SIEMENS

SIMATIC S5

Installation Guidelines for S5-130 K/W and S5-150 K/S

Instructions Order No. C79000-B8576-C252-03

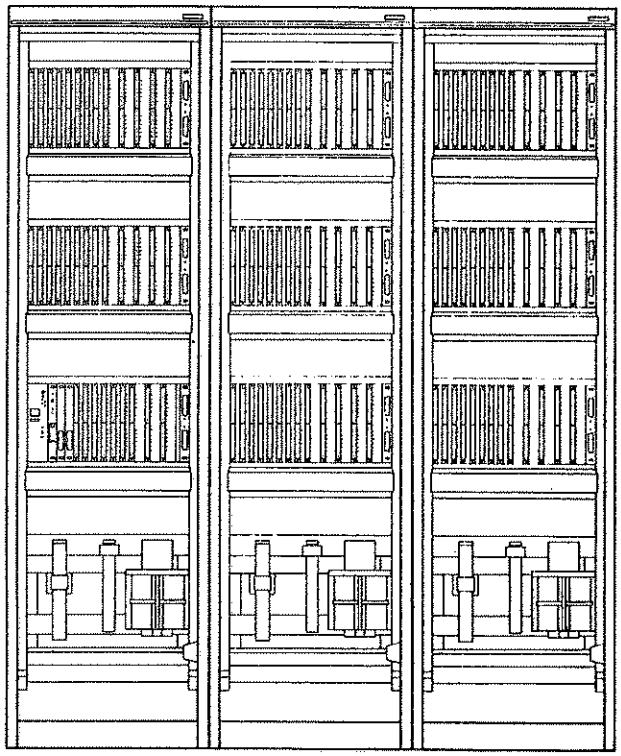

Fig. 1 SIMATIC® S5 in compact version

Contents

1 Power supply

A differentiation must be made between

- internal power supply
  for supply of the central controller and the extension units.

- load power supply
  for supply of the process peripherals (sensors, control devices).

1.1 Internal power supply

The power supply units (SV) built into the central controller and the extension units produce the internal DC supply of 5 V from the DC input voltage of 24 V.

When equipping the central controller or the extension units it must be ensured that the rated current of the respective built-in power supply unit is not exceeded. The current input to the individual modules on the 5-V side can be obtained from the respective catalogs (see Catalogs ST 53, ST 55, ST 58 under "Technical data").

Permissible input voltage:

Static 20 V DC to 30 V DC

Dynamic 35 V for 500 ms, 45 V for 10 ms[1)].

The E V3053 power supply unit (18 A) is fused in the unit on the input side with a 16-A fuse, fast blow. The 6ES5950 power supply (8a) is fused on the input side with a 4-A fuse, slow blow. Both power supply units are protected against incorrect polarity of the input voltage.

Note:

In the power supply units of the SIMATIC compact devices currently available, there is no electrical isolation between the 24-V side and the 5-V side whose reference potential is permanentaly connected to the casing of the compact devices. The casings of the devices must be connected to earth for noise immunity (see Section 4.3).

This means that particular measures must be taken when operating with unearthed or centrally-earthed batteries (see Section 1.3) and with unearthed process peripherals (see Section 4.8).

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1) If there is a common supply for the load and the internal supply (see Section 1.2) it must be ensured that the supply to peripheral modules whose Ord. No. contain the letter E (e.g. 6ES5444-3AE21) must not exceed 30 V (dynamic).

1.2 Load power supply

For monitoring reasons it is preferable to use a common supply (power supply unit or battery) for the internal supply of the SIMATIC compact devices and for the supply of the process peripherals.

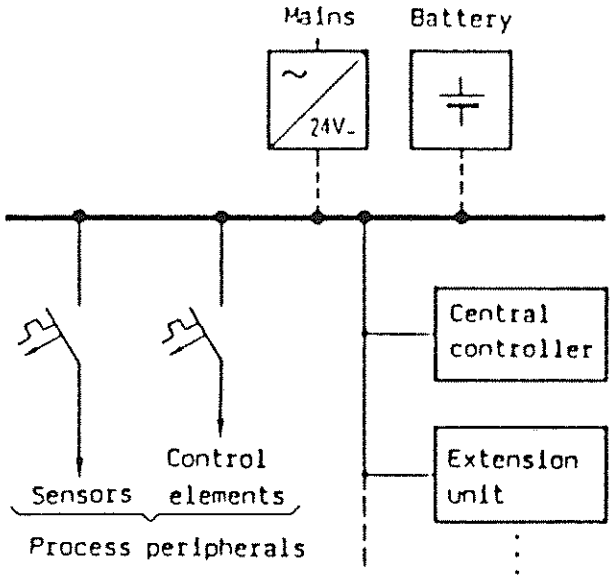


Fig. 2 Power supply strategy for process devices

If a separate power supply is used for the process peripherals, it must be ensured that its output voltage is not detected by the monitoring circuit of the compact modules. Suitable external monitoring systems must be provided to monitor the load voltage in this case (see Section 5.2).

Siemens power supply units from the 6EV13 series are recommended, e.g.

6EV1352 (20 A output current) and
6EV1362 (40 A output current).

Catalog ET1 provides more information.

When power supply units are only under partial load (e.g. during commissioning), it must be ensured that their output voltage does not exceed 30 V (see Section 1.1, footnote). This limit is never exceeded when using the power supply units recommended above and at the rated input voltage.

1.3 Power supply from an unearthed or a centrally-earthed battery

The internal voltage of the SIMATIC compact devices is earthed (see Section 1.1) which means that potential isolation must be provided if the power supply is an unearthed or centrally-earthed battery in order to prevent earthing or additional earthing of the battery by the SIMATIC modules. Figs. 3 to 5 show the measures possible.

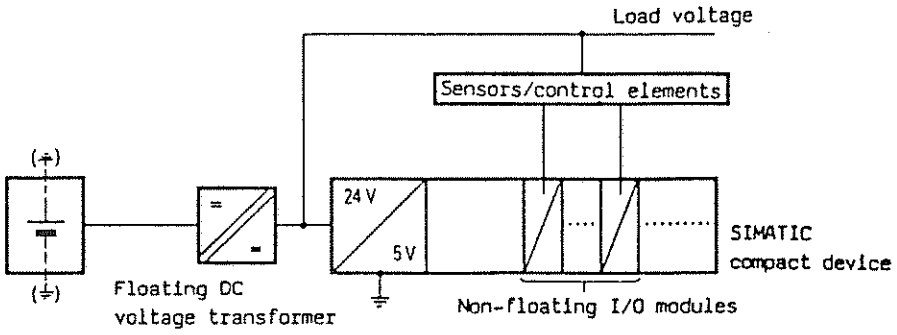


Fig. 3 Programmable controller and process peripheral electrically isolated from battery, process peripheral earthed

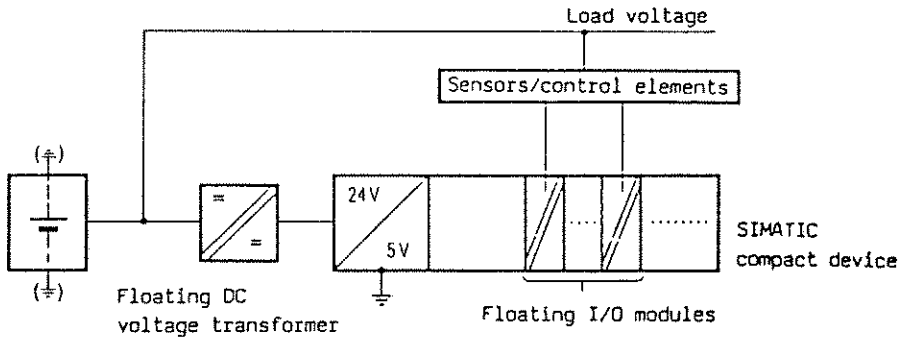


Fig. 4 Programmable controller electrically isolated from battery; process peripheral not earthed if battery not earthed

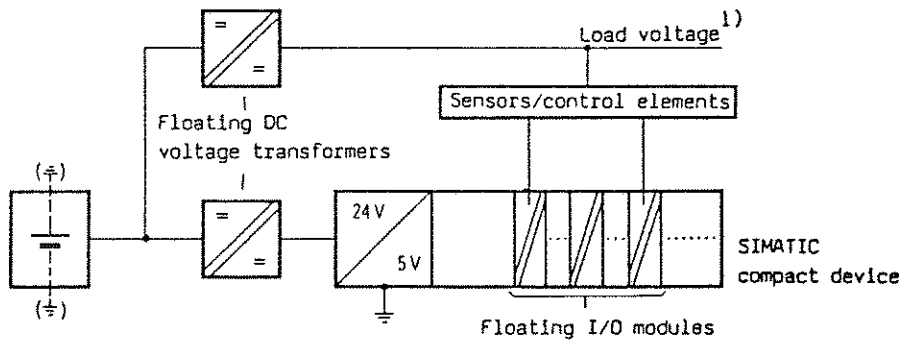
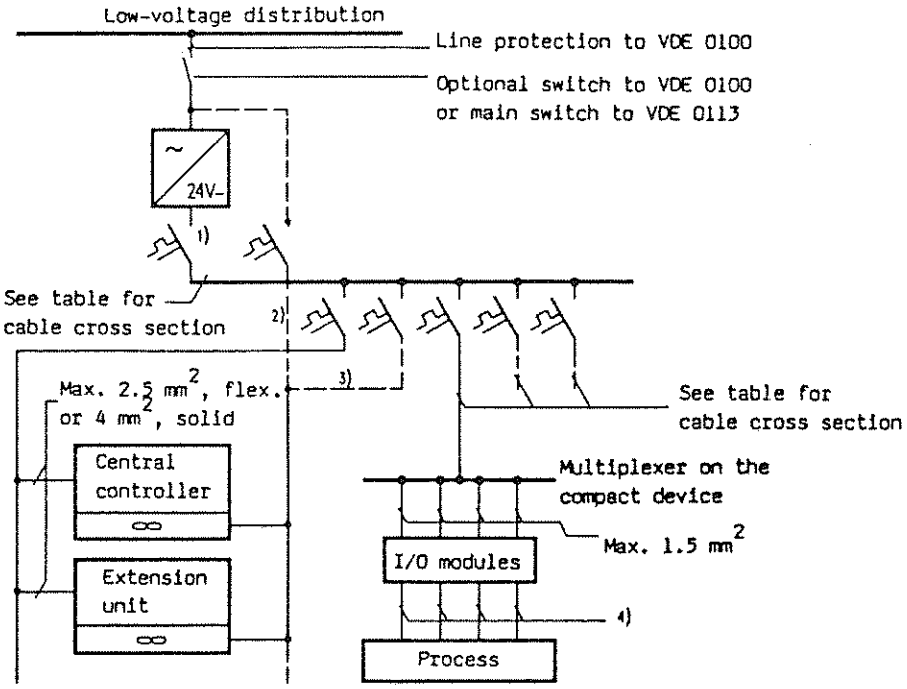


Fig. 5 Programmable controller and process peripheral electrically isolated from battery; process peripheral unearthed even with earthed battery

1) Monitoring for load voltage failure is necessary.

1.4 Wiring



1) Can be omitted if a protective cut-out is present in the power supply unit.
2) With 220-V fans (current input: 0.3 A per device)
3) With 24-V (current input: 0.7 A per device)
4) The output signal lines are protected against short-circuit by the fuses on the output modules if the voltage drop is $\leq$ 5 %. Additional fusing of the input signal lines is necessary however.

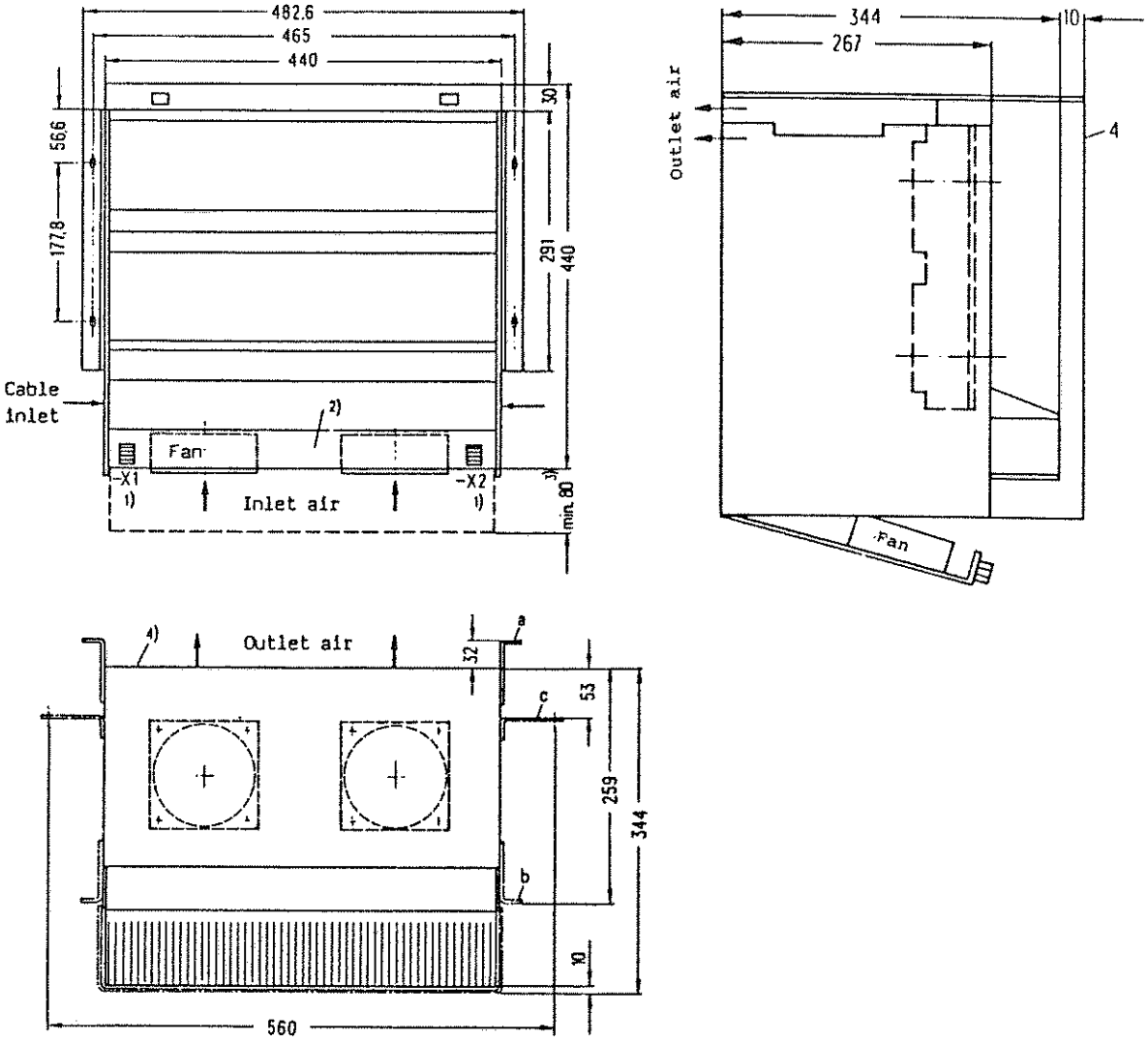
Fig. 6 Wiring

Rated current of the protective unit (A)	< 2	2...6	6...10	10...16	16...25[1)]	25...40[1)]
Cable length (m)	Cable cross section (mm^2)					
< 1	1	1.5	2.5	4	6	10
1...2.5	1.5	2.5	4	6	10	16

Table 1 Cable cross sections

1) When using cut-outs of this magnitude, the cable from the multiplexer to the module is to be laid protected from short-circuits and earth faults.

2 Cabinet design



1) Terminals X1/X2
2) Space for up to 3 multiplexers
3) Free space to permit replacement of fans
4) The cover may be omitted when installing in cabinets of protection class ≥ IP2...

Types of bracket mounting

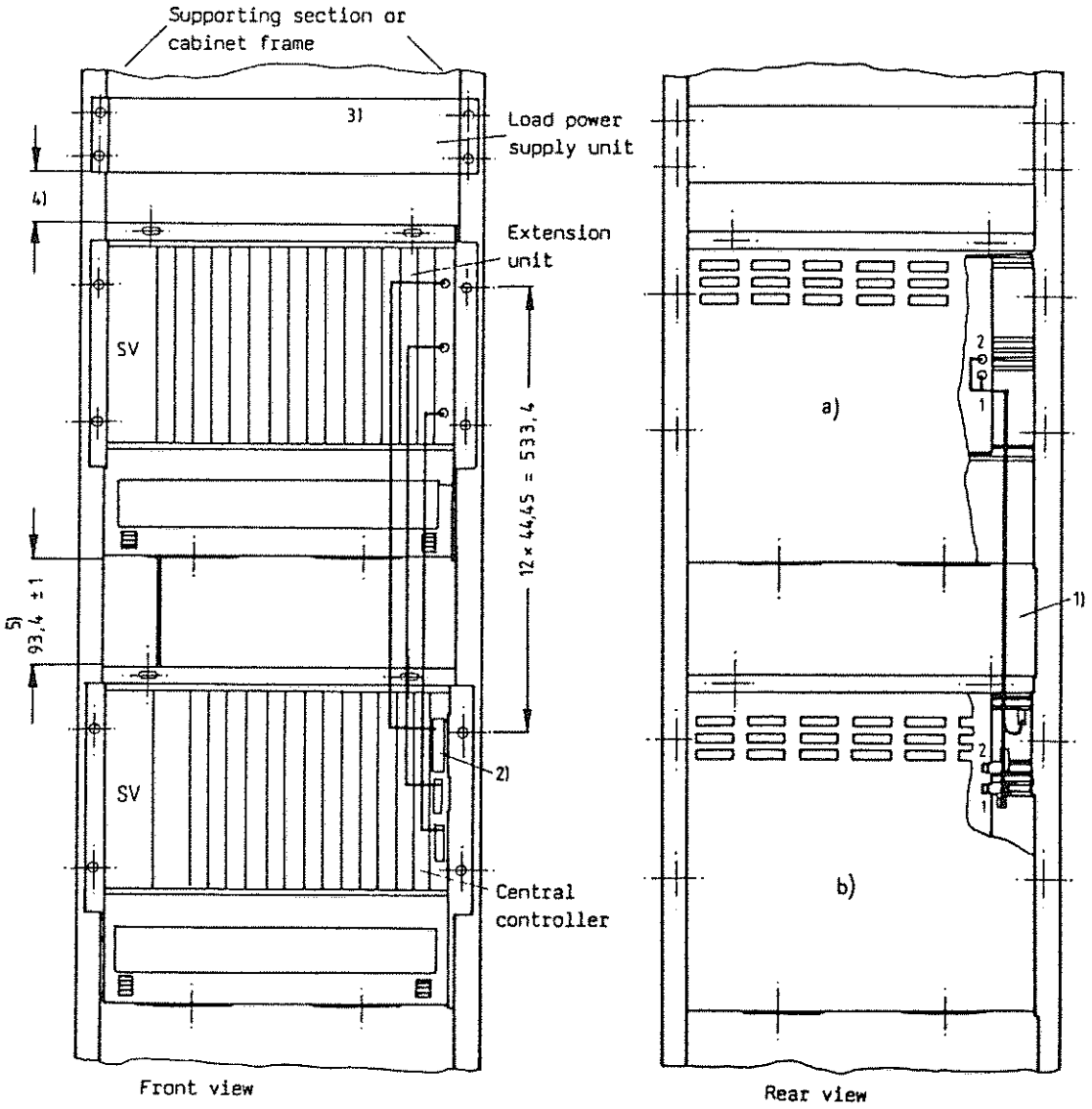
a) For individual unit (wall mounting)
b) In conjunction with further units or singly in 19-inch cabinet
c) For 8MF cabinet, e.g. with additional supporting member.

Connection of the screen can be made via the cable clips at A and B.

Mount units onto highly conductive, earthed units (frame or simular) using M6 screws and earthing washers (DIN 6797).

Provide correct clearance from wall.

Fig. 7 Dimensions of casing (programmable controllers AG 130/150 and extension units 182)



1) Cable only with S5-150 S
   a) Cable connection fitted in factory
   b) Cable connection during cabinet mounting
2) Cable and connector of the interface module
3) Special measures for heat dissipation (e.g. air baffles) are necessary if the load power supply units are arranged in the bottom of the cabinet.
4) Minimum clearance 44.45 mm
5) 100 mm when installed in 8MF cabinet
6) 520 mm when installed in 8MF cabinet

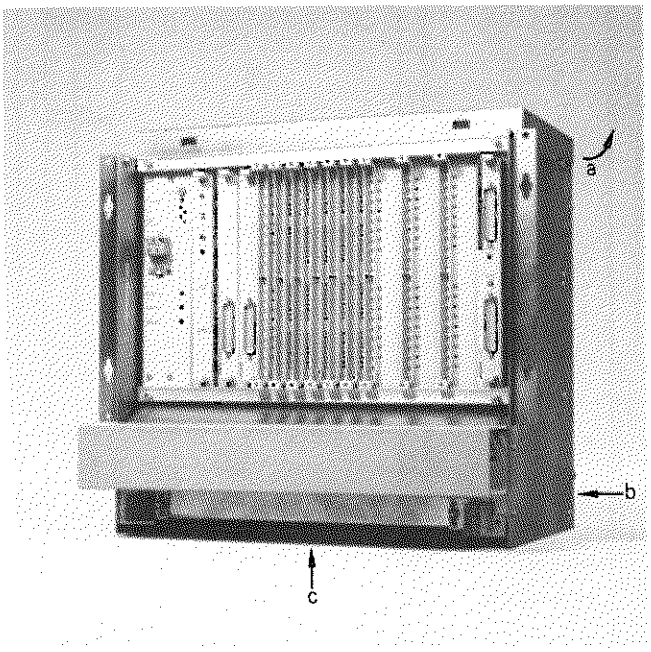
Fig. 8 Arrangement of devices in the cabinet

3 Cabinet cooling

3.1 Power dissipation, limit temperature

The maximum power dissipation of the fans must not be exceeded when equipping the compact devices.

The maximum power dissipation at air supply temperature of 55 °C is 250 W. This value is increased by 20 W for each 1 °C decrease in the air supply temperature.



a) Air outlet at the rear of the unit, top
b) Fan module
c) Air inlet, max. 55 °C

Fig. 9 Air inlet and outlet

The power dissipation of the modules used in the compact devices can be obtained from the following list.

Power supply units

6EV3053	Max. 45.0 W
6ES5950	Max. 19.0 W

S5-130 K/W

Central processing module	921-1	9.0 W
Central processing module	921-3 W	25.0 W
Timer module	392	1.7 W
Timer module	390	7.5 W
Display module	320	4.0 W
Test module	331	4.5 W
Control panel	391	2.5 W

S5-150 K

Central processing modules	150 K	30.0 W

S5-150 S

Central processing modules	150 S	63.5 W
Memory interface module	341	7.5 W
Parity module	342	7.5 W
Bus interfacing	775-3AA21	3.5 W
Bus interfacing	775-3AA11	3.5 W

S5-210 A/B

Bit processor	921	8.5 W
Byte processor	922	11.0 W
Testing panel	105	10.0 W
Control panel	231	2.5 W
Byte processor	103	9.0 W
Memory and parameter assignment module		7.5 W

Interface modules

EU interface module	300	3.0 W
EU interface module	301	4.0 W
EU interface module	302	10.0 W
EU/CC interface module	310	3.0 W
EU/CC interface module	311	7.5 W
CC interface module	312	1.5 W
PU interface module	511	8.5 W
Interface module	512 G	8.0 W
Interface module	512 E	6.5 W
Interface module	501	4.0 W

Memory modules

Memory module	340	6.0 W
Memory module	350	9.0 W

I/O modules, digital

Digital input module	420-3	Max. 7.0 W
Digital input module	430-3	Max. 7.0 W
Digital input module	431-3	Max. 4.0 W
Digital input module	432-3	Max. 5.0 W
Digital input module	433-3	Max. 7.0 W
Digital input/output module	481-3	Max. 9.0 W
Digital input/output module	482-3	Max. 14.0 W
Digital output module	442-3	Max. 8.0 W
Digital output module	443-3	Max. 14.0 W
Digital output module	444-3	Max. 30.0 W
Digital output module	445-3	Max. 24.0 W
Digital output module	450-3	Max. 16.0 W
Digital output module	451-3	Max. 18.0 W
Digital output module	453-3	Max. 16.0 W
Digital output module	457-3	Max. 14.0 W

I/O modules, analog

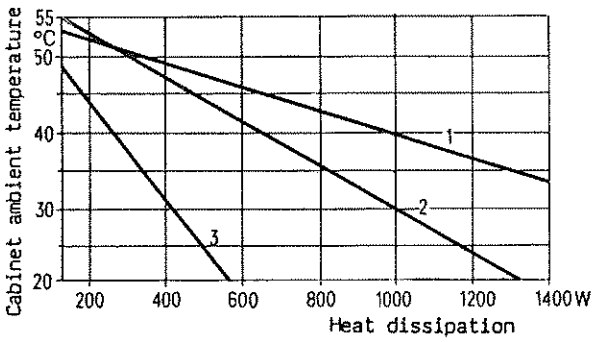
Analog input module	465-3	Max. 2.0 W
Analog output module	475-3	Max. 5.0 W
Analog output module	476-3	Max. 7.0 W

The maximum values apply to full loading of the modules.

3.2 Removal of power dissipation

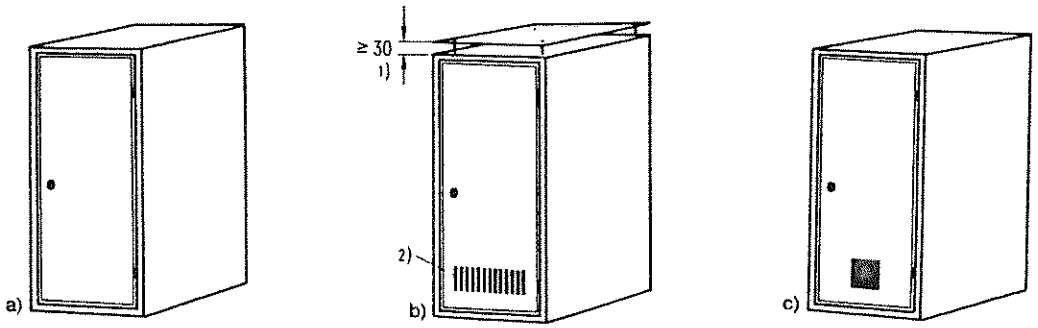
The power dissipation to be removed from a cabinet is dependent on the design of the cabinet, the ambient temperature and the arrangement of the devices in the cabinet.

The approximate values for the maximum permissible ambient temperature of a cabinet with dimensions 600 mm x 600 mm x 2000 mm dependent on the power dissipation from the installed modules can be obtained from Fig. 10. These values are only applicable if the arrangement of the devices in the cabinet corresponds to that specified in Figs. 12 to 14.



1 Closed cabinet with heat exchanger
2 Open cabinet
3 Closed cabinet with self-convection and forced circulation by device fans

Fig. 10 Maximum cabinet ambient temperature dependent on the power dissipation from the installed modules



a) Closed cabinet with self-convection and forced circulation by device fans
b) Open cabinet
c) Closed cabinet with heat exchanger if higher protection class is required

Fig. 11 Cabinet designs

Example:

1 central controller	200 W
2 extension units with power dissipation of 250 W each	500 W
1 load power supply, 24 V/40 A, 6EV1362 at full load	200 W
Total power dissipation	900 W

Cabinet design	Maximum cabinet ambient temperature
closed, with self-convection and forced circulation	not possible
open	approx. 33 °C
closed, with heat exchanger	approx. 42 °C

The arrangement of the devices in the three types of cabinet mentioned above is shown in Figs: 12 to 14.

1) Adhere to IP protection class.
2) Slots, ca. 600 cm^2

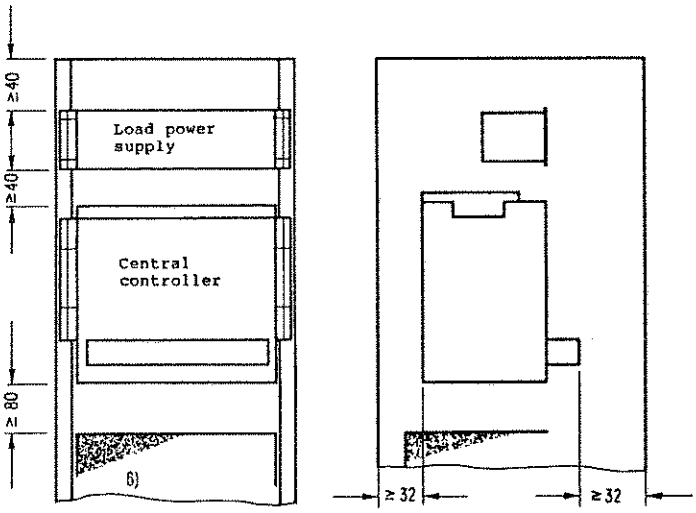


Fig. 12 Arrangement of devices in a closed cabinet with self-convection and forced circulation by device fans

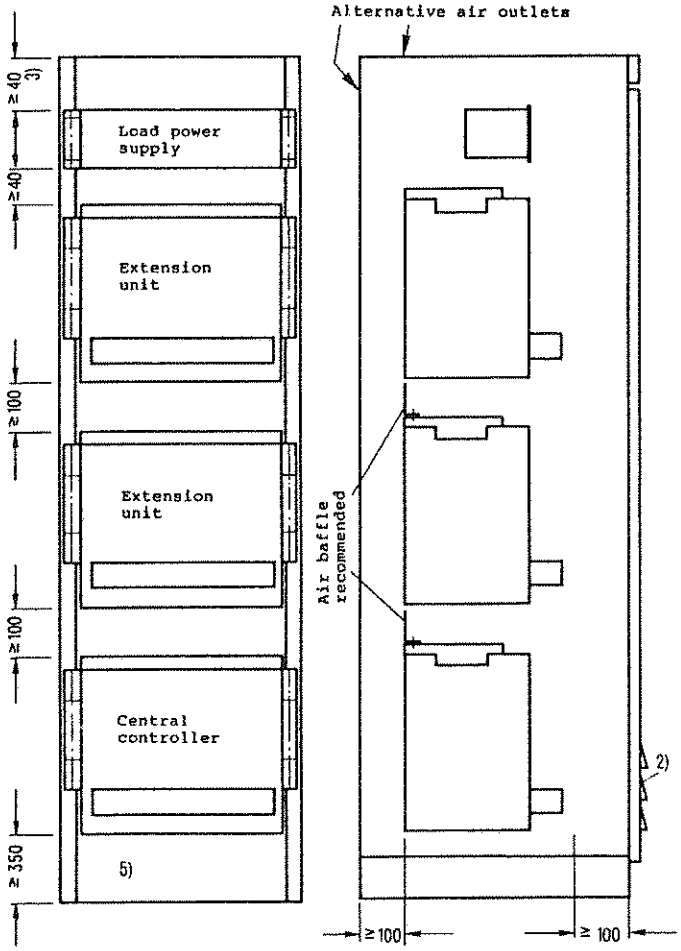


Fig. 13 Arrangement of devices in a cabinet with open-circuit cooling

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2) Slots, approx. 600 cm^2
3) 20 mm with perforated roof panel
5) Space required for cables, fans, mains distributor, FU filter, screen bars
6) Space required for mains distributor and other equipment, e.g. terminals

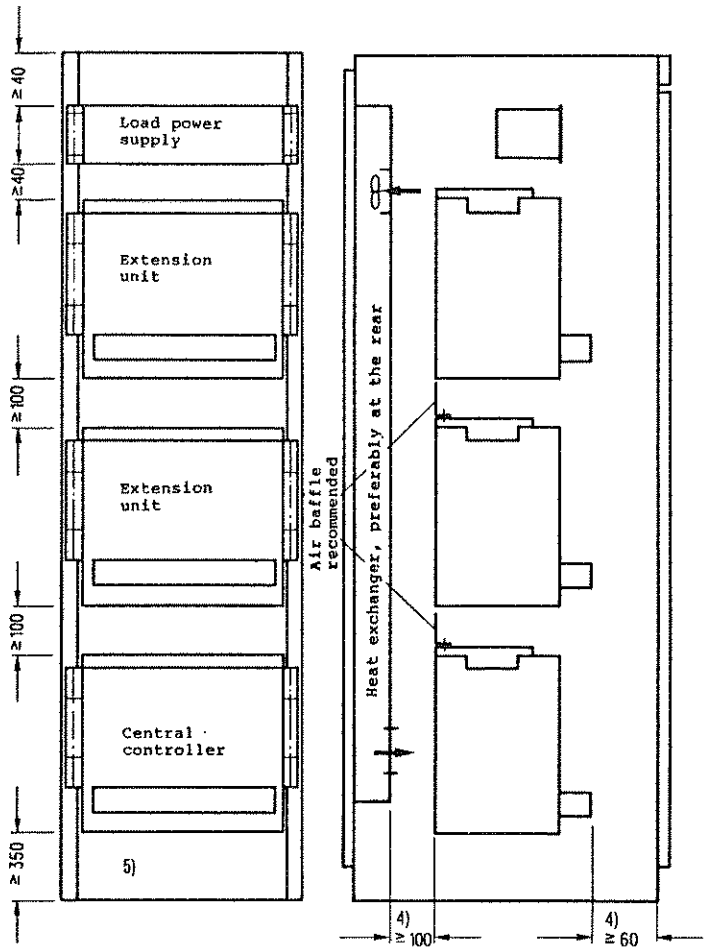

Fig. 14 Arrangement of devices in a cabinet with heat exchanger

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4) The clearances of 100 mm and 60 mm apply in an analogeous manner if the heat exchanger is fitted at the front.

5) Space required for cables, fans, mains distributor, FU filter, screen bars

3.3 Fan/temperature monitoring

The compact devices are provided with fan subassemblies to prevent heat accumulation. Monitoring of the fan subassemblies can be evaluated as follows by inserting corresponding jumpers across the connection terminals of the subassembly (see Fig. 15).

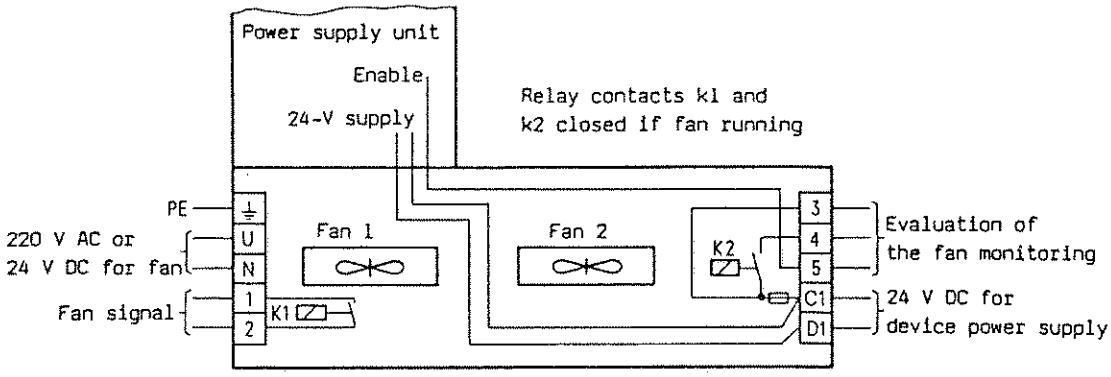

Fig. 15 Location of the terminals on the front panel of the fan subassembly

- Jumper 4-5 inserted (state upon delivery):

  The enable of the programmable controller is reset if a fan fails and the internal power supply of the associated compact device then switched off. A floating signal compact[1)] is available at terminals 1 and 2. This contact is closed if the fan is running.

- Jumper 3-5 inserted:

  The associated power supply is **not** directly influenced if a fan fails. The programmable controller can be shut down as required by the customer via the signal contact 1-2. It must be observed, however, that the shut-down period **must not exceed 3 min** in order to prevent a dangerously high temperature in the devices.

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1) Contact loading capacity: 220 V/3.5 A; 250 V DC/50 W (inductive load)
30 V DC/100 W (resistive load)

- Monitoring of several modules

  Several devices in one cabinet can be monitored as shown in Fig. 16.
  None of the above-mentioned jumpers is inserted in this case. Cancellation of the enable is made via the time relay K1 with a delayed drop-out. A heat exchanger, if fitted, should be incorporated in the monitoring circuit.

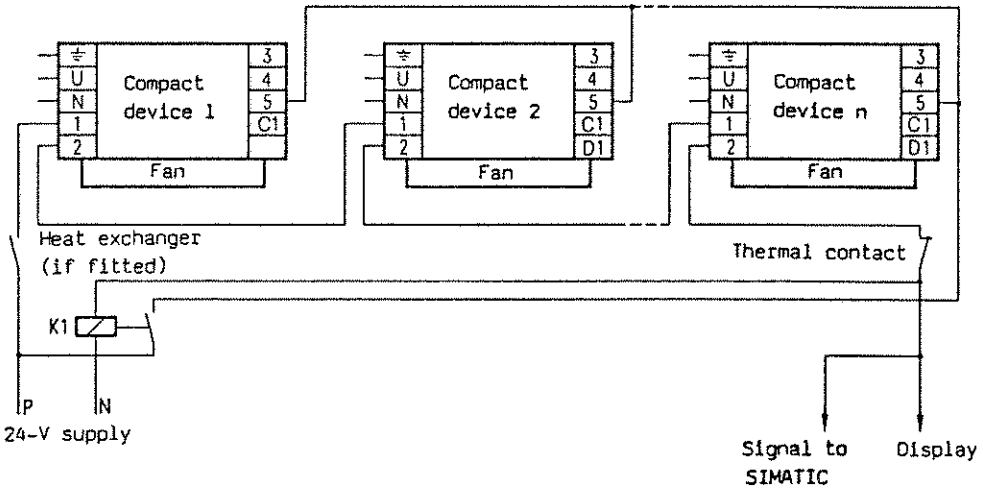

Fig. 16 Recommended circuit for fan/temperature monitoring

Additional protection against overheating of the compact devices can be made using a thermal contact as shown in Fig. 16. This thermal contact should be fitted in the exhaust current from the uppermost device in the cabinet and should be set to 70 °C.

4 Cabinet wiring

4.1 Types of connection

- Power supply connections

  The terminals of the compact devices are suitable for
  - max. 4 mm^2 solid conductors or
  - max. 2.5 mm^2 stranded conductors with core sleeves at the end.

- Peripherals

  Up to 3 P/M multiplexers can be mounted on the fan tier of a compact device for distribution of the 24-V supply to the peripherals (see Section 2).

  The following are suitable for connection to the peripheral modules:

- Front plug 6XX3068 with spring contacts 6XX3070 (see catalog) with connection cross sections from 0.5 mm^2 to 1.5 mm^2 (stranded conductors).

- Flat receptacles
  2.8-1 DIN 46 247 (single conductor) or
  B2.8-1 DIN 46 245 (front plug)
  with connection cross sections up to 1 mm^2 (stranded conductors).

- Receptacles, e.g.
  C74334-Z708-L20 (single contact) or
  C74334-Z708-L19 (ribbon)
  with cross sections fromn 0.2 mm^2 to 0.6 mm^2 (stranded conductors).

  Adapters or marshalling distributors must be provided when using solid conductors.

4.2 Cable paths

A differentiation must be made between the following types of cables because of noise immunity:

- 220 V AC cables for programmable controllers, extension units and load power supplies,

- digital signal cables for AC voltage,

- digital signal cables for DC voltage,

- analog signal cables.

- Cable paths within the cabinets

  220-V supply cables should not be housed in a common cable duct with signal cables. If 220-V supply cable must be housed in a common cable duct with signal cables because of particular reasons, the 220-V supply cables have to be screened.

  Signal cables (low voltages) and power cables may not be housed in a common duct (VDE 100, § 42a). A cable duct, separated from the AC voltage cables, is to be provided in the cabinet for the digital signal cables with DC voltage and for the analog signal cables.

  Analog signal cables must be screened if they are to be housed in a common duct with digital signal cables.
  The screen must only be earthed at the cabinet exit (see section 4.10).

- Cable paths outside the cabinet

  Digital signal cables and analog signal cables must be separated from one another. The analog signal cables must always be screened. Signal cables can be housed in common ducts with power cables.

  Signal cables and power cables up to 380 V do not need any min. distance between each other.

  To increase noise suppression, it is advisable to install the cables with an interspace of approx. 10 cm.

  Keep a distance of 10 cm between signal cables and power cables > 500 V.

  Screening by means of separating metal sheets is advisable for the sections of cabinet in which inductive resistors (especially transformers and contactors) are installed.

4.3 Chassis earth

This is to be understood as the conductive connection of inactive metal parts (VDE 0160). The compact device frames must be correspondingly mounted on the supporting members with a good conductive contact using toothed contact washers. The corresponding members must also be connected to the cabinet housing in a conductive manner.

In the event of wall mounting of the devices, the housing must be connected to the earth potential (e.g. protective earth bar) using a cable with cross section $\geq 10\ mm^2$.

4.4 Protective earth

The cabinet must be connected with a protective earth cable $\geq 10\ mm^2$ to the building earth and/or the protective earth bar of the circuit from which the 220 V fan is supplied. The protective earth cable of the fan and/or the load power supply inlet must be connected to the protective earth terminal of these devices.

Several cabinets located next to each other can be screwed together to provide a good conducting contact or a protective earth cable $\geq 10\ mm^2$ can be connected to each cabinet. The measures mentioned above also ensure that the cabinet and other equipment installed cannot produce dangerous currents upon accidental contact.

4.5 Potential equalization

A differentiation must be made between the following cases in a distributed system:

- Spacially separated (up to 200 m) central controllers and expansion units with coupling via interface modules 301/310 (Fig. 17a).
  The interface modules 301/310 are not floating. An additional exchange of signals can take place via input and output modules in a non-floating manner.

- Spaciallay separated (up to 1000 m) central controllers and extension units with serial coupling via interface modules 302/311 (Fig. 17a).
  The interface modules 302/311 are floating. Floating input and output modules must be used for an additional exchange of signals. Electrical isolation on one side is sufficient.

- Exchange of signals between separate systems via input and output modules (Fig. 17b).

  Floating input and output modules must be used for the exchange of signals.

A potential equalization cable $\geq 10\ mm^2$ must be provided in all three cases (see VDE 0100, Part 547 - Main potential equalization cable).

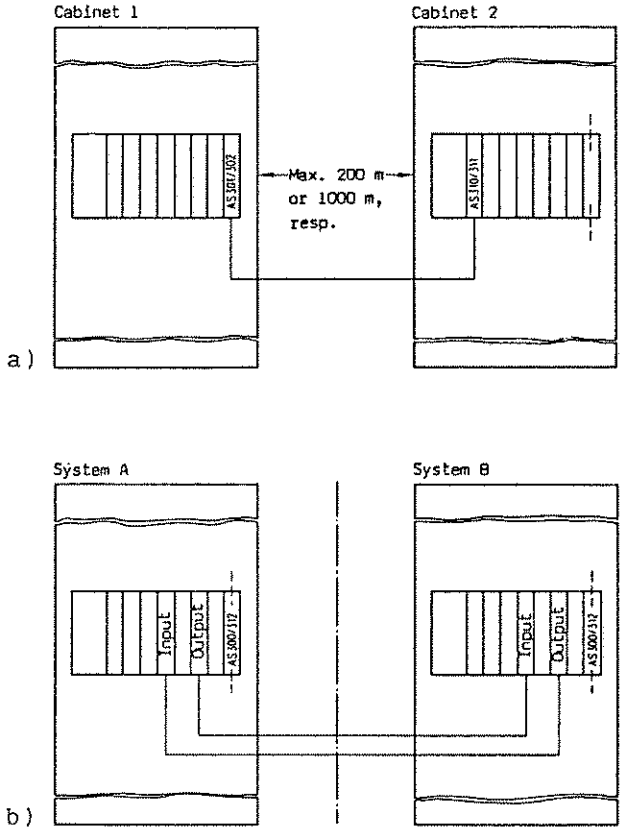

Fig. 17 Signal equalization via input and output modules

4.6 Earthing of the power supply

If central controllers, extension units and peripheral units are fed from a common load power supply (see Section 1.2), the L-line must be connected to the cabinet housing directly next to the load power supply. This connection must be as short possible ($\leq$ 15 cm) and should be copper cable of at least 6 mm^2.

If the central controllers and extension units are supplied separately from the peripheral units, the 24-V supply for the central controllers and extension units in cabinets is to be earthed as described above. The power supply to the peripheral units is handled as follows in this case:

- When using non-floating peripheral modules, earthing of the power supply can be carried out as described above.

- When using floating modules, earthed or non earthed power supplies are possible.

Note: Monitoring of the insulation is necessary with non-earthed power supplies for controllers to VDE 0113 and VDE 0100, § 60.

4.7 L- connections of the peripheral modules

All L- pins of the peripheral modules must be connected to L-. Pin 43, however, must not be connected to L-. A screen may need to be connected to this pin (see also Section 4.10). An interruption in the L- line can lead to faulty functioning of floating peripheral modules.

4.8 Floating operation of the process peripherals

Earthing of the internal reference potential of the SIMATIC compact devices (see Section 1.1) means that measures have to be taken for electrical isolation if the process peripherals are to be operated non-earthed.

The measures possible are shown in Fig. 18.

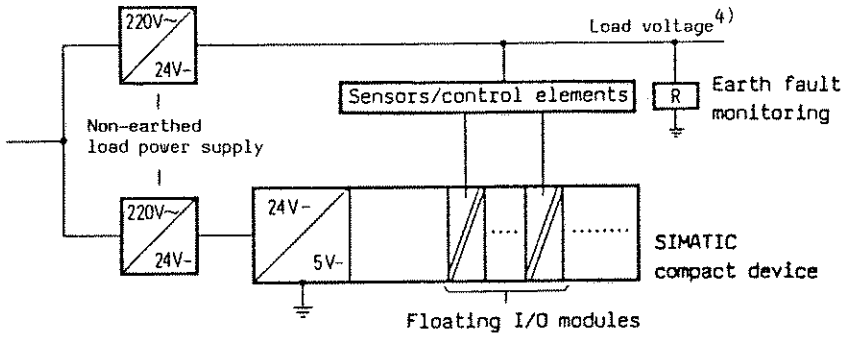

Fig. 18 Floating peripheral units by using a separate non-earthed power supply for them and floating I/O modules

4.9 Measures against noise voltages

Overvoltages must not occur on the 24 V power supply cables and the signal cables in the cabinet. The following measures must therefore be taken.

- Inductors fitted in the same cabinet must be fitted with quenching units (e.g. RC elements) if they are not directly controlled by SIMATIC outputs (e.g. contactor and relay coils).

- Screening by means of separation metal sheets is advisable for the cabinet section in which inductive resistors (especially transformers and contactors) are installed.

- Fluorescent lamps should not be used for the cabinet illumination for interference reasons. We recommend the use of LINESTRA lamps in this case.

  The measures shown in Fig. 19 must be taken if fluorescent lamps are indispensible.

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4) Monitoring for load voltage failure is necessary.

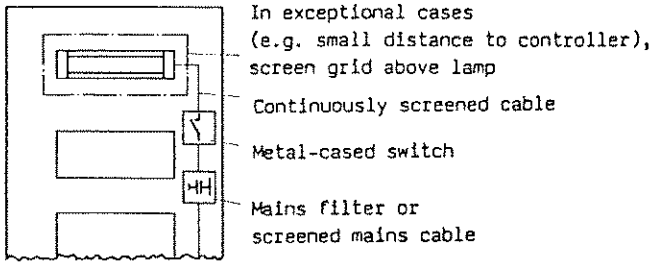


Fig. 19 Measures to eliminate noise from fluorescent lamps installed in the cabinet

4.10 Screening, permissible lengths

Analog signal cables must always be screened outside the cabinet. Digital signal cables can be left unscreened up to a certain distance (see Table 2). Data on permissible cable lengths can be obtained from Tables 2 and 3.

Digital modules

Module	unscreened	screened
Output modules	400 m	1000 m
Input modules 24 V	600 m	1000 m
Input modules 220 V	600 m	1000 m
431 input modules, 24 to 60 V	400 m	1000 m
434 input modules, 5 to 15 V	200 m (600 m)[1)]	600 m (1000 m)[1)]

Table 2 Permissible cable lengths for digital signal cables when laid in a common cable

Analog modules

Module	Cable length	Permissible potential difference
460; 465 with U_E = 50 mV	50 m	1.0 V
U_E = 500 mV	200 m	1.0 V
470; 475	200 m	0.8 V
476	200 m	5.0 V

Table 3 Permissible cable lengths for analog signal cables when laid in a common screened cable

1) Only when NAMUR output devices are connected.

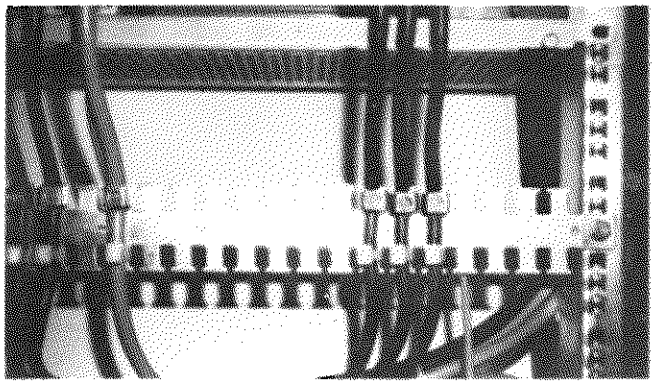


Fig. 20 Screening

- The following applies to connection of the screen:

  The cable screen is earthed in the cabinet near the cable inlet on a screen rail. Braided screening should be connected to the screen rail with a large-area contact (e.g. using metal hose clamps surrounding the screen or PUK cable clamps).

  In the case of cables with a foil screen , the supplementary screen wire must be connected to the screen rail in the shortest possible manner (approx. 3 cm). The foil screen is to be earthed with area contact. The screen rail must be connected to the cabinet housing in a well conducting manner; it must be connected to the support bar as well as to the central earthing point in the cabinet.

- One-end earthing of the cable screens:

  The cable screen of analog signal cables with small signals (mV or uA) is earthed at one end in the cabinet. It may be necessary to continue the screen up to the module. In this case, the screen is not connected again to the module.

  The screen of digital signal cables terminate on the screen rail. One-end earthing of the cable screen is only usefull if no low impedance potential balancing line can be connected to the other cable end or if only low-frequency or static noise interference is to be expected.

- Both-ends earthing of the cable screens

  For a both-ends earthing of cable screens of digital signal cables, which assures a very good attenuation of high frequency interferences, a low impedance potential balancing line is necessary. The resistance must be $\leq$ 1/10 of the screen braiding resistance.

  In the case of system signal cables which partially or exclusively transmit the internal bus (e.g. extension unit interface modules), the screen must be connected to earth at both ends. These connections must not be opened.

The screen terminals on the modules should only be used in exceptional cases (e.g. if only one single screened cable is provided and the screen rail is therefore dispensed with).

4.11 Lightening protection measures

Screened cables must always be used for S5 module lines laid outside buildings. The screen must be capable of carrying currents and must be earthed at both ends.

Doubly screened cables must be used in this case for analog signal lines; the inner screen, as described in section 4.10, must be connected to earth at one end only.

Furthermore, the signal cables must be fitted with protecting elements against overvoltages (varistors SI OV and surge absorbers ÜsAg filled with rare gas). Those should be fitted at the cable inlet to the building if possible or, at the latest, on the cabinet (Fig. 21).

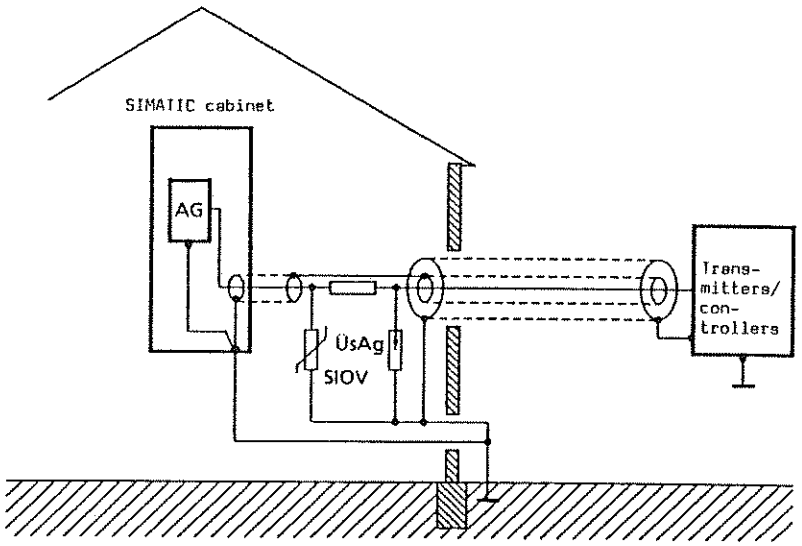


Fig. 21 Lightening protection measures

4.12 Mains connection for programming units

An earthed socket must be provided in each group of cabinets for the supply to programming units. The sockets should be supplied from the circuit to which the protective earth for the cabinet is connected.

5 Protection and monitoring

5.1 Measures to prevent danger

The relevant VDE regulations (e.g. VDE 0113, VDE 0100) must be obserbed when planning programmable controllers and contactor controllers. The following applies in particular:

- Dangers must be prevented through which persons could be endangered or machines and material damaged.

- Machines must not start up again automatically upon return of a previously failed power supply or after activation of the EMERGENCY OFF equipment.

- Commands from EMERGENCY OFF equipment and from safety limit keys must always remain effective upon faults in the programmable controller.
  These protective units must therefore act directly on the control units in the power section.

- A non-hazardous condition for persons and plant must be achieved when the EMERGENCY OFF equipment is activated, e.g.

  - Control elements or drives through which dangerous conditions could occur (e.g. main spindle drives of machine tools) must be switched off.

  - On the other hand, control elements or drives whose switching off could endanger persons or plant (e..g. clamping devices) must **not** be switched off by the EMERGENCY OFF equipment.

Operation of the EMERGENCY OFF equipment must be detected by the programmable controller and evaluated by the user program.

5.2 Monitoring and signalling

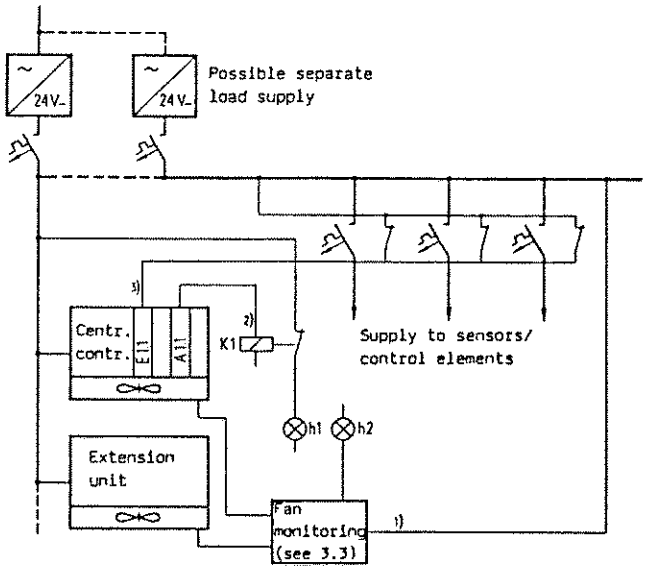
The following faults are detected by the monitoring circuit as recommended in Fig. 22.

- Fan failure

- Load voltage failure (only applies when using a separate load power supply)

- Stop status of the programmable controller

- Blown fuse in the load current circuits.



Signal lamp h1: stop status/load voltage failure
Signal lamp h2: fan fault/heat exchanger fault

Fig. 22 Circuit for monitoring and signalling

1) Monitoring of the load voltage with a separate load power supply takes place because the 24 V DC supply for the fan monitoring circuit is obtained from the load power supply as in Section 3.3. The internal power supply to the compact modules is switched off in the case of a load power failure and the programmable controller shut down.

2) All outputs are internally blocked if the programmable controller is shut down because of a load voltage failure or if it enters the stop status (e.g. cycle time exceeded). Output A1.1 and thus relay K1 switch off in this case and the signal lamp h1 is triggered. Output A1.1 must always be set in the user program.

3) A blown fuse in the load circuits is signalled to the programmable controller, evaluated by the user program and signalled as a fault if necessary.

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