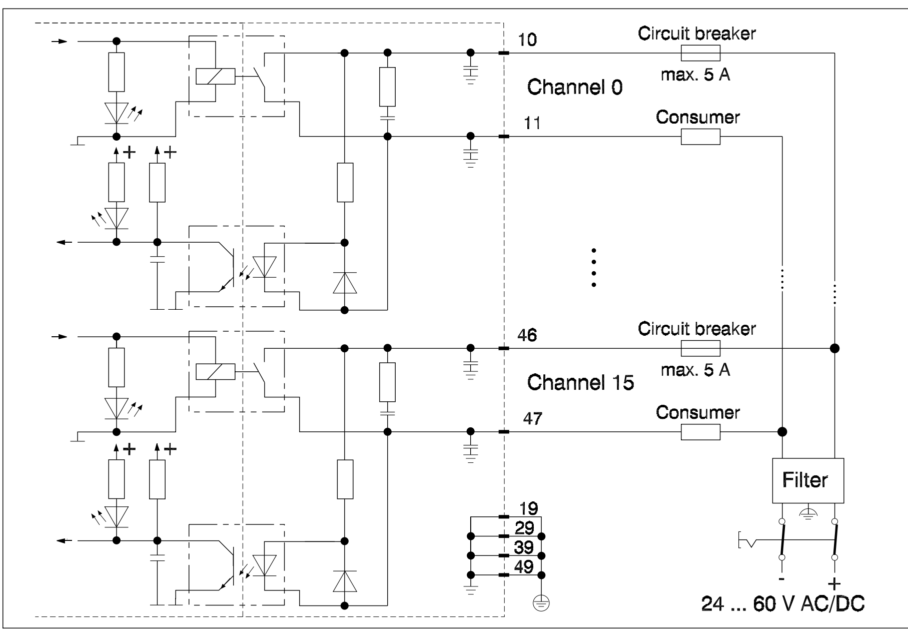


Fig. 4-67 Output circuitry of DDO 03

The digital output module DDO 03 is identical with the DDO 02 module, but has an additional readback function. All specifications made for DDO 02 are also valid for DDO 03, except for the voltage range which is 24 ... 60 V AC/DC for the DDO 03. For voltages of 115 ... 230 V AC the digital output module DDO 04 is available.

Observe the safety instructions given in Section 4.8.10.1.

Note that the permissible voltage range for DDO 03 is 24 ... 60 V AC/DC.

4.8.11.2 Additional information for DDO 03

All specifications made for DDO 02 are also valid for DDO 03.

Exception: The voltage range for DDO 03 is 24 ... 60 V AC/DC. Observe the instructions given in Sections 4.8.10.1 to 4.8.10.4.

4.8.12 Cabling the digital output module DDO 04

The digital output module DDO 04 has 16 relay outputs with channel-wise electrical isolation. The relays are normally open (NO) contacts. The voltage range is 115 ... 230 V AC. Do **not** supply with DC voltage. The maximum permissible current is 5 A, the minimum current is 100 mA.

Digital output module DDO 04 reads back its outputs and performs an internal comparison for monitoring the relay contacts. A system alarm is generated if the relay output switching status is different from the set point. Additionally, the digital output module DDO 04 is capable to recognize a power failure at the switching contact.

For inductive loads additionally refer to Section 4.8.10.4.

4.8.12.1 Terminal assignment of DDO 04

The digital output module DDO 04 is identical with the DDO 02 module, but additionally has a readback function. All specifications made for DDO 02 are valid, except for the voltage range, which is 115 ... 230 V AC for the DDO 04 module. For the voltage range 24 ... 60 V AC/DC the digital output module DDO 03 is available.

Observe the safety instructions given in Sections 4.8.10.1 to 4.8.10.4.

Exception: The permissible voltage range for DDO 04 is 115 ... 230 V AC. Do not supply with DC voltage.

Cable the digital output module DDO 04 as shown in Figure 4-68.

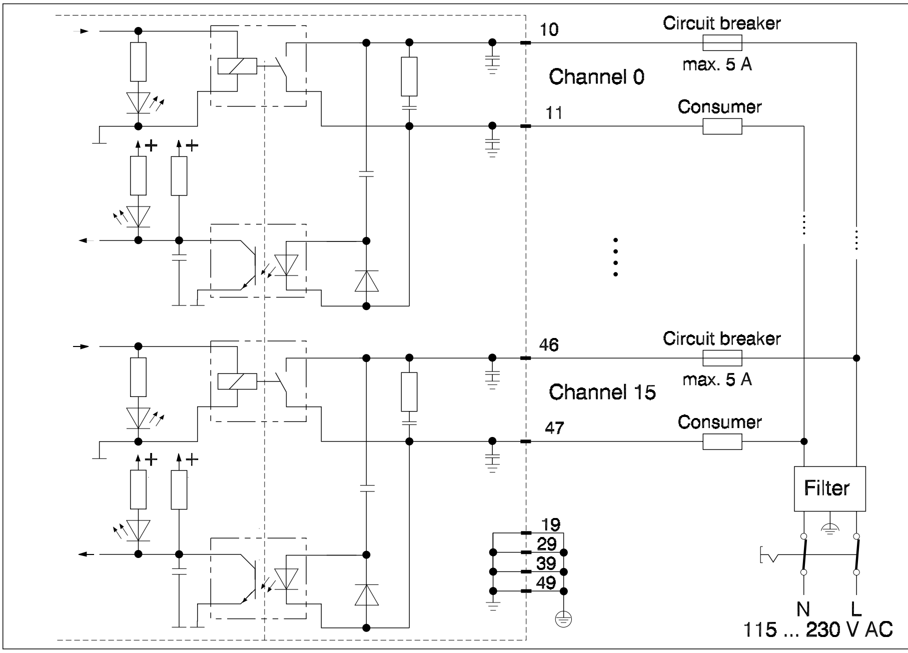


Fig. 4-68 Output circuitry of DDO 04

4.8.13 Cabling the analog input module DAI 01

The analog input module DAI 01 has 16 analog inputs 0/4 ... 20 mA. The inputs are passive and have **no** transmitter supply.

4.8.13.1 Terminal assignment of DAI 01

Cable the analog input module DAI 01 as shown in Figure 4-69. Permissible input signals are 0 ... 20 mA or 4 ... 20 mA (software-configurable). The input load is 50 Ω.

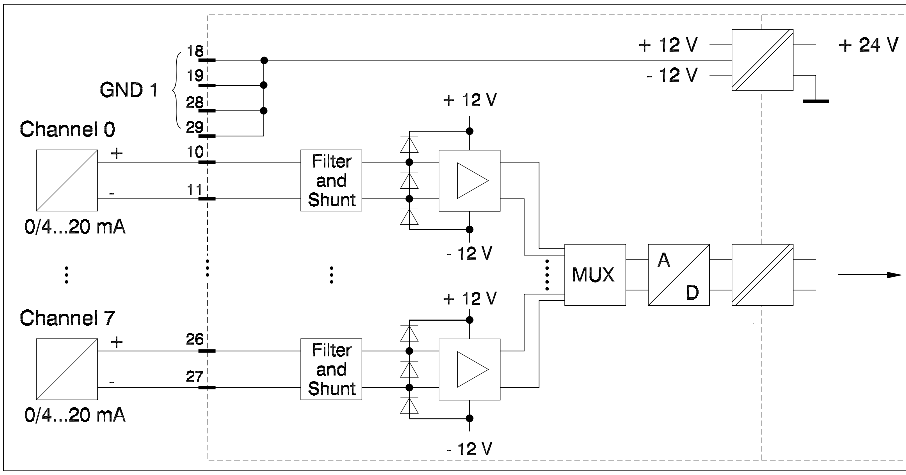
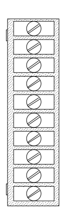


Fig. 4-69 Input circuitry DAI 01

The analog inputs are passive and are not provided with a transmitter supply. If transmitters without an own supply are used, a separate transmitter supply or equivalent is needed. Analog input module DAI 05 with an integrated transmitter supply can be used for 2-wire transmitters.

Figure 4-70 shows the channel assignment of the analog input module DAI 01. For detailed technical data refer to Section 7.6.13.



Connector 1		Connector 2		Connector 3		Connector 4	
Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.
10	0 (+)	20	4 (+)	30	8 (+)	40	12 (+)
11	0 (-)	21	4 (-)	31	8 (-)	41	12 (-)
12	1 (+)	22	5 (+)	32	9 (+)	42	13 (+)
13	1 (-)	23	5 (-)	33	9 (-)	43	13 (-)
14	2 (+)	24	6 (+)	34	10 (+)	44	14 (+)
15	2 (-)	25	6 (-)	35	10 (-)	45	14 (-)
16	3 (+)	26	7 (+)	36	11 (+)	46	15 (+)
17	3 (-)	27	7 (-)	37	11 (-)	47	15 (-)
18	GND 1	28	GND 1	38	GND 2	48	GND 2
19	GND 1	29	GND 1	39	GND 2	49	GND 2

Fig. 4-70 Terminal assignment of DAI 01

4.8.13.2 Electrical isolation of DAI 01

The 16 channels of the analog input module DAI 01 are electrically isolated in 2 groups of 8 channels. Channels 0 ... 7 form one group and channels 8 ... 15 the other. The groups are electrically isolated from each other and from the system by opto-couplers.

The I/O circuits must have a protective separation from circuits with hazardous voltage.

In addition to the electrical isolation in two groups of 8 the analog input module DAI 01 has an electronic channel-wise voltage isolation. Due to the differential input stages the channels of one group can have a voltage offset of ± 3.5 V referred to ground without the channels interfering each other. The electronic voltage isolation permits, for example, to connect inputs in series and to connect recorders into an existing circuit until reaching the maximum permissible offset voltage. A multimeter can be used to check if the permissible offset voltage is observed.

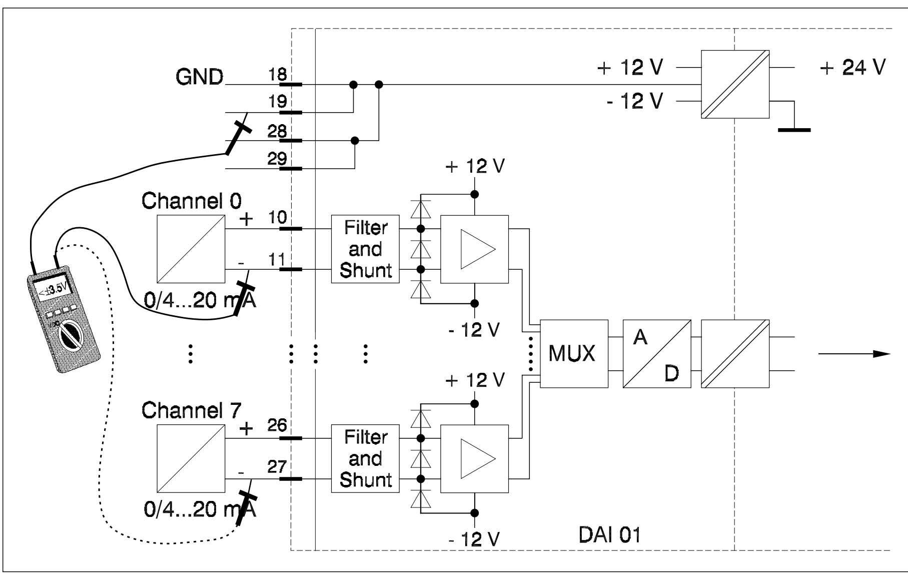


Fig. 4-71 Observing the maximum offset voltage DAI 01

Measure the negative input of a group of 8 towards ground with a voltmeter. The maximum permissible voltage is ± 3.5 V. In case of higher potential differences distribute the respective channels to different groups of 8 or use an isolating amplifier.

4.8.14 Cabling the analog input module DAI 02

The analog input module DAI 02 has sixteen 0 ... 10 V voltage inputs. This module is a variant of the DAI 01 module. Refer to Section 4.8.13 for further information. Note that the input voltage range and the offset voltages are different.

4.8.15 Cabling the analog input module DAI 03

The analog input module DAI 03 has sixteen 0 ... 20 mA or 4 ... 20 mA current inputs (software-configurable). This module has an **increased input resistance** compared to the DAI 01 module. Use DAI 03 with HART transmitters. The increased input resistance ensures **reliable transmission of the HART signals** to the transmitter. In normal cases, i.e. without HART data transmission, analog input module DAI 01 has to be used.

This module is a variant of the DAI 01 module. Refer to Section 4.8.13 for further information. Note that the input resistance of 271 Ω and the offset voltages are different.

There is no re-processing of HART signals in the DAI 03 module.

4.8.16 Cabling the temperature module DAI 04

The temperature module DAI 04 serves for direct temperature data acquisition. The following sensors can be connected:

- RTD Pt100, 2-wire, 3-wire or 4-wire.
- Thermocouple type B, R, S, E, K, J, L, T with external Pt100 reference junction or for connection via isothermal terminal.
- Direct measurement of mV quantities in different measuring ranges up to max. ± 308 mV.
- Resistance teletransmitter of max. 1000 Ω. Connection to other - e.g. 100 Ω, 200 Ω or 500 Ω - sensors is possible. In this case only the sub-range is used.

4.8.16.1 Terminal assignment of DAI 04

A block diagram of DAI 04 is seen in Figure 4-72.

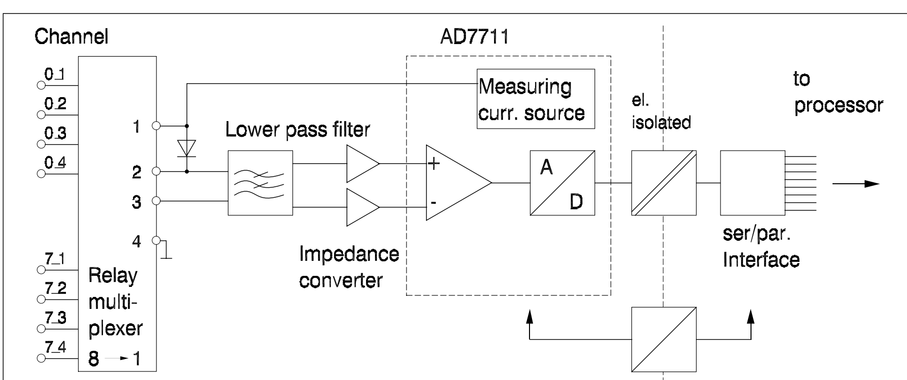
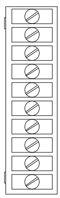


Fig. 4-72 Block diagram DAI 04

The relay has eight inputs. A relay multiplexer connects the eight input channels to a central A/D converter. The A/D converter has a programmable input amplifier and an integrated measuring current source. Fig 4-73 shows the terminal assignment of the analog input module DAI 04. Refer to Section 7.6.14 for details.



Connector 1		Connector 2		Connector 3		Connector 4	
Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.
10	0_1	20	2_1	30	4_1	40	6_1
11	0_2	21	2_2	31	4_2	41	6_2
12	0_3	22	2_3	32	4_3	42	6_3
13	0_4	23	2_4	33	4_4	43	6_4
14	1_1	24	3_1	34	5_1	44	7_1
15	1_2	25	3_2	35	5_2	45	7_2
16	1_3	26	3_3	36	5_3	46	7_3
17	1_4	27	3_4	37	5_4	47	7_4
18	n. c.	28	n. c.	38	n. c.	48	n. c.
19	n. c.	29	n. c.	39	n. c.	49	n. c.

Fig. 4-73 Terminal assignment of DAI 04

Figure 4-74 shows how to connect different sensors to channel 0. Proceed as shown in Figure 4-74. The connection to other channels has to be done analogously.

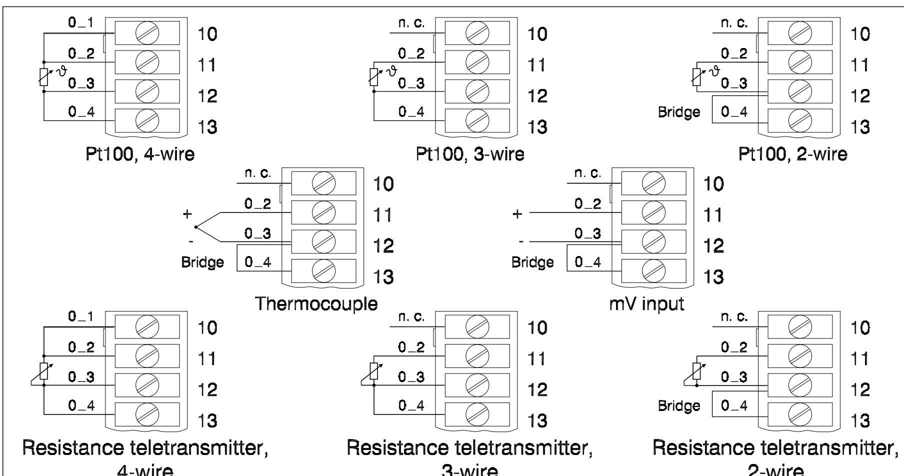


Fig. 4-74 Connecting different sensors

The measured quantity is transmitted to the system in °C, °F or Kelvin (depending on the configuration) in the board function block. In the mV input range the mV values are transmitted directly to the system without linearization. If a resistance teletransmitter is connected, the measured value output is in ohms. Different sensor types can be connected to the channels of the temperature module, as required. It is possible, for example, to connect thermocouples, RTD Pt100's and resistance teletransmitters to one module at the same time.

If, however, sensors of different type, e.g. different thermocouple types, are connected to one module, an internal change-over between the measuring ranges has to be performed. The change-over takes some time.

If the same sensors, e.g. thermocouples of the same type, are connected to all channels, the module can work in an especially quick mode. Therefore, it is recommended to connect the same sensors to all channels if you wish to achieve a rapid measurement. The more different sensor types are used on the same module, the more measurement slows down. Refer to Section 7.6.14, Technical Data.

4.8.16.2 Cold junction compensation at DAI 04

Temperature measurement with thermocouples requires compensation of the terminal temperature. The temperature module offers two possibilities:

- Terminal temperature measurement by an RTD Pt100 via a channel of any temperature module of the process station. Note that the temperature must be homogeneous over the entire thermocouple terminal block. **Temperature differences within the terminal block will have a direct effect on the measuring accuracy!**
- Use of heated or cooled isothermal terminals with a temperature of 0 °C, 20 °C, 50 °C, 60 °C or 70 ° C.
- **Use a copper lead** to connect the thermocouple terminal block or the isothermal terminal with the connection terminal of the DAI 04 module. Do not use an extension lead!

As the terminals are pluggable, internal terminal temperature measurement inside the module is not possible.

Figure 4-75 shows how to measure the terminal temperature for seven thermocouples with a common RTD Pt100.

The RTD Pt100 (preferably a 4-wire device) at channel 7 measures the terminal temperature of channels 0 ... 6. Any channel of a temperature module can be used for terminal temperature measurement. The assignment can be selected as required.

If a big number of thermocouples are used, a common temperature measurement for several temperature modules is also possible.

Terminal temperature measurement can be done via a channel of either the same or another temperature module.

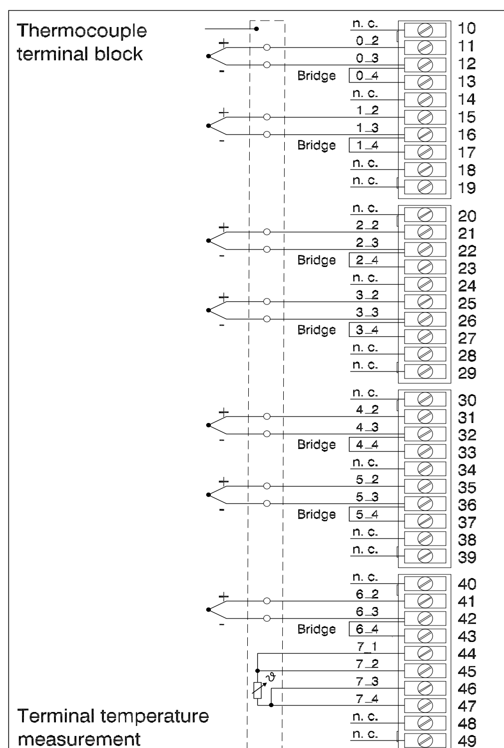


Fig. 4-75 Cold junction compensation at DAI 04

It is also possible to measure the temperature of several terminal blocks with one temperature module. Figure 4-76 shows how to achieve cold junction compensation at two different terminal blocks.

A 4-wire RTD Pt100 at channel 1 measures the terminal temperature of the thermocouples at channels 0, 2 and 3. Another RTD Pt100 (4-wire) at channel 7 measures the terminal temperature of the thermocouples at channels 4 ... 6. The channel assignment is arbitrary. An RTD Pt100 can be assigned to each thermocouple.

If isothermal terminals heated up or cooled down to a special temperature are used, no RTD Pt100 is required. Select the relevant temperature of your terminal from the configuration mask. Terminal temperature compensation is not necessary in that case.

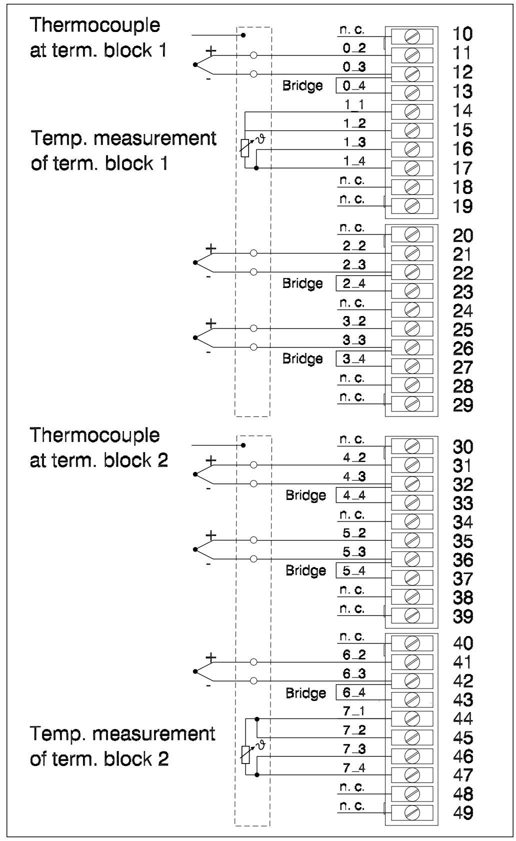


Fig. 4-76 Cold junction compensation, double

4.8.16.3 Electrical isolation of DAI 04

The 8 channels of the temperature module DAI 04 have a channel-wise electrical isolation from each other and from the system. Isolation between channels is done by Reed relays. The control logic ensures that only one channel is triggered at the same time. Isolation from the system is done by opto-couplers.

The I/O circuits must have a protective separation from circuits with hazardous voltage.

4.8.17 Cabling the analog input module DAI 05 with transmitter supply

The DAI 05 module serves for direct connection of 2-wire transmitters with a measuring range of 4 ... 20 mA. The module supplies the transmitter with a 24 V voltage. No external supplies are required. Every channel is current-limited and protected against external supply. The 16 channels are voltage-isolated in two groups of 8 channels (channels 0...7 and 8...15). **One** external 24 V DC supply voltage is needed.

4.8.17.1 Terminal assignment of DAI 05

Fig. 4-77 shows the DAI 05 block diagram. Cable the analog input module DAI 05 as shown in the diagram. With 2-wire transmitters the GND 1 and GND 2 connectors are not used.

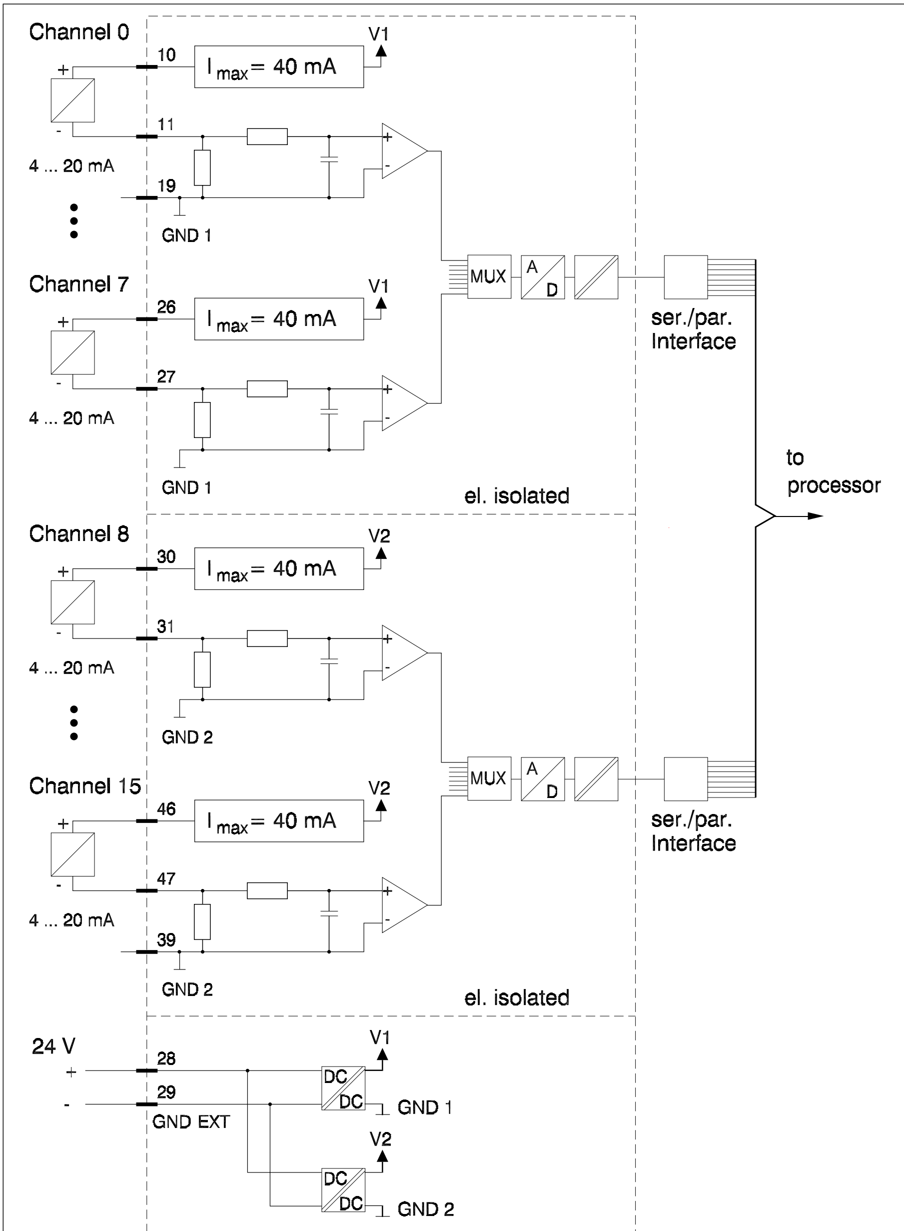


Fig. 4-77 DAI 05 block diagram

Figure 4-78 shows the terminal assignment of DAI 05. The terminal numbers are found on the label at the door inside. The channel assignment is seen on the label at the door outside.

Connector 1		Connector 2		Connector 3		Connector 4	
Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.
10	0 (+)	20	4 (+)	30	8 (+)	40	12 (+)
11	0 (-)	21	4 (-)	31	8 (-)	41	12 (-)
12	1 (+)	22	5 (+)	32	9 (+)	42	13 (+)
13	1 (-)	23	5 (-)	33	9 (-)	43	13 (-)
14	2 (+)	24	6 (+)	34	10 (+)	44	14 (+)
15	2 (-)	25	6 (-)	35	10 (-)	45	14 (-)
16	3 (+)	26	7 (+)	36	11 (+)	46	15 (+)
17	3 (-)	27	7 (-)	37	11 (-)	47	15 (-)
18	n. c.	28	24V	38	n. c.	48	n. c.
19	GND 1	29	GND EXT	39	GND 2	49	n. c.

Fig. 4-78 Terminal assignment of DAI 05

Fig. 4-79 shows how to connect 2-wire transmitters to channels 0, 1, 2, 6 and 7 of a DAI 05 module.

It is also possible to connect some 4-wire transmitters if required. The figure shows how this is done for channels 3, 4, and 5. The negative terminals of the 4-wire transmitters are connected to GND 1 for channels 0 ... 7 or to GND 2 for channels 8 ... 15, respectively. The positive terminals of the 4-wire transmitters are connected to the negative inputs of the channels.

The integrated supply of the DAI 05 module is not active with this wiring of channels 3, 4, and 5.

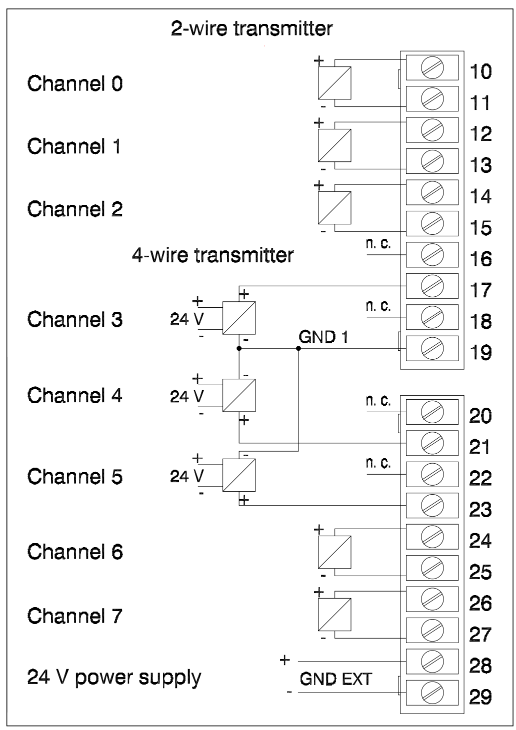


Fig. 4-79 Connecting 2-wire or 4-wire transmitters

When wiring the DAI 05 module observe the following:

- Connect 2-wire transmitters to channel terminals, only (e.g. 0(+) and 0(-)).
- Do not connect 2-wire transmitters to GND 1, GND 2 or GND EXT.
- An external supply voltage (terminals 28 and 29) is always required.
- GND 1, GND 2 and GND EXT are voltage-isolated.

4.8.17.2 Electrical isolation of DAI 05

The 16 channels of the analog input module DAI 05 are electrically isolated in two groups of 8 channels. Channels 0 ... 7 form one group and channels 8 ... 15 the other. The groups are isolated from each other and from the system by opto-couplers. All channels of a group have the same reference potential.

The I/O circuits must have a protective separation from circuits with hazardous voltage.

The external module supply voltage is internally separated by DC/DC converters. As a result, the electrical isolation in groups is preserved although the module is supplied via a central power input.

4.8.17.3 External power supply for DAI 05

The analog input module DAI 05 needs an external power supply for powering the transmitters. The nominal voltage of the external supply is:

24 V DC ± 25%

It is recommended to use regulated power supplies for this purpose.

The power supply used for this purpose must have a protective separation from other circuits.

External power is supplied via terminal 28 (24 V) and terminal 29 (GND EXT) for the two groups of 8. DC/DC converters provide for internal voltage isolation for each group of 8. As a result, several analog input modules DAI 05 can be powered by a common power supply without affecting the voltage isolation of the channel groups.

4.8.18 Cabling the analog output module DAO 01

The analog output module DAO 01 accommodates 16 current outputs 0/4 ... 20 mA. It can handle a maximum load of 400 ohms per channel.

4.8.18.1 Terminal assignment of DAO 01

Cable the analog output module DAO 01 as shown in Figure 4-80.

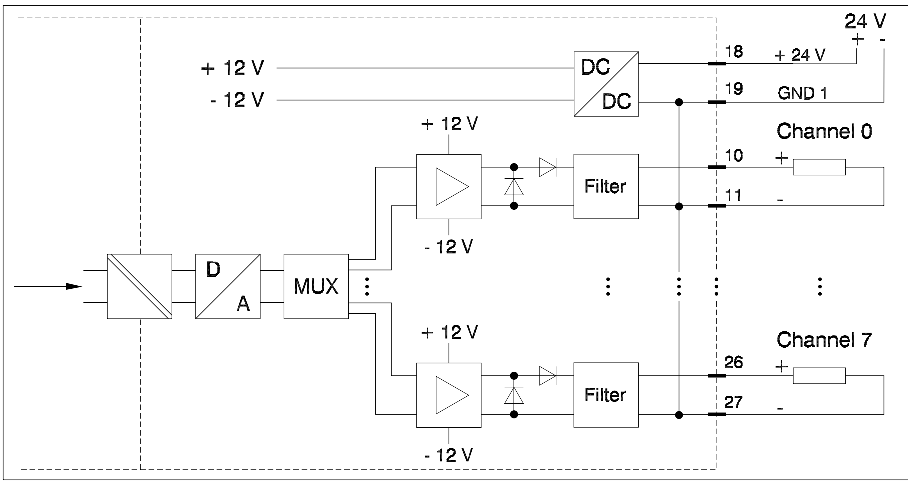
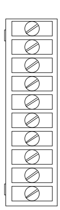


Fig. 4-80 Output circuitry of DAO 01

8 outputs of the same potential are combined to form one group. The two groups formed by channels **0 ... 7** and **8 ... 15** are electrically isolated from each other, and so are the grounds (GND 1 and GND 2) and the respective 24 V connectors.

Figure 4-81 shows the channel assignment of the analog output module DAO 01. Refer to Section 7.6.16 for the technical data of the analog output module.



Connector 1		Connector 2		Connector 3		Connector 4	
Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.	Terminal no.	Channel no.
10	0 (+)	20	4 (+)	30	8 (+)	40	12 (+)
11	0 (-)	21	4 (-)	31	8 (-)	41	12 (-)
12	1 (+)	22	5 (+)	32	9 (+)	42	13 (+)
13	1 (-)	23	5 (-)	33	9 (-)	43	13 (-)
14	2 (+)	24	6 (+)	34	10 (+)	44	14 (+)
15	2 (-)	25	6 (-)	35	10 (-)	45	14 (-)
16	3 (+)	26	7 (+)	36	11 (+)	46	15 (+)
17	3 (-)	27	7 (-)	37	11 (-)	47	15 (-)
18	24 V	28	n. c.	38	24 V	48	n. c.
19	GND 1	29	n. c.	39	GND 2	49	n. c.

Fig. 4-81 Terminal assignment DAO 01

4.8.18.2 Electrical isolation of DAO 01

The 16 channels of the analog output module DAO 01 are arranged in two groups of 8 channels (channels 0 ... 7 and 8 ... 15). The groups are electrically isolated from each other and from the system through opto-couplers. All channels of a group have the same reference potential.

The I/O circuits must have a protective separation from circuits with hazardous voltage.

4.8.18.3 External power supply for DAO 01

The analog output module DAO 01 needs an external power supply for each of the electrically isolated groups, for powering the outputs. The nominal voltage of the external supply is

24 V DC ± 25 %

It is recommended to use regulated power supplies for this purpose. When using unregulated power supplies make sure that the supply voltage is always within in the range of 24 V DC ± 25 %, even in case of mains variations. When using three-phase transformers with bridge rectifiers, the RMS value of the voltage must be within the range of 19.2 ... 28 V.

The power supply used for this purpose must have a protective separation from other circuits.

4.8.19 Cabling the analog output module DAO 02

The analog output module DAO 02 is still under preparation. It will be available by mid 2001.

All information given here is preliminary and only intended to be used for planning. Subject to change!

The analog output module DAO 02 provides 24 current outputs 0/4 ... 20 mA. It can handle a maximum load of 800 ohms per channel. The design is for the most part identical with that of DAO 01.

4.8.19.1 Terminal assignment of DAO 02

At the time when this manual is printed, the terminal assignment of the analog output module DAO 02 has not yet been defined. The assignment will most probably be identical with that of the DAO 01 module. Please contact one of our sales offices for further information.

4.8.19.2 Electrical isolation of DAO 02

The 16 channels of the analog output module DAO 02 are arranged in two groups of 8 channels (channels 0 ... 7 and 8 ... 15). The groups are electrically isolated from each other and from the system through opto-couplers. All channels of a group have the same reference potential.

The I/O circuits must have a protective separation from circuits with hazardous voltage.

4.8.19.3 External power supply for DAO 02

The analog output module DAO 02 needs an external power supply for powering the outputs, one for each of the electrically isolated groups. The nominal voltage of the external supply is

24 V DC ± 25 %

It is recommended to use regulated power supplies for this purpose. When using unregulated power supplies make sure that the supply voltage is always within in the range of 24 V DC ± 25 %, even in case of mains variations. When using three-phase transformers with bridge rectifiers, the RMS value of the voltage must be within the range of 19.2 ... 28 V.

The power supply used for this purpose must have a protective separation from other circuits.

4.8.20 Cabling the frequency input module DFI 01

The frequency input module DFI 01 serves for acquiring and pre-processing frequencies and impulses. It provides four channels with counter inputs, digital control inputs, and digital outputs. NAMUR sensors, 24 V contacts, 8 V contacts, and 24 V proximity switches can be connected to the inputs.

The channels can be used as dosing circuits or for event counting, frequency measurement, period measurement, and pulse width measurement.

The channels have a channel-wise electrical isolation from each other. For each channel the module is provided with one counter input, two digital control inputs, and two digital control outputs. The outputs require external power supply. The counter input, the control inputs and the control outputs of each channel are electrically isolated from each other, too.

4.8.20.1 Terminal assignment of DFI 01

Cable the four channels of the frequency input module as shown in Figure 4-82 for the first channel.

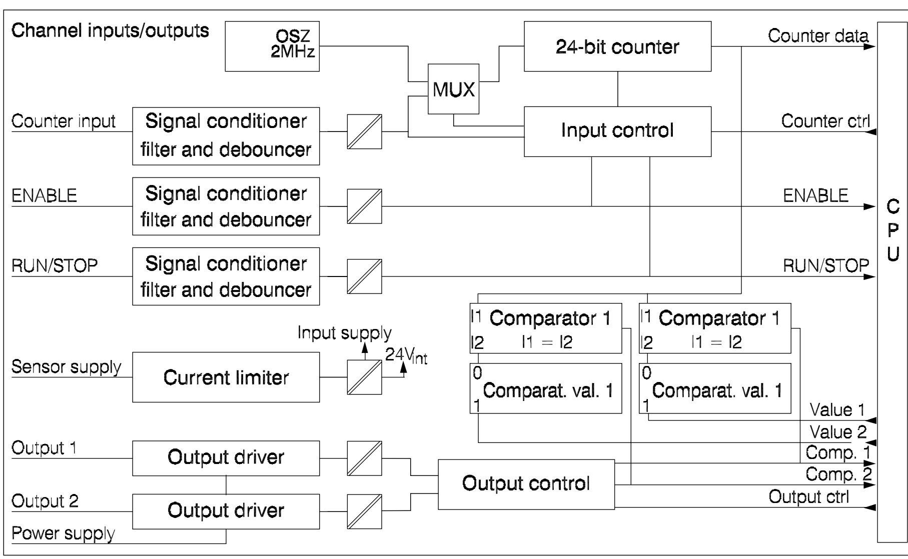


Fig. 4-82 Block diagram of DFI 01

Refer to Section 4-83 for the channel and terminal assignment.

Terminal no.	Channel 0	Terminal no.	Channel 1	Terminal no.	Channel 2	Terminal no.	Channel 3
10	IN Supply	25	IN Supply	40	IN Supply	55	IN Supply
11	IN Input	26	IN Input	41	IN Input	56	IN Input
12	IN GND	27	IN GND	42	IN GND	57	IN GND
13	EN Supply	28	EN Supply	43	EN Supply	58	EN Supply
14	EN Input	29	EN Input	44	EN Input	59	EN Input
15	EN GND	30	EN GND	45	EN GND	60	EN GND
16	RS Supply	31	RS Supply	46	RS Supply	61	RS Supply
17	RS Input	32	RS Input	47	RS Input	62	RS Input
18	RS GND	33	RS GND	48	RS GND	63	RS GND
19	O1 Output	34	O1 Output	49	O1 Output	64	O1 Output
20	O1 GND	35	O1 GND	50	O1 GND	65	O1 GND
21	O2 Output	36	O2 Output	51	O2 Output	66	O2 Output
22	O2 GND	37	O2 GND	52	O2 GND	22	O2 GND
23	24 V	38	24 V	53	24 V	67	24 V
24	GND	39	GND	54	GND	68	GND
Connector 1		Connector 2		Connector 3		Connector 4	

Fig. 4-83 Terminal assignment of DFI 01

Figure 4-84 shows a channel configuration as an example.

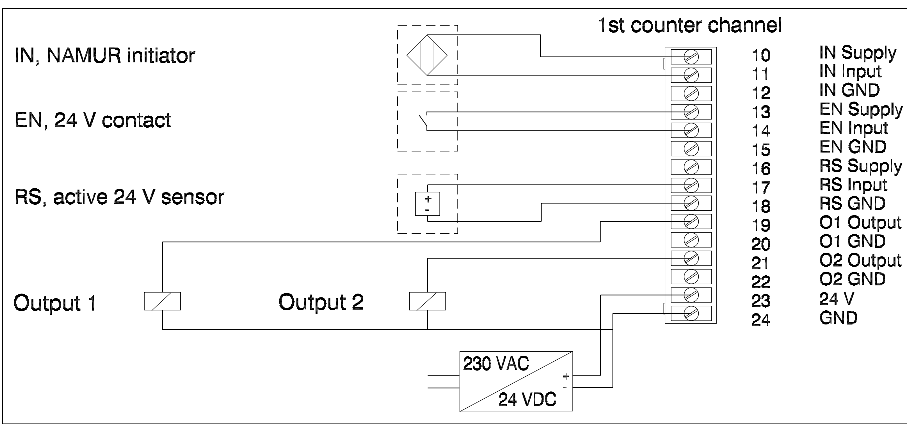


Fig. 4-84 Channel configuration example of DFI 01

4.8.20.2 Counter function of DFI 01

A positive edge at the control input (ENABLE) starts the counter, a negative edge stops the counter, saves the measured value and resets the count.

A second control input (RUN/STOP) can be used for stopping the counter. A positive edge stops the counter, a negative edge restarts it (without deleting the count).

In the dosing circuit mode a positive edge disables the outputs, a negative edge sets them to the configured values according to the current count (counter is not stopped).

The count is increased by positive edges at the counter input (counter input = INPUT). The starting value of the counter (PRESET VALUE) is configurable. A counter overflow (i.e. counter > 2^{24}-1) is detected.

Two comparative values (LIMIT_LOW and LIMIT_HIGH) can be loaded, which are permanently compared with the current count. A digital output (OUT1, OUT2) is assigned to each comparator. The output status of the comparator can be scanned by software and can be used for generating an alarm. The output and/or alarm remain active as long as counter value ≥ comparative value. The outputs can be switched off by the software, so that the result of comparison can be processed by the software exclusively.

The ENABLE and RUN/STOP functions can also be controlled by software. The control inputs and the digital outputs can be enabled or disabled by software.

4.8.20.3 DFI 01 operating modes

Dosing circuit (functional example)

The function of the dosing circuit is illustrated with the functional example shown in Fig. 4-85. In this functional example it is assumed that outputs 1 and 2 were interactively configured through the DigiTool configuration software before.

The counter is started by setting the ENABLE control input. At the same time the outputs are set to the active status (the active level can be defined via DigiTool, too). Incoming counter impulses (IN) increase the count.

When the count reaches the comparative value of the first comparator, the latter sets output 1 to the inactive status. When the count reaches the comparative value of the second comparator, it switches output 2 to the inactive status as well.

If the ENABLE control input becomes inactive, the count is saved as a measured value, and the counter is reset to the initial value. The RUN/STOP control input can be used for stopping the dosing function, i.e. for resetting the outputs to the initial value (inactive). Note that the counter is not stopped. After a reset of RUN/STOP the outputs assume the current counter statuses.

The count and the measured value are cyclically reported to the operator level. The count represents the instantaneous value and the measured value corresponds to the count of the previous measuring cycle. A counter overflow and malfunctions (frame errors), i.e. incorrect time behavior of the control inputs, can be activated as alarm functions.

All functions and control properties are set through DigiTool.

Event counting (functional example)

This functional example and Fig. 4-85 illustrate the event counting function. It is assumed that outputs 1 and 2 were set to the inactive state through DigiTool, before. If the ENABLE control input becomes active, the counter is started. The outputs remain inactive in the beginning. Impulses at the IN counter input increase the count.

When the count reaches the comparative value of the first comparator, output 1 is set to the active state. When the count reaches the comparative value of the second comparator (greater than the value of the first comparator), output 1 is set to the inactive state again and output 2 is set to the active state instead. If the ENABLE control input becomes inactive, the current count is saved as a measured value and reported to the operator level. The counter is then reset to the initial value, and outputs 1 and 2 become inactive again. The event counting function is then ready for the next sequence, which is started when the ENABLE control input becomes active again.

The RUN/STOP control input can be used for stopping the counter without changing the control outputs.

The count and the measured value are cyclically reported to the operator level. The count represents the instantaneous value and the measured value corresponds to the count of the previous measuring cycle. A counter overflow and malfunctions (frame errors), i.e. incorrect time behavior of the control inputs, can be activated as alarm functions.

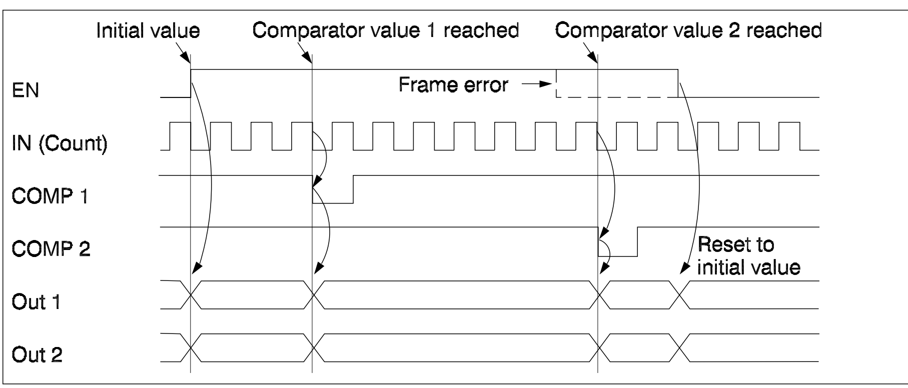


Fig. 4-85 Event counting of dosing circuit

Frequency, time period and pulse width measurement

This functional example and Fig. 4-86 illustrate the frequency measurement function of the DFI 01 module. In this case the ENABLE control input functions as a gate controller. While the gate is active, the signal curve over the time is measured at the counter input. Measurement is done

- between two subsequent positive edges of the input signal (in operating modes frequency measurement and time period measurement).
- between subsequent positive and negative edges of the input signal (in operating mode pulse width measurement).

During this measurement the counter counts the impulses from the internal time base (2 MHz corresponding to 500 ns).

The result is reported to the operator level, together with the configured communication cycle time. A high and a low limit can be configured for frequency time monitoring. When the limits are exceeded or fallen below, an alarm can be reported to the operator level and/or a control output can be set.

The count and the measured value are cyclically reported to the operator level. The count represents the instantaneous value and the measured value corresponds to the count of the previous measuring cycle. A counter overflow and malfunctions (frame errors), i.e. incorrect time behavior of the control inputs, can be activated as alarm functions.

All functions and control properties are set through DigiTool.

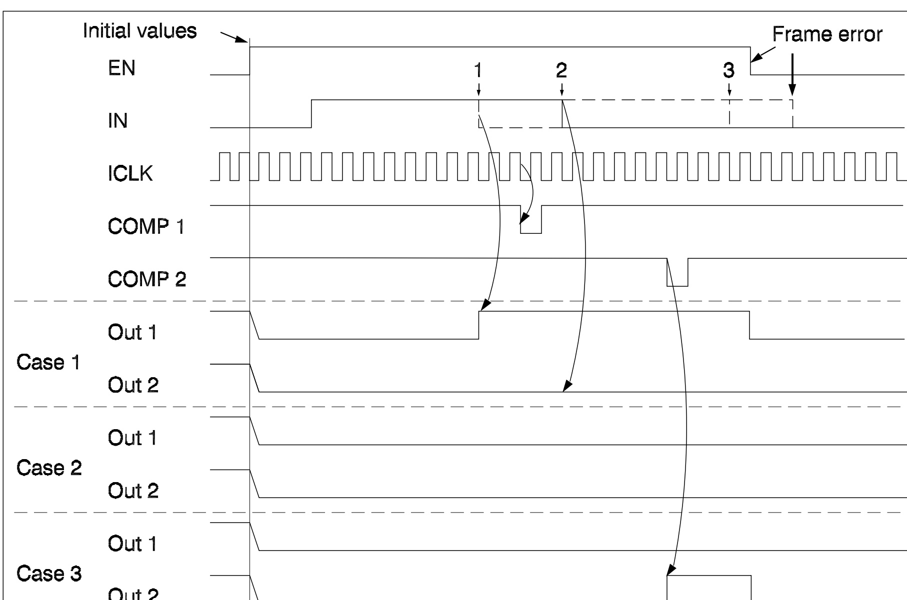


Fig. 4-86 Frequency measurement of DFI 01

In this example the values in case 2 are all right when setting the outputs, whereas in case 1 and case 3 the limits are exceeded or fallen below.

Input signal conditioning

Signal matching for the NAMUR initiators and 24 V inputs or contacts is made for every input (i.e. counter input, ENABLE control input, RUN/STOP control input). The control inputs have a common ground potential. The counter input is electrically isolated.

Sensor supply of inputs

A sensor supply is available for every input. It is current-limited and protected against external supply. The supply is designed as a current source which delivers a constant output voltage with low current and attenuates the voltage when the max. permissible current (around 15 mA) is reached.

The sensor supply can be set to 8 V or 24 V or switched off. When the module is switched on, the sensor supply of each channel is switched off.

Filter and debouncer

A configurable debouncer is provided in the signal branch. A low pass filter is inserted into the signal path for this purpose. The debouncing/filter time of 10 µs is always available. Additionally, debouncing times of 10 ms and 50 ms can be selected by software.

Outputs

Two digital outputs are available for each channel. They are linked with the counter logic and are enabled and set by the module CPU. Additionally, the output polarity is configurable.

The two outputs are externally supplied with 24 V DC and, thus, have a common potential. The outputs are realized as solid state switches. They are short-circuit and overtemperature proof and capable of delivering 500 mA.

4.8.20.4 Electrical isolation of DFI 01

The four channels of frequency input module DFI 01 are electrically isolated from each other and from the system. Within one channel the control inputs have a common potential, but are isolated from the counter input and from the outputs. The outputs have the same potential. Thus, each channel has three circuits which are electrically isolated from each other: the counter input circuit, the control input circuit, and the control output circuit.

The channels are electrically isolated from each other and from the processor by opto-couplers. The switching signals for selection of the sensor, sensor supply and filter are also conducted via opto-couplers. Thus, the frequency input module has a total of 12 I/O circuits which are electrically isolated from each other.

⚠ **The I/O circuits must have a protective separation from circuits with hazardous voltage**.

4.8.20.5 External power supply for DFI 01

The control outputs of the frequency input module DFI 01 require an external power supply for each of the electrically isolated groups. The nominal voltage of the external power supply is

24 V DC ± 25%

It is recommended to use regulated power supplies.

⚠ **The used power supply must have a protective separation from other circuits.**

4.9 Cabling the communication module DCO 01

The communication module DCO 01 has 5 serial interfaces for connecting subsystems via an RS232C, an RS422 or an RS485 interface, as required. The Ser 1 interface is reserved for internal tasks like firmware updates. At present, the communication module supports the Modbus protocol on the interfaces Ser 2 ... Ser 5. The Ser 2 and Ser 3 interfaces are primarily designed for higher transmission rates, whereas Ser 4 and Ser 5 should only be used for lower transmission rates.

Due to the performance limits of the CPU module it is recommended not to load all four Modbus interfaces with their max. possible transmission rate. A total transmission rate of max. 38.4 Kbauds for all channels used should not be exceeded.

The possible number of communication modules per process station is not limited by the hardware. However, a logical limit should be observed, which results from the memory requirements of the individual communication interfaces. It is recommended not to use more than seven communication channels.

Additionally, the module is provided with an RS232C diagnostic interface which is not electrically isolated.

4.9.1 Connection via serial interfaces

There are 5 serial interfaces, Ser 1 ... Ser 5. They can be configured as an RS232C, RS422 or RS485 interfaces, as required. The signal levels of all three interfaces are applied to the 15-pin connectors Ser 1 ... Ser 5 at the same time. The interface type is selected by using the appropriate cable, which only connects the signal wires needed. No jumper setting is required. All five interfaces are electrically isolated from each other and from the system. Each of the five interfaces can be used with any of the three interface types. Although all interfaces Ser 1 ... Ser 5 are identical, software protocols are available only for **Ser 2 ... Ser 5** interfaces.

Refer to Section 13.6.1 for the pin assignment of the communication module interfaces.

4.9.1.1 Connection via RS232C interface

The RS232C interface provides for a point-to-point connection. One node can be connected to each communication module interface. Use the RS232C cable DSU 212 to cable the appropriate Ser 1 ... Ser 5 interface. The signals mentioned above are available at the cable on single wires provided with wire end sleeves.

TxD	Transmit data	(Output)	Pin 3
RxD	Receive data	(Input)	Pin 2
GND	Ground		Pin 5
RTS	Request to send	(Output)	Pin 4
CTS	Clear to send	(Input)	Pin 6

Fig. 4-87 shows how to cable the communication module DCO 01. Connect the signal wires with the device to be linked with the module. The max. cable length is 15 m.

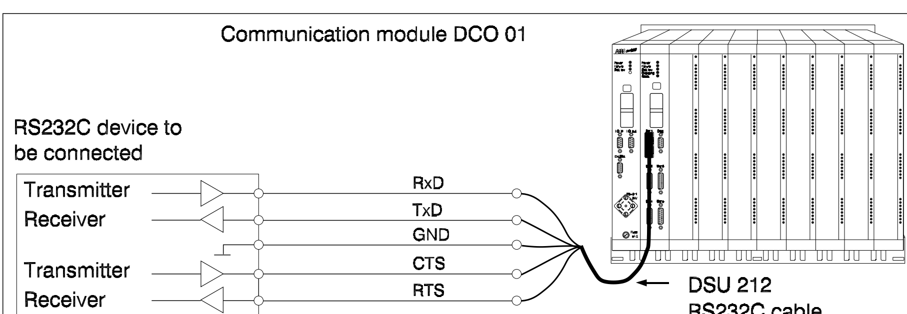


Fig. 4-87 Cabling DCO 01 via RS232C interface

Refer to Section 13.6.1 for the terminal assignment of the interface and of the connection cable.

4.9.1.2 Connection via RS422 interface

The RS422 interface provides for a point-to-point connection. One node can be connected to each communication module interface.

Tx+:	Transmit data	(Output)	Pin 11
Tx-:	Transmit data	(Output)	Pin 12
Rx+:	Receive data	(Input)	Pin 7
Rx-:	Receive data	(Input)	Pin 8
GND:	Ground		Pin 5

With RS422-type transmission the transmit data are differentially transmitted by a wire pair. A second wire pair transfers the receive data. Thus, the communication module can transmit and receive data at the same time (full duplex mode). Cable the appropriate Ser 1 ... Ser 5 interface using the RS422 cable DSU 213. The signals mentioned above are available at the cable on single wires provided with wire end sleeves. The GND connectors are not needed for field cabling.

They are only used for measuring purposes during commissioning, as shown in Fig. 4-71. Note that the offset voltage between GND and the signal lines is lower than ± 7 V. The maximum permissible cable length is 1200 m. The cable DSU 213 is deliverable with a maximum length of 1000 m (cable reel). Cable lengths of 1000 ... 1200 m are available on request.

Fig. 4-88 shows how to cable the communication module DCO 01 via the RS422 interface. Connect the appropriate signal wires to the device to be linked with the communication module.

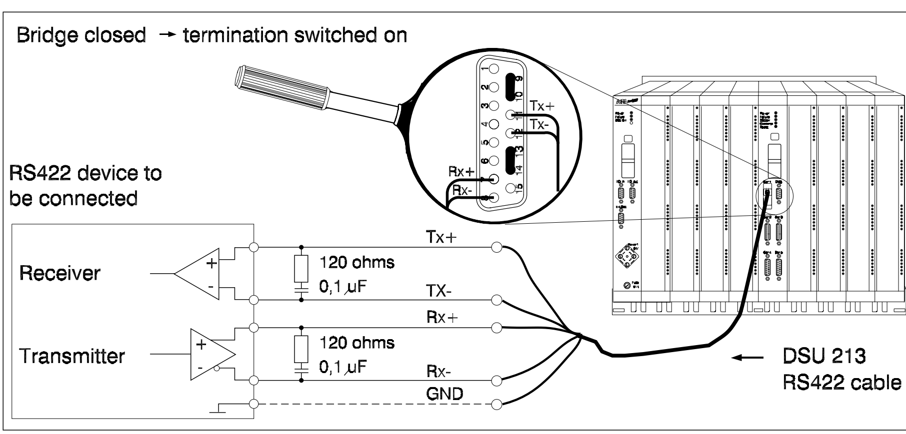


Fig. 4-88 Cabling DCO 01 via RS422 interface, case 1

Terminate the two signal wire pairs at the device to be linked with the module. A termination is made up of a 120 Ω resistor and a 0.1 µF capacitor connected in series. The terminations are already integrated in the communication module and switched on. They can be switched off by opening the cable bridges in the connector plug. However, this is only necessary if the connected devices require another termination. Normally, you can proceed as shown in Fig. 4-89.

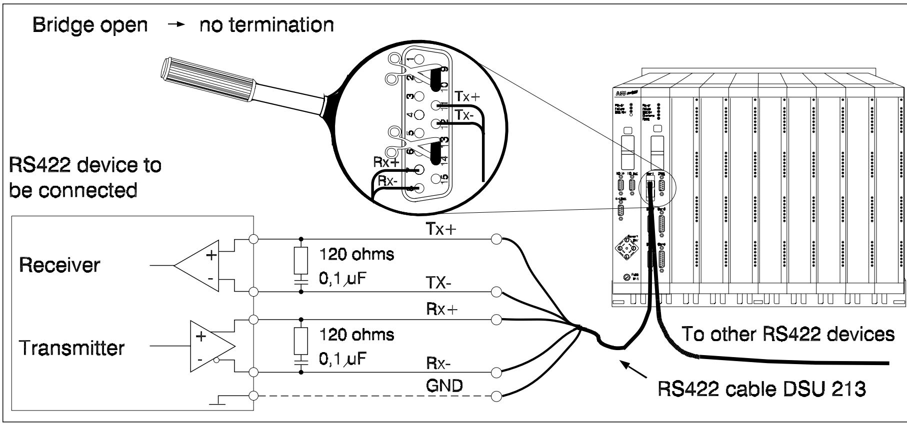


Fig. 4-89 Cabling DCO 01 via RS422 interface, case 2

A description of the interface and connector cable terminal assignment and of the respective bridges is given in Section 13.6.1.

4.9.1.3 Connection via RS485 interface

The RS232C and RS422 interfaces described above only offer the possibility of a point-to-point connection, i.e. only one node can be connected to each interface. The RS485 interface enables bus operation. Up to 32 interfaces can be connected in parallel to the interface, i.e. the DCO 01 plus another 31 nodes.

RxTx+:	Combined transmit/receive data (Input/output)	Pin 7
RxTx-:	Combined transmit/receive data (Input/output)	Pin 8
GND:	Ground	Pin 5

With RS485 transmission transmit and receive data are differentially transmitted in time-multiplex mode by a wire pair. This means that data can be either transmitted or received (half duplex mode). Cable the appropriate Ser 1 ... Ser 5 interface using the RS485 cable DSU 211. The signals mentioned above are available at the cable on single wires provided with wire end sleeves

The GND connectors are not needed for field cabling. They are only used for measuring purposes during commissioning, as shown in Fig. 4-71. Note that the offset voltage between GND and the signal lines is lower than ± 7 V. The maximum permissible cable length is 1200 m. The cable DSU 211 is deliverable with a maximum length of 1000 m (cable reel). Cable lengths of 1000 ... 1200 m are available on request.

Note that the RS485 cable DSU 13 is designed for connecting the CPU module, only. Do **not** use this cable for the communication module DCO 01.

Terminate the bus cable ends using a 120 Ω resistor and a 0.1 µF capacitor connected in series. This termination is already integrated in the communication module. It can be switched on and off by a cable bridge in the connector plug of the RS485 cable DSU 211. The following cases have to be distinguished:

1. **Communication module located at the end of the bus cable**

   The **bridge between pin 9** and **pin 10** of the connector **activates the termination** in the communication module. The DSU 211 cable remains unchanged.

   Cable the communication module and the other bus nodes as shown in Fig. 4-90. Use a shielded twisted pair cable - e.g. LiFYCY or LiYCY(TP) - for the bus. The wires must have at a minimum cross-sectional area of 0.25 mm². The cable shield is connected to the housing potential of the process station via the RS485 cable connector shell.

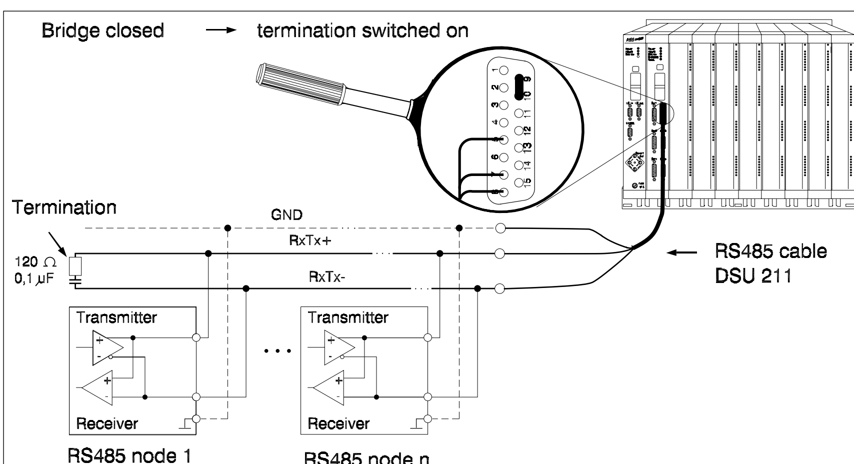


Fig. 4-90 Cabling DCO 01 via RS485 interface, case 1

2. Communication module is not located at the cable end

The communication module has to be cabled with the other RS485 nodes as shown in Fig. 4-91. The stub cables to the nodes and the RS485 cable DSU 211 must be as short as possible in this case.

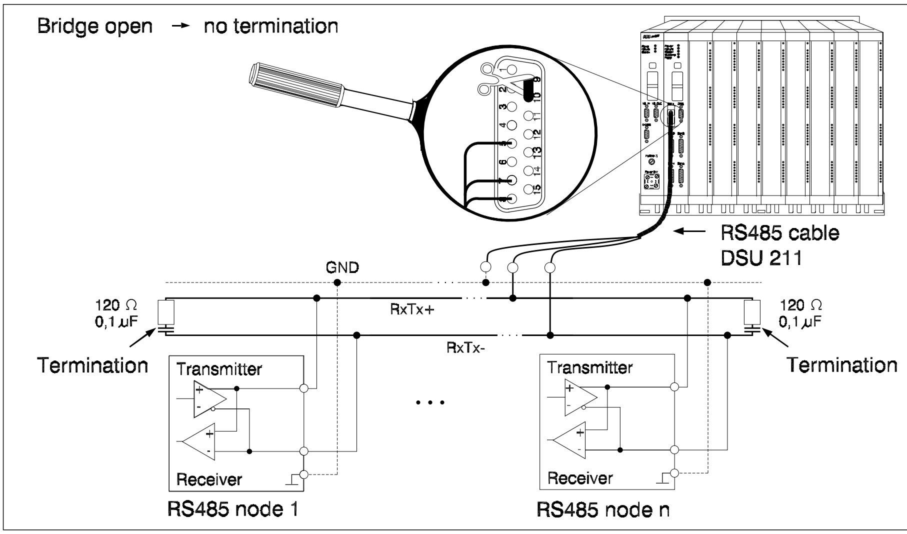


Fig. 4-91 Cabling DCO 01 with RS485 interface, case 2

Terminate the bus cable at both ends. The termination consists of a 120 Ω resistor and a 0.1 µF capacitor connected in series. Use a bus cable as described in the previous section.

In this case the termination integrated in the communication module must be switched off. Proceed as described below:

- Open the connector hood of the RS485 cable DSU 211.
- **Remove** the **bridge** between **pin 9 and pin 10**. Insulate or cut off the cable ends.
- Close the connector hood.

The termination integrated in the communication module is switched off due to the bridge removed from the connector. Section 13.6.1 describes the interface and connection cable terminal assignment and the bridges.

4.9.2 Connection via RS232C interface for diagnosis

The diagnostic interface is reserved for diagnosis and commissioning. For normal operation it is not necessary to connect a diagnostic PC. When connecting a diagnostic PC proceed as described in Section 4.5.4. The information given there is analogously valid for the communication module.

4.9.3 Mounting the battery

The battery serves for buffering the RAM data of the communication module. The information about data buffering given in Section 4.2.3 is analogously valid for the communication module. Proceed as described in this section. If no battery is installed in the communication module, data buffering is done by the external battery or by the battery in the link module.

It is recommended to install a battery in the communication module. Buffer battery DSU 08 is not included in the delivery scope of the communication module and has to be ordered separately.

4.9.4 Caps for unused connectors

In factory, all connectors are protected with caps. Leave these caps on all unused connectors. The caps can also be ordered separately under the following code designations:

DSU 80	for diagnostic connector
DSU 82	for Ser 1 ... Ser 5 connectors

Cover unused connectors with caps to avoid static discharge.

5 Installing the DigiNet S and DigiNet Sr System Buses

The same designations are used for the Ethernet components of both the compact control system Freelance 2000 and the operator system Symphony, to enable a common engineering basis. DigiNet S is the name of the system bus for communication between the operator station and the process stations of the Freelance 2000 compact control system. DigiNet Sr is the system bus for communication in redundant mode.

All installation instructions given in the following text for the DigiNet S are analogously valid for the DigiNet Sr

5.1 Overview

The system bus of the Freelance 2000 System is based upon the widespread Ethernet standard. Ethernet stands for LANs to DIN ISO 8802, Part 3 (corresponding to ISO 8802-3 and ANSI/IEEE STD 802.3). The original Ethernet specification is slightly different from the IEEE standard 802.3 valid today. However, this difference has no technical impact.

The following transmission media are available:

10Base2	**Thin coaxial cable**
10Base5	**Thick coaxial cable**
10BaseFL	**Fiber optic cable**

The standard 10Base2 is based upon a **thin coaxial cable**. Applications are short distance networks with few nodes connected via 10Base2 F-connectors.

A network in accordance with standard 10Base5 is based on a **thick coaxial cable**. The nodes are connected via external transceivers. AUI cables link the nodes with the transceivers. 10Base5 networks are used for medium-size installations located in one building.

The transmission standard 10BaseFL is based on **fiber optic cables** and provides good EMI/RFI shielding and protective separation of the nodes. An active network concentrator is needed for operation.

The following sections describe the transmission standards used and the respective technical data.

5.1.1 10Base2 (Thin Coax)

Topology	bus topology, branches with transceivers and AUI cable
Transmission medium	coaxial cable 50 Ω, two 50 Ω terminating resistors
Transmission	Base band, data rate 10 MBit/s
Maximum segment length	185 m
Maximum number of nodes per segment	30
Maximum number of nodes per network	1024
Minimum spacing between two nodes	0.5 m
Connection of nodes	via 10Base2 F-connectors
Coupling of segments via repeaters	possible, see Section 5.7

Applications

- Networks within one building
- Small installations
- Networks with few nodes
- Installations with low EMI and low potential differences
- Installations powered by the same low-voltage source

5.1.2 10Base5 (Full Ethernet)

Topology	bus topology; branches (AUI cables) possible.
Transmission medium	coaxial cable 50 Ω (Yellow Cable) two 50 Ω terminating resistors
Transmission	Base band, data rate 10 MBit/s
Maximum segment length	500 m
Maximum number of nodes per segment	100
Maximum number of nodes per network	1024
Minimum spacing between two nodes	2.5 m
Connection of nodes	via transceivers; AUI branches with a max. length of 50 m are possible.
Coupling of segments via repeaters	possible, see Section 5.7.

Applications:

- Networks within one building
- Medium-size installations
- Networks with a medium or high number of nodes
- Installations with low or medium EMI

5.1.3 10BaseFL

Contrary to 10Base2 and 10Base5 this standard has no bus structure, but a star architecture. Fiber optic cables are the transmission medium used here. The maximum length of a fiber optic cable link is 4 km. Transmission is done in the base band with a data rate of 10 MBit/s.

Topology	star topology with active network concentrator (star coupler)
Transmission medium	gradient fiber with fiber diameter of 50/125 µm (core/fiber)
Reachable distance / fiber optic cable type	up to 4000 m with FO cable type 50/125 up to 20 km with mono mode fiber optic cable (bridge required) observe max. deliverable length, splicing may be necessary
Maximum number of nodes	depends on network concentrator and interface boards
Minimum spacing between network concentrator and node	minimum ready-made cable length: 1 m
Connection of nodes	via optical transceiver at the AUI interface
Max number of network concentrators per network	15 (50 with special re-timing modules)
Coupling with 10Base2 or 10Base5 segments	possible with special network concentrator modules, see Section 5.6

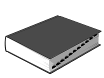
Applications:

- Networks within one building or between buildings
- Installations with high EMI
- Network cables close to power cables
- Areas with high potential differences
- Large installations
- Installations where a protective separation by the network is required
- Cables in narrow cable ducts (fiber optic cables are relatively thin)
- Installations with redundant cabling

The appropriate network concentrator modules also provide adapters to other transmission media e.g. 10BaseT (4-wire twisted pair cable), 10Base5 or 10Base2.

Larger networks can be achieved by coupling several segments via repeaters. However, the maximum possible number of repeaters is limited, see Sections 5.6 and 5.7.

For details on the Ethernet refer to:



- DIN ISO 8802, Part 3 corresponding to ISO 8802-3 and ANSI/**IEEE 802.3,** Beuth-Verlag Berlin. Mainly describes the bus access and is not useful as an introduction.

5.2 Designing the network

5.2.1 General information

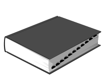
When designing the Ethernet network of an automation system you should consider that this has an impact on the infrastructure of the building. Therefore, possible future requirements should be taken into account, e.g.:

- Connection to a corporate management level or a supervisory archiving computer at a later time
- Network expansions
- When connecting several segments you should note that the maximum possible number of repeaters is limited. The repeaters and the network concentrators require an own power supply (230 V AC, 115 V AC, or 24 V DC), see Section 5.7.
- Use a 10Base5 or 10BaseFL segment instead of several 10Base2 segments with repeaters.
- When expanding an existing network you should consider a change to fiber optic cables.

As a rule, fiber optic cables should be used wherever this is possible. Besides a high transmission reliability these cables provide an excellent EMC. With supplementary diagnostic boards in the network concentrators it is possible to make checks while the system is running and to switch off defective nodes if required. Additionally, redundant fiber optic links can be laid between network concentrators. For details refer to Section 5.5.5.

If you don't have any experience in designing and installing LANs please contact an expert.

For details on the network design refer to



- ABB: Technical Bulletins ,. 30/72-6211-EN.

5.2.2 Acceptance measurement

An acceptance measurement should always be performed after installation of the DigiNet S. The results should be noted down in an acceptance record. Normally, a time-domain reflectometer (TDR) is used for measuring 10Base2 and 10Base5 cables. Fiber optic cables can be measured with an optical time-domain reflectometer (OTDR). The following errors can be detected with TDR or OTDR measurements:

- Max. permissible cable length exceeded
- Damaged cable
- Sharp cable kinks
- 10Base2 T-connector with improper characteristic impedance
- Improperly connected transceiver (short-circuit)
- Cable segments with improper characteristic impedance

Ask for a copy of the acceptance record and keep it in your file. If troubles should occur at a later time, the record can help you to find out immediately if the cable characteristics have changed (e.g. due to kinks or breaks).

Fiber optic cables should not only be submitted to an OTDR measurement, but also to an attenuation measurement. This is especially important after splicing works at the cable.

ABB Service can be engaged to perform the acceptance measurements. Please contact us under the following service phone number: +49 61 96-8 00 46 00.

5.3 Installing a 10Base2 network

5.3.1 General

This section describes the installation of a single 10Base2 segment. When installing several segments also refer to Sections 5.6 and 5.7.

10Base2 segments are used under the following conditions:

Maximum segment length	185 m
Maximum number of nodes per segment	30
Minimum spacing	0.5 m

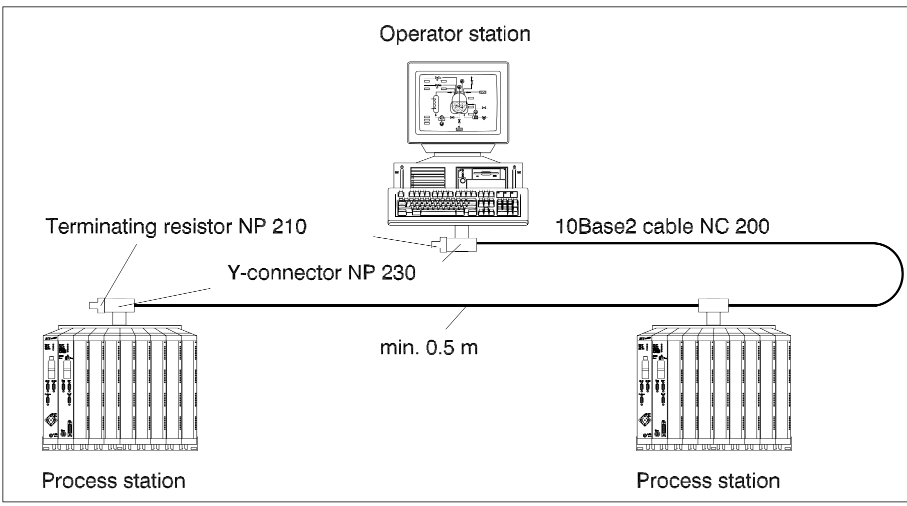


Fig. 5-1 Installing a 10Base2 network

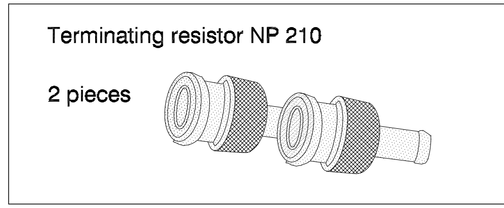
Applications of 10Base2 segments:

- Installations within one building
- Small networks with few nodes
- Areas with low EMI
- Installations powered by a common low-voltage source
- Installations with low potential differences.

5.3.2 Cabling a 10Base2 segment

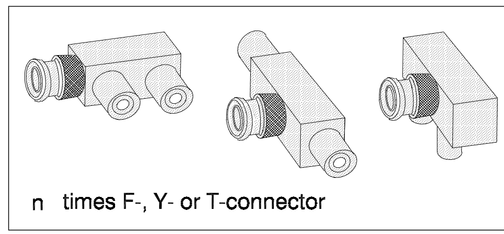
The following components are needed for cabling a 10Base2 segment with n nodes:

10Base2 terminating resistor
dual package, NP 210

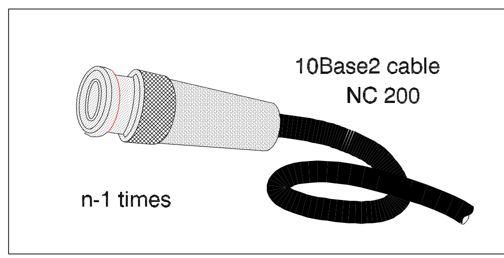


10Base2 F-connector NP 231,
10Base2 Y-connector NP 230 or
10Base2 T-connector NP 232

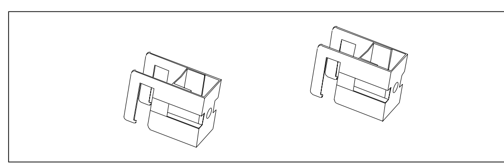
All connectors can be used, as they have the **same function**. In the following text only one of these possibilities is shown.



10Base2 cable NC 200.



Clip DSU 426/427



Example

The following components are needed for a network with three nodes:

1 dual package of terminating resistors NP 210
3 10Base2 Y-connectors NP 230
2 10Base2 cables NC 200
3 clips DSU 426/427

The cabling has to be done as shown in Figure 5-2.

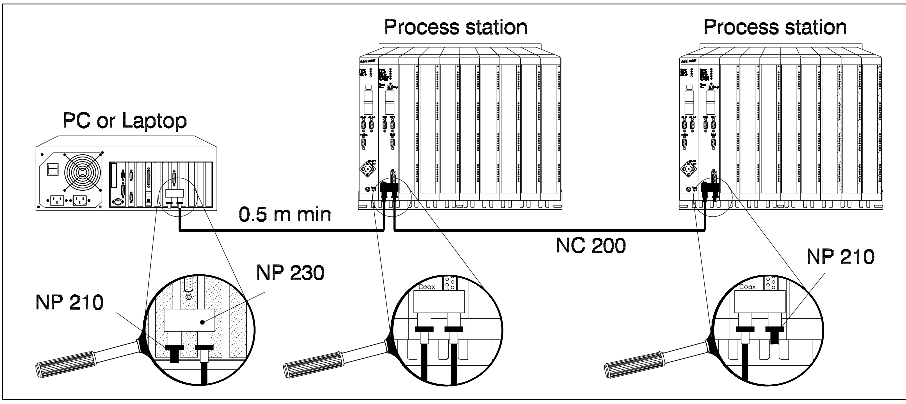


Fig. 5-2 10Base2 cabling with 3 nodes

Note

- Connect terminating resistors to both cable ends.
- Minimum spacing between two nodes 0.5 m.
- Maximum total length of the 10Base2 cable 185 m.
- Bending radius 5 cm.
- Connect the 10Base2 Y-connectors directly to the CPU module or the Ethernet board of the PC. **Do not use branch lines**.
- Protect the unsheathed metallic 10Base2 Y-connectors and 10Base2 cable connectors from any contact with ground or conductive parts of the building, e.g. by using an insulating sleeve.
- Connect the 10Base2 cable to ground at **exactly every point**. Follow the instructions given on the next page.
- The 10Base2 cable of the PC or laptop should be grounded properly as well. Note that usually only industrial PCs provide this feature.

Grounding the 10Base2 cable

Check the cable for unwanted ground shorts before connecting it to ground.

⚠ In case of insufficient grounding the **RFI suppression**, **EMI/RFI shielding** and **operational reliability** of the Ethernet **cannot be guaranteed**.

Observe the **safety regulations** and **standards** applicable in your country.

Connect the 10Base2 cable to ground at **every** Freelance 2000 process station as shown in Figure 5-3.

Proceed as follows:

- **Strip** off the insulating sheath from one of the two cables at a about 2 cm.
- Fix the braided cable shield to the rack using the clip DSU 426/427.

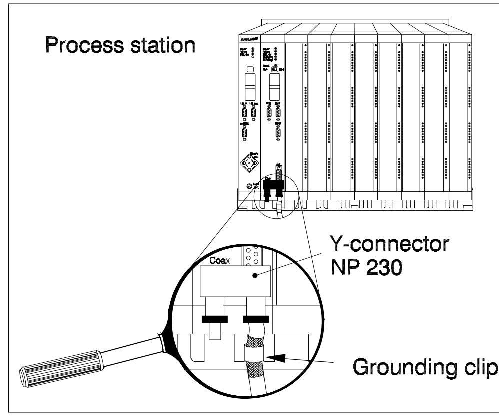


Fig. 5-3 Grounding the 10Base2 cable

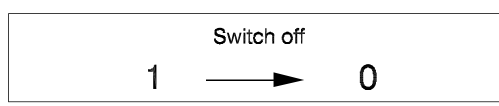
5.3.3 Connecting 10Base2 nodes while the system is running

In many cases, the engineering station is only temporarily connected to the Freelance 2000 System. There are three ways to connect and disconnect the engineering station while bus operation is in progress:

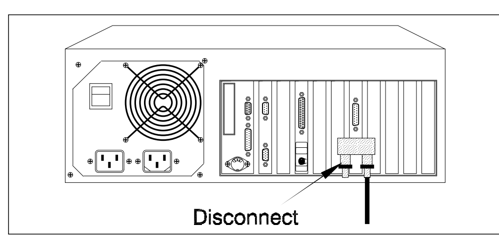
1. Connection via 10Base2 Y-connector

This is the easiest way to connect or disconnect a node to/from the network without requiring additional material. Proceed as follows to disconnect the node:

Switch off engineering station.

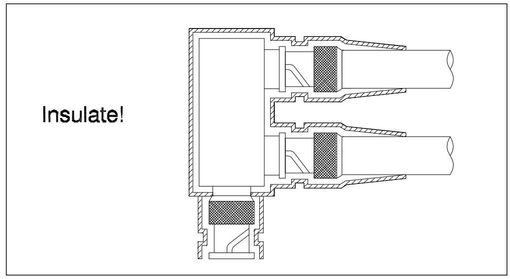


Disconnect 10Base2 Y-connector from engineering station.



Avoid **shorts** with ground or any conductive parts of the building.

Insulate **10Base2 F-connector** to avoid contact with ground or conductive parts of the building.



To connect the engineering station proceed in reverse order. The disadvantage of this method is that the disconnected 10Base2 F-connector must not have any contact with ground or any conductive parts of the building.

2. Connection via special junction boxes

If an engineering station is to be frequently connected or disconnected to/from a 10Base2 network it is recommended to use a 10Base2 junction box with automatic make contact.

These boxes are provided with a micro switch which connects the bus through if no plug is in the socket.

When the plug of a new bus node is connected, the node is automatically connected into the network.

The junction boxes are available on request.

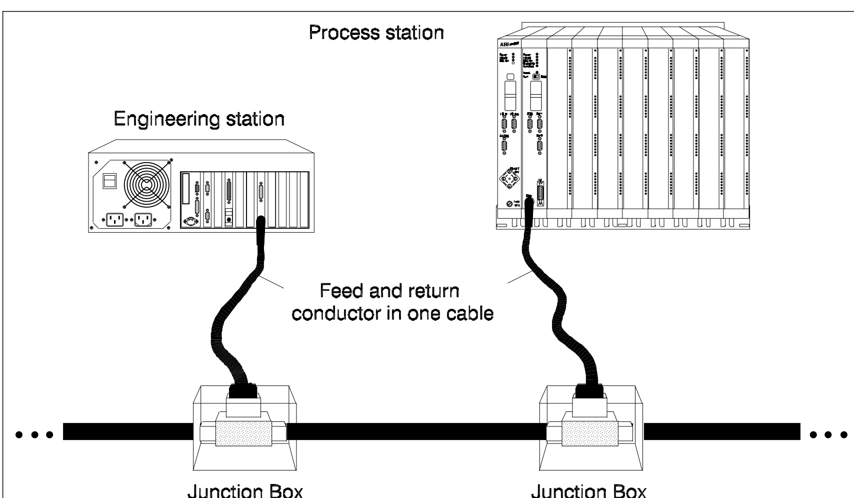


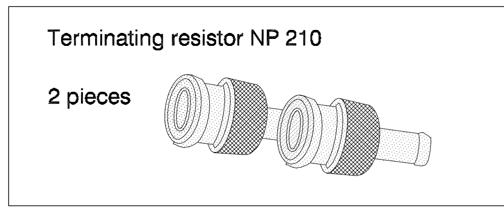
Fig. 5-4 Connection via junction boxes

3. Connection via transceiver

This network connection should be used if an engineering station is to be connected alternately to 10Base2 and 10Base5 networks. If you need a branch cable from the 10Base2 cable it is also useful to connect via a transceiver. You work with the AUI interface, independently of the network type. In this case it is not necessary to reconfigure the network board in the engineering station to change from AUI to coaxial interface which - otherwise - would be required.

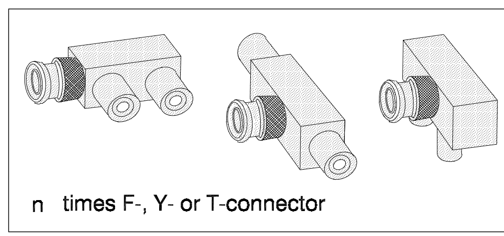
The following components are needed for connecting several process stations and one engineering station:

10Base2 terminating resistor dual package NP 210

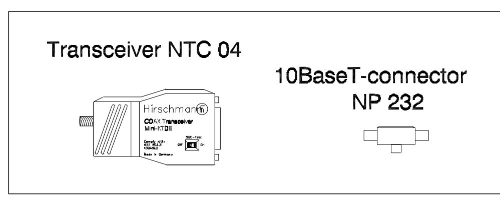


10Base2 F-connector NP 231
10Base2 Y-connector NP 230
or **10Base2 T-connector** NP 232

All connectors can be used, as they have the **same function**.

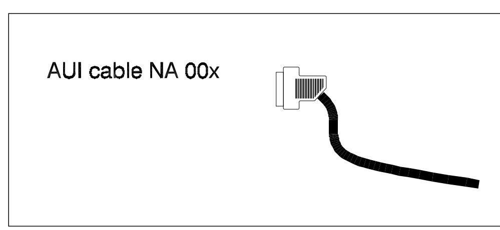


10Base2/AUI network transceiver NTC 04
with 10Base2 T-connector NP 232



AUI cable NA 00x

(x → depending on length)



Cable the system as shown in Figure 5-5.

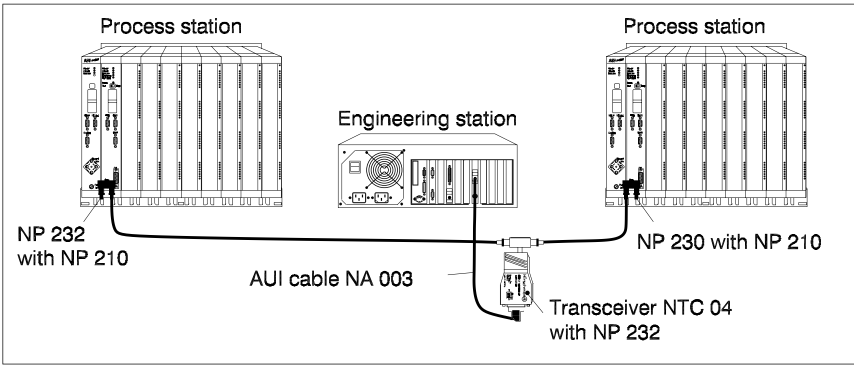
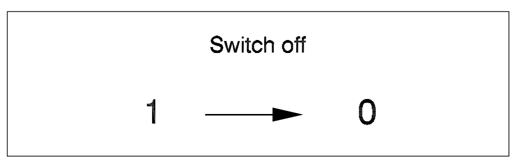


Fig. 5-5 10Base2 connection via transceiver

Insert the transceiver NTC 04 with the 10Base2 T-connector NP 232 in the network at the point where you intend to temporarily connect the engineering station. Link the engineering station with the transceiver using the AUI cable NA 003.

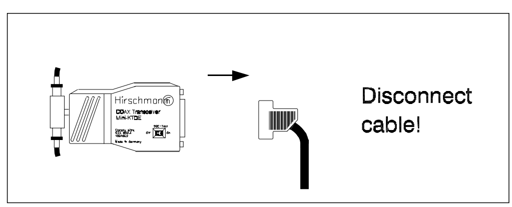
To disconnect the station while the system is running proceed as follows:

Switch off
engineering station



Disconnect AUI cable
from transceiver

Transceiver remains installed.



5.3.4 Crimping 10Base2 cables

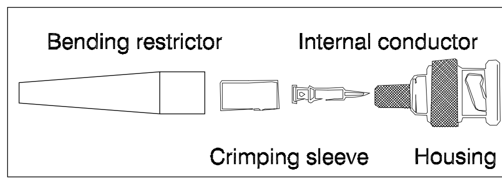
Ready-made NC 200 cables with a maximum length of 185 m are available for 10Base2 networks.

If it is necessary to shorten or repair a cable while installing, all necessary parts can be found in the **10Base2 mounting tool kit NP 200**. 10Base2 cable connectors **NP 250** can be ordered separately.

The mounting tool kit consists of a crimp tool and a three-step wire stripper. Before first use the wire stripper has to be adjusted as described in the instructions. The crimping steps are described below.

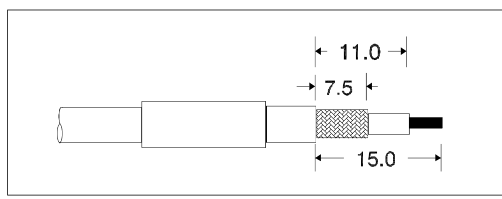
Required material :

1. Bending restrictor
2. Crimping sleeve
3. Internal conductor
4. Housing



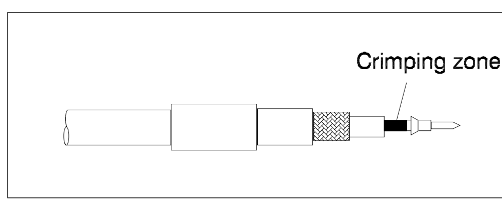
Strip off the cable sheath

Put the **bending restrictor** and the **crimping sleeve on** the **cable**



Crimp the internal conductor

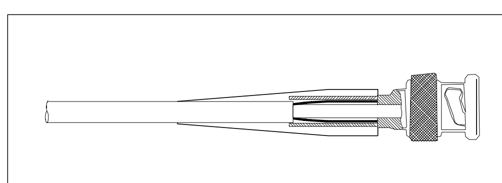
Widen the braided shield



Put on the housing

Slip the **crimping sleeve** over the shield and housing and **crimp**

Push the bending restrictor into the right position.



5.4 Installing a 10Base5 network (Yellow Cable)

5.4.1 General

This section describes the installation of a single 10Base5 segment. A 10Base5 cable should be used in the following cases:

Maximum segment length	500 m
Maximum number of transceivers per segment	100
Minimum spacing between two transceivers	2.5 m

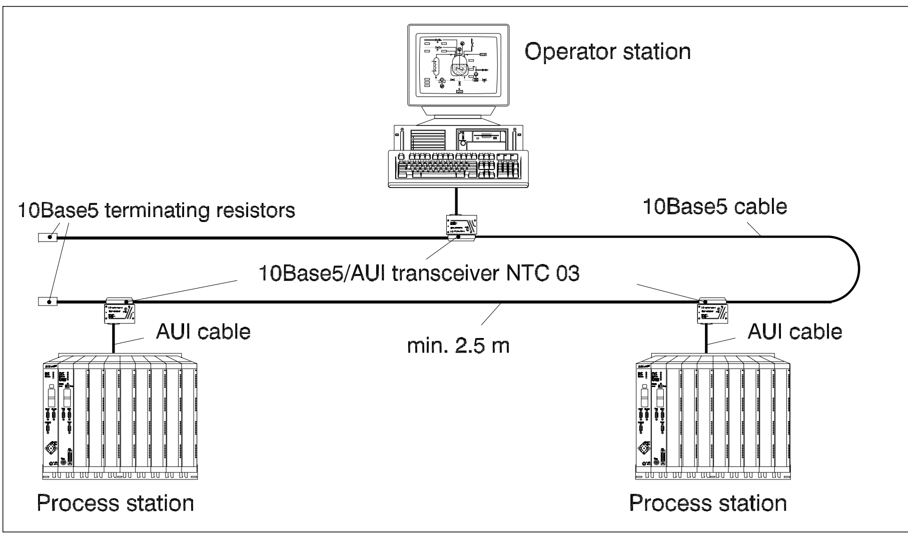


Fig. 5-6 Installing a 10Base5 network

Applications of 10Base5 segments are:

- Networks within one building
- Medium-size installations with medium to high number of nodes
- Installations with low or medium EMI

5.4.2 Linking 10Base5 cable segments

Several short 10Base5 cable segments can be linked by 10Base5 N/N connectors NP 512 until reaching the maximum length. The following standardized 10Base5 network cable lengths are available, due to their physical features:

- NC 501: 23.4 m
- NC 502: 70.2 m
- NC 503: 117 m
- NC 504: 257.4 m
- NC 505: 500 m

Observe the following rules when deciding upon the cable lengths you want to use:

1. Use one of the standardized cable lengths listed above.

If you need, for example, a 230 m 10Base5 network cable you should use the 257.4 m cable NC 504. Wind up the remaining cable length you don't need. The advantage of this solution is that the cable consists of a single piece. No errors can result from defective cable joints.

Under certain conditions, however, the solution given above is uneconomic. If you need, for example, a 400 m 10Base5 cable, there would be a surplus length of 100 m when cable NC 505 is used. The following alternative solutions are possible:

2. Link several standardized cables until achieving the desired length

Link standardized cables by NP 512 N/N connectors until achieving the desired length. If you need, for example, a 400 m network cable, link the following standardized cables:

NC 501:	23.4 m
NC 501:	23.4 m
NC 503:	117.0 m
NC 504:	257.4 m
Sum	**421.2 m**

The cables should be from the same manufacturer and production lot (if possible).

The advantage of this solution is that the cable consists of standardized segments. The disadvantage is that this cable is less reliable than a single-piece one, due to the cable joints. Therefore, the 3rd alternative described below should be preferred.

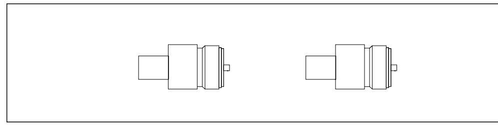
3. Ready-made cables in customized lengths

Ready-made cables in lengths specified by the customer are available on request. It is recommended to order cable lengths which are a multiple or a combination of the standardized lengths listed above (for example, you should order 421.2 m instead of 400 m, see example given in solution 2). This will enable future expansions.

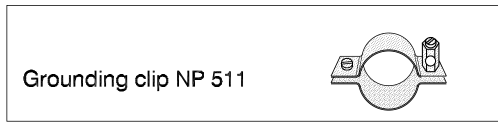
5.4.3 Cabling a 10Base5 segment

The following components are needed for cabling a 10Base5 segment with n nodes:

10Base5 terminating resistors
NP 510 with external thread for network concentrator
NP 513 with internal thread for cable

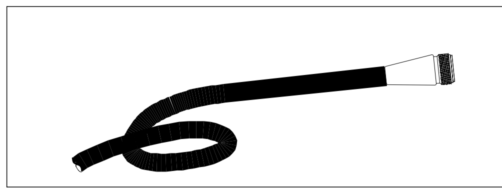


Grounding clip NP 511

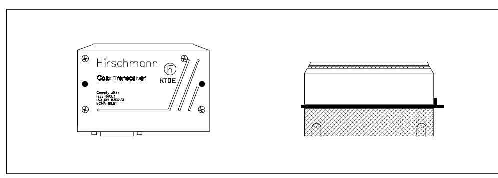


10Base5 cable NC 50x

(x → depending on length)

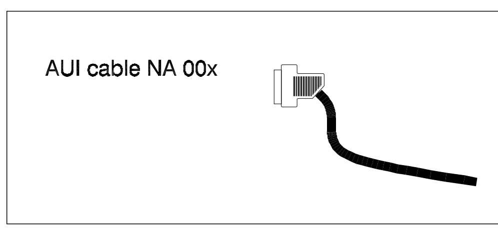


10Base5/AUI transceiver NTC 03

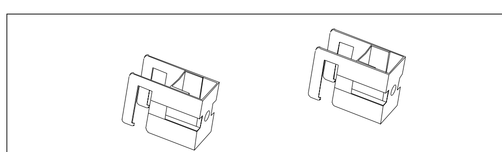


AUI cable NA 00x

(x → depending on length)



Clip DSU 426/427



Example:

The following components are needed for a network with 3 nodes

1	10Base5 cable, e.g. NC 503
2	10Base5 terminating resistors NP 513
1	10Base5 grounding clip NP 511
3	10Base5/AUI transceivers NTC 03
3	AUI cables, e. g. NA 004
2	clips DSU 426/427

The cabling is done as shown in Figure 5-7.

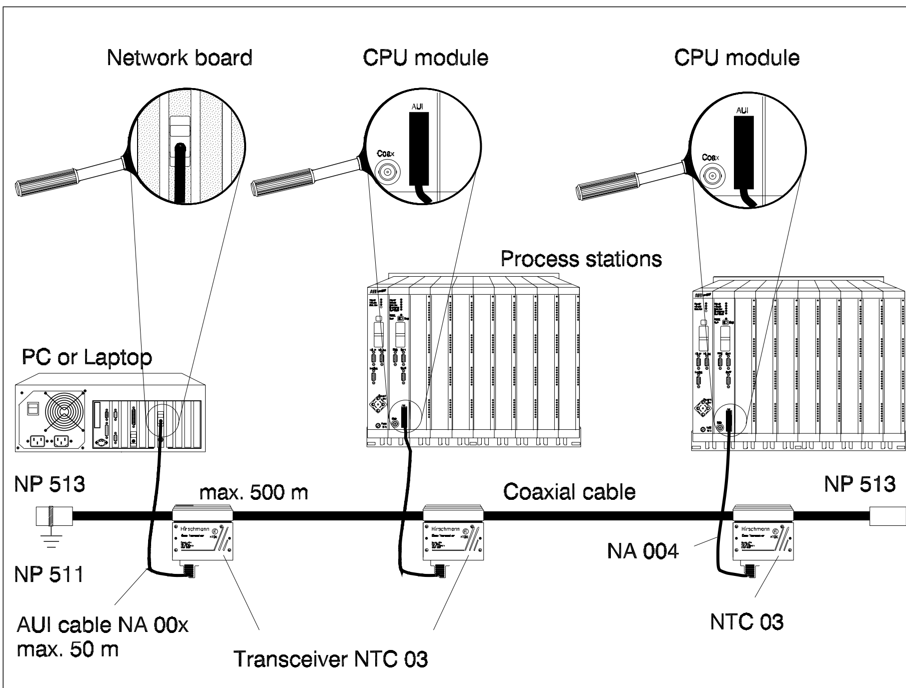


Fig. 5-7 Cabling a 10Base5 network with 3 nodes

When cabling proceed as follows:

1. Lay the bus cable

- **Do not lay** the cable **close to** power cables
- Screw the **terminating resistors** to **both cable ends**
- Note that the **min. bending radius** of the 10Base5 cable is **15 cm**.

2. Connect the bus cable to ground

- Provide for a low transition resistance and a reliable contact. **Ground the bus cable** using clip NP 511. This is done by connecting the clip to terminating resistor NP 510 and grounding it**.**
- Insulate the terminating resistor without grounding clamp. Make sure that **no contact** to **ground** (neither earth nor a conductive part of the building) exists.
- When several cable segments are connected by **10Base5 N/N connectors** NP 512, these must also be isolated from ground.

If your installation has not been connected to ground as described above, neither **operational reliability** nor **RFI suppression** or **EMI/RFI shielding** can be guaranteed.

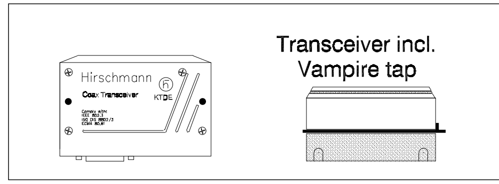
The **terminating resistors** or **connectors** of a grounded cable have the same potential as the grounding point. **Do not touch.** A **compensating current** may flow through your **body**.

When linking two **cable segments**, do not directly touch them before. A **compensating current** may flow through your **body**, if the cable is in contact with ground at two points.

Observe the **safety regulations and standards** applicable in your country**.**

3. Mounting a 10Base5 tap (Vampire tap) with transceiver

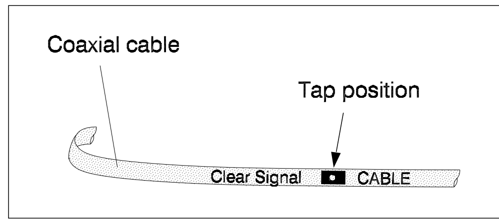
Material NTC 03



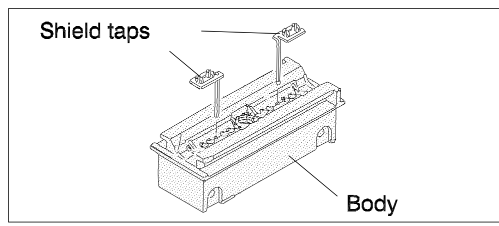
Determine tap position

Only attach transceivers at the marks.

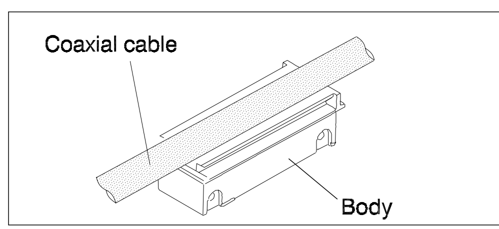
The spacing between two marks is 2.5 m.



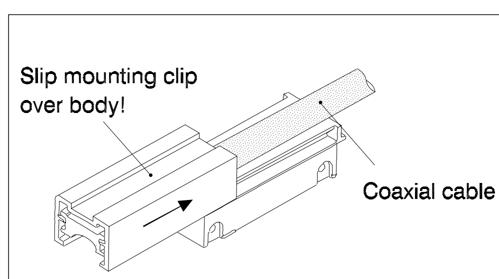
Insert the shield taps in the body**.**



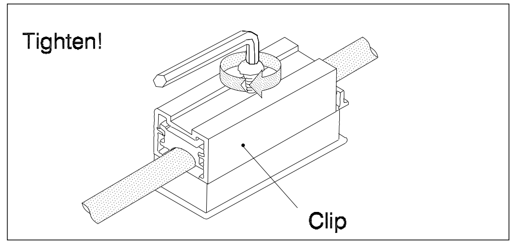
Lay the **cable** in the slot of the body.



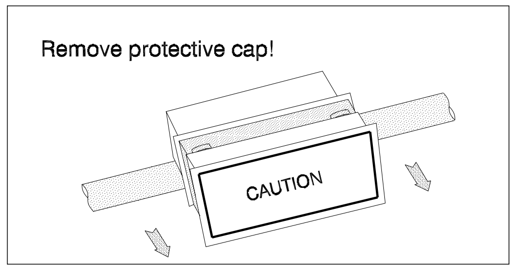
Slip the **mounting clip over** the **body** from the side**.**



Fasten screw with Allan key **until the clip fits tightly** to the cable.

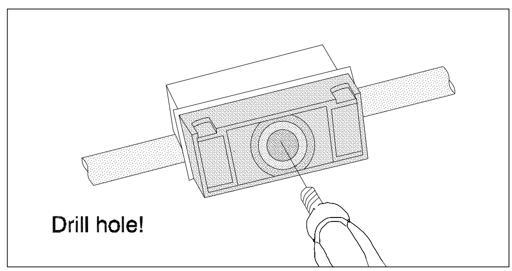


Remove protective cap.

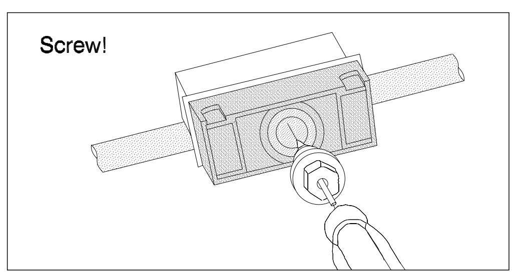


Use the drill of the 10Base5 mounting tool kit NP 500 to **drill** a **hole** in the cable down to the internal conductor.

Thoroughly remove drilling chips to avoid short circuits!



Screw in the contact piece using the 10Base5 mounting tool kit NP 500.

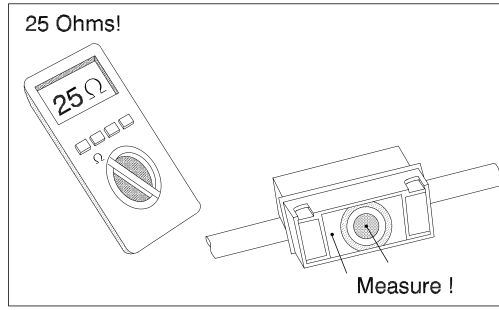


Only if cable is not yet live

Check contact with ohmmeter.

Measure resistance between contact piece and shield tap.

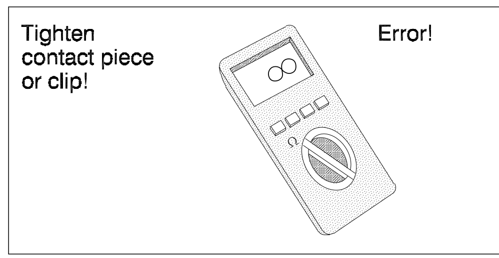
With two terminating resistors the measured resistance should be **25** Ω.



Error :

Resistance = ∞ infinite

-> **The contact piece or the clip has not been tightened sufficiently**

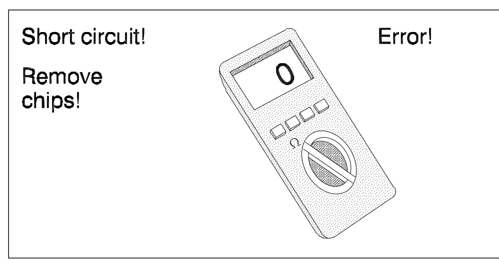


Error:

Resistance = **0**

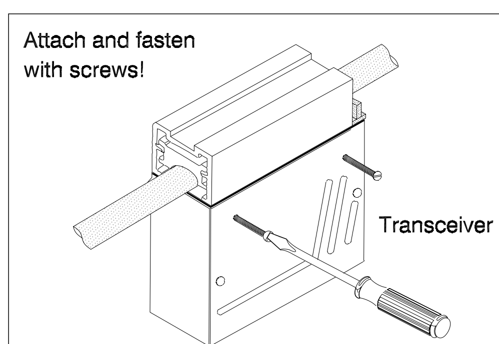
-> **Short circuit!**

Remove chips from drilling hole



Attach transceiver to body.

Fasten with screws.



4. Connecting and grounding the AUI cable

Link the node with the transceiver using the AUI cable NA 00x. Plug the AUI cable side with the slide lock to the transceiver and lock. Then connect the other side to the process station and lock using the slide lock on the process station front panel.

Ground the AUI cable of the Freelance 2000 process station at the rack as shown in Figure 5-8 using the grounding clip DSU 426/427.

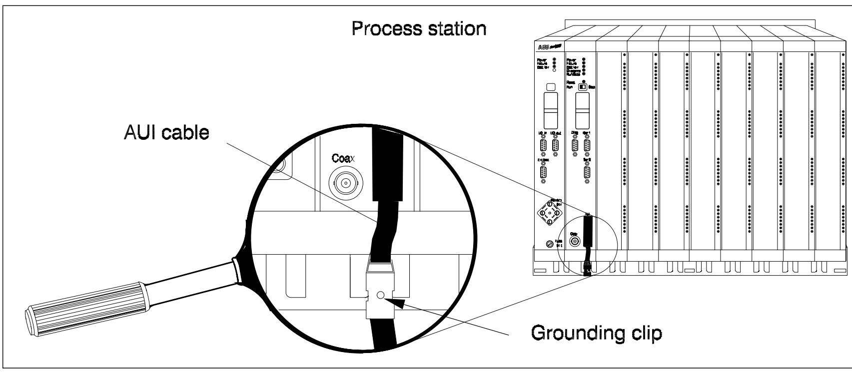


Fig. 5-8 Connecting and grounding the AUI cable

⚠ If the installation is not grounded as described above, the **operational reliability, RFI suppression** and **EMI/RFI shielding** cannot be guaranteed.

Do not lay the AUI cable close to power cables.

5.4.4 Connecting and disconnecting nodes while the system is running

Transceivers can be connected while the system is running. However, drilling chips may cause short circuits.

When disconnecting a node while the system is running proceed as follows:

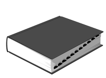
- Switch off the node
- Disconnect the AUI network cable
- The transceiver itself remains connected to the 10Base5 cable.

The 10Base5 tap remains in the cable. **Do not remove** the 10Base5 tap when no node is connected. If required detach the transceiver from the tap and protect the contacts with the cap delivered with the unit.

5.5 Installing a 10BaseFL network (fiber optic cable)

One or several active network concentrators (star couplers) are needed for cabling the DigiNet S system bus. Various models are available, for 115/230 V AC or 24 V DC, with single or redundant power supply.

This manual refers to network concentrator type NCU 02, a 9.5 inch device (width) for 115/230 V. All other models can be used as well.



For information about the other network concentrators see Symphony Product Catalog (3BDD 010 026 R0003).

5.5.1 General

This section describes the installation of a single active network concentrator. For large installations with several network concentrators please contact an expert.

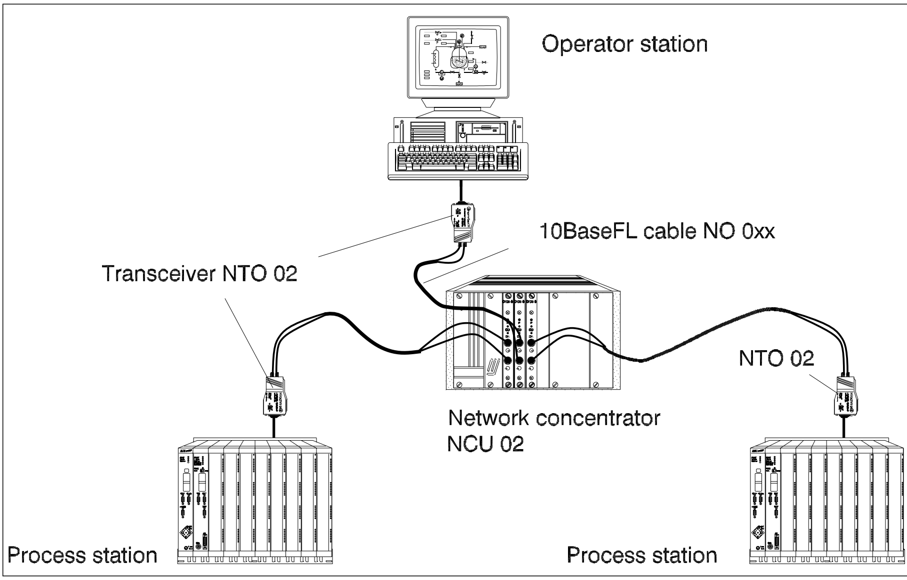


Fig. 5-9 Installing a 10BaseFL network (fiber optic cable)

Fiber optic cables are used for:

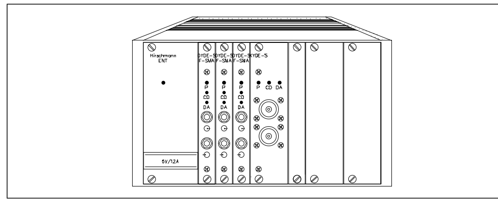
- Long distance links
- Links between buildings
- Installations with high EMI
- Links close to power cables
- Areas with high potential differences
- Large installations
- Installations where a protective separation by the network is required
- Cables in narrow cable ducts
- If cable redundancy requirements have to be met

Use fiber optic cables wherever this is possible to improve the operational reliability and achieve optimal EMI shielding.

5.5.2 Cabling

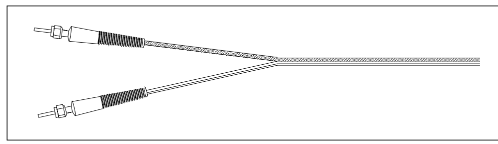
The following components are needed for a network with up to 9 nodes:

Network concentrator NCU 02
with 5/9 slots
incl. 230/115 V power supply
and power cable

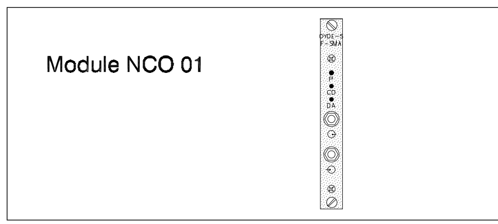


10BaseFL cable NO 00x

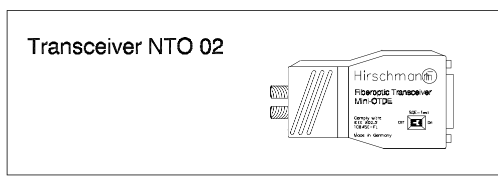
(x → depending on length)



10BaseFL module NCO 01

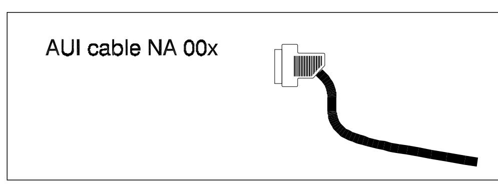


10BaseFL transceiver NTO 02

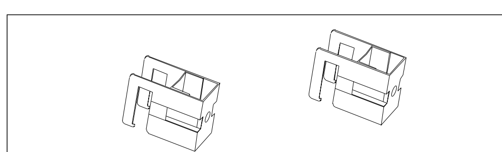


AUI cable NA 00x

(x → depending on length)



Clip DSU 426/427



Example for a network with three nodes:

1 Network concentrator 5/9 slots NCU 02
3 10BaseFL cables NO 00x
3 10BaseFL modules NCO 01
3 10BaseFL transceivers NTO 02
3 AUI cables NA 00x
2 clips DSU 426/427

With a 19-slot network concentrator - e. g. NCU 01 - it is possible to connect more nodes. Moreover, the network concentrators can be cascaded. Ready-made 10BaseFL cables NO 00x are used for the network described here. Ready-made cables are deliverable in lengths of up to 100 m. If you should need longer cables, observe the information given in Sections 5.5.3 and 5.5.4.

Cable the network concentrators as shown in the illustration. Observe the operating instructions for the individual components. Ground every AUI cable shield as described in Section 5.4.3.

If the available mounting depth permits you can also plug the 10BaseFL transceivers NTO 02 directly to the CPU module. In this case no AUI cables are needed.

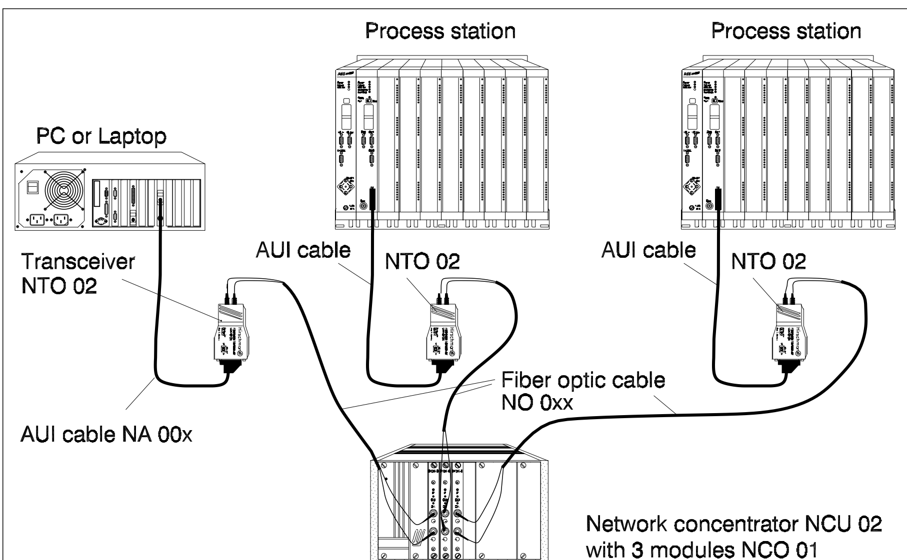


Fig. 5-10 Cabling a 10BaseFL network with 3 nodes

When installing proceed as follows:

1. Set the 10BaseFL modules NCO 01 to the appropriate transmission power, depending on the length of the connected fiber optic cable. Refer to the module operating instructions for the correct setting.

2. Insert the 10BaseFL modules in the network concentrator, fasten with screws, and cover unused slots with caps.

3. Connect the power cable of the network concentrator NCU 02 to the power supply (230 V AC, 115 V AC).

4. Use 10BaseFL cables NO 00x to connect the 10BaseFL modules NCO 01 with the 10BaseFL transceivers NTO 02, as shown in Figure 5-11:

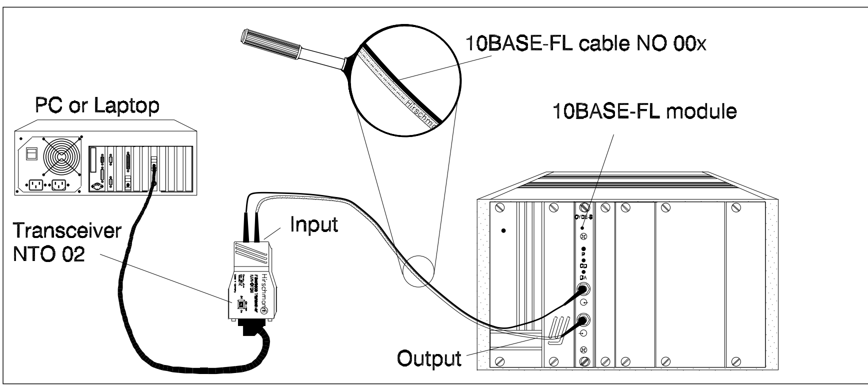


Fig. 5-11 10BaseFL cable link

Link the 0-> jack of the network concentrator with the ->0 jack of the transceiver. Link the 0-> jack of the transceiver with the ->0 jack of the network concentrator. For easy distinction one cable wire is marked black.

5. Link the 10BaseFL transceiver NTO 02 with the AUI interface of the node via the AUI cable NA 00x. If possible plug the transceiver directly to the AUI interface.

   Connect the AUI cable side provided with a **slide lock** to the transceiver and lock. Connect the other cable side to the process station and lock using the slide lock on the process station front panel.

5.5.3 Long-distance links within buildings

The fiber optic 10BaseFL cables NO 0xx described in the examples above are two-wire, ready-made cables with BFOC connectors. They are designed for dry indoor applications. The maximum possible length of a ready-made cable is 100 m.

Longer fiber optic cables first have to be to laid without connectors to avoid the risk of fiber breaks. In a second operation so-called pig-tails are welded (spliced) to the fiber optic cables. Pig-tails are short fiber optic cables of around 10 m with a connector plug mounted to one end. The splice points are protected by splice boxes, which are available for wall mounting or ceiling suspension under the designation NO 550.

Figure 5-12 shows the basic structure of a point-to-point connection with two splice boxes.

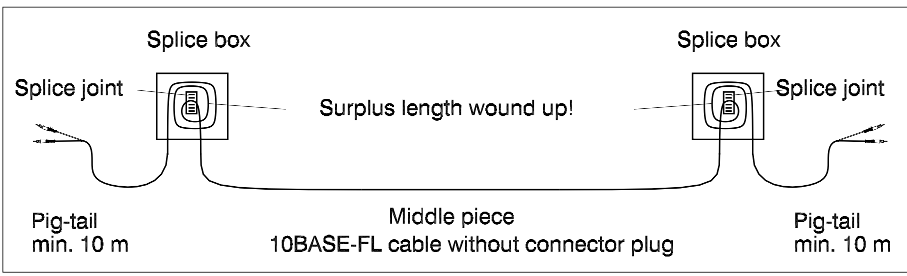


Fig. 5-12 Point-to-point connection with splice boxes

Note that the fiber optic cables are normally available in a maximum length of 2000 m. For longer distances an additional splice box for connecting the middle pieces or an overlength cable is required.

Splicing is a welding operation which must be carried out by qualified personnel, only. Contact the ABB mounting department for splicing works. Splicing pig-tails is easier than mounting connectors to the middle piece on site. Therefore, splicing should be preferred. Make sure that the splice points meet the quality requirements by measuring/testing the whole link on site and noting down the results in an acceptance record.

Pig-tails can be produced by cutting a 10BaseFL cable NO 0xx in two pieces. Pig-tails should have a maximum length of 6 ... 10 m to enable easy measurement. The surplus length, if existing, can be wound up in the splice box.

The splice box is a special housing for protecting the splice point and winding up the surplus cable length. Splice box NO 550 for wall-mounting is a part of the delivery program. It is designed for connecting multi-wire cables. If the boxes have to meet special requirements for your application - e.g. mountability in 19“ cabinets or integrability of patch fields please contact us for more information.

Although only one wire pair is needed for an Ethernet link, it is recommended to lay multi-wire cables in order to enable additional data links in future. Moreover, you can change over to an unused wire in case of wire-break.

When designing a larger network please contact us for more information. Several standardized cabling concepts enabling future network expansions already exist.

5.5.4 Links between buildings

Always use fiber optic cables for links between buildings. Fiber optic cables provide for protective voltage separation and ensure lightning protection without requiring additional measures. Besides the indoor cables already described above, outdoor and underground cables are also available.

Use multi-wire cable to reduce cable laying cost. As already mentioned for indoor cable links, multi-wire cables enable additional data links in future. Moreover, you can change over to an unused wire in case of wire-break.

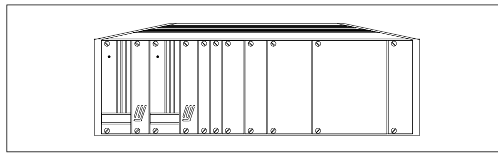
Several outdoor cable types - e.g. gopher-protected or with a special steel or aramid reinforcement - are available. Note that steel-reinforced cables should only be used under special conditions for outdoor applications. In this case, the reinforcement must be grounded at both ends when entering the buildings to provide lightning protection.

When cabling underground and outdoor cables proceed as described in Section 5.5.3. The information about splice boxes given in that section is analogously valid for these cables. Contact us for more information about how to select the appropriate splice boxes and cable types. Sealed underground splice boxes are also available.

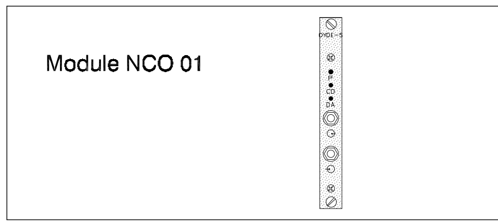
5.5.5 Redundant 10BaseFL cable link

In order to meet higher DigiNet S availability requirements, redundant fiber optic cable links can be laid between the network concentrators. In this case it also recommended to use network concentrators with redundant power supplies. The following parts are needed for a redundant link:

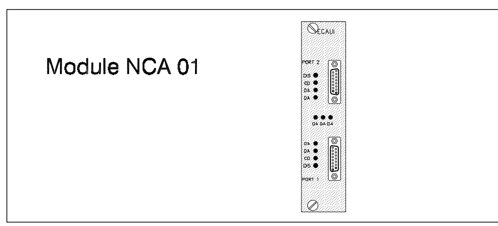
Network concentrator NCU 01
with redundant power supply



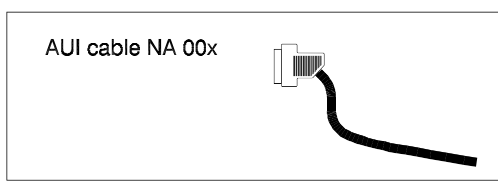
10BaseFL module NCO 01



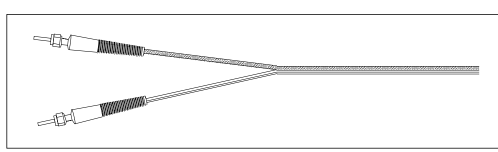
AUI module NCA 01



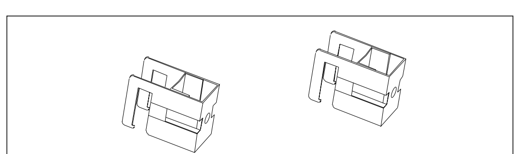
AUI cable NA 00x



10BaseFL cable NO 0xx



Clip DSU 426/427



Example for two nodes:

2 network concentrators NCU 01, 10/19 slots, with redundant power supply
4 10BaseFL modules NCO 01
2 AUI modules NCA 01
2 AUI cables, e.g. NA 001
2 10BaseFL cables NO 0xx
1 clip DSU 426/427

Cable the components as shown in Fig. 5-13.

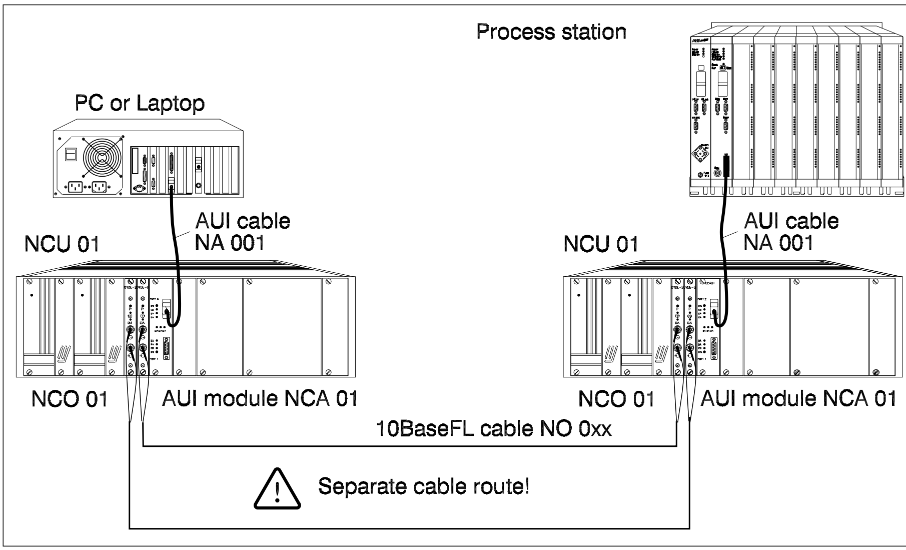


Fig. 5-13 Redundant 10BaseFL cabling, case 1

Configure one of the two 10BaseFL modules for redundant operation by setting the jumper accordingly. Set the 10BaseFL modules to the appropriate transmission power, depending on the distance. Observe the operating instructions for the individual components and the information given in Section 5.5.2.

The fiber optic cable link between the two network concentrators is redundant. The cables should be laid on different routes to reduce the risk that both cables are damaged at the same time. If one of the two links fails, the network concentrators automatically switch over to the redundant link without interrupting operation. The 10BaseFL modules permanently monitor the replacement link for correct functioning. The status is indicated by LEDs.

It is recommended to keep the link between the process station or operator station and the network concentrator as short as possible in this case. This reduces the risk that the non-redundant link between the network concentrator and the process station or operator station fails. Ideally the network concentrators should be placed close to the process station or operator station.

If more than two nodes have to be linked, it is recommended to use a ring topology. Figure 5-14 shows as an example the redundant connection of three nodes.

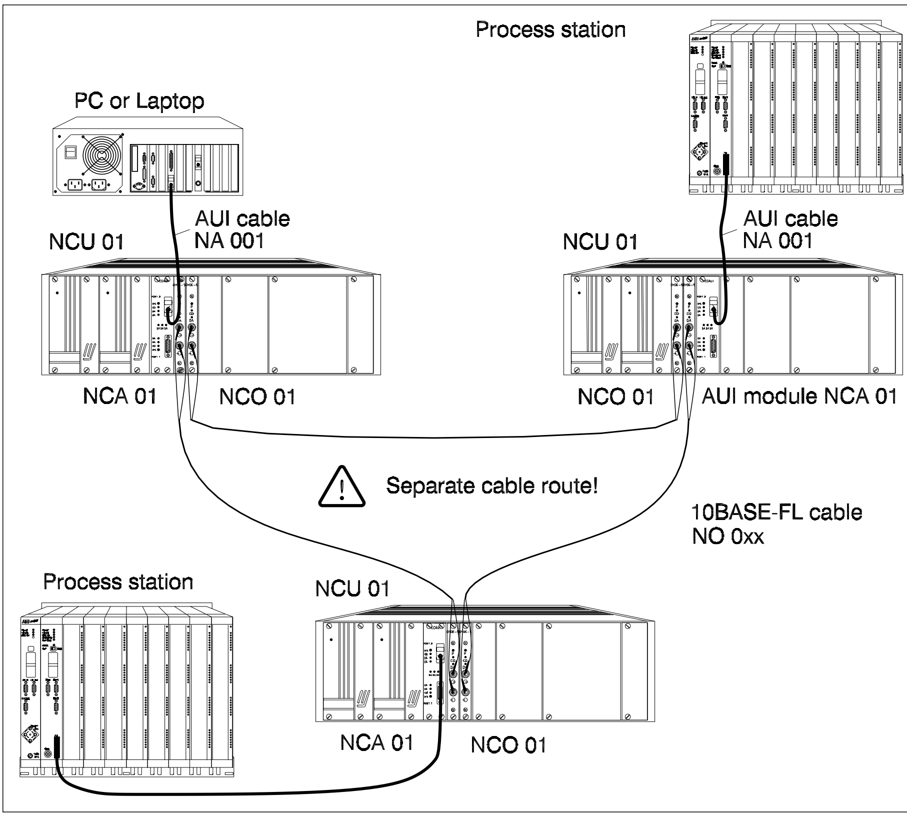


Fig. 5-14 Redundant 10BaseFL cabling, case 2

The fiber optic cable links form a ring. Even if any of the links fails, the connection between all three nodes is preserved. The three cables should be laid on separate routes to increase safety in case of accidental damages (e.g. by excavators).

5.5.6 Protective separation via 10BaseFL

There are two ways to achieve protective separation of the operator, process and engineering stations which will be described below. Note that the power supplies DPW 01 of the process stations are provided with a protective separation. When realizing one of the ways described below, make sure that the AUI cable shields are grounded properly.

1st way

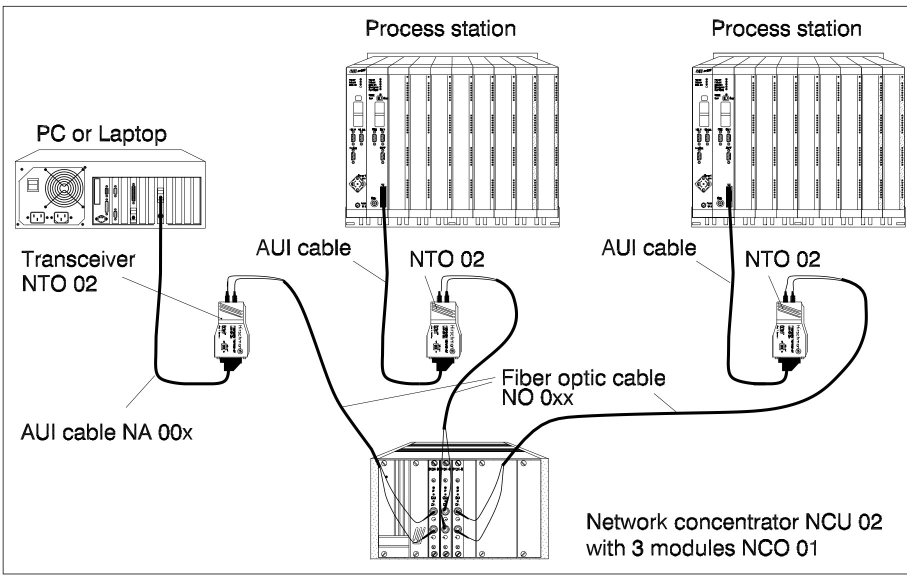


Fig. 5-15 Protective separation via Ethernet, 1st way

In this case all nodes are linked via a fiber optic cable. This provides for protective separation of the nodes from each other and makes long distance links possible.

2nd way

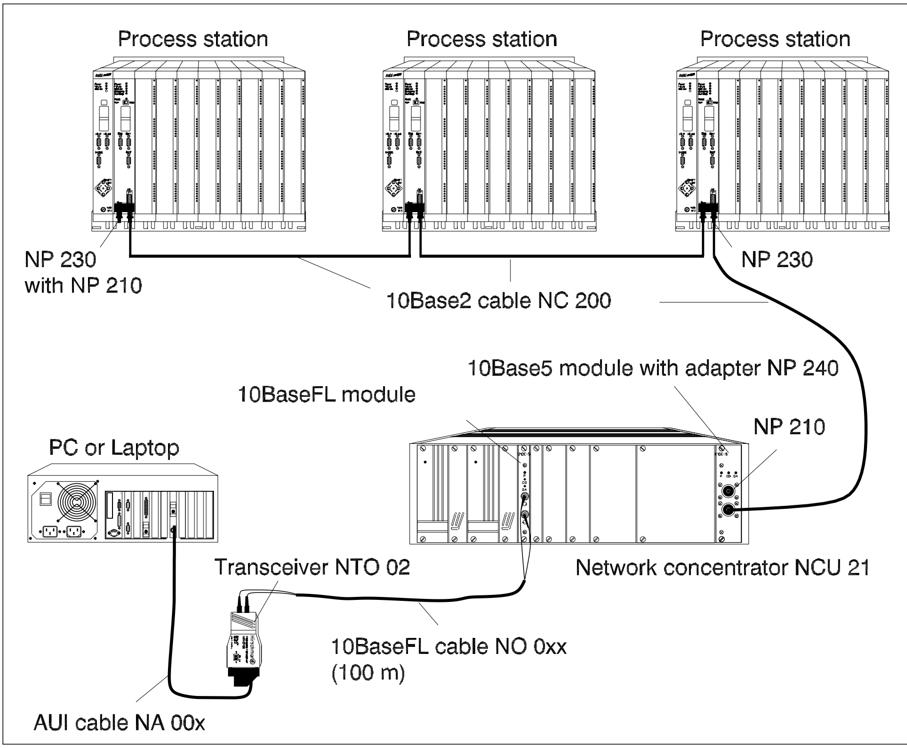


Fig. 5-16 Protective separation via Ethernet, 2nd way

This way is an interesting alternative if the distances between the process stations are relatively short. The process stations are linked via 10Base2 cables and are protectively separated by the power supplies DPW 01. The fiber optic cable provides for separation from the operator level. Since the network concentrator NCU 21 uses the same 10Base2 cable as the process stations, it must be a 24 V unit, the 24 V supply of which must have a protective separation as well.

5.5.7 Max. permissible network length with 10BaseFL cable

The explanations in this section give only a short overview. Observe the detailed information about how to design fiber optic cable networks given in

Fa. Hirschmann GmbH & Co, Esslingen: Manual Ethernet, ordering code 943 320-011

The principle of Ethernet data transmission with collision detection assumes a maximum propagation delay on the system bus between two nodes. Exclusive use of standardized 10Base2 and 10Base5 Ethernet components with max. cable lengths and a maximum of 4 repeaters ensures that the specified delay is achieved. For details see Section 5.7.

When using 10BaseFL components and network concentrators, the maximum network length is determined in another way. In this case the permissible length results from adding the propagation delays of the cables and electronic components. The following rule is valid:

Maximum network length ≤ 4800 m

Consider the longest distance in the network. A propagation delay equivalent in meters is assumed for the electronic components in the signal path.

The following table gives the propagation delay equivalents for the used components.

Network concentrator modules	Code design.	Delay equivalent
AUI network concentrator module	NCA 01	165 m
10Base2 network concentrator module	NCC 01	110 m
10Base5 network concentrator module	NCC 02	10 m
10BaseFL network concentrator module	NCO 01	30 m

Transceiver	Code design.	Delay equivalent
10Base2/AUI transceiver (miniature)	NTC 04	50 m
10Base2/AUI transceiver (flush-mount)	NTC 01	50 m
10Base5/AUI transceiver	NTC 03	50 m
10BaseFL transceiver (miniature)	NTO 02	30 m

Example:

Figure 5-17 shows an installation example to illustrate the calculation of the propagation delay.

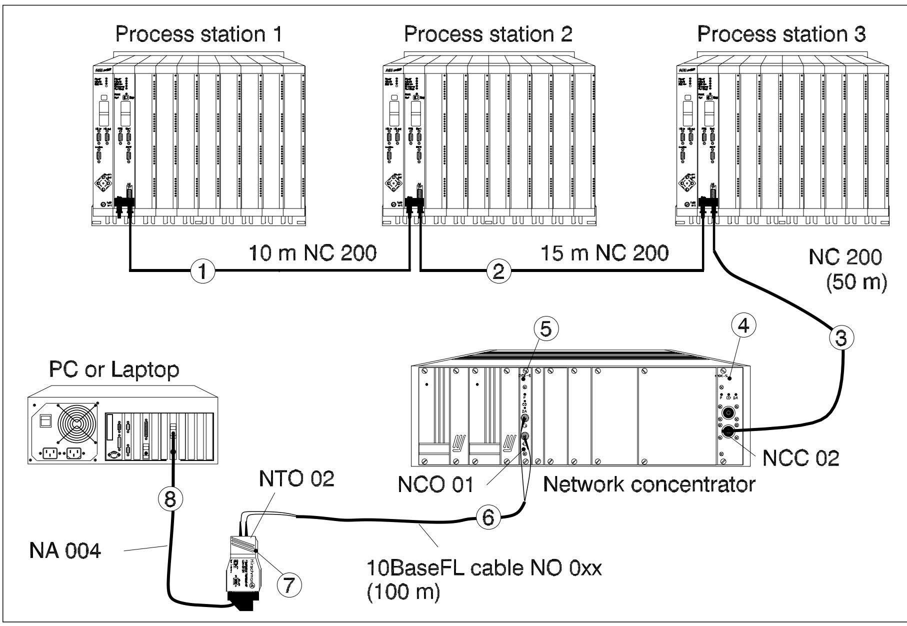


Fig. 5-17 Propagation delay calculation for an installation, example

In Fig. 5-17 the longest signal path is from process station 1 over process station 2 to process station 3, via the 10Base5 concentrator module, the 10BaseFL concentrator module, the 10BaseFL cable, the 10BaseFL transceiver, and the AUI cable to the operator station.

The numbers 1 ... 8 marked with circles indicate the signal path and can also be found in the table below. The cable lengths and propagation delay equivalents of the electronic components on this path have to be added.

The table below shows this calculation.

No.	Cable of length or component	Cable length
1	10Base2 cable NC 200, length 10 m	10 m
2	10Base2 cable NC 200, length 15 m	15 m
3	10Base2 cable NC 200, length 50 m	50 m
4	10Base5 concentrator module NCC 02	10 m
5	10BaseFL concentrator module NCO 01	30 m
6	10BaseFL cable NO 010, length 100 m	100 m
7	10BaseFL transceiver NTO 02	30 m
8	AUI cable NA 004, length 10 m	10 m
Sum of all cable lengths and propagation time equivalents		**255 m**

Hence the above-described network setup meets the requirement:

Maximum network length ≤ 4800 m

When designing a network observe the following rules:

- Maximum distance between two 10BaseFL modules NCO 01: 4000 m
- Maximum distance between 10BaseFL module NCO 01 and 10BaseFL transceiver NTO 02: 2000 m
- Connecting more than 5 network concentrators in series requires so-called re-timing boards
- When using unshielded twisted-pair (UTP) cables, the length of the UTP cables has to be increased by 10 % for calculation.

5.6 Mixed networks

In some cases, mixed networks are an economical alternative to all fiber optics networks. Modules for the connection of 10Base2 and 10Base5 segments are available for the network concentrator NCU 02. Direct connection of AUI cables is also possible.

Figure 5-18 shows an example for a mixed network:

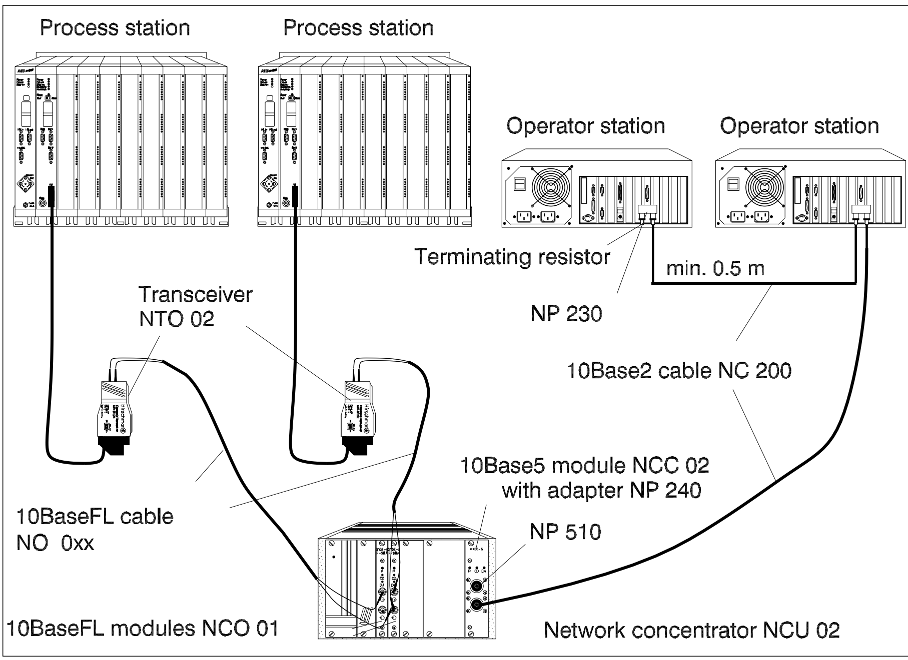


Fig. 5-18 Mixed network

Two 10BaseFL cables (fiber optic cables) link the CPU modules of the process stations with the network concentrator NCU 02. The fiber optic cables can be used for long distances and in environments with high EMI.

The network concentrator is installed near the two operator stations D-LS, which are connected via a 10Base2 segment, as this is only a short distance link in a low-EMI environment.

Both the 10Base5 and the 10Base2 segments can be connected via a 10Base5 module in the network concentrator using adapter NP 240.

5.7 Coupling cable segments via repeaters

For some applications more than one cable segment is needed. In these cases, cable segments can be coupled via repeaters. This is especially required if existing networks are expanded at a later time.

Figure 5-19 shows how to couple two 10Base5 cable segments via a repeater.

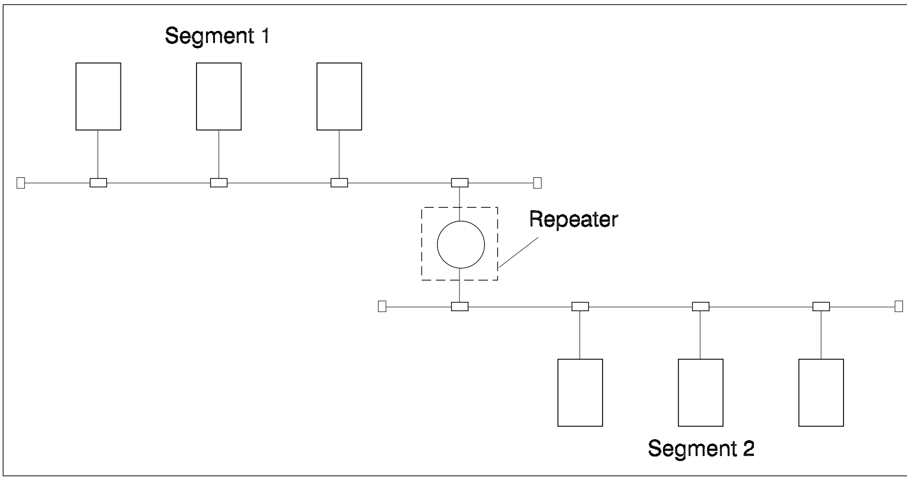


Fig. 5-19 Coupling via a repeater

The repeater is connected via an AUI transceiver NTC 03 and an AUI cable NA 00x.

Two segment types are distinguished here:

Coax segments:	Cable segments with nodes
Link segments:	Cable segments without nodes

The maximum transmission distance between two nodes is limited to 5 segments. Note that only three of these can be coax segments. At least two of them **must** be link segments.

Figure 5-20 shows a large system with repeaters and max. possible transmission distances as an example.

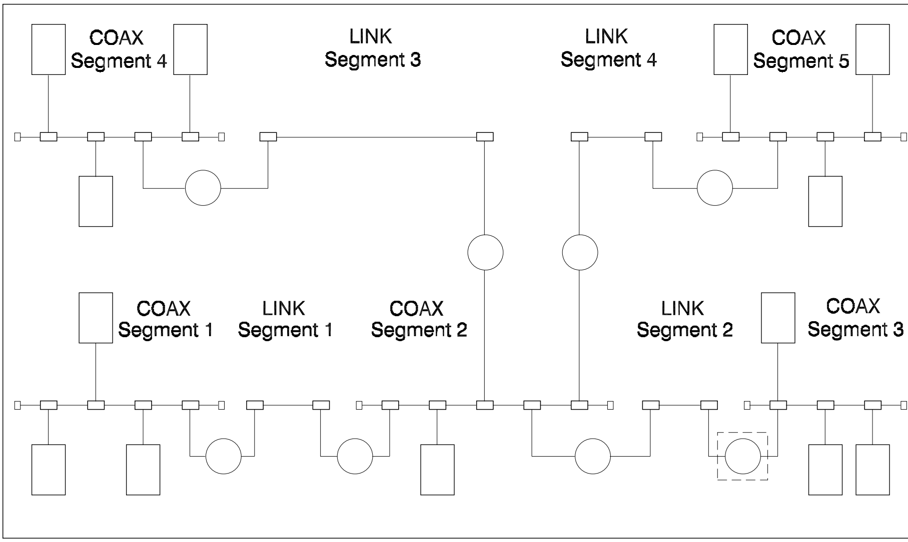


Fig. 5-20 Large system with max. possible transmission distances

The following rules must be observed when using repeaters:

- The number of repeaters between two nodes is limited to four.
- Installations with more than five segments (three coax and two link segments) require bridges.
- Repeaters for 10Base2 exist, but should not be used. Possible future expansions can be better realized by using a 10Base5 segment without repeaters than several 10Base2 segments with repeaters.
- When designing a new network, use as few repeaters as possible to allow future expansions.
- Fiber optic links with network concentrator are an alternative to coaxial cables with repeaters. Modules with repeater functionality are available.

5.8 Connection to the Symphony operator level

A Freelance 2000 system can be connected to the supervisory Symphony operator level via a gateway CPU, i.e. a normal CPU module DCP 02 or DCP 10 with a special gateway software. The gateway CPU collects the requests from the supervisory system, pre-processes the data, and transmits the data to the CPU modules of the Freelance 2000 system.

5.8.1 Connection without redundancy

Figure 5-21 shows a Freelance 2000 system with two process stations, one operator station, and one gateway CPU.

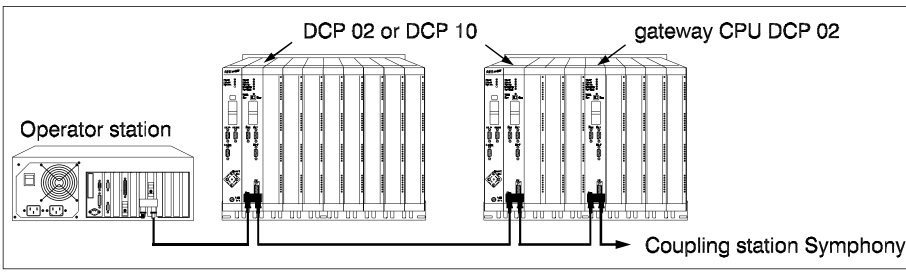


Fig. 5-21 Non-redundant connection to the Symphony operator level

Plug the gateway CPU in slot 1 ... 8 of a process station, slot 0 ... 8 of an I/O unit or a separate rack of the Freelance 2000 system. The gateway CPU needs only the power supply from the rack. Data transmission to the gateway CPU is done via the DigiNet S system bus, exclusively.

Connect the gateway CPU to the DigiNet S system bus in the same way as all other CPU modules. Note that the minimum length of the 10Base2 cable is 0.5 m. Lay the DigiNet S system bus up to the coupling station of the Symphony system. Connect the network cable to the coupling station as specified in the Symphony reference manual.

Fig. 5-22 shows the connection of two gateways using a DCP 10. Note that the DigiNet S buses have a separation from the operator station and from the Symphony coupling station.

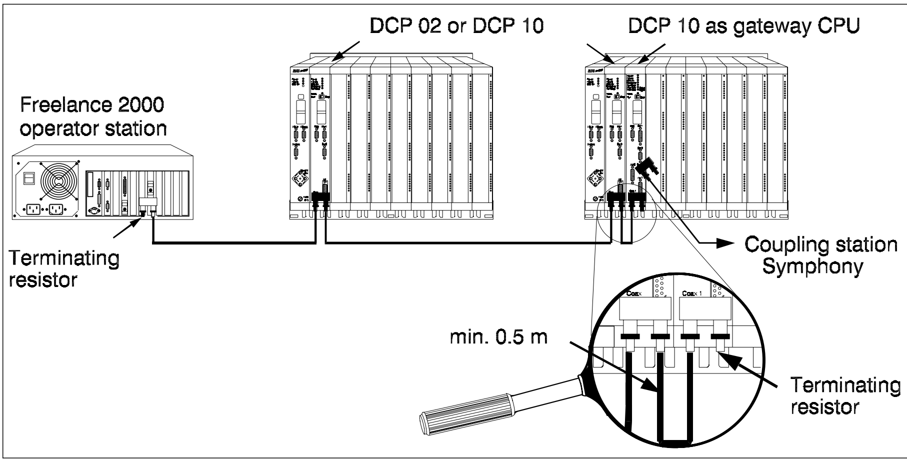


Fig. 5-22 Connection to the Symphony operator level via a DCP 10

The example seen in Fig. 5-22 shows cabling with a 10Base2 cable. Cabling with a 10Base5 or 10BaseFL cable can be done analogously, with the exception of the gateway CPU, which additionally has to be connected to the DigiNet S system bus.

5.8.2 Redundant connection

Redundant connection to the Symphony system is done as described in Section 5.8.1. Figure 5-23 shows a Freelance 2000 system with two process stations, one operator station and one gateway CPU.

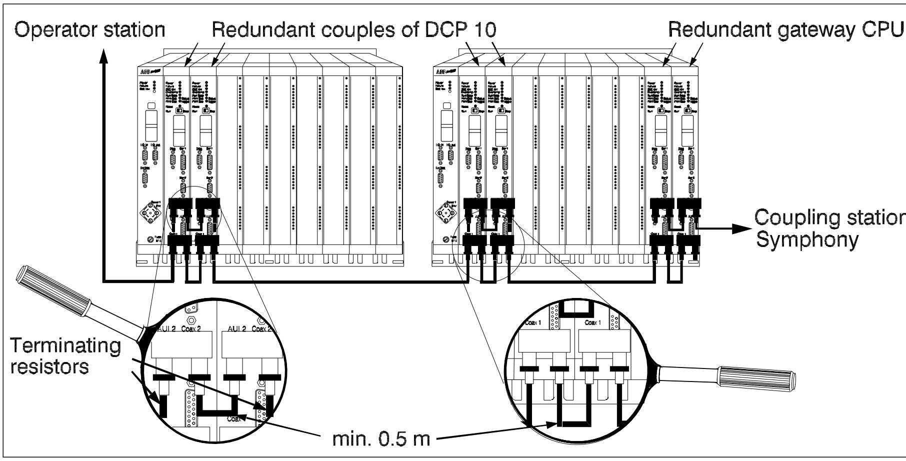


Fig. 5-23 Connection to the Symphony system via a redundant CPU and a redundant gateway

Use CPU module DCP 10 for redundant connection. It is not possible to use CPU module DCP 02. Connect the redundant network cable DigiNet Sr in the same way as described for DigiNet S.

Observe the minimum required cable length of 0.5 m for the 10Base2 cable. Lay the DigiNet S system bus up to the coupling station of the Symphony system.

6 Switching On the Process Station

6.1 Verifying rack ID and station number

Verify the rack ID and station number settings before switching on the supply voltage.

Check the type label to see **if valid numbers** were **filled in** when the station was mounted.

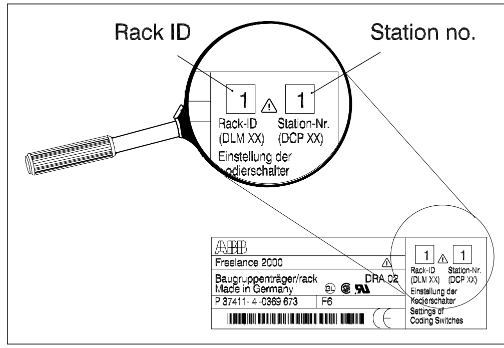


Fig. 6-1 Rack type label

Check the coding switches for correct rack ID settings. Refer to Section 3.3.1 **Adjusting the link module** for details. The station number is used to identify the station in the system. Check if the station number configured in **DigiTool** is the same as the one written on the type label.

6.2 Setting the IP address

Check the coding switches for correct station number settings. Refer to Section 3.3.3 **Adjusting the CPU module,** Section 3.3.8 **Adjusting the gateway CPU,** and Section 3.3.10, **Adjusting the CPU module for redundant operation** for details.

The coding switch is at the back of the CPU module. In Section 3.3.3 a distinction is made between IP address settings for the standard and the special case.

Standard case

The **standard case** is valid if:

- **up to 15 process stations** are used on a system bus **and**
- **Freelance 2000** components are used **exclusively and**
- there is **no connection to other networks.**

Set the coding switch of the first process station to **1** and **increase by one** for each additional process station. From the tenth station on the characters **A** to **F** have to be used. **Do not set to 0**. The assignment described above is **not** valid for coding switch position 0. The special case described further below applies instead. The process station will then work with a standard IP address:

172.16.1.<coding switch position> → (only for positions 1 to F)

Example:

- Coding switch position **1** → IP address = 172.16.1.**1**
- Coding switch position **9** → IP address = 172.16.1.**9**
- Coding switch position **A** → IP address = 172.16.1.**10**
- Coding switch position **F** → IP address = 172.16.1.**15**

Always make sure that the last field of the IP address is unique and is not used twice in the considered network!

Special case

This special case is valid if:

- **other nodes** are working on the Ethernet together with Freelance 2000 nodes (process station, operator station, engineering station) **or**
- the system bus is **connected to other networks or**
- **16 or more process stations** are used on the same system bus.
  (Notice maximum bus load of the system bus).

In this case the coding switches of **all** CPU modules must be set to **0**. However, the IP addresses of up to 15 CPU modules can be set as described for the standard case.

Make sure that the IP address is unique and is not used twice in the considered network!

Switch position 0 has a special function. The CPU module does not work under the standard IP address **172.16.1. ...** Instead, the user has to **enter** the **complete IP address** (all digits) via the diagnostic interface (see Section 6.4). Contact your network administrator for this IP address.

Adjusting the gateway CPU for Symphony connection

When using a gateway CPU DCP 02 or DCP 10 for connecting the Freelance 2000 system to the Symphony operator level, the IP address setting of this CPU module has to be verified as well.

In the standard case, the gateway CPU is handled like a CPU module in the Freelance 2000 system. The gateway functionality is set either automatically via the slot or manually via the diagnostic interface. The special case described in this section is analogously valid. Assign an IP address so far not used in your system to the gateway CPU.

Adjusting the redundant gateway CPU for Symphony connection

If two gateway CPUs DCP 10 are used for redundant connection to the Symphony operator level, check their IP addresses, too.

Assign different IP addresses to the redundant gateway CPUs using the coding switches, as described above. With this you assign IP addresses to each of the redundant gateway CPUs which are so far not used in your system.

6.3 Switching on the supply voltage

Set the Run/Stop switch of the CPU module to **Run**. Switch on the power supply of the process station and the external supply of the output modules.

Check the status indicators described below as a first diagnosis.

6.3.1 Status indicators of power supplies DPW 01, DPW 02 and DPW 03

Check the green **status indicator LED "V_{out}"** of **all power supplies DPW 01, DPW 02 or DPW 03**.

V_{out} indicates that a **24 V output voltage** is available.

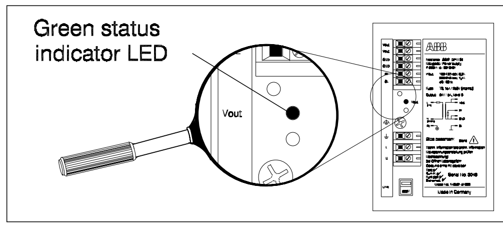


Fig. 6-2 Power supply status indicator LED

If the LED does not light up, check :

- the power input to see if the correct input voltage is applied.
- the voltage selector switch of the power supply to see if it is set correctly.
- the power supply output for shorts.
- the cables to the **Freelance 2000** process station.

The power supply output is short circuit and overload proof. If a short circuit occurs at the output, the power supply restarts normal operation after the short circuit has been removed.

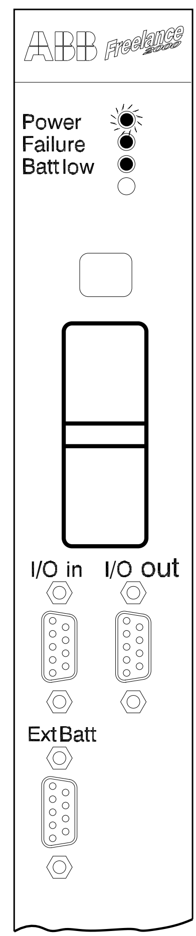
6.3.2 Status indicators of link module DLM 01

Figure 6-3 shows the status indicator LEDs of the link module DLM 01.

			Color	Nomal state
Status indicators	Power	●	green	On (during operation)
	Failure	●	red	Off
	Batt low	●	yellow	Off

Fig. 6-3 Status indicators of link module DLM 01

The LEDs indicate the following:



Power LED

Indicates that the supply voltage from the power supply is applied.

If the **Power** LED does not light up, check:

- the connection of the 24 V cable DSU 10
- and if a 24 V voltage is available at the power supply output.

Failure LED

Indicates the power fail signal of the power supply. Lights up in case of an undervoltage at the power input.

If the **Failure** LED lights up, check:

- the connection of the 24 V cable DSU 10 to the power supply
- the power input for correct voltage and proper cabling.

Batt low LED

Indicates that the buffer battery is discharged or not plugged in. In the case of external battery supply, no internal buffer battery is required. For details refer to Sections 4.2.3 and 4.2.4.

If the **Batt Low** LED lights up, check:

- if the buffer battery holder with the battery is plugged in,
- the battery for correct polarity,
- the buffer battery **voltage** (nominal voltage 3.6 V, minimum voltage 2.9 V).

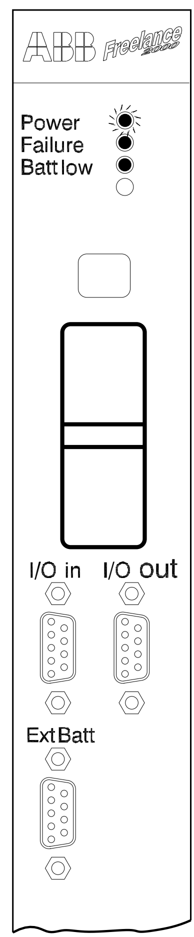
6.3.3 Status indicators of link module DLM 02

Figure 6-4 shows the status indicator LEDs of the link module DLM 02.

		Color	Nomal state
Status indicators	Power ●	green	On (during operation)
	Failure ●	red, orange, green	green
	Batt low ●	yellow	Off
	Status ●	red, red flashing, orange flashing, green flashing, off	green

Fig. 6-4 Status indicators of link module DLM 02

The LEDs indicate the following:



Power LED

Indicates that the internal supply voltage (5 V) is applied.

If the **Power** LED does not light up, check

- the connection of the 24 V cable DSU 10
- and if a 24 V voltage is available at the power supply output.

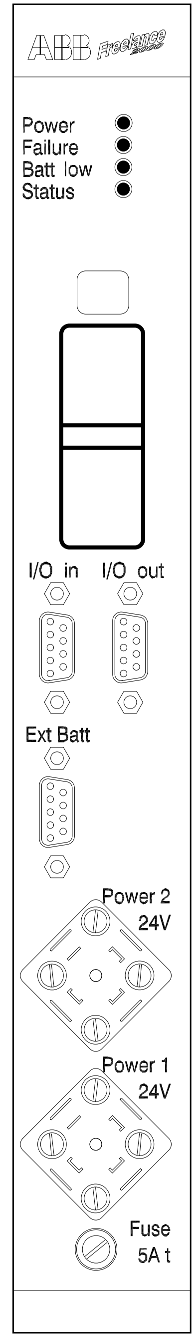
Failure LED

Indicates the power fail signal of the connected power supplies. If the **Failure LED does not light up green** check:

- the connection of the 24 V cables DSU 10 to the power supplies,
- the power inputs for correct voltage and proper cabling.

Note: DLM 02 is not intended to be powered by only one power supply. Use DLM 01 for this purpose.

Batt low LED



LED **must not light up** with plugged-in buffer battery or connected external battery.

Indicates that neither a buffer battery is plugged in the link module nor an external battery is connected.

If the **Batt low** LED **lights up** although a **buffer battery** is plugged in check:

- the buffer battery holder with the **battery** for correct installation and the battery for **correct polarity**.
- the buffer battery **voltage** (nominal voltage 3.6 V, minimum voltage 2.9 V).

If the **Batt low** LED **lights up** although an **external battery** is connected, check:

- if the battery is connected properly to the battery cable DSU 12 and if the **voltage** is correct (nominal voltage 3.6 V or 24 V).

For more details about the installation and connection of the used battery please refer to Sections 4.2.3 and 4.2.4.

Status LED

This LED indicates the operating status of the module. In the **normal status** this LED lights up **green**. If it should be flashing green or orange or be off for a short time after power-on, this indicates that the module is performing an internal self-test and software initialization. Only if the LED remains **off for a longer time** or **lights up or flashes red**, this indicates an **error**. In this case check:

- the connection of the 24 V cable DSU 10,
- if a 24 V voltage is available at the power supply outputs
- if the CAN terminating resistors DSU 01 are installed properly on the I/O in and I/O out connectors.

6.3.4 Status indicators of CPU module DCP 02

The CPU module DCP 02 has been modified. The new version can be identified through its hardware revision level (HW index) of 50.00 or higher. The differences were kept as small as possible. In the following text, the modified DCP 02 module (HW index ≥ 50.00) is described. Therefore, the only difference concerning the status indicators is explained here:

The **Failure** indicator has been adapted to that of the DCP 10 module and is now also a bi-color LED indicating statuses clearer and in the way already known from the DCP 10.

Figure 6-5 shows the status indicators and operating elements of the CPU module.

		Color	Normal state
Status indicators	Power ●	green	On (during operation)
	Failure ●	red, orange	Off
	Batt low ●	yellow	Off
	Overtemp ●	red	Off
	Run/Stop ●	red, orange, green	Temporarily on
Operating elements	Reset ●	Switch	
	Run/Stop	Switch	

Fig. 6-5 Status indicators and operating elements of CPU module DCP 02

The LEDs indicate the following:

Power LED

Indicates that all internal supply voltages of the CPU are available.

If the **Power** LED does not light up, check:

- if the CPU module has been plugged in correctly and fastened with screws.
- if the **Power** LED of the link module lights up. If so, the CPU module is defective.

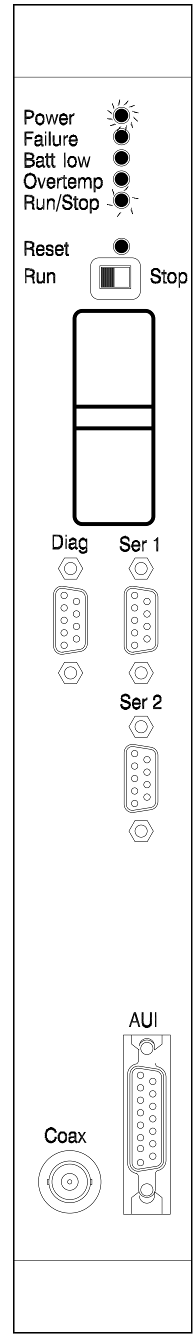
Failure LED

Indicates internal error statuses of the CPU module. While the self-test is in progress, the LED lights up orange permanently. (DCP 02 with a HW index < 50.00 only has a red LED which is permanently lighted while the self-test is in progress.) When the module is ready to operate after the test, the LED goes off.

If the **Failure** LED remains lighted red after the self-test is finished, this indicates that an internal module error has been detected. If an internal module error has been detected during a previous self-test, the **Failure** LED is permanently lighted orange, and remains lighted orange (permanently lighted red on DCP 02 with hardware index < 50.00). Only upon acknowledgement via a diagnostic terminal the self-test is started again.

- Connect a diagnostic terminal or PC. For details refer to Section 6.4.

Note: If **0** has been set as the **station number**, enter a valid IP address via the diagnostic interface. Switch Run/Stop switch to Stop. Otherwise, the **Failure** LED flashes.



Batt low LED

Indicates that the buffer battery of the CPU module is discharged or not plugged in. In the case of external battery supply, no internal buffer battery is required for the CPU module. For details refer to Sections 4.2.3 and 4.2.4.

If the **Batt Low** LED lights up, check:

- if the buffer battery holder with the battery is plugged in,
- the battery for correct polarity,
- the buffer battery **voltage** (nominal voltage 3.6 V, minimum voltage 2.9 V).

Overtemp LED

If the **Overtemp** LED lights up, the internal temperature of the module is higher than the max. permissible temperature of 70 °C.

In this case check:

- the ambient temperature at the CPU bottom side. The max. permissible temperature is 50 °C.
- the minimum spacing of the racks and power supplies.
- the air vents for dirt. Make sure that air convection is not impaired.

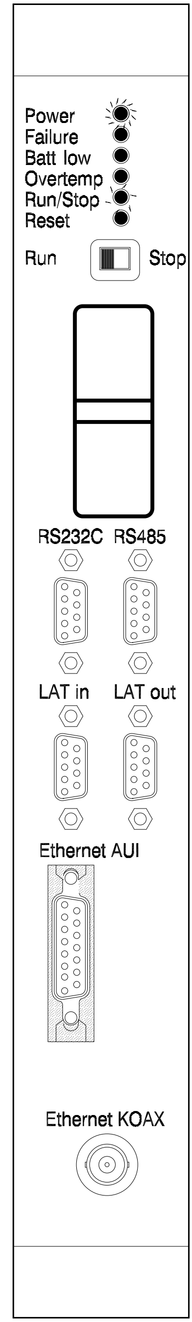
Run/Stop LED

The **Run/Stop** LED lights up **green** when the operating system of the process station is working. Modules straight from factory require a bootstrap through the engineering station.

If the **Run/Stop** LED remains lighted **red**

- set the Run/Stop switch to **Run**.

Note: The engineering station can set the process station to the **Stop** status, even if the Run/Stop switch is in the Run position.



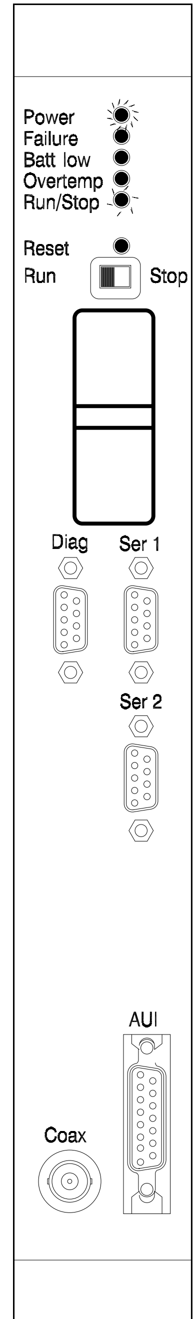
HW-Index < 50.0

Operating elements:

Reset switch

This push button switch serves for **resetting** the CPU module. A cold or a warm start is initiated, depending on the system status. The reset switch is recessed and can only be pressed with a "tool" (e.g. ball-point pen, paper clip, etc.).

The switch is provided with a **delay circuit** to protect it from accidental activation. A cold start of the module is initiated only when the Reset switch is pressed for approx. 4 seconds. Pressing the switch for a shorter time initiates a warm start.



HW-Index ≥ 50.0

Run/Stop switch

Serves for stopping the functional sequences of control.

Switch to **Run** position	Normal operation. Functional sequences are running. When the module is **reset**, **no** diagnostic menu appears at the diagnostic interface.
Switch to **Stop** position	Functional sequences are stopped. A **diagnostic menu appears** at the diagnostic interface when the module is **reset**.

The **Run/Stop** LED indicates the operating status of the process station:

Run/Stop LED

green	Processing of functional sequences is running.
red	Processing of functional sequences is stopped.
off	Process station not yet ready to operate. Operating system has not yet been loaded or started.

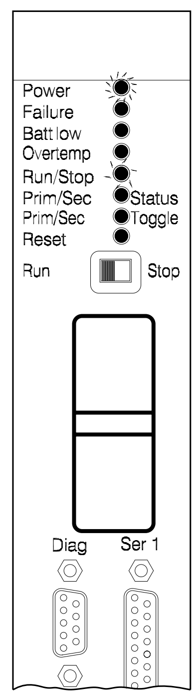
6.3.5 Status indicators of CPU-module DCP 10

Figure 6-6 shows the status indicators and operating elements of the CPU module.

			Color	Normal state
Status indicators	Power		green	On (during operation)
	Failure		red, orange, green	Off
	Batt low		yellow	Off
	Overtemp		red	Off
	Run/Stop		red, orange, green	Temporarily on
	Prim/Sec	Status	red, orange, green	green
Operating elements	Reset		Switch	
	Prim/Sec	Toggle	Switch	
	Run	Stop	Switch	

Fig. 6-6 Status indicators and operating elements of CPU module DCP 10

The LEDs indicate the following:



Power LED

Indicates that all internal supply voltages of the CPU are available. If the **Power** LED does not light up, check:

- if the CPU module has been plugged in correctly and fastened with screws.
- if the **Power** LED of the link module lights up. If so, the CPU module is defective.

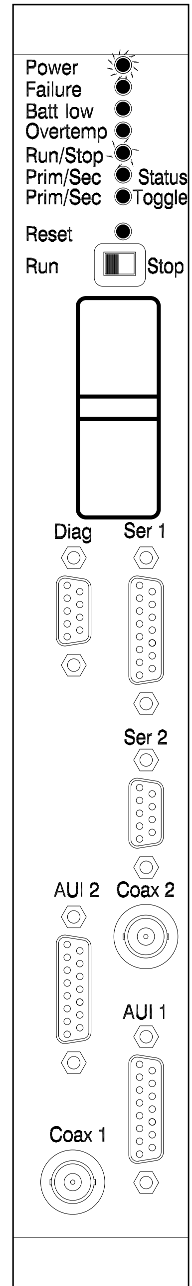
Failure LED

Indicates internal error statuses of the DCP 10 module. While the self-test is in progress, the LED lights up orange permanently. When the module is ready to operate after the test, the LED goes off.

If the **Failure** LED remains lighted red after the self-test is finished, this indicates that an internal module error has been detected. If an internal module error has been detected during a previous self-test, the **Failure** LED is permanently lighted orange, and remains lighted orange. Only upon acknowledgement via a diagnostic terminal the self-test is started again.

- Connect a diagnostic terminal or PC. For details refer to Section 6.4.

Note: If the **coding switch** has been set to **position 0**, enter a valid IP address via the diagnostic interface. Set the Run/Stop switch to Stop. Otherwise, the **Failure** LED flashes.



Batt low LED

Indicates that the buffer battery of CPU module is discharged or not plugged in. In the case of external battery supply, no internal buffer battery is required for the CPU module. For details refer to Sections 4.2.3 and 4.2.4.

If the **Batt Low** LED lights up, check

- the buffer battery holder with the battery for correct installation,
- the battery for correct polarity,
- the buffer battery **voltage** (nominal voltage 3.6 V, minimum voltage 2.9 V).

Overtemp LED

If the **Overtemp** LED lights up, the internal temperature of the module is higher than the max. permissible temperature of 70 °C.

In this case check:

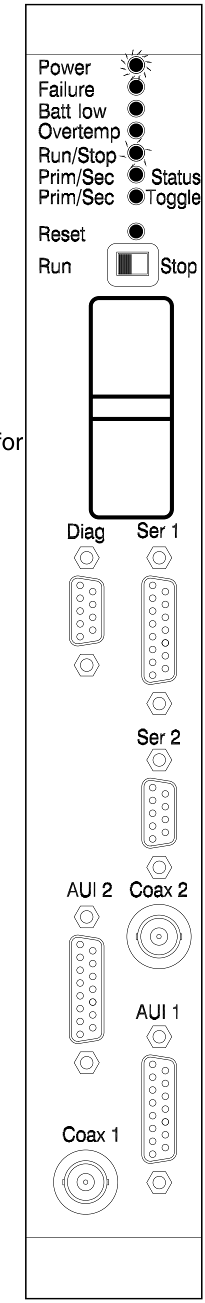
- the ambient temperature at the CPU bottom side. The max. permissible temperature is 50 °C.
- the minimum spacing of the racks and power supplies.
- the air vents for dirt. Make sure that air convection is not impaired.

Run/Stop LED

In redundant mode, only the status indicators of the **Primary** are important, since only these indicate the status of the process station. The **Run/Stop** LED on the Secondary is always off.

off	Process station not yet ready to operate. Operating system has not yet been loaded or started.
green, static	Processing of functional sequences is running. The operating system of the process station is working. Note that modules straight from factory will only do this after first bootstrap through the engineering station.
green, flashing	Functional sequence processing was stopped and is now started again. The user tasks are started, and the Run task is being executed.
orange	Self-test is in progress

red, static	Processing of functional sequences is stopped
red, flashing	Processing of functional sequences was 'running' and is stopped now. The user tasks are stopped, and the stop task is executed.



If the **Run/Stop** LED lights up **red** permanently:

- set the Run/Stop switch to the **Run** position.

Note: The engineering station can set the process station to the **Stop** status, even if the Run/Stop switch is in the Run position.

Prim/Sec Status LED

For a non-redundant process station only two states are possible for the **Prim/Sec Status** LED**.**

off	Normal operation
orange	Self-test is in progress

In the case of a redundant process station the **Prim/Sec** LED has a different meaning on the **Primary** and on the **Secondary**.

Prim/Sec Status LED on the **Primary:**

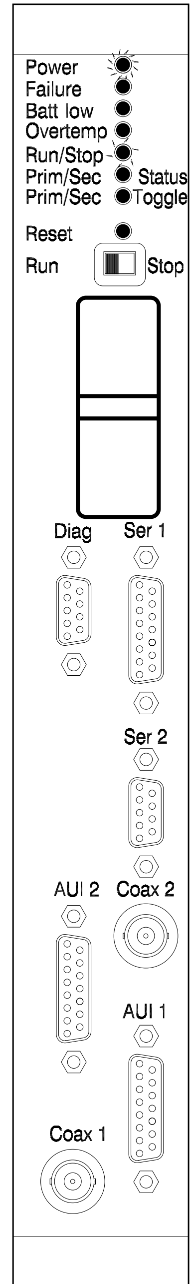
off	No redundant mode configured
green, static	Synchronous operation, normal operation in redundant mode.
green, flashing	Non-synchronous operation, transitional state while the data set is being matched with that of the **Secondary**
orange, static	Redundant mode configured, but **Secondary** not found or failed or error in redundant mode.

Prim/Sec Status LED on the **Secondary:**

off	No redundant mode configured, or operating system has not yet been downloaded to the process station.
orange, static	Synchronous operation
orange	Synchronization not yet complete.
red, static	Error occurred in redundant mode.

Operating elements:

Reset switch



This push button switch serves for **resetting** the CPU module. A cold or a warm start is initiated, depending on the system status. The reset switch is recessed and can only be pressed with a "tool" (e.g. ball-point pen, paper clip, etc.).

The switch is provided with a **delay circuit** to protect it from accidental activation. A cold start of the module is initiated only when the Reset switch is pressed for approx. 4 seconds. Pressing the switch for a shorter time initiates a warm start.

Peculiarities in redundant mode:

If the Reset button on the Primary is pressed for more than 4 seconds, the Primary performs a cold start, and a redundancy toggle is initiated.

If the same button is pressed for more than 4 seconds on the Secondary, only the Secondary performs a cold start. Pressing the Reset button on the Primary for less than 4 seconds initiates a warm start of both CPU modules. The CPU module previously active again becomes Primary. Pressing the Reset button on the Secondary for less than 4 seconds has no effect.

Run/Stop switch

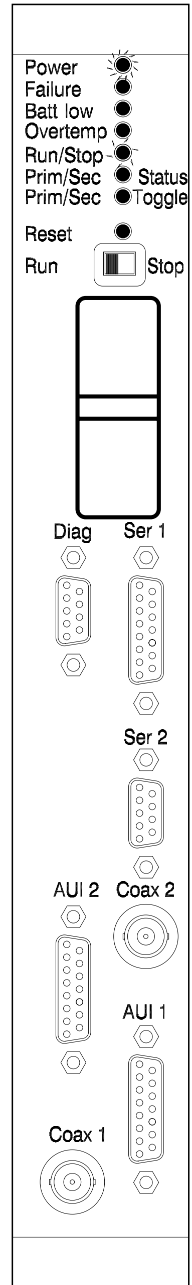
Serves for stopping the functional sequences of control.

In redundant mode, the position of the **Run/Stop** switch on the **Primary** has an effect on both CPU modules, whereas the switch on the **Secondary** is ignored. After a redundancy toggle the **Primary** retains its last state, independently of the switch position on the CPU module that has become active. Only when the switch is actuated again are the switch position and the indicator LED synchronized.

.

The positions of the Run/Stop switches on both CPU modules are permanently monitored. If they should be different, a corresponding system message indicating the current positions of the two switches is generated within 15 seconds.

Switch to **Run** position	Normal operation. Functional sequences are running. When the module is **reset**, **no** configuration menu appears at the diagnostic interface.
Switch to **Stop** position	Functional sequences are stopped. A **configuration menu appears** at the diagnostic interface when the module is **reset**.



Prim/Sec toggle switch

A redundancy toggle is initiated when the CPU modules are in redundant mode **and** in SYNC mode and the toggle switch on the **Primary** is actuated.

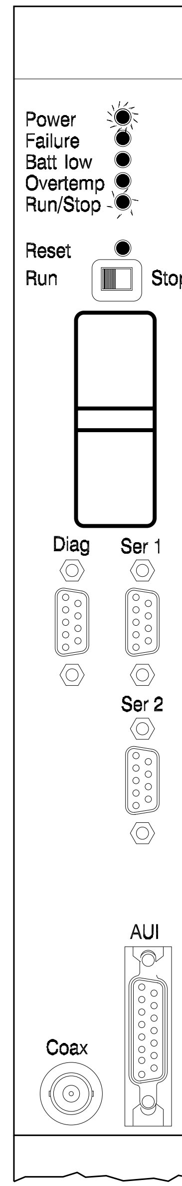
The previously active CPU module changes over to passive mode without rebooting.

Note: Manual switch-over using the Prim/Sec toggle switch is only possible on the **Primary**. Pressing this switch on the **Secondary** has no effect.

6.3.6 Status indicators of gateway CPU for Symphony connection

A conventional CPU module DCP 02 or DCP 10 is used as a gateway CPU for connecting the Freelance 2000 system to the Symphony system. The specifications given in Sections 6.3.4 and 6.3.5 are valid.

However, the following operating and indicating elements have **another** function than those of a conventional CPU module:



Run/Stop switch

Switch to **Run** position	After module **reset no** configuration menu appears at the diagnostic interface.
Switch to **Stop** position	A **configuration menu appears** at the diagnostic interface after module **reset**.

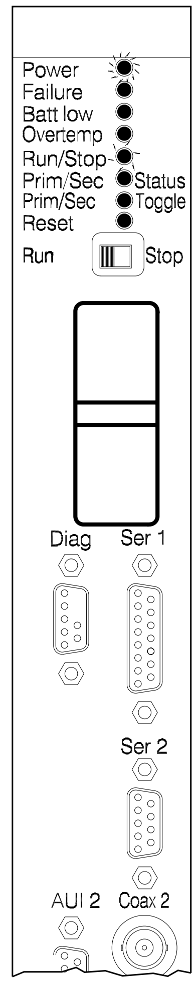
Run/Stop LED

green	Normal operation, gateway CPU ready to operate.
red	Not used.
off	Gateway CPU not yet ready to operate. Operating system has not yet been loaded or started.

6.3.7 Status indicators of redundant gateway CPU for Symphony connection

Two normal CPUs DCP 10 are used as a redundant gateway for connection to the Symphony level. The specifications given in Section 6.3.5 are valid.

The following operating and indicating elements have other functions which are **different** from the normal CPU function:



Run/Stop switch

Switch to **Run** pos.:	After module **reset no** configuration menu appears at the diagnostic interface.
Switch to **Stop** pos.:	**A configuration menu appears** at the diagnostic interface after module **reset**.
Note:	The engineering station can set the process station to the **Stop** status, even if the Run/Stop switch is in the Run position.

Run/Stop-LED

green	Normal operation. Gateway CPU ready to operate.
red	Not used.
off	Gateway CPU not yet ready to operate. Operating system not yet loaded or started.

6.3.8 General information about the I/O module status indicators

With Freelance 2000 software release 2 and higher the I/O modules have the capability to switch the outputs autonomously to pre-configured safe values. Any DigiNet P interruption or CPU module failure initiates the switch-over to the safe values. Therefore, the Status LED of the I/O modules has an extended functionality to be able to indicate the different I/O module statuses.

The status diagram seen in Fig. 6-7 shows the possible I/O module statuses and status changes. Some minor status changes resulting from internal errors have been omitted to simplify the diagram.

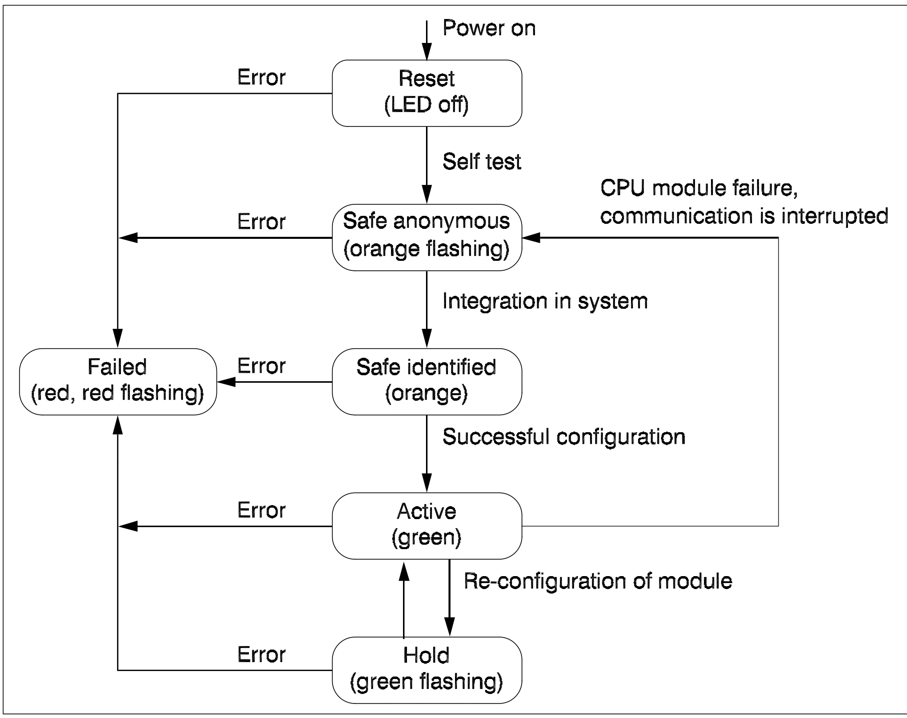


Fig. 6-7 I/O module status diagram

The following statuses are possible:

Reset status (Status LED off)

The module is powered up for the first time. There is no communication with the CPU module. The outputs are set to zero. This status can be quitted after successful performance of a self-test.

Safe anonymous status (Status LED flashes orange)

There are two ways to reach this status:

1. From the **Reset** status. In this case the module has successfully performed a self-test and waits for establishing communication with the CPU module. All outputs of output modules are set to the safe value. As the module does not yet know any safe values (e.g. if spare module from stock or first use of module), the safe values are set to the default value, which is zero.

2. From the **Active** status after CPU failure or interruption of the DigiNet P. In this case the module already knows its configured safe values. The outputs of digital output modules switch over to the Hold status, default one or default zero, as configured. The outputs of the analog output modules switch over to the Hold status or a default value, as configured. If no safe value was configured, the default setting of all outputs is zero.

The module can change over to the **Safe identified** status (Status LED lights up orange) by establishing communication with the CPU module.

Safe identified status (Status LED lights up orange)

The module can enter this status from the **Safe anonymous** status. The CPU module has set up communication with the I/O module. Communication monitoring is on. The information given above for the **Safe anonymous** status is valid for the outputs. All unconfigured I/O modules remain in the **Safe identified** status. The module can change over to the **Active** status by configuration. With the configuration data the module also receives the safe values and stores them.

Active status (Status LED lights up green)

The I/O module switches over to the **Active** status after successful configuration through the CPU module. Normal data transfer is in progress.

After CPU module failure or DigiNet P interruption the communication monitoring in the I/O module is activated. The module changes over to the **Safe anonymous** status and switches all outputs to the configured safe values. The module can be re-activated by a new communication setup of the CPU module by passing through the **Safe identified** status.

Hold status (Status LED flashes green)

This status can be reached from the **Active** status. If an I/O module receives a new configuration while the system is running, it changes over to the **Hold** status for a short time and then immediately returns to the **Active** status. This is done, for example, when an I/O module receives a new cycle time. The outputs hold their last value while re-configuration is in progress, independently of the configured safe values. After successful configuration the module automatically returns to the **Active** status.

Failed status (Status LED lights up red or flashes red)

The **Failed** status can be reached from all other statuses. The reason for the status change is a fatal internal error. After triggering the hardware watchdog the module either changes to the **Reset** status, or it remains in the **Failed** status. The module is defective and needs to be replaced.

The following table gives an overview of the Status LED colors:

Color	Module status	Output response [1]
Off	No voltage applied to module or self-test not yet completed.	Outputs to zero
Red or red flashing	Internal module error	Outputs to zero
Orange flashing	Self-test completed, module does not yet participate in communication on the DigiNet P	After module reset (power on): all outputs to zero. After DCP failure/DigiNet P interruption: all outputs to configured safe values.
Orange	Self-test completed, module is participating in communication on the DigiNet P.	After module reset (power on): all outputs to zero. After DCP failure/ DigiNet P interruption: all outputs to configured safe values.
Green flashing	Module is re-configured while the system is running.	Outputs are held for a short time
Green	System is running	Current values at the outputs.

⚠ **While a software update is in progress and data is downloaded to the station, the LED may assume a state that is different from the states described above.**

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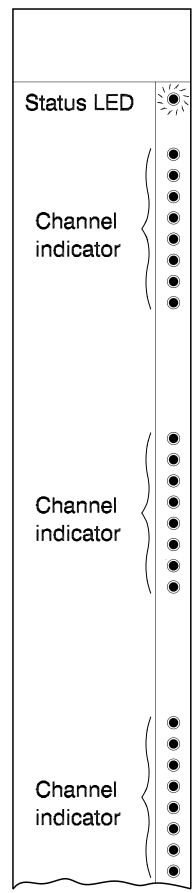
6.3.9 Status indicators of digital input module DDI 01

Figure 6-8 shows the status indicators of the digital input module DDI 01.

		Color	Normal state
Status LED	●	Off, red, red flashing, orange, orange flashing, green, green flashing	Lights up green
Channel indicator LED	●	green	Depending on input

Fig. 6-8 Status indicators of digital input module DDI 01

The LEDs indicate the following:



Status LED

Refer to Section 6.3.8, General information about the I/O module status indicators.

Channel indicator LEDs

Indicate the switching statuses of the inputs.

- Voltage across input higher than 15 V **green**
- Voltage across input lower than 5 V **off**

If a channel indicator LED does not light up although the input is switched:

- check the input cabling, especially the common ground connector.

6.3.10 Status indicators of digital input modules DDI 02 and DDI 03

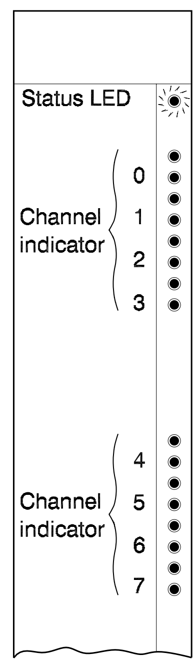
The DDI 02 and DDI 03 modules have the same status indicators. Only the input voltage ranges are different.

Figure 6-9 shows the status indicators of the digital input modules DDI 02 and DDI 03.

	Color	Normal state
Status LED ●	Off, red, red flashing, orange, orange flashing, green, green flashing	Lights up green
Channel indicator LED ●	green	Depending on input

Fig. 6-9 Status indicators of digital input modules DDI 02 and DDI 03

The LEDs indicate the following:



Status LED

Refer to Section 6.3.8, General information about the I/O module status indicators.

Channel indicator LEDs

Indicate the switching statuses of the inputs.

For the DDI 02 module:

- Voltage across input ≥ 15 V DC or ≥ 15 V AC **green**
- Voltage across input ≤ 5 V DC or ≤ 5 V AC **off**

For the DDI 03 module

- Voltage across input ≥ 79 V AC **green**
- Voltage across input ≤ 20 V AC **off**

6.3.11 Status indicators of digital input module DDI 04

Figure 6-10 shows the status indicators of digital input module DDI 04.

		Color	Normal state
Status LED	●	Off, red, red flashing, orange, orange flashing, green, green flashing	Lights up green
Channel indicator LED	●	Off, green, red	Depending on input
External supply LED	●	Off, green	green

Fig. 6-10 Status indicators of digital input module DDI 04

The LEDs indicate the following:

Status LED

Refer to Section 6.3.8, General information about the I/O module status indicators.

Channel indicator LEDs

Indicate the switching status of the input.

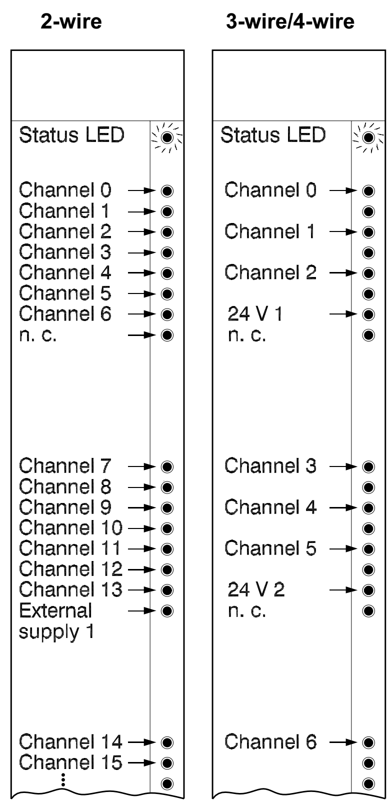
- Input voltage logical "High“ **green**
  Voltage level depending on configuration.
- Input voltage logical "Low“ **off**
- Disturbance of channel **red**

The channel indicator LEDs light up **red**

- in case of a channel disturbance. This may be due to a line break or short-circuit of the input. In this case check the channel cabling up to the transmitter for short-circuit or line break.

If the channel indicator LEDs do not light up although the input is set to "High":

- check the input cabling, especially the common ground connector.



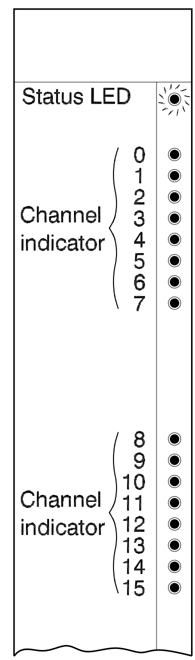
6.3.12 Status indicators of digital input module DDI 05

Figure 6-11 shows the status indicators of digital input module DDI 05.

	Color	Normal state
Status LED	Off, red, red flashing, orange, orange flashing, green, green flashing	Lights up green
Channel indicator LED	Off, green	Depending on input

Fig. 6-11 Status indicators of digital input module DDI 05

The LEDs indicate the following:



Status LED

Refer to Section 6.3.8, General information about the I/O module status indicators.

Channel indicator LEDs

Indicate the switching status of the inputs.

For the DDI 05 module:

Voltage across input $\geq$ 79 V AC **green**

Voltage across input $\leq$ 25 V AC **off**

If the channel indicator LED does not light up although the input is set to "High":

- check the input cabling, especially the common ground connector.

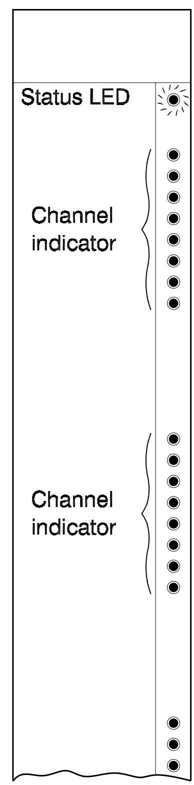
6.3.13 Status indicators of digital output module DDO 01

Figure 6-12 shows the status indicators of the digital output module DDO 01.

	Color	Normal state
Status LED ●	Off, red, red flashing orange, orange flashing, green, green flashing	Lights up green
Channel indicator LED ●	green	Depending on output

Fig. 6-12 Status indicators of digital output module DDO 01

The LEDs indicate the following:



Status LED

Refer to Section 6.3.8, General information about the I/O module status indicators.

Channel indicator LEDs

Indicate the switching statuses of the outputs.

- Output switched (to 24 V) **green**
- Output not switched **off**

The channel indicator LEDs only light up if the module has been configured through the engineering station and after output of the appropriate I/O values.

If a channel indicator LED does not light up although the output has been configured and switched, and the status LED lights up green:

- check the external power supply of the respective output group.

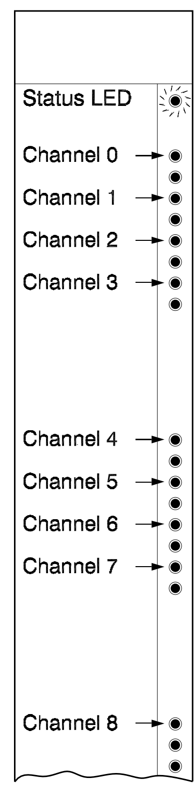
6.3.14 Status indicators of digital output module DDO 02

Figure 6-13 shows the status indicators of the digital output module DDO 02.

	Color	Normal state
Status LED ●	Off, red, red flashing, orange, orange flashing, green, green flashing	Lights up green
Channel indicator LED ●	green	Depending on output

Fig. 6-13 Status indicators of digital output module DDO 02

The LEDs indicate the following:



Status LED

Refer to Section 6.3.8, General information about the I/O module status indicators.

Channel indicator LEDs

Indicate the switching statuses of the outputs.

- Output switched (relay contact closed) **green**
- Output not switched (relay contact open) **off**

The control voltage for the relay coil also drives the channel indicator LEDs. Use relay modules DDO 03 and DDO 04 if you need an indicator which shows whether or not a voltage is applied to the contact. These relay modules have a feedback function and directly monitor the voltage across the relay contact.

6.3.15 Status indicators of digital output modules DDO 03 and DDO 04

Fig 6-14 shows the status indicators of the digital output modules DDO 03 and DDO 04.

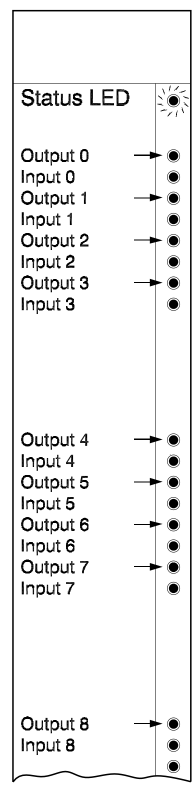
	Color	Normal state
Status LED ●	Off, red, red flashing orange, orange flashing, green, green flashing	Lights up green
Channel indicator LED ●	green	Depending on output

Fig. 6-14 Status indicators of digital output modules DDO 03 and DDO 04

The LEDs indicate the following:

Status LED

Refer to Section 6.3.8, General information about the I/O module status indicators.



Channel indicator LEDs

The digital output modules DDO 03 and DDO 04 are relay output modules with a feedback function. The module has a separate feedback channel for monitoring the relay contact to see:

- if it is working properly
- if a supply voltage is applied to the contact.

In case of error the module generates a system alarm. The module has two channel indicator LEDs for each channel.

Output LED

The output LED indicates the relay status.

- Output switched (relay contact closed) **green**
- Output not switched (relay contact open) **off**

The current for the LEDs is tapped off the relay field coil.

Input LED

The input LED indicates if a voltage is applied to the contact, i.e. the feedback status of the channel. The information listed in the table below is valid:

Output LED	Input LED	Condition indicated by the LEDs
on	off	Normal operation. Contact is working properly or no voltage across contact.
on	on	Relay contact defective (unable to close). A system alarm is generated.
off	on	Normal operation. Contact is working properly.
off	off	Relay contact defective (unable to open) or no voltage across output. A system alarm is generated.

It is recommended to switch off the feedback alarm for unused channels in the configuration mask to avoid false alarms.

Please observe minimum current of 100 mA for proper functioning of feedback function.

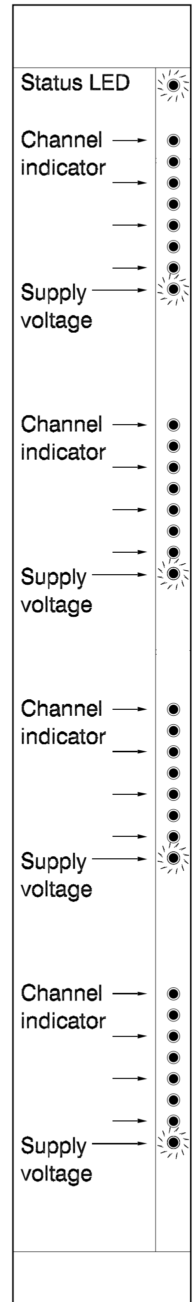
6.3.16 Status indicators of analog input modules DAI 01, DAI 02 and DAI 03

Figure 6-15 shows the status indicators of the analog input modules DAI 01, DAI 02 and DAI 03.

		Color	Normal state
Status LED	●	Off, red, red flashing orange, orange flashing, green, green flashing	Lights up green
Channel indicator LED	●	red	Off
Supply voltage LED	●	green	Light up green

Fig. 6-15 Status indicators of analog input modules DAI 01, DAI 02 and DAI 03

The LEDs indicate the following:



Status LED

Refer to Section 6.3.8, General information about the I/O module status indicators.

Channel indicator LEDs of DAI 01 and DAI 03

For the input signal range 0/4 ... 20 mA the channel indicator LEDs light up **red** if the current is out of this range (cable break or short circuit at the transmitter). If a channel indicator LED lights up check:

- the input circuit for cable break or transmitter short circuit.

Note: After switch-on the module defaults to measuring range 4 ... 20 mA. If you are working in the range 0 ... 20 mA and currents of less than 4 mA are applied, the red channel indicator LEDs go off only after module configuration (Status LED green).

Channel indicator LEDs of DAI 02 (0 ... 10 V)

In measuring range 0 ... 10 V the channel indicator LEDs light up **red** if the voltage is higher than 10 V (overvoltage across the input).

If a channel indicator LED lights up, check

- the input circuit for a short circuit

Supply voltage LEDs

All of the four supply voltage LEDs must light up. There are two DC/DC converters, each of them supplying one of the two I/O channel groups in the module (0 ... 7 and 8 ... 15) with supply voltages of + 12 V and - 12 V.

The **four supply voltage LEDs** indicate that these 12 V supply voltages are applied.

If the supply voltage LEDs do **not** light up, check:

- if the module has been plugged in and screwed correctly.
- the **Power** LED of the link module to see if a supply voltage is applied to the rack.

6.3.17 Status indicators of analog input module DAI 04

The DAI 04 module is designed for connection of RTD Pt100s, thermocouples and resistance teletransmitters and for direct input of millivolt signals.

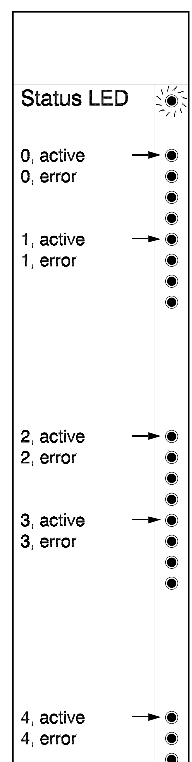
	Color	Normal state
Status LED	Off, red, red flashing orange, orange flashing green, green flashing	Lights up green
Channel active LED	green	Lights up at active input, only
Channel error LED	red	Off

Fig. 6-16 Status indicators of analog input module DAI 04

The LEDs indicate the following:

Status LED

Refer to Section 6.3.8, General information about the I/O module status indicators.



Channel active LEDs

The channel active LEDs of the DAI 04 module indicate which input channel is currently being processed. The module optimizes the channel processing order. All channels with the same measuring range are processed subsequently. The channel active LED indicates the following:

- **Channel being processed** **green**
- **Channel not being processed** **off**

Channel processing in the module is only started after successful configuration (Status LED lights up green).

Channel error LEDs

The DAI 04 module provides transient monitoring and channel-wise monitoring of the error statuses: measuring value above range and below range, so that cable breaks or other troubles are detected and indicated by the red channel error LEDs.

- **No channel error** **off**
- **Channel error** **red**

A system alarm is generated. After elimination of the fault statuses measuring value above or below range the channel error LED goes off. If a transient has been detected, the corresponding error indicator in the DigiVis system display or in the DigiTool (in commissioning mode) system display needs to be reset.

6.3.18 Status indicators of analog input module DAI 05

Figure 6-17 shows the status indicators of analog input module DAI 05.

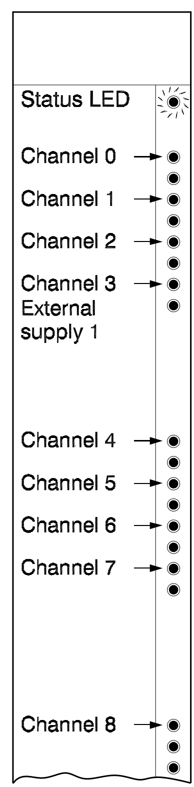
		Color	Normal state
Status LED	●	Off, red, red flashing orange, orange flashing green, green flashing	Lights up green
Channel active LED	●	Off, red	Off
External supply LED	●	Off, green	Lights up green

Fig. 6-17 Status indicators of analog input module DAI 05

The LEDs indicate the following:

Status LED

See Section 6.3.8, General information about the I/O module status indicators.



Channel indicator LED

Indicate input disturbances.

- Input current < 3.2 mA or > 20.8 mA **red**
- Input current 3.8 ... 20.2 mA **off**

If the channel indicator LED lights up **red**:

- the board has detected a **channel disturbance**. This may be due to a line break or short circuit of the input. In this case check the cabling of the channel up to the transmitter for short circuit or line break.

External supply LEDs

Indicate the secondary voltage status of transmitter supply. One LED is assigned to each group of 8.

- Voltage present **green**
- No voltage **off**

If the external supply LED does not light up:

- check the input cabling, especially the feed-in of the external power supply
- the module is defective; contact our service.

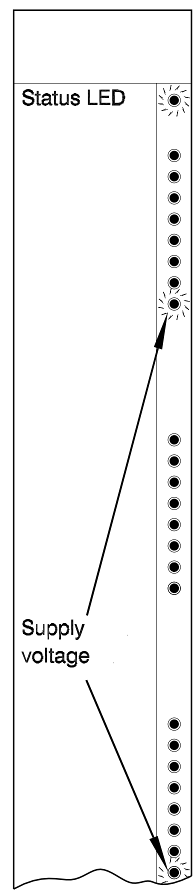
6.3.19 Status indicators of analog output module DAO 01

Fig. 6-18 shows the status indicators of the analog output module DAO 01.

		Color	Normal state
Status LED	●	Off, red, red flashing orange, orange flashing green, green flashing	Lights up green
Channel indicator LED	●	not available	-
Supply voltage LED	●	green	Lights up green

Fig. 6-18 Status indicators of analog output module DAO 01

The LEDs indicate the following:



Status LED

Refer to Section 6.3.8, General information about the I/O module status indicators

Channel indicator LED

There is no channel indicator LED for the analog output module.

Supply voltage LEDs

The two I/O channel groups (0 ... 7 and 8 ... 15) are externally supplied with 24 V. The two **supply voltage LEDs** indicate that the two external supply voltages are applied.

If the LEDs do **not** light up, check:

- the external power supply of the channel group (see Section 4.8.18).

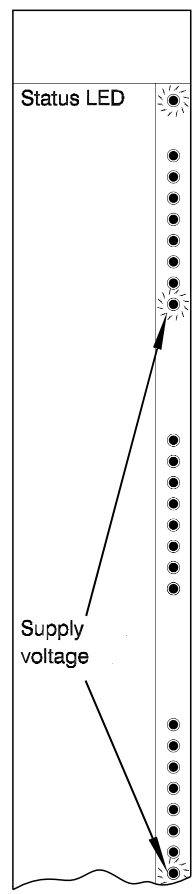
6.3.20 Status indicators of analog output module DAO 02

Fig. 6-19 shows the status indicators of the analog output module DAO 02.

		Color	Normal state
Status LED	●	Off, red, red flashing orange, orange flashing green, green flashing	Lights up green
Channel indicator LED	●	not available	-
Supply voltage LED	●	green	Lights up green

Fig. 6-19 Status indicators of analog output module DAO 02

The LEDs indicate the following:



Status LED

Refer to Section 6.3.8, General information about the I/O module status indicators

Channel indicator LED

There is no channel indicator LED for the analog output module.

Supply voltage LEDs

The two I/O channel groups (0 ... 7 and 8 ... 15) are externally supplied with 24 V. The two **supply voltage LEDs** indicate that the two external supply voltages are applied.

If the LEDs do **not** light up, check:

- the external power supply of the channel group (see Section 4.8.19).

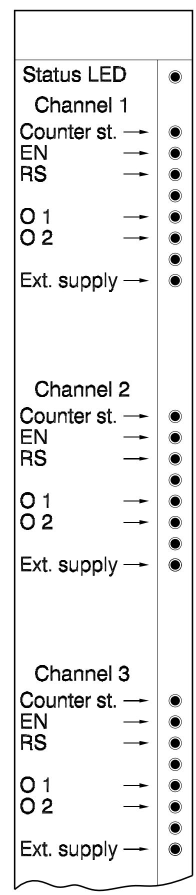
6.3.21 Status indicators of frequency input module DFI 01

Figure 6-20 shows the status indicators of frequency input module DFI 01.

		Color	Normal state
Status LED		Off, red, red flashing, orange, orange flashing, green, green flashing	Lights up green
Channel active LED	Counter status	Off, green, red, orange	Lights up green
	Enable (EN)	Off, green	Lights up green
	Run/Stop (RS)	Off, green	Off
	Output 1	Off, green	Lights up green
	Output 2	Off, green	Off
Channel error LED		Off, green	Lights up green

Fig. 6-20 Status indicators of frequency input module DFI 01

The LEDs indicate the following:



Status LED

See Section 6.3.8, General information about the I/O module status indicators

Channel indicator LEDs

Counter status

- Counter not ready	**off**	- Counter ready	**orange**
- Counter active	**green**	- Counter disturbed	**red**

Enable (EN), Run/Stop (RS)

- Input active **green** - Input not active **off**

Output 1, output 2

- Output active **green** - Output not active **off**

If the channel indicator LED for the counter status lights up **red**:

- There is a counter overflow. Check the project configuration for the counter limit setting.
- The counter input has detected a channel disturbance. Check the counter status cabling up to the transmitter for short circuit or line-break.

External supply LEDs

Indicate the secondary voltage status of transmitter supply. An LED is assigned to each channel.

- Voltage present **green** - No voltage **off**

If the external supply LED does not light up:

- check the input cabling, especially the feed-in of the external power supply
- the module is defective, contact our service.

6.3.22 Status indicators of communication module DCO 01

Figure 6-21 shows the status indicators and operating elements of the communication module DCO 01.

		Color	Normal state
Status indicators	Power ●	green	On (during operation)
	Failure ●	red	Off
	Batt low ●	yellow	Off
	Overtemp ●	red	Off
Operating elements	Reset ●	Switch	

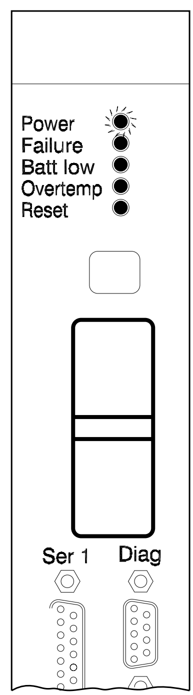
Fig. 6-21 Status indicators and operating elements of communication module DCO 01

The LEDs indicate the following:

Power LED

Indicates that the internal supply voltage of the communication module is present. If the **Power** LED does not light up, check:

- if the module has been plugged in correctly and fastened with screws.
- if the **Power** LED of the link module lights up. If so, the communication module is defective.



Failure LED

Indicates internal error statuses of the communication module. If the **Failure** LED lights up,

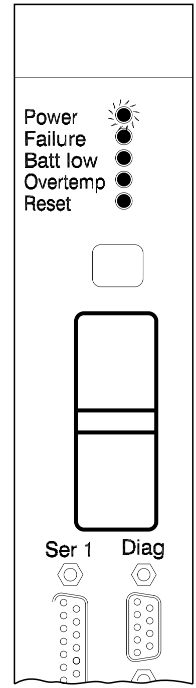
- connect a diagnostic terminal or PC to the communication module. For details refer to Section 6.4.12.

Batt low LED

Indicates that the buffer battery is discharged or not plugged in. In case of external battery supply, no internal buffer battery is required for the DCO 01. For details refer to Sections 4.2.3 and 4.2.4.

If the **Batt low** LED lights up, check:

- the battery holder with the battery for correct installation,
- the battery for correct polarity,
- the battery voltage (nominal voltage 3.6 V, minimum voltage 2.9 V).



Overtemp LED

If the **Overtemp** LED lights up, the internal temperature of the module is higher than the max. permissible temperature of 70 °C. In this case check:

- the ambient temperature at the communication module bottom side. The max. permissible temperature is 50 °C.
- the minimum spacing of the racks and power supplies.
- the air vents for dirt. Make sure that the air convection is not impaired.

Operating elements

Reset switch

This push button switch serves for **resetting** the communication module. It is recessed and can only be pressed with a "tool" (e.g. ball-point pen, paper clip, etc.). Pressing this button switch will immediately reset the entire module**, without any delay**. The reset is local and only restarts the communication module. None of the other process station modules is reset.

6.4 Diagnosing the process station

The diagnostic interface Diag at the CPU module serves for diagnosing and is solely used in case of error, for entering a customer-specific IP address (see Section 6.1) or for connecting the radio clock DCF77 or a GPS clock (see Sections 12.4 and 12.5).

A standard ANSI terminal (e. g. DEC VT 100, Visa MC4, Ampex A230 or similar) or a PC or laptop with a free serial interface is used for diagnosing.

The description in this section assumes that the engineering station is used as a diagnostic PC. The MS-Windows NT 4.0 package already includes a terminal emulation which you can use for diagnosis. The settings for all other terminal emulations or terminals are identical or similar to those described below.

Link the process station with the diagnostic PC as described in Section 4.4.2, using the cable DSU 141. Use the 9-pole port of the PC. For terminals with 25-pole connector additionally use a commercial adapter.

The diagnostic PC can be connected to a running process station when live.

When connecting the diagnostic PC to a **running** process station, first start the **terminal emulation and configure as specified**. Connecting a PC on which the terminal emulation is not yet running may stop the process station, since the hardware handshake lines can only be operated correctly after the terminal emulation has been started.

The **Freelance 2000** process station with power supply DPW 01 has a protective separation from other circuits. Connecting a diagnostic PC which has **no protective separation** and is not battery-powered may **cancel out this separation**.

6.4.1 Starting and setting up the Windows NT 4.0 terminal emulation

Windows NT 4.0 includes a **HyperTerminal emulation.** After proper installation of Windows NT 4.0 it is available in the **Accessories** program group. Click on the **Start** button of the task bar. Selecting **Programs** → **Accessories** will then call up the **HyperTerminal** icon**.** Clicking on the icon opens the HyperTerminal folder. The HyperTerminal program icon and all available emulations are shown. First double-click on the HyperTerminal icon to create a new emulation for Freelance diagnosis.

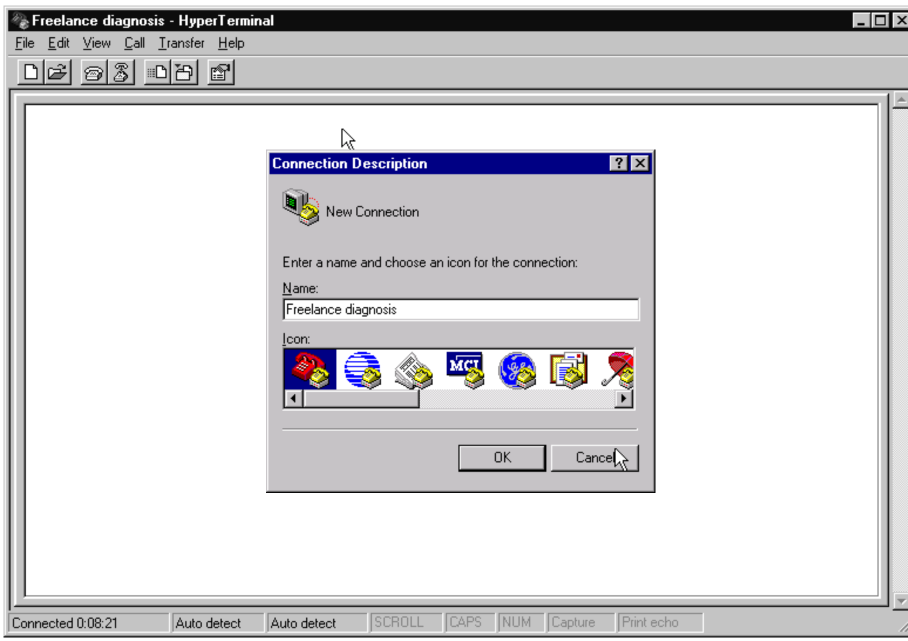


Fig. 6-22 Creating a new emulation

In the next window you can set up a direct connection via your serial interface. The appropriate serial interface (COM1, COM2 or other) to which the CPU module is connected must be selected under menu item **Connect To**.

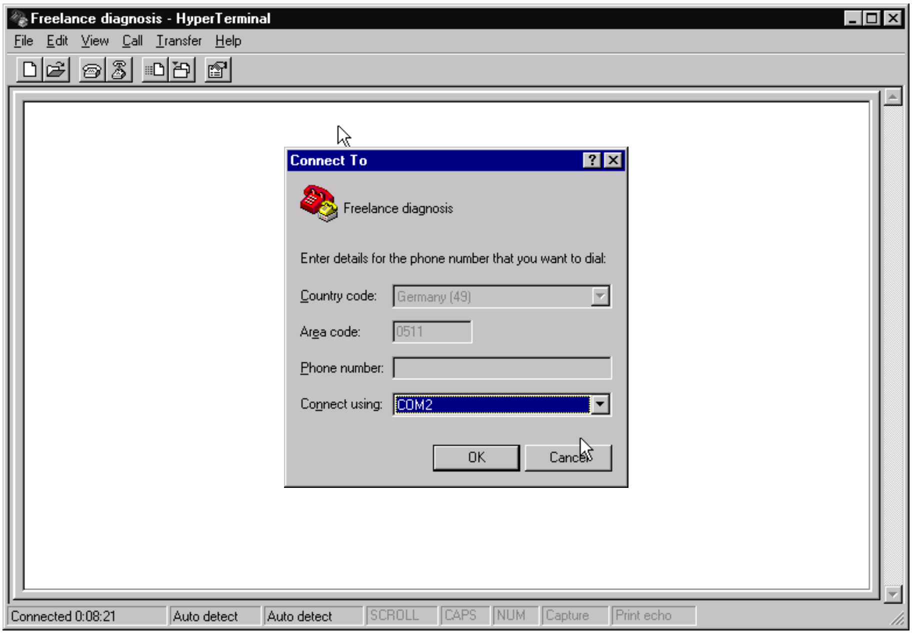


Fig. 6-23 Connecting the emulation

After this the terminal program must be adapted to the data format of the CPU module by making the settings shown below.

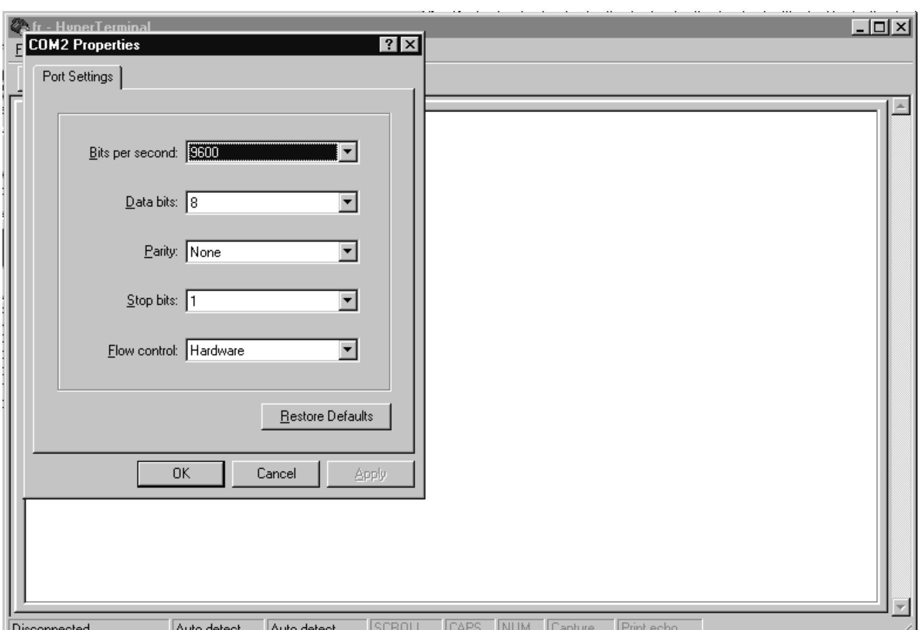


Fig. 6-24 Setting the port

This completes the setup. After confirmation with OK you can activate the connection to the Freelance diagnosis in the main menu via **Call** → **Connect To**.

The settings shown above can be saved as a .ht file under ***File*, *Save As***. When calling up the terminal program next time you can directly start the this .ht file by double-clicking on the icon. The settings made are immediately active. If you do not save the settings, they have to be remade after each start.

For details on the terminal emulation refer to your Microsoft® Windows™ User's Guide.

6.4.2 DCP 02 hardware self-test

The system messages of the CPU module DCP 02 can be monitored via the diagnostic interface. The power-up sequence is triggered by switching on the supply voltage or pressing the Reset switch for more than 4 seconds.

Behavior and system messages during "1st Stage"

In the first part of the boot sequence called the **1st Stage** the CPU module performs a self-test of the most important hardware components. The CPU module shows the rack ID, the memory expansion, and the version number of the 1st Stage software and EPROM version in the header of the 1st Stage message. While the 1st Stage is in progress, the **Failure** LED permanently lights up **orange** (DCP 02 with HW index < 50.00: permanently red).

There are four ways of error handling during these tests:

1. The program is finished in a **normal** way, i.e. all module components are ready to operate. The Failure LED goes **off**.
2. The test is aborted. The error is so serious that the CPU module function is no longer ensured. The **Failure** LED remains **lighted red**. Please contact your service, and observe the instructions regarding the **error memory**.
3. The command is not executed, to indicate that a serious error has occurred during a previous self-test. The Failure LED remains lighted orange. In this context also pay special attention to the explanations related to the error memory later in this text.
4. The program is continued in spite of the error, as this kind of error can be corrected at a later time. The Failure LED goes off.

The loopback test of the Ethernet interface is an example for the fourth case described above. Depending on the Ethernet interface used, the software will mark the interface, which is not physically wired, as defective.

```
Initialize: .........

    +--------------------------------------------------------------------+
    |                   |                                                |
    | F r e e l a n c e |  1st Stage  >> Startup Operation Checkout <<   |
    |      2 0 0 0      |  1st Stage version: F06.103.00,   Jul 19 2000  |
    |  - D C P 0 2 A -  |  EPROM version    : 6.04                       |
    |                   |  (C) 1998..2000 ABB Automation Products GmbH   |
    |                   |                                                |
    |                   |  Rack:0  Slot:0  Station:1   8MB-55ns EDC SRAM |
    |                   |                                                |
    +--------------------------------------------------------------------+

Hardware initialized

Diagnostic interface................:   OK
Testing checksum EPROM..............:   OK
Testing SRAM
        WORD access.................:   OK
        BURST access................:   OK
        address lines...............:   OK
Testing EDC Unit....................:   OK
Enabling EDC Unit..................
Testing interrupt controller........:   OK
Testing counter.....................:   OK
Testing system ticker...............:   OK
Testing checksum EEPROM1
        Page 2......................:   OK
Testing checksum EEPROM2
        Page 1......................:   OK
Testing LAN interface
        LAN controller..............:   OK
        local loopback test.........:   OK
        serial interface............:   OK
        loopback test AUI...........:   failed
        loopback test Cheapernet....:   OK
Testing serial port.................:   OK
Init CAN controller.................:   OK

*** Internal selftest completed, 1st Stage is activating Bootloader... ***
```

Fig. 6-25 1st Stage system messages

The error message related to the AUI loopback test is due to the fact that no AUI interface was connected when the test described here was performed. A Cheapernet interface was connected instead.

If a serious error occurs during the 1st **Stage** self-test, the respective message appears (see example below),

```
 Testing SRAM
        WORD access................:   failed !
-----------------------------------------------------------------
Error code 0x10000108  added to error memory...

P r o g r a m   t e r m i n a t e d
```

and the red **Failure** LED lights up permanently. This indicates that the CPU module is defective.

6.4.3 Messages of the hardware error memory

If a serious error is detected during the self-test, the error location, error code and date/time of its occurrence are saved in the non-volatile memory of the CPU board. Up to five such entries can be made in the error memory. This memory facilitates error diagnosis, since, usually, no terminal is connected when an error occurs for the first time.

If **no Reset** has been performed upon occurrence of a serious error, the DCP 02 **repeats** the last diagnosis messages when the **Return** key is pressed.

The error memory is checked on each restart of the DCP 02. The following messages appear on the screen:

```
-----------------------------------------------------------------
In former operation, following self test errors have been occurred:

Date    Time    Error        Location (test of...)
990401  162501  0x10000108   SRAM, word access

Continue anyway <ESC> ?: n
```

Pressing the **ESC** key will ignore the error and start the self-test of the 1st Stage. The message **„`n times skipped`“** indicates how often the entry has already been skipped by pressing **ESC**. If the reason for the serious error should still exist or if another serious error occurs, the next entry is created in the error memory, until the maximum error count of five is reached:

```
The  maximum  error  count  has  been  reached:  further  operation  rejected
                     !!! Please, contact service !!!
```

When the maximum error count is reached, the DCP 02 is locked, and no further operation is possible. In this case please contact the service.

6.4.4 Configure Boot-Loader

After error-free start-up of the **1st Stage,** the Boot Loader is started. If you want to change the configuration data of the Boot Loader, the Run/Stop switch must be in the Stop position**.** In the Run position no user settings can be made, and not all messages are output. The **EPROM version number** is shown in the header of the Boot Loader**.** If the Run/Stop switch is in the **STOP** position, the current parameters are output after this. These parameters can be modified by pressing the space bar during the waiting time to call the input menu.

The following diagram shows the system messages of the Boot Loader up to the keyboard inquiry. The lines **Subnet Mask** and **Default Router** solely appear if the coding switch is set to 0 (special case, expanded network configuration). In the standard case these lines are not shown.

```
Freelance 2000
Process Station BootLoader V6.04

(C)1999 ABB  Automation Products
24 Jun 2000  T.Guenther

Testing network connection  ... Ok
--------------------------------------------------------------------------
  CPU is i960HDs [B0/B1] with 8 MByte RAM
  System will startup in AUTO mode

  Network interface [00:C0:C9:10:00:74] - Cheapernet
   - IP address:  172.16.1.1
   - Subnet mask: 255.255.240.0

 RTC-Time is not initialized
--------------------------------------------------------------------------
To change these parameters, hit <SPACE> within 2 seconds
--------------------
```

Fig. 6-26 Boot Loader system messages

A time domain reflectometer (TDR) test is performed for the Ethernet interface. If the message

```
Error: Controller or other network problem
```

pops up, it usually indicates that the Ethernet cabling has not been made properly.

If the message

```
Error: Open Line 3 clocks away
```

appears, there is a problem with the bus hardware, e.g. a termination resistor is missing on the 10Base2 cable.

The message

```
Error: Short Line 5 clocks away
```

indicates a short circuit in the transmission path.

Press the space bar within the waiting time. The following prompt appears:

```
<C>hange, set <T>ime, <S>ave or continue <B>ooting?
```

The system configuration parameters listed below can be changed under menu item **<C>hange**:

- Ethernet interface
- IP address(only with extended network configuration)
- Behavior of the Boot Loader after operating system call
- Baud rate of diagnostic interface
- Boot Loader waiting time before configuration block startup

The default values for the configuration items are written in braces. They can be confirmed by pressing the RETURN key. The following prompt appears:

```
For each of the following questions, hit <RET> to keep
the value in braces or enter a new value.
```

Configuring the Ethernet interface

```
Network Interface Port:
   1. AUI (Transceiver)
   2. Cheapernet
Select:  [2]
```

Select the appropriate menu item, depending on the Ethernet interface used. If an invalid entry is made, the Boot Loader repeats this configuration item.

Setting the Internet address

This menu will appear only if the hex switch is in position 0. Adjusting the Internet address is only required if:

- other nodes are working on the Ethernet together with the Freelance 2000 components (process station, operator station, engineering station) **or**
- the Ethernet is not stand-alone and is connected to other networks **or**
- more than 15 process stations (special case) are used on the same system bus (see Sections 3.3.3 and 6.1).

If not more than 15 process stations are working on the Ethernet and there is no connection to other networks, use the standard address:

172.16.1.n (n → coding switch position) n= 1,2,3,4,..., A ... F

If other, non-Freelance 2000 nodes are on the same network or if there is a connection to other networks, contact your network administrator. He will assign an IP address to your stations.

The following menu items will only appear if the coding switch of the CPU module is set to **0**:

```
Enter interface IP address:  [172.16.1.1]
```

The prompt requests an entry with the form DDD.DDD.DDD.DDD. The entry is made in decimal numbers (DDD = 0...255). Zeros to the left of the number can be omitted.

Enter for example: **172.16.1.22<RETURN>**

The broadcast address 255.255.255.255 and the address 0.0.0.0 are special cases and cannot be entered by the operator. In case of an invalid entry the Boot Loader repeats this configuration item.

Configuring the subnet mask

There is a subnet mask for each Internet address. Contact your network administrator for this mask. The subnet mask is entered in the same way as the Internet address

```
Enter subnet mask:  [255.255.240.0]
```

Selecting the network type

Here you can set up the type of network. For a 10Base5 or 10Base2 network select the default setting [1]. Contact your system administrator for the type of network used.

```
Enter network transmission speed:
   1. High (pure Ethernet)
   2. Medium (Modem >= 64 KBit)
   3. Low (Modem < 64 KBit)
Select:  [1]
```

Only change this setting if your Ethernet link is routed via special WAN paths.

Setting the default router

This prompt serves for entering the Internet address of a default router for communication with remote operator stations, if applicable.

```
Enter default-router IP Address:  [0.0.0.0]
```

The following configuration steps are always shown:

Setting operating system startup

```
Enter startup mode:
    1. Auto Startup
   2. Force execution of BootLoader
Select:  [1]
```

Fig. 6-27 Operating system startup, adjustment prompt

Menu item 1: The Boot Loader starts an operating system residing in the RAM or waits for a bootstrap through the engineering station, if the operating system is faulty or not yet available in the RAM.

Menu item 2: The Boot Loader waits for a bootstrap in any case.

During a bootstrap the engineering stations downloads the operating system into the battery-buffered RAM of the CPU module. Normally, the operating system remains in the RAM until the next software update or until a battery buffer failure.

Select option 1 for automatic process station startup after power failure. Option 2 is only relevant for testing.

Setting the selftest

```
Do extended selftest on WarmBoot?   [n]
```

The selftest is normally only executed in a short form after a power failure to reduce the system startup time. If you want the system to perform an extended selftest on each system warm start answer with “y“.

Setting the baud rate of the diagnostic interface

```
Enter baud rate of console port:   [9600]
```

Valid entries for the baud rate are 300, 600, 1200, 2400, 4800, 9200 and 19200 bauds. In case of invalid entries the Boot Loader will repeat this configuration item. The default setting should not be modified.

Setting the waiting time before configuration block startup

```
Enter CPU delay (in seconds) before starting up:  [2]
```

Any time between 2 ... 60 seconds can be entered as the waiting time. In case of invalid entries the Boot Loader will repeat this configuration item. The default setting should not be modified. After this the Boot Loader shows again all current parameters of the configuration block.

```
  CPU is i960HD [B0/B1] with 8 MByte RAM
  System will startup in AUTO mode

  Network interface [00:C0:C9:10:00:74] - Cheapernet
   - IP address:  172.16.1.1
   - Subnet mask: 255.255.240.0

  RTC-Time is not initialized
<C>hange, set <T>ime, <S>ave or continue <B>ooting?
```

Fig. 6-28 Current parameters of the configuration block

<S>ave saves all displayed configuration data in a non-volatile memory and the message

```
Parameters saved
```

is output.

Setting date and time

The entry is done in the order day, month, year.

```
Enter Date <dd.mm.yy>: 17.04.97
```

<T>ime sets the r**eal-time clock** of the CPU module.

```
Enter local Time (hh:mm:ss):14:21:59
```

The time is entered in the order hours, minutes, seconds. In case of an invalid entry the Boot Loader repeats this configuration item. A valid entry starts the battery-buffered real-time clock of the CPU module.

```
RTC-Time: 17.04.97, 19:00:17 local
```

Date and time must be set correctly at first use!

Bootstrap and/or startup of the operating system

After the configuration has been done as described above using item **<B>ooting** or after the waiting time has elapsed without any keyboard entries being made, the Boot Loader attempts to start an existing operating system or waits for the bootstrap through the engineering station, depending on the configuration.

Setting: **`Force execution of BootLoader:`**

The message **`BootLoader waiting ...`** is displayed until a connection to the configuration PC is established. After this the Boot Loader records all stations to which a connection has been established and the station from which bootstrap is done.

While the bootstrap is in progress the menu indicates as a percentage how far data transfer has already been completed. After successful data transfer the connections to all stations are broken off, and the startup code of the operating system is executed. During bootstrap the following Boot Loader messages are displayed:

```
Connected to station 172.16.0.4
Loading from Station 172.16.0.4
Status: 100% loaded
OsStartAddress : 80070070  (<- example address)
172.16.0.4 disconnected
*** Freelance 2000 Startup Code ***
```

Setting: `Auto Startup:`

In this mode the Boot Loader first checks the memory for an existing and intact operating system. If no error is detected, the following messages appear:

```
Checking Configuration ... Ok
Checking Operating System ... Ok
Startaddress: 0x80070070       (<- example address)
*** Freelance 2000 Startup Code ***
```

Then the startup code of the operating system is executed. If no or a defective operating system is found, the following message appears:

```
Checking Configuration ... invalid !
DPS-BootLoader waiting ...
```

The program continues at the point described under “Setting operating system startup”:

```
 Force execution of BootLoader
```

After operating system startup several other initialization messages appear. These message are not further described here. Commissioning is done via the engineering station.

6.4.5 DCP 10 hardware self-test

The system messages of the CPU module DCP 10 can be monitored analogously to DCP 02 via the diagnostic interface. The messages are for the most part identical to those of DCP 02. The power-up sequence is triggered by switching on the supply voltage or pressing the Reset switch for more than 4 seconds.

Behavior and system messages during "1^{st} Stage"

In the first part of the boot sequence called the **1^{st} Stage** the CPU module performs a self-test of the most important hardware components. The CPU module shows the rack ID, the memory expansion, and the version number of the 1^{st} Stage software and EPROM version in the header of the 1^{st} Stage message. While the 1^{st} Stage is in progress, the **Failure** LED permanently lights up **orange**.

There are four ways of error handling during these tests:

1. The program is finished in a **normal** way, i.e. all module components are ready to operate. The Failure LED goes **off**.
5. The test is aborted. The error is so serious that the CPU module function is no longer ensured. The **Failure** LED remains **lighted red**. Please contact your service, and observe the following instructions related to the **error memory**.
6. The command is not executed, to indicate that a serious error has occurred during a previous self-test. The Failure LED remains lighted orange. In this context also pay special attention to the explanations related to the error memory later in this text.
7. The program is continued in spite of the error, as this kind of error can be corrected at a later time. The Failure LED goes off.

The loopback test of the Ethernet interface is an example for the fourth case described above. Depending on the Ethernet interface used, the software will mark the interface, which is not physically wired, as defective.

```
    +---------------------------------------------------------------------+
    |                   |                                                 |
    | F r e e l a n c e |  1st Stage  >> Startup Operation Checkout <<    |
    |      2 0 0 0      |  1st Stage version: F06.103.00,   Jul 19 2000   |
    |    - D C P 1 0 -  |  EPROM version    : 6.04                        |
    |                   |  (C) 1998..2000 ABB Automation Products GmbH    |
    |                   |                                                 |
    |                   |  Rack:0  Slot:0  Station:8   8MB-55ns EDC SRAM  |
    |                   |                                                 |
    +---------------------------------------------------------------------+

Hardware initialized

Diagnostic interface................:   OK
Testing checksum EPROM..............:   OK
Testing SRAM
        WORD access.................:   OK
        BURST access................:   OK
        address lines...............:   OK
Testing EDC Unit....................:   OK
Enabling EDC Unit...................
Testing interrupt controller........:   OK
Testing counter.....................:   OK
Testing system ticker...............:   OK
Testing checksum EEPROM1
        Page 2......................:   OK
Testing checksum EEPROM2
        Page 1......................:   OK
Testing primary LAN interface
        LAN controller..............:   OK
        local loopback test.........:   OK
        serial interface............:   OK
        loopback test AUI...........:   failed
        loopback test Cheapernet....:   OK
Testing secondary LAN interface
        LAN controller..............:   OK
        local loopback test.........:   OK
        serial interface............:   OK
        loopback test AUI...........:   failed
        loopback test Cheapernet....:   OK
Testing serial port.................:   OK
Init CAN controller.................:   OK

*** Internal selftest completed, 1st Stage is activating Bootloader... **a*
```

Fig. 6-29 1st Stage system messages

The error message related to the AUI loopback test is due to the fact that no AUI interface was connected when the test described here was performed. A Cheapernet interface was connected instead.

If a serious error occurs during the **1st Stage** self-test, the respective message appears (see example below),

```
 Testing SRAM
       WORD access................:   failed !
-----------------------------------------------------------------
Error code 0x10000108  added to error memory...

P r o g r a m   t e r m i n a t e d
```

and the red **Failure** LED lights up permanently. This indicates that the CPU module is defective.

6.4.6 Messages of the hardware error memory

If a serious error is detected during the self-test, the error location, error code and date/time of its occurrence are saved in the non-volatile memory of the CPU board. Up to five such entries can be made in the error memory. This memory facilitates error diagnosis, since, usually, no terminal is connected when an error occurs for the first time.

If **no Reset** has been performed upon occurrence of a serious error, the DCP 10 **repeats** the last diagnosis messages when the **Return** key is pressed.

The error memory is checked on each restart of the DCP 10. The following messages appear on the screen:

```
-----------------------------------------------------------------
In former operation, following self test errors have been occurred:

Date    Time    Error       Location (test of...)
990401  162501  0x10000108  SRAM, word access

Continue anyway <ESC> ?: n
```

Pressing the **ESC** key will ignore the error and start the self-test of the 1st Stage. The message „`n times skipped`“ indicates how often the entry has already been skipped by pressing **ESC**. If the reason for the serious error should still exist or if another serious error occurs, the next entry is created in the error memory, until the maximum error count of five is reached:

```
The maximum error count has been reached: further operation rejected
                     !!! Please, contact service !!!
```

When the maximum error count is reached, the DCP 10 is locked, and no further operation is possible. In this case please contact the service.

6.4.7 Configure Boot Loader

After error-free start-up of the 1st **Stage,** the Boot Loader is started. If you want to change the configuration data of the Boot Loader, the Run/Stop switch must be in the Stop position. In the Run position no user settings can be made, and not all messages are output.

The **EPROM version number** is shown in the header of the Boot Loader. If the Run/Stop switch is in the **STOP** position, the current parameters are output after this. These parameters can be modified by pressing the space bar during the waiting time to call the input menu.

The following diagram shows the system messages of the Boot Loader up to the keyboard inquiry. The lines **Subnet Mask** and **Default Router** solely appear if the coding switch is set to 0 (special case, expanded network configuration). In the standard case these lines are not shown.

```
Freelance 2000
Process Station BootLoader V6.04

(C)1999 ABB  Automation Products
24 Jun 2000  T.Guenther

Testing network connection 1 ... Ok
Testing network connection 2 ... Ok
--------------------------------------------------------------------------
  CPU is i960HD [B0/B1] with 8 MByte RAM
  System will startup in AUTO mode

  First Network interface [00:C0:C9:10:00:72] - Cheapernet
   - IP address:  172.16.1.8
   - Subnet mask: 255.255.240.0

  Second Network interface [00:C0:C9:10:00:73] - Cheapernet as RedLink

  RTC is not initialized
-------------------------------------------------------------------------
To change these parameters, hit <SPACE> within 2 seconds
---------------------------------------------------
```

Fig. 6-30 Boot Loader system messages

A time domain reflectometer (TDR) test is performed for the Ethernet interface. If the message

```
Error: Controller or other network problem
```

pops up, this usually indicates that the Ethernet cabling has not been made properly.

If the message

```
Error: Open Line 3 clocks away
```

appears, there is a problem with the bus hardware, e.g. a termination resistor is missing on the 10Base2 cable.

The message

```
Error: Short Line 5 clocks away
```

indicates a short circuit in the transmission path.

Press the space bar within the waiting time. The following prompt appears:

```
<C>hange, set <T>ime, <S>ave or continue <B>ooting?
```

The system configuration parameters listed below can be changed under menu item **<C>hange**:

- Ethernet interface
- Second Ethernet interface
- IP address (only with extended network configuration)
- Behavior of the Boot Loader after operating system call
- Baud rate of diagnostic interface
- Boot Loader waiting time before configuration block startup

The default values for the configuration items are written in braces. They can be confirmed by pressing the RETURN key. The following prompt appears:

```
For each of the following questions, hit <RET> to keep
the value in braces or enter a new value.
```

Configuring the Ethernet interface

Select the function of the first Ethernet channel:

```
First Network Interface Port:
   1. AUI (Transceiver)
   2. Cheapernet
Select: [2]
```

Select the appropriate menu item, depending on the Ethernet interface used. If an invalid entry is made, the Boot Loader repeats this configuration item.

Setting the Internet address

This menu will solely appear if the Hex switch is set to 0. This setting is only required if:

- other nodes are working on the Ethernet together with the Freelance 2000 components (process station, operator station, engineering station) **or**
- the Ethernet is not stand-alone and is connected to other networks **or**
- more than 15 process stations (special case) are used on the same system bus (see Sections 3.3.3 and 6.1).

Please note that different IP addresses have to set for the two CPU modules DCP 10 in a redundant process station.

If more than 15 process stations are working on the Ethernet and there is no connection to other networks, use the standard address:

172.16.1.n (n → coding switch position) n= 1,2,3,4,..., A ... F

If other, non-Freelance 2000 nodes are on the same network or if there is a connection to other networks, contact your network administrator. He will assign an IP address to your stations.

The following menu items will only appear if the coding switch of the CPU module is set to **0**:

```
Enter interface IP address:  [172.16.1.1]
```

The prompt requests an entry with the form DDD.DDD.DDD.DDD. The entry is made in decimal numbers (DDD = 0...255). Zeros to the left of the number can be omitted.

Enter for example: **172.16.1.22<RETURN>**

The broadcast address 255.255.255.255 and the address 0.0.0.0 are special cases and cannot be entered by the operator. In case of an invalid entry the Boot Loader repeats this configuration item.

Configuring the subnet mask

There is a subnet mask for each Internet address. Contact your network administrator for this mask. The subnet mask is entered in the same way as the Internet address.

```
Enter Subnet Mask:  [255.255.240.0]
```

Selecting the network type

Here you can set up the type of network. For a 10Base5 or 10Base2 network select the default setting [1]. Contact your system administrator for the type of network used.

```
Enter network transmission speed:
   1. High (pure Ethernet)
   2. Medium (Modem >= 64 KBit)
   3. Low (Modem < 64 KBit)
Select:  [1]
```

Only change this setting if your Ethernet link is routed via special WAN paths.

Using the second Ethernet interface

The second Ethernet channel can be either disabled or configured as a redundant or gateway link.

```
Second Network Interface:
   0. Disabled
   1. RedLink
   2. Gateway
Select:  [1]
```

If you are using the **second Ethernet channel**, the system prompts you to set it up as required.

```
Second Network Interface Port:
   1. AUI (Transceiver)
   2. Cheapernet
Select:  [2]
```

The following prompts for setting the IP address and subnet mask will be displayed only if you have selected the gateway functionality before.

```
Enter interface IP address:  [128.1.1.17]
```

```
Enter Subnet Mask:  [255.255.0.0]
```

```
Enter network transmission speed:
   1. High (pure Ethernet)
   2. Medium (Modem >= 64 KBit)
   3. Low (Modem < 64 KBit)
Select:  [1]
```

This terminates the special configurations (second Ethernet channel, gateway). The other possible configurations apply to all operating modes, again.

Adjusting the default router

If a default router for communication with remote operator stations is installed in your network, you can enter its internet address in this prompt.

```
Enter default-router IP Address: [0.0.0.0]
```

The following configuration steps are always shown:

Adjusting operating system startup

```
Enter startup mode:
   1. Auto Startup
   2. Force execution of BootLoader
Select:  [1]
```

Fig. 6-31 Operating system startup, adjustment prompt

Menu item 1: The Boot Loader starts an operating system residing in the RAM or waits for a bootstrap through the engineering station, if the operating system is faulty or not yet available in the RAM.

Menu item 2: The Boot Loader waits for a bootstrap in any case.

During a bootstrap the engineering stations loads the operating system into the battery-buffered RAM of the CPU module. Normally, the operating system remains in the RAM until the next software update or until a battery buffer failure. Select option 1 for automatic process station startup after power failure. Option 2 is only relevant for testing.

Adjusting the selftest

```
Do extended selftest on WarmBoot?   [n]
```

The selftest is normally only executed in a short form after a power failure to reduce the system startup time. If you want the system to perform and extended selftest on each system warm start answer with “y“.

Adjusting the baud rate of the diagnostic interface

```
Enter baud rate of console port:   [9600]
```

Valid entries for the baud rate are 300, 600, 1200, 2400, 4800, 9200 and 19200 bauds. In case of invalid entries the Boot Loader will repeat this configuration item. The default setting should not be modified.

Adjusting the waiting time before configuration block startup

```
Enter CPU delay (in seconds) before starting up:  [2]
```

Any time between 2 ... 60 seconds can be entered as the waiting time. In case of invalid entries the Boot Loader will repeat this configuration item. The default setting should not be modified.

After this the Boot Loader shows again all current parameters of the configuration block.

```
--------------------------

CPU is i960HD [B0/B1] with 8 MByte RAM
System will startup in AUTO mode

  First Network interface [00:C0:C9:10:00:72] - Cheapernet
   - IP address:  172.16.1.8
   - Subnet mask: 255.255.240.0

  Second Network interface [00:C0:C9:10:00:73] - Cheapernet as RedLink

  RTC-Time:  20.07.00, 16:06:12 local
------------------------------------------------------------------------------
 <C>hange, set <T>ime, <S>ave or continue <B>ooting?
```

Fig. **6**-32 Current parameters of the configuration block

<S>ave saves all displayed configuration data in a non-volatile memory, and the message

```
Parameters saved
```

is output.

Setting date and time

The entry is done in the order day, month, year.

```
Enter Date <dd.mm.yy>:17.08.00
```

<T>ime sets the r**eal-time clock** of the CPU module.

```
Enter local Time (hh:mm:ss): 14:21:59
```

The time is entered in the order hours, minutes, seconds. In case of an invalid entry the Boot Loader repeats this configuration item. A valid entry starts the battery-buffered real-time clock of the CPU module.

```
RTC-Time: 17.08.00, 19:00:17 local
```

⚠ **Date and time must be set correctly at first use!**

Bootstrap and/or startup of the operating system

After the configuration has been done as described above using item **<B>ooting** or after the waiting time has elapsed without any keyboard entries being made, the Boot Loader attempts to start an existing operating system or waits for the bootstrap through the engineering station, depending on the configuration.

Setting: **`Force execution of BootLoader:`**

The message **`BootLoader waiting ...`** is displayed until a connection to the configuration PC is established. After this the Boot Loader records all stations to which a connection has been established and the station from which bootstrap is done. While bootstrap is in progress the menu indicates as a percentage how far data transfer has already been completed. After successful data transfer the connections to all stations are broken off, and the startup code of the operating system is executed.

During bootstrap the following Boot Loader messages are displayed:

```
Connected to station 172.16.0.4
Loading from Station 172.16.0.4

100% loaded

OsStartAddress : 80070070   (<-example address)
172.16.0.4 disconnected

*** Freelance 2000 Startup Code ***
```

Setting: **`Auto Startup:`**

In this mode the Boot Loader first checks the memory for an existing and intact operating system. If no error is detected, the following messages appear:

```
Checking Configuration ... Ok
Checking Operating System ... Ok

Startaddress: 0x80070070        (<-example adress)

*** Freelance 2000 Startup Code ***
```

Then the startup code of the operating system is executed. If no or a defective operating system is found, the following message appears:

```
Checking Configuration ... failed !
DPS-BootLoader waiting ...
```

The program continues at startup mode:

```
Force execution of BootLoader
```

After operating system startup several other initialization messages appear. These message are not further described here. Commissioning is done via the engineering station.

6.4.8 Checking the gateway CPU configuration with the CPU module DCP 02

The hardware diagnosis is identical with that of the CPU functionality of CPU module DCP 02. Refer to Section 6.4.2 for details about diagnosis.

6.4.9 Checking the gateway functionality with the CPU module DCP 10

The hardware diagnosis is identical with the diagnosis of the CPU functionality of CPU module DCP 10. For details refer to Section 6.4.2.

6.4.10 Checking the redundant gateway functionality with DCP 10

The hardware diagnosis is identical with the diagnosis of the CPU functionality of CPU module DCP 10. For details refer to Section 6.4.2.

6.4.11 Connecting a gateway CPU via the diagnostic interface

The connection via the diagnostic cable and the configuration of the terminal emulation are identical with those of a module with CPU functionality. Refer to Section 6.4.1 for details. Note that the output after operating system startup is different from the conventional CPU module, due to the special gateway software.

6.4.12 Testing the communication module DCO 01 via the diagnostic interface

The communication module DCO 01 is handled as an I/O module in the process station. Normally, checking this module via the diagnostic interface is not necessary, since the supervisory CPU module monitors the status of the DCO 01 module.

If, however, a DCO 01 diagnosis is required, you can proceed as described for the CPU module. Connect the diagnostic cable DSU 141 to the **Diag** interface. Configure the terminal emulation as described in Section 6.4.1. The following self-test results are reported by the communication module after reset:

```
+----------------------------------------------------------------------+
|                                                                      |
|  D i g i m a t i k    DCO 1st Stage (operating to User-Mode)         |
|                       Software Version: F02.105     Mar 28 1997      |
|    - D C O -          EPROM Version:    3.10                         |
|                       (C) 1994-96 ABB   , R.Mueller                  |
|                                                                      |
|                      Rack: 0   Slot: 4                               |
+----------------------------------------------------------------------+

Testing EPROM checksum..............:   OK
Initializing Hardware...............:   OK
Testing SRAM
        WORD Access.................:   OK
        Adress-Test.................:   OK
Testing interrupt controller........:   OK
Testing counter.....................:   OK
Testing checksum EEPROM
        Page 2......................:   OK

***   Internal selftest completed, activating Bootloader...        ***
```

No entries like time are required.

Do not make any settings in the next menu. It is to be used by service and engineering personnel, only. Therefore, no further details of this menu are described here.

```
DCO01 OS-Entry Version 2.00 kompiliert am Apr  2 1997 um 20:37:22

IdleTask: 100% Count = 20233
-----------------------------------------------------------------
       CGENLIB-Main-Menue PSOS86 $Revision:   1.4.1.0  $

abort   |output-     |follow-|global-|task-|keyword-    |lock
        |destination|pointer|trace  |trace|trace       |system
  100   |  98        |  97   |  96   | 95  |   94       | 93

   0    CAN - Com.       |     5    free 1
   1    Serial - Com.    |     6    free 2
   2    Flashloader      |     7    free 3
   3    OS               |     8    CGEN-Libary
   4    free 0           |

 Followpointers = OFF     Globaltrace = ON
```

7 Technical Data of the Process Station

7.1 Environmental specifications

Max. ambient temp.	0 °C ... 50 °C (no fan required)
Max. internal module temp.	0 °C ... 70 °C temperature monitoring on CPU and I/O modules.
Temperature gradient to DIN/IEC 68, Part 14	operational: 1 °C/minute
Storage and transportation temperature	- 25 °C ... + 85 °C

Air humidity/air temperature diagram

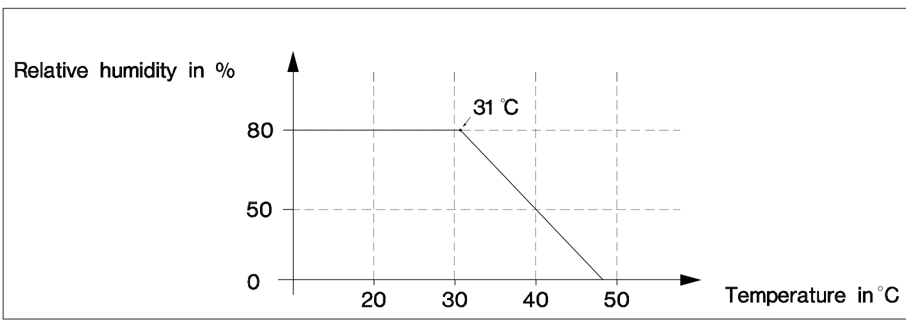


Fig. 7-1 Max. relative humidity

Degree of relative humidity	RH-1 according to EN 61131-2:1994 (IEC 1131-2)
Operating altitude	max. 2000 m above sea level; higher altitudes on request
Climate class	KWF to DIN 40 040 3K3 to DIN IEC 721, Part 3-3
Corrosion resistance	to IEC 68-2-30 lower air temperature 25 °C upper air temperature 55 °C/ 95 % air humidity 9 hours dwell time, 6 cycles
Protection	IP 20 for rack with mounted modules

7.2 Mechanical specifications

Test to DIN IEC 68, T. 2 - 27 and T. 2 - 6

Transportation

Shock	30 g/18 ms/18 shocks Max. values for the individual modules. The values are valid for assembled process stations only if a transportation restraint is used.
Vibration, 3 * 5 cycles	2 g/0.15 mm/5 ... 150 Hz

Always put the modules in their original packing for transportation to avoid damage. When transporting completely assembled racks with mounted modules, always protect the modules with transportation restraints DSU 482.

Operation

Vibration, 3 * 2 cycles	2 g/0.075 mm/5 ... 150 Hz

7.3 Electromagnetic compatibility (EMC)

Meets the requirements of the EC directive 89/336/EEC for EMC, as of May 1989, or the EMCG regulation dated November 1992, respectively.

RFI suppression	to EN 55022 1987 (DIN VDE 0878, Part 3/11.89, Class B) expanded by limits specified in regulation 243/1991 of the German Federal Telecommunications Office

EMI/RFI shielding to EN 50 082

Test in accordance with IEC 1000-4/IEC 801/EN 60801/ EN 61000-4/VDE 0843	- shielded I/O cables meet Parts 1 to 6, degree 3 - unshielded I/O cables meet Parts 1 to 4 and Part 6, degree 3

ESD degree to EN 61131-2:1994 : degree ESD-3

The industrial standard to NAMUR 21 as of 05.93 is met.

7.4 Safety specifications

The requirements of EC directive 73/23/EEC (low voltage directive) and of CSA/UL are met.

Class of equipment	I
Overvoltage category	II for all other connectors, pollution degree 2 Exception: DDO 02, DDO 03, DDO 04, DDI 02, DDI 03, DDI 05
Design	to IEC 1010-1 (1990 - 09), EN 61010-1/03.93 or DIN/EN 61010 Part 1 03.94 (VDE 0411, Part 1) UL 3101-1, CSA 22.2, No. 1010-1 E-File No. : E183961
Supply of modules	DDI 01, DDI 04, DDO 01, DAI 01, DAI 02, DAI 03, DAI 04, DAI 05, DAO 01, DFI 01, DCO 01: extra low voltage with protective separation from other circuits which may be earthed according to IEC 364-4-41:1991
Power supply DPW 01/02/03	Safety isolating transformer according to EN 60 742:1989 (IEC 742 - 1st edition, modified) Opto-coupler for protective separation against electric shock (German standard DIN VDE 0884 / 08.1987)

Separation of I/O signals

For the modules DDI 01, DDI 04, DDO 01, DAI 01, DAI 02, DAI 03, DAI 04, DAI 05, DAO 01, DAO 02, DFI 01

Rated voltage value:	50 V DC or 25 V AC, overvoltage category II, pollution degree 2.
Test voltage for I/O signals	500 V DC, between channel groups, between channel groups and protective conductor terminal, and between channel groups and electronic potential in the type acceptance test 300 V DC, between channel groups, between channel groups and protective conductor terminal, and between channel groups and electronic potential in the routine check test

Do not supply the modules with any voltage other than extra low voltage with protective separation from other circuits which may be earthed (PELV), according to IEC 364-4-41:1991.

For the modules DDO 02, DDO 03, DDO 04, DDI 02, DDI 03, DDI 05

Rated voltage value:	300 V AC/DC, overvoltage category III, pollution degree 2
Test voltage for I/O signals	2200 V AC, between I/O channels and between I/O channels and protective conductor terminal 3700 V AC, between I/O channels and electronic potential in type acceptance test 700 V AC, between I/O channels and electronic potential in routine check test

The modules have a protective separation from other circuits according to the German standard DIN VDE 0106, Part 101/11.86.

7.5 Power loss specifications for cooling system calculation

The specifications in the following sections are based on the conditions listed below:

- The module is working with a nominal voltage of 24 V DC.
- The coverage factor for the inputs and outputs can be defined by the user.
- No safety margin has been considered for calculation. It has to be specified and considered by the user, based on his experience.

The specifications refer to the thermal power loss in the module. The electrical power consumption of the module may be higher or lower than the power loss. For example, the electrical power consumption of the DDO 01 module is higher than the thermal power loss, since the module transfers the major part of the consumed energy to the actors via its outputs and does not convert it to heat by itself.

Calculation examples

The specified thermal power loss is composed of the basic power loss and the power loss per channel. The basic loss is always given. The power loss of each switched channel has to be added, hence:

Total power loss = basic power loss + number of simultaneously switched channels × power loss per channel

The DDO 03 module with a basic power loss of 3.6 W and a power loss of 0.32 W per switched channel has 16 outputs. Assume half of the outputs, (i.e. 8 outputs) be switched in a typical operating situation (coverage factor = 50 %). From this results:

3.6 W + 8 × 0.32 W = 6.2 W (typical value)

In the worst case all 16 outputs are switched simultaneously (coverage factor = 100 %). From this results:

3.6 W + 16 × 0.32 W = 8.7 W (maximum value)

This formula and the tables below can be used to calculate the power loss for any other coverage factor.

7.5.1 Power loss of power supplies DPW 01, DPW 02 and DPW 03

Power loss of DPW 01 at nominal load	20 W
Power loss of DPW 02 at nominal load	20 W
Power loss of DPW 03 at nominal load	13 W

7.5.2 Power loss of link module DLM 01

Basic power loss	1 W

7.5.3 Power loss of link module DLM 02

Basic power loss	7 W

7.5.4 Power loss of CPU module DCP 02

Basic power loss	12 W

7.5.5 Power loss of CPU module DCP 10

Basic power loss	14 W

7.5.6 Power loss of digital input modules DDI 01, DDI 02, DDI 03

	DDI 01	DDI 02	DDI 03
Basic power loss	0.65 W	1.3 W	1.3 W
Power loss per switched input	0.2 W	0.14 W	0.075 W
Number of inputs	32	16	16
Typical power loss (coverage factor 50 %)	3.9 W	2.4 W	1.9 W
Max. power loss (coverage factor 100 %)	7.1 W	3.5 W	2.5 W

The specifications for DDI 02 refer to a 24 V operating voltage. At 60 V the maximum power loss is 9.7 W.

7.5.7 Power loss of digital input module DDI 04

Basic power loss		6.3 W
Power loss per switched input	2-wire NAMUR initiators	0.1 W
	3-/4-wire initiators	0.6 W
	Contacts (NO/NC)	0.1 W
	Contacts (change-over)	0.2 W
No. of inputs	2-wire NAMUR initiators	28
	3-/4-wire initiators	12
	Contacts (NO/NC)	28
	Contacts (change-over)	12
Typical power loss (coverage factor 50 %)	2-wire NAMUR initiators	7.1 W
	3-/4-wire initiators	9.2 W
	Contacts (NO/NC)	7.9 W
	Contacts (change-over)	7.6 W
Max. power loss (coverage factor 100 %)	2-wire NAMUR initiators	7.9 W
	3-/4-wire initiators	12.7 W
	Contacts (NO/NC)	9.7 W
	Contacts (change-over)	9.2 W

7.5.8 Power loss of digital input module DDI 05

Basic power loss	2.7 W
Power loss per switched input	0.075 W
No. of inputs	32
Typical power loss (coverage factor 50 %)	3.9 W
Max. power loss (coverage factor 100 %)	5.1 W

7.5.9 Power loss of digital output module DDO 01

Basic power loss	5.5 W
Power loss per switched output at nominal current 0.5 A	0.15 W
Number of outputs	32
Typical power loss (coverage factor 50 %)	7.9 W
Max. power loss (coverage factor 100 %)	10.3 W

The electrical power consumption of the module is higher than the thermal power loss, since the module transfers the major part of the energy to the current-sourcing outputs. Only the voltage drop at the power switches contributes to the thermal power loss. The remaining energy is converted to heat in the driven actors.

7.5.10 Power loss of digital output modules DDO 02, DDO 03, DDO 04

	DDO 02	DDO 03	DDO 04
Basic power loss	1.3 W	3.6 W	2.4 W
Power loss per switched output	0.45 W	0.32 W	0.40 W
Number of outputs	16	16	16
Typical power loss (coverage factor 50 %)	4.9 W	6.2 W	5.6 W
Max. power loss (coverage factor 100 %)	8.5 W	8.7 W	8.8 W

The specifications for DDO 03 refer to a 24 V DC operating voltage. The influence of the load current on the power loss is negligible due to the relatively small transfer resistances of the relay contacts.

The higher basic power loss of DDO 03 and DDO 04 compared to DDO 02 results from the driven LEDs of the feedback channel. The LEDs are switched off when the relays pick up. This reduces the power loss per switched output.

7.5.11 Power loss of analog input modules DAI 01, DAI 02, DAI 03

	DAI 01	DAI 02	DAI 03
Basic power loss	7.5 W	7.5 W	7.5 W
Power loss per input at 100 % drive	0.02 W	0.01 W	0.11 W
Number of inputs	16	16	16
Typical power loss (coverage factor 50 %)	7.7 W	7.6 W	8.4 W
Max. power loss (coverage factor 100 %)	7.8 W	7.7 W	9.26 W

7.5.12 Power loss of analog input module DAI 04

Basic power loss	3 W
Power loss per input	none

7.5.13 Power loss of analog input module DAI 05

Basic power loss (from internal power supply)	2.4 W
Basic power loss (from external power supply)	5.0 W
Power per input at 100 % drive (20mA , 250 Ω)	0.1 W
Number of inputs	16
Typical power loss (coverage factor 50 %)	8.2 W
Max. power loss (coverage factor 100 %)	9.0 W

7.5.14 Power loss of analog output module DAO 01

Basic power loss	6.8 W
Power loss per output at 100 % drive and 50 Ω load	0.46 W
Number of outputs	16
Typical power loss (coverage factor 50 %)	10.5 W
Max. power loss (coverage factor 100 %)	14.2 W

Note that the analog output module is supplied by the internal power supply and externally.

7.5.15 Power loss of analog output module DAO 02

Not yet specified as the module is still under development.

7.5.16 Power loss of frequency input module DFI 01

Power loss of internal and external power supply	20.0 W

7.5.17 Power loss of communication module DCO 01

Basic power loss:	9.1 W

7.6 Technical data of the modules

7.6.1 Technical data of power supplies DPW 01, DPW 02 and DPW 03

Features

- DPW 01: input voltage switchable between 230 V AC and 115 V AC

  DPW 02: 24 V DC input voltage

  DPW 03: input voltage switchable between 230 V AC and 115 V AC

- 24 V DC output voltage.
  DPW 01: Extra low voltage with protective separation from other circuits which may be earthed (PELV) at the output.

  DPW 02: Extra low voltage with protective separation from other circuits which may be earthed (PELV) at the input.

  DPW 03: Extra low voltage with protective separation from other circuits which may be earthed (PELV) at the output.

- Power-fail signal is transmitted to link module

- Mounting on support rails

- Status indicator LEDs for output voltage

- Open-circuit proof, overcurrent limiter, continued short-circuit proof

- 20 ms bridging in case of power failure

- meets EMC requirements, all metal housing

Technical data of DPW 01

Input voltage	230 V AC, perm. range 195.5 ... 253 V AC 115 V AC, perm. range 97.8 ... 126,5 V AC
Mains frequency	50/60 Hz, perm. range 47 ... 63 Hz
Protection against polarity reversal	AC power supply, not applicable
Protection against improper voltage values and/or frequency	application of voltages below nominal voltage does not lead to destruction, DC supply possible.
Bridging time in case of power failure	> 20 ms without malfunctions
Fuse	glass fuse, type 5 AT, in input circuit
Output voltage	24 V DC (± 5 %), typical
Spikes	max. 150 mV (peak - peak)
Ripple	max. 100 mV (peak - peak)
Output current	0 ... 5 A
Current limiting	above approximately 6 A, automatic restart of normal operation
Input current at nominal load (RMS)	max. 1.4 A at 230 V AC, max. 3.0 A at 115 V AC
Inrush current	max. 15 times the peak value of the nominal current (NAMUR)
Efficiency	around 87 %
Thermal power loss	20 W
Weight	0.66 kg
Terminals	input: one screw terminal for cross-sectional areas of up to 2.5 mm² output: two screw-terminals for cross-sectional areas of up to 2.5 mm²
Test voltage (routine check test)	1.5 KV DC primary/secondary (3 KV AC transformer) 1.5 KV DC primary / PE 500 V DC secondary / PE
Protection	IP 20
Safety low voltage at the output	yes (SELV)
Protective separation from other circuits	yes, according to IEC 364-4-41:1991
Mark of conformity	conf. to IEC 1010, DIN/EN 60950, CSA, UL, CB scheme, CE mark

Technical data of DPW 02

Input voltage	24 V DC. Perm. range 19.2 ... 32.5 V DC. Perm. ripple 14 % peak-peak, supply via three-phase bridge rectifier permissible
Mains frequency	DC input, not applicable
Protection against polarity reversal	yes
Protection against improper voltage values and/or frequency	application of voltages below nominal voltage does not lead to destruction
Bridging time in case of power failure	> 20 ms without malfunctions
Fuse	fuse, type 30 AT, in input circuit
Output voltage	24 V DC (± 5 %) typical
Spikes	max. 150 mV (peak - peak)
Ripple	max. 100 mV (peak - peak)
Output current	0 ... 5 A
Current limiting	above approximately 6 A, automatic restart of normal operation
Input current at nominal load (RMS)	5.4 A at 24 V DC
Inrush current	max. 15 times the peak value of the nominal current (NAMUR)
Efficiency	around 89 %
Thermal power loss	20 W
Weight	0.7 kg
Terminals	For cross-sectional areas of up to 2.5 mm² input: one screw terminal output: two screw-terminals
Test voltage (routine check test)	2.2 KV AC primary secondary 2.2 KV AC primary / PE 350 V AC secondary / PE
Protection	IP 20
Safety low voltage at the output	yes, if power supply is powered with safety low voltage
Protective separation from other circuits according to IEC 364-4-41:1991	not necessary, since device must be supplied with extra low voltage.
Mark of conformity	conf. to IEC 1010, DIN/EN 60950, CSA, UL, CB scheme, CE mark

Technical data of DPW 03

Input voltage	230 V AC, perm. range 195.5 ... 253 V AC 115 V AC, perm. range 97.8 ... 126.5 V AC
Mains frequency	50/60 Hz, perm. range 47 ... 63 Hz
Protection against polarity reversal	AC power supply, not applicable
Protection against improper voltage values and/or frequency	application of voltages below nominal voltage does not lead to destruction, DC operation possible
Bridging time in case of power failure	> 20 ms without malfunctions
Fuse	Glass fuse, type 5 AT , on the primary side
Output voltage	24 V DC (± 2 %) typical
Spikes	max. 150 mV (peak - peak)
Ripple	max. 25 mV (peak - peak)
Output current	0 ... 5 A
Current limiting	above approximately 6 A, automatic restart of normal operation
Input current at nominal load (RMS)	max. 1.4 A with 230 V AC, max. 2.6 A with 115 V AC
Inrush current	max. 15 times the peak value of the nominal current (NAMUR)
Efficiency	Around 90%
Thermal power loss	13 W
Weight	0.62 kg
Terminals	Input: one screw terminal, each, for cross-sectional areas of up to 4 mm² Output: two screw terminals, each, for cross-sectional areas of up to 4 mm²
Test voltage (routine check test)	1.5 KV DC primary/secondary. (3 KV AC transformer) 1.5 KV DC primary/PE 500 V DC secondary/PE
Protection	IP 20
Safety low voltage at the output	yes (SELV)
Protective separation from other circuits	yes, according to IEC 364-4-41:1991
Mark of conformity	EN 60950, UL1950, UL508 listed, CUL/CSA-C22.2 No. 950-M90, EN 50178, CB scheme, CE conformity mark, including low-voltage directive and EMC directive

7.6.2 Technical data of link module DLM 01

Features

- Application of 24 V supply voltage from power supply DPW
- Supply voltage monitoring
- LED status indicator
- Connection of additional I/O units possible
- Replaceable battery for redundant CPU module RAM buffering
- Connector plug for external RAM buffering
- Short-circuit and overvoltage protection

Technical data

Supply voltage	24 V DC, ± 10 % 120 W from power supply DPW
Power consumption	1 W for internal supply max. 120 W for module supply in rack
Glass fuse, type 5 AT	Model: Wickmann 19195 (UR)
Buffer battery	3.6 V
Add. external battery voltage	3.6 V (nominal voltage) and/or 24 V DC permissible range 2.9 ... 4.5 V or 18 ... 30 V
Weight	1.7 kg

7.6.3 Technical data of link module DLM 02

Features

- 24 V double connection , powered by two power supplies DPW
- Supply voltage monitoring
- Automatic switch-over in case one power supply fails
- Microprocessor for module monitoring
- Module temperature monitoring
- LED status indicator
- Connection of additional I/O units possible
- Replaceable battery for redundant CPU module RAM buffering
- Connector plug for external RAM buffering
- Short-circuit and overvoltage protection

Technical data

Supply voltage		24 V DC, ± 10 % 120 W from power supply DPW
Power consumption		max. 7 W for internal supply max. 120 W for module supply in rack
Fuse	external internal	glass fuse type 5 AT, Wickmann 19195 (UR) glass fuse type 0.4-AT, Wickmann 19198 (UL)
Buffer battery		3.6 V
Add. external battery voltage		3.6 V (nominal voltage) and/or 24 V DC permissible range 2.9 ... 4.5 V or 18 ... 30 V
Weight		1.7 kg

7.6.4 Technical data of CPU module DCP 02

CPU module DCP 02 has been modified. The new version can be identified through its hardware revision level (HW index 50.00 or higher). The differences were kept as small as possible. In the following text, the modified DCP 02 module (HW index ≥ 50.00) is described. Therefore, the major differences from the previous version are al data.

Features

- Efficient super scalar RISC CPU
- Coprocessor for DigiNet S Ethernet bus
- 8 MB static RAM, battery-buffered, ensures quick restart after failure of the primary power
- Write-protection for main memory, programmable areas
- Main memory with error detection and correction (EDC) unit, automatically correcting 1-bit errors and recognizing all 2-bit errors in a data word for both CPU and DMA memory access of the coprocessor
- Hardware configuration and diagnostic data stored in serial 16 Kbit EEPROM
- Flash EPROM, software/firmware update possible without replacing EPROM
- Connectors for DigiNet S system bus meet Ethernet standard
- Serial interfaces RS485 and RS232C
- Module self-test , inquiry via diagnostic interface
- Reset switch, Run/Stop switch
- LED status indicators
- Internal and/or external RAM buffering
- Processing of ‘Battery low‘ or ‘No battery‘ signals
- CPU board temperature monitoring, both cyclic temperature measurement and asynchronous signaling when a temperature limit is exceeded
- DCP 02 with a HW index < 50.00 only provides asynchronous signaling when a temperature limit is exceeded
- Counter for running hours at normal and at excess temperature.
- Monitoring of the internal operating voltage.
- Independent watchdog function block, reliably preventing that the operating system gets “stuck“
- Battery-buffered real-time clock retaining the system time while the process station is off
- Processing of power-fail signal

Technical data

Weight CPU board in module case.	2 kg
Power consumption Depending on CPU load and cycle times	- typ.: 10 W - max.: 12 W
Voltage monitoring If either of the two internal supply voltages is fallen below by the specified value, a reset of the CPU board is initiated. In this case supply voltages of 5.0 V ± 3 % and 3.3 V ± 3 % are generated on the DCP02. (DCP 02 with a HW index < 50.00 only has an internal supply voltage of 5 V.)	Reset threshold with 5 V: 4.65 V Reset threshold with 3.3 V: 3.08 V
Power failure Short-time interruptions of the primary power supply can be bridged by the DPW power supplies without generating a power fail signal. Also, in cases where a power fail signal is generated the power supplies continue to power the system for a time T_{PF} to ensure that all running processes can be shut down properly.	$T_{PF} \geq 15$ ms
CPU Intel 80960HD 25/50, 32-bit super scalar RISC processor (with HW index < 50.00: Intel 80960 CA processor)	50 MHz CPU clock 100 MIPS
Coprocessor Intel 82596 CA, for Ethernet communication	25 MHz
Processing time for 1000 commands	
(preliminary specifications) binary IL	< 2.0 ms
fixed point arithmetic	< 3.5 ms
floating point arithmetic	< 4.5 ms
RAM 32-bit words, battery-buffered data retention.	8 MB static RAM
EDC unit Every 32-bit value in the main memory is provided with a checksum, to improve the data integrity	Correct 1-bit errors Signal 2-bit errors
EPROM Flash EPROM, allowing for quick access; can be programmed while installed in the system, no EPROM change required	2 MB, 32-bit words
With HW index < 50.00:	512 kB, 32-bit words

EEPROM Configuration data and diagnostic data memory, independent of battery buffering	Serial 16-Kbit EEPROM, Write cycles ≥ 10^7, Data retention time ≥ 10 years
Temperature monitoring When the module is used at temperatures below or above the specified operating temperature, the MTBF is reduced. For this reason the temperature is measured cyclically, and excess temperature is immediately signaled. The signal is reset at hysteresis temperature. The running hours at excess temperature and at normal temperature are measured separately.	Resolution: 0.5 °C Accuracy: ± 2 °C Excess temperature: 70 °C Hysteresis 65 °C
Hot swapping (inserting/removing module when live)	Permissible without restrictions
Watchdog An independent watchdog function block must be triggered within the specified time. Otherwise, a module reset is initiated. This prevents that the operating system gets “stuck“.	Trigger time ≤ 1.6 s
Real-time clock The correct time and date of the real-time clock must be set when the module is used for the first time. When a buffer battery is used, the time and date is retained even when the system is off. If the specified max. deviation should be too great for your application, it is recommended to use a radio clock instead.	Basic accuracy: ± 20ppm Temperature influence: -10/+120 ppm Aging: ± 5ppm/a Max. deviation p. a.: -1104 ... +4573 s/a
Internal fuses	Self-resetting, no replacement required
Battery DSU 08 Replaceable, external and redundant buffering possible	3.6 V lithium battery, Battery life > 1.5 years (full-time operation)
I/O polling/ output cycle The I/O modules are driven through 3 powerful CAN communication controller ASICs (HiCAN) (DCP 02 with HW index < 50.00 is only provided with three standard CAN controllers).	**digital**, at least 2 ms per rack **analog**, at least 10 ms per rack

System bus

Full Ethernet	according to 10Base5 (AUI connector)
Thin Ethernet	according to 10Base2 with 50 Ω coaxial cable
Fiber optic cable	according to 10Base-FL via AUI connector

Serial interface RS485 / Ser 1

RS485	9-pole Sub D female connector, half-duplex, suitable for bus operation, max. 32 bus nodes, configurable transmission rate, max. 19200 Baud.

Diagnostic interface RS232C / Diag

RS232C	9-pole Sub-D male plug, RTS and CTS handshake signals available, connection of radio clock possible, configurable transmission rate, max. 19200 Baud connection of diagnostic PC possible via diagnostic cable DSU 141 Also suitable for connection of a radio clock, provided that the instructions given in Section 12.2.4. are observed.

Cables

DSU 13:	RS485 cable for DCP 02 9 pole Sub-D connector at one end, wire end sleeves at the other end,
DSU 141:	RS232C cable for DCP 02 9-pole Sub-D connector (male) for connection to diagnostic interface at one end, 25-pole Sub-D connector for connection to PC or terminal at the other end
NA 00x:	AUI cable for connecting system bus DigiNet S in accordance with 10Base5 15-pole Sub-D connector (male) for connection to DCP 02 at one end, 15-pole Sub-D connector (female) for connection to AUI transceiver NTC 03, star coupler NCU 02 or 10Base-FL transceiver NTC 02.
NC 200:	10Base2-cable (coax) for connecting to system bus DigiNet S in accordance with 10Base2 coax. connectors at both ends.

7.6.5 Technical data of CPU module DCP 10

Features

- Efficient super scalar RISC CPU
- Coprocessor for DigiNet S bus and redundant Diginet Sr bus
- 8 MB static RAM, battery-buffered, ensures quick restart after failure of the primary power
- Write-protection for main memory, programmable areas.
- Main memory with error detection and correction (EDC) unit, automatically correcting 1-bit errors and recognizing all 2-bit errors in a data word for both CPU and DMA memory access of the coprocessors
- Hardware configuration and diagnostic data stored in serial 16 Kbit EEPROM
- Flash EPROM, software/firmware update possible without replacing EPROM
- Connectors for DigiNet S system bus and redundant DigiNet Sr system bus meet Ethernet standard
- Serial interfaces RS485, RS422 and RS232C, electrically isolated
- Module self-test and inquiry via diagnostic interface
- Serial interfaces and diagnostic port suitable for redundancy mode
- Reset switch, Run/Stop switch, redundancy toggle switch
- LED status indicators
- Internal and/or external RAM buffering
- Processing of ‘Battery low‘ or ‘No battery‘ signals
- CPU board temperature monitoring, both cyclic temperature measurement and asynchronous signaling when a temperature limit is exceeded
- Counter for running hours at normal and at excess temperature.
- Monitoring of the internal operating voltage.
- Independent watchdog function block, reliably preventing that the operating system gets “stuck“
- Battery-buffered real-time clock retaining the system time while the process station is off
- Processing of power-fail signal

Technical data

Weight CPU board in module case.	2 kg
Power consumption Depending on CPU load and cycle times	- typ.: 10.4 W - max.: 14 W
Voltage monitoring If either of the two internal supply voltages is fallen below by the specified value, a reset of the CPU board is initiated. In this case supply voltages of 5.0 V ± 3 % and 3.3 V ± 3 % are generated on the DCP10.	Reset threshold with 5 V: 4.65 V Reset threshold with 3.3 V: 3.08 V
Power failure Short-time interruptions of the primary power supply can be bridged by the DPW 01, DPW 02 and DPW 03 power supplies without generating a power fail signal. Also, in cases where a power fail signal is generated the power supplies continue to power the system for a time T_{PF} to ensure that all running processes can be shut down properly.	$T_{PF} \geq 15$ ms
CPU Intel 80960HD 25/50, 32-bit super scalar RISC processor	50 MHz CPU clock 100 MIPS
Co-processors Two Intel 82596 CA communication processors for Ethernet.	25 MHz

Processing time for 1000 commands

(preliminary specifications)	binary IL	< 1.0 ms
	fixed point arithmetic	< 1.5 ms
	floating point arithmetic	< 1.5 ms

RAM 32-bit words, battery-buffered data retention.	8 MB static RAM
EDC unit Every 32-bit value in the main memory is provided with a checksum, to improve the data integrity	Correct 1-bit errors Signal 2j-bit errors

EPROM

Flash EPROM, allowing for quick access; can be programmed while installed in the system, no EPROM change required

2 MB, 32-bit words

EEPROM

Configuration data and diagnostic data memory, independent of battery buffering

Serial 16-Kbit EEPROM,
Write cycles ≥ 10^7,
Data retention time ≥ 10 years

Temperature monitoring

When the module is used at temperatures below or above the specified operating temperature, the MTBF is reduced. For this reason the temperature is measured cyclically, and excess temperature is immediately signaled. The signal is reset at hysteresis temperature. The running hours at excess temperature and at normal temperature are measured separately.

Resolution:	0.5 °C
Accuracy:	± 2 °C
Excess temperature:	70 °C
Hysteresis	65 °C

Hot swapping (inserting/removing module when live)

Permissible without restrictions

Watchdog

An independent watchdog function block must be triggered within the specified time. Otherwise, a module reset is initiated. This prevents that the operating system gets “stuck“.

Trigger time ≤ 1.6 s

Real-time clock

The correct time and date of the real-time clock must be set when the module is used for the first time. When a buffer battery is used, the time and date is retained even when the system is off. If the specified max. deviation should be too great for your application, it is recommended to use a radio clock instead.

Basic accuracy: ± 20ppm
Temperature influence:
-10/+120 ppm
Aging: ± 5ppm/a
Max. deviation p. a.:
-1104 ... +4573 s/a

Internal fuses

Self-resetting, no replacement required

Battery DSU 08

Exchangeable, external and redundant buffering possible

3.6 V lithium battery,
Battery life > 1.5 years (full-time operation)

I/O polling/ output cycle

The I/O modules are driven through 3 powerful CAN communication controller ASICs (HiCAN)

digital, at least 2 ms per rack
analog, at least 10 ms per rack

System buses DigiNet S and DigiNet Sr

Full Ethernet	according to 10Base5 (AUI-connector)
Thin Ethernet	according to 10Base2 with 50 Ω coax. cable
Fiber optic cable	according to 10Base-FL, via AUI connector

Serial interface Ser 1

15-pole Sub-D female connector. Depending on connector pin assignment

RS485	half-duplex, suitable for bus operation with max. 32 bus nodes, suitable for redundant operation
RS422	full-duplex, point-to-point connection, suitable for redundant operation
RS232C	full-duplex with RTS/CTS handshake; point-to-point connection, suitable for redundant operation.
Transmission rate	configurable, max. 19200 Baud. 9-pole Sub-D connector (female)

Diagnostic interface Diag

RS232C	9-pole Sub-D connector, male. Handshake signals RTS, CTS available, suitable for redundant operation only in conjunction with a radio clock DSU 153 configurable transmission rate, max. 19200 Baud; connection of diagnostic PCs via diagnostic cable DSU 141
RS232C radio clock cable	DSU 153: two 9-pin Sub-D plug (male) on one side and 25-pin Sub-D connector plug for connection to DCF77 radio clock or GPS satellite radio clock on the other side

Cables for non-redundant use

RS232C cable for DCP 10	DSU 212: 15-pole Sub-D connector at one end, wire end sleeves at the other end
RS422 cable for DCP 10	DSU 213: 15-pole Sub-D connector at one end, wire end sleeves at the other end
RS485 cable for DCP 10	DSU 211: 15-pole Sub-D connector at one end, wire end sleeves at the other end
RS232C diagnostic cable for DCP 10	DSU 141: 9-pole Sub-D connector (male) for connection to diagnostic interface at one end, 9-pole Sub-D connector for connection to PC or terminal at the other end
AUI cable NA 00x	for connecting DigiNet S and DigiNet Sr system buses: 15-pole Sub-D connector (male) for connection to DCP 10 at one end, 15-pole Sub-D connector (female) for connection to AUI transceiver NTC 03, star coupler NCU 02 or 10BaseFL transceiver NTC 02.
10Base2 cable NC 200	for connection to DigiNet S and DigiNet Sr system buses, coax. cable connectors at both ends

Cables for redundant operation

RS232C cable	DSU 222: two 15-pole Sub-D connectors at one end, wire end sleeves at the other end
RS422 redundancy cable	DSU 223: two 15-pole Sub-D connectors, wire end sleeves at the other end
RS485 redundancy cable	DSU 221: two 15-pole Sub-D connectors, wire end sleeves at the other end
RS232C diagnostic cable	DSU 142: two 9-pole Sub-D connectors (male), 9-pole Sub-D connector for connection to a PC or terminal at the other end
NA 00X:	AUI cable for connection to DigiNet S or DigiNet Sr system bus in accordance with 10Base5 15-pole Sub-D connector (male) for connection to a DCP 10 at one end, 15-pole Sub-D connector (female) for connection to AUI transceiver NTC 03, star coupler NCU 02 or 10Base-FL transceiver NTC 02.
NC 200:	10Base2 cable (coax) for connection to DigiNet S or DigiNet Sr system bus in acc. with 10Base2, coax. connectors at both ends

7.6.6 Technical data of digital input module DDI 01

General characteristics

Type	digital input, type 1 to EN 61131-2:1994 (IEC 1131-2), current-sinking, protected against polarity reversal
Number of channels	32
Nominal voltage	for active sensors 24 V DC or contacts with external 24 V DC supply
Operating mode	self-scan, configurable cycle time, shortest time 2 ms
Potential separation	four groups of eight; electrically isolated by opto-couplers, 8 inputs have a common ground potential.
Tap of channel indicator LEDs	at I/O side, directly at input
Power consumption from rack	1.8 W
Glass fuse, type 1 AT	Model: Wickmann 19198 (UL)
Weight	1.7 kg
Max. permissible cable length	1000 m with appropriate cross-sectional area
Insertion/withdrawal under power	permissible, without restrictions

Static characteristics

Volt/ampere curve over the full operating range		State 0 UL	IL	Transition region UT	IT	State 1 UH	IH
24 V DC	max.	5 V	1 mA	15 V	3.7 mA	30 V	12.0 mA
	min.	-15 V	-9.5 mA	5 V	1 mA	15 V	3.7 mA
Input impedance		$R_{(IN)} \approx 3\ k\Omega$					
Rated input current		$I_{(IN)} = 8\ mA$					

Dynamic characteristics

Sample repetition time (cycle time)	configurable, 2 ms or slower.
Delay time for 1 to 0 and 0 to 1 transitions	configurable in 2 ms steps; additional debouncing function configurable.
Input filter characteristic	first order
Input filter delay time	≤ 400 μs

7.6.7 Technical data of digital input module DDI 02

General characteristics

Type	digital input with expanded input voltage range for DC and AC, current-sinking, protected against polarity reversal
Number of channels	16
Nominal voltage	for active sensors with the range 24 ... 60 V AC/DC or contacts with external 24 ... 60 V AC/DC supply
Operating mode	self-scan, configurable cycle time, shortest time 2 ms
Potential separation	all channels electrically isolated from each other; protective separation between I/O channels and electronic potential.
Tap of channel indicator LEDs	at the system side, behind the opto-coupler.
Power consumption from rack	2.7 W
Glass fuse, type 1 AT	Model: Wickmann 19198 (UL)
Weight	1.7 kg
Max. permissible cable length	1000 m with appropriate cross-sectional area
Insertion/withdrawal under power	permissible; when applying hazardous voltages switch off the I/O circuits before withdrawal.

Static characteristics

Volt/ampere curve over the full operating range		State 0 UL	IL	Transition region UT	IT	State 1 UH	IH
24 ... 60 V DC	max.	5 V	0.5 mA	15 V	2 mA	70 V	11 mA
	min.	-3 V	-0.4 mA	5 V	0.5 mA	15 V	2 mA
24 ... 60 V AC	max.	5 V	0.65 mA	15 V	2 mA	70 V	11 mA
	min.	0 V	0 mA	5 V	0.65 mA	15 V	2 mA
Input impedance		$R_{(IN)} \approx 7k\Omega$					

Dynamic characteristics

Sample repetition time (cycle time)	configurable, 2 ms or slower
Input filter characteristic	first order
Input filter delay time	≈ 70 ms

7.6.8 Technical data of digital input module DDI 03

General characteristics

Type	digital input with expanded input voltage range for AC, current-sinking, protected against polarity reversal
Number of channels	16
Nominal voltage	for active sensors with the range 115 ... 230 V AC or contacts with external 115 ... 230 V AC supply
Operating mode	self-scan, configurable cycle time, shortest time 2 ms
Potential separation	all channels electrically isolated from each other; protective separation between I/O channels and electronic potential.
Tap of the channel indicator LEDs	at the system side, behind the opto-coupler
Power consumption from rack	2.7 W
Glass fuse, type 1 AT	Model: Wickmann 19198 (UL)
Weight	1.7 kg
Max. permissible cable length	1000 m with appropriate cross-sectional area
Insertion/withdrawal under power	permissible; switch off the I/O circuits before withdrawal

Static characteristics:

Volt/ampere curve over the full operating range	State 0 UL	IL	Transition region UT	IT	State 1 UH	IH
115 ... 230 V AC max.	20 V	0.5 mA	79 V	2 mA	250 V	5 mA
min.	0 V	0 mA	25 V	0.5 mA	79 V	2 mA
Input impedance	$Z_{(IN)}$ ≈ 47 kΩ (capacitive)					

Dynamic characteristics

Sample repetition time (cycle time)	configurable, 2 ms or slower
Input filter characteristic	first order
Input filter delay time	≈ 70 ms

7.6.9 Technical data of digital input module DDI 04

General characteristics

Type	digital input for NAMUR proximity switch, 2-wire to DIN 19234 and 3/4-wire to DIN 19240 digital input for contact inquiry with 8.2 V or 24 V switching threshold, current-sourcing, protected against polarity reversal
Number of channels	28 for 2-wire, 12 for 3/4-wire or mixed in groups
Nominal voltage	8.2 V (8 ... 9 V for NAMUR proximity switch, 8.2 V (8 ... 9 V), or 24 V ± 10 % for contacts
Operating mode	self-scan, configurable cycle time, shortest time 2 ms
Potential separation	two groups, electrically isolated through opto-couplers. each group consists of 14 inputs for 2-wire sensor and 6 inputs for 3/4-wire sensors and has its own common ground potential for the inputs.
Tap of the channel indicator LEDs	at the I/O side after the input interface
Power consumption from rack	6.3 W
Glass fuse, type 1 AT	Model: Wickmann 19198 (UL)
Weight	1.7 kg
Max. permissible cable length	1000 m with appropriate cross-sectional area
Insertion/withdrawal under power	permissible, without restrictions

Static characteristics

2-wire proximity switch

Volt/ampere curve over the full operating range	State 0 UL	IL	Transition region UT	IT	State 1 UH	IH
max.		1mA		2.1mA		6.5mA
min.		0.4mA		1.2mA		2.2mA
Input impedance	$R_{(IN)} \approx 1\ k\Omega$					

8.2 V DC contact

Volt/ampere curve over the full operating range	State 0 UL	IL	Transition region UT	IT	State 1 UH	IH
max.	1V		2.1 V		9 V	
min.	0 V		1.2 V		2.2 V	
Input impedance	$R_{(IN)} \approx 1\ k\Omega$					

3-wire and 4-wire proximity switch

Volt/ampere curve over the full operating range	State 0 UL	IL	Transition region UT	IT	State 1 UH	IH
max.	6 V		12.6 V		35 V	
min.	-3 V		7.2 V		13 V	
Input impedance	$R_{(IN)} \approx 6\ k\Omega$					

24 V DC contact

Volt/ampere curve over the full operating range	State 0 UL	IL	Transition region UT	IT	State 1 UH	IH
max.	5 V		12.6 V		30 V	
min.	0 V		7.2 V		15 V	
Input impedance	$R_{(IN)} \approx 6\ k\Omega$					

Sensor supply

Sensor supply	Voltage min.	max.	Current nom.	max.	Max. number
2-wire proximity switch	8.0V	9.0V	3.0mA	6.5mA	28
3/4-wire proximity switch	22.6V	26.4V	20mA	21mA	12
24 V DC contact inquiry	22.6V	26.4V	4.2mA	4.5mA	28
8.2 V contact inquiry	8.0V	9.0V	4.2mA	8.2mA	28

Dynamic characteristics

Sample repetition time (cycle time)	configurable, 2 ms or slower
Delay time for 1 to 0 and 0 to 1 transitions	software-configurable
Switching frequency	less than 200 Hz
Scan time	less than 80 μs

7.6.10 Technical data of digital input module DDI 05

General characteristics

Type	digital input with expanded input voltage range for AC, current-sinking, protected against polarity reversal
Number of channels	32
Nominal voltage	for active sensors with the range 115 ... 230 V AC or contacts with external 115 ... 230 V AC supply , in accordance with IEC 1010
Input voltage tolerances	115 V AC, - 20 % ... 230 V AC, + 10 %
Input frequency range	45 ... 65 Hz
Operating mode	self-scan, configurable cycle time, shortest time 2 ms
Potential separation	four groups of eight inputs, electrically isolated from each other via opto-couplers; the eight inputs of each group are connected to the same ground potential.
Tap of the channel indicator LEDs	at the system side, behind the opto-coupler, one LED per input channel
Channel indicator LED	**green** - State 1 recognized **off** - State 0 recognized
Power consumption from rack	5 W
Glass fuse, type 1 AT	Model: Wickmann 19198 (UL)
Weight	1.8 kg
Max. permissible cable length	1000 m with appropriate cross-sectional area
Insertion/withdrawal under power	permissible; switch off the I/O circuits before withdrawal

Static characteristics:

Volt/ampere curve over the full operating range	State 0 UL	State 0 IL	Transition region UT	Transition region IT	State 1 UH	State 1 IH
115 - 230 V AC max.	20 V	0.5 mA	79 V	2 mA	250 V	5 mA
min.	0 V	0 mA	25 V	0,5 mA	79 V	2 mA
Input impedance	$Z_{(IN)} \approx$ 47 kΩ (capacitive)					

Dynamic characteristics

Sample repetition time (cycle time)	configurable, 2 ms or slower
	more than 10 ms with 32 channels
Input filter characteristic	first order
Input frequency range	45 ... 65 Hz
Input filter delay time	≈ 10 ms

7.6.11 Technical data of digital output module DDO 01

General characteristics

Type	current-sourcing digital output for DC voltages, short-circuit-proof and overload-proof, resistant to feedback voltage (if smaller than external mains voltage)
Number of channels	32 (4 x 2 groups of 4 outputs)
Type of output switch	high-side solid state switch with short-circuit and overtemperature recognition and status feedback
Output protection	automatic switch-off of a group of four after short-circuit; resetting switch-off via DigiTool or DigiVis
Demagnetization for inductive loads	integrated, refer to Section 4.8.9.4 for max. permissible switching frequency
Operating mode	cyclic output, configurable cycle time, quickest time 2 ms
Safety values in case of CPU module failure or communication interruption	configurable; selectable choice: 0, 1 or last value. Default setting: all outputs to 0
Status after reset	all outputs to 0

Potential separation	four groups of eight, electrically isolated by opto-couplers; eight outputs are powered by a common supply, each
Tap of the channel indicator LEDs	at the I/O side, directly at the output
Power consumption from rack	2.4 W
External power supply	separately for each of the four groups of eight; permissible range 24 V DC (±25%).
Supply from three-phase mains with three-phase bridge rectifier	permissible voltage range 19.2 ... 28 V RMS. Provide for protective separation.
Power consumption from external power supply	104 W per group of eight, at nominal output current and nominal voltage.
Monitoring of external power supply	yes, with system alarm. The outputs are automatically switched off in case of undervoltage
Glass fuse, type 1 AT	Model: Wickmann 19198 (UL)
Weight	1.7 kg
Max. permissible cable length	1000 m with appropriate cross-sectional area
Insertion/ withdrawal under power	permissible without restrictions.

Static characteristics

Nominal output voltage	24 V DC
Rated current per output	0.5 A DC
Temporary overload	up to 1.2 A per output
Current range for state 1	0 ... 0.55 A
Voltage drop at state 1	max. 1 V
Leakage current at state 0	≤ 1 mA
Voltage level at state 0	≤ 2 V

Dynamic characteristics

Input/output delay time	≤ 50 µs
Output repetition time	configurable, 2 ms or slower
Max. switching frequency	250 Hz (with resistive load). Refer to Section 4.8.9.4 for the maximum switching frequency with inductive load.

7.6.12 Technical data of digital output modules DDO 02, DDO 03, DDO 04

General characteristics

Type	electromechanical relay output
Number of channels	16
Output type of DDO 02	relay contact
Output type of DDO 03, DDO 04	relay contact with status feedback; recognition of no power and defective relay contacts.
Output protection	must be provided externally, e.g. fuse
Demagnetization for inductive loads	external clamping diode required; spark quenching element at relay contact exists
Operating mode	cyclic output, configurable cycle time, quickest time 2 ms
Safety values for CPU module failure or communication interruption	configurable. Selectable choice 0 (contact open), 1 (contact closed) or last value. Default setting: all contacts open.
Status after reset	all outputs to 0 (contact open)
Potential separation	none, all channels electrically isolated
Tap of channel indicator LEDs	at electronic side, behind the opto-coupler
Power consumption from rack	8.8 W
Glass fuse, type 1 AT	Model: Wickmann 19198 (UL)
Weight	1.7 kg
Max. permissible cable length	1000 m with appropriate cross-sectional area
Insertion/withdrawal under power	perm. When applying hazardous voltages switch off the I/O circuits before withdrawal.

Static characteristics

Nominal output voltage (V_{ext})	DDO 02	24 ... 230 V AC/DC
	DDO 03	24 ... 60 V AC/DC
	DDO 04	115 ... 230 V AC
Rated current per output	5 A per output with resistive load. Observe load limit curve for DC operation (see Section 4.8.10.3)	
Minimum current	100 mA	
Leakage current at open contact	DDO 02	0 mA DC, 10 mA AC [1]
	DDO 03	< 9 mA (read back)
	DDO 04	< 15 mA (read back)[1]
Max. making/breaking capacity	direct current voltage: 250 W, alternating current voltage: 1250 V A, with resistive load	
Inductive loads	Observe reduction factor specified in Sec. 4.8.10.4.	

Dynamic characteristics

Chatter time	8 ms	
Output repetition time	configurable, 2 ms or slower	
Max. switching frequency	360 switching operations per hour at nominal load	
Contact life	mechanical	$5 \bullet 10^7$
	resistive DC load (load limit curve)	$1 \bullet 10^6$
	resistive AC load 1250 VA	$2 \bullet 10^5$
	resistive AC load 250 VA	$2 \bullet 10^6$

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1 No active power, input impedance is capacitive

7.6.13 Technical data of analog input modules DAI 01, DAI 02, DAI 03

General characteristics

Type		analog input
Number of channels		16
Type of input	DAI 01	current input 0/4 ... 20 mA with standard impedance 50 Ω
	DAI 02	voltage input 0 ... 10 V
	DAI 03	current input 0/4 ... 20 mA with increased input impedance 270 Ω for connection of Hart transmitters **(no further processing)**
Operating mode		self-scan, configurable cycle time, 10 ms or slower
Potential separation		two groups of eight, electrically isolated by opto-couplers
4 voltage control LEDs		light up if all DC/DC converters are OK.
Channel indicator LEDs DAI 01 and DAI 03		16 red LEDs **in the range 4 ... 20 mA** LED on if I < 3.2 mA LED off if I > 3.8 mA LED on if I > 20.8 mA LED off if I < 20.2 mA **in the range 0 ... 20 mA** LED on if I > 20.8 mA LED off if I < 20.2 mA
DAI 02		**in the range 0 ... 10 V** LED on if I > 10.4 V LED off if I < 10.1 V
Tap of channel indicator LEDs		driven via microprocessor of I/O module by software algorithm
Line break detection		in the range 4 ... 20 mA by signal evaluation. Channel-wise indication by channel-indicator LEDs, alarm generation. in the range 0 ... 10 V or 0 ... 20 mA by transient monitoring in the conversion block.
Power consumption from rack		9.6 W

Glass fuse, type 1 AT	Model: Wickmann 19198 (UL)
Weight	1.7 kg
Max. permissible cable length	twisted-pair cable. 1000 m with appropriate cross-sectional area
Insertion/withdrawal under power	permissible, without restrictions

Static characteristics of DAI 01

Input impedance	50 Ω, ± 1 %
Max. measuring error at 25 °C [1]	± 1 ‰
Temperature coefficient [1]	± 1.36 ‰ / 10 K
Max. error from 0°... 50 °C [1]	± 4.4 ‰
Digital resolution	12 bits
Value of least significant bit (LSB)	5.5 µA
Permissible overload without the channels influencing each other	up to around 40 mA
Max. permanent allowed overload (no module damage)	50 mA
Digital output reading under overload conditions	> 4096
Polarity reversal	permissible
Digital output reading under polarity reversal conditions	const. 0
Type of input	differential
Common-mode voltage	± 3.5 V referred to GND terminal
Noise suppression of differential mode noise sources	54 dB [2]
Noise suppression of common mode noise sources	56 dB for DC [2], 52 dB for AC [2]
Monotonicity with no missing codes	yes
Conversion method	successive approximation
Non-linearity	± 0.75 bits

[1] of end of range value, at ambient temperature

[2] N 60873:1993

Static characteristics of DAI 02

Input impedance	40.1 kΩ, ±1 %
Max. measuring error at 25°C [1]	± 1 ‰
Temperature coefficient [1]	± 1.04 ‰ / 10 K
Max. error from 0°...50 °C [1]	± 3.6 ‰
Digital resolution	12 bits
Value of least significant bit (LSB)	2.7 mV
Permissible overload without the channels influencing each other	up to around 20 V
Max. permanent allowed overload (no module damage)	25 V
Digital output reading under overload conditions	> 4096
Polarity reversal	permissible
Digital output reading under polarity reversal conditions	const. 0
Type of input	differential
Common-mode voltage	± 5V referred to GND
Noise suppression of differential mode noise sources	23 dB [2],
Noise suppression of common mode noise sources	48 dB for DC [2], 58 dB for AC [2]
Monotonicity with no missing codes	yes
Conversion method	successive approximation
Non-linearity	± 0.75 bits

Static characteristics of DAI 03

Input impedance	271Ω ±1%
Max. measuring error at 25°C[1]	± 1 ‰
Temperature coefficient [1]	± 1.36 ‰/10K
Max. error from 0°...50°C[1]	± 4.4 ‰

[1] of end of range value, at ambient temperature
[2] test procedure following EN 60873:1993

Digital resolution :	12 bits
Value of least significant bit (LSB)	5.5 µA
Permissible overload without the channels influencing each other	up to around 40 mA
Max. permanent allowed overload (no module damage)	50 mA
Digital output reading under overload conditions	> 4096
Polarity reversal	permissible
Digital value under polarity reversal conditions	const. 0
Type of input	differential
Common-mode voltage	± 3.5 Volt referred to GND terminal
Noise suppression of differential mode noise sources	54 dB [1]
Noise suppression of common mode noise sources	56 dB for DC [1] 52 dB for AC [1]
Monotonicity with no missing codes	yes
Conversion method	successive approximation
Non-linearity	± 0.75 bits

Dynamic characteristics

Sample duration time (including settling time)	≤ 52 µs	
Sample repetition time (cycle time)	configurable, 10 ms or slower	
Input filter characteristic	first order	
Time-constant input filter (70.7% of end value)	DAI 01	33 ms
	DAI 02	24 ms
	DAI 03	33 ms

[1] test procedure following EN 60873:1993

7.6.14 Technical data of analog input module DAI 04

General characteristics

Type	analog input for connection of RTD Pt100s, thermocouples or resistance teletransmitters or for direct measurement of mV signals
Number of channels	8
Type of input	relay multiplexer with subsequent differential impedance converter. Integrated current source for Pt100 and resistance teletransmitter.
Connection possibilities	• Pt100 (2-wire, 3-wire, 4-wire, measuring current 0.2 mA) • resistance teletransmitter (2-wire, 3-wire, 4-wire, measuring current 0.2 mA) • thermocouples (see types below), 2-wire • measurement of mV signals, 2-wire
Resistance teletransmitter	0 Ω ... 1000 Ω including sub-ranges 100 Ω, 200 Ω, 500 Ω
mV ranges	± 19 mV, ± 38 mV, ± 76 mV ± 154 mV, ± 308 mV
Thermocouple cold junction	selectable choice: • adjustable fixed temperature: 0 °C, 20 °C, 50 °C, 60 °C or 70 °C (isothermal terminal). • measurement via a module channel with RTD Pt100 measurement via any other channel of the process station.
Operating mode	self-scan, I/O transfer cycle time 500 ms
Potential separation	none, all channels electrically isolated from each other.
Tap of channel indicator LEDs	driven via microprocessor of I/O module by software algorithm
Line break detection	through overflow, underflow or gradient monitoring (indicated by red channel indicator LED). System alarm generation. Configurable threshold for gradient monitoring.

Power consumption from rack	3 W
Weight	1.7 kg
Max. permissible cable length	400 m for Pt100, resistance teletransmitter 200 m for thermocouple and mV shielded twisted pair cable with appropriate cross-sectional area. Use of unshielded cables possible if reduced precision requirements have to be met.
Insertion/withdrawal under power	permissible, without restrictions

Sensor type	Measuring range	Equivalent value
Pt100	-200 ... +850°C -50 ...+150°C	18 ... 390 Ω 80.31 ... 157.31 Ω
Thermoc. Type B, (Pt30Rh-Pt6Rh)	+200 ... +1820°C	+0.178 ... +13.814 mV
Thermoc. Type R, (Pt13Rh-Pt)	-50 ... +1769°C	-0.226 ... +21.121 mV
Thermoc. Type S, (Pt10Rh-Pt)	-50 ... +1769°C	-0.236 ... +18.709 mV
Thermoc. Type E, (NiCr-CuNi)	-270 ... +1000°C	-9.835 ... +76.358 mV
Thermoc. Type K, (NiCr-Ni)	-270 ... +1372°C	-6.458 ... +54.875 mV
Thermoc. Type J, (Fe-CuNi)	-210 ... +1200°C	-8.096 ... +69.536 mV
Thermoc. Type L, (Fe-CuNi)	-200 ... +900°C	-8.15 ... +53.14 mV
Thermoc. Type N, (NiCrSi-NiSi)	- 150 ... +1300 °C	-3.336 ... +47.502 mV
Thermoc. Type T, (Cu-CuNi)	- 270 ... + 400 °C	-6.258 ... +20.869 mV
Thermoc. Type U, (Cu-CuNi)	- 200 ... + 600 °C	-5.70 ... +34.31 mV

Static characteristics

Input impedance	≥ 10 MΩ	
Max. measuring error at 25 °C[1]	≤ ± 1.0 ‰	(see measuring error limits table)
Temperature coefficient[1]	≤ ± 1.6 ‰ / 10 K	
Max. error from 0°... 50 °C[1]	≤ ± 5.0 ‰	(see measuring error limits table)
Digital resolution	16 bits	
Value of least significant bit (LSB)	Range ± 19 mV	LSB = 0.6 µV
	range ± 38 mV	LSB = 1.2 µV
	range ± 76 mV	LSB = 2.5 µV
	range ± 154 mV	LSB = 5.1 µV
	range ± 308 mV	LSB = 10.2 µV

[1] mbient temperature

Digital output value reading under overload conditions	> max. measuring range value
Type of input	8 differential inputs, channel-wise isolation
Common mode voltage	max. ± 4 V
Noise suppression of differential mode noise sources	60 dB, test procedure following EN 60873:1993
Noise suppression of common-mode noise sources	100 dB for DC, >100 dB for AC test procedure following EN 60873:1993
Monotonicity with no missing codes	16 bits, with no missing codes
Conversion method	sigma-delta
Non-linearity	within intrinsic accuracy
Repetition accuracy at a special temperature after stabilization time	within operating error limits
Relay multiplexer life time	≥ 4 x 10^8 operations

Measuring error limits:

Sensor type	Range	Intrinsic accuracy (at 25°C [1])	Operating error limit (0 ... 50°C [1])
RTD Pt100	-200 ... +850°C -50 ....+150°C	± 0.5 ‰ (±0.5°C) ± 1 ‰ (±0.2°C)	~ ±5.0 ‰ (±5.0°C) ~ ±5.0 ‰ (±1.0°C)
Thermocouple Type B	200 ... +1820°C	±1.0 ‰ (±1.5°C)	~ ±3.0 ‰ (±4.5°C)
Type R	-50 ... +1769°C	±1.0 ‰ (±1.8°C)	~ ±3.0 ‰ (±5.4°C)
Type S	-50 ... +1769°C	±1.0 ‰ (±1.8°C)	~ ±3.0 ‰ (±5.4°C)
Type E	-270 .. +1000°C	±1.0 ‰ (±1.3°C)	~ ±3.0 ‰ (±3.9°C)
Type K	-270 .. +1372°C	±1.0 ‰ (±1.6°C)	~ ±3.0 ‰ (±4.8°C)
Type J	-210 .. +1200°C	±1.0 ‰ (±1.4°C)	~ ±3.0 ‰ (±4.2°C)
Type L	-200 .. +900°C	±1.0 ‰ (±1.1°C)	~ ±3.0 ‰ (±3.3°C)
Type N	-150 ... +1300°C	±1.0 ‰ (±1.5°C)	~ ±3.0 ‰ (±4.5°C)
Type T	-270 .. +400°C	±1.0 ‰ (±0.7°C)	~ ±3.0 ‰ (±2.1°C)
Type U	-200 ... +600°C	±1.0 ‰ (±0.8°C)	~ ±3.0 ‰ (±2.4°C)
Resistance teletransmitter	0 ... 1000 Ω	±0.5 ‰ (±0.5 Ω)	~ ±5.0 ‰ (±5.0 Ω)
mV ranges	± 19 mV	± 1.0 ‰ (± 38 μV)	~ ± 3.0 ‰ (± 0.114 mV)
	± 38 mV	± 1.0 ‰ (± 76 μV)	~ ± 3.0 ‰ (± 0.228 mV)
	± 76 mV	± 1.0 ‰ (± 152 μV)	~ ± 3.0 ‰ (± 0.456 mV)
	± 154 mV	± 0.5 ‰ (± 154 μV)	~ ± 2.5 ‰ (± 0.77 mV)
	± 308 mV	±0.5 ‰ (±308μV)	~ ±2.5 ‰ (±1.54mV)

[1] ure = internal module temperature

This section specifies the exact values for each measuring range. The specified intrinsic accuracies are valid for:

PRECISE measuring mode and Pt100 and resistance teletransmitter in 4-wire technique, thermocouple with isothermal block. This accuracy is valid for the measuring range between 20 ... 100 %. For 3-wire measurement (Pt100 measurement) the intrinsic error is doubled. For thermocouple measurement with external cold junction the error is increased by the error of the corresponding Pt100 cold junction.

In FAST measuring mode the intrinsic error specified above is doubled.

Dynamic characteristics

Sample duration time (including settling time)	100 ... 500 ms/channel (depending on channel assignment)
Sample repetition time (cycle time)	500 ms
Input filter characteristic and transition frequency	second-order hardware filter, time constant 1.25 ms, subsequent filter in sigma-delta converter 25 Hz in PRECISE measuring mode, 50 Hz in FAST measuring mode.

Cycle time

Mode	Min.	Max.
PRECISE	250 ms per channel	500 ms per channel
FAST	111 ms per channel	250 ms per channel

The minimum cycle time values are achieved with homogeneous equipment (all channels have the same assignment) and a thermocouple with isothermal block (without external cold junction) and 2-wire or 4-wire Pt100.

The max. cycle time values are achieved with inhomogeneous equipment (channels with different sensor types), with thermocouples with external cold junction, and 3-wire Pt100.

7.6.15 Technical data of analog input module DAI 05

General characteristics

Type	analog input with transmitter supply
Number of channels	16
Type of input	4 ... 20 mA current input, standard impedance 250 Ω for 2-wire transmitter
Transmitter supply	14..24 VDC transmitter supply, short-circuit current limited to 40mA electrical isolation for two groups from an external supply
External supply	24 V (nominal), 18 V ... 32.5 V (permissible)
Operating mode	self-scan, configurable cycle time, 10 ms or slower
Potential separation	two groups of eight, electrically isolated by opto-couplers
2 voltage control LEDs	assigned to each group of eight light up if DC/DC converter is OK.
Channel indicator LEDs	16 red LEDs LED on if $I < 3.2$ mA LED off if $I > 3.8$ mA LED off if $I < 20.2$ mA LED on if $I > 20.8$ mA
Tap of channel indicator LEDs	driven via microprocessor of I/O module by software algorithm
Line break detection	by signal evaluation, indication by channel-indicator LED, alarm generation.
Power consumption from rack	2.4 W
Power consumption from external power unit for transmitter supply	max. 24 W
Glass fuse, type 1AT	Model: Wickmann 19198 UL
Weight	1.8 kg
Max. permissible cable length	twisted-pair, 1000 m with appropriate cross-sectional area
Insertion/withdrawal under power	permissible, no restrictions

Static characteristics of DAI 05

Input impedance	250 Ω, ± 1 %
Input measuring range	4 ... 20 mA, nominal 3 ... 22.5 mA permiss.
Max. measuring error at 25 °C[1]	± 1 ‰
Temperature coefficient	± 1.6 ‰ / 10 K
Max. error from 0°... 50 °C [1]	± 5 ‰
Digital resolution	12 bits
Value of least significant bit (LSB)	5.0 µA
Permissible overload without the channels influencing each other	up to around 40 mA
Max. permanent allowed load (no module damage)	50 mA
Digital value in case of overdriving	> 4096
Polarity reversal	permissible
Digital value under polarity reversal conditions	constant 0
Type of input	differential
Common mode voltage	± 3.5 V referred to GND terminal
Noise suppression of differential mode noise sources	54 dB [2]
Noise suppression of common-mode noise sources	56 dB for DC [2], 52 dB for AC [2]
Monotonicity with no missing codes	yes
Conversion method	successive approxim.
Non-linearity	± 0.75 Bit

Dynamic characteristics

Sample duration time per channel	≤ 160 µs (incl. settling time)
Sample repetition time (cycle time)	configurable, 10 ms or slower
Input filter characteristic	low pass 1st degree
Time-constant input filter	τ = 12 ms (70.7 % of final value)

1 of end of range value
2 N 60873:1993

7.6.16 Technical data of analog output module DAO 01

General characteristics

Type	analog output for current signals
Number of channels	16
Type of output	0/4 ... 20 mA, software-configurable
Setup	two monolithic D/A converters with eight channels, each
Output protection	short-circuit proof, overload proof, external supply proof
Operating mode	serial sequential data transfer, asynchronous conversion start
Safety values for CPU module failure or communication interruption	configurable. Selectable choice: 0 ... 20 mA or last value. Default setting: all outputs to 0 mA
Status after reset	all outputs to 0 mA
Potential separation	two groups of eight, electrically isolated by opto-couplers. Eight outputs are powered by a common supply, each.
Channel indicator LEDs	none
Line break detection	none
Power consumption from rack	1.2 W
External power supply	24 V DC (± 25%). separately for each of the groups of eight.
Supply from three-phase mains with three-phase bridge rectifier	permissible. Voltage range 19.2...28 V RMS. Provide for protective separation of the power supply.
Power consumption from external power supply at 24 V DC	6.5 W per group of eight at nominal voltage and maximum output current on all channels.
Weight	1.7 kg
Max. permissible cable length	twisted pair cable. 1000 m with appropriate cross-sectional area
Insertion/ withdrawal under power	permissible. Switch off external power supply before withdrawing the module. Otherwise, the outputs will be held.
Peculiarities	If the module power supply fails, but the external supply keeps on running, the outputs hold their signal. If you don’t want this reaction, make sure that the external power supply is switched off via the rack power supply and a relay or an output of the digital output module.

Static characteristics

Load	≤ 400 Ω
Output voltage	max. 8 V at 20 mA
Max. measuring error at 25 °C [1]	± 1.0 ‰
Temperature coefficient[1]	± 1.8 ‰ / 10 K
Max. error from 0°... 50 ° C [1]:	± 5.5 ‰
Digital resolution	12 bits
Value of least significant bit (LSB)	5.0 µA
Overload	up to around 21 mA
Monotonicity	12 bits with no missing codes
Conversion method	digital/analog converter. R/2R network, 2-quadrant multiplication, unipolar
Non-linearity	< 1 LSB

Dynamic characteristics

Transfer time	< 100 µs
Output cycle time	configurable, quickest time 10 ms
Overshoot	included in intrinsic accuracy
Repeatability at fixed temperature after specified stabilization time	within operating error limits
Output ripple	≤ 0.05 % of end of range value

[1] e at ambient temperature

7.6.17 Technical data of analog output module DAO 02

General characteristics

Type	analog output for current signals
Number of channels	16
Type of output	0/4 ... 20 mA, software-configurable
Output protection	short-circuit proof, overload proof, external supply proof
Potential separation	two groups of eight, electrically isolated by opto-couplers
External power supply	24 V DC (± 25 %)
Weight	1.7 kg
Insertion/ withdrawal under power	permissible; switch off external power supply before withdrawing the module; otherwise, the outputs will be held.

Static characteristics

Load	≤ 800 Ω
Output voltage	max. 16 V with 20 mA

This module is still under development. The technical data are therefore still subject to change.

7.6.18 Technical data of frequency input module DFI 01

Features

- Operating modes: dosing circuit, event counting, frequency measurement, time period measurement, pulse width measurement
- 4 channels with individual electrical isolation for each channel
- 1 counter input, 2 control inputs, 2 control outputs per channel
- Electrical isolation of counter input, control inputs, control outputs per channel
- Inputs are configurable for NAMUR sensors, 8 V, 24 V contact, 24 V.
  If configured to 8 V or 24 V the supply voltage of the appropriate input is switched off. An active source will be expected.
- Adjustable debouncing time for inputs
- LED status indicators for: module status, counter input status, control input statuses, control output statuses, external supply
- Modules can be plugged in or withdrawn under power.

General characteristics

Configurable input type:	• digital, Type 1 acc. to EN 61131-2:1994, current-sinking, protected against polarity reversal • digital, two-wire in acc. with NAMUR, to DIN 19234, current-sinking, protected against polarity reversal • digital acc. to DIN 19240, current-sinking, protected against polarity reversal
Number of inputs	1 counter input per channel 2 control inputs per channel
Rated voltage, sensor supply	for proximity switch to NAMUR, 8.2 V (8 ... 9 V), for contacts 8.2 V (8 ... 9 V) or 24 V ± 10 %
Types of outputs:	digital output, current-sourcing, short-circuit proof and overload proof external 24-V-DC supply (± 25 %) for both outputs; solid state switch (high-side-switch); drive configurable directly from counter-comparator or module CPU; configurable polarity.
Number of outputs	2 control outputs per channel
Operating mode	self-scan, configurable cycle time, quickest time 10 ms

Potential separation	12 separate potentials, electrically isolated by opto-couplers. Three separated potentials per channel, for counter input, control inputs, control outputs. The control inputs and control outputs have a common ground potential for each channel
Tap of channel indicator LEDs	at I/O side, directly at input
Power consumption from rack	18 W
Glass fuse, type 1 AT	Model: Wickmann 19198
Weight	1.7 kg
Max. permissible cable length	1000 m with appropriate cross-sectional area
Insertion/withdrawal under power	permissible, without restrictions

Static characteristics of inputs (counter input, control inputs)

NAMUR (2-wire proximity switch)

Volt/ampere curve over the full operating range	State 0 UL	IL	Transition region UT	IT	State 1 UH	IH
max.		1 mA		2.1 mA		6.5 mA
min.		0.4mA		1.2 mA		2.2 mA
Input impedance	$R_{(IN)} \approx 1\ k\Omega$					

8 V DC contact

Volt/ampere curve over the full operating range	State 0 UL	IL	Transition region UT	IT	State 1 UH	IH
max.	1 V		2.1 V		9 V	
min.	0 V		1.2 V		2.2 V	
Input impedance	$R_{(IN)} \approx 1\ k\Omega$					

24 V DC contact

Volt/ampere curve over the full operating range	State 0 UL	IL	Transition region UT	IT	State 1 UH	IH
max.	5V		12.6 V		30 V	
min.	0 V		7.2 V		15 V	
Input impedance	$R_{(IN)} \approx 6\ k\Omega$					

Static characteristics of outputs (control outputs)

Nominal output voltage	24 V DC (ext. supply voltage – max. 1 V)
Rated current per output	0.5 A DC
Short-time overload	up to 1.2 A per output
Current range with signal 1	0 ... 0.55 A
Voltage drop with signal 1	max. 1 V
Leakage current with signal 0	≤ 1 mA
Voltage level with signal 0	≤ 2 V

Dynamic characteristics of inputs (counter inputs, control inputs)

Input frequency	IN input	≤ 45 kHz, min. resolution 10 µs duty cycle 1:1...1:10 for f_{in} ≤ 5kHz
	EN/RS input	≤ 50 Hz, min. resolution 10 ms
Input filtering, Delay time for 1 to 0 and 0 to 1 transitions		10 µs set by default, 10 ms or 50 ms additionally configurable
Value transfer to process station		10 ms or slower, configurable
Counter		counting up, starting with 0
Counter width		24-bit
Max. counter value		16777215
Internal time base		crystal oscillator, 2MHz
Resolution: ($T_{Amb.}$ = 0 ... 50 °C):		
- Frequency measurement, Time period measurement		≤ ± 1‰ no prescaler f_{in} ≥ 0.15 Hz ... ≤ 2 kHz
		≤ ± 1‰ double prescaler f_{in} ≥ 2 kHz ...≤ 4 kHz
		≤ ± 1‰ 4-fold prescaler f_{in} ≥ 4 kHz ...≤ 8 kHz
		≤ ± 1‰ 8-fold prescaler f_{in} ≥ 8 kHz ...≤ 16 kHz
		≤ ± 2‰ 16-fold prescaler f_{in} ≥ 16 kHz... ≤ 45 kHz
- Pulse width measurement:		intrinsic error ≤ 10 µs
- Event counting, dosing:		accuracy ± 1 digit
Reaction time		input → output ≤ 2 ms

Dynamic characteristics of control outputs

Switch-on/switch-off delay	≤ 50 µs
Output repetition time	configurable, 10 ms or slower
Max. switching frequency	500 Hz with resistive load (with inductive loads see chapter 4.8.9.4)

Sensor supply

Sensor supply	Voltage Min.	Voltage Max.	Current Nom.	Current Max.	No. of sensors (max.)
Contacts/NAMUR	8.0 V	9.0 V	3.0mA	6.5mA	12
Contacts 24 V DC	22.6 V	26.4 V	4.2mA	4.5mA	12
Sensor monitoring	Line-break or short-circuit (NAMUR), can be disabled				
External supply voltage	Nominal: 24 V DC, permissible: 18..32.5VDC				
Current consumption	approximately 1A per channel				

7.6.19 Technical data of communication module DCO 01

Features

- Five serial interfaces
- Separate electrical isolation for each interface
- Configurable for RS485, RS422 or RS232C
- At present Modbus master/slave is implemented four times. Other protocols are available on request.
- Service/diagnostic interface; suitable for modem connection (not yet supported by software)
- Reset switch
- Status indicator LEDs for: power, hardware/software error, battery status, overtemperature.
- Battery-buffering of RAM
- Module can be inserted and withdrawn under power

The communication module DCO 01 serves for direct connection of subsystems like diagnostic systems, balances or other PLCs via Modbus protocol. Software revision 2 or higher supports four of the five existing interfaces.

Protocols other than Modbus available on request.

Technical data

CPU	80C186XL 16-bit embedded controller, 20 MHz
RAM	512 Kbytes static RAM. Word length 16 bits. Internal or external RAM buffering
EPROM	515 Kbytes flash EPROM. Word length 16 bits. Board parameters stored in EEPROM
	Connectable to process station bus DigiNet P. The module can also be installed in I/O units. It is recommended to install not more than three communication modules in a process station.
Current consumption	around 380 mA
Power consumption	9.1 W
Weight	1.7 kg
Battery DSU 08	3.6 V lithium battery, replaceable while system is running, battery life 5 years. External or redundant buffering possible.

Serial interfaces Ser 1 ... Ser 5

15-pole Sub-D female connector. Depending on connector assignment

RS485	half duplex, bus connection possible, max. 32 bus nodes
RS422	full duplex, point-to-point connection
RS232	full duplex with RTS/CTS handshake, point-to-point connection

Configurable transmission rate, max. 19200 baud.

Diagnostic interface Diag

9-pole Sub-D connector, male. RS232C. Modem connection possible. RTS, CTS, DSR, DTR, CD and RI signals are available. Configurable transmission rate, max. 19200 baud. Connection of a diagnostic PC via diagnostic cable DSU 141.

Cable

DSU 212:	RS232C cable for DCO 01	15-pole Sub-D connector at one end, wire end sleeves at the other end
DSU 213:	RS422 cable for DCO 01	15-pole Sub-D connector at one end, wire end sleeves at the other end
DSU 211:	RS485 cable for DCO 01	15-pole Sub-D connector at one end, wire end sleeves at the other end

7.7 Approvals/certificates

7.7.1 ISO 9001

Z E R T I F I K A T

Die

DQS Deutsche Gesellschaft zur Zertifizierung von Managementsystemen mbH

bescheinigt hiermit, dass das Unternehmen

ABB Automation Products GmbH
Industriestraße 28
D-65760 Eschborn

mit den im Anhang gelisteten Unternehmenseinheiten

für den Geltungsbereich

Entwicklung, Herstellung und Vertrieb
von Produkten und Dienstleistungen für die
Mess-, Steuer-, Antriebs-, Analysen- und Automatisierungstechnik

ein

Qualitätsmanagementsystem

eingeführt hat und anwendet.

Durch ein Audit, dokumentiert in einem Bericht, wurde der Nachweis erbracht, dass dieses Qualitätsmanagementsystem die Forderungen der folgenden Norm erfüllt:

DIN EN ISO 9001
Ausgabe August 1994

Dieses Zertifikat ist gültig bis	2003-08-29
Zertifikat-Registrier-Nr.:	70213-01
Frankfurt am Main, Berlin	2000-08-30

Dr.-Ing. K. Petrick   Dipl.-Ing. J. Pärsch

GESCHÄFTSFÜHRER

IQNet

Geschäftsstellen: D-60433 Frankfurt am Main, August-Schanz-Straße 21
D-10787 Berlin, Burggrafenstraße 6

Deutscher Akkreditierungs Rat
TGA-ZM-02-90-00
TGA-ZM-33-95-00

Fig. 7-2 ISO 9001

Anhang zum Zertifikat Registrier-Nr.: 70213-01

ABB Automation Products GmbH
Industriestraße 28
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Borsigstraße 2
D-63755 Alzenau

Standort Frankfurt
Stierstädter Straße 5
D-60488 Frankfurt am Main

Standort Heiligenhaus
Höseler Platz 2
D-42579 Heiligenhaus

Standort Lampertheim
Edisonstraße 15
D-68623 Lampertheim

Standort Mannheim
Dudenstraße 44-46
D-68167 Mannheim

mit dem Geltungsbereich
Entwicklung und Vertrieb von Produkten und Dienstleistungen
für die Antriebs- und Automatisierungstechnik

Standort Minden
Schillerstraße 72
D-32425 Minden

Dieser Anhang ist nur gültig in Verbindung
mit dem oben genannten Zertifikat.
(Stand: 2000-08-30)

Fig. 7-3 ISO 9001

7.7.2 ISO 9000

IQNet

THE INTERNATIONAL CERTIFICATION NETWORK

CERTIFICATE

IQNet and **DQS** Deutsche Gesellschaft zur
Zertifizierung von Managementsystemen mbH
hereby certify that the company

ABB Automation Products GmbH
Industriestraße 28
D-65760 Eschborn

with the organizational units/sites as listed in the annex

for the scope

development, manufacturing and sales
of products and services for
measurement, control, drives, analytical and automation technologies

has implemented and maintains a

Quality Management System.

An audit, documented in a report, has verified that
this quality management system fulfills the requirements
of the following standard:

ISO 9001 : 1994

This certificate is valid until 2003-08-29

Frankfurt am Main, Berlin 2000-08-30

Registration Number: DE-70213-01

Catherine Neville
President of IQNet

J. Pärsch *Dr. K. Petrick*
Managing Directors of DQS

Members of IQNet (registered association):

AENOR *Spain* AFAQ *France* AIB-Vinçotte International *Belgium* APCER *Portugal* CISQ *Italy*
CQS *Czech Republic* DQS *Germany* DS *Denmark* ELOT *Greece* FCAV *Brazil* HKQAA *Hong Kong*
ICONTEC *Colombia* IRAM *Argentina* JQA *Japan* KEMA *Netherland* KSA-QA *Korea* MSZT *Hungary* NCS *Norway*
NSAI *Ireland* ÖQS *Austria* PCBC *Poland* PSB *Singapore* QAS *Australia* QMI *Canada* SFS *Finland*
SII *Israel* SIQ *Slovenia* SQS *Switzerland*

IQNet is represented in the USA by the following IQNet members: AFAQ, AIB-Vinçotte International, CISQ, DQS, KEMA, NSAI and QMI

Fig. 7-4 ISO 9000

IQNet

THE INTERNATIONAL CERTIFICATION NETWORK

Annex to IQNet Certificate Number: DE-70213-01

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Site Heiligenhaus
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Site Lampertheim
Edisonstraße 15
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Site Mannheim
Dudenstraße 44-46
D-68167 Mannheim

with the scope
development and sales of products and services
for drives and automation technologies

Site Minden
Schillerstraße 72
D-32425 Minden

This annex is only valid in connection
with the above-mentioned IQNet Certificate.
(Date: 2000-08-30)

Fig. 7-5 ISO 9000

7.7.3 CE

ABB

Konformitätserklärung
Declaration of conformity

ABB Automation Products GmbH
D-65760 Eschborn

erklärt, daß das Produkt *declares that the product*	**Freelance 2000**
Geräteart *Device*	**Kompakt-Leitsystem** ***Compact control system***
Typbezeichnung *Type*	**Auflistung der Komponenten siehe Anhang** ***See annex for components***
Produktnummer *Product No.*	**37xxx**

mit den Bestimmungen der nachstehenden EG-Richtlinie(n) übereinstimmt :
complies with the requirements of the European Directives :

Referenz-Nr. *Reference-No.*	**Titel** *Titel*	**Angewendete harmonisierte Norm Oder andere Norm / Spezifikation** *Applied harmonized standard or other standard / specification*	**Ausgabe** *Edition*
89/336/EWG *89/336/EEC*	EMV *EMC*	EN 55011 + A1 + A2 EN 50082-2	1997 1995
73/23/EWG [1]) *73/23/EEC*	NSR *LVD*	EN 60950 + A1 + A2 + A3 + A4	1997

[1]) Die letzten beiden Ziffern des Jahres in dem die CE-Kennzeichnung angebracht wurde: **siehe Anlage**
The last two digits of the year in which the CE marking was affixed.

Weitere Angaben über die Einhaltung dieser Richtlinien enthalten die Anhänge
Further information about compliance with the Directives are given in the annex.

ABB Automation Products GmbH

Heiligenhaus, den 20.07.2000

DEAPR Leiter Qualitätssicherung *head of quality assurance*	DEAPR Leiter HW-Entwicklung Hannover *head of Hw development*
W. Warscheid	H. Gnichel

Die Anhänge sind Bestandteil dieser Erklärung.
Annexes are part of this declaration
Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, beeinhaltet jedoch keine Zusicherung von Eigenschaften im rechtichen Sinne.
This declaration certifies conformance with the above mentioned Directives. Affirmaton of attributes in a legal sense is not included.
Die Sicherheitshinweise der zugehörigen Produktdokumentation sind zu beachten.
Security declarations given in the product documentation have to be considered.

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Anhang zur Konformitätserklärung
Annex

Liste der Komponenten
List of Components

Produktnummer *Product No.*	Komponente *Component*		CE Zeichen *CE mark*
37211-0369651	DCP 01 CPU	4MB SRAM	95
37211-0369654	DCP 02 CPU	8MB SRAM	95
37211-0338701	DCP 10 CPU	8MB SRAM, for redundancy	98
37111-0369626	DDI 01 32 digital inputs	24VDC	95
37111-0369637	DDI 02 16 digital inputs	24VDC ... 60VDC	95
37111-0369638	DDI 03 16 digial inputs	115VAC ... 230VAC	95
37111-0369639	DDI 04 28 digital inputs	NAMUR initiators	98
37111-0369640	DDI 05 32 digital inputs	120/230VAC	98
37131-0369628	DAI 01 16 analogue inputs	0/4mA ... 20mA / Re = 50 Ohms	95
37131-0369630	DAI 02 16 analogue inputs	0V ... 10V	95
37131-0369631	DAI 03 16 analogue inputs	0/4mA ... 20mA / Re = 270 Ohms	95
37131-0369632	DAI 04 8 thermo couple inputs	Pt100 module	95
37131-0336025	DAI 05 16 analogue inputs	4mA ... 20mA / Re = 250 Ohms, ext. supply	96
37151-0369627	DDO 01 32 digital outputs	24V, 0,5A	95
37151-0369642	DDO 02 16 relay outputs	24VAC/DC ... 230VAC/DC, 5A	95
37151-0369643	DDO 03 16 relay outputs with readback	24VAC/DC ... 60VAC/DC, 5A	95
37151-0369644	DDO 04 32 digital outputs with readback	60VAC ... 230VAC, 5A	95
37171-0369629	DAO 01 16 analogue outputs	0/4mA ... 20mA	95
37112-0369681	DFI 01 4 frequency inputs	2 control inputs and outputs per channel	98
37511-0369666	DCO 01 4 channel communictions module		95
37411-0369653	DRA01 rack	10 slots	95
37411-0369673	DRA02 Rack	10 slots, for redundancy	98

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Fig. 7-7 CE certificate, page 2

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Produktnummer *Product No.*	Komponente *Component*		CE Zeichen *CE mark*
37411-0369674	DRA03 Rack	3 slots, for redundancy	98
37411-0369675	DRA04 Rack	5 slots, for redundancy	98
37421-0369652	DLM01 Link module		95
37421-0338434	DLM 02 Link module	for redundancy	98
37611-8018181	DPW01 Power supply	115VAC/230VAC // 24VDC	98
37611-8018277	DPW02 Power supply	24VDC // 24VDC	95
37611-8018544	DPW03 power supply	115VAC/230VAC // 24VDC	98

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Fig. 7-8 CE certificate, page 3

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Prüfergebnisse
Testresults

EMV
EMC

Festigkeit gegen elektromagnetische Störungen *EMC immunity*	**Norm** *standard*	**Prüfschärfe** *test level*	**Einfluß** *Influence*
Surge auf Netzleitungen *(mains power lines)* com. diff.	EN 61000-4-5	 2 kV 1 kV	 < 0,5% < 0,5%
Burst auf Netzleitungen *(power ports)* auf Signal- und Datenleitungen *(other lines)*	EN 61000-4-4	 ± 2 kV ± 1 kV	 < 0,5% < 0,5%
Entladung statischer Elektrizität *(electrostatic discharge)* Luftentladung *(air discharge)* Kontaktentladung *(contact discharge)*	EN 61000-4-2	 ± 8 kV ± 6 kV	 < 0,5% < 0,5%
Magnetfeld mit energietechnischer Frequenz *(power frequency magnetic field)*	EN 61000-4-8	30 A/m	-/-
Gestrahltes HF-Feld *(radiated RF-field)*	EN 61000-4-3	10 V/m	< 0,5%
Leitungsgeführte Störgrößen, induziert durch hochfrequente Felder *(conducted disturbance, inducted by radio-frequency fields)* auf Netzleitungen *(mains power lines)* auf sonstige Leitungen *(all other lines)*	EN 61000-4-6	 10 V 10 V	 < 1% < 1%
Netzunterbrechungen, Spannungseinbruch *(mains power interruptions)*	EN 50082-2	100% 20ms 30% 10ms 60% 100ms 100% 5000ms	< 0,5% < 0,5% [1]) [1])
Gedämpfte Schwingungen 1MHz-Impuls auf Netzleitungen *(damped oscillatory waves)* com. diff.	IEC 255-4	 2 kV 1 kV	 < 0,5% < 0,5%
Funkentstörung *radio disturbance*	**Norm** *standard*	**Grenzwertklasse** *Limits met*	
Funkstörspannung Netzleitung *(mains terminal interference voltage)*	EN 55011	B	
Störfeldstärke *(radiated interference field strength)*	EN 55011	B	

[1]) Gerät geht in definierten Einschaltzustand *(the device switches into a defined state)*

Bemerkung:
Remark:

- Einflußangaben beziehen sich auf die analogen Ein- und Ausgänge
  Influence is related to analogue input/output
- Aussagen bezüglich DAI04-Pt100 und DCO01 Modul gelten nur mit geschirmten Leitungen
  statements related to DAI04-Pt100 and DCO01 module are only true for shielded wires
- Die Standardanforderungen der NAMUR-Empfehlung NE 21, Mai 1993 werden erfüllt.
  the standard requirements of NAMUR-recommendation NE 21, May 1993 are fulfilled.

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Fig. 7-9 CE certificate, supplement

ABB

Konformitätserklärung
Interne Anlage zu 3BDU000310

Geräteart	**Freelance 2000**	
Typbezeichnung		
Produktnummer	**37xxx**	
Zugrunde liegende Einzelprotokolle	S036/93, P102/93, P122/93, P016/94, P074/94, P075/94, S021/94, S022/94, S026/94, H027/95, H020/95, H068/95, H071/95, H072/95, H075/95, H079/95, H092/95, H104/95, H107/95, H138/95, H139/95, H042/96, H053/96, H056/96, H012/97, H021/97 H024/97, H026/97, H027/97, H29/98, H31/98, H001/99, H002/99, H003/99, H004/99, H005/99, H006/99 9441027	**Lagerort:** EZH-P GTQ-Mi PSK-H
Prüfingenieure	EZH-P: H. Pfeiffer / H.Hahn, H.Hesse, Hartmann & Braun GTQ-Mi: H.Beuger, H.Stelter, ABB	
Bemerkungen	Diese Konformitätserklärung 3BDU000310 ersetzt die Konformitätserklärung CG 001/98, die hiermit ungültig wird.	

3BDU000310 Seite/Page 6 von 6 Ausgabe/Edition: 1

Fig. 7-10 CE certificate, supplement

7.7.4 CSA

CSA INTERNATIONAL

Certificate of Compliance

Certificate: 187187-2500004056 (LR 109330-2)

Project: 2500004056 **Date Issued:** February 11, 2000

Issued to: **Hartman & Braun AG**
Hoeseler Platz 2
D-42579
Heiligenhaus, 99999
Germany

The products listed below are eligible to bear the CSA Mark shown

Issued by: Alexander Kandathil, C.E.T.

Signature:

PRODUCTS

Class 2252-03 - Process Control Equipment
Compact Control System, Model Freelance 2000

RATINGS

ELECTRICAL RATINGS :

Module / component	Input voltage / wattage	Measuring ranges voltage / current	Description
DRA 01	-	-	rack
DRA 02	-	-	rack with additional traces in the backplane
DLM 01	24V / 0.7W	-	Link Supply module for the whole rack
DLM 02	24V / 0.7W	-	like DLM01 but with two supply plugs
DCP 01	24V / 12W	-	CPU module, 4MB RAM, 16MHz, 80960CA processor
DCP02	24V / 12W	-	CPU module, 8MB RAM, 16MHz, 80960CA processor
DCP06	24V / 12W	-	CPU module, 8MB RAM, 16MHz, 80960CF processor
DCP 10	24V / 14W	-	CPU module, 8-16MB RAM, 25MHz, 80960HQ processor
DCP 11	24V / 14W	-	CPU module, 8MB RAM, 25MHz, 80960HA processor
DCP 12	24V / 14W	-	CPU module, 8-16MB RAM, 25MHz, 80960HT processor
DCO 01	24V / 9.1W	-	6 channel serial communication
DDI 01	24V / 0.65W	24Vdc / 8 mA	32 channel digital input module
DDI 02	24V / 1.3W	24-60V ac,dc / 7.5 mA	16 channel digital input module, optical isolators
DDI 03	24V / 1.3W	115-230Vac / 5mA	16 channel digital input module, optical isolators
DDI 04	24V / 1.3W	8-24V dc / 8mA	16 channel digital input module
DDI 05	24V / 5 W	115-230 V ac 5 mA	32 channel digital input module, optical isolators
DDO 01	24V / 5.5W	17.3-29.3V dc / 500mA	32 channel digital output module with external signal supply, solid state

DQD 507WP 99/09/13 Page 1

Fig. 7-11 CSA certificate, page 1

CSA INTERNATIONAL

Certificate: 187187-2500004056 (LR 109330-~~2)~~ **Date:** February 11, 2000

Project: 2500004056

Module / component	Input voltage / wattage	Measuring ranges voltage / current	Description
DDO 02	24V / 1.3W	24-230V ac,dc / 5A	16 channel digital output module with external signal supply, relay
DDO 03	24V / 3.6W	24-60V ac,dc / 5A	16 channel digital output module with external signal supply, relay, optical isolators
DDO 04	24V / 2.4W	115-230V ac / 5A	16 channel digital output module with external signal supply, relay, optical isolators
DDO 06	24V / 3.6W	230V ac / 5A	16 channel digital output module with external signal supply, solid state
DDO 07	24V / 5.5W	17.3-29.3V dc / 1A	32 channel digital output module with external signal supply, solid state
DAI 01	24V / 7.5W	1Vdc / 20mA	16 channel analog input module, current sensed
DAI 02	24V / 7.5W	10V dc / 22mA	16 channel analog input module, voltage sensed
DAI 03	24V / 7.5W	5V dc / 20mA	16 channel analog input module, current sensed
DAI 04	24V / 3.0 W	0.5V dc / 1mA	8 channel analog input for thermocouples and similar signals
DAI 05	24V / 7.5W	1V dc / 20mA	16 channel analog input module, current sensed, with transmitter supply.
DAO 01	24V / 1.2W	8V dc / 20mA	16 channel analog current output module
DAO 02	24V / 1.2W	16V dc / 20mA	16 channel analog current output module
DFI 01	24V / 5.5W	5-24V dc / 8mA	4 channel frequency input

APPLICABLE REQUIREMENTS

CAN/CSA Std. C22.2 No 0-M - General Requirements - Canadian Electrical Code, Part II
CAN/CSA Std. C22.2 No 0.4-M - Bonding and Grounding of Electrical Equipment (Protective Grounding)
CAN/CSA Std. C22.2 No 1010.1- 92 - Safety Requirement for Electrical Equipment For Measurement, Control and Laboratory Use.

Conditions of Acceptibility

1. The suitability of the appropriate segregation between the limited and unlimited circuit external connection to the module should be determined in the end use application.
2. The suitability of any alternate power supplies, shall be determined in the end use investigation.
3. The input to this unit is considered to be SELV (24V dc) isolated from the mains by reinforced insulation.
4. The power supply shall be installed in compliance with the enclosure, mounting, spacing, and segregation requirements of the ultimate application.

DQD 507WP 99/09/13 Page 2

Fig. 7-12 CSA certificate, page 2

CSA INTERNATIONAL

Supplement to Certificate of Compliance

Certificate: 187187-2500004056 (LR 109330-2)

Project: 2500004056

Issued to: **Hartman & Braun AG**
Hoeseler Platz 2
D-42579
Heiligenhaus, 99999
Germany

The products listed, including the latest revision described below, are eligible to be marked in accordance with the referenced Certificate.

Issued By: Alexander Kandathil, C.E.T.

Signature: AKandath

Product Certification History

Project	Date	Description
LR 109330-2	February 23, 1997	Original Certification. Compact Control System, Model Freelance 2000 Certificate of Compliance Issued.
2500004056	February 11, 2000	Update LR 109330-2 report to add alternate power supply (Type 149501-51008) and to add new module (DDI 05)

DQD 507WP 99/09/13 Page 1

Fig. 7-13 CSA certificate, page 3

7.7.5 UL

Melville, New York • (516) 271–620
Santa Clara, California • (408) 985-
Research Triangle Park,
North Carolina • (919) 549–1400
Camas, Washington • (360) 817–5!

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HARTMANN & BRAUN
MS V KUEHNL
MESSTECHNIK UND PROZESSAUTOMATISIERUNG
HOESELER PLATZ 2
42579 HEILIGENHAUS FED REP GERMANY

Your most recent listing is shown below. Please review this information and report any inaccuracies to the UL Engineering staff member who handled your UL project.

PICQ2 April 1, 1997
Component - Measuring, Testing And Signal Generation Equipment

HARTMANN & BRAUN **E183961 (N)**
MESSTECHNIK UND PROZESSAUTOMATISIERUNG HOESELER PLATZ 2, 42579 HEILIGENHAUS FED REP GERMANY

Compact control system, Model Freelance 2000 with following modules: DAI01, DAI02, DAI03, DAI04, DAI05, DAO01, DAO02, DCO01, DCP01, DCP02, DCP06, DCP10, DCP11, DCP12, DDI01, DDI02, DDI03, DDI04, DDO01, DDO02, DDO03, DDO04, DDO05, DDO06, DDO07, DFI01, DLM01, DLM02, DRA01, DRA02.

Electrical measuring equipment, Model ScreenMaster 100.

Marking: Company name, model designation, electrical ratings and Recognized Component Mark, ⒭.

See General Information Preceding These Recognitions.

For use only in equipment where the acceptability of the combination is determined by Underwriters Laboratories Inc.

Reports: **April 4, 1997; September 9, 1996.**

Replaces E183961 dated October 15, 1996.

988660001 **Underwriters Laboratories Inc.®** D1I/0305181
105

For information on placing an order for UL Listing Cards in a 3 × 5 inch card format, please refer to the enclosed ordering information.

UNDERWRITERS LABORATORIES INC.

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Fig. 7-14 UL certificate

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Santa Clara, California • (408) 985-
Research Triangle Park,
North Carolina • (919) 549–1400
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HOESELER PLATZ 2
42579 HEILIGENHAUS FED REP GERMANY

Your most recent listing is shown below. Please review this information and report any inaccuracies to the UL Engineering staff member who handled your UL project.

PICQ8 April 1, 1997
Component - Measuring, Testing And Signal Generation Equipment Certified For Canada

HARTMANN & BRAUN **E183961 (N)**
MESSTECHNIK UND PROZESSAUTOMATISIERUNG HOESELER PLATZ 2, 42579 HEILIGENHAUS FED REP GERMANY
Compact control system, Model Freelance 2000 with following modules: DAI01, DAI02, DAI03, DAI04, DAI05, DAO01, DAO02, DCO01, DCP01, DCP02, DCP06, DCP10, DCP11, DCP12, DDI01, DDI02, DDI03, DDI04, DDO01, DDO02, DDO03, DDO04, DDO05, DDO06, DDO07, DFI01, DLM01, DLM02, DRA01, DRA02.
Electrical measuring equipment, Model ScreenMaster 100.
Marking: Company name, model designation, electrical ratings and Recognized Component Mark for Canada.

See General Information Preceding These Recognitions.
For use only in equipment where the acceptability of the combination is determined by Underwriters Laboratories Inc.
Reports: **September 9, 1996; March 7, 1997.**

Replaces E183961 dated October 15, 1996.
988660001 **Underwriters Laboratories Inc.®** D1I/0308095
106

For information on placing an order for UL Listing Cards in a 3 × 5 inch card format, please refer to the enclosed ordering information.

UNDERWRITERS LABORATORIES INC.

A not-for-profit organization dedicated to public safety and committed to quality service

Fig. 7-15 UL certificate

File E183961 Vol. 1 Sec. 2 *Page 1 Issued: 4-7-97
and Report Revised: 7-2-99

DESCRIPTION

PRODUCT COVERED:

USR, CNR Component - Compact Control System, Model Freelance 2000 *with following modules: DRA01, DRA02, DRA03, DRA04, DLM01, DLM02, DCP01, DCP02, DCP06, DCP10, DCP11, DCP12, DCO01, DDI01, DDI02, DDI03, DDI04, DDI05, DDO01, DDO02, DDO03, DDO04, DDO05, DDO06, DDO07, DAI01, DAI02, DAI03, DAI04, DAI05, DAO01, DAO02, DFI01.

ELECTRICAL RATINGS:

Module/ Component	Input Voltage/ Wattage	Measuring Ranges Voltage/Current	Description
DRA01	-	-	Rack, 10 slots
DRA02	-	-	Rack with additional traces in the backplane, 10 slots
DRA03	-	-	Rack like DRA02 but only 3 slots
DRA04	-	-	Rack like DRA02 but only 5 slots
DLM01	24 V/1 W	-	Link supply module for the whole rack
DLM02	24 V/7 W	-	Like DLM01 but with two supply plugs
DCP01	24 V/12 W	-	CPU module, 4MB RAM, 16 M Hz, 80960CA processor
DCP02	24 V/12 W	-	CPU module, 8MB RAM, 16 M Hz, 80960CA processor
DCP06	24 V/12 W	-	CPU module, 8MB RAM, 16 M Hz, 80960CF processor
DCP10	24 V/14 W	-	CPU module, 8-16MB RAM, 25 M Hz, 80960HD processor
DCP11	24 V/14 W	-	CPU module, 8-16 MB RAM, 16 M Hz, 80960HA processor
DCP12	24 V/14 W	-	CPU module, 8-16MB RAM, 16 M Hz, 80960HT processor
DCO01	24 V/9.1 W	-	6 channel serial communication
DDI01	24 V/1.8 W	24 V dc/8 mA	32 channel digital input module
DDI02	24 V/2.7 W	24-60 V ac, dc/ 7.5 mA	16 channel digital input module, optical isolators
DDI03	24 V/2.7 W	115-230 V ac/ 5 mA	16 channel digital input module, optical isolators
DDI04	24 V/6.3 W	8-24 V dc/ 8 mA	16 channel digital input module
DDI05	24 V/5 W	115-230 V ac/ 5 mA	32 channel digital input module, optical isolators

(Table Cont'd.)

KB/SS:rrr
NKDLS

Fig. 7-16 UL certificate

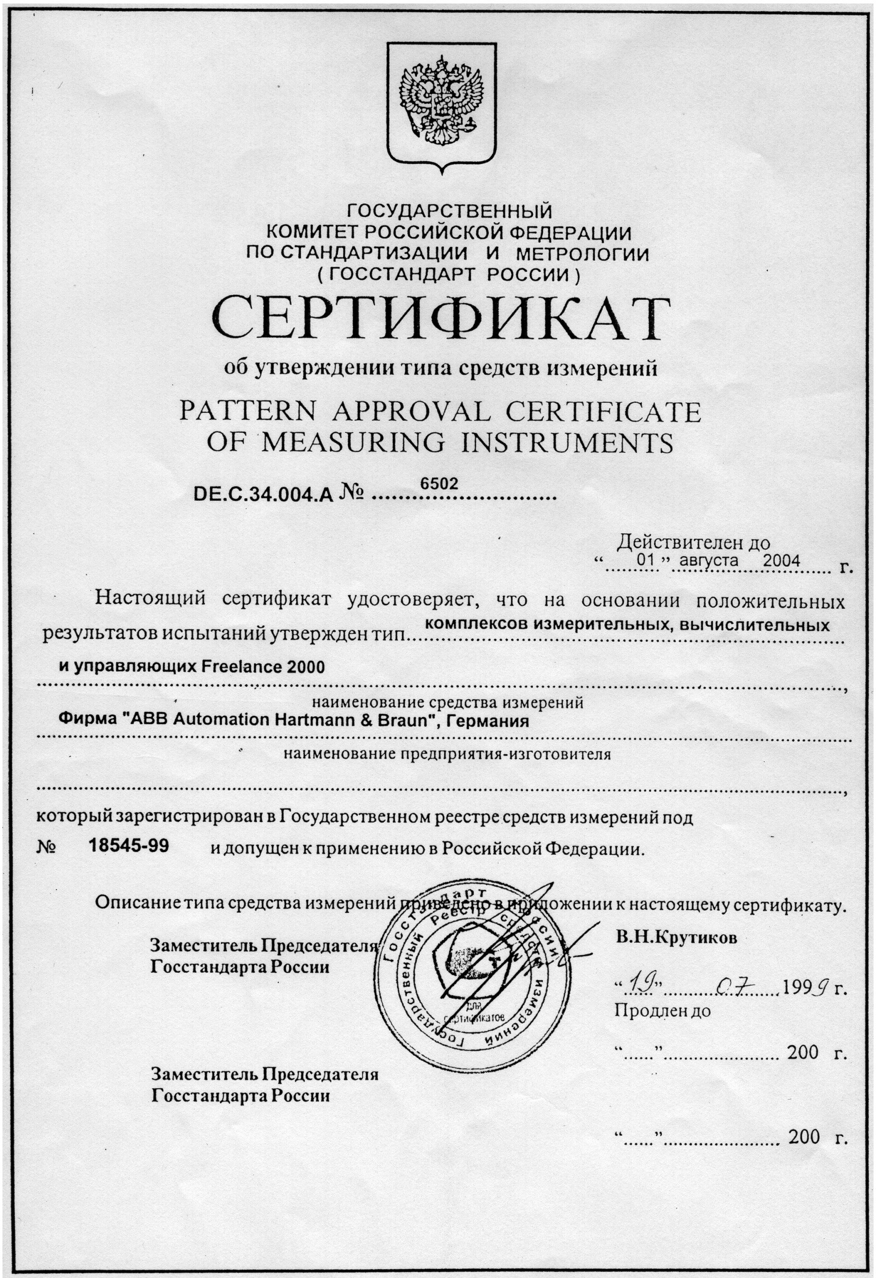
File E183961 Vol. 1 and Report Sec. 2 Page 2 Issued: 4-7-97 Revised: 6-6-00

Module/ Component	Input Voltage/ Wattage	Measuring Ranges Voltage/Current	Description
DDO01	24 V/2.4 W	17.3-29.3 V dc/ 500 mA	32 channel digital output module with external signal supply, solid state
*DDO02	24 V/8.8 W	24-230 V ac, 16 dc/max 5 A	channel digital output module with external supply, relay
*DDO03	24 V/8.8 W	24-60 V ac, dc/max 5 A	16 channel digital output module with external signal supply, relay, optical isolators
*DDO04	24 V/2.4 W	115-230 V ac/max 5 A	16 channel digital output module with external signal supply, relay, optical isolators
DDO05	24 V/3.6 W	120 V ac/5 A 16	channel digital output module with external signal supply, optical isolators
DDO06	24 V/3.6 W	230 V ac/5 A 16	channel digital output module with external signal supply, optical isolators
DDO07	24 V/5.5 W	17.3-29.3 V dc/ 1 A	32 channel digital output module with external signal supply, solid state
DAI01	24 V/9.6 W	1 V dc, 20 mA 16	channel analog input module, current sensed
DAI02	24 V/9.6 W	10 V dc/22 mA 16	channel analog input module, voltage sensed
DAI03	24 V/9.6 W	5 V dc/20 mA 16	channel analog input module, current sensed
DAI04	24 V/3.0 W	0.5 V dc/1 mA 8	channel analog input for thermocouples and similar signals
DAI05	24 V/2.4 W	1 V dc/20 mA 16	channel analog input module, current sensed, with transmitter supply
DAO01	24 V/1.2 W	8 V dc/20 mA 16	channel analog current output module
DAO02	24 V/1.2 W	16 V dc/20 mA 16	channel analog current output module
*DFI01	24 V/18 W	Input: 8.2 V dc/ 15 mA Output: 24 V/max, 500 mA	4 channel frequency input with control outputs

TB/SS:lds
DMS

Fig. 7-17 UL certificate

7.7.6 GUS certificate



ГОСУДАРСТВЕННЫЙ
КОМИТЕТ РОССИЙСКОЙ ФЕДЕРАЦИИ
ПО СТАНДАРТИЗАЦИИ И МЕТРОЛОГИИ
(ГОССТАНДАРТ РОССИИ)

СЕРТИФИКАТ

об утверждении типа средств измерений

PATTERN APPROVAL CERTIFICATE
OF MEASURING INSTRUMENTS

DE.C.34.004.A № 6502

Действителен до
" 01 " августа 2004 г.

Настоящий сертификат удостоверяет, что на основании положительных результатов испытаний утвержден тип комплексов измерительных, вычислительных и управляющих Freelance 2000,

наименование средства измерений

Фирма "ABB Automation Hartmann & Braun", Германия

наименование предприятия-изготовителя

который зарегистрирован в Государственном реестре средств измерений под № 18545-99 и допущен к применению в Российской Федерации.

Описание типа средства измерений приведено в приложении к настоящему сертификату.

Заместитель Председателя
Госстандарта России

В.Н.Крутиков

"19" 07 1999 г.

Продлен до

"......"...................... 200 г.

Заместитель Председателя
Госстандарта России

"......"...................... 200 г.

Fig. 7-18 GUS certificate

8 Mounting the Operator Station

This section is only an abstract which summarizes the important technical data needed for mounting the operator station. The specifications given in the following chapter for off-the-shelf products represent the current status of the operator station components. These components are subject to the usual cycles of change due to improvement and the invention of new models. Therefore they can be different in type and description from the versions described in this manual.

If a successor or substitute different from the model described here has been delivered to you please contact the sales office next to your place for details.

Read the manuals of the individual components (e.g. PC central unit, keyboard, printer, network board, monitor) for details.

8.1 Dimensions of the operator station

Please note that the specifications for new models may be different from what is stated in this chapter.

This section only describes PC central unit **DPC 01** - a 19" rack-mounting industrial PC. For the dimensions of PC central units **DPC 02** and **DPC 03** refer to the documentation delivered with them. Figure 8-1 shows the dimensions of the PC central unit DPC 01.

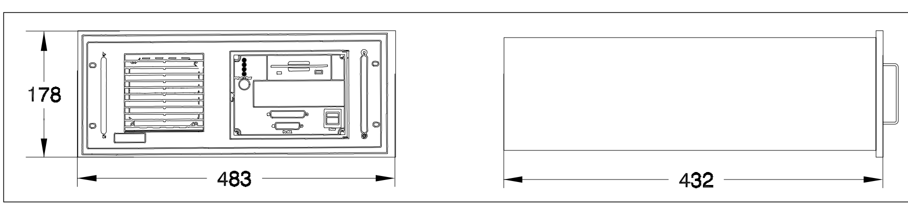


Fig. 8-1 Dimensions of the PC central unit DPC 01 (design example)

When mounting the PC in a cabinet, observe the following:

- **Leave a space of 150 mm** behind the central unit. It is needed for the cables and the hard key, and **for air circulation**.
- The **PC back must be accessible** for mounting the rear connectors.
- Mount the PC central unit **horizontally** or **vertically**. Do not mount upside down over head.

8.2 Installing add-on boards in the PC central unit

Observe the **operating instructions** of the PC central unit and of the add-on board. Refer to these documents for details.

When installing refer to the manuals of the PC central unit and of the add-on board for the neccessary details and help.

Always take the necessary ESD (electrostatic discharge) protection measures

- Use a grounded wrist strap (connected to the PC housing), or touch the PC housing (metal surface) prior to unpacking the extension board.

- Take the extension board out of the ESD protection bag. **Do not** touch the electronic components on the board. Only touch the edges or the panel of the board.

- Prior to inserting the extension board into the free slot touch the housing again, if you are not using a grounded wrist strap.

- Plug in the board. Do not force in. Carefully fasten the panel to the housing with screws.

8.3 Monitor, keyboard, and printer dimensions

8.3.1 Dimensions of the 17" monitor DMO 01 (Iiyama Vision Master 404, S704HT)

- The **specifications** for **new models** may be **different.**
- Read the monitor operating instructions for details**.**

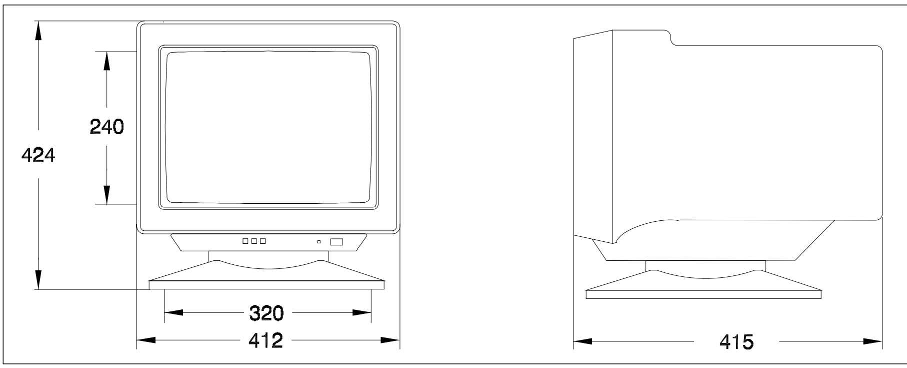


Fig. 8-2 Dimensions of the 17" monitor DMO 01

8.3.2 Dimensions of the 21" monitor DMO 02 (Iiyama Vision Master 503, S103MT)

- The **specifications** for **new models** may be **different.**
- Read the monitor operating instructions for details.

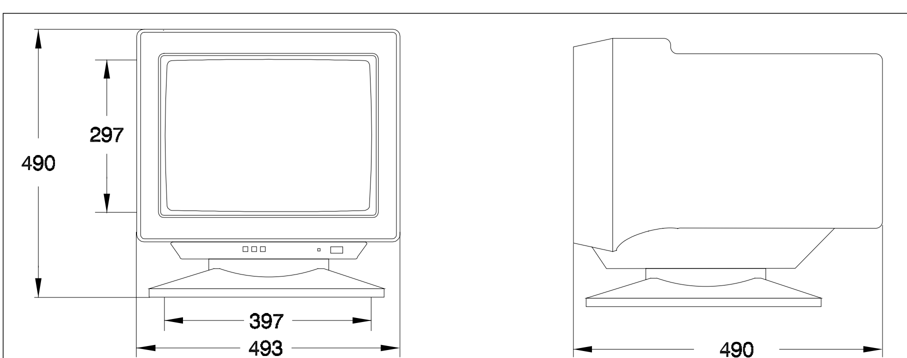


Fig. 8-3 Dimensions of the 21" monitor DMO 02

8.3.3 Dimensions of MF-2 standard keyboard DPK 01 (Cherry G80-3000 HAD German)

- The **specifications** for **new models** may be **different.**
- Read the keyboard operating instructions for details.

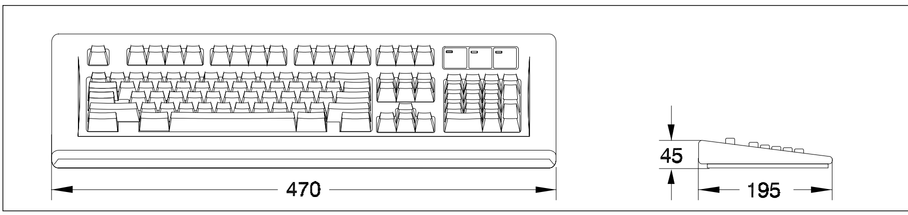


Fig. 8-4 Dimensions of the standard keyboard DPK 01

The coiled keyboard cable has a length of 135 cm at rest and is extendible to 200 cm.

8.3.4 Dimensions of the MF-2 membrane keyboard DPK 02 (EMTRON MF2-PC-4-D) to IP65

- The **specifications** for **new models** may be **different.**
- Read the keyboard operating instructions for details.

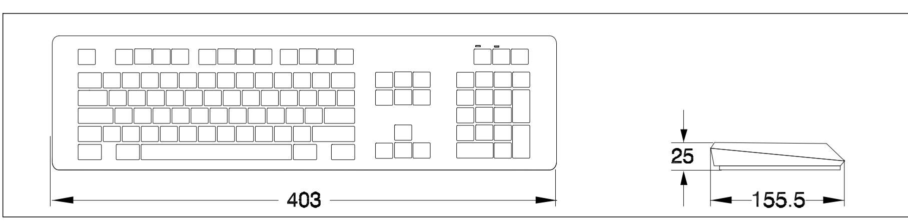


Fig. 8-5 Dimensions of the membrane keyboard DPK 02 to IP65

The coiled keyboard cable has a length of 90 cm at rest and is extendible to 210 cm.
The keyboard DPK 02 has a German keyboard layout. Other layouts on request.

8.3.5 Dimensions of tractor feed printer DPR 01 (Epson LQ-2080)

- The **specifications** for **new models** may be **different.**
- Read the printer operating instructions for details.

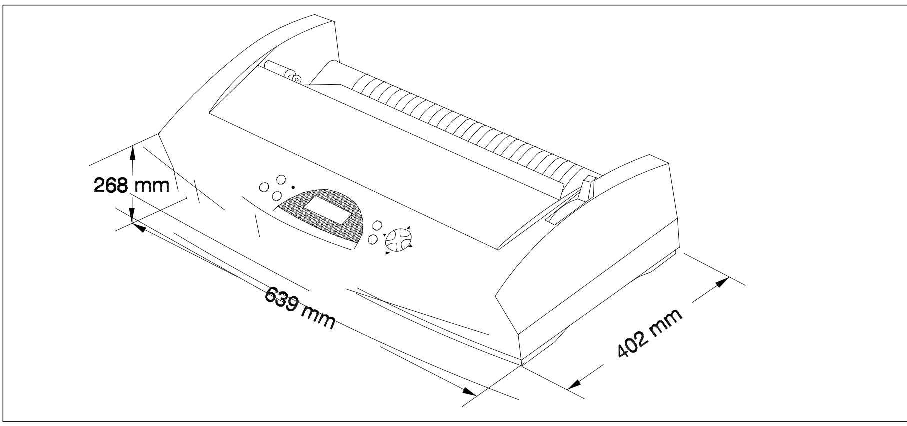


Fig. 8-6 Dimensions of the tractor feed printer DPR 01 (design example)

When installing the printer, observe the following:

- Continuous fan-fold paper is fed from the back. Therefore, enough space must be available behind the printer.

8.3.7 Dimensions of the color hardcopy printer DPR 02 (HP DeskJet 895 Cxi)

- The **specifications** for **new models** may be **different.**
- Read the printer operating instructions for details.

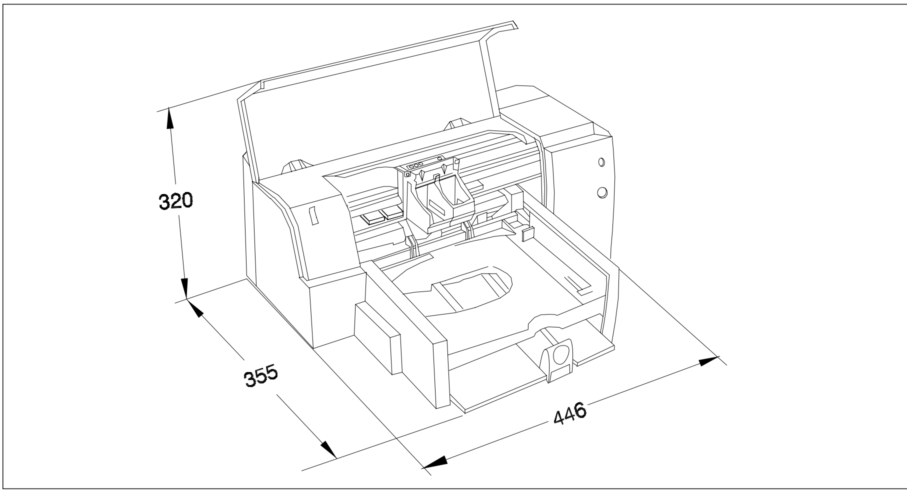


Fig. 8-7 Dimensions of the color hardcopy printer DPR 02 (example)

When installing the printer, observe the following:

- The printer works with single sheet feed. The paper tray is at the front.
- The upper printer cover has to be opened for replacing the print cartridge. When the upper cover is open, the printer has a total height of 320 mm.
- The printer is powered via an external power supply.

9 Cabling the Operator Station

- This section is only an abstract which summarizes some information needed for cabling the operator station.
- **Read the manuals of the individual components for details**

9.1 Connectors at the PC central unit

The following connectors are relevant when using the PC central unit as an operator station:

1. Mains connector for 230 V AC or 115 V AC, with power selector switch.
2. Keyboard connector
3. Mouse connector (serial interface COM 1 or COM 2).
4. Hard key connector (printer port LPT 1 or LPT 2)
5. Printer connector (printer port LPT 1 or LPT 2)
6. Connector for DigiNet S (Ethernet) system bus in accordance with 10BaseT (RJ45 jack), 10Base2 (BNC jack), or 10Base5 (15-pole SUB-MIN-D jack).
7. VGA monitor connector.

Refer to the manuals delivered with the individual components for information about the connector positions.

9.2 Cabling

Figure 9-1 shows an example for cabling the operator station consisting of:

- PC central unit DPC 01 with
  - one monitor DMO 01,
  - one MF-2 standard keyboard DPK 01,
  - one mouse DPM 01 and
  - one color hardcopy printer DPR 02

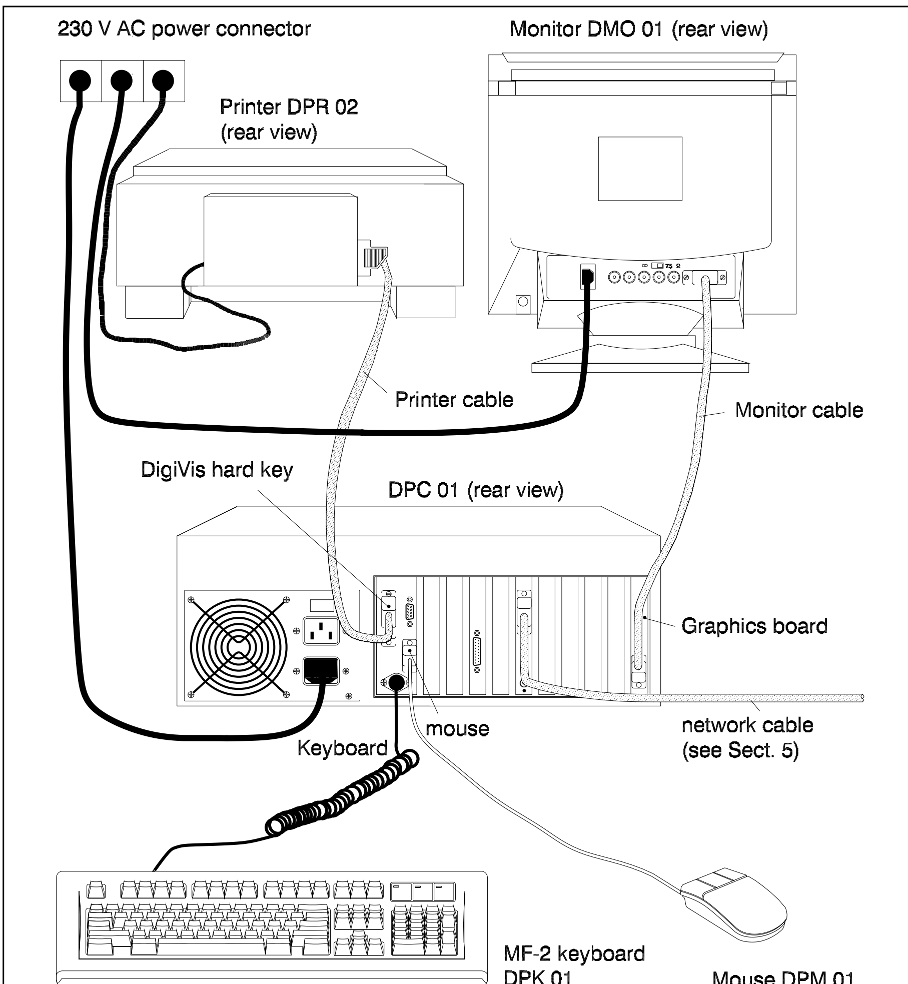


Fig. 9-1 Cabling the operator station

The shown setup can be expanded by optional components, if applicable. Please note that the connector positions and device design shown in the illustrations are only examples. Always observe the manuals delivered with the components.

Read the manuals of the individual components (e.g. PC central unit, keyboard, printer, Ethernet board, monitor) for details

When cabling proceed as follows:

1. Plug the **connector** of **keyboard** DPK 01 **in** the appropriate **jack** at the PC back.

2. Plug the **connector** of **mouse** DPM 01 into the mouse port of your PC. If you are using a standard mouse, use the serial PC interface **COM 1**. **Fasten with screws**.

3. Connect the TP, AUI or 10Base2 cable to the appropriate connector of the PC Ethernet board. Refer to Section 5 for details. **Lock** the **AUI cable** with the slide lock.

4. Link the Sub-D jack of the monitor DMO 01 through the monitor cable with the VGA monitor connector of the graphics board. **Fasten** the connectors **with screws**. The monitor cable is included in the scope of delivery of the monitor.

5. **Connect the hard key** of the DigiVis and/or DigiTool software **to** the **LPT 1** printer interface (Centronics). **Link** the **printer DPR 02** through the printer cable DPA 04 with the **hard key**. **Fasten** the hard key and the printer cable **with screws**. Use second printer interface if applicable.

   The printer cable DPA 04 is **not included in the scope of delivery** of the printer.

6. Verify the position of the PC power selector switch. Set the switch to the proper mains voltage used in your country, if required. Connect the power cable of the PC central unit.

7. **Check** the monitor rating plate to see if the specified **mains voltage** is identical with the one used in your country. If so, connect the monitor to the mains, using the monitor mains cable included in its scope of delivery.

8. **Check** the rating plate and the printer power supply to see if the specified **mains voltage** is identical with the one used in your country. If so, connect the printer to the mains, using the mains cable included in its scope of delivery.

This completes PC central unit cabling. Additional units, e.g. a second printer, may expand the cabling of your operator station.

10 Switching on the Operator Station

10.1 Starting up the PC central unit

After having cabled the operator station as described in Section 9.2, you can switch it on. **Proceed as follows:**

1. **Switch on** the **monitor** at its mains switch. A **lamp** at its front indicates that the monitor is operational. The monitor switches over to **standby mode** when the PC central unit is switched off or the screen is black, to reduce power consumption.
2. **Switch on** the **PC central unit** at the mains switch.

After computer switch-on, the PC central unit performs a self-test to check the hardware for possible defects.

While starting up, the PC central unit outputs some information, e.g. PC system software version (ROM-BIOS) and memory expansion

Errors detected during the self-test are indicated by a **sound signal** (beep) a few seconds after system startup. An error message appears on the screen, if possible. If the self-test has been performed without any errors being detected, the system indicates that it is ready to operate.

If your PC central unit has been delivered pre-configured and with the operating system already installed, the operating system automatically starts up after the self-test has been finished.

10.2 Using the hard key on parallel interfaces in EPP or EPS mode

Modern PCs often have an improved parallel interface which supports the so-called EPP or EPS mode. The interface meant here is a parallel port interface with integrated FIFO memory, which relieves the load of the CPU while printing is in progress and also increases the printing speed.

However, using the EPP or EPS mode may cause hard key scanning problems. If you should have problems with the hard key or the printer connected to it, it is recommended to switch off the EPP or EPS mode in the PC setup program. If this does not solve the problems, use a separate parallel port board for connecting the hard key.

Please note that the existence of the EPP or EPS mode is no engineering deficiency of your PC. This mode considerably improves the printing speed.

11 Maintenance

11.1 Maintaining the process station

11.1.1 Checking the air vents

The process station is designed to work without a fan. Therefore, air filter or fan checks are not required. Nevertheless check periodically the air vents at the process station top and bottom side for dust, and clean if required.

Clean the process station with a dry, non-aggressive cleanser, if possible. Make sure that neither water nor any moisture gets into the process station when you are cleaning it.

The CPU and I/O modules have a temperature monitoring system, which triggers a system alarm if overtemperature occurs. Additionally, the red **Overtemp** LED at the CPU module lights up in case of overtemperature inside the module.

Check the air vents at the top and bottom side of the modules for dust if an **Overtemperature** system alarm is triggered or the **Overtemp** LED at the CPU module lights up.

11.1.2 Replacing the buffer battery

A buffer battery can be installed in a battery holder in the CPU module, the communication module, and the link module. It can be replaced easily while the system is running.

Figure 11-1 shows where the buffer battery holder is located in the CPU module, the communication module, and the link module.

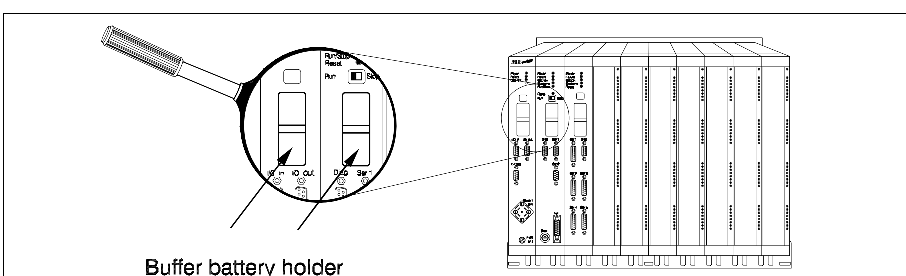


Fig. 11-1 Buffer battery CPU module/link module/communication module

Depending on the battery buffering concept chosen for your process station, buffer batteries are used:

- only in the CPU module or communication module or
- only in the link module or
- in the CPU module, the communication module and the link module or
- in none of the modules; an external battery is used instead.

Battery holders - even if empty - must be installed in the modules in any case. For details see Sections 4.2.3, 4.3.3, 4.4.3 and 4.9.3.

When the process station is switched on, no current is taken out of the buffer battery. Thus, the buffering time is only limited by the life of the battery DSU 08, which is 5 years at an ambient temperature of 25 °C.

The table below shows the buffering times achieved with the individual buffering concepts. Note that the times are valid for a **switched-off** process station.

CPU modules DCP 02 and DCP 10

Battery in CPU module	Battery in link module	External battery	Buffering time
no	no	no	**no buffering!**
yes	no	no	1.5 years
no	yes	no	1.5 years
yes	yes	no	3 years
no	no	yes	dep. on battery [1)]

Communication module DCO 01

Battery in commun. module	Battery in link module	External battery	Buffering time
no	no	no	**no buffering**
yes	no	no	5 years
no	yes	no	dep. on equipmt.
yes	yes	no	5 years
no	no	yes	dep. on battery [1)]

[1] Current consumption with ext. 3.6 V battery 7 mA at 3.6 V ± 10 %
12 mA at 24 V ± 10 %

The specified times include a safety tolerance of 10 %. At higher ambient temperatures the replacement intervals are shorter.

While replacing batteries, always leave one of them in the link module to avoid data loss in case a power failure occurs. If redundant buffering is used (two batteries), replace them **one by one**.

In case of simple buffering (i.e. one battery is used) proceed as follows:

1. Additionally insert a second battery holder with an auxiliary battery in the link module while replacing the buffer battery.
2. Take the battery holder with the exhausted buffer battery out of the CPU module. Replace the old battery. Re-insert the battery holder with the new battery in the CPU module.
3. Remove the auxiliary battery from the link module.

Refer to Section 4.2.3 for detailed buffer battery mounting instructions.

When installing the buffer battery take care of the battery polarity. Do not recharge empty batteries. Explosion hazard!

The exhausted batteries must be disposed of in accordance with the environmental protection regulations applicable in your country.

Always replace the battery - independent of the replacement interval - if the **Batt low** LED of a module lights up. This indicates that the battery voltage is below limit and replacement is required.

The system separately monitors the battery voltage of the link module, the communication module, and the CPU module and sends a system alarm to the operator station if the battery voltage falls below an alarm value.

11.1.3 Maintaining the operator station

This section is only an abstract and summarizes the important information. All specifications made here refer to the current process station model. The instructions for successors and substitutes may be different. In this case please contact the sales office next to your place.

Read the manuals delivered with the PC central unit for details.

Cleaning or replacing the air filter pad

The PC central unit DCP 01 has an overpressure ventilating system. The air is taken in through a replaceable filter pad to protect the internal parts of the system from pollution.

If the filter pad is choked up with dirt, the system may overheat.

Regularly check the filter pad for dirt accumulation.

In dusty environments the filter pad must be replaced more frequently than in an unpolluted atmosphere.

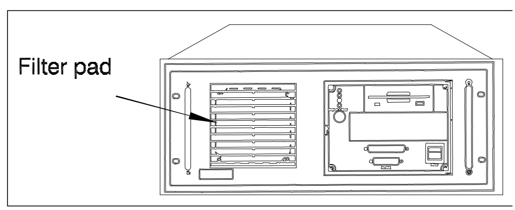


Fig. 11-2 Filter of PC central unit

The filter pad is located at the system front panel behind a front grille.

Refer to the manual delivered with the central unit for details about how to clean and/or replace the filter pad.

- **Only reinsert the filter pad when dry.**
- If the filter pad is choked up, the system will **overheat**

11.1.4 Maintaining the printers

The maintenance works required for this printer are cleaning and print cartridge replacement. Refer to the manual for detailed instructions.

Read the manual delivered with the printer for details

Note:

- Switch off the printer and disconnect the mains cable before starting any maintenance or cleaning.
- Do not use aggressive detergents or solvents.
- Clean the housing with a soft, non-fluffy cloth.
- Use a paint brush to remove paper rests and dust from the print mechanism.
- Do not use any liquids to clean the printer inside. Make sure that no liquids get into the printer.

Proceed as follows to ensure high print quality:

- Always leave the print cartridges in the cartridge holders.
- Leave the print cartridges in their sealed packing until actually using them.
- Store the print cartridges at room temperature.

12 Accessories

12.1 Emulator box

12.1.1 Short description

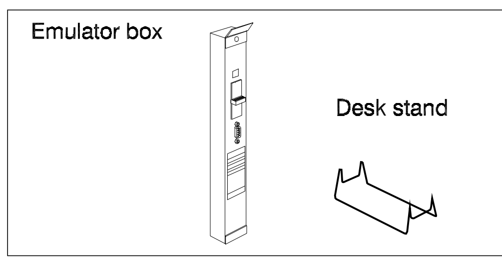
The emulator box DSU 67 is used to run a single CPU module without a rack. One possible application are system configuration tests without I/O modules which can be carried out in the office. The emulator box is primarily designed for testing, approval, and demonstration. Therefore, it only meets the minimum requirements prescribed by law in terms of RFI suppression and EMI/RFI shielding. **Do not use in industrial environment**.

Since a low-cost standard power supply is used, the CPU module cannot perform a warm start after power failure when used in the emulator box, as it does not receive a power-fail signal.

The emulator box simulates - in a compressed form - the functions of the link module and the rack. Note that it is **not** possible to connect I/O modules. I/O module diagnoses for service purposes can be performed by means of the emulator box serial interface. However, this function is normally not used.

12.1.2 Emulator box deliverables

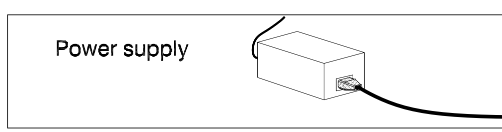
Adapter and desk stand



The emulator box can only be used in conjunction with a desk-top power supply DSU 90 and a CPU module, which are **not included in the scope of delivery**

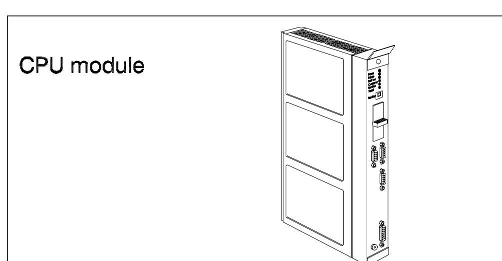
Desk-top power supply DSU 90

Order separately!



CPU module

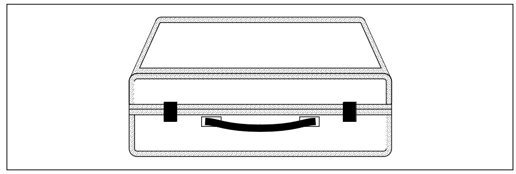
Order separately!



Transport case DSU 91 is available for carrying the adapter, the CPU module, the desk stand and the power supply.

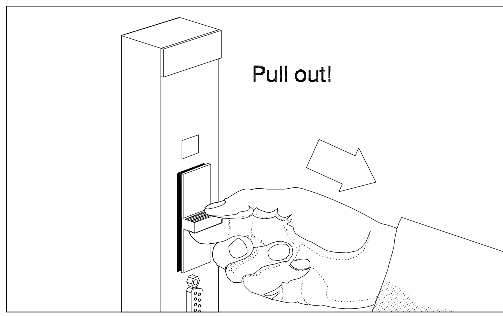
Transport case DSU 91

Order separately!



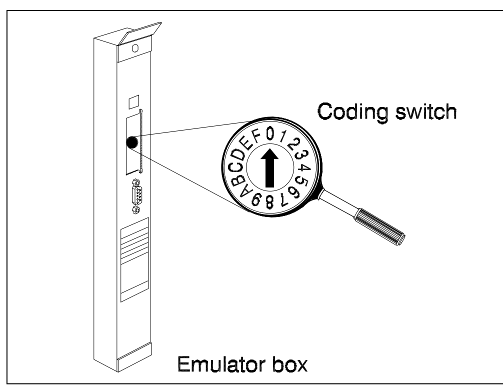
12.1.3 Mounting the emulator box

Remove cover

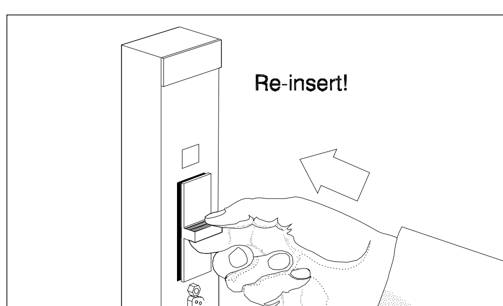


Set coding switch **to position 0**.

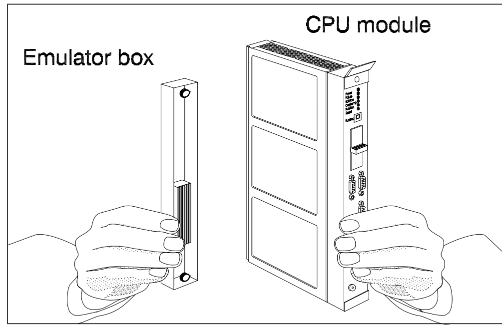
The coding switch has the same functionality as the one of the link module. It serves for adjusting the rack ID.



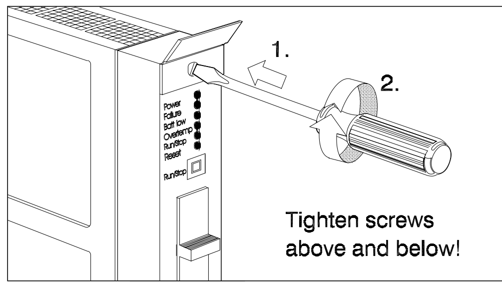
Re-insert cover



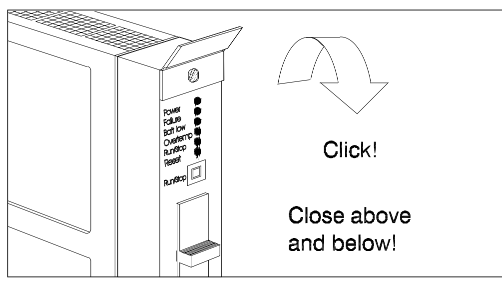
Plug CPU module on adapter



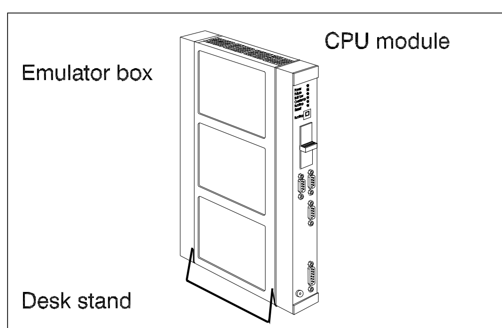
Fasten CPU module with screws



Close cover



Set CPU module with adapter **on desk stand**



Always run the CPU module in vertical position, i.e. standing upright on the desk-stand. Running the module in horizontal position implies the risk of overheating.

12.1.4 Cabling the emulator box

Cable the emulator box as seen in Fig. 12-1. Link the power supply output with the adapter and the power supply input - via the mains cable delivered with it - with the mains.

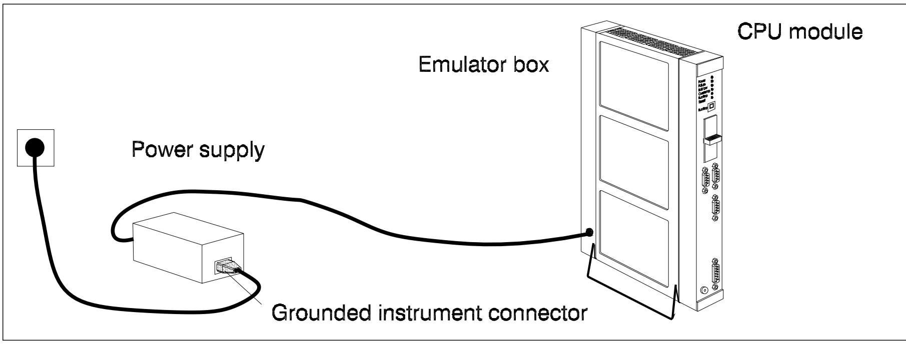


Fig. 12-1 Cabling the emulator box

Observe the instructions given in Section 4.4 when cabling the CPU module. Section 5 describes how to connect the DigiNet S. It is not necessary to put on the cable shields, since lower EMC requirements have to be met in this case.

12.1.5 Technical data of the emulator box

Power supply DSU 90

Output voltage	24 V DC
Output current	750 ... 1000 mA
Input voltage	85 ... 265 V AC
Nominal frequency	50 ... 60 Hz
Dimensions	129 x 78 x 41 mm (L x W × H)
Protection	EN 60950, IEC 950, UL 950, CSA 22.2 No. 223

Adapter DSU 67

Power consumption	0.5 W own consumption, around 12 W transmitted to DCP

12.2 Connecting the radio clock to the process station

12.2.1 DCF77 radio clock

An external Hopf (manufacturer) DCF77 radio clock, which is installed in a separate rack (19" wide, or smaller), can be connected to the process station. The clock works with an external antenna (indoor or outdoor, as required), which is linked with the clock by a coax. cable. The radio clock is connected to the process station through the diagnostic interface (RS232C) of the CPU module, except for the gateway CPU. It is not intended to be connected to the operator station.

The radio clock receives a standard time signal from the PTB (Physikalisch-Technische Bundesanstalt = Federal German Institute of Physics and Technology). A long-wave transmitter station near Frankfurt/Main transmits this signal. Under normal conditions this signal can be received in an area with a radius of approximately 1500 km from this point.

If you need a standard time signal which can be received outside Germany, please use the GPS satellite radio clock. For details refer to Section 12.3.

The time synchronization is system-wide. Thus, only one radio clock per system is needed. The time of all process and operator stations connected to a DigiNet S is set by the radio clock. If several systems are connected to a DigiNet S, **one** radio clock synchronizes the times of all process and operator stations connected to the DigiNet S.

12.2.2 Radio clock deliverables

Normally, the components listed below are needed for using a radio clock with the Freelance 2000 system.

Qty.	Component [1]	Order code [1]
1	Radio clock board 6021 with power supply and frame	FG 602103
1	19“ case, 3 height units, 84 part units	GE 7000
1	Indoor antenna type 4436 with wall-mount and 10 m cable	FG 443600

Note that the component names and order codes may have changed. Please contact Hopf for details.

[1] Hopf Elektronik GmbH, Abt. Industrieelektronik - Postfach 18 47 - D-58468 Lüdenscheid
6 - Fax: + 49 23 51 / 93 86 93 - http://www.hopf-time.com/

The clock is delivered in a 19" case and can be mounted on the same support rails as the process station. In the ordering example seen in the table above the clock is equipped with an indoor antenna and a 10 m antenna cable. Under difficult receiving conditions (e.g. in buildings made of reinforced concrete) it is recommended to use an outdoor antenna with lightning protection module. Please contact the company Hopf for more detailed information and the selection of the appropriate configuration for your application. Figure 12-2 shows the radio clock dimensional drawing.

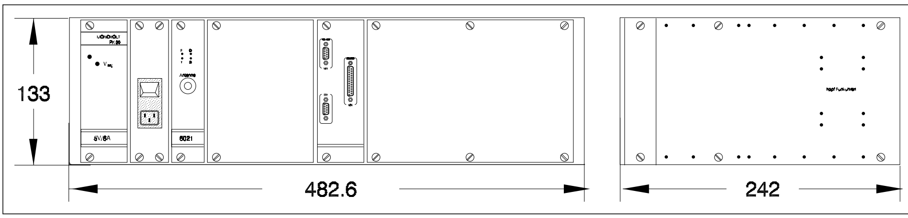


Fig. 12-2 Radio clock dimensions

12.2.3 Adjusting the radio clock

Set the jumpers on the radio clock board as shown in Fig. 12-3.

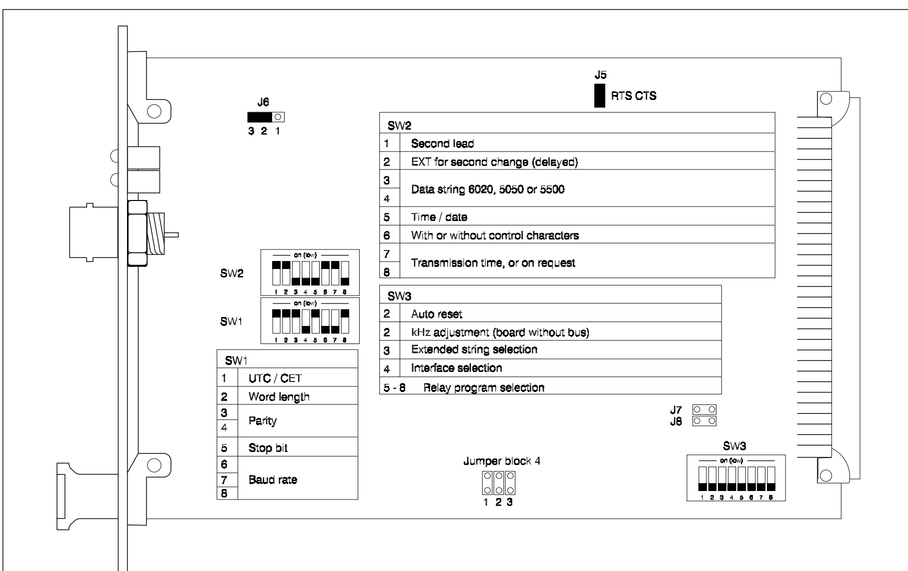


Fig. 12-3 Radio clock jumper setting

Read the technical documentation which the company Hopf delivers with the clock, and observe the information and the technical data given here.

12.2.4 Connecting the radio clock to the process station

The radio clock can be connected to any process station of the Freelance 2000 system. This process station will then synchronize the times of all process and operator stations connected to the DigiNet S. Link the radio clock with the CPU module of the process station as shown in Fig. 12-4.

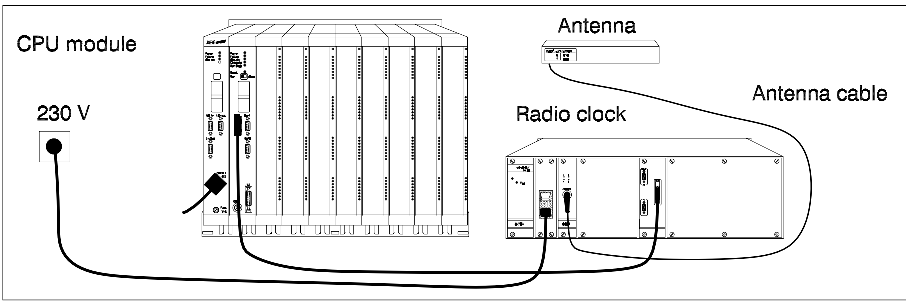


Fig. 12-4 Linking the radio clock with the CPU module

A cable with the terminal assignment seen in Fig. 12-5 is needed for linking the radio clock with the process station.

When using a cable DSU 141, open the connector hood, disconnect surplus links, and cut off or insulate surplus wires.

Use a commercial adapter for adaptation to the 25-pole connector of the radio clock.

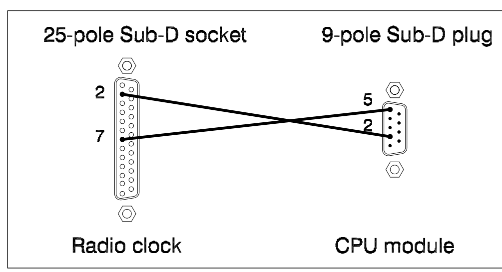


Fig. 12-5 Radio clock cable assignment

The radio clock and the process station are electrically connected. If protective separation from mains is required, mount a radio clock with a 24 V power supply and power it with extra low voltage with protective separation from other circuits.

12.2.5 Diagnosing a process station with radio clock

The connected radio clock occupies the RS232C interface of the process station, which is normally intended to be used for diagnosis. Proceed as described below to connect a diagnostic terminal to a process station with radio clock:

- Disconnect the radio clock connection cable from the **Diag** interface of the process station.
- Plug the diagnostic cable into the process station and perform the diagnosis.
- When the diagnosis is complete, connect the radio clock cable again.

The cables can be connected and disconnected while the system is running. During diagnosis the internal clock of the process station takes over time synchronization of the Freelance 2000 system. After re-connection of the radio clock the internal time of the Freelance 2000 system follows the received time signals, again.

12.3 Connecting the GPS satellite radio clock to the process station

12.3.1 GPS satellite radio clock 6841

As an alternative to the external DCF77 radio clock, an external GPS (Global Positioning System) radio clock from Hopf (manufacturer) can be connected to the Freelance 2000 process station. The connection to the process station is established through the **Diag** interface of the CPU module.

The satellite radio clock is installed in a separate rack with half 19“ size (241.3 mm) or full 19“ size (482.6 mm). GPS data reception requires an external antenna with a "free line of sight" over the full horizon.

The antenna is connected via a coax. cable with a standard length of 25 m (50 m for special cable). With longer cables of max. 150 m a GPS line amplifier must be connected into the antenna line. An indirect lightning protector must be installed at a maximum distance of 1 meter from the coax. cable house lead-in.

With the GPS satellite radio clock the exact time can be provided worldwide. The GPS satellite radio clock is a good solution if no DCF77 signal can be received.

12.3.2 Functional principle of the GPS satellite radio clock

The time base of the satellite radio clock is synchronized by the GPS (Global Positioning System) satellite navigation system installed everywhere in the world. Satellites are orbiting the earth twice a day at 20,000 km of height, on different paths and at different angles. Each satellite is equipped with a high-precision atomic clock. The GPS receiver receives the orbit positions and a GPS world time from as many satellites as possible. This allows to determine the exact position of the receiver (location). Once the position has been determined, the travel time of the received GPS world time signal from a satellite can be determined. After conversion of the GPS UTC and regional adaptation, the local time is available with high precision.

The connection of the satellite radio clock to the Freelance 2000 system and the time synchronization is done system-wide, as for the DCF77 radio clock (see Section 12.2).

12.3.3 GPS satellite radio clock deliverables

Normally, the components listed below are needed for connecting a GPS satellite radio clock to the Freelance 2000 system:

Qty.	Component	Order code
1	Stand-alone 6841GPS system with LC display, keyboard and power supply in half 19" rack	FG6841G11
1	Active GPS antenna with 25 m standard cable for flat roof and wall mounting	FG4490G0
1	Indirect lightning protector for GPS antenna	FG4495G0

Note that the component names and order codes may have changed. Please contact Hopf for details.

If the distance between the GPS system and the external antenna should be longer than 25 m, please contact the company Hopf who will then offer you the appropriate components for your application. The clock in the ordering example listed above is equipped with an outdoor antenna and a 25 m antenna cable.

The 19" model can be mounted to the same support rails as the Freelance 2000 process station. A space-saving model with half 19" mounting width is also available.

An external antenna is always required for satellite radio reception. It is therefore recommended to order the appropriate lightning protection module, too. Please contact Hopf for the configuration meeting your requirements and for further details.

12.3.4 Satellite radio clock dimensions (half 19" size)

Figure 12-6 shows the satellite radio clock dimensional drawing.

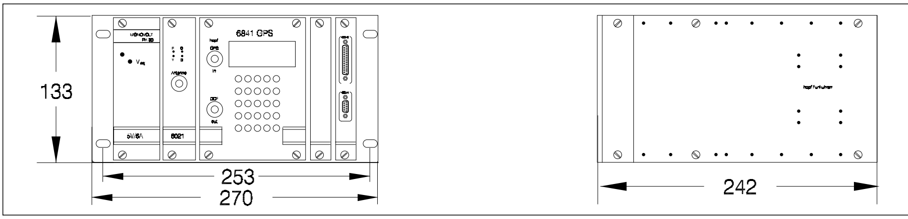


Fig. 12-6 Satellite radio clock (half 19" size) dimensions

The dimensions of the full 19" size satellite radio clock are identical to those oft the DCF77 radio clock. Refer to Section 12.2.2 for these dimensions.

12.3.5 Adjusting the satellite radio clock

Basic adjustment of the GPS satellite radio clock is done using the built-in keyboard (user-guided through built-in LC display).

For a keyboard description and configuration instructions please refer to the documentation delivered by Hopf with the clock.

12.3.6 Connecting the radio satellite clock to the process station

The satellite radio clock is connected to any process station of the Freelance 2000 system in the same way as the DCF77 radio clock. The connection cable used for the DCF77 radio clock is also usable for the satellite radio clock (see Section 12.2.4).

13 Terminal Assignment

13.1 Terminal assignment of DLM 01

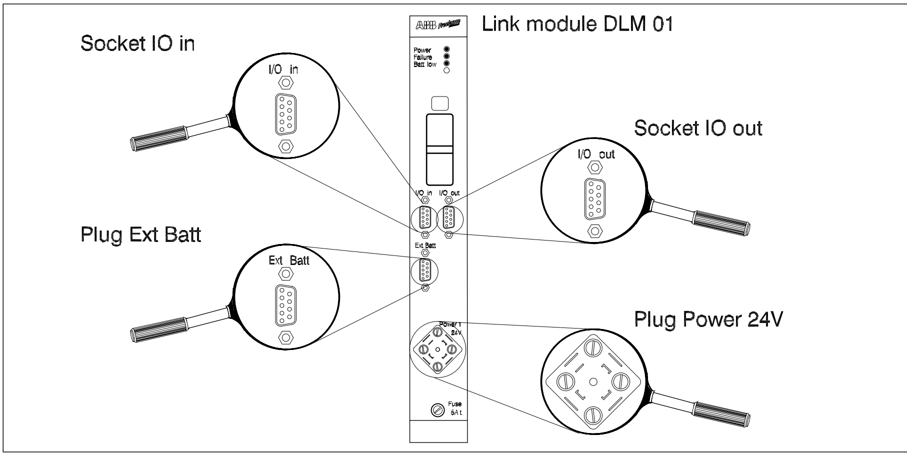


Fig. 13-1 Connector assignment of DLM 01

13.1.1 Terminal assignment of the DLM 01 plugs and sockets

IO in and IO out sockets

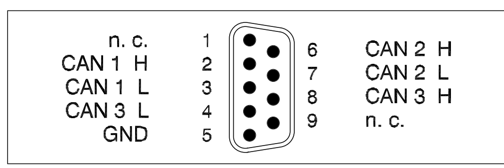


Fig. 13-2 Terminal assignment of the IO in and IO out sockets

Ext Batt plug

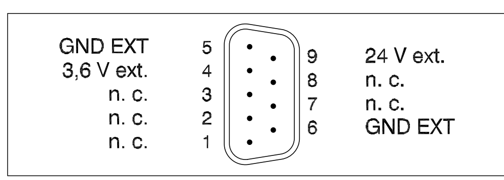


Fig. 13-3 Terminal assignment of the Ext Batt plug

Power 24 V plug

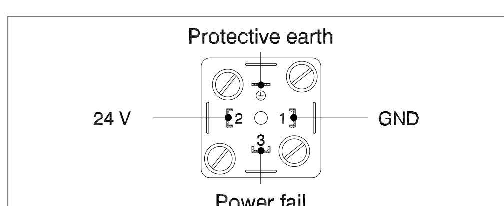


Fig. 13-4 Terminal assignment of the Power 24 V plug

13.2 Terminal assignment of DLM 02

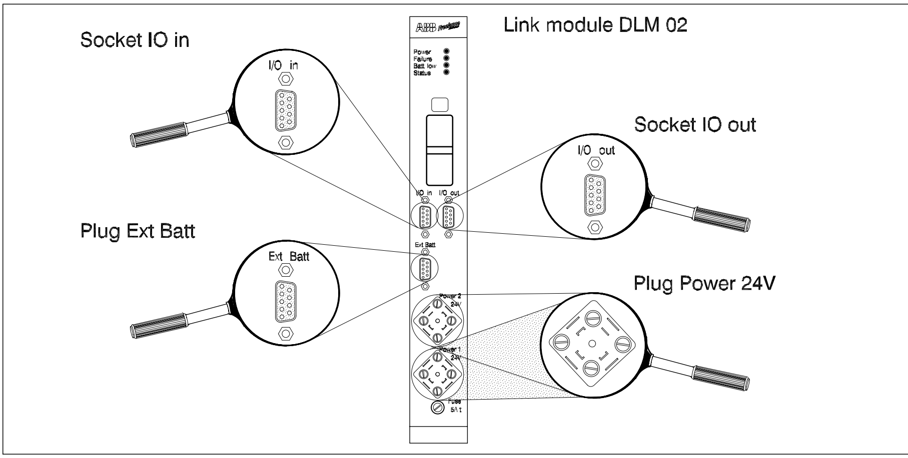


Fig. 13-5 Connector assignment DLM 02

13.2.1 Terminal assignment of the DLM 02 plugs and sockets

IO in and IO out sockets

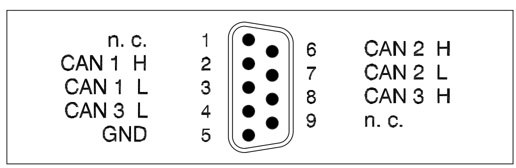


Fig. 13-6 Terminal assignment of the IO in and IO out sockets

Ext Batt plug

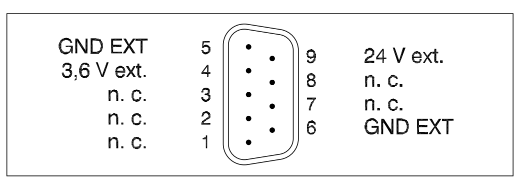


Fig. 13-7 Terminal assignment of the Ext Batt plug

Power 24 V plug

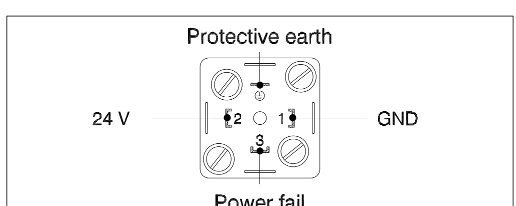


Fig. 13-8 Terminal assignment of the Power 24 V plug

13.3 Terminal assignment of CPU module DCP 02 with HW index < 50.00

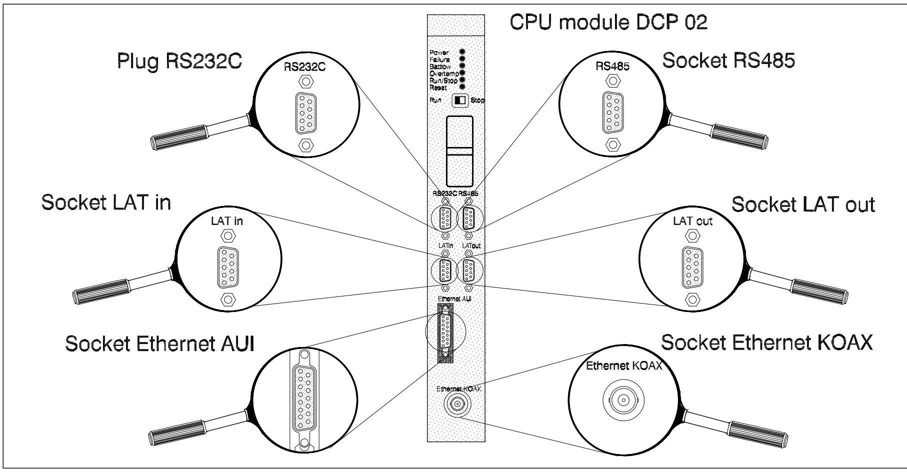


Fig. 13-9 Connector assignment of CPU-module DCP 02 with HW index < 50.00

13.3.1 Terminal assignment of the DCP 02 plugs and sockets

RS232C plug

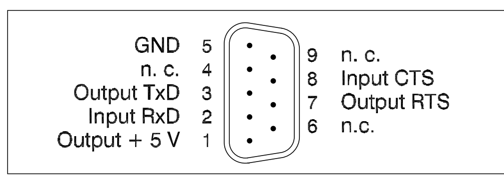


Fig. 13-10 Terminal assignment of the RS232C plug

RS485 socket

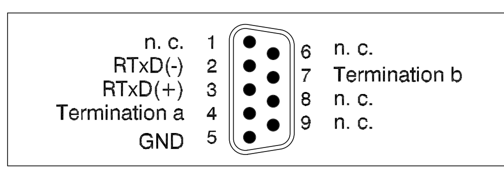


Fig. 13-11 Terminal assignment of the RS485 socket

LAT in socket

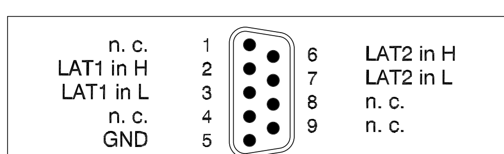


Fig. 13-12 Terminal assignment of the LAT in socket

LAT out socket

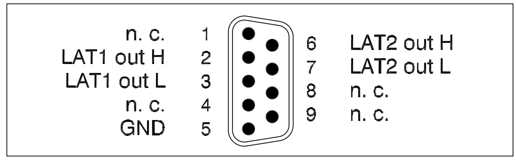


Fig. 13-13 Terminal assignment of the LAT out socket

Ethernet AUI socket

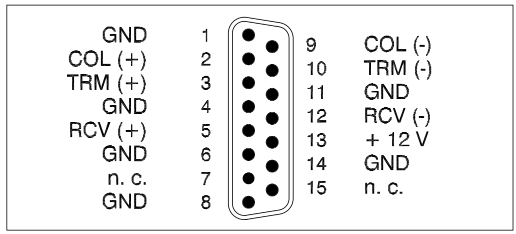


Fig. 13-14 Terminal assignment of the Ethernet AUI socket

Ethernet KOAX socket

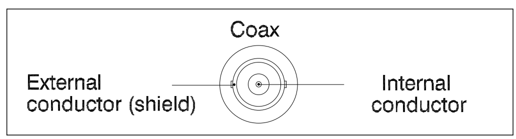


Fig. 13-15 Terminal assignment of the Ethernet KOAX socket

Internal circuitry of RS232C for CPU module DCP 02

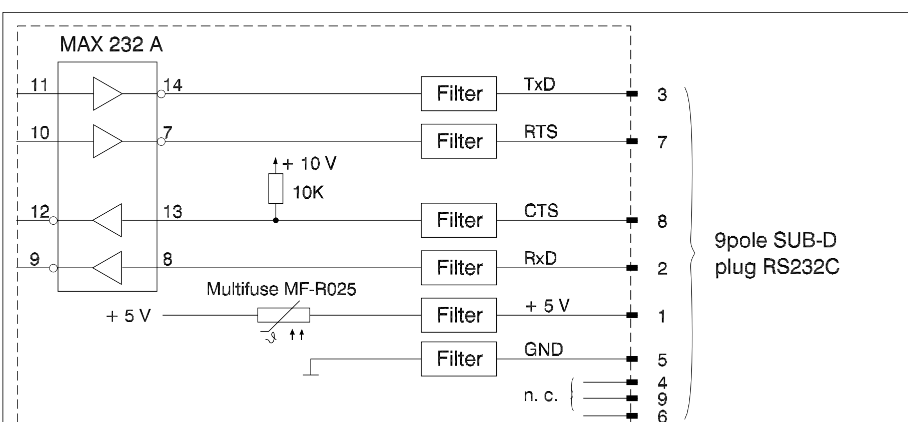


Fig. 13-16 Internal circuitry of RS232C for CPU module DCP 02

Internal circuitry of RS485 for CPU module DCP 02

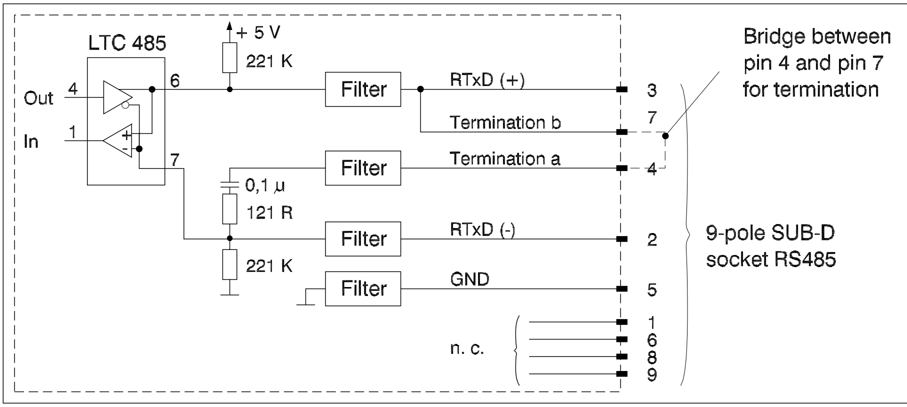


Fig. 13-17 Internal circuitry of RS485 for CPU module DCP 02

13.4 Terminal assignment of CPU module DCP 02 with HW index ≥ 50.00

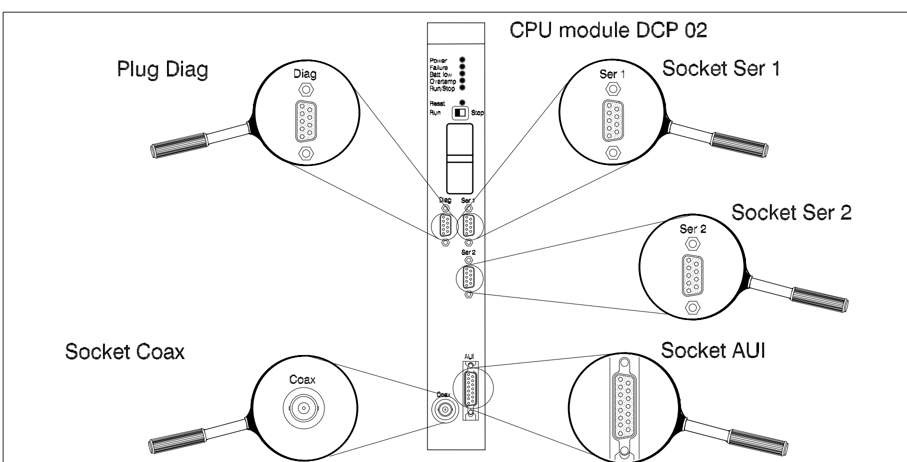


Fig. 13-18 Connector assignment of CPU-module DCP 02 with HW index ≥ 50.00

13.4.1 Terminal assignment of the DCP 02 plugs and sockets

Diag plug

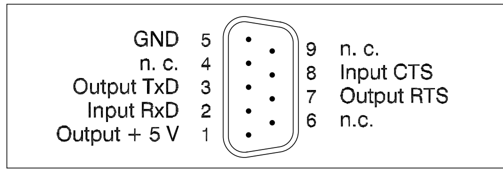


Fig. 13-19 Terminal assignment of the Diag plug

Ser 1 socket

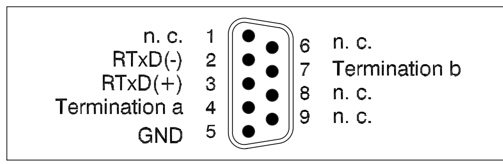


Fig. 13-20 Terminal assignment of the Ser 1 socket

Ser 2 socket

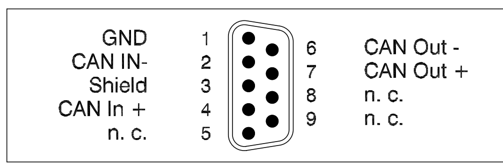


Fig. 13-21 Terminal assignment of the Ser 2 socket

AUI socket

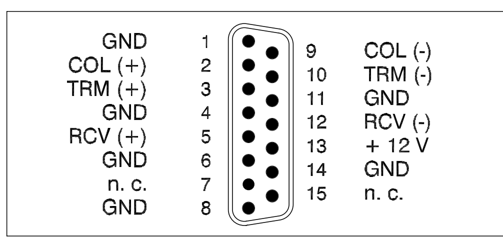


Fig. 13-22 Terminal assignment of the AUI socket

Coax socket

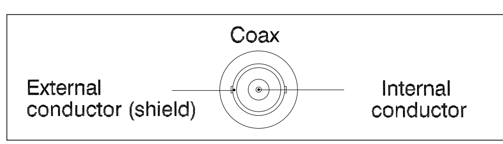


Fig. 13-23 Terminal assignment of the Coax socket

Internal circuitry (RS232C) of the Diag plug for CPU module DCP 02

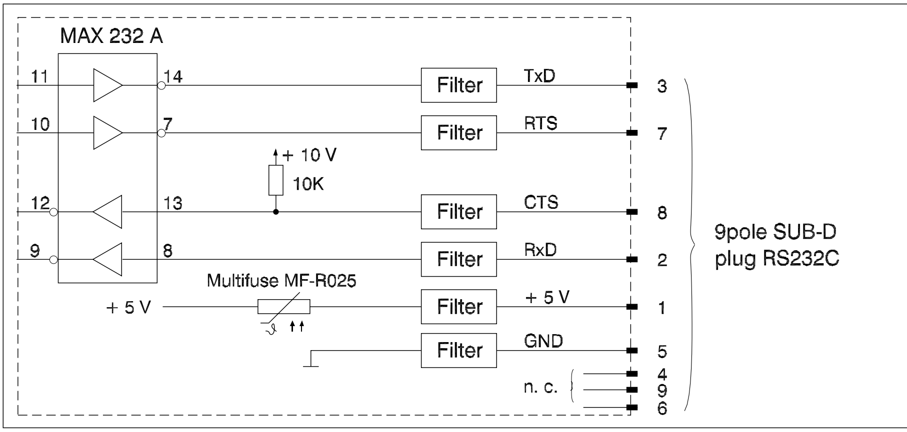


Fig. 13-24 Internal circuitry (RS232C) **of the Diag plug** for CPU module DCP 02

Internal circuitry (RS485) of the Ser 1 plug for CPU module DCP 02

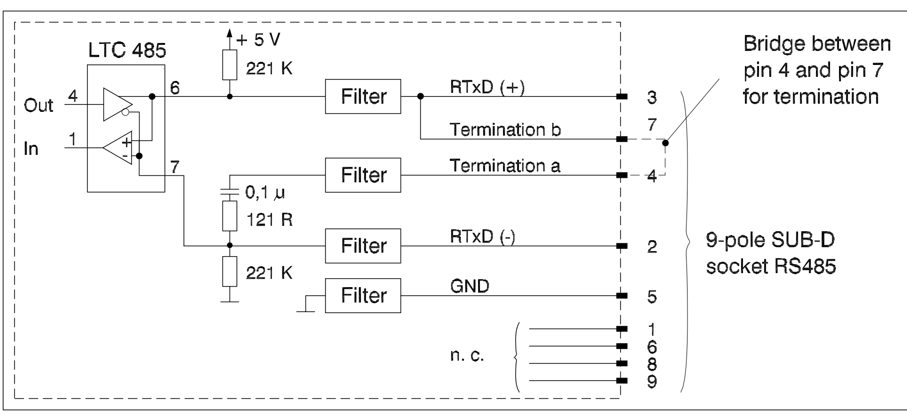


Fig. 13-25 Internal circuitry (RS485) of the Ser 1 plug for CPU module DCP 02

13.5 Terminal assignment of CPU module DCP 10

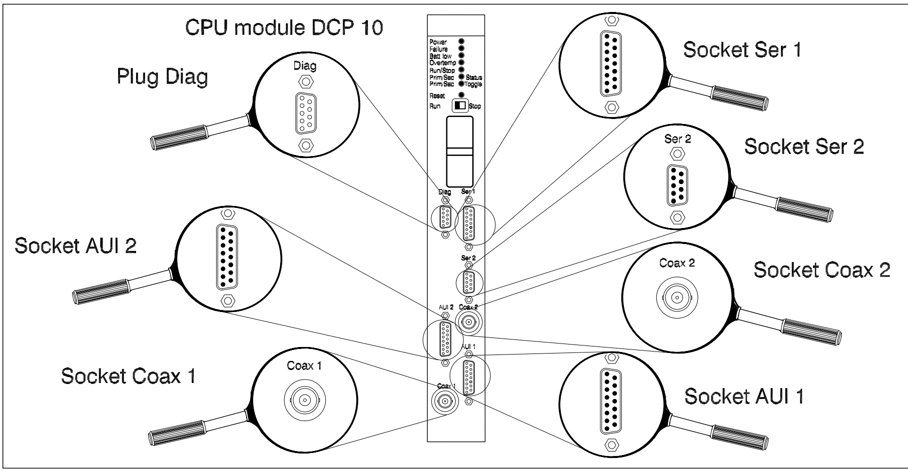


Fig. 13-26 Connector assignment of CPU module DCP 10

13.5.1 Terminal assignment of the plugs and sockets

Diag plug

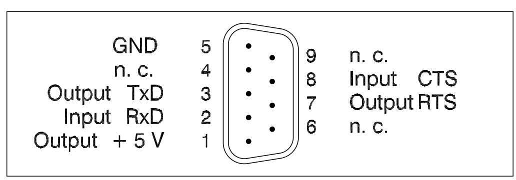


Fig. 13-27 Terminal assignment of the Diag plug

Ser 1 socket

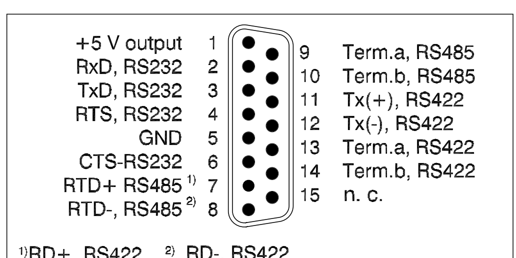


Fig. 13-28 Terminal assignment of the Ser 1 socket

Ser 2 socket

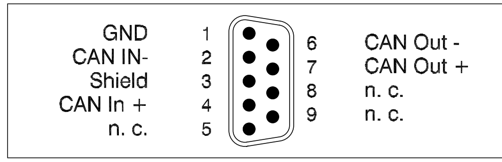


Fig. 13-29 Terminal assignment of the Ser 2 socket

AUI 1 and AUI 2 sockets

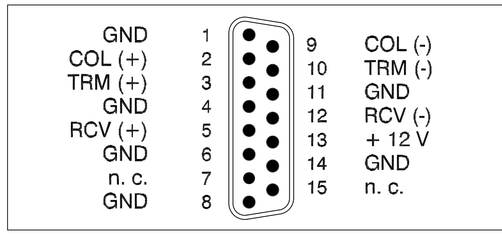


Fig. 13-30 Terminal assignment of the AUI 1 and AUI 2 sockets

Coax 1 and Coax 2 socket

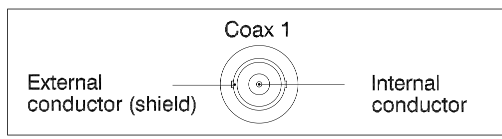


Fig. 13-31 Terminal assignment of the Coax 1 and Coax 2 sockets

Internal circuitry (RS232C) of the Diag plug for CPU module DCP 10

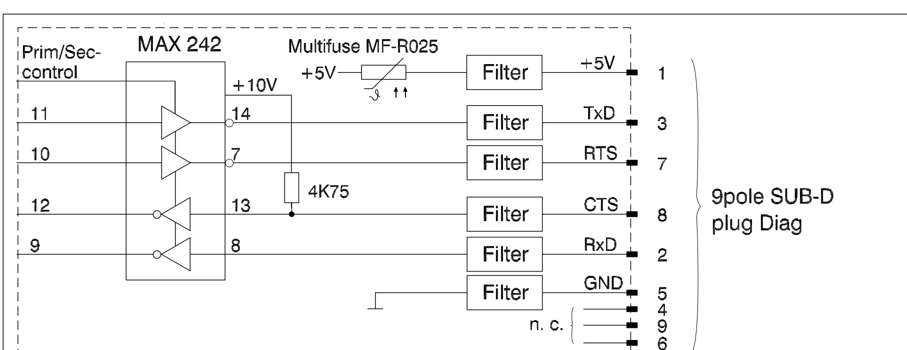


Fig. 13-32 Internal circuitry of the Diag plug for CPU module DCP 10

Internal circuitry of Ser 1 for CPU module DCP 10

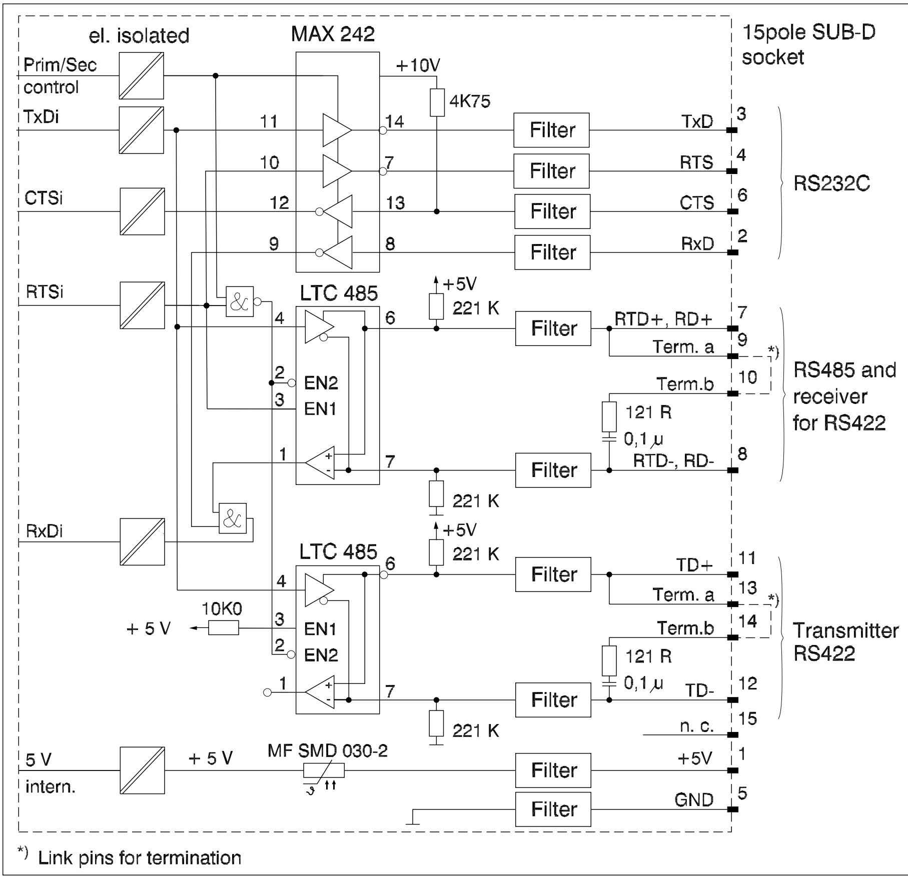


Fig. 13-33 Internal circuitry of Ser 1 for CPU module DCP 10

13.6 Terminal assignment of communication module DCO 01

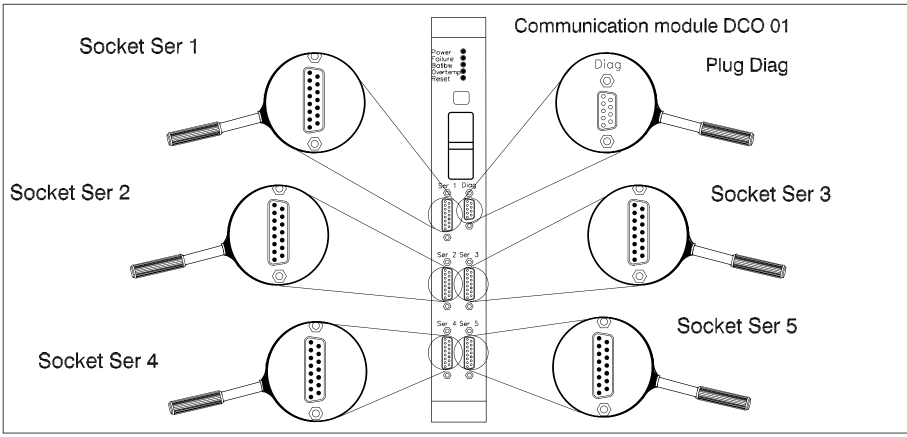


Fig. 13-34 Connector assignment of communication module DCO 01

13.6.1 Terminal assignment of the DCO 01 plug and sockets

Diag plug

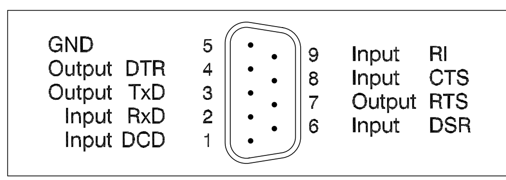


Fig. 13-35 Terminal assignment of the Diag plug

Ser 1 ... Ser 5 sockets (15-pole Sub-D)

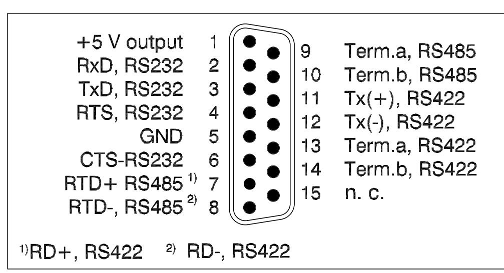


Fig. 13-36 Terminal assignment of the Ser 1 ... Ser 5 sockets

Internal circuitry of Diag interface for DCO 01

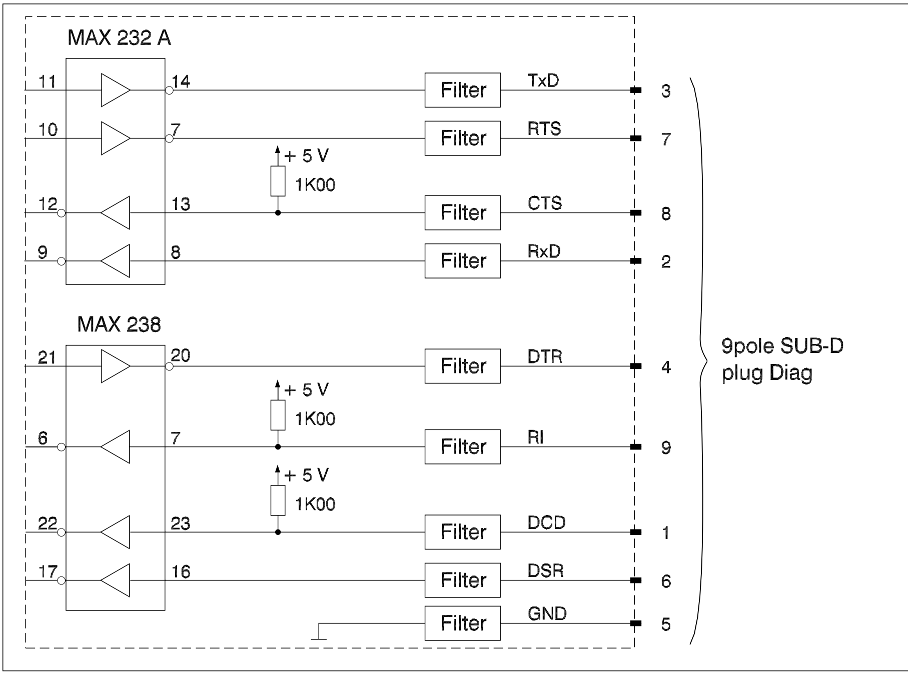
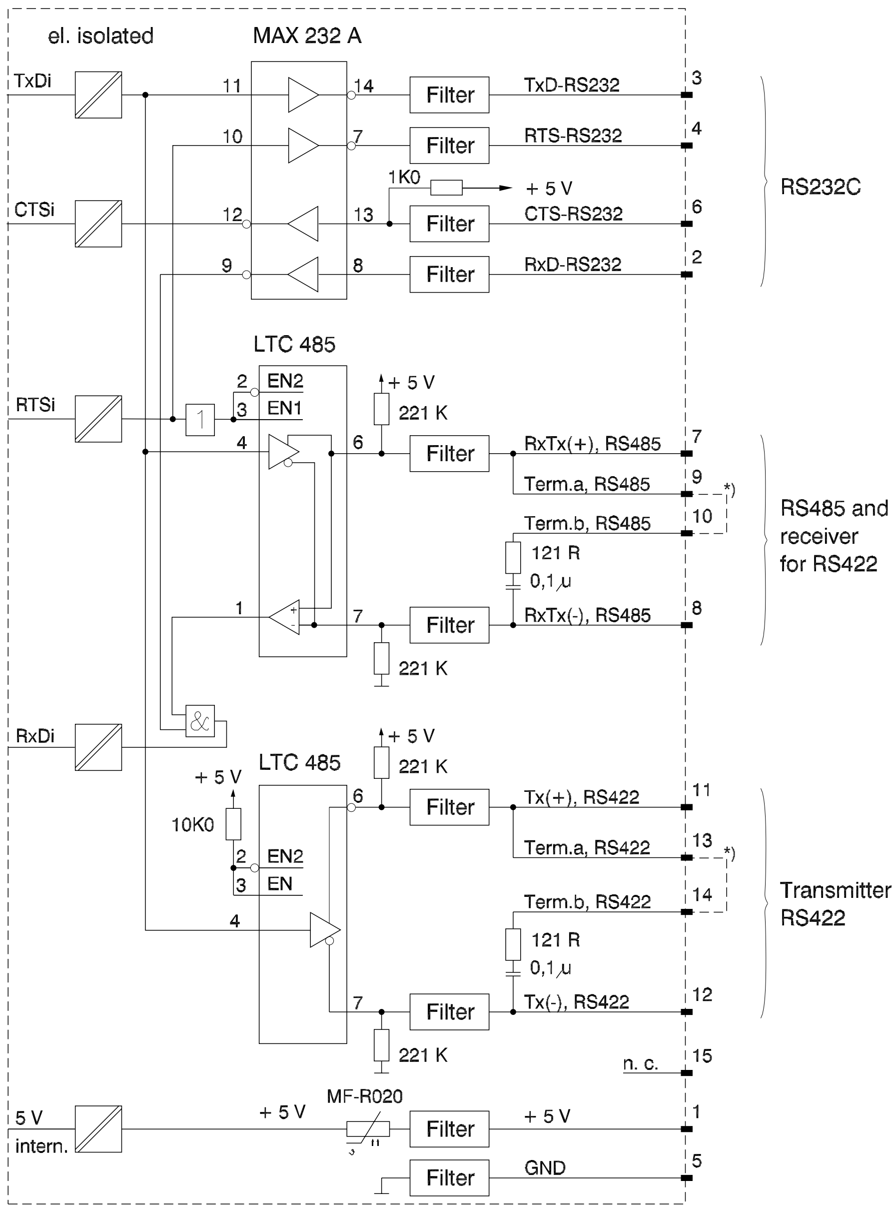


Fig. 13-37 Internal circuitry of Diag interface for DCO 01

Internal circuitry of Ser 1 ... Ser 5 for DCO 01



*) Link pins for termination

Fig. 13-38 Internal circuitry of Ser 1 ... Ser 5 for DCO 01

14 Check-List for Mounting

This check-list is only an overview which sums up the most important mounting instructions, e.g. those relevant for making the acceptance test of an installation.

Always read and observe the information given in the relevant sections of this manual. Working through this check-list does not relieve you of reading and observing these instructions.

Sec. 2 Precautions

Did you observe all precautions? ❑

Sec. 3 Mounting the process station

Is the minimum spacing of 100 mm observed (3.1.3)? ❑

Are air vents unblocked (3.1.3)? ❑

Is the max. permissible cabinet temperature 50 °C observed (3.1.3)? ❑

Did you make the functional grounding of the rack (3.1.5)? ❑

Is good conductivity of the grounding strap for functional grounding ensured? Did you use bright metal surfaces without varnish for grounding (3.1.5)? ❑

Does the grounding strap have a max. length of 300 mm (3.1.5)? ❑

Is the minimum spacing **between** power supplies of 8 mm observed (3.2.2)? ❑

Did you make the functional grounding of the power supply (3.2.3)? ❑

Has the grounding conductor for functional grounding a min. cross-sectional area of 4 mm² (3.2.3)? ❑

Is good conductivity ensured for the functional grounding of the power supply (3.2.3)? ❑

Has the grounding strap for the functional grounding of the power supply a maximum length of 300 mm (3.2.3)? ❑

Is the rack ID of the link module set to the correct value (3.3.1)? ❑

Is the coding switch of the CPU module set to the correct value (3.3.3)? ❑

With redundant CPU: were different coding switch positions set for the two CPU modules? ❑

Did you fill in the I/O module door labels and stick them on the door inside and outside (3.3.5)? ❑

When using a gateway CPU for Symphony connection: did you adjust the coding switch for the gateway CPU (3.3.8)? ❑

Did you fasten all modules in the rack with screws (3)? ❑

Sec. 4.1 Power supply, mains connection

- Do you use power supplies of type DPW 01, DPW 02 or DPW 03 for powering the central units and I/O units (4.1)? ❑
- Is the **correct** power supply used? DPW 01 or DPW 03 for 115/230 V AC, DPW 02 for 24 V DC (4.1) ❑
- Are **no** other power consumers connected to the power supplies for the central units and I/O units (4.1)? ❑
- Is the voltage selector switch of power supply DPW 01 or DPW 03 set to the correct voltage (4.1.1)? ❑
- Is the input circuit of the power supply protected by an external fuse (4.1)? ❑
- Does the power supply input have a 2-pole switch (4.1)? ❑
- Is the power supply input cable laid separately from the output cable (4.1)? ❑
- Is a protective earth conductor connected to the power supply (4.1)? ❑
- Did you put the cable shield of the 24 V cable DSU 10 on the screw of the housing (4.1)? ❑
- Is the 24 V cable connected correctly to the power supply? Check wire colors! (4.1) ❑

Sec. 4.2 Link module DLM 01

- Is the 24 V cable DSU 10 grounded via the rack grounding clip (4.2.1)? ❑
- Is DigiNet P longer than 80 m? If yes, is a CAN cable DSU 07 used (4.2.2)? ❑
- Are the CAN cables DSU 11 or DSU 07 fastened with screws (4.2.2)? ❑
- Are two CAN terminations DSU 01 connected to the first and last bus node (station) (4.2.2)? ❑
- Are the CAN terminations fastened with screws (4.2.2)? ❑
- Is a battery installed in the link module or is an external buffer battery used (4.2.3)? ❑
- Does the battery in the link module have the right polarity (4.2.3)? ❑

With external battery buffering:

- Is the buffer voltage within the permissible range (4.2.4)? ❑
- Check external buffer voltage connection.
  Were the proper wires connected (4.2.4)? ❑

Are unused connectors of link module DLM 01 protected by caps (4.2.5)? ❑

Sec. 4.3 Link module DLM 02

Check all items listed for link module DLM 01! Additionally check:

- Are two power supplies connected (4.3.1)? ❑
- Are the two power supplies supplied via two separated current circuits (4.3.1)? ❑
- Are the input circuits of the power supplies protected separately (4.3.1)? ❑

Sec. 4.4 CPU module DCP 02

With Ser 1 connection (RS485):

- Does the cable have a sufficient cross-sectional area or is the correct connection cable (DSU 13) used (4.4.1)? ❑
- Are both cable ends provided with a termination (4.4.1)? ❑
- Is an RC element consisting of an 120 Ω resistor and an 0.1 μF capacitor used as the termination (4.4.1)? ❑
- If the CPU module is not located at the end of the bus cable: is the termination in the CPU module switched off (4.4.1)? ❑
- Is the GND terminal left unconnected (4.4.1)? ❑
- Did you mind the fact that the protective separation may be canceled out by another Modbus node (4.4.1) ❑

With Diag connection (RS232C)

- Did you mind the fact that connecting a diagnostic PC or terminal may cancel out the protective separation of the process station (4.4.2)? ❑

Do you have a diagnostic cable DSU 141 (4.4.2)? If not please get one. You will need it for commissioning. ❑

Is a buffer battery installed in the CPU module? If not is another kind of battery buffering used (4.4.3)? ❑

Does the buffer battery in the CPU module have the right polarity (4.4.3)? ❑

Are unused connectors of the CPU module protected by caps (4.4.4)? ❑

Sec. 4.5 CPU module DCP 10

With connector Ser 1 as RS485

- Does the cable have a sufficient cross-sectional area or is the correct connection cable(DSU 211) used (4.5.3)? ❑
- Are both cable ends provided with a termination(4.5.3)? ❑
- Is an RC element consisting of an 120 Ω resistor and an 0.1 μF capacitor used as the termination (internal or external) (4.5.3)? ❑
- If the CPU module is not located at the end of the bus cable: is the termination in the CPU module switched off (4.5.3)? ❑
- Are all connector pins unconnected which are not assigned to RS485 ? ❑

For redundant operation additionally check:

- Is the proper connection cable (DSU 221) used (4.5.3)?
- Is the termination installed externally at both cable ends (4.5.3)? ❑
- Is the internal termination deactivated at both CPU modules, regardless whether the CPU is or is not installed at the end of the bus cable (4.5.3)? ❑

With connector Ser 1 as RS422

- Does the cable have a sufficient cross-sectional area or is the correct connection cable (DSU 213) used (4.5.2)? ❑
- Are both the transmit and the receive cable provided with a termination at both ends (4.5.2)? ❑
- Is an RC element consisting of an 120 Ω resistor and an 0.1 µF capacitor used as the termination (internal or external) (4.5.2)? ❑
- If the CPU module is not located at the end of the bus cable: is the termination in the CPU module switched off (4.5.2)? ❑
- Are all connector pins unconnected which are not assigned to RS422? ❑

For redundant operation additionally check:

- Is the proper connection cable (DSU 223) used (4.5.2)?
- Is the termination installed externally at both cable ends (4.5.2)? ❑
- Is the internal termination deactivated at both CPU modules, regardless whether the CPU is or is not installed at the end of the bus cable (4.5.2)? ❑

With connector Ser 1 as RS232C

- Is the proper connection cable (DSU 212) used (4.5.1)? ❑
- Are all connector pins unconnected which are not assigned to RS232C? ❑

For redundant operation additionally check:

- Is the proper connection cable (DSU 222) used (4.5.1)?

With Diag connector

- Did you mind the fact that the protective separation of the process station may be canceled out by connecting a diagnostic PC/terminal. (4.5.4)? ❑
- Is a diagnostic cable DSU 141 available for commissioning (4.5.4)? ❑

Is a buffer battery installed in the CPU module? If not is another kind of battery buffering used(4.5.5)? ❑

Does the buffer battery in the CPU module have the right polarity (4.5.5)? ❑

Are unused connectors of the CPU module protected by caps (4.5.6)? ❑

Sec. 4.6 Gateway CPU for connection to Symphony

Is a CPU module DCP 02 with a hardware index higher than 10 or a DCP10 (any hardware index) used as the gateway CPU? ❑

Sec. 4.7 Redundant gateway CPU connection to Symphony

Is a CPU module DCP10 (any hardware index) used as the gateway CPU? ❑

Sec. 4.8 I/O modules, general

- Are only black I/O connectors DSU 491 used as the 10-pole module connectors for extra low voltage (4.8.1)? ❑
- Are only orange I/O connectors DSU 492 used as the 10-pole module connectors for hazardous voltage (4.8.1)? ❑
- Are only black I/O connectors DSU 493 used as the 15-pole module connectors for extra low voltage (4.8.1)? ❑
- Are extra low signal voltages separated from hazardous voltages, i.e. are they lead to different connectors (4.8.1)? ❑
- Are all I/O connectors coded correctly, according to the instructions (4.8.1.1)? ❑
- Does the I/O cable have a sufficient cross-sectional area (4.8.2.3)? ❑
- Did you calculate the voltage drop on the cables and consider it, e.g. for the load (4.8.2.3)? ❑
- Is the control voltage for digital actors sufficient if the voltage drop on the cable is considered (4.8.2.3)? ❑
- Is the cable laid according to the instructions (4.8.2)? ❑
- Are input and output cables laid separately (4.8.2)? ❑
- Are power circuits laid separately from measuring circuits (4.8.2)? ❑
- Did you observe the recommendations for using shielded cables (4.8.2)? ❑
- Is the maximum permissible cable length observed (4.8.2.4)? ❑
- Did you observe the instruction that a hazardous voltage and an extra low voltage must not be connected to the same module (4.8.3)? ❑
- When using shielded cables: is the cable shield put correctly on the rack (4.8.3)? ❑

When applying hazardous voltages:

- Can the signals be switched off with a two-pole switch (e.g. 4.8.10.1)? ❑
- Are all four protective earth conductors connected at the I/O connectors (e.g. 4.8.10.2)? ❑
- Are all four I/O connectors installed (e.g. 4.8.10.2)? ❑
- Are orange I/O connectors (DSU 492) used (4.8.1)? ❑
- Were the warning labels delivered with the unit attached according to the instructions (4.8.3)? ❑

Sec. 4.8.4 Digital input module DDI 01

Is the nominal 24 V DC voltage observed (4.8.4)? ❑

Is module DDI 01 supplied with an extra low voltage with protective separation from other circuits (4.8.4.2)? ❑

cal isolation in groups of eight (4.8.4.2)? ❑

Sec. 4.8.5 Digital input module DDI 02

When applying hazardous voltages: are all modules provided with a 2-pole switch for switching off the signal circuits (4.8.5.1)? ❑

When applying hazardous voltages: are all four I/O connectors orange and plugged in, even if not all channels are used (4.8.5.2)? ❑

When applying hazardous voltages: are no other extra low voltages connected to the module (4.8.5.2)? ❑

When applying hazardous voltages: are all four protective earth conductors connected to the module (4.8.5.2)? ❑

Do you use orange I/O connectors DSU 492 for hazardous voltages and black I/O connectors DSU 491 for other voltages (4.8.1)? ❑

Were the warning labels delivered with the unit attached according to the instructions (4.8.3)? ❑

Sec. 4.8.6 Digital input module DDI 03

Are 2-pole switches provided for switching off the measuring circuits (4.8.6.1)? ❑

Are all four I/O connectors orange and plugged in, even if not all channels are used (4.8.6.2)? ❑

Are all four protective earth conductors connected to the module (4.8.6.2)? ❑

Are orange I/O connectors DSU 492 used (4.8.6.2)? ❑

Were the warning labels delivered with the unit attached according to the instructions (4.8.3)? ❑

Sec. 4.8.7 Digital input module DDI 04

Are 15-pole connectors DSU 493 used (4.8.7)? ❑

Did you mind the group-wise selectable supply voltage of 8.2 V or 24 V when making the terminal assignment (4.8.7.1)? ❑

Are proper combinations used for 2-wire, 3-wire and 3-wire mixed operation 4.8.7.1)? ❑

Did you fill in the door labels correctly to indicate the assignment of the terminals to the LEDs (4.8.7.1)? ❑

With external supply: Is the maximum permissible supply voltage observed (4.8.7.3)? ❑

Is the maximum number of 7 modules per rack considered for power consumption (4.8.7.2)? ❑

Sec. 4.8.8 Digital input module DDI 05

Are 2-pole switches provided for the signal circuits (4.8.6.1)? ❑

Are all four I/O connectors orange and plugged in, even if not all channels are used (4.8.6.2)? ❑

Are all four protective earth conductors connected to the module (4.8.6.2)? ❑

Are orange I/O connectors DSU 492 used (4.8.6.2)? ❑

Were the warning labels delivered with the unit attached according to the instructions (4.8.3)? ❑

Sec. 4.8.9 Digital output module DDO 01

Is the nominal 24 V DC voltage observed (4.8.9)? ❑

Is the module DDO 01 supplied with extra low voltage with protective separation from other circuits (4.8.9.3)? ❑

Is the external power supply sufficient (4.8.9.3)? ❑

Is the tolerance for external power supply observed (4.8.9.3)? ❑

Did you consider the electrical isolation in groups of eight (4.8.9.3) ? ❑

Is the maximum permissible switching frequency for inductive loads observed (4.8.9.4)? ❑

Sec. 4.8.10 Digital output module DDO 02

Is the nominal 24 ... 230 V AC/DC voltage observed (4.8.10)? ❑

Is a mains filter provided for the power input (4.8.10.1)? ❑

Are the relay contacts protected by fuses (4.8.10.1)? ❑

Are the fuses sufficient (4.8.10.1)? ❑

Did you observe the instruction that a hazardous voltage (e. g. 230 V AC) and an extra low voltage with protective separation from other circuits (e.g. 24 V DC) must not be connected to the same module (4.8.10.1)? ❑

When applying hazardous voltages:

- Is a 2-pole power switch provided (4.8.10.1)? ❑
- Are all four protective earth conductors connected to the module (4.8.10.2)? ❑
- Are all four I/O connectors plugged in (4.8.10.2)? ❑
- Are orange I/O connectors (DSU 492) used (4.8.10)? ❑
- Were the warning labels delivered with the unit attached according to the instructions (4.8.3)? ❑

Did you observe the load limit curve for DC voltage operation (4.8.10.3)? ❑

Did you consider the reduction factor for inductive loads (4.8.10.4)? ❑

Is a clamping diode or a spark quencher provided for inductive loads (4.8.10.4)? ❑

Sec. 4.8.11 Digital output module DDO 03

Is the permissible voltage range of 24 ... 60 V AC/DC observed (4.8.11)? ❑

Is a mains filter provided for the power input (4.8.11.1)? ❑

When applying hazardous voltages:

- Is a 2-pole power switch provided (4.8.11.1)? ❑
- Are all four protective earth conductors connected (4.8.11.2)? ❑
- Are all four I/O connectors plugged in (4.8.11.2)? ❑
- Are orange I/O connectors (DSU 492) used (4.8.10)? ❑
- Were the warning labels delivered with the unit attached according to the instructions (4.8.3)? ❑

Are the relay contacts protected by fuses (4.8.11.2)? ❑

Are the fuses sufficient (4.8.11.2)? ❑

Did you observe the instruction that a hazardous voltage (e.g. 60 V AC) and an extra low voltage with protective separation from other circuits (e.g. 24 V DC) must not be connected to the same module (4.8.11.2)? ❑

Is the load limit curve for DC voltage operation observed (4.8.11.2)? ❑

Did you consider the reduction factor for inductive loads (4.8.11.2)? ❑

Is a clamping diode or a spark quencher provided for inductive loads (4.8.11.2)? ❑

Sec. 4.8.12 Digital output module DDO 04

Is the input voltage range of 115 ... 230 V AC observed (4.8.12)? ❑

Is a mains filter provided for the power input (4.8.12.1)? ❑

Is a 2-pole power switch provided (4.8.12.1)? ❑

Are the relay contacts protected by fuses (4.8.12.1)? ❑

Are the fuses sufficient (4.8.12.1)? ❑

Are all four protective earth conductors connected (4.8.12.1)? ❑

Are all four I/O connectors plugged in (4.8.12.1)? ❑

Were the warning labels delivered with the unit attached according to the instructions (4.8.3)? ❑

Did you consider the reduction factor for inductive loads (4.8.12.1)? ❑

Is a clamping diode/spark quencher provided for inductive loads (4.8.12.1)? ❑

Sect. 4.8.13 Analog input module DAI 01

- Is the input range 0/4 ... 20 mA observed (4.8.13.1)? ❑
- Did you calculate the load for the input circuits under consideration of the module input load of 50 Ω (4.8.13.1)? ❑
- The module is not provided with a transmitter supply. Did you provide an external transmitter supply (4.8.13.1)? ❑
- Did you leave GND unconnected (only necessary during commissioning) (4.8.13.1)? ❑
- Do you use the DAI 05 module for the 2-wire transmitters, which is better suited for this application (4.8.13.1). ❑
- Did you consider the electrical isolation in groups of eight (4.8.13.2)? ❑
- Did you provide for a protective separation of the input circuits from circuits with hazardous voltages (4.8.13.2)? ❑
- Did you check the max. offset voltage in each group of eight (4.8.13.2)? ❑
- Did you consider the max. overload protection (7.6.13)? ❑

Sec. 4.8.14 Analog input module DAI 02

- Is the input voltage range 0 ... 10 V observed (4.8.14)? ❑
- Did you consider the electrical isolation in groups of eight (4.8.14)? ❑
- Did you provide for protective separation of the input circuits from circuits with hazardous voltage (4.8.14)? ❑
- Did you check the max. offset voltage in each group of eight (4.8.14)? ❑
- Did you consider the maximum overload protection (7.6.13)? ❑

Sec. 4.8.15 Analog input module DAI 03

- Is the input range of 0/4 ... 20 mA observed (4.8.15)? ❑
- Did you calculate the load for the input circuits under consideration of the module input load of 271 Ω (4.8.15)? ❑
- The module is not provided with a transmitter supply. Did you provide an external transmitter supply (4.8.15)? ❑
- Did you leave GND unconnected (only necessary during commissioning) (4.8.15)? ❑
- Did you consider the electrical isolation in groups of eight (4.8.15)? ❑
- Did you provide for a protective separation of the input circuits from circuits with hazardous voltages (4.8.15)? ❑
- Did you check the max. offset voltage which can occur in each group of eight (4.8.15)? ❑
- Did you consider the max. overload protection (7.6.13)? ❑

Sec. 4.8.16 Analog input DAI 04 for temperature sensors

- Are the sensors connected according to the instructions (4.8.16.1)? ❑
- Did you remember the bridges (4.8.16.1)? ❑
- When using thermocouples: is cold junction compensation provided (4.8.16.2)? ❑
- Did you provide for protective separation of the I/O circuits from circuits with hazardous voltages (4.8.16.3)? ❑

Sec. 4.8.17 Analog input module with transmitter supply DAI 05

- Did you make the wiring in accordance with the instructions (4.8.17.1)? ❑
- Did you consider the electrical isolation in two groups of eight (4.8.17.2)? ❑
- Is an external power supply connected (4.8.17.3)? ❑
- Did you check the tolerance for the external power supply (4.8.17.3)? ❑
- Is the external power supply sufficient (4.8.17.3)? ❑

Sec. 4.8.18 Analog output module DAO 01

- Is an external power supply connected (4.8.18.1)? ❑
- Did you check the tolerance for external power supply (4.8.18.1)? ❑
- Is the external power supply sufficient (4.8.18.1)? ❑

Sec. 4.8.19 Analog output module DAO 02

- Is an external power supply connected (4.8.19.1)? ❑
- Did you check the tolerance for external power supply (4.8.19.1)? ❑
- Is the external power supply sufficient (4.8.19.1)? ❑

Sec. 4.8.20 Frequency input module DFI 01

- Are 15-pole I/O connectors DSU 493 used (4.8.20)? ❑
- Are the terminals connected in accordance with the terminal assignment and the wiring diagram (4.8.20.1)? ❑
- Did you fill in the door labels correctly to indicate the assignment of the terminals to the LEDs (4.8.20.1)? ❑

With external supply:

- Did you mind and observe the maximum permissible supply voltage (4.8.20.5)? ❑
- Is the external power supply provided with a protective electrical separation (4.8.20.5)? ❑

Sec. 4.9 Cabling the communication module DCO 01

Is the battery installed in the module (4.9.3)? ❑

Does the battery have the correct polarity (4.9.3)? ❑

Are unused connectors protected by caps (4.9.4)? ❑

Connection via RS232C interface for diagnosis (4.9.2.1)

- Is cable DSU 141 used (4.9.2)? ❑
- Is the maximum permissible cable length observed (4.9.2)? ❑
- Is GND connected (4.9.2)? ❑

Connection to Ser 1 ... Ser 5 user interfaces via RS232

- Is the cable DSU 212 used (4.9.1.1)? ❑
- Is the maximum permissible cable length observed (4.9.1.1)? ❑
- Is GND connected (4.9.1.1)? ❑

Connection to Ser 1 ... Ser 5 user interface via RS422 (4.9.2.2)

- Is cable DSU 213 used (4.9.1.2)? ❑
- Is the maximum permissible cable length observed (4.9.1.2)? ❑
- Is a termination of the transmit and receive cables provided for the external device (4.9.1.2)? ❑
- Is an RC element consisting of an 120 Ω resistor and an 0.1 µF capacitor connected in series used as the termination for the transmit and receive line (4.9.1.2)? ❑
- If the communication module is not installed at the end of the line: is the termination in the communication module deactivated by opening the bridges for the transmit and receive lines in the connector (4.9.1.2)? ❑

Connection to Ser 1 ... Ser 5 user interface via RS485 (4.9.2.3)

- Is cable DSU 211 used (4.9.1.3)? ❑
- Is the maximum permissible cable length observed (4.9.1.3)? ❑
- Is a termination provided at the external device (4.9.1.3)? ❑
- Does the termination consist of a 120 Ω resistor and a 0.1 µF capacitor connected in series? ❑
- If the communication module is not located at the end of the line: did you deactivate the termination in the communication module by opening the bridge in the connector (4.9.1.3)? ❑

Sec. 5 Installing the DigiNet S and DigiNet Sr system buses

Do you use 10Base2 for small installations with low electromagnetic interference, only (5.1.1)? ❑

Do you use 10Base5 for medium-size installations with low to medium electromagnetic interference, only (5.1.2)? ❑

Did you check if fiber-optic cables have to be used (5.2.1)? ❑

Was an acceptance measurement of the network performed (5.2.2)? ❑

Are copies of the acceptance record available to you (5.2.2)? ❑

Sec. 5.3 Installing a 10Base2 network

Are terminating resistors provided at both cable ends (5.3.1)? ❑

Is the 10Base2 cable grounded at one station by a grounding clip (5.3.1)? ❑

Is the minimum spacing between two nodes 0.5 m (5.3.1)? ❑

Is the maximum permissible bus cable length observed (5.3.1)? ❑

Branches are not permissible. Is this observed (5.3.1)? ❑

Sec. 5.4 Installing a 10Base5 network

Is the bus cable length a multiple or a combination of standard cable lengths (5.4.1)? ❑

Is the max. permissible cable length of 500 m observed (5.4.2)? ❑

Is the maximum cable length confirmed by a TDR measurement record (5.2.2)? ❑

Is each cable end provided with a terminating resistor (5.4.3)? ❑

Is the bus cable grounded at exactly one point (5.4.3)? ❑

Did you prevent accidental ground fault of the 10Base5 bus cable by insulating the ungrounded terminating resistor and the N/N connectors (5.4.3)? ❑

Are the transceivers attached to the cable at the marks (5.4.3)? ❑

Did you measure the resistance at each transceiver with an ohmmeter to see if it is 25 Ω between the shield contact and core contact, with terminating resistors screwed on (5.4.3)? ❑

Did you ground the AUI cable at the process stations (5.4.3)? ❑

Sec. 5.5 Installing a 10BaseFL network (fiber optic cable)

Were the jumpers on all plug-in modules for the network concentrator set according to the instructions (5.5.2)? ❑

Are AUI cables - if used - grounded properly (5.5.2)? ❑

Were the 10BaseFL modules set to the appropriate transmission power, as required for the fiber length (5.5.2)? ❑

Are the plug-in modules fastened with screws in the network concentrator (5.5.2)? ❑

Are all slide locks of the AUI cables - if used - locked (5.5.2)? ❑

When using spliced cables: were the spliced fiber optic cables submitted to an acceptance measurement (5.5.3)? ❑

For links between buildings with steel-reinforced cables: is the steel-reinforcement grounded sufficiently (5.5.4)? ❑

For redundant 10BaseFL cable links: were the 10BaseFL modules configured for redundant operation by setting the jumpers accordingly (5.5.5)? ❑

Did you check the redundant link by disconnecting one link (5.5.5)? ❑

Did you calculate the max. permissible network length (5.5.7)? ❑

Did you check if your network exceeds the max. permissible length (5.5.7)? ❑

Did you observe the max. permissible fiber length between two 10BaseFL modules NCO 01 (5.5.7)? ❑

Did you observe the max. permissible fiber length between a 10BaseFL transceiver NTO 02 and a 10BaseFL module NCO 01 (5.5.7)? ❑

Did you observe the original operating instructions of the 10BaseFL components (5.5.7)? ❑

Sec. 5.8 Connecting the Freelance 2000 system to the Symphony operation level

Did you provide an additional gateway CPU? ❑

Did you connect the gateway CPU to the DigiNet S? ❑

Did you lay the DigiNet S close to the Symphony coupling station? ❑

With redundant connection additionally check:

Are two CPU modules DCP 10 used? ❑

Did you install DigiNet Sr in the same way as DigiNet-S? ❑

Did you assign different IP addresses to the gateway CPUs? ❑

Sec. 6 Switching on the process station

- Did you verify the rack ID and station number (6.1)? ❑
- Did you check the status indicators (6.2)? ❑
- Did you configure the Ethernet interface(s) for AUI or Cheapernet (6.3.1)? ❑
- If the station number was set to 0: was a valid IP address and subnet mask adjusted via the diagnostic terminal (6.3.1)? ❑
- Were date and time adjusted (6.3.1)? ❑
- Did you save the new settings in the process station (6.3.1) ❑

Sec. 8 Mounting the operator station

- Is sufficient space available to enable air circulation (8.1)? ❑
- Were the instructions for installing additional boards in the PC observed (8.2)? ❑

Sec. 9 Cabling the operator station

- Was the voltage selector switch a the PC power supply set to the correct voltage? ❑
- Was the hard key plugged in and fastened with screws? ❑
- Were the keyboard and mouse connected properly? ❑
- Were all screwable connection cables fastened with screws? ❑
- Were the slide locks of the AUI cables - if existing - locked? ❑
- Does the monitor have the correct mains voltage? ❑
- Does the printer have the correct mains voltage? ❑

Sec. 10 Switching on the operator station

- Only applicable for DPR 01: was the basic adjustment made (10.2)? ❑
- Was the EPP or EPS mode disabled in the PC setup menu, if applicable (10.3)? ❑

Sec. 11 Maintenance

- Was the customer notified of the maintenance instructions given in the mounting and installation instructions manual? ❑

15 Glossary

- 1 -

10BaseFL network cable	Fiber optic system bus cable to Ethernet standard 10BaseFL. Delivered as ready-made cable with connectors. Requires optical transceivers and an active network concentrator (star coupler). Up to two nodes can be connected without a network concentrator via two optical transceivers, only.
10BaseFL network concentrator module	Module plugged in the network concentrator for connecting a 10BaseFL network cable.
10BaseFL transceiver	10BaseFL transceivers are used for connecting fiber optic cables directly to the Freelance 2000 system, also referred to as optical transceivers. An AUI network cable links the optical transceiver with the CPU module. Two fiber optic cables connect the optical transceiver to the network concentrator module.
10Base2 F-connector 10Base2 Y- connector 10Base2 T- connector	Connectors for connecting 10Base2 nodes to the network cable. Available as F-connector, Y-connector or T-connector.
10Base2 mounting tool kit	Crimp tool and wire stripper for making 10Base2 network cables. Normally not required as ready-made cables should be used.
10Base2 N-BNC adapter	Adapter for connecting a 10Base2 segment to a 10Base5 concentrator module. Note that direct connection of 10Base2 cables to 10Base5 cables via this adapter is not allowed.
10Base2 network cable	Transmission cable to Ethernet standard. Single-shielded coaxial cable with BNC connectors. Max. possible segment lengths 185 m. Used for the DigiNet S system bus.
10Base2 network concentrator module	Module plugged in the network concentrator for connecting four 10Base2 network segments. **Warning**: The segments are grounded by the module. Use 10Base5 network concentrator module with 10Base2 N-BNC adapter as an alternative.
10Base2 terminating resistor	Resistor for terminating a 10Base2 network cable.
10Base2 network transceiver	→ Transceiver (AUI)
10Base5 grounding clip	The cable shield of the 10Base5 network cable has to be grounded by a grounding clip which is attached to the 10Base5 terminating resistor.
10Base5 mounting tool kit	Tool kit for mounting a 10Base5/AUI network transceiver to a 10Base5 network cable. The set includes a drill for drilling holes into the cable for mounting purposes, and a screwed contact piece.
10Base5 N/N connector	Barrel connector for interconnecting two 10Base5 cables.

10Base5 network cable	Network cable to Ethernet standard 10Base5, also called "Yellow Cable". A node is connected to the Yellow Cable via a 10Base5/AUI network transceiver NTC 03 and an AUI network cable.
10Base5 network concentrator module	Module plugged in the network concentrator for connecting a 10Base5 network segment. A 10Base2 network cable can be connected via the 10Base2 N-BNC adapter.
10Base5 tap	Also called Vampire tap or MAU (Medium Attachment Unit). Tap for 10Base5 network cable. An AUI network cable links the transceiver attached to the tap with the node. A 10Base5 tap is included in the delivery scope of the 10Base5/AUI network transceivers NTC 03.
10Base5 terminating resistor	Terminator of a 10Base5 network cable. Connected to the 10Base5 network cable via N-series connectors.
10Base5/AUI network transceiver	→ Transceiver(AUI)

- 2 -

2-wire transmitter	Transmitter which is powered via the 4 ... 20 mA signal. The transmitter has no power connectors. The analog input module DAI 05 has an integrated power supply for 2-wire transmitters. → 4-wire transmitter
2-wire, 3-wire, 4-wire	Identifies the number of connection wires (2, 3 or 4) through which devices like an RTD Pt100 measuring resistors or NAMUR initiators are connected.
230 V AC power cable	Cable linking the 230 V power supply DPW 01 and DPW 03 with the 230 V mains. Provided with ground contact plug.
24 V cable	Cable linking power supply DPW 02 and link module DLM; serves for 24 V power supply.

- 4 -

4-wire transmitter	Transmitter which is powered externally via its power connectors. The DAI 01 module is designed for connecting 4-wire transmitters, since it is not provided with a transmitter supply. → 2-wire transmitter

- A -

A/D converter	Analog/Digital converter. Module for converting an analog signal into a digital one. Used in the analog input modules. Different methods of A/D conversion are used.
AC	Abbreviation of **A**lternating **C**urrent. Voltages are always given in V AC or V DC in this manual. Note that the specified voltages in this manual are RMS (Root Means Square) values. Sometimes the writing style "a.c." may be used. → DC
Air deflector	The air deflector DSU 65 improves air circulation in the cabinet. It prevents that heated air from a process station passes through the process station above it.
Analog input modules	The following analog input modules are available: DAI 01: passive 0/4 ... 20 mA input. Input resistance 50 Ω. DAI 02: 0 ... 10 V voltage inputs DAI 03: 0/4 ... 20 mA. High-resistance input for HART transmitters. DAI 04: see temperature measurement DAI 05: 4 ... 20 mA with integrated transmitter supply
Analog output module	Module for outputting analog standard signals of 0/4 ... 20 mA.
Analog/Digital converter	→ A/D converter
ANSI terminal	→ Terminal
AUI network cable	AUI (**A**ttachment **U**nit **I**nterface) network cables are used in a network to Ethernet standard 10Base5 (Yellow-Cable) to connect nodes to transceivers. Provided with 15-pole SUB-MIN-D connectors with slide locks.
AUI network concentrator module	Module plugged in the network concentrator, for direct connection of two nodes via AUI network cable.
AUI transceiver	→ Transceiver (AUI)

- B -

Back plane	Board at the back of the rack; serves for connecting all modules plugged in.
Batt low LED	Indicates that no battery is connected or the connected battery is empty. **CPU module and communication module**: Batt low LED lights up yellow when the module buffer battery is empty. **Link module**: Batt low LED lights up yellow when the link module buffer battery and/or the external battery are/is empty.
Battery	→ buffer battery
Battery cable	Cable used for connecting an external 3.6 V battery or a 24 V battery to the link module.
Battery holder	Holder for the buffer battery. The link module, the CPU module and the communication module are provided with a battery holder.
Boot Loader	Basic software of the CPU module; capable of loading an operating system into the CPU module via the Ethernet. The bootstrap of the operating system is done by the engineering station.
Bootstrap	Loading the operating system into the RAM of an "empty" process station. The operating system can also be loaded together with the application program (menu item: Load whole station). In this case, a bootstrap is not required. → Initial all
Bridge	Couples two Ethernet segments. Contrary to a repeater a bridge is capable of filtering data packets and, thus, can provide for load separation of two Ethernet segments.
Buffer battery	Internal buffer battery of CPU, communication or link module. Provides for CMOS RAM data retention in case of power failure. Can be plugged in the module with the aid of a battery holder. **The buffer battery is not rechargeable.**
Buffer battery holder	Holder of the buffer battery. Serves for installing the battery in a link module, a communication module or a CPU module. Battery replacement is possible while operation is running.

- C -

Cable	General term for multi-wire links. In this manual there is no explicit distinction between cables and lines. The term “cable“ is mainly used, independent of the type of insulation.
CAN	Abbreviation of **C**ontroller **A**rea **N**etwork.
CAN bus	Sensor/actuator bus developed for automotive applications. Stands out for its high data integrity, data rates of up to 1Mbit/s, and good electromagnetic compatibility (EMC).
CAN network cable	Network cable for DigiNet P (process station bus).
CAN termination	9-pole Sub-Min-D connector with integral terminating resistor; for terminating a CAN bus.
Cap	Plastic cap for protecting unused connectors against static discharge.
Central unit	A process station consists of one central unit and up to two I/O units. The central unit contains the CPU module, which does the processing.
Channel	Input or output of an I/O module. The channels of an I/O module are numbered consecutively.
Channel number	Number of a channel in an I/O module.
Cheapernet	Colloquial name for Ethernet standard 10Base2. → 10Base2 network cable
CMOS RAM	Battery-buffered memory on the CPU board of the PC central unit; serves for storing the current setting of the PC central unit.
COAX segment	Ethernet cable segment to which nodes are connected. → Link segment
Coding	Action of marking I/O modules and I/O connectors with coding pins. Coding is mandatory. If I/O connectors are mixed up due to missing coding pins, this may destroy the modules. → Coding element, coding pin
Coding element	Each I/O connector packing also includes 8 coding elements. A coding element is a plastic part with four coding pins. The coding pins are to be used for marking the I/O connectors and I/O modules. Ready-made I/O cables are also delivered with coding elements. Spare coding elements can be ordered under code designation DSU 661 or DSU 663. Note that coding of I/O modules and I/O connectors is mandatory. If I/O connectors are mixed up due to missing coding pins, this may destroy the modules. → Coding pin, coding
Coding pin	Part of the coding element. Each coding element contains two coding pins for insertion into the I/O module and two coding pins for insertion into the I/O connector. → Coding element, coding
Coding switch	Rotary switch at link module, communication module and CPU module. Located at the back of the modules, accessible and adjustable from outside. Provides 16 switch positions (0 ... 9 and A ... F).
Cold junction	Connection point for a thermocouple. The temperature of the cold junction must be known for temperature measurement with a thermocouple. → Thermocouple, isothermal terminal

Cold junction compensation	Method for taking into account the terminal temperature when using thermocouples for temperature measurement. → Cold junction, thermocouple, isothermal terminal
Communication module	The communication module accommodates five serial interface for connecting subsystems. The interfaces can be used as RS232C, RS422 or RS485, as required. Additionally, the communication module has a diagnostic interface.
Contronic S	Previous name of → Symphony
Coverage factor	For output modules: ratio of the permissible total current (total output current) to the sum of all max. rated currents of a multi-channel output module.
CPU **C**entral **P**rocessing **U**nit	Microprocessor providing the main processing functions. An Intel 80960 CPU is used for the Freelance 2000 CPU module.
CPU module	Data processing module of the Freelance 2000 central unit. Must be plugged in slot 0 (second from left). Features: 80960 RISC processor, RAM of up to 8 MBytes, Ethernet connector.
CPU module for Symphony connection	→Gateway CPU
CPU redundancy	A CPU redundancy can be realized in the Freelance 2000 system by using two CPU modules DCP 10. This improves Freelance 2000 availability by 430 %. → Redundancy
Current-sinking	Describes the action of consuming current.
Current-sourcing	Describes the action of delivering current.

- D -

DC	Abbreviation of **D**irect **C**urrent. Alternative writing style: “d.c.“ → AC
DC/DC converter	Component which converts a DC voltage into another DC voltage. Normally, DC/DC converters also provide for voltage separation. DC/DC converters are, for example, used in the DAI 01 and DAI 05 modules.
DCF77 radio clock	The PTB (Physikalisch-Technische Bundesanstalt = Federal German Institute of Physics and Technology) in Braunschweig/Germany transmits a standard time signal from its long-wave transmitter station near Frankfurt/Main. This signal can be received by a DCF77 clock and is then used for synchronizing the times throughout the Freelance 2000 system. The DCF77 radio clock is connected to the Freelance 2000 system via the diagnostic interface of the CPU module. → GPS
Desk stand	Stand for the module rack. Additional support rail for the power supply and terminal blocks. Available as individual part or with installed and cabled process station with connected I/O test cables. The desk stand can be used for mounting a single process station for demonstration or test if no cabinet or support is available. → I/O test cable
Diagnostic cable (RS232C)	Zero modem cable DSU 141 with two 9-pole SUB-MIN-D connectors; serves for connecting a diagnostic PC, laptop or ANSI terminal to the process station. A cable with a 25-pin connector for connection to a terminal is available under code designation DSU 20.

Diagnostic interface	RS232C interface of the CPU module; for status and error message output during diagnosis. The diagnostic interface is also used for connecting a DCF77 radio clock. → DCF77 radio clock, GPS
DigiLink	RS485 connection of the process station; for connecting subsystems like balances and bar code readers via Modbus protocol. Several times available at the communication module DCO 01. → RS485 interface
Digimatik system	Previous name of → Freelance 2000 system. Components: . →Process station, engineering station, operator station
DigiNet S	System bus linking process, engineering and operator stations with each other. Based on DIN/ISO 8802, Part 3 (IEEE 802.3). Serial transmission principle. Suitable for working with different transmission media (two different coaxial cables, twisted-pair cable, fiber optic cable).
DigiNet Sr	Redundant system bus with same physical setup as DigiNet S. Provides for data exchange in redundant Freelance 2000 systems → Redundancy, redundant CPU
Digital input modules	For the time being four digital input modules are available: DDI 01: Digital input module for 24 V DC, 32 channels which are electrically isolated in groups of 8. Two ground connectors for each group of eight. DDI 02: Module for 24 ... 60 V AC/DC, 16 channels with individual electrical isolation. DDI 03: Module for 115 ... 230 V AC, 16 channels with individual electrical isolation. DDI 04 Module for NAMUR initiators-, Supply voltage 8. 2 V or 24 V, 56 channels with 2-wire sensors or 24 channels with 3-/4-wire sensors
Digital output modules	For the time being four digital output modules are available. DDO 01: Current-sourcing digital outputs, 32 channels which are electrically isolated in groups of 8, 24 V DC, 0.5 A. DDO 02: Relay outputs, 24 ... 230V AC/DC, 16 channels with individual electrical isolation, max. resistive load of 5 A. DDO 03: Relay outputs, 24 ... 60 V AC/DC, with output signal feedback, 16 channels with individual electrical isolation, max. resistive load of 5 A. DDO 04: Relay outputs, 115 ... 230V AC, with output signal feedback, 16 channels with individual electrical isolation, max. resistive load of 5 A. Digital output modules serve for connecting digital actors (relays, solenoid valves, lamps, motors).
DigiTool	Software for the engineering station; runs under MS Windows. → Engineering station
DigiVis	Software for the operator station; runs under MS Windows. → Operator station

- E -

EEPROM	**E**lectrically **E**rasable and **P**rogrammable **R**ead **o**nly **M**emory. Advanced EPROM (**E**rasable and **P**rogrammable **R**ead **o**nly **M**emory). While EPROMS can only be erased with an ultraviolet ray lamp, it is possible to erase built-in EEPROMS. EEPROMS are used in the CPU module and in the I/O modules for storing manufacturing information (e.g. serial no. or version no.). → EPROM, ROM
EMC	**E**lectro**m**agnetic **C**ompatibility. Represents the EMI/RFI shielding capability as well as the degree of RFI suppression of a unit.
EMI	**E**lectro**m**agnetic **I**nterference
EMI/RFI shielding	Degree of shielding against external EMI and RFI. → RFI suppression, EMC
Emulator box	Accessory part which enables operation of a single CPU module without a rack and without a link module.
Engineering station	PC or laptop with MS Windows and DigiTool software. Used by the Freelance 2000 system operator for configuration, commissioning, and documentation.
EPROM	**E**rasable and **P**rogrammable **R**ead **O**nly **M**emory Normally, EPROMS are provided with a window, through which the memory is erased using ultraviolet light. So-called OTP (One-Time-Programmable) EPROMS without a window can only be programmed once and are not erasable. → EEPROM, Flash EPROM, ROM
Ethernet	Serial bus system to DIN/ISO 8802, Part 3 (IEEE 802.3). Used for the DigiNet S and DigiNet Sr system buses.
Ethernet board	PC plug-in board for connecting engineering station and operator station to Ethernet system bus. Built in the PC central unit. Provided with an AUI connector (SUB-MIN-D jack) and a BNC jack for connecting 10Base2 network cables.
Extra low voltage with	protective separation from other circuits which may be earthed (PELV) according to IEC 364-4-41:1991.

- F -

Failure LED	**Link module**: Failure LED indicates the Power Fail signal of the power supply. Lights up red in case of undervoltage at the power input. **CPU module and communication module**: Failure LED indicates internal hardware and software errors. Lights up red permanently or flashes red, depending on error. Additionally orange for DCP 10 and DCP 02 with HW index ≥ 50.00 orange.
Fiber optic cable	→ 10BaseFL network cable
FieldController	The FieldController in its basic configuration consists of a housing, a power supply module, an Ethernet module, and a fieldbus module.
Flash EPROM	Memory similar to EEPROM. Can be erased and reprogrammed when built in. Flash EPROMs are used for storing the CPU module firmware.
Freelance 2000	New name for the Digimatik system. All Freelance 2000 components. → Process station, engineering station, operator station
Frequency input module DFI 01	Input module for acquisition and evaluation of frequencies and pulses/count events. It has 4 independently configurable counter channels with 2 control inputs and 2 control outputs, each.
Functional earth	→ Functional grounding
Functional grounding	Rack and power supply grounding for draining high-frequency interference. The terminal for functional grounding (functional earth) is marked with the symbol ⏚ according to 417-IEC-5018-a. → Grounding, safety grounding

- G -

Gateway CPU	CPU module for connection to Symphony. An additional CPU module which serves as a gateway CPU is needed for connecting the Freelance 2000 system to the supervisory Symphony operation system. The Freelance 2000 CPU module DCP 02 or DCP 10 is used for this purpose. Using a gateway CPU reduces the max. number of operator stations of the Freelance 2000 system from four to three. Using a redundant gateway with two CPU modules DCP 10 is also possible.
GPS	Abbreviation of **G**lobal **P**ositioning **S**ystem A satellite-supported navigation system. A standard time signal can be received worldwide from GPS by a special receiver. A GPS clock can be used for synchronizing the times in the Freelance 2000 system. For installations in Germany it is recommended to use the DCF77 radio clock to reduce cost. → DCF77 radio clock
Graphics board	Graphics PC plug-in board used in operator and engineering station. Depending on the requirements, graphics boards of different processing speed and resolution can be built in the PC central unit. Laptops are already equipped with a graphics board, so there is not choice in this case.

Grounding	The Freelance 2000 system requires safety grounding in accordance with the relevant VDE standards or equivalent standards applicable in your country. The safety grounding eliminates the hazard of electric shocks. An additional functional grounding drains high-frequency interference.
Grounding strip DSU 485	Flat conductor for the functional grounding of the process station. A woven copper braid is used. This conductor type is capable of draining high-frequency interference.

- H -

Hard key	Module which protects software from unauthorized use. The Freelance 2000 software only works if the hard key delivered with it is connected to the parallel interface of the PC central unit. You can also connect the printer cable to this interface. The hard key will not affect the printer functions.
Hardware index (HW index)	Describes the hardware revision level. The hardware index can be seen in a square field when opening the upper cover of the module
HART data transmission	With this transmission method an audio frequency signal is modulated upon the analog signal to transmit additional data to and from the transmitter. HART data transmission is often used for configuring intelligent transmitters. The DAI 03 module has a high input impedance of 271 Ω. This enables the user to couple in HART signals directly, for example via a hand-held terminal.
Hazardous voltage	A voltage higher than 42.4 V (peak value) or a DC voltage that exists in a current circuit which does not meet the requirements for circuits with limited energy.

- I -

I/O cable	Cable linking the sensors and actuators with the I/O modules; connected to the I/O connectors.
I/O connector	10-pole connector with screw-type terminals; serves for transmitting I/O signals to the I/O modules. Use black connectors DSU 491 for extra low voltage and orange connectors DSU 492 for hazardous voltage. Use gray connectors DSU 493 for I/O modules with 15-pole connectors (DDI 04, DFI 01).
I/O module	→ Digital input module, digital output module, analog input module, analog output module.
I/O test cable	Ready-made cable DSU 461, DSU 462 (different lengths) for linking a digital output module DDO 01 with a digital input module DDI 01 or for linking an analog output module DAO 01 with an analog input module DAI 01.
I/O unit	Component of the process station. An I/O unit accommodates one link module and a maximum of nine I/O modules. The I/O modules are controlled by the CPU module of the central unit.

Icon	Symbol linked with a program or application which can be started by double-clicking the mouse on it. In the MS Windows "Accessories" window, for example, the Terminal, Write, Computer, and File icons are shown and can be selected by double mouse click.
Initial all	Menu item for erasing the operating system of a process station from an engineering station. Switching off the power supply and removing the buffer battery has the same effect. After this, the process station RAM does not contain any data.
Inputs, digital, Type 1	Digital inputs, suitable for signals from electromechanical switches like relay contacts, spring-return buttons, switches, etc. Type 1 inputs are not necessarily suitable for connecting solid state switches like sensors and proximity switches.
Internet address	→ IP address
IP address	**I**nternet **P**rotocol address of an Ethernet node, in accordance with the TCP/IP protocol. Adjustable through the coding switch at the CPU module back.
Isothermal terminal	Terminal for connecting thermocouples. The isothermal terminal is heated up or cooled down to a fixed temperature by an electrical heater or Peltier elements. → Thermocouple

- K -

Keyboard	Input device of operator and engineering station. Standard AT keyboard layout (MF2). Keyboards to IP 65 available on request.

- L -

Laptop	Portable personal computer. Preferably used for engineering station.
Lateral bus	→ DigiNet C
LED	**L**ight **E**mitting **D**iode
Link module	Module for supply voltage input and for connection of external batteries. Essential part of central units and I/O units. Must be plugged in slot A (first slot on the left hand side). Two different models of the link module are available. The standard link module DLM 01 provides a simple power supply. Link module DLM 02 with a redundant power supply meets higher requirements in terms of power supply availability.
Link segment	Cable segment to which no nodes can be connected. Serves for connecting two coax segments. Connecting several link segments is also possible.

- M -

Measuring current source	For temperature measurement with RTD Pt100s the resistance of the Pt100 has to be measured. The temperature module feeds a measuring current (0.2 mA) from its integrated measuring current source to the Pt100 and then measures the voltage drop at the resistor. → RTD Pt100
Modbus	Transmission protocol used for DigiLink. → DigiLink
Module	Generic term → Link ~, Communication ~, CPU~, I/O ~, digital input ~, digital output ~, analog input ~, analog output ~
Module guide	Guide rail set in the rack. Spare guides can be ordered under code designation DSU 481.
Module screw covers	Plastic covers at the top and bottom of the front panels of link and CPU modules. Protect the module screws.
Module screws	Screws at the module front panels, prolonged with shaft-like mechanisms; serve for screwing the modules to the rack.
Monitor	Display unit for operator station and engineering station. Available with a 17 " or 21 " CRT (diagonal measurement).
Monitor cable	Cable linking the monitor with the PC central unit. Included in the scope of delivery of the monitor. Also called VGA cable.
Mouse	Input device for operator and engineering station. Track ball and touch pad to IP54 or IP65 are available on request.
MS Windows	Graphical user interface.
MUX	**Mu**ltiple**x**er

- N -

NAMUR	Abbreviation for "Normen-Ausschuß Meß- und Regeltechnik" (German standardization committee for control technology). Committee working our guidelines and recommendations for performance features of electrical apparatus. Mainly used in the chemical industry.
NAMUR initiator	Digital sensor meeting the NAMUR recommendations. Provides, in addition to digital status information, values for line break and short-circuit..
Network concentrator	Used for linking fiber optic cables with each other or with other network cables in a star-like manner. Consists of a rack with power supply and network concentrator modules. Additional modules for 10Base2, 10Base5, 10BaseT, and AUI.
Network concentrator module	Module plugged in a network concentrator rack. Modules for fiber optic, 10Base5, 10Base2 and 10BaseT network cables as well as a module for direct connection of AUI network cables are available.

- O -

Open end cable	Ready-made I/O cable with I/O connectors and wire pins already attached. → Ready-made I/O cables
Operator station	PC with MS Windows and DigiVis software. Used for operation and monitoring, alarms, trends, archives, and reports.
Optical Time Domain Reflectometer (OTDR)	→ Time Domain Reflectometer (TDR).
Optocoupler	Component for electrical isolation of digital electrical signals.
OTDR	Optical Time Domain Reflectometer → Time Domain Reflectometer
Overtemp LED	Indicates that the internal temperature of the CPU module is above the permissible range. Lights up red if temperature is higher than approx. 70 °C.

- P -

Parallel interface	Interface for connecting the printer to the PC central unit. Often called Centronics interface. Also used for the hard key.
PC central unit	Central unit of a standard or industrial PC; without keyboard, monitor, and mouse. Laptops normally accommodate the central unit, keyboard, and display in a single case.
PELV	→ Extra low voltage ...
Pig-tail	Ready-made fiber optic cable with a connector mounted to one end. Often used when a fiber optic cable is to be provided with a connector, since splicing a pig-tail is easier than mounting a connector on site. You can get two pig-tails by simply cutting a normal 10BaseFL network cable NO 0xx in two pieces. → Splicing, → splice box
Power fail signal	Signal generated by the power supply after power failure; transmitted to the link module. The CPU responds by saving its internal data in the battery-buffered CMOS RAM.
Power LED	**Link module:** Power LED lights up green to indicate that a 24 V input voltage is applied. **CPU module and communication module:** Power LED indicates that all internal supply voltages are applied.
Power supply	Power supply DPW 01 and DPW 03 converts the 230 V AC or 115 V AC input voltage to a 24 V DC voltage. The 24 V cable leads the 24 V DC voltage to the link module. Power the process station with DPW power supplies, only. Do not use the process station on a 24 V DC mains without a power supply DPW 02 (24 V input). Does not apply to external supply of I/O modules.
Primary	Term from redundancy terminology, designating the CPU which currently controls the process.
Prim/Sec Status (LED)	Light emitting diode indicating the CPU redundancy status. Normally, this LED lights up green a the primary and orange at the redundant CPU.

Prim/Sec Toggle (switch)	Push-button for manually switching over the Primary. Only active at the Primary. After this switch is actuated, a redundancy alignment takes place, and the Primary becomes the Secondary one, which in turn becomes the Primary and takes over process control.
Printer	Printers can be connected to the operator and to the engineering station. Different printer types can be used ; inkjet printer (b/w or color), depending on the requirements.
Printer cable	Links the printer with the PC central unit.
Process station	Serves for process control. Consists of a central unit and a maximum of four I/O units or of a FieldController and a maximum of five I/O units .
Process station bus	→ DigiNet P
Protective earth	→ Safety grounding

- R -

Rack	Framework for the process station modules; used for the central unit and the I/O unit(s).
Rack ID	Identification code of the rack. Setable with the coding switch at the link module back. → Coding switch
RAM	**R**andom **A**ccess **M**emory Read/write working memory of the CPU module or PC central unit. The CPU module RAM is battery-buffered. →CMOS RAM
Rated voltage value	Voltage for which the voltage separation of the module was calculated and specified. In the final quality control of manufacturing (routine check test) the modules are submitted for a short time to a much higher test voltage to assure their insulating property. → Test voltage
Ready-made I/O cables	Cables DSU 431, DSU 432 and DSU 441, DSU 442 with I/O connector mounted to one side and wire end sleeves or open end at the other side. Length as requested. Cables DSU 431 and DSU 432 have a cross-sectional area of 0.14 mm². Cables DSU 441 and DSU 442 have a cross-sectional area of 0.5 mm². Also referred to as open end cable.
Reed relay	Sophisticated relay type. The contacts are gas-tight melted into a glass cylinder.
Redundancy	To improve Freelance 2000 availability, the power supply and CPU can be provided as redundant units, i.e. twice. If one of them should fail, the redundant unit, which up to that moment was passive, takes over the function and thus prevents a total system failure. The defective component can be replaced without the process being stopped. → Redundant power supply → Secondary
Redundant power supply	Two power supplies DPW can be used together with link module DLM 02 in redundant mode. This improves system availability and at the same time enables replacement of defective components in case of failure without requiring that the process is stopped.

Repeater	Couples two Ethernet segments. The number of possible repeaters on an Ethernet is limited.
Reset switch	Push-button switch at the CPU module. Resets the module, i.e. initiates a cold start when pressed for more than 5 seconds. Mounted recessed. Can only be pressed with a "tool" (e.g. ball-point pen, paper clip, etc.).
Resistance teletransmitter	Potentiometer. Mainly used for valves and vanes for determining the valve position. In most cases resistance teletransmitters with a resistance of 100 Ω, 200 Ω, 500 Ω and 1000 Ω are used.
RFI	**R**adio **F**requency **I**nterference
RFI suppression	Measures taken to limit/suppress radio frequency interference from the Freelance 2000 system which might impair radio services or other units.
ROM	**R**ead **O**nly **M**emory Data is already stored in a ROM during chip manufacturing. ROMs are neither erasable nor re-programmable. They are used for applications requiring lots of pre-programmed memory chips. → EPROM, EEPROM.
ROM BIOS	**R**ead **O**nly **M**emory **B**asic **I**nput **O**utput **S**ystem Basic software of a PC containing the basic input/output routines as well as other basic functions. Stored in a mask-programmed ROM on the CPU board of the PC central unit.
Routine check test	Test for checking the voltage separation of the modules during the final quality control of manufacturing. In this test the insulating property is checked with a high-voltage tester. In the type acceptance test the individual modules are additionally submitted to higher voltages.
RS232C interface	Serial interface of the CPU module, reserved for diagnosis. → Diagnostic interface
RS422 interface	Serial interface of the communication module according to EIA standard RS422. Two wire pairs are used for RS422 transmission - one for transmit and one for receive data. RS422 transmission is often considered as equivalent to full-duplex RS485 transmission. However, the number of bus nodes is different.
RS485 interface	Serial interface of the CPU module, in accordance with EIA standard RS485. Used as half-duplex link with one wire pair. Called DigiLink in the Freelance 2000 system. Currently, the Modbus protocol is implemented on this interface.
RS485 cable	Network cable linking subsystems with the process station.→ DigiLink

RTD Pt100	Platinum resistor with a resistance of 100 Ω at 0 °C. RTD Pt100s are used for temperature measurement. As the resistance is temperature-dependent, the temperature can be determined by measuring the resistance. RTD Pt100s are available as 2-wire, 3-wire or 4-wire devices. A 2-wire Pt100 is connected via two wires. In this case the resistance of the wires cannot be compensated and the wire resistance has to be measured. This method is hardly used anymore. 3-wire and 4-wire devices are connected via 3 or 4 wires, respectively. In this case the resistance of the connection wire can be determined and compensated. As the resistance of the Pt100 has a non-linear dependence of the temperature, a correction is necessary when deriving the temperature from the resistance.
Run/Stop LED	Bicolor (red/green) LED. Indicates if functional sequence processing is running or stopped. Alternately lights up red and green for about 1 second after CPU module reset. Remains always dark at redundant CPU and temporarily (until functional sequence processing is started again) at primary CPU until functional sequence processing is started again. → Run/Stop switch
Run/Stop switch	Stops functional sequence processing when set to the **Stop** position. Communication with the operator or engineering station via Ethernet is still possible. Processing stop is indicated by the Run/Stop LED. The process station can also be stopped from the engineering station, independent of the Run/Stop switch. If, however, the switch is in Stop position, the process station cannot be started from the engineering station for safety reasons. Note that in the redundant system the switch positions on the primary and redundant CPU must be identical. Otherwise, a system alarm will be triggered after around 15 seconds.

- S -

Safety grounding (protective earth)	Grounding to avoid hazardous voltages, according to the German VDE standards. Additionally, functional grounding is required to drain high-frequency interference. The terminal for safety grounding (protective earth) is marked with the symbol ⏚ according to 417-IEC-5019-a.
Secondary	Term from redundancy terminology designating the passive CPU available in addition to the Primary, ready to take over process control if required
Slot	The rack has ten slots where the modules are plugged in. → Slot number
Slot number	Identifies the slot in the rack. The slots are numbered consecutively from the left to the right: A, 0, 1, 2 ... 8.
Socket 24 V DC supply	Connector socket for connecting the 24 V supply of the link module. Can be ordered under the code designation DSU 60.

Splice box	For long fiber optic links first a cable without connectors is laid, for mechanical reasons. Pig-tails are spliced to this cable in a second operation. Pig-tails are short fiber optic cables of around 10 m with a connector at one end. The splicing points have to be protected by a case, the so-called splice box. Splice boxes are available for wall mounting and ceiling suspension, and in 19“ size. → Splicing, → pig-tail
Splicing	Action of welding two fiber optic cables together. For long fiber optic cable links ready-made short cables with a connector at one end are spliced to a long middle piece. This method is easier than mounting the connectors on site.
Star coupler	→ network concentrator
Station number	Adjusted in DigiTool. Identifies the station in the system.
Symphony	Operation system from ABB. Using a Symphony operation system enables you to operate several Freelance 2000 systems on the next lower level. In this case there is no longer a limitation to max. five process stations and four operator stations.
System bus	→ DigiNet S

- T -

TCP/IP	Transmission protocol for Ethernet system bus. In accordance with layers 2 to 4 of the ISO/OSI seven-layer model.
TDR	→ Time Domain Reflectometer
Temperature measurement	The module DAI 04 offers the possibility of temperature measurement via RTD Pt100s or thermocouples. Additionally, mV values can be measured directly. Resistance teletransmitters can also be connected.
Terminal	Display terminal with serial RS232C interface. Usable for diagnosis as an alternative to a PC with terminal emulation. Control sequences in accordance with ANSI standard, therefore often called "ANSI terminal".
Terminal emulation	Runs on a PC. The terminal emulation used for Freelance 2000 is included in the scope of delivery of MS Windows. → Terminal.
Test voltage	Voltage applied to a module during the type acceptance test or the final quality control of manufacturing to check the insulating capability of the module. The test voltage is a multiple of the rated voltage value. → Rated voltage value
Thermocouple	Used for temperature measurement. A thermocouple consists of two wires of different material, welded together at one point. When the welding point is heated, a voltage is available at the wire ends, the so-called thermovoltage. The thermovoltage depends upon the temperature difference between the welding point and the wire ends. Therefore, the temperature of the connection terminals must be known for determining the temperature of the welding point from the thermovoltage.
Three-wire	→ 2-wire, 3-wire, 4-wire, RTD Pt100

Time Domain Reflectometer (TDR)	Instrument for measuring cables. The TDR transmits a short electrical impulse into the cable and then records the time sequence of the reflected signals on a screen. If the cable is all right, there is only a reflection at the open cable end. Cable kinks, cable breaks, and T-connectors with improper characteristic impedance cause further reflections, which can be seen on the measuring record. The cable length can also be determined by means of the impulse propagation time. Therefore, the TDR is also suitable for detecting short circuits and cable breaks. An optical time domain reflectometer (OTDR) is used for fiber optic cables. The OTDR works with light pulses instead of electrical pulses. Apart from this it has the same functionality as the TDR.
Transceiver (10Base2)	Transceiver for connection to a 10Base2 network cable. Used, for example, for a PC which has only an AUI connector but is to be connected to a 10Base2 segment.
Transceiver (AUI)	AUI is an abbreviation of **A**ttachment **U**nit **I**nterface. When using a 10Base5 network cable (Yellow-Cable), a 10Base5/AUI network transceiver and an AUI network cable are needed for connecting the node to the network cable. The 10Base2 network transceiver can also be used for connecting a node via the AUI interface to a 10Base2 network cable.
Transceiver (optical)	→ 10BaseFL transceiver
Two-wire	2-wire, 3-wire, 4-wire

- V -

Voltage selector	Switch at power supply DPW 01 and DPW 03 with which the input voltage can be changed from 230 V AC to 115 V AC. Power supply DPW 02 with 24 V DC input has no voltage selector.

- Y -

Yellow Cable	Colloquial name for the Ethernet standard 10Base5 network cable. The name results from the network cable color. → 10Base5 network cable

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