

6 Connections



WARNING

The manufacturer can only provide a warranty for correct functioning of the SIMOREG CM converter and accept liability for any damage if the device is installed and started up by qualified personnel and the instructions in this manual are correctly observed. The converters are operated at high voltages.

The converters are operated at high voltages.

Disconnect the power supply before making any connections!

Only qualified personnel who are thoroughly familiar with all safety notices contained in the operating instructions as well as erection, installation, operating and maintenance instructions must be allowed to work on these devices.

Non-observance of the safety instructions can result in death, severe personal injury or substantial damage to property .

The converter might sustain serious or irreparable damage if connected incorrectly.

Voltage may be present at the power and control terminals even when the motor is stopped.

A hazardous voltage might still be present in the snubber capacitors even after isolation. For this reason, wait for an appropriate time before opening the converter.

When working on the open converter, remember that live parts are exposed. The unit must always be operated with the standard front covers in place.

The user is responsible for ensuring that the motor, SIMOREG converter and other devices are installed and connected up in accordance with the approved codes of practice of the country concerned and any other regional or local codes that may apply. Special attention must be paid to proper conductor sizing, fusing, grounding, isolation, and disconnection measures and to overcurrent protection.

These converters contain hazardous rotating machinery (fans) and control rotating mechanical components (drives). Death, serious bodily injury or substantial damage to property may occur if the instructions in the relevant operating manuals are not observed.

Successful and safe operation of this equipment is dependent on careful transportation, proper storage and installation as well as correct operation and maintenance.



6.1 Installation instructions for proper EMC installation of drives

NOTE

These installation instructions do not purport to handle or take into account all of the equipment details or versions or to cover every conceivable operating situation or application. If you require more detailed information, or if special problems occur, which are not handled in enough detail in this document, please contact your local Siemens office.

The contents of these installation instructions are not part of an earlier or existing agreement or legal contract and neither do they change it. The actual purchase contract represents the complete liability of the ASI 1 Variable-Speed Drives Group of Siemens AG. The warranty agreed in the contract between the parties is the sole warranty to which the Automation and Drives Division A&D is bound. The warranty conditions specified in the contract are neither expanded nor changed by the information provided in the installation instructions.

6.1.1 Fundamental principles of EMC

6.1.1.1 What is EMC

EMC stands for "electromagnetic compatibility" and defines the capability of an item of equipment to operate satisfactorily in an electromagnetic environment without itself causing electromagnetic disturbances that would adversely affect other items of equipment in its vicinity.

Different items of equipment must therefore not adversely affect one another.

6.1.1.2 Noise radiation and noise immunity

EMC is dependent on two characteristics of the equipment/units involved, i.e. radiated noise and noise immunity. Items of electrical equipment can either be fault sources (transmitters) and/or noise receivers.

Electromagnetic compatibility exists if the fault sources do not adversely affect the function of the noise receivers.

An item of equipment can be both a fault source and a fault receiver. For example, the power section of a converter must be regarded as a fault source and the control section as a noise receiver.

6.1.1.3 Limit values

Electrical drives are governed by Product Standard EN 61800-3. According to this standard, it is not necessary to implement all EMC measures for industrial supply networks. Instead, a solution adapted specifically to the relevant environment can be applied. It might therefore be more economical to increase the interference immunity of a sensitive device rather than implementing noise suppression measures for the converter. In this way, solutions selected will depend on their cost-effectiveness.

SIMOREG converters are designed for industrial applications (industrial low-voltage supply system, i.e. a system that does not supply domestic households).

Noise immunity defines the behavior of a piece of equipment when subjected to electromagnetic disturbance. The Product Standard regulates the requirements and assessment criteria for the behavior of equipment in industrial environments. The converters in this description comply with this Standard (Section 6.1.2.3).

6.1.1.4 SIMOREG CM in industrial applications

In an industrial environment, equipment must have a high level of noise immunity whereas lower demands are placed on noise radiation.

SIMOREG CM converters are components of an electrical drive system in the same way as contactors, switches, and the power section. Properly qualified personnel must integrate them into a drive system consisting, at least, of the converter, power section, motor cables, and motor. Commutating reactors and fuses are also required in most cases. Limit values can only be maintained if these components are installed and mounted in the correct way. In order to limit the radiated noise according to limit value "A1", the appropriate radio interference suppression filter and a commutating reactor are required in addition to the converter itself. Without an RI suppression filter, the noise radiated by a SIMOREG CM converters exceeds limit value "A1" as defined by EN55011.

If the drive forms part of a complete installation, it does not initially have to fulfill any requirements regarding radiated noise. However, EMC legislation requires the installation as a whole to be electromagnetically compatible with its environment.

If all control components in the installation (e.g. PLCs) have noise immunity for industrial environments, it is not necessary for each drive to meet limit value "A1" in its own right.

6.1.1.5 Non-grounded supply systems

Non-grounded supply systems (IT systems) are used in a number of industrial sectors to increase plant availability. In the event of a ground fault, no fault current flows so that the plant can continue to produce. However, with radio interference suppression filters, in the event of a ground fault a fault current will flow that can cause irreparable damage to the radio interference suppression filter. The product standard therefore does not define limit values for such networks. From the economic viewpoint, RI suppression should, if required, be implemented on the grounded primary side of the supply transformer.

Radio interference suppression filters for IT networks up to 690V have recently become available (Epcos B84143-Bxxx-S24).

6.1.1.6 EMC planning

If two units are not electromagnetically compatible, you can either reduce the noise radiated by the noise source, or increase the noise immunity of the noise receiver. Noise sources are generally power electronics units with a high power consumption. To reduce the radiated noise from these units, complex and costly filters are required. Noise receivers are predominantly control equipment and sensors including evaluation circuitry. Increasing the noise immunity of less powerful equipment is generally easier and cheaper. In an industrial environment, therefore, it is often more cost-effective to increase noise immunity rather than reduce radiated noise. For example, in order to adhere to limit value class A1 of EN 55011, the noise suppression voltage at the mains connection may be max. 79 dB(μV) between 150 kHz and 500 kHz and max. 73 dB (μV) (9 mV or 4.5 mV) between 500 kHz and 30 MHz.

In industrial environments, the EMC of the equipment used must be based on a well balanced mixture of noise radiation and noise immunity.

The most cost-effective RI suppression measure is the physical separation of noise sources and noise receivers, assuming that it has already been taken into account when designing the machine/plant. The first step is to define whether each unit is a potential noise source (noise radiator or noise receiver). Noise sources are, for example, converter units, contactors. Interference sinks include, for example, programmable controllers, encoders, and sensors.

The components in the switching cabinet (sources of interference, interference sinks) must be kept separate, if necessary using partition plates or by placing them in a metal housing. Proper EMC installation of drives (installation instructions)

6.1.2 Proper EMC installation of drives (installation instructions)

6.1.2.1 General information

Since drives can be operated in a wide range of differing environments and the electrical components used (controls, switched-mode power supplies, etc.) can widely differ with respect to noise immunity and radiation, any mounting/installation guideline can only represent a practical compromise. For that reason, EMC regulations do not need to be implemented to the letter, provided that measures are checked out on a case by case basis.

In order to guarantee electromagnetic compatibility in your cabinets in rugged electrical environments and fulfill the standards specified by the relevant regulatory bodies, the following EMC regulations must be observed when designing and installing cabinets.

Rules 1 to 10 generally apply. Rules 11 to 15 must be followed to fulfill standards governing radiated noise.

6.1.2.2 Rules for proper EMC installation

Rule 1

All the metal components in the cabinet must be conductively connected with one another over a large contact area.

(Not paint to paint!)

Serrated or contact washers must be used where necessary. The cabinet door should be connected to the cabinet through the shortest possible grounding straps (top, center, bottom).

Rule 2

Contactors, relays, solenoid valves, electromechanical hours counters, etc. in the cabinet, and, if applicable, in adjacent cabinets, must be provided with quenching elements, for example, RC elements, varistors, diodes. These devices must be connected directly at the coil.
(RC elements are better than varistors)

Rule 3

Signal cables ¹⁾ should enter the cabinet at only one level wherever possible.

Rule 4

Unshielded cables in the same circuit (incoming and outgoing conductors) must be twisted where possible, or the area between them kept as small as possible in order to prevent unnecessary coupling effects.

Rule 5

Connect spare strands at both ends with cabinet frame (ground ²⁾). This provides an additional shielding effect.

Rule 6

Avoid unnecessary cable lengths. This keeps coupling capacitances and inductances to a minimum.

Rule 7

Crosstalk is kept low if cables are routed close to the cabinet ground. For this reason, wiring should not be routed freely in the cabinet, but as close as possible to the cabinet frame and mounting panels. This applies equally to spare cables.

Rule 8

Signal and power cables must be routed separately from one another (to prevent noise from being coupled in). Minimum distance: A clearance of 20 cm should be maintained.

If the encoder cables and motor cables cannot be routed separately, then the encoder cable must be decoupled by means of a metal partition or installation in a metal conduit. The partition or metal conduit must be grounded at several points.

Rule 9

The shields of digital signal cables must be connected to ground at both ends (source and destination). If there is poor equipotential bonding between the shield connections, an additional equipotential bonding cable of at least 10 mm² must be connected in parallel to the shield to reduce the shield current. Generally speaking, the shields can be connected to the cabinet housing (ground²⁾) at several points. The shields may also be connected at several locations outside the cabinet. Foil-type shields should be avoided. Their shielding effect is five times poorer than that of braided shields.

Rule 10

The shields of analog signal cables may be connected to ground at both ends (conductively over a large area) if equipotential bonding is good. Equipotential bonding can be assumed to be good if all metal parts are well connected and all the electronic components involved are supplied from the same source.

The single-ended shield connection prevents low-frequency, capacitive noise from being coupled in (e.g. 50 Hz hum). The shield connection should then be made in the cabinet. In that case, the shield can be connected by means of a sheath wire.

Rule 11

The RI suppression filter must always be mounted close to the suspected noise source. The filter must be connected to the cabinet housing, mounting plates, etc., over a large area. Input and output cables must be kept separate.

Rule 12

To ensure adherence to limit value class A1, the use of RI suppression filters is obligatory. Additional loads must be connected on the line side of the filter.

The control system used and the other wiring in the cubicle determines whether an additional line filter needs to be installed.

Rule 13

A commutating reactor must be installed in the field circuit for controlled field supplies.

Rule 14

A commutating reactor must be installed in the converter armature circuit.

Rule 15

Unshielded motor cables may be used in SIMOREG drive systems.

In such cases, the line supply cable must be routed at a distance of at least 20 cm from the motor cables (field, armature). Use a metal partition if necessary.

Footnotes:

- 1) Signal cables are defined as:

Digital signal cable:

Binary inputs and outputs

Pulse encoder cables

Serial interfaces, e.g. PROFIBUS-DP

Analog signal cable.:

e.g. ± 10 V setpoint cable

- 2) The term "ground" generally refers to all metallic, conductive components which can be connected to a protective conductor, e.g. cabinet housing, motor housing, foundation ground, etc.

Cabinet design and shielding:

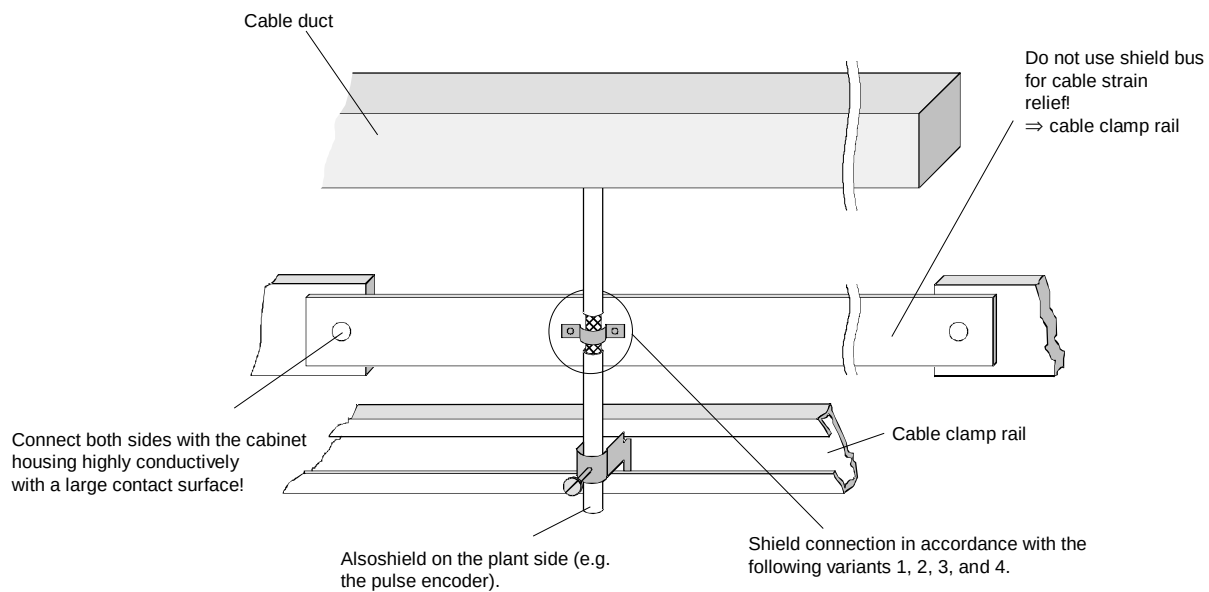


Fig. 1a: Shield at cable entry point to cabinet

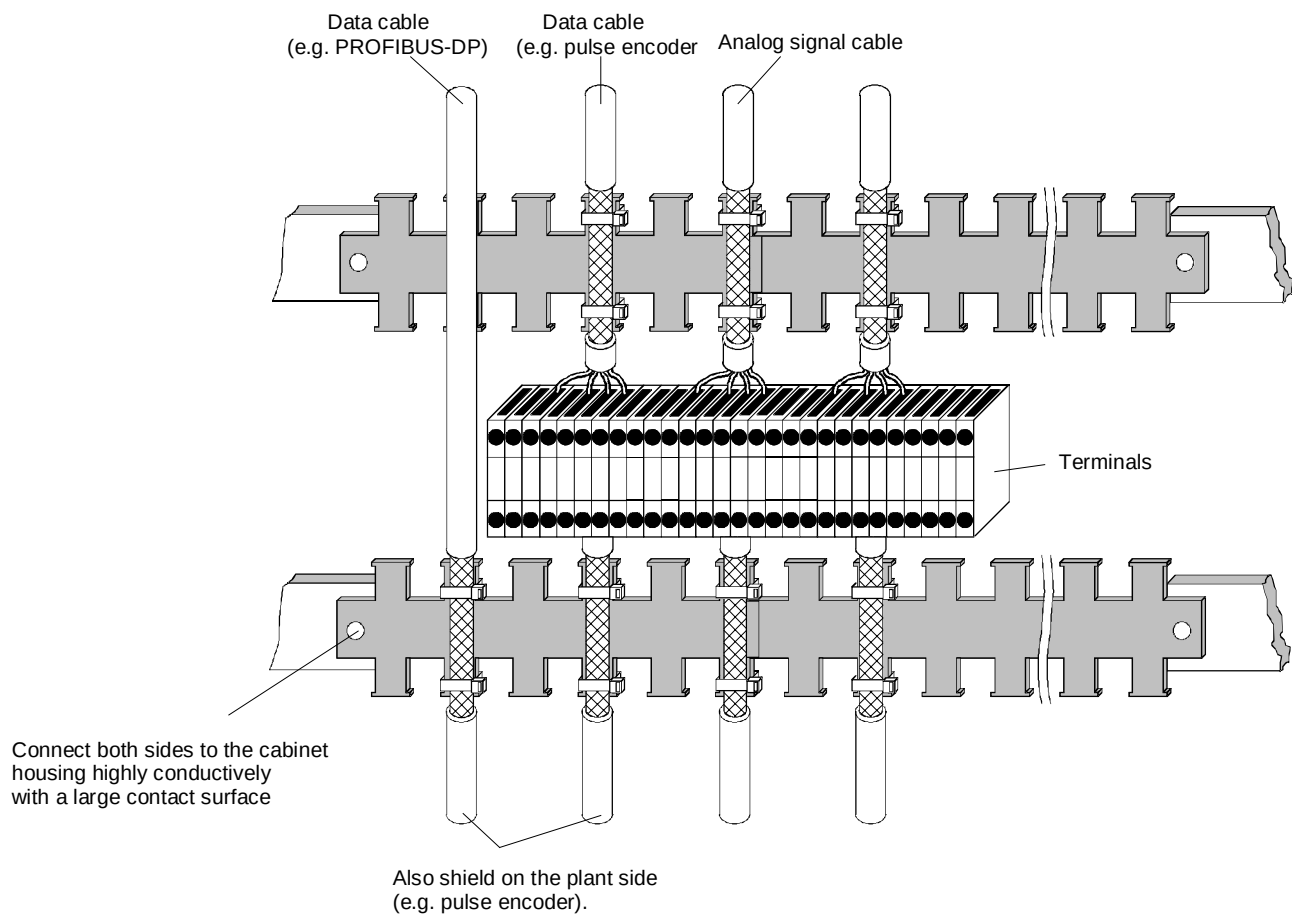
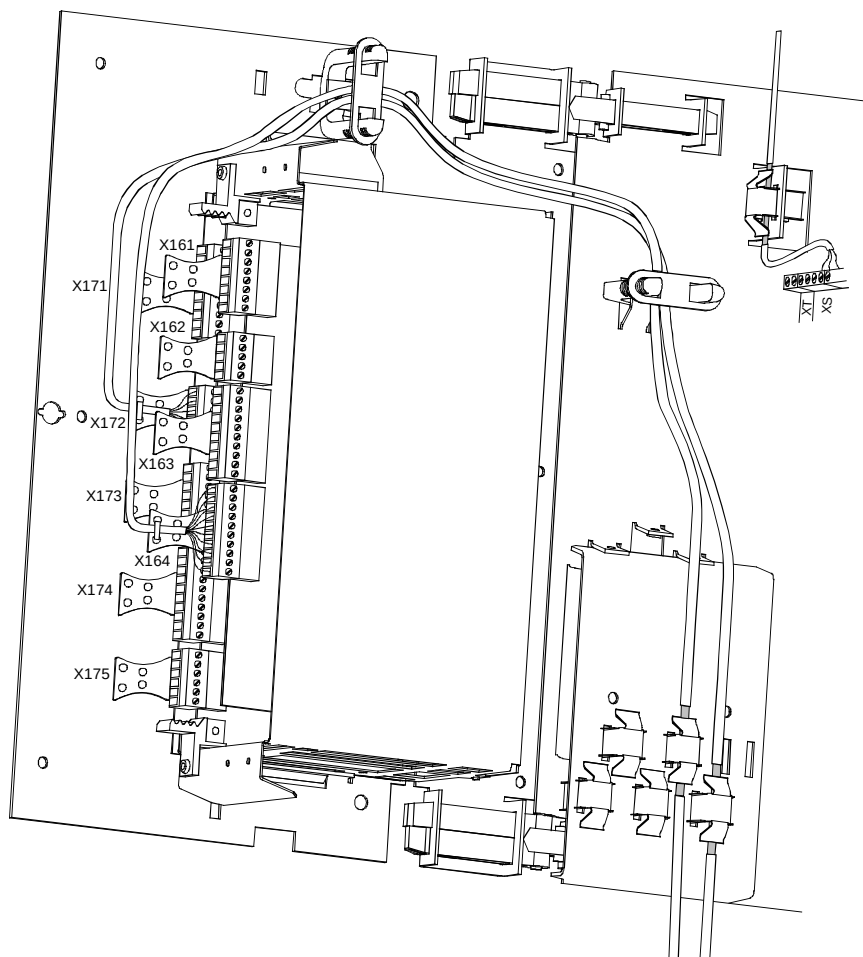


Fig. 1b: Shielding in the cabinet



The customer connections must be routed above the electronics box.

Fig. 1c: Shield contacting on SIMOREG CM

**Connect line filter with cabinet
with large contact surface**

Separate filtered and
unfiltered cables

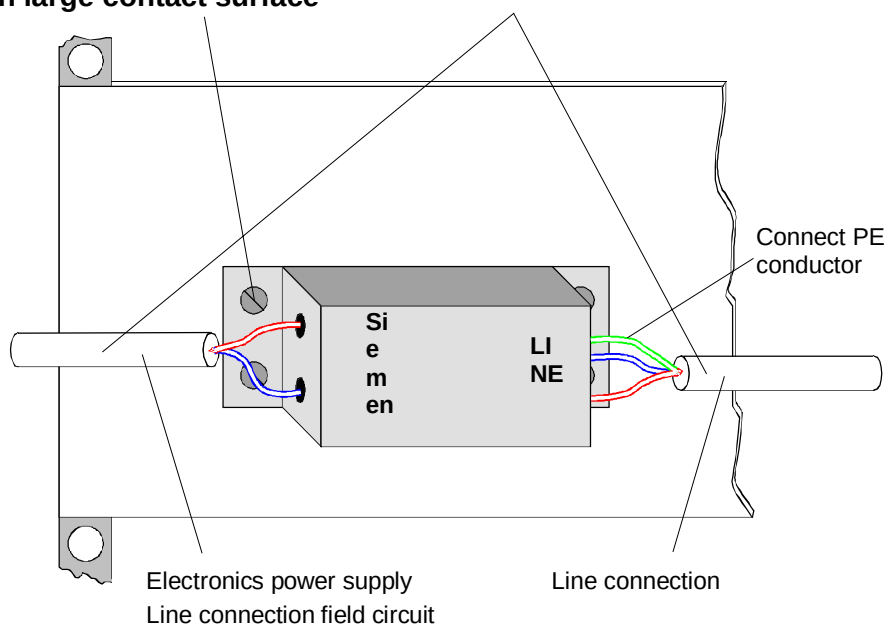
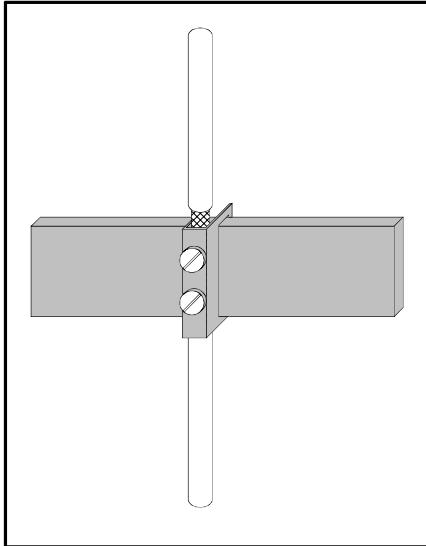


Fig. 1d: Line filter for SIMOREG DC Master 6RA70 electronics power supply

Shield connections:

Variant 1:



Variant 2:

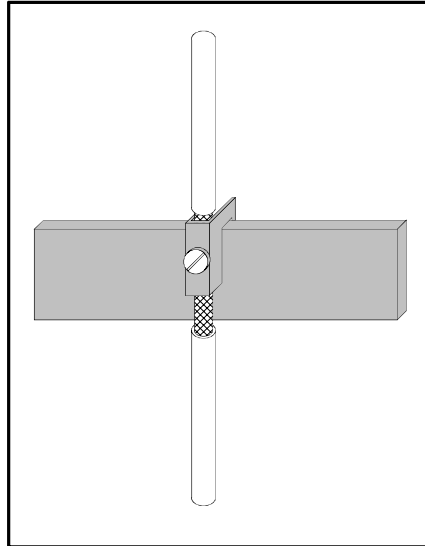


Fig. 2a: Terminal on a copper busbar, max. cable diameter 15 mm

Fig. 2b: Terminal on copper busbar, max. cable diameter 10 mm

Caution!

The conductor could be damaged if the terminal screw is over-tightened.

Note:

Terminals:
5 mm busbar thickness
Order No. 8US1921-2AC00
10 mm busbar thickness
Order No. 8US1921-2BC00

Note:

Terminals:
Order No. 8HS7104,
8HS7104, 8HS7174, 8HS7164

Variant 3:

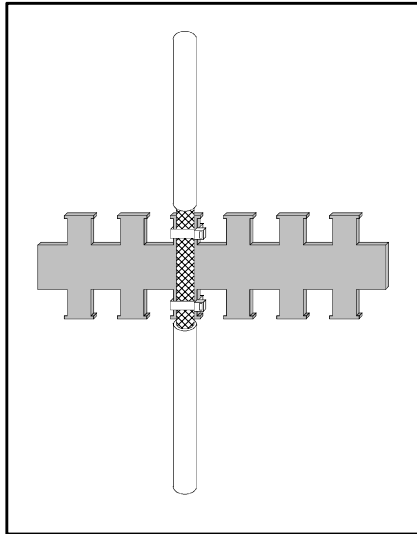


Fig. 2c: Metallized tubing or cable ties on a bare metal comb-type/serrated rail

Note:

Comb-type rail:
Item No. J48028

Variant 4:

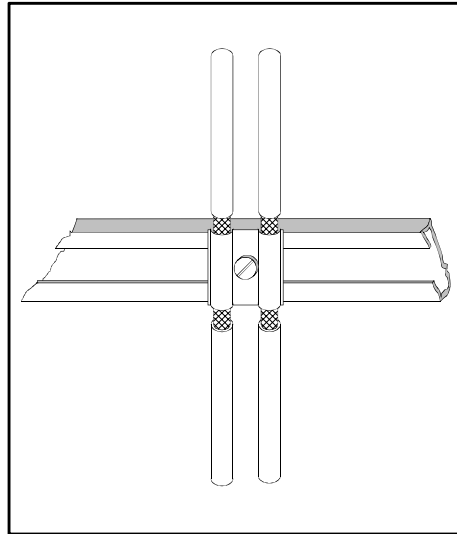


Fig. 2d: Clamp and metallic mating piece on a cable clamping rail

Note:

Siemens 5VC55... cable clamps;
Clamping rails in various sizes:
Item No. K48001 to 48005

6.1.2.3 Arrangement of components for converters

Arrangement of reactors and radio interference suppression filters

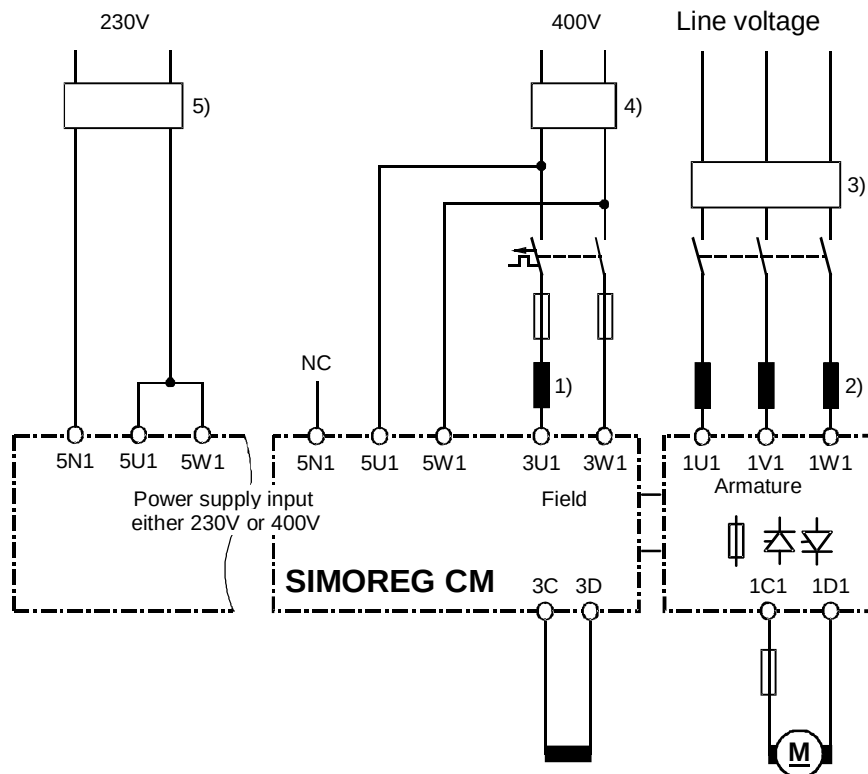


Fig. 6.1.2.3.1

- 1) The commutating reactor in the field circuit is dimensioned for the rated motor field current.
- 2) The commutating reactor in the armature circuit is dimensioned for the rated motor current in the armature. The line current equals DC current x 0.82.
- 3) The radio interference suppression filter for the armature circuit is dimensioned for the rated motor current in the armature. The line current equals DC current x 0.82.
- 4) The radio interference suppression filter for the field circuit and the electronics power supply (if 380 to 460 V) is designed for the rated current of the motor of plus 1 A (see description terminal XP).
- 5) The radio interference suppression filter for the electronics power supply (if 190 to 230 V) is designed for 2 A (see description for terminal XP).

Note:

When radio interference suppression filters are used, commutating reactors are always required at the converter input to decouple the snubber circuitry.
Commutating reactors are selected according to the information in Catalog DA93.1.

6.1.3 Information on line-side harmonics generated by converters in a fully-controlled three-phase bridge circuit configuration B6C and (B6)A(B6)C

Converters for the medium power range usually consist of fully-controlled three-phase bridge circuit configurations. An example of the harmonics generated by a typical system configuration for two firing angles ($\alpha = 20^\circ$ and $\alpha = 60^\circ$) is given below.

The values have been taken from an earlier publication entitled "Harmonics in the Line-Side Current of Six-Pulse Line-Commutated Converters" written by H. Arremann and G. Möltgen, Siemens Research and Development Dept., Volume 7 (1978) No. 2, © Springer-Verlag 1978.

Formulas have been specified with which the short circuit power S_K and armature inductance L_a of the motor to which the specified harmonics spectrum applies can be calculated depending on the applicable operating data [line voltage (no-load voltage U_{V0}), line frequency f_N , and DC current I_d]. A dedicated calculation must be performed if the actual system short circuit power and/or actual armature reactance deviate from the values determined by this method.

The spectrum of harmonics listed below is obtained if the values for short circuit power S_K at the converter supply connection point and the armature inductance L_a of the motor calculated by the following formulas correspond to the actual plant data. If the calculated values differ, the harmonics must be calculated separately.

a.) $\alpha = 20^\circ$

b.) $\alpha = 60^\circ$

Fundamental factor $g = 0.962$

Fundamental factor $g = 0.953$

v	I_v/I_1	v	I_v/I_1
5	0.235	29	0.018
7	0.100	31	0.016
11	0.083	35	0.011
13	0.056	37	0.010
17	0.046	41	0.006
19	0.035	43	0.006
23	0.028	47	0.003
25	0.024	49	0.003

v	I_v/I_1	v	I_v/I_1
5	0.283	29	0.026
7	0.050	31	0.019
11	0.089	35	0.020
13	0.038	37	0.016
17	0.050	41	0.016
19	0.029	43	0.013
23	0.034	47	0.013
25	0.023	49	0.011

The fundamental-frequency current I_1 as a reference quantity is calculated with the following equation:

$$I_1 = g \times 0.817 \times I_d$$

where I_d DC current of operating point under investigation

where g Fundamental factor (see above)

The harmonic currents calculated from the above tables are valid **only** for

I.) Short-circuit power S_K at converter supply connection point

$$S_K = \frac{U_{V0}^2}{X_N} \quad (\text{VA})$$

where

$$X_N = X_K - X_D = 0.3536 \times \frac{U_{v0}}{I_d} - 2\pi f_N \times L_D \quad (\Omega)$$

and

U_{v0} No-load voltage in V at the converter supply connection point

I_d DC current in A of operating point under investigation

f_N Line frequency in Hz

L_D Inductance in H of commutating reactor used

X_D Impedance of the commutating reactor

X_N Impedance of the network

X_K Impedance at the device terminals

II.) Armature inductance L_a

$$L_a = 0.0488 \times \frac{U_{v0}}{f_N \times I_d} \text{ (H)}$$

A separate calculation must be performed if the actual values for short-circuit power S_K and/or armature inductance L_a deviate from the values calculated on the basis of the above equations.

Example

Let us assume that a drive has the following data:

$U_{v0} = 400 \text{ V}$

$I_d = 150 \text{ A}$

$f_N = 50 \text{ Hz}$

$L_D = 0.169 \text{ mH}$ (4EU2421-7AA10 where $L_{LN} = 125 \text{ A}$)

When

$$X_N = 0.3536 \times \frac{400}{150} - 2\pi \times 50 \times 0.169 \times 10^{-3} = 0.0412 \Omega$$

the required system short-circuit power at the converter supply connection point is as follows:

$$S_K = \frac{400^2}{0.0412} = 3.88 \text{ MVA}$$

and the required motor armature inductance as follows:

$$L_a = 0.0488 \times \frac{400}{50 \times 150} = 2.60 \text{ mH}$$

The harmonic currents I_v listed in the tables above (where $I_1 = g \times 0.817 \times I_d$ for firing angles $\alpha = 20^\circ$ and $\alpha = 60^\circ$) apply only to the values S_K and L_a calculated by the above method. If the calculated and actual values are not the same, the harmonics must be calculated separately.

For the purpose of dimensioning filters and compensation circuits with reactors, the harmonic values calculated by these equations can be applied only if the values calculated for S_K and L_a tally with the actual values of the system. If they do not, they must be calculated separately (this is especially true when using compensated motors as these have a very low armature inductance).

6.2 Block diagram with recommended connection

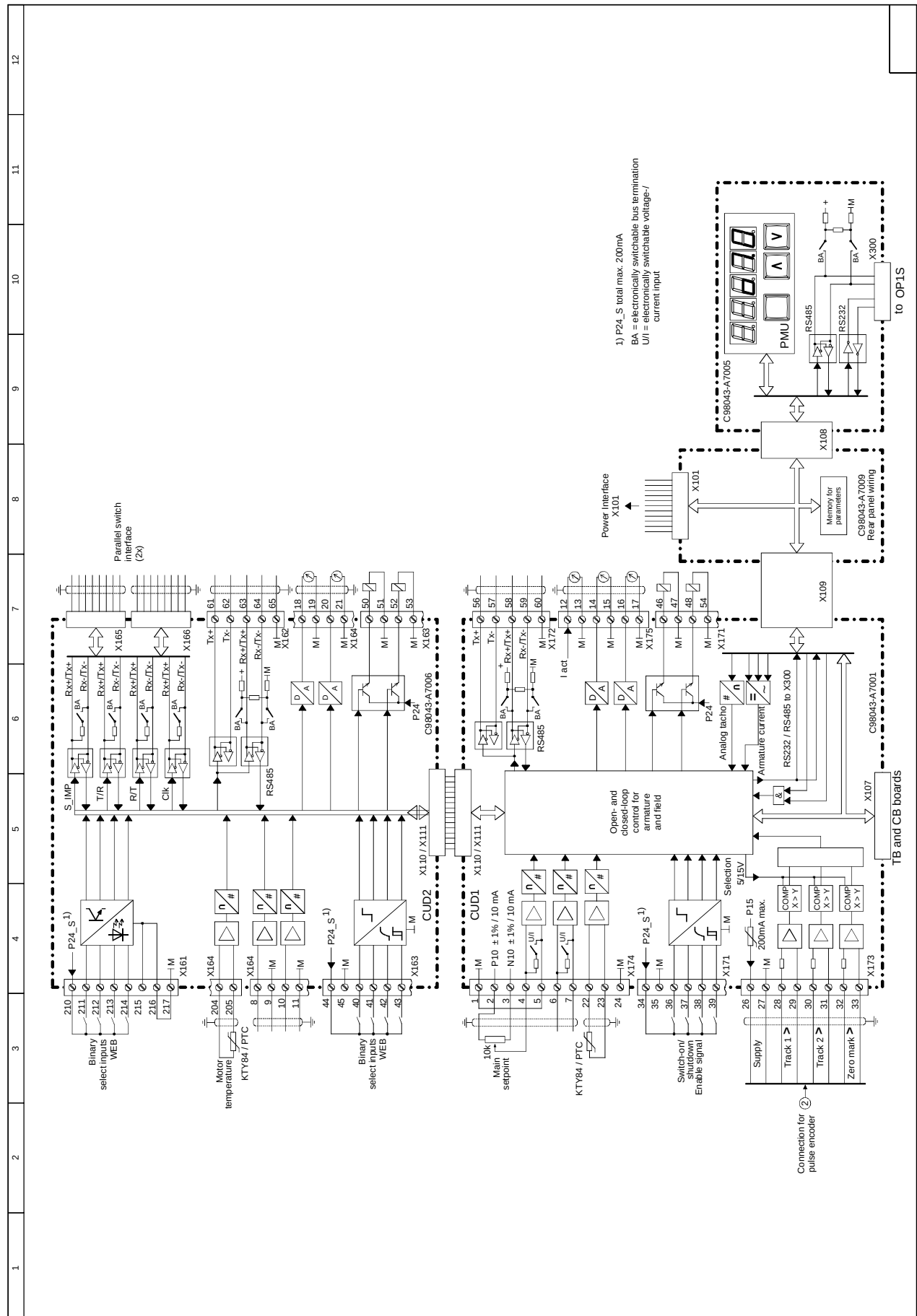


Fig. 6.2.1 a

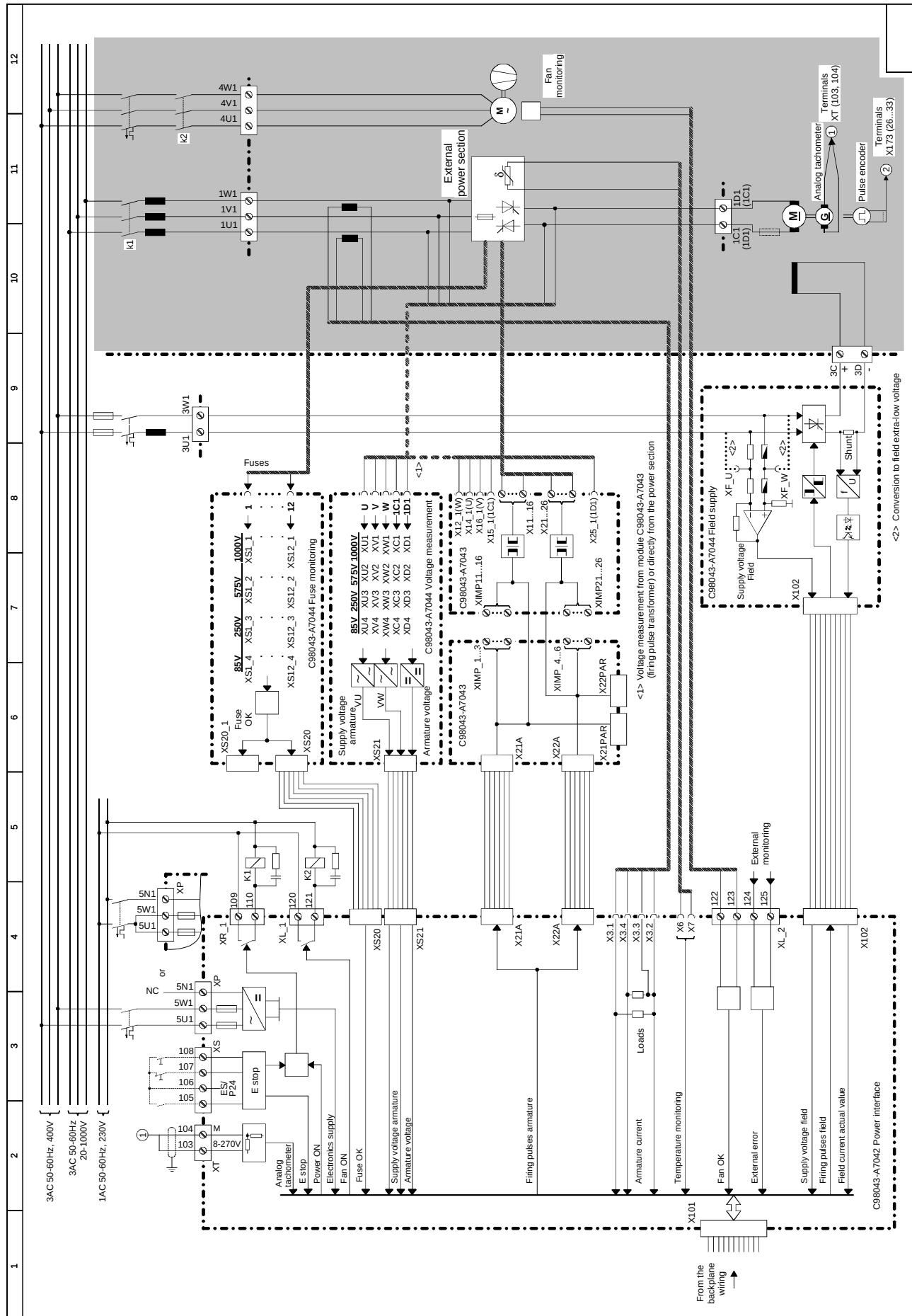


Fig. 6.2.1b

6.3 Connection of the external power section

All the necessary connections to the power section are shown in the following figs. 6.3.1 to 6.3.4.

Fig. 6.3.1

- Four-quadrant drive (parameterized as a four-quadrant drive – U825=4 when supplied from the factory)
- Measurement of the line voltage and armature voltage via the Faston connections on the firing pulse transfer module (when supplied from the factory)

Fig. 6.3.2

- Four-quadrant drive (parameterized as a four-quadrant drive – U825=4 when supplied from the factory)
- Measurement of the system voltage and armature voltage directly from the power section via cables that must be additionally laid

Fig. 6.3.3:

- Single-quadrant drive (parameterization via parameter U825 = 1)
- Measurement of the system voltage and armature voltage via the Faston connections on the firing pulse transfer module (state as delivered) In order to measure the armature voltage it is necessary to make a connection to 1D1 on the power section.

Fig. 6.3.4:

- Single-quadrant drive (parameterization via parameter U825 = 1)
- Measurement of the system voltage and armature voltage directly from the power section via cables that must be additionally laid

See Chapter 6.4 for possible ways of positioning the two troughs and dismantling the device.



WARNING

The following electrical cables between the power section (system voltage) and the electronics must be protected against short-circuits:
Secondary sides of the firing transmission, voltage measurement, fuse monitoring.



All these cables (that lead to the supply voltage) must be laid in a such a way as to preclude short circuits or with short-circuit protection.
The effective currents in the specified cables are smaller than 0.5 A.

Method 1: Short-circuit protected cables that burn internally but whose insulation does not split.

Method 2: Protect the cables as close as possible to the power section with fuses.
The fuses must have the necessary cutout capability.

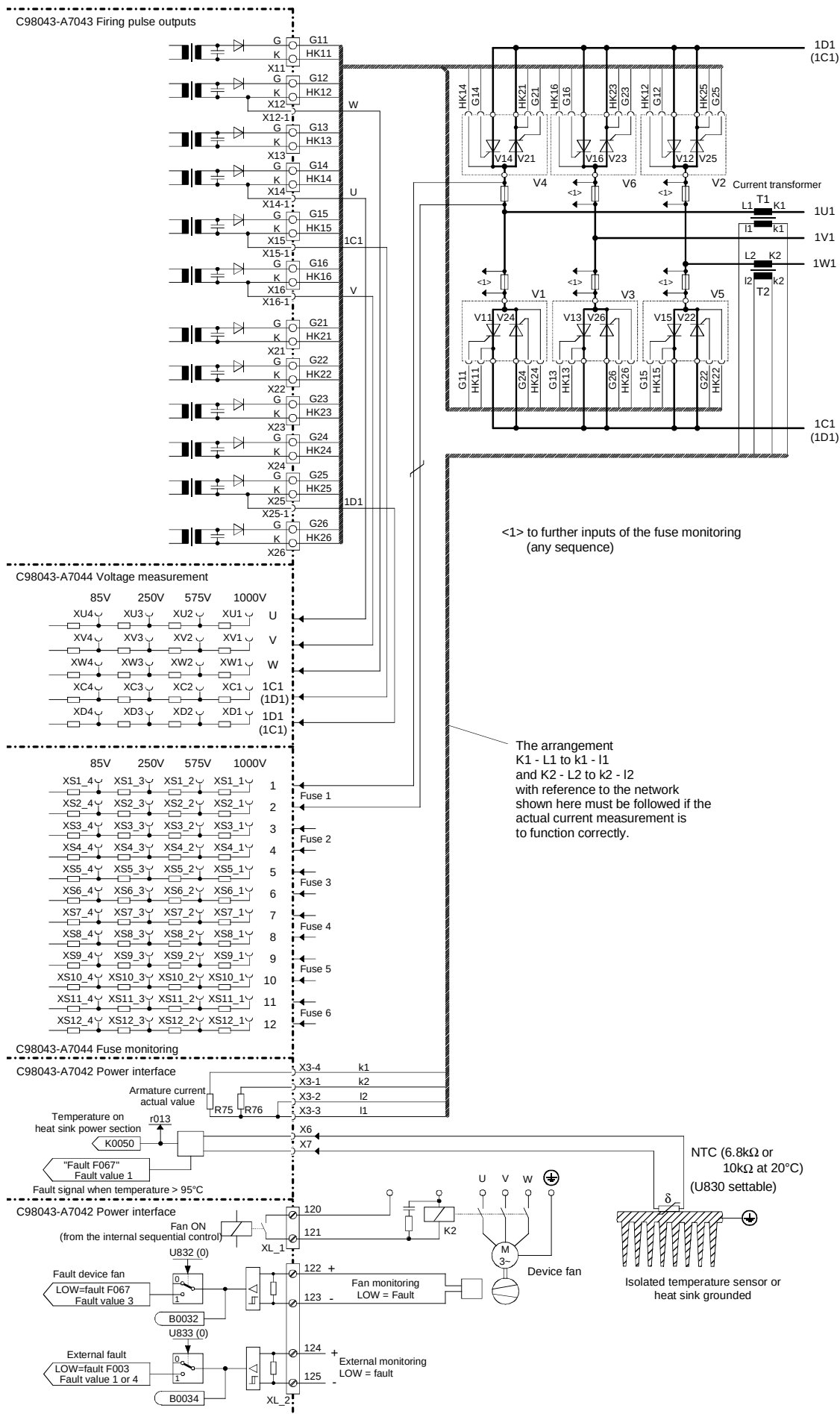


Fig. 6.3.1

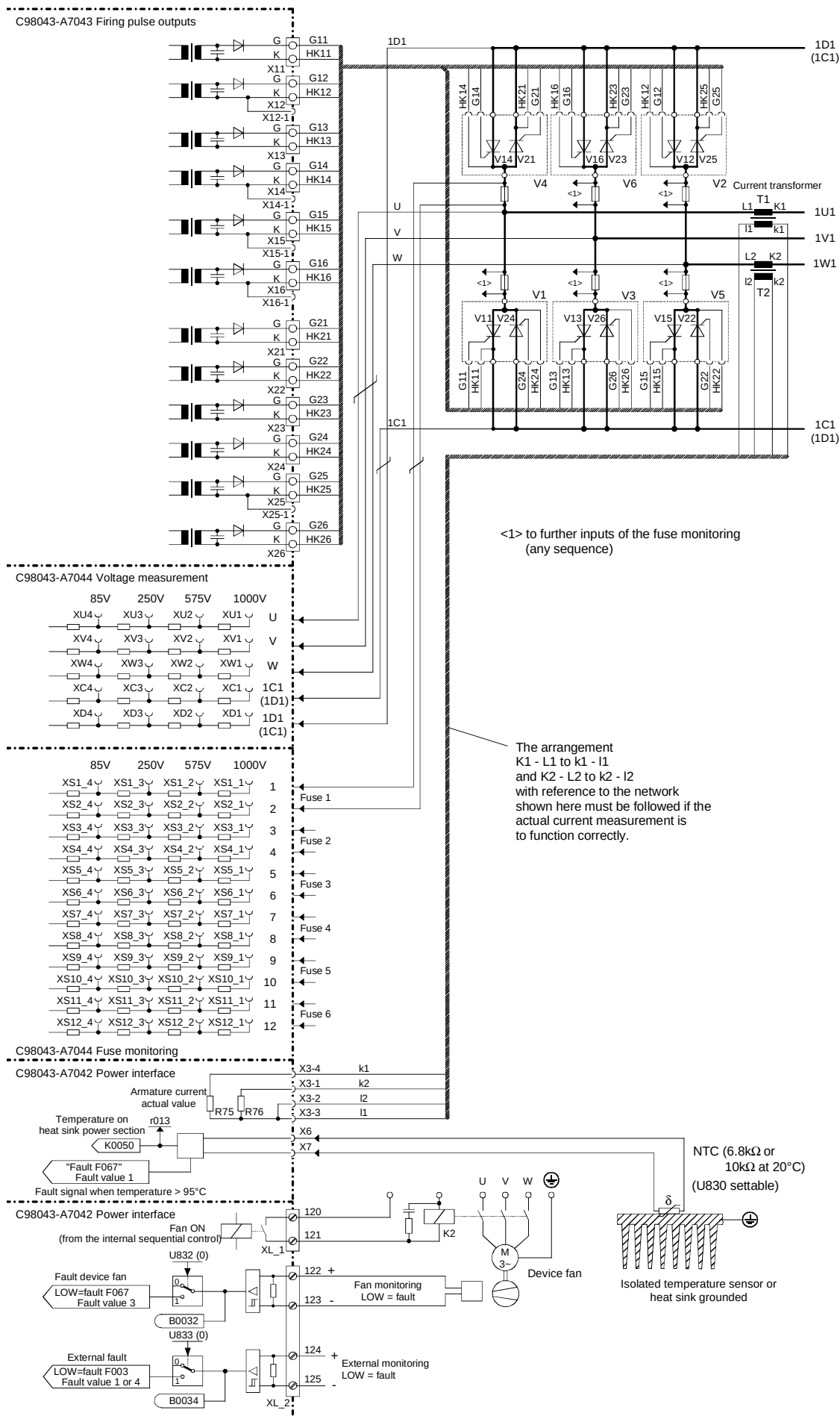


Fig. 6.3.2

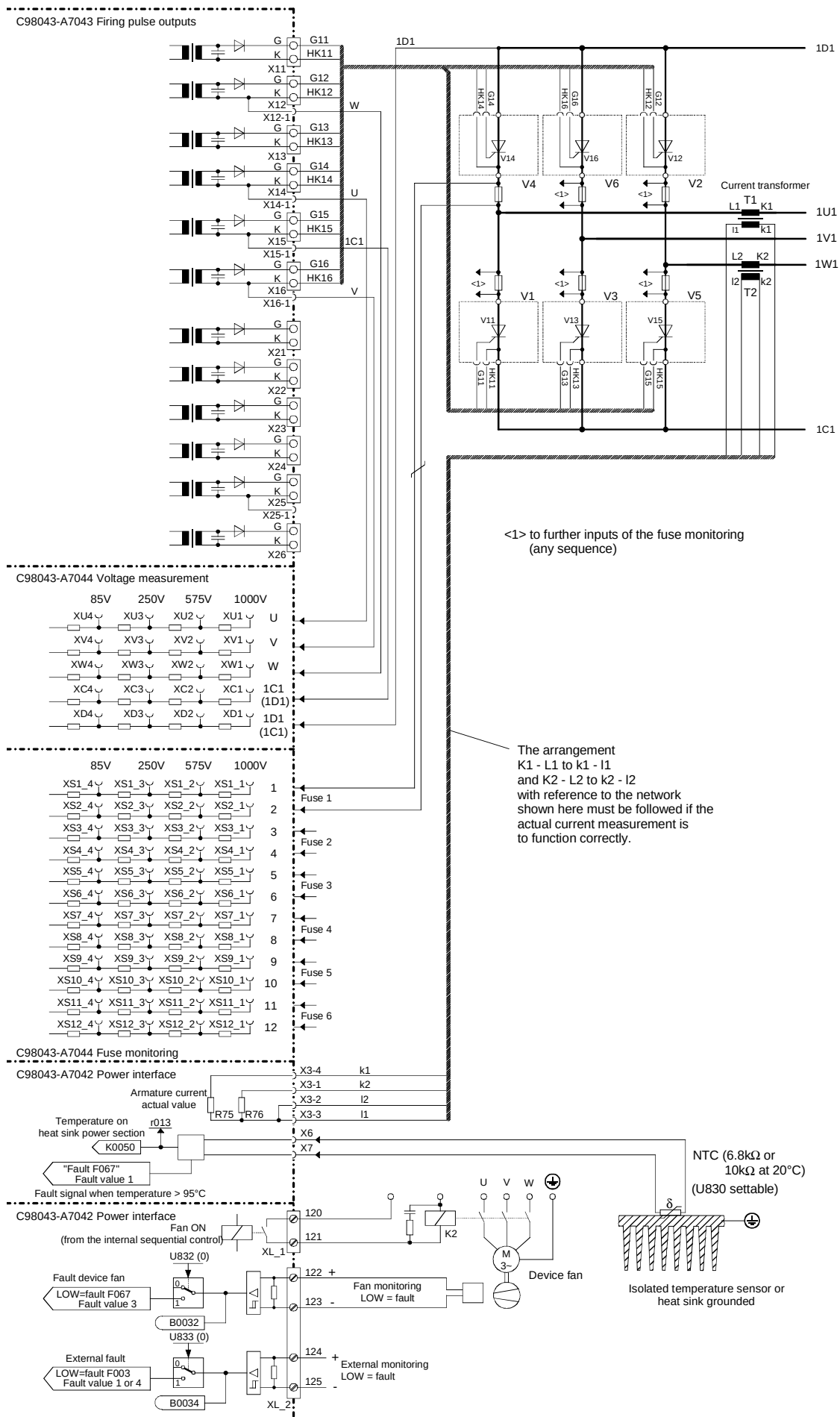


Fig. 6.3.3

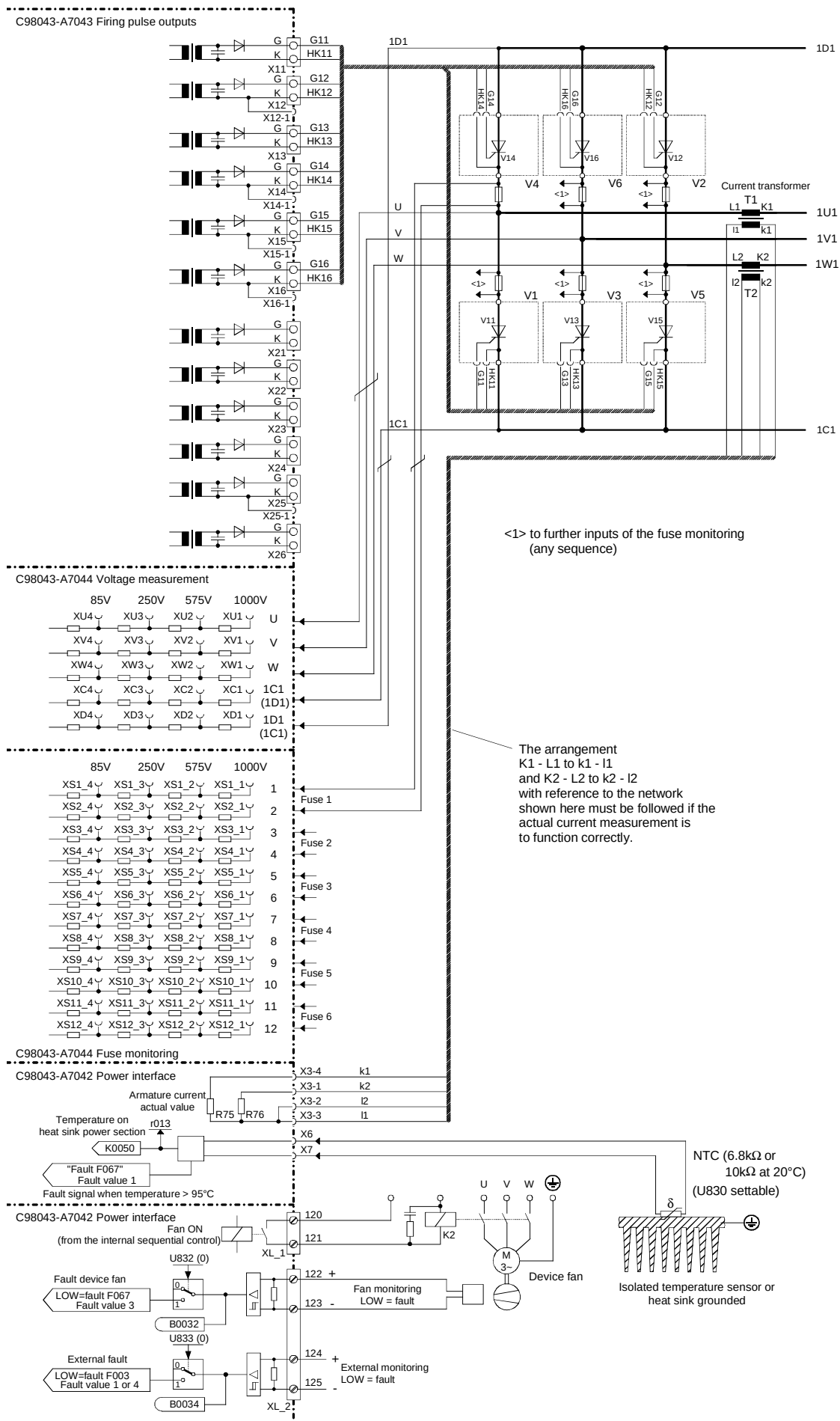


Fig. 6.3.4

6.4 Dismantle capability

See also Chapter 5.2

The SIMOREG control module is mounted in two troughs.

The front trough contains the power interface module and the electronics box with the electronics module CUD1 (C98043-A7001) and the terminal expansion CUD2 (ordering option K01) (C98043-A7006) as an option, and further supplementary modules such as technology modules or interface modules.

The rear trough contains the firing pulse transmission module (C98043-A7043) and the module with the voltage measurement, fuse monitoring, and field supply (C98043-A7044). The two modules can be separated mechanically so that parts of it can be mounted in the proximity of the power section.

The two troughs can be mounted one on top of the other or separately.

Here are a few examples:

1. Rear and front troughs mounted one on top of the other or separately, modules C98043-A7043 and C98043-A7044 not separated (Fig. 6.4.1)

Connection (connectors / terminals)	Cable	Length	Comments
X21A (torque direction 1)	Ribbon cable 26-way	max. 10m *)	Shield if >1m
X22A (torque direction 2)	Ribbon cable 26-way	max. 10m *)	Shield if >1m
XS20 (fuse monitoring)	Ribbon cable 10-way	max. 10m *)	Shield if >1m
XS21 (voltage measurement)	Ribbon cable 10-way	max. 10m *)	Shield if >1m
X102 (field)	Ribbon cable 20-way	max. 10m *)	Shield if >1m
Current transformer (X3)	Single wires (stranded) twisted pairs	max. 10m *)	Shield if >2m
Heat sink temperature (X6, X7)	Single wires (stranded) twisted	max. 10m *)	Shield if >1m
Firing pulse (X11...X16, X21...X26)	Single wires (short-circuit-proof cables) twisted pairs	max. 3m *)	Do not shield !
Fuse monitoring (XS1_1...XS1_12 etc.)	Single wires (short-circuit-proof cables) laid in pairs (for each monitored fuse)	max. 10m *)	
Voltage measurement (XU1,XV1,XW1,XC1,CD1 etc.)	Single wires (short-circuit-proof cables) U,V,W twisted C,D twisted	max. 3m *)	Connection of voltage measurement see also Chapter . 6.3

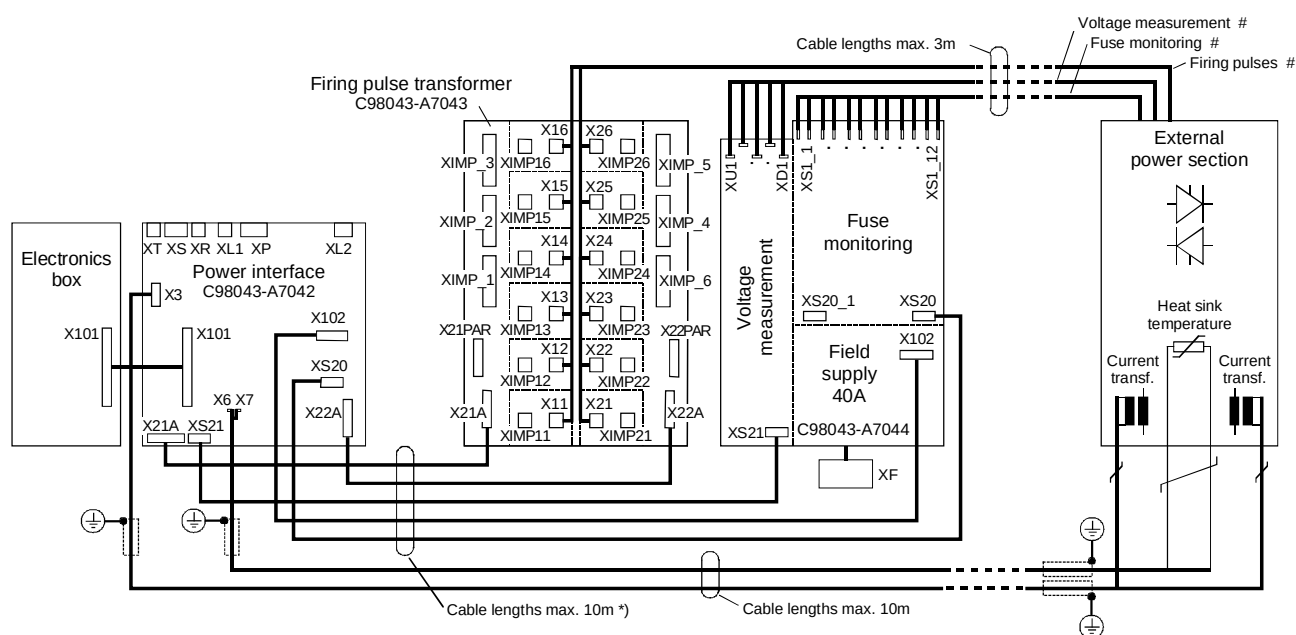


Fig. 6.4.1

#...short-circuit-proof cable laying

*) The SIMOREG control module is supplied with the front and rear trough mounted one on top of the other. Ribbon cables are already installed for this assembly type.
See Chapter 2.3 for other cable lengths

2. Rear and front trough mounted one on top of the other or separately, module C98043-A7043 and separated (firing pulse transformer mounted with power section), module C98043-A7044 not separated (Fig. 6.4.2)

Mechanical conversion see Chapter 5

Connection (connectors / terminals)	Cable	Length	Comments
X21A (torque direction 1)	Ribbon cable 26-way	max. 10m *)	Shield if >1m
X22A (torque direction 2)	Ribbon cable 26-way	max. 10m *)	Shield if >1m
XS20 (fuse monitoring)	Ribbon cable 10-way	max. 10m *)	Shield if >1m
XS21 (voltage measurement)	Ribbon cable 10-way	max. 10m *)	Shield if >1m
X102 (field)	Ribbon cable 20-way	max. 10m *)	Shield if >1m
Current transformer (X3)	Single wires (stranded) twisted pairs	max. 10m *)	Shield if >2m
Heat sink temperature (X6, X7)	Single wires (stranded) twisted	max. 10m *)	Shield if >1m
Control firing pulse transformer (XIMP_1 - XIMP11...16) (XIMP_6 - XIMP21...26)	2x LiyCY 8x2x0.5(or 1)mm ² or Single wires (stranded) twisted pairs	max. 10m *)	Apply shield on both sides
		max. 3m *)	Shield if >1m
Firing pulse (X11...X16, X21...X26)	Single wires (short-circuit-proof cables) twisted pairs	max. 3m *)	Do not shield !
Fuse monitoring (XS1_1...XS1_12 etc.)	Single wires (short-circuit-proof cables) laid in pairs (for each monitored fuse)	max. 10m *)	
Voltage measurement (XU1,XV1,XW1,XC1,CD1 etc.)	Single wires (short-circuit-proof cables) U-V-W twisted, C-D twisted	max. 3m *)	Connection of voltage measurement see also Chapter 6.3

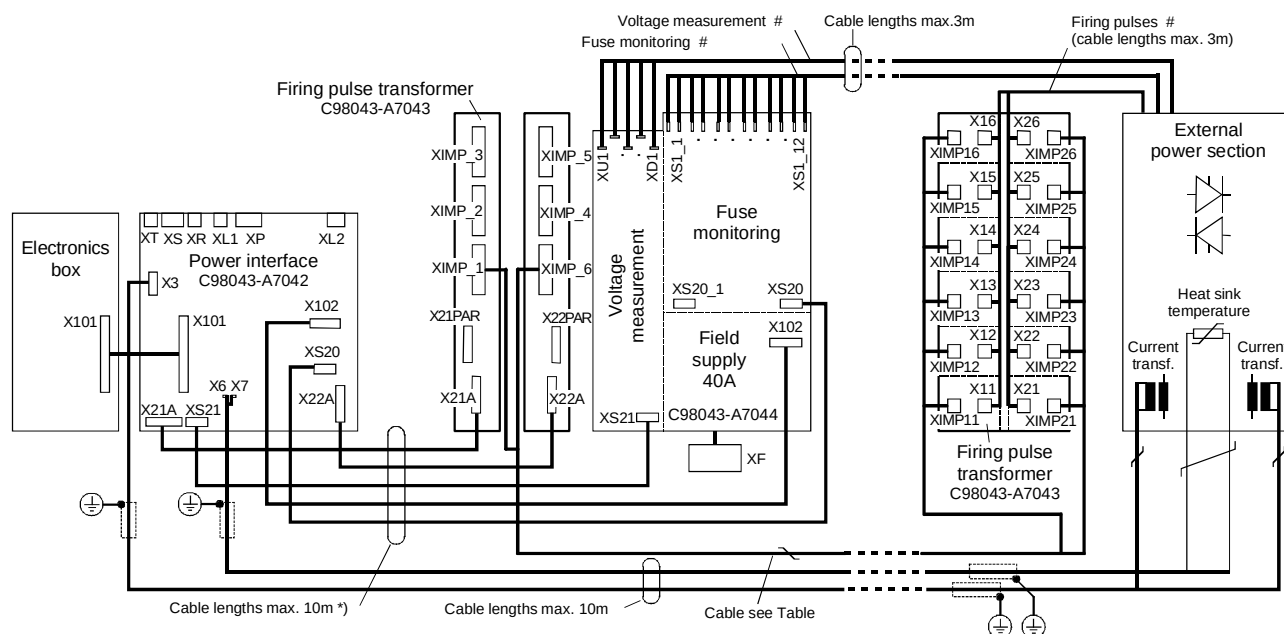


Fig. 6.4.2

#...short-circuit-proof cable laying

*) The SIMOREG control module is supplied with the front and rear trough mounted one on top of the other. Ribbon cables are already installed for this assembly type.

See Chapter 2.3 for other cable lengths

3. Rear and front trough mounted one on top of the other or separately, modules C98043-A7043 C98043-A7044 separated (firing pulse transformer, voltage measurement, and fuse monitoring mounted with power section), field supply remains in trough (Fig. 6.4.3)

Mechanical conversion see Chapter 5

Connection (connectors / terminals)	Cable	Length	Comments
X21A (torque direction 1)	Ribbon cable 26-way	max. 10m *)	Shield if >1m
X22A (torque direction 2)	Ribbon cable 26-way	max. 10m *)	Shield if >1m
XS20 (fuse monitoring)	Ribbon cable 10-way	max. 10m *)	Shield if >1m
XS21 (voltage measurement)	Ribbon cable 10-way	max. 10m *)	Shield if >1m
X102 (field)	Ribbon cable 20-way	max. 10m *)	Shield if >1m
Current transformer (X3)	Single wires (stranded) twisted pairs	max. 10m *)	Shield if >2m
Heat sink temperature (X6, X7)	Single wires (stranded) twisted	max. 10m *)	Shield if >1m
Control firing pulse transformer (XIMP_1 - XIMP11...16) (XIMP_6 - XIMP21...26)	2x LiCY8x2x0.5 (or 1) mm ² or Single wires (stranded) twisted pairs	max. 10m *) max. 3m *)	Apply shield on both sides Shield if >1m
Firing pulse (X11...X16, X21...X26)	Single wires (short-circuit-proof cables) twisted pairs	max. 3m *)	Do not shield !
Fuse monitoring (XS1_1...XS1_12 etc.)	Single wires (short-circuit-proof cables) laid in pairs (for each monitored fuse)	max. 10m *)	
Voltage measurement (XU1,XV1,XW1,XC1,CD1 etc.)	Single wires (short-circuit-proof cables) U-V-W twisted, C-D twisted	max. 3m *)	Connection of voltage measurement see also Chapter 6.3

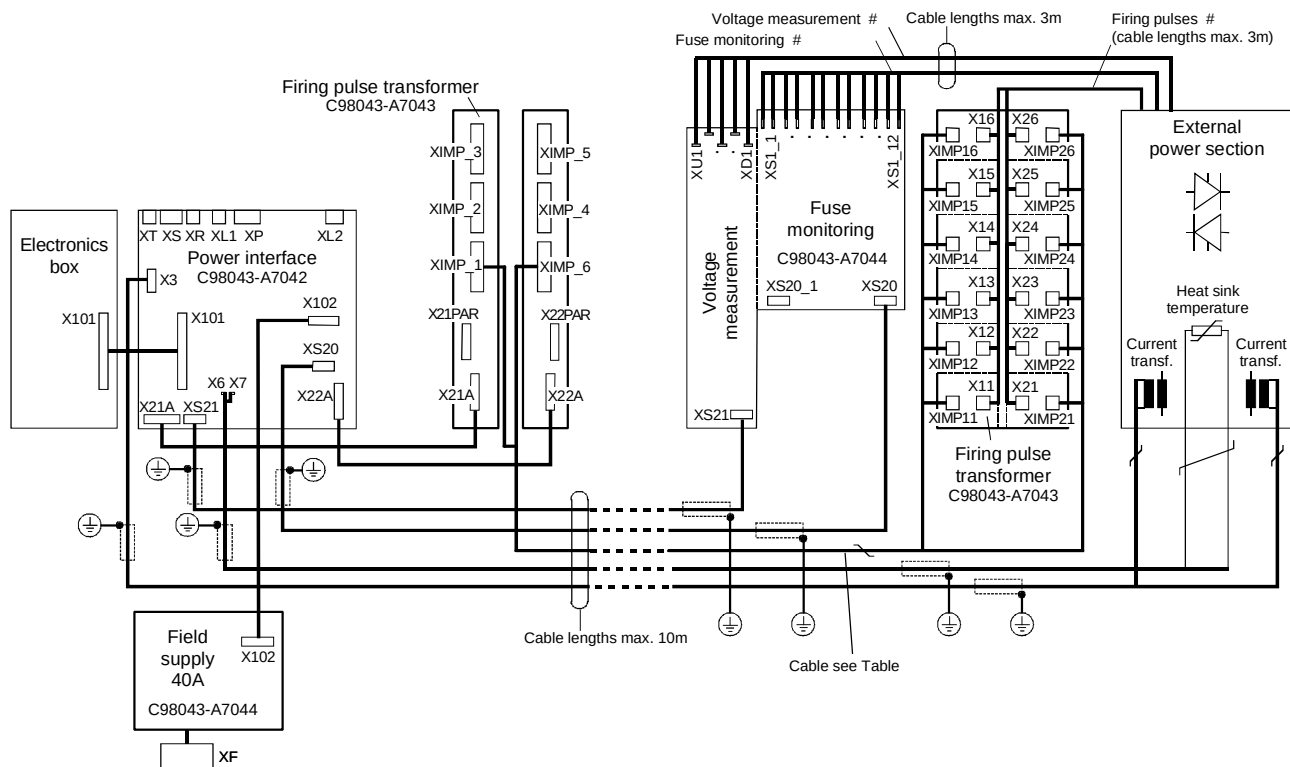


Fig. 6.4.3

#...short-circuit-proof cable laying

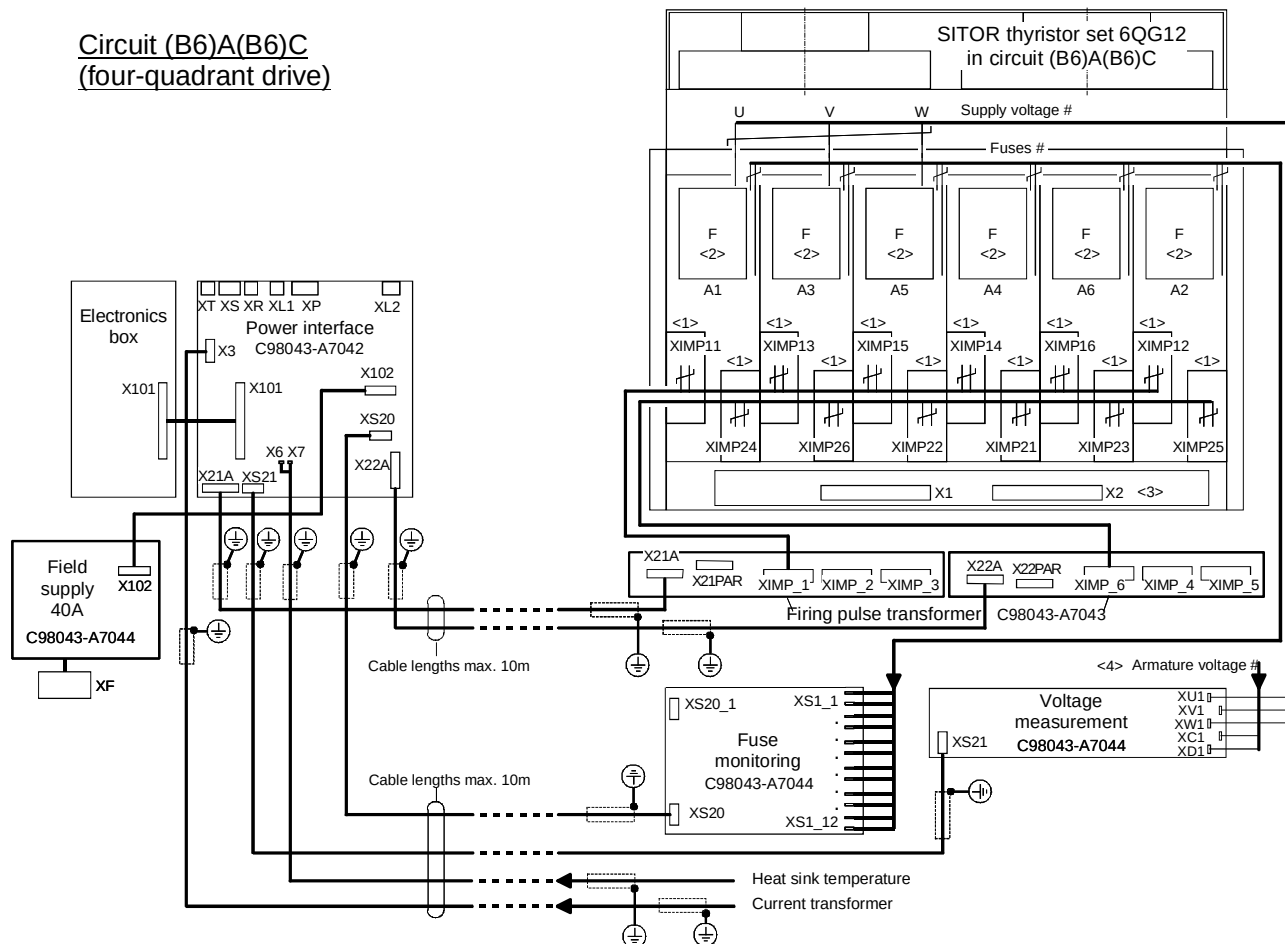
*) The SIMOREG control module is supplied with the front and rear trough mounted one on top of the other. Ribbon cables are already installed for this assembly type. See Chapter 2.3 for other cable lengths

4. Control of SITOR thyristor set 6QG12 U (Figs. 6.4 to 6.4)

With respect to cables, cable lengths, and separation of modules, largely corresponds to example 3.

The firing pulse transmission module (C98043-A7043) is completely separated. The individual plates with the firing pulse transformers can be slotted into the plastic supports on the power section instead of the old firing pulse transformer plates. The safety monitoring and voltage measurement are mounted directly next to the SITOR set.

Circuit (B6)A(B6)C (four-quadrant drive)



<1>

Firing pulse transformer C98043-A7043 into existing plastic mounts
(sequence according to the terminal designations as shown in the figure)

Cables to the firing pulse transformers from the terminal strips XIMP_1 and XIMP_6 to XIMP11 (IMP11, P24) to XIMP26 (IMP26, P24)

Firing cables X11 (K, G) to X26 (K, G) to the thyristors not shown
(X11 to X16 each to thyristor V01 in thyristor double module, X21 to X26 to thyristor V02)

<2>

Connection of fuse monitors to the Faston tabs on the fuse-carriers.
The supply voltage measurement can be connected to Faston tabs in thyristor modules A1 (=AK1 =U), A3 (=AK3 =V) and A5 (=AK5 =W) (see circuit diagram on next page).

<3> Do not connect X1, X2

<4> Measurement of armature voltage: Connections KW (AW) to C and AW (KW) to D

Fig. 6.4.4

#...short-circuit-proof cable laying

See also Fig. 6.4.6 for information and to simplify conversion (circuit diagram of SITOR set before conversion).

Rear view

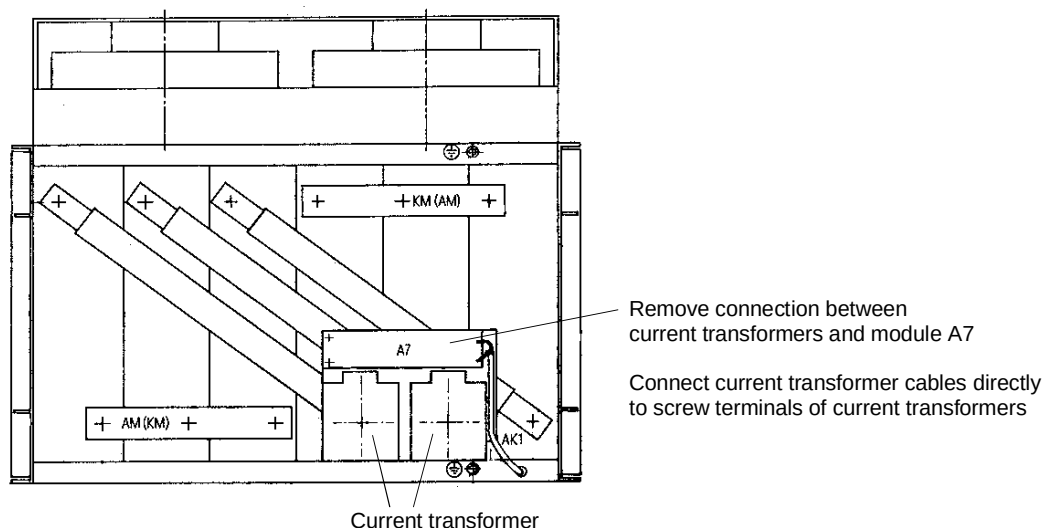
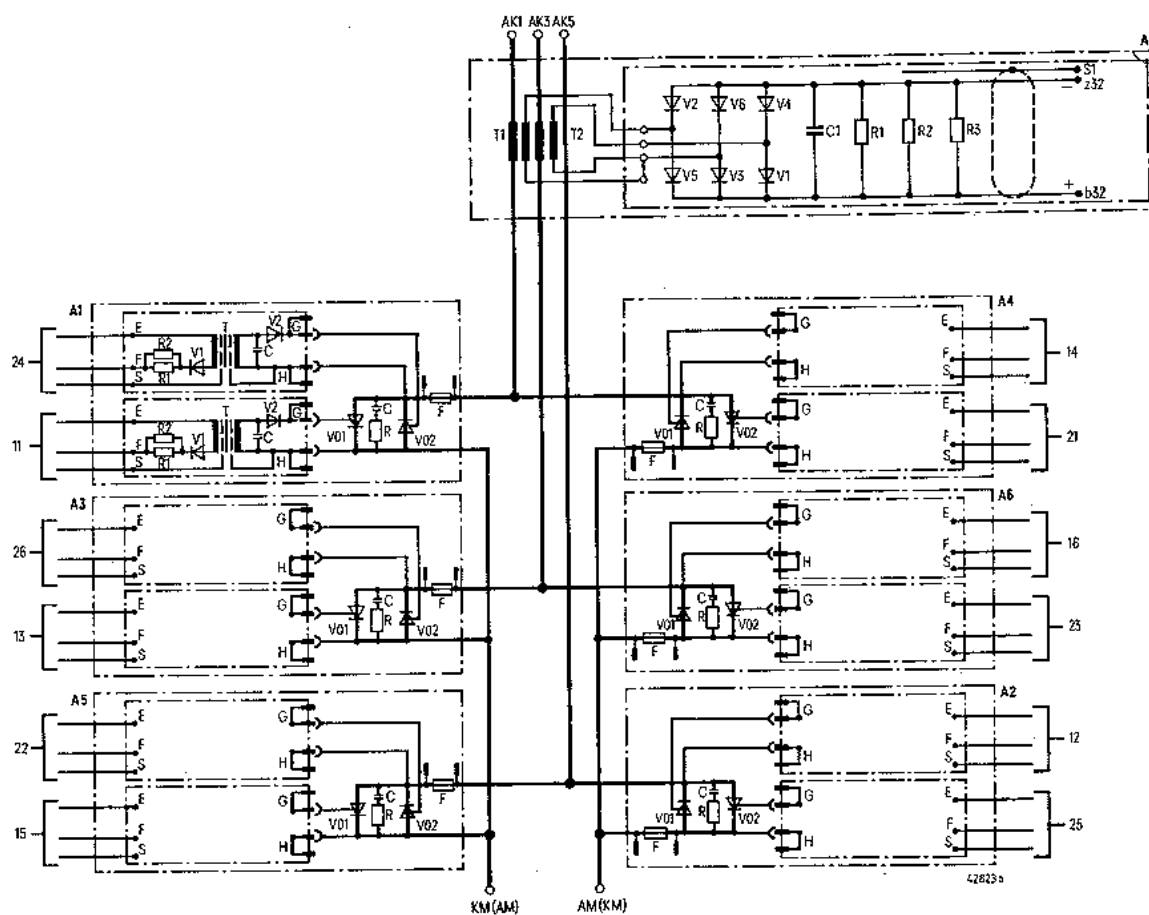


Fig. 6.4.5

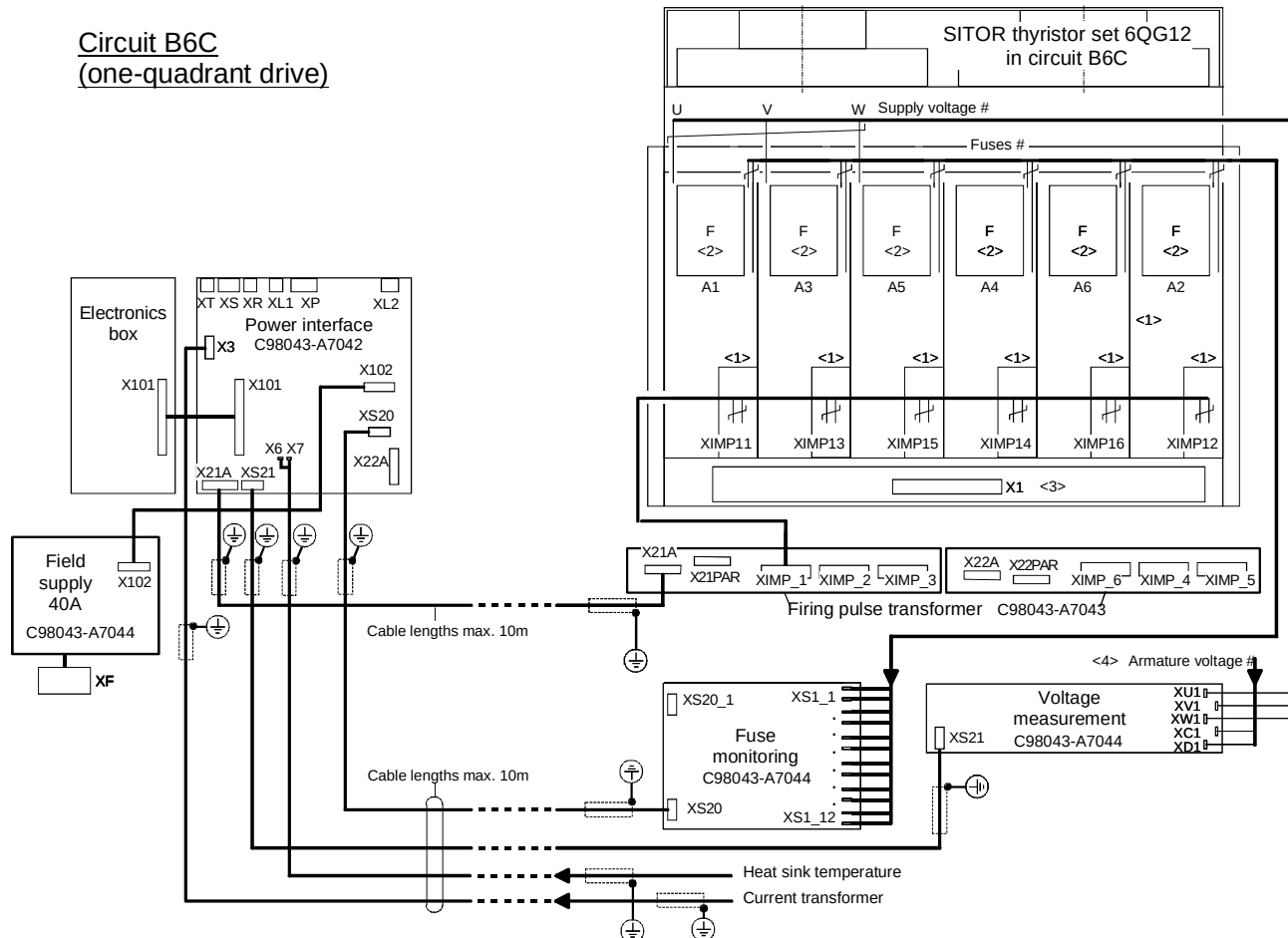
Circuit diagram SITOR set (4Q) before being equipped with SIMOREG CM (for information):



SITOR sets 6QG12 in inverse parallel connection of two three-phase connections [(B6)A(B6)C] with transformer module for actual current measurement (module A7 not used for SITOR sets 6QG12 without transformer module for actual current measurement)

Fig. 6.4.6

Circuit B6C (one-quadrant drive)



<1>

Firing pulse transformer C98043-A7043 into existing plastic mounts (sequence according to the terminal designations as shown in the figure)

Cables to the firing pulse transformers from the terminal strips XIMP_1 to XIMP11 (IMP11, P24) to XIMP16 (IMP16, P24)

Firing cables X11 (K, G) to X16 (K, G) to the thyristors not shown

<2>

Connection of fuse monitors to the Faston tabs on the fuse-carriers.

The supply voltage measurement can be connected to Faston tabs in thyristor modules A1 (=AK1 =U), A3 (=AK3 =V) and A5 (=AK5 =W) (see circuit diagram on next page).

<3>

Do not connect X1

<4>

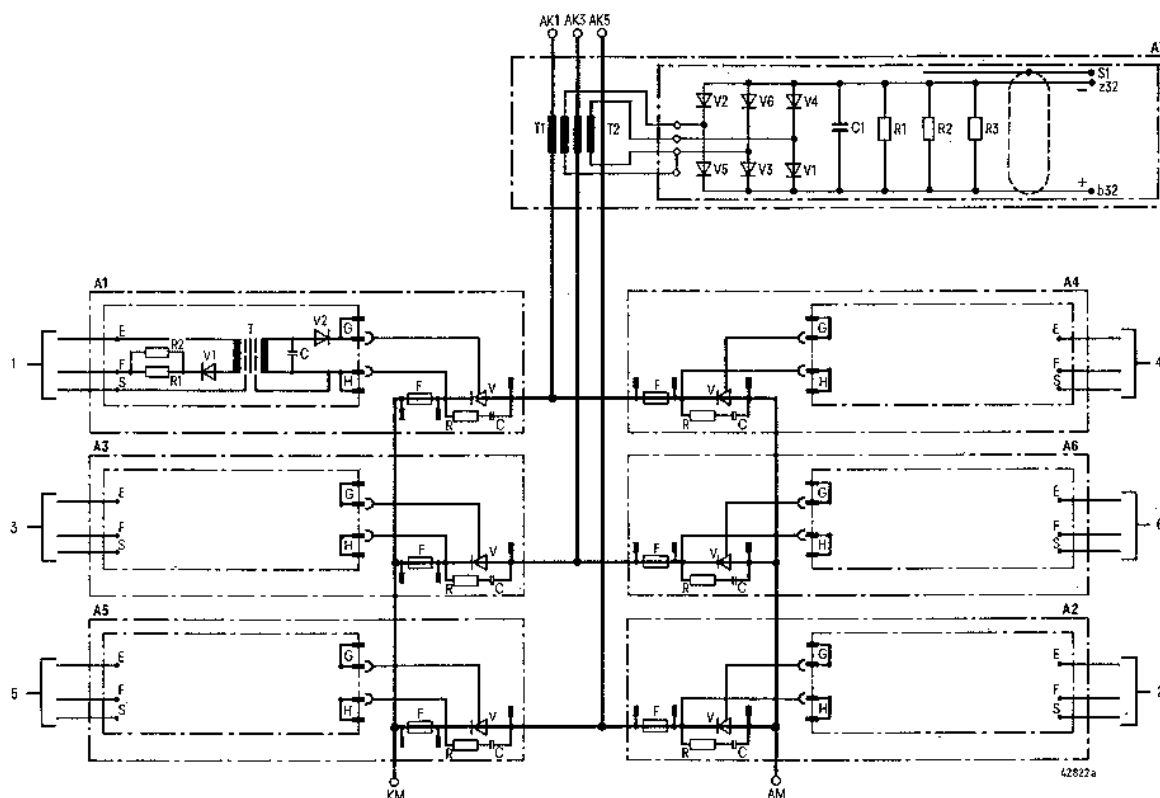
Measurement of armature voltage: Connection KW - C und AW - D (for how to connect Faston tabs on thyristor modules see circuit diagram on next page).

Fig. 6.4.7

#...short-circuit-proof cable laying

See also Fig. 6.4.8 for information and to simplify conversion (circuit diagram of SITOR set before conversion).

Circuit diagram SITOR set (1Q) before being equipped with SIMOREG CM (for information):



SITOR sets 6QG12 in three-phase bridge connection [B6C] with transformer module for actual current measurement (module A7 not used for SITOR sets 6QG12 without transformer module for actual current measurement)

Fig. 6.4.8

6.5 Measuring the armature current

6.5.1 General information

Measuring circuit at the power interface C98043-A7042:

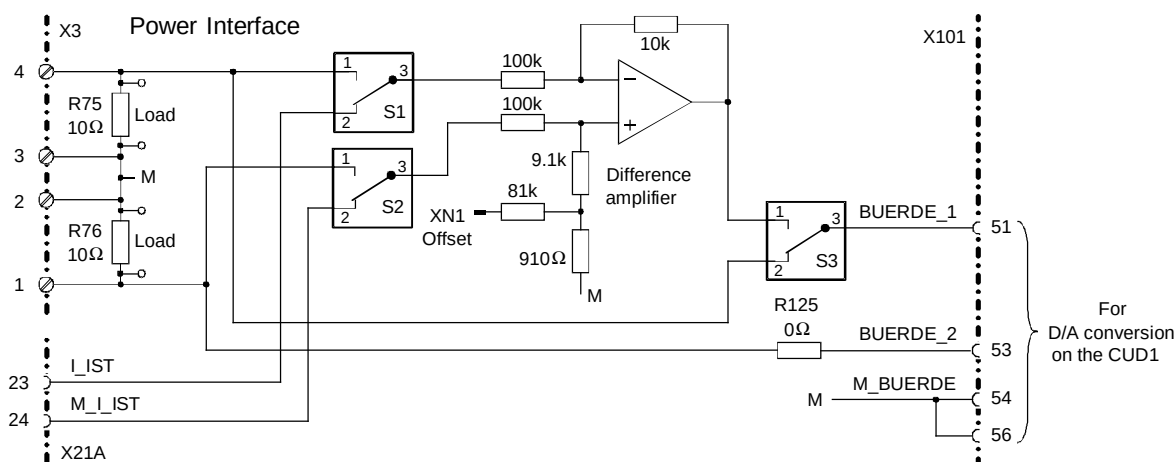
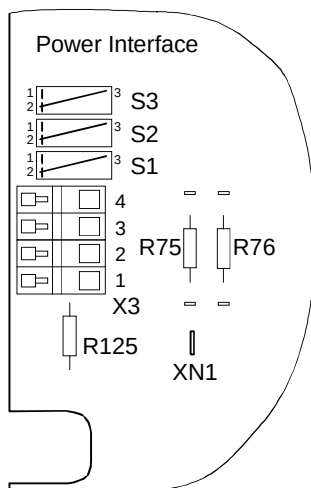


Fig. 6.5.1

Mechanical arrangement at the power interface C98043-A7042:



Note:

To ensure a secure connection, the jumpers of switches S1, S2, and S3 must be soldered into the hooks

Fig. 6.5.2

Dimensioning of the current transformers, load resistances

The D/A converter circuit on the CUD1 can process voltages up to $\pm 2.5V$ (peak value). When dimensioning the current transformers and load resistances, it is important to ensure that the voltage to X101-51 (BUERDE_1) or X101-53 (BUERDE_2) (see Fig. 6.5.1) never exceeds this value even with the highest overcurrent to be expected in the power section. In the state as delivered, the current actual value measurement of the CM is set such that a 1 V current actual value signal is set at device rated current. The difference amplifier with an amplification of 0.1 shown in Fig. 6.5.1 can be used to adapt the input voltage of existing measurements with other scalings.

We recommend that the current transformers and load resistors are dimensioned such that an average load voltage of maximum 1V is present at rated direct current of the armature.

If an external load resistor is used, the wires from it to terminal X3 should be kept as short as possible and twisted. The external load resistor itself should be contacted at four points (potential pick-off) and have as little inductance as possible to prevent measuring errors.

Four-point contacting means: The current to be measured is routed through the resistor. The resulting voltage (load voltage) is picked off at the connections at the distances specified by the manufacturer. This method ensures the most precise possible measurement. The load resistance must never be connected via two separate cables – this only increases the effective value of the load resistance and the converter provides too little current.

Only load resistances with a maximum power loss of 0.5 watts can be soldered to the soldering terminals parallel to the installed load resistances of 10 ohms. If 5A current converters already exist, 5A / 0.1 A coupling transformers should be used. In that case, standard R75 and R76 load resistances of 10 ohms each can be used.

If two current transformers in V-connection already exist, they can be connected directly to terminal X3 to reduce the time to the next current reversal (higher dynamic response on change of torque). For calculation of the load resistances see above.

Interposing transformers must not be connected directly behind a current transformer – and not behind a V-connection !

6.5.2 Current measurement with two current transformers on the network side

(state as delivered)

Configuration as shown in Chapter 6.3

Current transformer

X3-1	k	Current transformer signal	K	line side
X3-2	l	Reference ground	L	device side
X3-3	l	Reference ground		
X3-4	k	Current transformer 2 signal		

The current transformers must not be connected to ground externally. The connection must be made via terminals X3-2 and X3-3 only.

Recommended current transformers:

Up to armature current	Transformation ratio	Item number	MLFB number	Primary side
600 A	6000 : 1	C98130-A1023-C771	6RY1702-0AA03	Hole 31 x 5.5 mm
850 A	8500 : 1	C98130-A1023-C850	6RY1702-0AA06	Hole Ø 22 mm
1200 A	12000 : 1	C98130-A1023-C772	6RY1702-0AA04	Hole 61 x 10.5 mm
2400 A	24000 : 1	C98130-A1023-C773	6RY1702-0AA05	Cylindrical el. Cu height 45 mm hole dia. 12.2 mm

Switch positions

S1 in position 2 - 3

S2 in position 2 - 3

S3 in position 2 - 3

The position of switches S1 to S3 makes the difference amplifier on power interface C98043-A7042 (Fig. 6.5.1) inactive. The load voltages of X3 are connected directly to the control electronics.

Load resistances

$$R_B = \frac{U_B}{\dot{U} * I_d}$$

R_B = Load resistance

U_B = Load resistance (= average value across 1 current maximum value, not rms value or average value across whole period); Recommended value = 1 V

$\dot{U}$ = Transmission ratio of current transformer (I_2 / I_1)
(in general $\dot{U} = 1 / \text{number of turns per unit length}$)

I_d = Rated armature direct current

In the state as delivered, load resistors (R75, R76) of 10Ω are installed.

The values calculated for the load resistances can be set by soldering additional resistors on the soldering tags parallel to R75 and R76, possibly also removing R75 and R76.

To calculate load resistances precisely, the influence of the magnetizing current can be taken into account. If the magnetization current is not taken into account, "magnetizing current x number of turns" more current flows in the cables than is indicated.

Determining the magnetizing current:

The secondary current of the current transformer must flow through the series connection of its ohmic resistance (at maximum working temperature) and the load resistor, and any rectifier diodes. This produces a calculated voltage drop at rated current (sinusoidal). This voltage (50 Hz sine) is now applied on the secondary side and the magnetizing current measured. This is used in the calculations for R_B .

It is also important to ensure that the current transformers do not easily become saturated on overcurrent because otherwise the magnetization current would rise too quickly. A temperature rise caused by continuous load must also be monitored.

Load resistance taking the magnetizing current into account:

$$R_B = \frac{U_B}{\ddot{U} * (I_d + \frac{I_m}{\ddot{U}})}$$

I_m = Magnetizing current

Parameter settings

U822 = Rated armature direct current

U823 = Load voltage at armature rated current (state as delivered = 1000.0 mV)

U824 = 1: Current transformer in phases U and V

2: Current transformer in phases U and W (state as delivered)

3: Current transformer in phases V and W

6.5.3 Current measurement via terminal block X3 with external measuring circuit

6.5.3.1 External current transformer in V connection with +1V with rated armature direct current

Connection

The output signal of the V connection is connected to terminals X3-4 (I_IST) and X3-3 (M) (terminals X3-1 and X3-2 are not used).

Switch positions

S1 in position 2 - 3 (parking position)

S2 in position 2 - 3 (parking position)

S3 in position 2 - 3

Remove resistor R125. The difference amplifier is not used.

Parameter settings

U822 = Rated armature direct current

U823 = Input voltage for armature rated current

U824 = 4

Load

The load resistor of the V connection must be connected externally and must not be grounded. It is grounded via terminals X3-2 or X3-3. Remove R75 and R76.

6.5.3.2 External current transformer in V connection with +10V with rated armature direct current

Connection

The output signals of the V connection is connected to terminals X3-1 (I_IST) and X3-2 (M). Connect terminals X3-3 and X3-4.

Switch positions

S1 in position 1 - 3

S2 in position 1 - 3

S3 in position 1 - 3

Remove resistor R125.

The difference amplifier on the power interface is active. The input signal is attenuated by a factor of 10 (10 V to 1 V at rated direct current).

Parameter settings

U822 = Rated armature direct current

U823 = Input voltage for armature rated current / 10

U824 = 4

Load

The load resistor of the V connection must be connected externally and must not be grounded. It is grounded via terminals X3-2 or X3-3. Remove R75 and R76.

6.5.3.3 Differential input for +10V at rated armature direct current

Connection

X3-1 positive (not inverting), X3-4 negative (inverting). External grounding of the measuring circuit is recommended.

The effect of the difference amplifier is as a 10 / 1 attenuator.

Parameters, load and switches

Set as for V connection with +10V at rated armature direct current.

6.5.4 External current measurement via X21A

X21A-23 I_IST Negative current actual value via ribbon cable (e.g. of SIMADYN-D)

X21A-24 M_I_IST Reference potential

Switch positions

S1 in position 1 - 3

S2 in position 2 - 3

S3 in position 2 - 3

Remove resistor R125.

The difference amplifier is active. The input signal is attenuated by a factor of 10 (10 V to 1 V at rated direct current).

Parameter settings

U822 = Rated armature direct current

U823 = Input voltage for armature rated current / 10

U824 = 4

Optional offset correction via XN1

For 6QGXX Sitor sets with shunt current measurement and U/f and f/U conversion, the potentiometer (R202 on module 6QM400 for SITOR thyristor set 6QG22) must be adjusted to exactly voltage zero of the output voltage on the secondary side when the device is at zero current. See Chapter 6 of 6QG22 "Improvement of the noise immunity and drift problems of the analog current actual value in SITOR electronics". If this potentiometer is incorrectly set, not only an offset error, but also a scaling error in current measurement will occur. To allow extra adjustment of the offset for an exact current zero signal, connector XN1 on power interface A7042 must be connected to an analog output (± 10 volts) on control electronics A7001. The offset can be minimized by parameterizing the output voltage manually. However, this method does not eliminate the scaling error mentioned above. We therefore urge you first to set the potentiometer as precisely as possible.

6.5.5 Notes on the difference input, control range limits, and grounding

The difference amplifier reduces the signal level to a tenth of the input voltage and specification of the output level is only guaranteed up to ± 10 volts.

If the output signal of the external armature current measurement is normalized to ± 10 volts at rated current, no overcurrent can be measured. If the output signal of the armature current measurement is normalized to ± 5 volts at rated current, a current of $2 \times I_{\text{NOM}}$ can be measured. The user of the 6RA70 CM is urged to check whether the current measurement used provides a true image of the required overcurrent and the expected peak values within the necessary tolerance. Please ensure that image of the current in the current measurement circuit runs linearly up to the required

overcurrent capability. Otherwise clipping of the actual value with current overshoots and finally a tripped fuse is to be expected.

The most common risk is that the last operational amplifier of the measuring circuit will be overdriven. The problem can usually be avoided by normalizing the external current measurement to ± 5 volts. For example, R 462 must be short-circuited in the 6QG22. For example, R 71 must be jumpered with an additional 100k in the 6QG35. This ensures a control range up to 2 x rated current (± 10 volts).

Simoreg 6RA70 can process load signals up to ± 2.5 volts peak value ($= 2.5 \times$ rated current). Using the differential input, it is therefore possible to process a level of ± 25 volts peak value.

If a V connection with a load resistor without a downstream amplifier is used, it is advisable to dimension the load resistor for 1 volt at rated current. The internal resistor R76 with 10 ohms should be removed to minimize the effect of the resistance of the instrument lead and the terminal. Take care with the calculation if the resistor is left inside! Existing load resistors for 10 volts at rated current can be reduced to a tenth of their previous value and power loss. The connection is made at terminals X3-1 and X3-2, where X3-2 is the ground connection. There must be no other connections between the V connection and ground or zero potential.

If the connection of the V connection for 10 volts at rated current remains unchanged, one end of the load resistor should be grounded for EMC reasons. This can be done by directly placing a jumper between X3-1 and X3-2. If the V connection has already been grounded somewhere else, this connection must not be made. If an external measuring circuit is connected, its electronics reference potential must be grounded for EMC reasons. This can be done by directly placing a jumper between X3-1 and X3-2. If the measuring circuit has already be grounded somewhere else, the specified connection must not be made.

To avoid humming loops, the external measuring circuit or V connection must only be grounded at one point.

6.6 Connecting the firing transformer

6.6.1 General information

The 12 firing pulse drivers for the firing transformers are located on module A7042. The firing pulses for the first torque direction can be accessed by connector X21A and for the second torque direction, via connector X22A. Each firing pulse driver has its own open collector output with a parallel diode to electronics reference potential. A further diode is used to divert the opening overvoltages to P44 (plus 44 volts) internally. The 12 firing transformers (with internal 33 ohm series resistors) are located on module A7043 and are each connected between P24 and the firing circuit cable. The 12 firing pulse drivers can control a maximum of three firing transformers each (with internal 33 ohm series resistors). No short-circuit protection is provided! The user must ensure that the outputs are not overloaded. The maximum pulse current at each of these outputs is 1.5 amperes each. The whole circuit is dimensioned for long pulses.

6.6.1.1 Normal use (individual)

Connectors X21A and X22A are connected to connectors with the same designation on modules A7043 via two 26-way ribbon cables. The firing transformers on the module of the same name are then connected. If operation is in one current direction only, only the ribbon cable for X21A need be connected. If module A7043 is divided (broken), each firing transformer must be connected to the terminal row via two twisted cables.

6.6.1.2 Parallel connection of firing pulses

Up to three firing transformers (with 33 ohm series resistors installed) can be connected in parallel. They are supplemented by additional A7043 modules (firing transformers) (spare part order number 6RY1703-0CM01) connected via ribbon cable, or individual firing transformers are connected in parallel via two twisted cables each to the terminals of the same name.

- a) Two or three firing transformers can be connected in parallel to increase the firing current. In addition, the secondary sides of the firing transformers are connected in parallel for each firing pulse. The resulting firing current should be tested with a current probe and an oscilloscope.
- b) For operation in one current direction only (torque direction), the second half of module A7043 can be used for parallel connection of a power section or to increase the firing current. In this case, module A7043 of connector X21PAR is connected to connected X22PAR via a 26-way ribbon cable. Designations X21 and X26 on the firing pulse transformers are then no longer correct.



WARNING



Never connect more than three firing transformers to a firing pulse output !
There is a risk that the firing drivers on module A7042 (power interface) could be damaged by overloading.

Fuse on power interface (C98043-A7042) with F3 (1A medium time-lag fuse)

6.6.1.3 External amplification of firing pulses

If more than three power sections are to be connected in parallel, external firing pulse amplifiers (with PNP transistors) must be connected with a separate 24V supply. The maximum possible load on the internal firing pulse drivers (open collectors) is 1.5 A per pulse.

Their electronics ground cables are also brought out at connectors X21A and X22A.

The P24 cables on connectors X21A and X22A must not be loaded with more than 1 A (not usually connected). The external firing pulse amplifiers must be supplied with 24V (22V to 30 V) by a separate power supply unit. The supply conductors of the external firing pulse amplifiers must be sufficiently interference-free to avoid misfiring of the thyristors under the applicable conditions.

Note 1:

Normally, pull-up resistors are installed in the external firing pulse amplifiers. If they are missing, extra pull-up resistors can be connected to increase noise immunity. However, the pulse current must not exceed 1 A per output.

Note 2:

If several firing pulse amplifiers are connected in parallel on the input side to separate power supply units (e.g. Sitor sets), the inputs must be decoupled with isolation diodes. This measure is already included in the Sitor sets.

6.7 Connecting the voltage measurement

The following potentials on the power section must be connected to the voltage measurement (part of module A7044).

Power supply voltage 1U1, 1V1, and 1W1

Output voltage 1C1 and 1D1

The tabs are arranged in groups for the different power supply ranges.

Rated system voltage	Connect at	Parameters	Discharge resistor against ground
24 volts to 85 volts	85 V	U821 = 85	134 k Ω
86 volts to 250 volts	250 V	U821 = 250	394 k Ω
251 volts to 575 volts	575V	U821 = 575	910 k Ω
575 volts to 1000 volts	1000 V	U821 = 1000	1576 k Ω

Note: Parameter P078 index.001 must be set to the actual rated armature input voltage.

The voltage stage selected on the printed-circuit board must correspond to that in the software, otherwise the voltages measured will be grossly incorrect. External voltage transformers must be used for operation with supply voltages greater than 1000 V.

The leakage resistances against ground specified in the table are used to calculate the discharge current during hipot tests.



WARNING



The firing transformers no longer fulfill the safety requirements for supply voltages above 1000 volts.

The use of firing transformers with line isolation for higher voltages is then strongly recommended.



WARNING



Disconnect the power supply before making any connections!

The measurements might sustain serious or irreparable damage if connected incorrectly.

Non-observance of the safety instructions can result in death, severe personal injury, or substantial damage to property.

6.8 Connecting the fuse monitors

The fuses of one or more power sections can be monitored with one or more fuse monitors on the A7044. These cables must be connected in the same way as those of the voltage monitors. Each pair of adjacent tabs form a single monitor. The fuse monitors do not generate a ground leakage current.

Up to six groups of 6 fuse monitors each can be connected in parallel. This is achieved by looping through the signal of connector XS20_1 to connector XS20 on the next module. In this way, a maximum of 36 individual fuses can be monitored isolated from each other, or 72 fuses, if each pair is linked to a single phase.

Additional modules C98043-A7044 are available under spare part order number 6RY1703-0CM02.



WARNING



Disconnect the power supply before making any connections!

The monitors might sustain serious or irreparable damage if connected incorrectly.

Non-observance of the safety instructions can result in death, severe personal injury or substantial damage to property.

6.9 Parallel connection

6.9.1 Parallel connection of devices

6.9.1.1 Circuit diagram showing parallel connection of SIMOREG converters

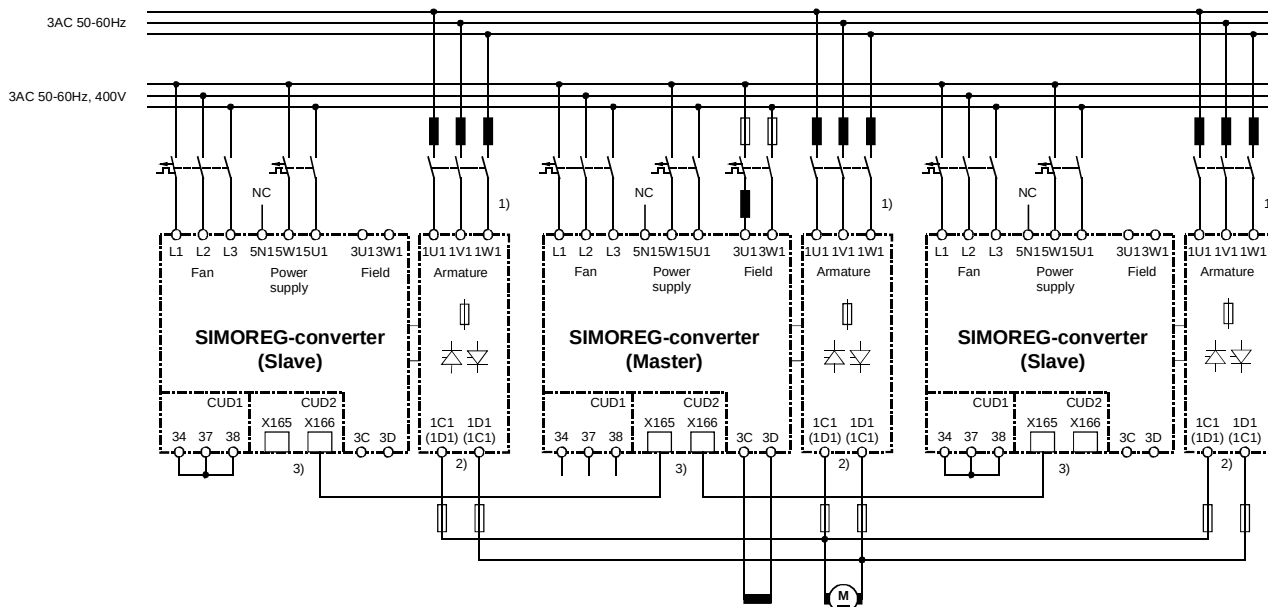


Fig. 6.9.1

- 1) The same phase sequence is required between 1U1 / 1V1 / 1W1.
- 2) The same phase sequence is required between 1C1 / 1D1.
- 3) The converters are connected by means of an (8-pin) shielded Patch cable of type UTP CAT5 according to ANSI/EIA/TIA 568, such as those used in PC networking.
A standard 5 m cable can be ordered directly from Siemens (order number: 6RY1707-0AA08).
(n-1) cables are needed to connect n converters in parallel.
The bus terminator must be activated (U805=1) on the converter at each end of the bus.

The terminal expansion option (CUD2) is required for each converter in a parallel connection.

A maximum of 6 converters can be connected in parallel.

When several converters are connected in parallel, the master unit should be positioned in the center to allow for signal transit times. Maximum length of paralleling interface cable between master and slave converters at each end of bus: 15m.

For the purpose of current distribution, separate commutating reactors of the same type are required for each power section. Current distribution is determined by the differential reactor tolerance. A tolerance of 5% or higher is recommended for operation without derating (reduced current).

Caution:

Parallel connections may only be made between converters with the same DC current rating!

6.9.1.2 Parameterization of SIMOREG converters for parallel connection

1) Standard operating mode

Master	Slaves
U800 = 1 Paralleling interface active	U800 = 2 Paralleling interface active Use master firing pulses
U803 = 0 "N+1 operation" not active	
U804.01 = 30 Control word 1 U804.02 = 31 Control word 2 U804.03 = 167 Actual speed value	U804.01 = 32 Status word 1
U805 = 1 (bus terminator) at the two outermost devices (at the two physical ends of the bus cable) 0 (no bus terminator) at all other devices	
U806.01 = 12 master for one slave 13 master for 2 slaves 14 master for 3 slaves 15 master for 4 slaves 16 master for 5 slaves set U806.02 as U806.01	U806.01 = 2 1 slave U806.01 = 2 and 3 2 slaves U806.01 = 2, 3 and 4 3 slaves U806.01 = 2,3,4 and 5 4 slaves U806.01 = 2,3,4,5 and 6 5 slaves set U806.02 as U806.01
P082 <> 0 operating mode for field	P082 = 0 internal field is not used
Set P083 according to source of speed actual value	P083 = 4 Freely connected actual speed value P609 = 6023 Use actual speed value of master
$P100 = \frac{\text{Motor_rated_current}}{\text{Number_of_SIMOREG_units}}$	$P100 = \frac{\text{Motor_rated_current}}{\text{Number_of_SIMOREG_units}}$
Set P648, P649 according to source of control word	P648 = 6021 Use control word 1 from master P649 = 6022 Use control word 2 from master
	P821.01 = 31 Suppress alarm A031
P110 = actual armature resistance x no. of SIMOREG converters P111 = actual armature inductance x no. of SIMOREG converters The optimization run for current controller and precontrol (P021 = 25) sets these parameters correctly.	P110 = set as on master P111 = set as on master

For further details about the operating principle of parallel connections between SIMOREG converters, please refer to Section 8, Function Diagrams, Sheet 41 (paralleling interface).

Notes:

Control commands "Switch-on/Shutdown", "Enable operation", "Emergency stop" etc. must be connected to a group of parallel-connected SIMOREG converters via the master device. Terminals 37 and 38 must be permanently connected to terminal 34 on the slaves !

Optimization runs must be started on the master device. All slaves must be connected and ready to run when optimization is started.

2) Operating mode "N+1 – operation" (redundancy operation)

Master	Standby master	Slaves
U800 = 1 Paralleling interface active	U800 = 2 Paralleling interface active Use master firing pulses	
U803 = 1 "N+1 operation" active		
U804.01 = 30 control word 1 U804.02 = 31 control word 2 U804.02 = 167 speed actual value U804.04 = any U804.05 = any U804.06 = 32 status word 1 U804.07 = any U804.08 = any U804.09 = any U804.10 = any	U804.01 = 32 status word 1 U804.02 = any U804.03 = any U804.04 = any U804.05 = any U804.06 = 30 control word 1 U804.07 = 31 control word 2 U804.08 = 167 speed actual value U804.09 = any U804.10 = any	U804.01 = 32 status word 1 U804.02 = any U804.03 = any U804.04 = any U804.05 = any U804.06 = any U804.07 = any U804.08 = any U804.09 = any U804.10 = any
U805 = 1 (bus terminator) 0 (no bus terminator)	on the two outermost devices (at the two physical ends of the bus cable) at all other devices	
U806.01 = 12 masters + 1 slave 13 masters +2 slaves 14 masters +3 slaves 15 masters +4 slaves 16 masters + 5 slaves U806.02 = 2 Slave 2	U806.01 = 2 Slave 2 U806.02 = 12 masters + 1 slave 13 masters +2 slaves 14 masters +3 slaves 15 masters +4 slaves 16 masters + 5 slaves	U806.01 = 3 2 slaves U806.01 = 3 and 4 3 slaves U806.01 = 3,4 and 5 4 slaves U806.01 = 3,4,5 and 6 5 slaves U806.02 = set like U601.01
P082 <> 0 operating mode for field	P082 = 0 internal field is not used	
Set P083 according to source of speed actual value		P083 = 4 Freely connected actual speed value P609 = 6023 Use actual speed value of master
$P100 = \frac{\text{Motornennstrom}}{\text{Anzahl der SIMOREG – Geräte}}$		
Set P648, P649 according to source of control word		P648 = 6021 Use control word 1 from master P649 = 6022 Use control word 2 from master
		P821.01 = 31 Suppress alarm A031
U807 = 0.000s telegram failure does not cause a fault signal		
P110 = Actual armature resistance x no. of SIMOREG converters P111 = Actual armature inductance x no. of SIMOREG converters The optimization run for current controller and precontrol (P021 = 25) sets these parameters correctly.	P110 = set as on master P111 = set as on master	

For further details about the operating principle of parallel connections between SIMOREG converters, please refer to Section 8, Function Diagrams, Sheet 41 (paralleling interface).

Notes:

In this mode, it is possible to maintain operation of the remaining SIMOREG converters even if one of the devices fails (e.g. fuse tripped on power section). The correctly functioning SIMOREG converters continue operation without interruption even if a device fails. When configuring, it is necessary to take into account that the power of only n devices (instead of n+1 devices) must be sufficient for the application.

- Control commands "Switch-on/Shutdown", "Enable operation", "Emergency stop" etc. must be connected to a group of parallel-connected SIMOREG converters on the master AND on the "standby" master.
Terminals 37 and 38 must be permanently connected to terminal 34 on the slaves !
- The speed setpoint and the speed actual value must also be connected to a group of parallel-connected SIMOREG converters on the master AND on the "standby" master. !
- All parameters, with the exception of those specified in the list above, must be set on the master and the "standby" master.
- Optimization runs must be started on the master device. All slaves must be connected and ready to run when optimization is started.

6.9.2 Parallel connection of power sections

6.9.2.1 Current distribution / symmetry:

When connecting power sections in parallel, correct current distribution is important. None of the power sections must be overloaded in unsuitable conditions. Provision for sufficient power reduction must be made if necessary. The same type of construction and design for all parallel firing transformers / firing pulse amplifiers is therefore urgently recommended. Current distribution in the parallel connected power sections must be checked during commissioning and, if necessary, corrected by adapting the series impedances (commutating reactors, supply leads, and transformer). If there are unexpected problems, the simultaneity of the triggering pulses on the thyristors must be checked. The operating times of the firing pulses must not differ by more than 200 nanoseconds. We recommend comparing the firing currents of the thyristors with two small current probes on the oscilloscope. In the case of a galvanic connection, the power section must be safely de-energized to prevent accidents.

6.9.2.2 Comment about voltage measurement / synchronization:

The most suitable method is the connection of voltage measurements 1U1, 1V1, and 1W1 and the branching points of the network supply. The motor voltage connections 1C1 and 1D1 are non-critical.

6.9.2.3 Comment about fuse monitoring

As far as possible, all fuses of the parallel connected devices should be monitored. Especially important is the monitoring of the fuses on the branches that are not measured by a current transformer. Here, a current splitting unbalance by the SIMOREG converters is not measurable.

NOTE:

The currents measured through the SIMOREG converters (current distribution) are only based on the values derived from the current transformer. Current distribution in the phase that is not routed through current transformers (usually 1V1), cannot be measured on the SIMOREG itself.

**WARNING**

Disconnect the power supply before making any connections!

The measurements might sustain serious or irreparable damage if connected incorrectly.

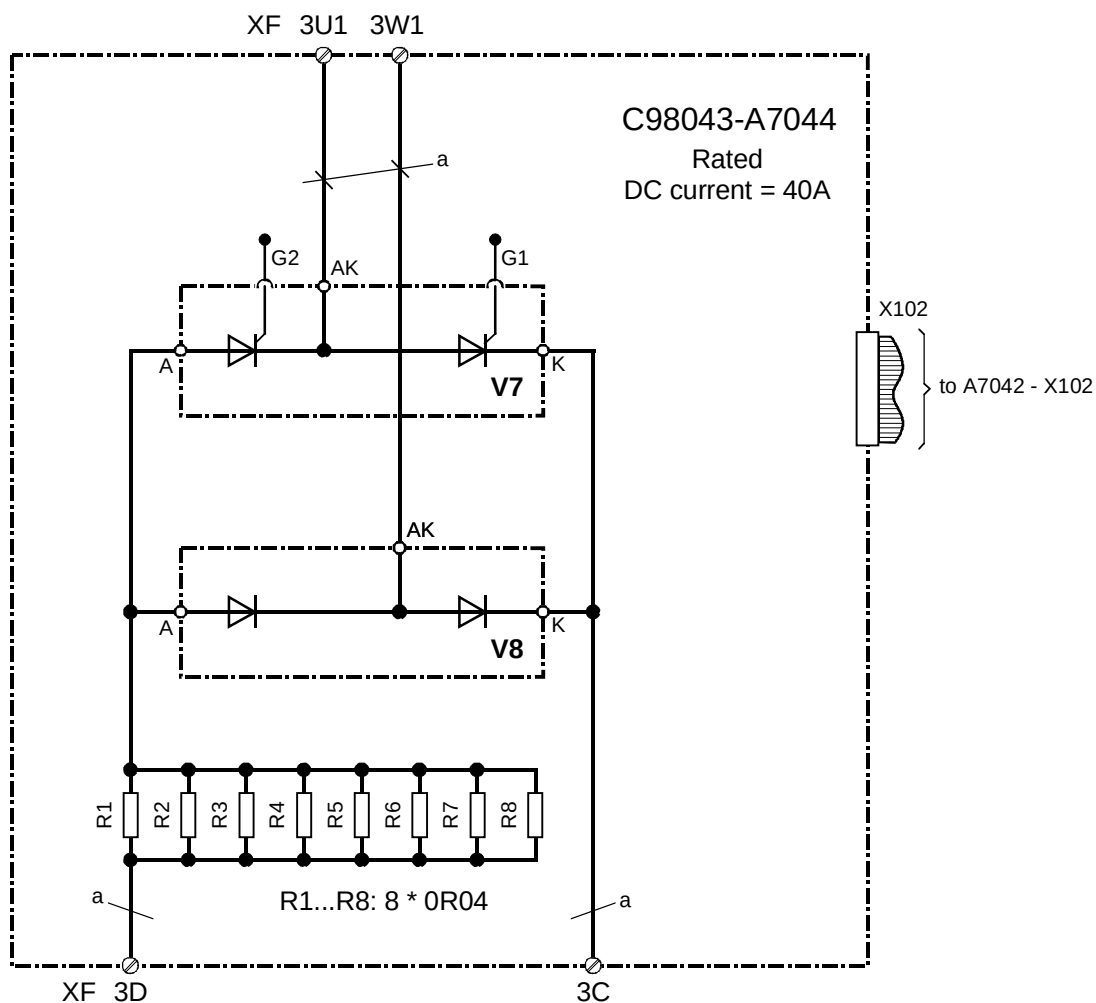


The device must be installed in conformance with the safety regulations (e.g. DIN, VDE) and all other relevant national and regional guidelines. Correct grounding, cable dimensioning, and the relevant short-circuit protection must be provided to guarantee operational safety.

Non-observance of the safety instructions can result in death, severe personal injury or substantial damage to property .

6.10 Field supply

6.10.1 Circuit diagram of the power section



a = Betatherm 145 6mm²

Gating leads are Betatherm 145 1mm²

Fig. 6.10.1.1

6.10.2 Voltage measurement of the field power section

Rated supply voltage	Parameters	Ground leakage resistance
130 V (field extra-low voltage)	U828 = 130	510 kΩ
460V (state as delivered)	U828 = 460	1815 kΩ

6.10.3 Conversion to field extra-low voltage

For a field supply of less than 130 V supply voltage, the field supply section of module A7044 must be converted.

-Insert wire jumpers acc. to Fig. 6.10.3.1

Ring cable lugs for M6, 6.3 mm Faston connectors, wire cross section > 0.75 mm²

-Set parameter U828 = 130 (field extra-low voltage).

-Set P078 index.002 to the actual field rated input voltage

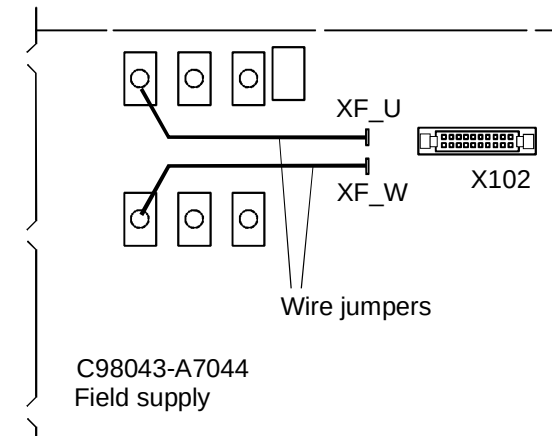


Fig. 6.10.3.1



WARNING

These two wire jumpers must be removed again for operation with a higher field supply voltage.

6.11 Fuses and commutating reactors

6.11.1 Notes on commutating reactors

The network impedance including commutating reactors should be between 4% and 10% short-circuit voltage. Commutating reactors must be dimensioned according to the regional guidelines for feedback on the network.

Please refer to Catalog DA93.1 regarding ordering data and selection criteria of commutating reactors.

6.11.2 Fuses for the field circuit

For technical data, configuring data and dimension drawings, please refer to Catalog DA94.1.

Recommended fuses for the field circuit

Max. permissible field current	Fuse order No.	Rated current of fuse
10 A	5SD420	16 A
15 A	5SD440	25 A
25 A	5SD440	25 A
30 A	5SD480	30 A
40 A	3NE1802-0	40 A

6.12 Arrangement of printed circuit boards

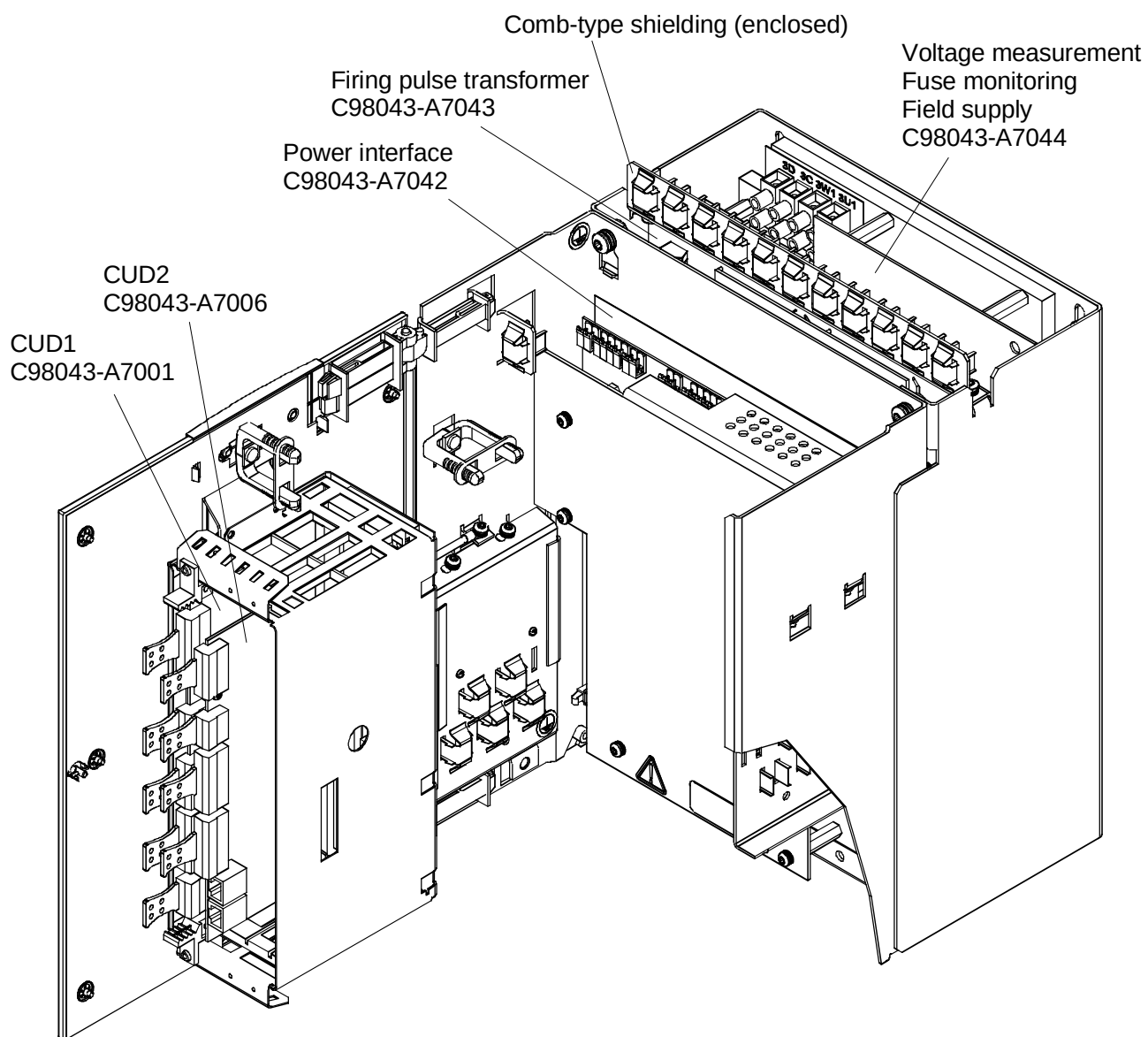


Fig. 6.3.1

6.13 Arrangement of customer connections
(terminals, connectors, Faston tabs)

Module C98043-A7001 (CUD1)

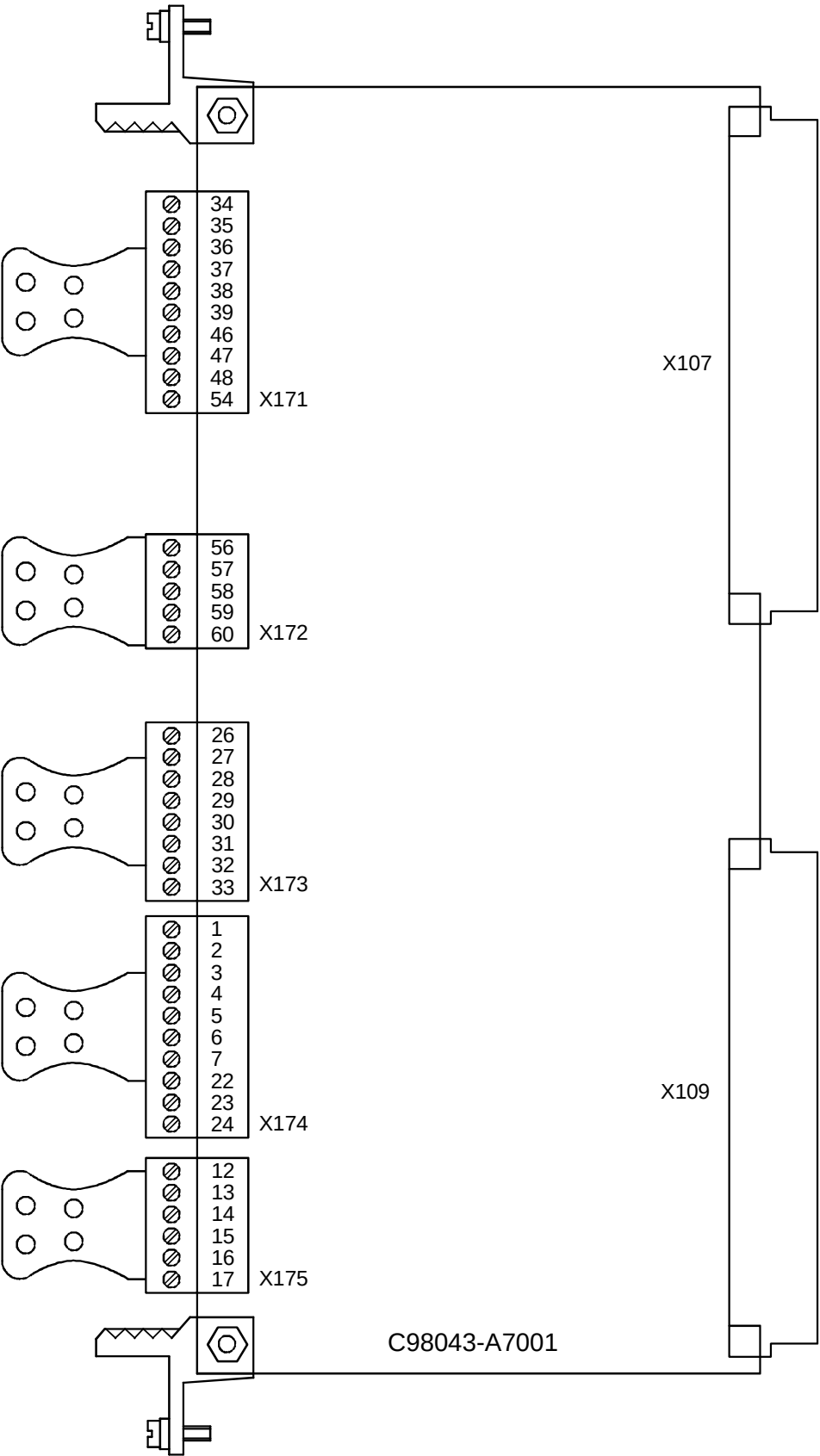


Fig. 6.13.1

Module C98043-A7006 (CUD2)

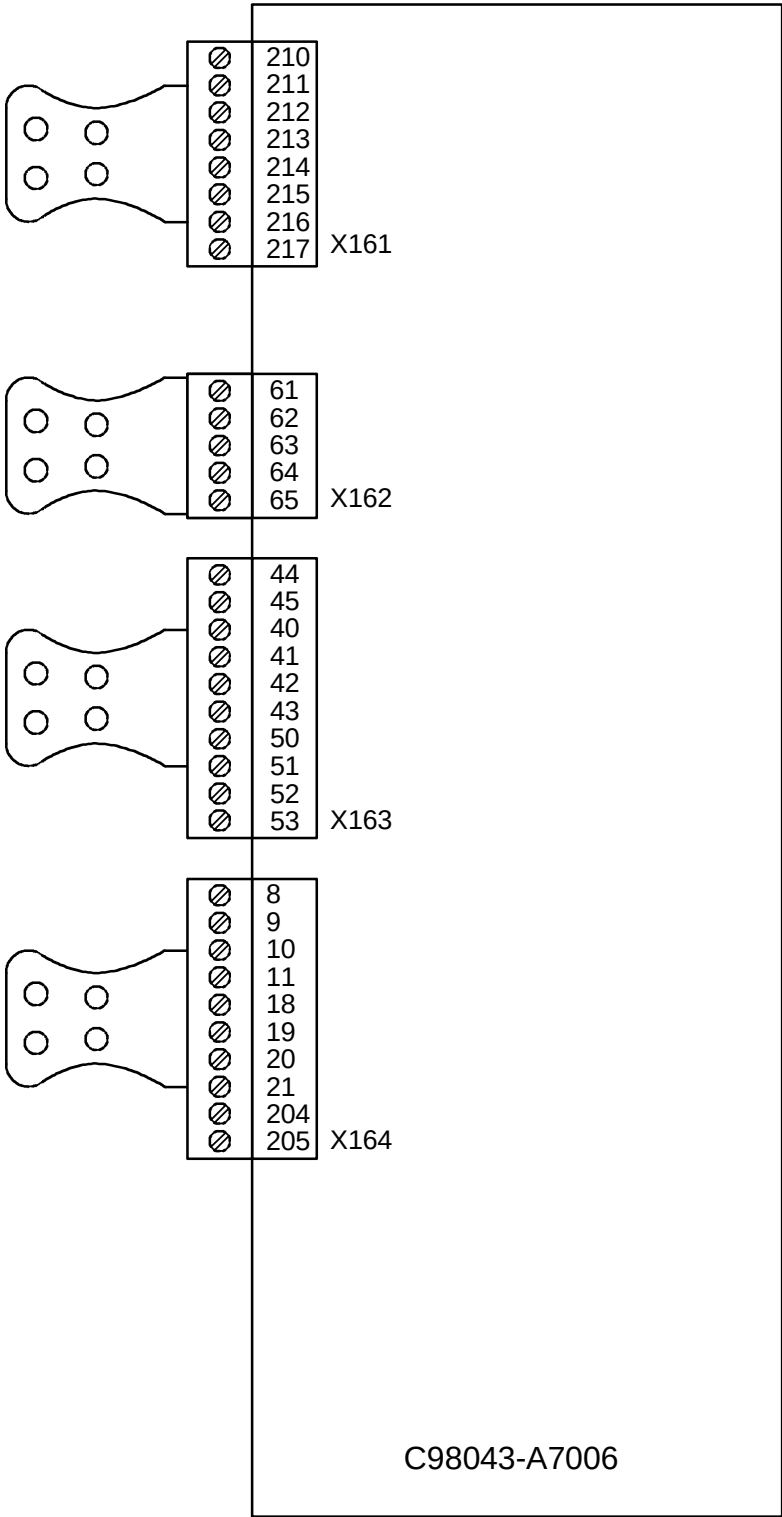


Fig. 6.13.2

Module C98043-A7042

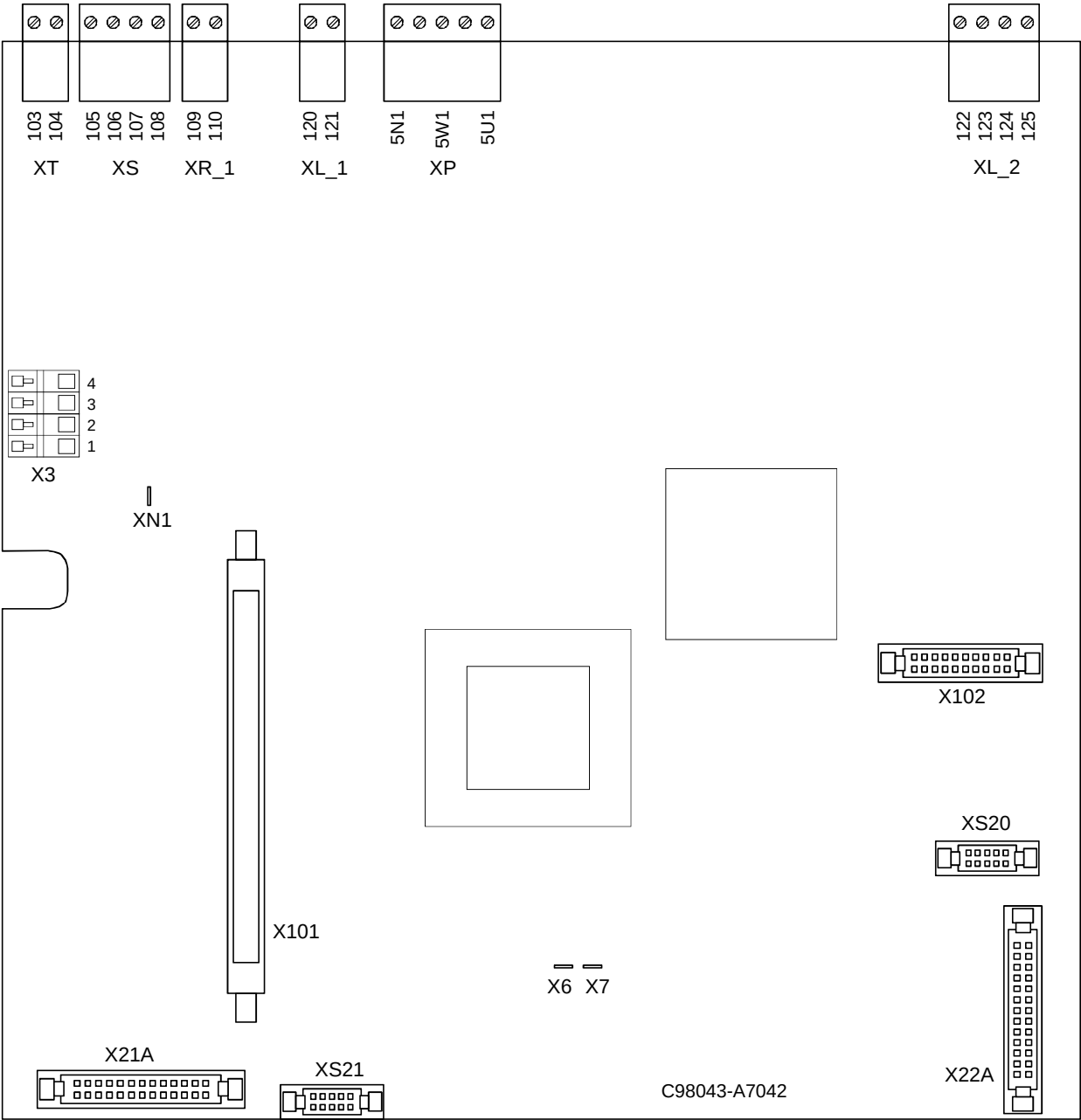


Fig. 6.13.3

Module C98043-A7043

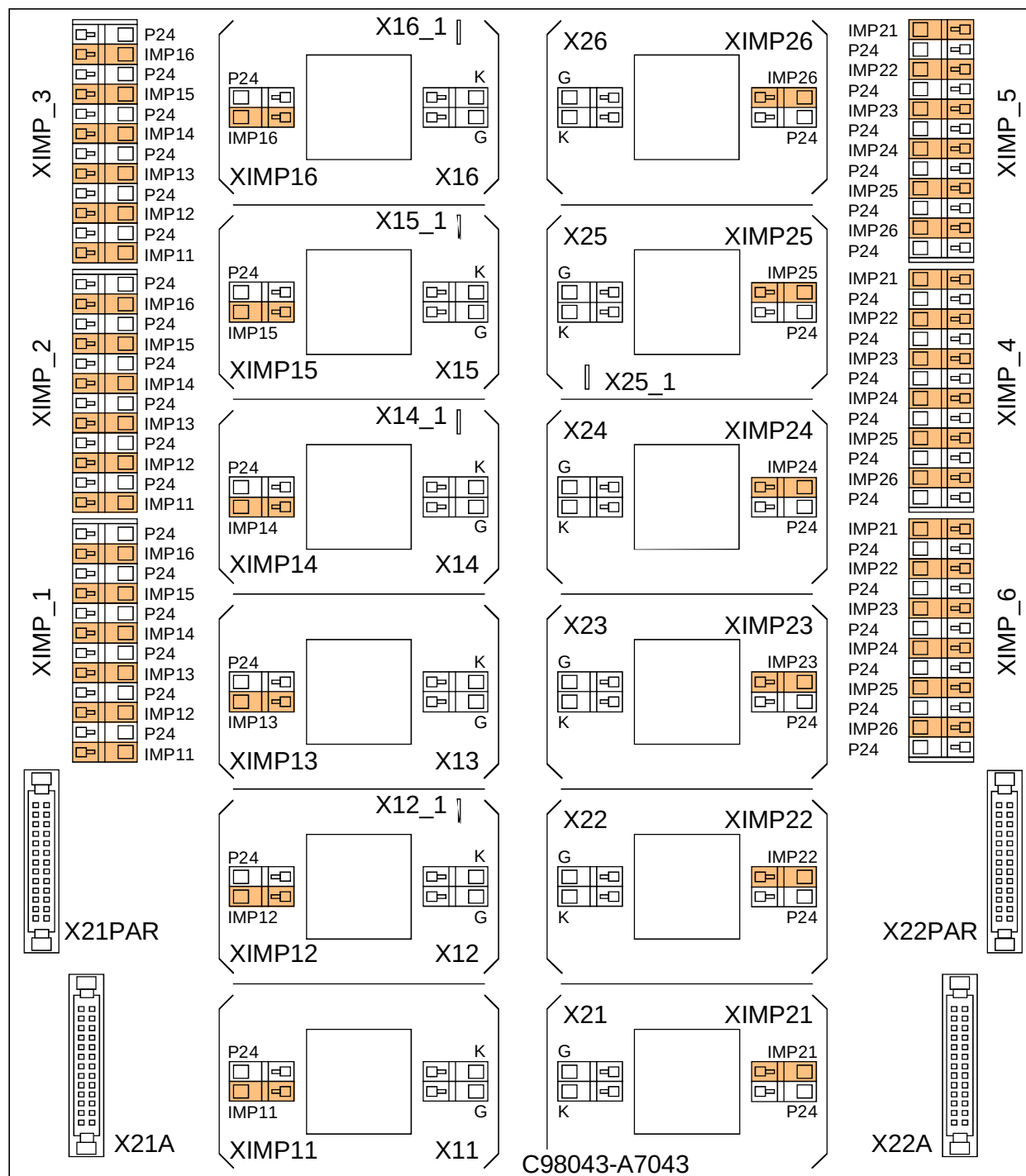


Fig. 6.13.4

Note:

Each of the following connections are connected in parallel:

- Terminals with the same designation on terminal strips XIMP_1, XIMP_2 and XIMP_3
- Terminals with the same designation on terminal strips XIMP_4, XIMP_5 and XIMP_6
- X21A and X21PAR
- X22A and X22PAR

Module C98043-A7044

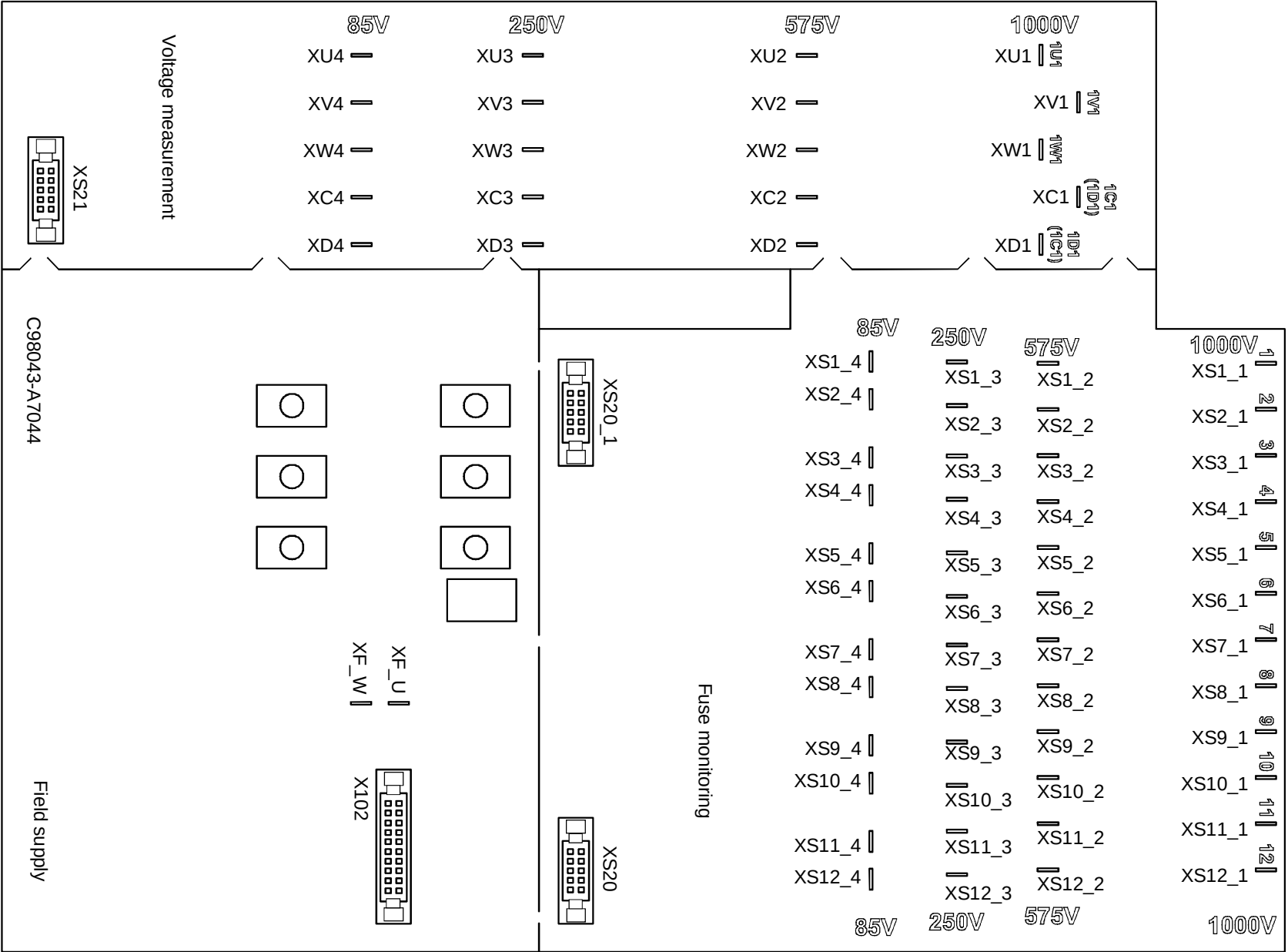


Fig. 6.13.5

6.14 Terminal assignment (terminals, Faston tabs, ribbon cables)



WARNING



The converter might sustain serious or irreparable damage if connected incorrectly.

The power cables and/or busbars must be secured mechanically with strain relief outside the converter.

Field circuit

Terminal type: European standard terminal strip (screw-type terminal)
maximum conductor cross section 10 mm²

Function	Terminal XF	Connection values/remarks
Supply connection	3U1 3W1	2AC 400 (– 20%), 2AC 460 (+10%)
Field winding connection	3C 3D	Rated DC voltage 325V / 373V For 2AC 400 / 460 supply connection

Type of connection: Faston tabs, 6.3mm

Function	Connection	Connection values/remarks
	XF_U XF_W	For conversion of supply voltage measurement (field) to extra-low voltage acc. to Chapter 6.10.2.

Electronics power supply

Terminal type: Type 49 plug-in terminal
Maximum cross-section 1.5mm², finely stranded

Module C98043-A7042 power interface

Function	Connect.	Terminal XP	Connection values/remarks
Incoming supply 400V	12NC 3	5U1 5W1 5N1	2AC 380V (–25%) to 460V (+15%); I _n =1A (– 35% for 1min) Internal fusing with F1, F2 (1A medium time lag) on module C98043-A7042 External fusing max. 6A, characteristic C
or			
Incoming supply 230V	123	5U1 5W1 5N1	1AC 190V (–25%) to 230V (+15%); I _n =1A (– 35% for 1min) Internal fusing with F1, F2 (2 x 1A medium time lag) on module C98043-A7042 External fusing max. 6A, characteristic C

NOTE

In the case of line voltages which exceed the tolerance range specified in Section 3.4, the electronics supply voltage and the field circuit mains supply connection must be adjusted by means of transformers to the permissible value stated in Section 3.4. It is essential to use an isolating transformer for rated line voltages in excess of 460V.

The rated supply voltage for the armature circuit (index 001) and the field circuit (index 002) must be set in parameter P078.

Open-loop and closed-loop control sectionTerminal type: X171 to X175

Plug-in terminal (screw-type)

Maximum connection cross-section 1.5mm²**XR_1, XL_1, XS, XT**

MSTB2.5 plug-in terminal

Maximum connection cross-section 2.5mm²**Analog inputs - setpoint inputs, reference voltage** (see also Section 8, sheet G113)

Module C98043-A7001 (CUD1)

Function	Terminal X174	Connection values/remarks
Reference M P10 N10	1 2 3	} ±1% at 25°C (stability 0.1% per 10°K); 10mA short-circuit-proof
Unassigned inputmain setpoint + main setpoint –	4 5	
Unassigned inputanalog 1 + analog 1 –	6 7	
		Input type (signal type) parameterizable: - Differential input ±10V; 150kΩ - Current input 0 - 20mA; 300Ω or 4 - 20mA; 300Ω Resolution can be parameterized up to approx. 555µV (±14bit) Common mode suppression: ±15V

Analog inputs - actual speed inputs, tacho inputs (see also Section 8, sheet G113)

Module C98043-A7042 power interface

Function	Terminal XT	Connection values/remarks
Tachometer connection8V to 270V	103	±270V; >143kΩ
Ground analog M	104	

Pulse encoder input (see also Section 8, sheet G145)

Module C98043-A7001 (CUD1)

Function		Terminal X173	Connection values/remarks
Supply (+13.7V to +15.2V)		26	200mA; short-circuit-proof (electronic protection)
Ground pulse encoder M		27	Overload response: Error signal F018 Warning signal A018
Track 1	Plus connection	28	Load: =5.25mA at 15V (w/o switching losses, see below for cable, cable length, shield connection)
	Minus connection	29	
Track 2	Plus connection	30	Switching hysteresis: see below
	Minus connection	31	Pulse/pause ratio: 1:1
Zero marker	Plus connection	32	Level of input pulses: see below.
	Minus connection	33	Track offset: Table 1 see below. Pulse frequency: Table 2 see below. Cable length: see below

Characteristic data of pulse generator evaluation electronics**Level of input pulses:**

Encoder signals (symmetrical / asymmetrical) up to a max. 27V differential voltage can be processed by the analyzer electronics.

Electronic adaptation of evaluation electronics to the signal voltage of the encoder:

- Rated input voltage range **5V** (P142=0):
 Low level: Differential voltage <0.8V
 High level: Differential voltage >2.0V
 Hysteresis: >0.2V
 Common-mode control range: ±10V
- Rated input voltage range **15V** (P142=1):
 Low level: Differential voltage <5.0V
 High level: Differential voltage >8.0V
 Restriction: See switching frequency
 Hysteresis: >1V
 Common-mode control range: ±10V

If the pulse encoder does not supply symmetrical encoder signals, then its ground must be routed as a twisted-pair lead with every signal cable and connected to the negative terminals of track 1, track 2, and the zero marker.

Switching frequency:

The maximum permissible frequency of the encoder pulses is 300kHz. To ensure correct evaluation of the encoder pulses, the minimum distance $T_{\min}$ between two encoder signal edges (tracks 1 and 2) specified in the table must be observed:

Table 1:

	Rated input voltage 5V		Rated input voltage 15V		
Differential voltage ¹⁾	2V	>2.5V	8V	10V	>14V
$T_{\min}$ ²⁾	630ns	380ns	630ns	430ns	380ns

- 1) Differential voltage at the terminals of the evaluation electronics
- 2) The phase error L_G (deviating from 90°), which may occur as the result of encoder and cable, can be calculated from $T_{\min}$:

$$L_G = \pm (90^\circ - f_p * T_{\min} * 360^\circ)$$

L_G = phase error

f_p = pulse frequency

$T_{\min}$ = minimum edge spacing

This formula applies only if the encoder pulse/pause ratio is 1:1.

If the pulse encoder is incorrectly matched to the encoder cable, disturbing cable reflections will be produced at the receive end. These reflections must be damped so that the encoder pulses can be correctly evaluated. The limit values listed in the table below must be maintained to ensure that the resultant power loss in the adapting element of the evaluation electronics is not exceeded.

Table 2:

$f_{\max}$	50kHz	100kHz	150kHz	200kHz	300kHz
Differential voltage ³⁾	Up to 27V	Up to 22V	Up to 18V	Up to 16V	Up to 14V

- 3) Differential voltage of encoder pulses at no load
(approximate encoder power supply voltage)

Cable, cable length, shield connection:

The encoder cable capacitance must be recharged at each encoder edge change. The RMS value of this current is proportional to the cable length and the pulse frequency and must exceed the current specified by the encoder manufacturer. A suitable cable as recommended by the encoder manufacturer must be used. The maximum cable length must not be exceeded. Generally, a twisted cable pair with common pair shield is sufficient for each track. Crosstalk between the cables is thus reduced. The shielding of all pairs protects against noise pulses. The shield must be connected to the shield bar of the SIMOREG converter with a large contact surface.

Temperature sensor inputs – Motor interface (1) (see also Chapter 8, Sheet G185)

Module C98043-A7001 (CUD1)

Function	Terminal X174	Connection values/remarks
Motor temperature	22	Sensor acc. to P490 index 1
Connection of temperature sensor	23	
Ground analog M	24	

Analog outputs (see also Section 8, sheet G115)

Module C98043-A7001 (CUD1)

Function	Terminal X175	Connection values/remarks
Actual current	12	0. . . ±10V corresponds to 0. . . ±200% Rated device current Max. load 2mA, short-circuit-proof
Ground analog M	13	
Unassigned output analog 1	14	0. . . ±10V, max. 2mA Short circuit proof Resolution ±11bit
Ground analog M	15	
Unassigned output analog 2	16	
Ground analog M	17	

Digital inputs (see also Section 8, sheet G110)

Module C98043-A7001 (CUD1)

Function	Terminal X171	Connection values/remarks
Supply (output)	34	24V DC, short circuit proof max. load 200mA (terminals 34, 44, and 210 combined), internal supply with respect to internal ground Overload response: Error signal F018 Warning signal A018
Ground digital M	35	
Unassigned input binary 1	36	
Power On / Shutdown H signal: Power ON Line contactor CLOSED + (with H signal at terminal 38), acceleration along ramp-function generator ramp to operating speed. L signal: Shutdown Deceleration along ramp- function generator ramp to $n < n_{min}$ (P370) + , controller disable + line contactor OPEN. See Section 9.3.3 for exact function description.	37	
Enable operation H signal: Controller enabled L signal: Controller disabled See Section 9.3.4 for exact function description	38	H signal: +13V to +33V L signal: – 33V to +3V or terminal open 8.5mA at 24V
Unassigned input binary 2	39	

Monitoring inputs

Module C98043-A7042 power interface

Function	Terminal XL_2	Connection values/remarks
Fan monitoring + (L signal = interference F067)-	122 123	Differential inputs Max. input voltage $\pm 50V$ Common mode range $-2V$ to $+50V$ L signal: $< 8V$ H signal: $> 11V$ Input resistance 30 kohms
External monitoring + (L signal = interference F003)-	124 125	

Safety shutdown (E-STOP, see also Section 9.8)

Module C98043-A7042 power interface

Function	Terminal XS	Connection values/remarks
Supply for safety shutdown (output)	106	24V DC, max. load 50mA, short-circuit-proof Overload response: Error signal F018 Warning signal A018
Safety shutdown Switch	105	$I_e = 20\text{mA}$
Safety shutdown Button	107	NC contact $I_e = 30\text{mA}$
Safety shutdown Reset	108	NO contact $I_e = 10\text{mA}$

NOTE

Both 105 + 106 terminals or 106, 107 + 108 terminals can be used! Combined use of terminals 105 – 108 will result in a malfunction.

Terminal 105 is connected to terminal 106 in the state as delivered.

Digital outputs (see also Section 8, sheet G112)

Module C98043-A7001 (CUD1)

Function	Terminal X171	Connection values/remarks
Unassigned outputbinary 1 Ground M	46 47	H signal: +19 to +30V L signal: 0 to +2V short circuit proof 100mA
Unassigned outputbinary 2 Ground M	48 54	Internal suppressor circuit (freewheeling diode)

Control outputs (floating relay outputs)

Module C98043-A7042 power interface

Function	Terminal XR_1	Connection values/remarks
Relay for line contactor	109 110	Load capability: =250V AC, 4A; $\cos\Phi=1$ =250V AC, 2A; $\cos\Phi=0,4$ =30V DC, 2A External fusing max. 4A, characteristic C recommended

Module C98043-A7042 power interface

Function	Terminal XL_2	Connection values/remarks
Relay for fan protection	120 121	Load capability: =250V AC, 4A; $\cos\Phi=1$ =250V AC, 2A; $\cos\Phi=0,4$ =30V DC, 2A External fusing max. 4A, characteristic C recommended

Serial interface 1 RS232 (9-pin SUBMIN D socket connector)**X300****Use a shielded connecting cable! Ground shield at both ends!**

Module C98043-A7005 PMU

Con. pin X300	Function
1	Housing ground
2	Receive cable to RS232 (V.24) standard
3	Send and receive cables to RS485, two-wire, positive differential input/output
4	Input: Reserved for later use
5	Ground
6	5 V voltage supply for OP1S
7	Send cable to RS232 (V.24) standard
8	Send and receive cables to RS485, two-wire, positive differential input/output
9	Ground

Cable length: Up to 15m according to EIA Standard RS232C
Up to 30 m capacitive load, max. 2.5nF (cable and receiver)

A serial connection can be made to a PLC or PC with cable connector X300 on the PMU. The device can then be controlled and operated from a central control center or control room.

Serial interface 2 RS485

Module C98043-A7001 (CUD1)

Function	Terminal X172	Connection values/remarks
TX+	56	RS485, 4-wire send cable, positive differential input
TX-	57	RS485, 4-wire send cable, negative differential input
RX+/TX+	58	RS485, 4-wire receive cable, positive differential input, 2-wire send/receive cable, positive differential input
RX-/TX-	59	RS485, 4-wire receive cable, negative differential input, 2-wire send/receive cable, negative differential input
M	60	Ground

Cable length: For transmission rate =187.5kBd $\Rightarrow$ 600m
For transmission rate =93.75kBd $\Rightarrow$ 1200m

The following must be observed: DIN 19245 Part 1

In particular, the difference in potential between the data reference potentials M of all interfaces must not exceed -7V / +12V. If this cannot be guaranteed, equipotential bonding must be provided.

Activation of interface 1 or 2:

- Set the baud rate in parameter P783 or P793.
- Set the protocol in parameter P780 or P790.

Temperature sensor inputs

Type of connection: Faston tabs, 2.8mm

Module C98043-A7042 power interface

Function	Connection	Connection values/remarks
Heat sink temperature	X6	Sensor acc. to U830
Connection of temperature sensor	X7	

Current transformer connections

Terminal type: Cage clamp terminal
maximum connection cross-section 1.5mm²

Module C98043-A7042 power interface

Function	Terminal X3	Connection values/remarks
Current transf.T1 Connect. k1	4	see Chapter 6.3 Configuration of current transformer acc. to U824
Connect. I1 (M)	3	
Current transf.T2 Connect. I2 (M)	2	
Connect. k2	1	

Balance actual current measurement

Type of connection: Faston tabs, 2.8mm

Module C98043-A7042 power interface

Function	Connection	Connection values/remarks
Feed-in point for balance actual current measurement	XN1	see Chapter 6.5

Monitoring, field supply**Voltage measurement**

Type of connection: Faston tabs, 6.3mm

Module C98043-A7044 voltage measurement

Function	Connection	Connection values/remarks
Meas. of the supply voltage Phases U-V-W (1000V)	XU1 XV1 XW1	Rated voltage network (armature) = > 575 to 1000V (U821 = 1000)
Meas. of armature voltage (1000V)	XC1 XD1	Rated voltage network (armature) = > 575 to 1000V (U821 = 1000)
Meas. of the supply voltage Phases U-V-W (575V)	XU2 XV2 XW2	Rated voltage network (armature) = > 250 to 600V (U821 = 575)
Meas. of armature voltage (575V)	XC2 XD2	Rated voltage network (armature) = > 250 to 600V (U821 = 575)
Meas. of the supply voltage Phases U-V-W (250V)	XU3 XV3 XW3	Rated voltage network (armature) = > 85 to 250V (U821 = 250)
Meas. of armature voltage (250V)	XC3 XD3	Rated voltage network (armature) = > 85 to 250V (U821 = 250)
Meas. of the supply voltage Phases U-V-W (85V)	XU4 XV4 XW4	Rated voltage network (armature) = ≤ 85V (U821 = 85)
Meas. of armature voltage (85V)	XC4 XD4	Rated voltage network (armature) = ≤ 85V (U821 = 85)

Fuse monitoring

Type of connection: Faston tabs, 6.3mm

Module C98043-A7044 fuse monitoring

Function	Connection	Connection values/remarks
Fuse 1 (1000V)	XS1_1 XS2_1	Measuring cables for the monitored fuses at network rated voltage = > 575 to 1000V *)
Fuse 2 (1000V)	XS3_1 XS4_1	
Fuse 3 (1000V)	XS5_1 XS6_1	
Fuse 4 (1000V)	XS7_1 XS8_1	
Sicherung 5 (1000V)	XS9_1 XS10_1	
Fuse 6 (1000V)	XS11_1 XS12_1	
Sicherung 1 (575V)	XS1_2 XS2_2	Measuring cables for the monitored fuses at network rated voltage > 250 to 600V *)
Fuse 2 (575V)	XS3_2 XS4_2	
Fuse 3 (575V)	XS5_2 XS6_2	
Sicherung 4 (575V)	XS7_2 XS8_2	
Fuse 5 (575V)	XS9_2 XS10_2	
Fuse 6 (575V)	XS11_2 XS12_2	
Fuse 1 (250V)	XS1_3 XS2_3	Measuring cables for the monitored fuses at network rated voltage > 85 to 250V *)
Fuse 2 (250V)	XS3_3 XS4_3	
Fuse 3 (250V)	XS5_3 XS6_3	
Fuse 4 (250V)	XS7_3 XS8_3	
Fuse 5 (250V)	XS9_3 XS10_3	
Fuse 6 (250V)	XS11_3 XS12_3	
Fuse 1 (85V)	XS1_4 XS2_4	Measuring cables for the monitored fuses at network rated voltage = 20 to 85V *)
Fuse 2 (85V)	XS3_4 XS4_4	
Fuse 3 (85V)	XS5_4 XS6_4	
Fuse 4 (85V)	XS7_4 XS8_4	
Fuse 5 (85V)	XS9_4 XS10_4	
Fuse 6 (85V)	XS11_4 XS12_4	

*) The fuse monitoring device is usually connected to the armature current circuit but can also be used for the field circuit, fan circuit, or the primary circuit of a heavy current transformer. The connections of the fuse monitoring used are based on the voltage applied to a tripped fuse.

Firing pulse transformer (C98043-A7043)

Terminal type: Cage clamp terminal
maximum connection cross-section 1.5mm²

Fuse of P24 on power interface (C98043-A7042) with F3 (1A medium time-lag fuse)

Module C98043-A7043 firing pulse module

Function	Terminal XIMP_1	Connection values/remarks
Gate control for firing pulse transformer for thyristor V11	IMP11 P24	When the firing pulse transformer module is divided (see Chapter 6.4), the gate controls for the firing pulse transformers are led through these terminal connections The following connections must be implemented for this: XIMP_1 - IMP11 → XIMP11 - IMP11 (for thyristor V11) XIMP_1 - P24 → XIMP11 - P24 (for thyristor V11) XIMP_1 - IMP12 → XIMP12 - IMP12 (for thyristor V12) XIMP_1 - P24 → XIMP12 - P24 (for thyristor V12) etc.
Gate control for firing pulse transformer for thyristor V12	IMP12 P24	
Gate control for firing pulse transformer for thyristor V13	IMP13 P24	
Gate control for firing pulse transformer for thyristor V14	IMP14 P24	
Gate control for firing pulse transformer for thyristor V15	IMP15 P24	
Gate control for firing pulse transformer for thyristor V16	IMP16 P24	

Module C98043-A7043 firing pulse module

Function	Terminal XIMP_2	Connection values/remarks
Gate control for firing pulse transformer for thyristor V11	IMP11 P24	The terminals of terminal strip IMP_2 are parallel to the terminals of the same designation of terminal strip XIMP_1.
Gate control for firing pulse transformer for thyristor V12	IMP12 P24	
Gate control for firing pulse transformer for thyristor V13	IMP13 P24	
Gate control for firing pulse transformer for thyristor V14	IMP14 P24	
Gate control for firing pulse transformer for thyristor V15	IMP15 P24	
Gate control for firing pulse transformer for thyristor V16	IMP16 P24	

Module C98043-A7043 firing pulse module

Function	Terminal XIMP_3	Connection values/remarks
Gate control for firing pulse transformer for thyristor V11	IMP11 P24	The terminals of terminal strip IMP_3 are parallel to the terminals of the same designation of terminal strip XIMP_1.
Gate control for firing pulse transformer for thyristor V12	IMP12 P24	
Gate control for firing pulse transformer for thyristor V13	IMP13 P24	
Gate control for firing pulse transformer for thyristor V14	IMP14 P24	
Gate control for firing pulse transformer for thyristor V15	IMP15 P24	
Gate control for firing pulse transformer for thyristor V16	IMP16 P24	

Module C98043-A7043 firing pulse module

Function	Terminal XIMP_4	Connection values/remarks
Gate control for firing pulse transformer for thyristor V21	IMP21 P24	When the firing pulse transformer module is divided (see Chapter 6.4), the gate controls for the firing pulse transformers are led through these terminal connections The following connections must be implemented for this: XIMP_4 - IMP21 → XIMP21 - IMP21(for thyristor V21) XIMP_4 - P24 → XIMP21 - P24(for thyristor V11) XIMP_4 - IMP22 → XIMP22 - IMP22(for thyristor V22) XIMP_4 - P24 → XIMP22 - P24(for thyristor V12) etc.
Gate control for firing pulse transformer for thyristor V22	IMP22 P24	
Gate control for firing pulse transformer for thyristor V23	IMP23 P24	
Gate control for firing pulse transformer for thyristor V24	IMP24 P24	
Gate control for firing pulse transformer for thyristor V25	IMP25 P24	
Gate control for firing pulse transformer for thyristor V26	IMP26 P24	

Module C98043-A7043 firing pulse module

Function	Terminal XIMP_5	Connection values/remarks
Gate control for firing pulse transformer for thyristor V21	IMP21 P24	The terminals of terminal strip IMP_5 are parallel to the terminals of the same designation of terminal strip XIMP_4.
Gate control for firing pulse transformer for thyristor V22	IMP22 P24	
Gate control for firing pulse transformer for thyristor V23	IMP23 P24	
Gate control for firing pulse transformer for thyristor V24	IMP24 P24	
Gate control for firing pulse transformer for thyristor V25	IMP25 P24	
Gate control for firing pulse transformer for thyristor V26	IMP26 P24	

Module C98043-A7043 firing pulse module

Function	Terminal XIMP_6	Connection values/remarks
Gate control for firing pulse transformer for thyristor V21	IMP21 P24	The terminals of terminal strip IMP_6 are parallel to the terminals of the same designation of terminal strip XIMP_4.
Gate control for firing pulse transformer for thyristor V22	IMP22 P24	
Gate control for firing pulse transformer for thyristor V23	IMP23 P24	
Gate control for firing pulse transformer for thyristor V24	IMP24 P24	
Gate control for firing pulse transformer for thyristor V25	IMP25 P24	
Gate control for firing pulse transformer for thyristor V26	IMP26 P24	

Module C98043-A7043 firing pulse module

Function	Terminal XIMP11	Connection values/remarks
Gate control for firing pulse transformer for thyristor V11	IMP11 P24	Only connect if the firing pulse transformer module is divided (see terminal strip IMP_1)

Function	Terminal X11	Connection values/remarks
Firing cable thyristor V11	G K	Firing pulse (see below) gate (G) against auxiliary cathode (K)

Function	Terminal XIMP12	Connection values/remarks
Gate control for firing pulse transformer for thyristor V12	IMP12 P24	only connect if the firing pulse transformer module is divided (see terminal strip IMP_1)

Function	Terminal X12	Connection values/remarks
Firing cable thyristor V12	G K	Firing pulse (see below) gate (G) against auxiliary cathode (K)

Function	Terminal XIMP13	Connection values/remarks
Gate control for firing pulse transformer for thyristor V13	IMP13 P24	Only connect if the firing pulse transformer module is divided (see terminal strip IMP_1)

Function	Terminal X13	Connection values/remarks
Firing cable thyristor V13	G K	Firing pulse (see below) gate (G) against auxiliary cathode (K)

Function	Terminal XIMP143	Connection values/remarks
Gate control for firing pulse transformer for thyristor V14	IMP14 P24	Only connect if the firing pulse transformer module is divided (see terminal strip IMP_1)

Function	Terminal X14	Connection values/remarks
Firing cable thyristor V14	G K	Firing pulse (see below) gate (G) against auxiliary cathode (K)

Function	Terminal XIMP15	Connection values/remarks
Gate control for firing pulse transformer for thyristor V15	IMP15 P24	Only connect if the firing pulse transformer module is divided (see terminal strip IMP_1)

Function	Terminal X15	Connection values/remarks
Firing cable thyristor V15	G K	Firing pulse (see below) gate (G) against auxiliary cathode (K)

Function	Terminal XIMP16	Connection values/remarks
Gate control for firing pulse transformer for thyristor V16	IMP16 P24	Only connect if the firing pulse transformer module is divided (see terminal strip IMP_1)

Function	Terminal X16	Connection values/remarks
Firing cable thyristor V16	G K	Firing pulse (see below) gate (G) against auxiliary cathode (K)

Function	Terminal XIMP21	Connection values/remarks
Gate control for firing pulse transformer for thyristor V21	IMP21 P24	Only connect if the firing pulse transformer module is divided (see terminal strip IMP_4)

Function	Terminal X21	Connection values/remarks
Firing cable thyristor V21	G K	Firing pulse (see below) gate (G) against auxiliary cathode (K)

Function	Terminal XIMP22	Connection values/remarks
Gate control for firing pulse transformer for thyristor V22	IMP22 P24	Only connect if the firing pulse transformer module is divided (see terminal strip IMP_4)

Function	Terminal X22	Connection values/remarks
Firing cable thyristor V22	G K	Firing pulse (see below) gate (G) against auxiliary cathode (K)

Function	Terminal XIMP23	Connection values/remarks
Gate control for firing pulse transformer for thyristor V23	IMP23 P24	Only connect if the firing pulse transformer module is divided (see terminal strip IMP_4)

Function	Terminal X23	Connection values/remarks
Firing cable thyristor V23	G K	Firing pulse (see below) gate (G) against auxiliary cathode (K)

Function	Terminal XIMP24	Connection values/remarks
Gate control for firing pulse transformer for thyristor V24	IMP24 P24	Only connect if the firing pulse transformer module is divided (see terminal strip IMP_4)

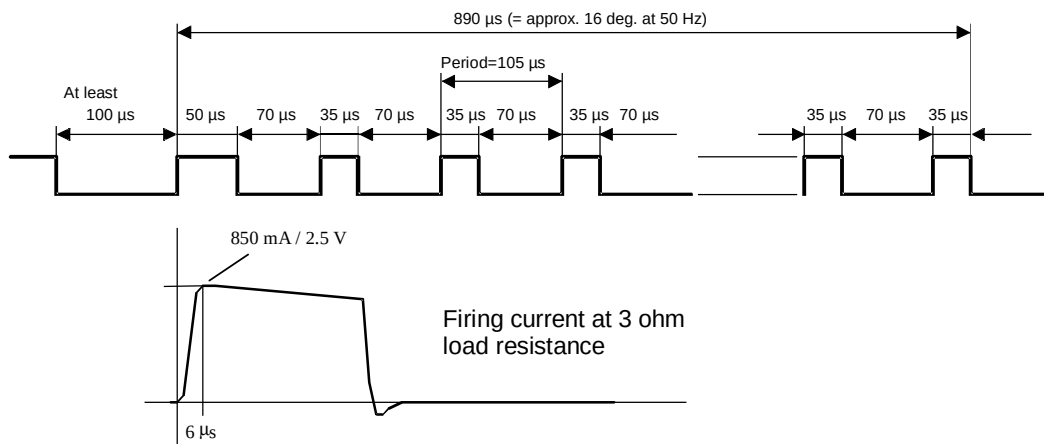
Function	Terminal X24	Connection values/remarks
Firing cable thyristor V24	G K	Firing pulse (see below) gate (G) against auxiliary cathode (K)

Function	Terminal XIMP25	Connection values/remarks
Gate control for firing pulse transformer for thyristor V25	IMP25 P24	Only connect if the firing pulse transformer module is divided (see terminal strip IMP_4)

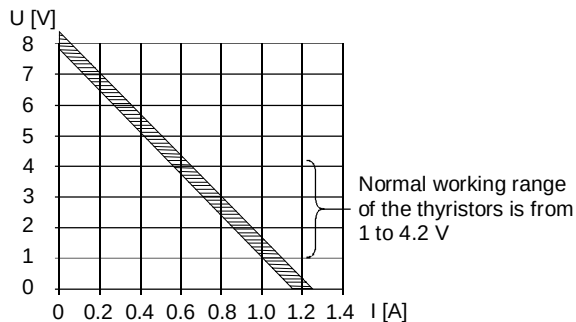
Function	Terminal X25	Connection values/remarks
Firing cable thyristor V25	G K	Firing pulse (see below) gate (G) against auxiliary cathode (K)

Function	Terminal XIMP26	Connection values/remarks
Gate control for firing pulse transformer for thyristor V26	IMP26 P24	Only connect if the firing pulse transformer module is divided (see terminal strip IMP_4)

Function	Terminal X26	Connection values/remarks
Firing cable thyristor V26	G K	Firing pulse (see below) gate (G) against auxiliary cathode (K)

Firing pulse:**Time characteristic:**

The pulse shape of the current depends on the length of the cable to the thyristor (cathode / gate). Because of the cable inductance, the rising edge of the current pulse slows down as the cable length increases.

Relationship between firing current and output voltage (incl. tolerances):

Open-circuit voltage = 7.8 to 8.4 V

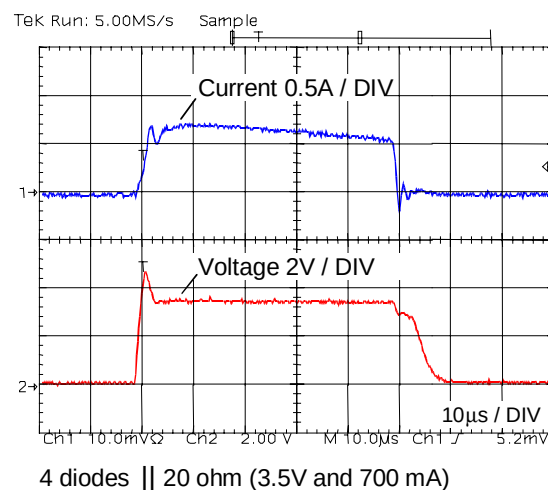
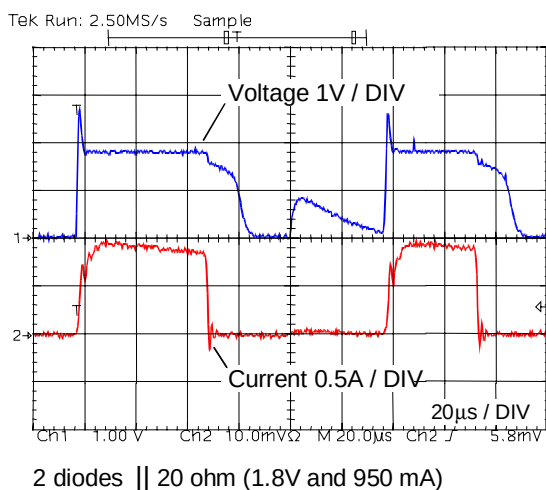
Short circuit current = 1.15 to 1.25 A

Application:

The firing condition for the thyristor used (minimum firing current) must be to the left of the characteristic of the firing circuit. The firing current can be derived graphically by intersecting the input characteristic of the thyristor with the output characteristic of the firing circuit. In this respect it is important to consider that as the temperature decreases, the voltage drop gate / cathode of the thyristor increases.

Examples of oscillograms

Firing voltage = voltage gate / cathode with 1 m twisted cable from the firing circuit
firing current in the gate connection of the thyristor



Outputs of the voltage measurement

Type of connection: Faston tabs, 6.3mm

Module C98043-A7043 firing pulse module

Function		Connection	Connection values/remarks
Armature supply voltage	W	X12_1	When the firing cables are connected to the thyristors in the power section, the supply voltage and armature voltage are automatically available on the firing pulse module (C98043-A7043). These voltage can then be led from there (connections X12_1 etc.) to the voltage measurement (C98043-A7044) without connecting additional cables to the power section. See also Chapter 6.3
Armature supply voltage	U	X14_1	
Armature voltage	1C1	X15_1	
Armature supply voltage	V	X16_1	
Armature voltage	1D1	X25_1	

Ribbon cables**Firing pulse cable torque direction 1, connector X21A, X21PAR**

Ribbon cable 26-way

C98043-A7042 power interface / C98043-A7043 firing pulse module

Function	Pin X21A/ X21PAR	Signal name	Connection values/remarks
Free	1		
Free	2		
Free	3		
Electronics ground	4	M	
Firing pulse thyristor armature 2	5	IMP_12	24 V / 2 A pulse
Firing 24 V supply	6	P24_Z	24 VDC / 2 A
Electronics ground	7	M	
Firing pulse thyristor armature 6	8	IMP_16	24 V / 2 A pulse
Firing 24 V supply	9	P24_Z	24 VDC / 2 A
Electronics ground	10	M	
Firing pulse thyristor armature 4	11	IMP_14	24 V / 2 A pulse
Firing 24 V supply	12	P24_Z	24 VDC / 2 A
Electronics ground	13	M	
Firing pulse thyristor armature 5	14	IMP_15	4 V / 2 A pulse
Firing 24 V supply	15	P24_Z	24 VDC / 2 A
Electronics ground	16	M	
Firing pulse thyristor armature 3	17	IMP_13	24 V / 2 A pulse
Firing 24 V supply	18	P24_Z	24 VDC / 2 A
Electronics ground	19	M	
Firing pulse thyristor armature 1	20	IMP_11	24 V / 2 A pulse
Firing 24 V supply	21	P24_Z	24 VDC / 2 A
Electronics ground	22	M	
Actual current	23	I_IST	analog ± 10 V
Reference ground to actual current	24	M_I_IST	analog ± 10 V
Electronics ground	25	M	
Free	26		

Connectors X21A and X32PAR are connected in parallel on module C98043-A7043

Firing pulse cable torque direction 2, connector X22A, X22PAR

Ribbon cable 26-way

C98043-A7042 power interface / C98043-A7043 firing pulse module

Function	Pin X21A/ X21PAR	Signal name	Connection values/remarks
Free	1		
Free	2		
Free	3		
Electronics ground	4	M	
Firing pulse thyristor armature 2	5	IMP_22	24 V / 2 A pulse
Firing 24 V supply	6	P24_Z	24 VDC / 2 A
Electronics ground	7	M	
Firing pulse thyristor armature 6	8	IMP_26	24 V / 2 A pulse
Firing 24 V supply	9	P24_Z	24 VDC / 2 A
Electronics ground	10	M	
Firing pulse thyristor armature 4	11	IMP_24	24 V / 2 A pulse
Firing 24 V supply	12	P24_Z	24 VDC / 2 A
Electronics ground	13	M	
Firing pulse thyristor armature 5	14	IMP_25	4 V / 2 A pulse
Firing 24 V supply	15	P24_Z	24 VDC / 2 A
Electronics ground	16	M	
Firing pulse thyristor armature 3	17	IMP_23	24 V / 2 A pulse
Firing 24 V supply	18	P24_Z	24 VDC / 2 A
Electronics ground	19	M	
Firing pulse thyristor armature 1	20	IMP_21	24 V / 2 A pulse
Firing 24 V supply	21	P24_Z	24 VDC / 2 A
Electronics ground	22	M	
Actual current	23	I_IST	Analog ± 10 V
Reference ground to actual current	24	M_I_IST	Analog ± 10 V
Electronics ground	25	M	
Free	26		

Connectors X22A and X22PAR are connected in parallel on module C98043-A7043

Connecting cable power interface – fuse monitoring

Ribbon cable 10-way

C98043-A7042 power interface / C98043-A7044 firing pulse module

Function	Pin XS20	Signal name	Connection values/remarks
24 V supply	1	P24	22...26 V
24 V supply	2	P24	22...26 V
Fuse monitoring	3	SICHERUNG_OK	CMOS 5V
Electronics ground	4	M	
Free	5		
Electronics ground	6	M	
Fuse monitoring	7	SICHERUNG_OK	CMOS 5V
Electronic ground	8	M	
Free	9		
Free	10		

Connecting cable power interface – voltage measurement

Ribbon cable 10-way

C98043-A7042 power interface / C98043-A7044 voltage measurement

Function	Pin XS21	Signal name	Connection values/remarks
15 V vers. of voltage measurement	1	P15_MESS	15 V / 20 mA
15 V vers. of voltage measurement	2	P15_MESS	15 V / 20 mA
Supply voltage V-U signal	3	NETZ_VU	Analog ± 5 V
Ground of voltage meas.	4	M_MESS	
Armature voltage signal	5	ANKERSPG	Analog ± 10 V
Ground of voltage meas.	6	M_MESS	
Supply voltage V-U signal	7	NETZ_VW	Analog ± 5 V
Ground of voltage meas.	8	M_MESS	
-15 V vers. Of voltage measurement	9	N15_MESS	-15 V / 20 mA
-15 V vers. Of voltage measurement	10	N15_MESS	-15 V / 20 mA

Connecting cable power interface – field supply

Ribbon cable 20-way

C98043-A7042 power interface / C98043-A7044 field supply

Function	Pin X102	Signal name	Connection values/remarks
Electronics ground	1	M	
Field current measurement supply	2	HF_16	± 16 V HF
Electronics ground	3	M	
Firing pulse thyristor field 1	4	IMP_F1	CMOS 5V
24 V supply	5	P24	22...26 V
Firing pulse thyristor field 2	6	IMP_F2	CMOS 5V
24 V supply	7	P24	22...26 V
Field current amplification	8	FELD_VERST	CMOS 5V
Electronics ground	9	M	
Field current frequency coded	10	FELD_STROM	CMOS 5V
Electronic ground	11	M	
Fuse monitoring	12	SICHERUNG_OK	CMOS 5V
15 V supply of voltage meas.	13	P15_MESS	15 V / 7 mA
Fan monitoring	14	LUEFTER_OK	Open collector
Ground voltage measurement	15	M_MESS	
Fan control	16	LUEFTER_EIN	CMOS 5V
Ground voltage measurement	17	M_MESS	
Signal supply voltage field	18	NETZ_FELD	Analog
-15 V supply of voltage meas.	19	N15_MESS	-15 V / 7 mA
Electronics ground	20	M	

Options:**Terminal expansion CUD2**

Terminal type: Plug-in terminal (screw-type)
max. connection cross-section 1.5mm²

Motor interface (see also function diagrams, Section 8, sheets G185 and G186)

Module C98043-A7006 (CUD2)

Function	Terminal X164	Connection values/remarks
Motor temperature (temperature sensor input)	204 205	Sensor acc. to P490 index 2

Module C98043-A7006 (CUD2)

Function	Terminal X161	Connection values/remarks
Supply for digital inputs	210	24V DC, short circuit proof with respect to internal ground max. load 200mA (terminals 34, 44, and 210 combined), Overload response: Error signal F01 Warning signal A018
Binary input	211	} H signal: +13V to +33V L signal: – 33V to +3V or terminal open Input resistance = 2.8 kΩ
Binary input	212	
Binary input	213	
Binary input	214	
Supply for digital inputs	215	can be isolated from internal ground
Supply for digital inputs	216	(Open wire jumper between terminal 216 and 217)
M	217	

Digital inputs (see also Section 8, sheet G114)

Module C98043-A7006 (CUD2)

Function	Terminal X164	Connection values/remarks
Unassigned input analog 2	8	±10V, 52kΩ
Ground analog	9	Resolution: ±10bit
Unassigned input analog 3	10	Common mode suppression: ±15V
Ground analog	11	

Analog outputs (see also Section 8, sheet G116)

Module C98043-A7006 (CUD2)

Function	Terminal X164	Connection values/remarks
Unassigned output analog 3	18	0...±10V, max. 2mA
Ground analog M	19	Short-circuit-proof
Unassigned output analog 4	20	Resolution ±11bit
Ground analog M	21	

Digital inputs (see also Section 8, sheet G111)

Module C98043-A7006 (CUD2)

Function	Terminal X163	Connection values/remarks
Supply (output)	44	24V DC, short circuit proof max. load 200mA (terminals 34, 44, and 210 combined), internal supply with respect to internal ground
Ground digital M	45	Overload response: Error signal F018 Warning signal A018
Unassigned input binary 3	40	H signal: +13V to +33V
Unassigned input binary 4	41	L signal: – 33V to +3V or terminal open
Unassigned input binary 5	42	8.5mA at 24V
Unassigned input binary 6	43	

Digital outputs (see also Section 8, sheet G112)

Module C98043-A7006 (CUD2)

Function	Terminal X163	Connection values/remarks
Unassigned output binary 3	50	H signal: +20 to +26V
Ground M	51	L signal: 0 to +2V short circuit proof 100mA
Unassigned output binary 4	52	Overload response: Error signal F018 Warning signal A018
Ground M	53	Internal suppressor circuit (freewheeling diode)

Serial interface 3 RS485

Module C98043-A7006 (CUD2)

Function	Terminal X162	Connection values/remarks
TX+	61	RS485, 4-wire send cable, positive differential input
TX-	62	RS485, 4-wire send cable, negative differential input
RX+/TX+	63	RS485, 4-wire receive cable, positive differential input, 2-wire send/receive cable, positive differential input
RX-/TX-	64	RS485, 4-wire receive cable, negative differential input, 2-wire send/receive cable, negative differential input
M	65	Ground

Cable length: For transmission rate =187.5kBd $\Rightarrow$ 600m
 For transmission rate =93.75kBd $\Rightarrow$ 1200m

The following must be observed: DIN 19245 Part 1

The potential difference between the data reference potentials M of all interfaces must not exceed -7V / +12V. If this cannot be guaranteed, then equipotential bonding must be provided.

Activate interface 3:

- Set the baud rate in parameter P803.
- Set the protocol in parameter P800.

