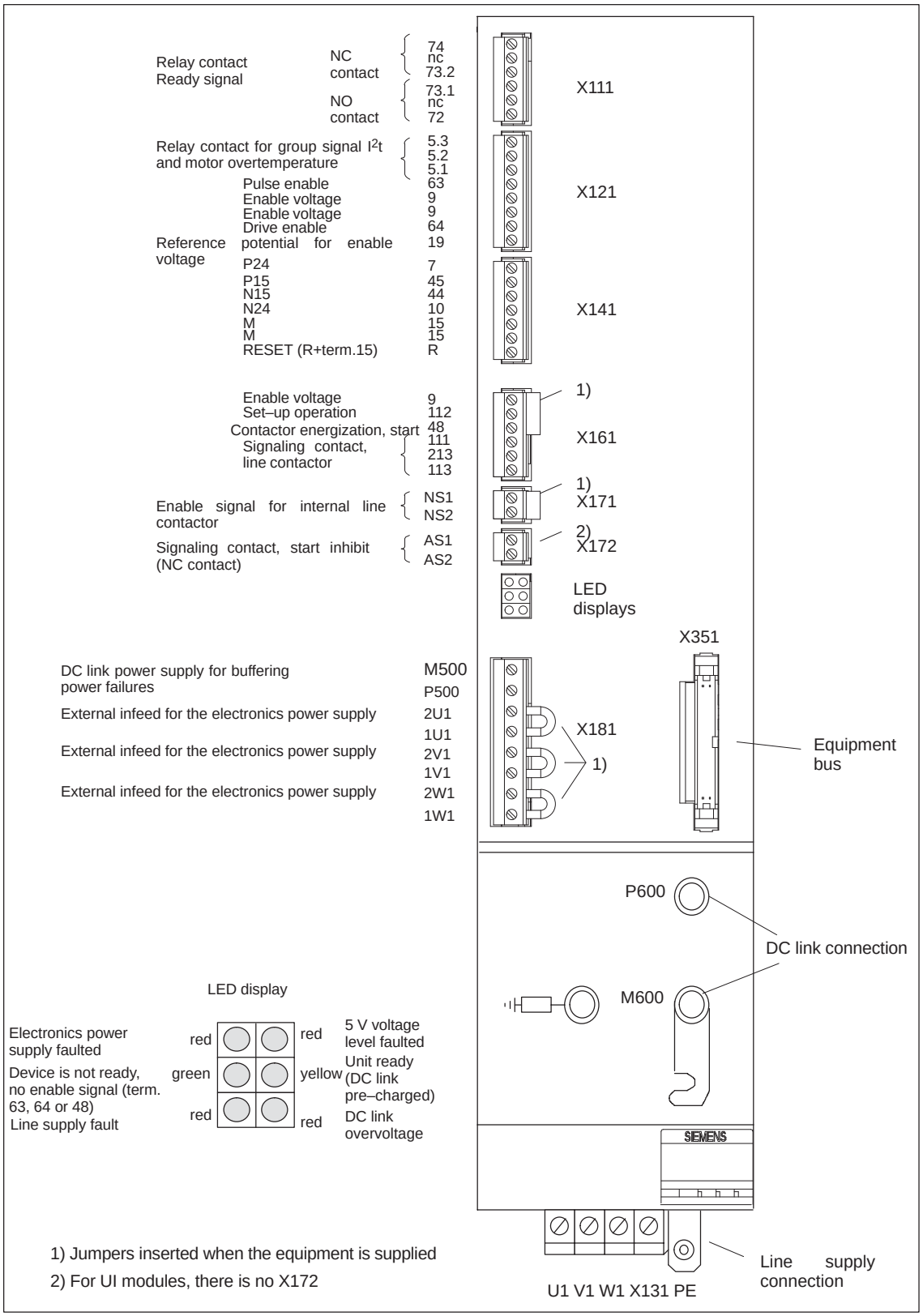


Fig. 6-2 Interfaces, infeed module (UI module) or infeed/regenerative feedback module (16 to 55 kW I/R module)

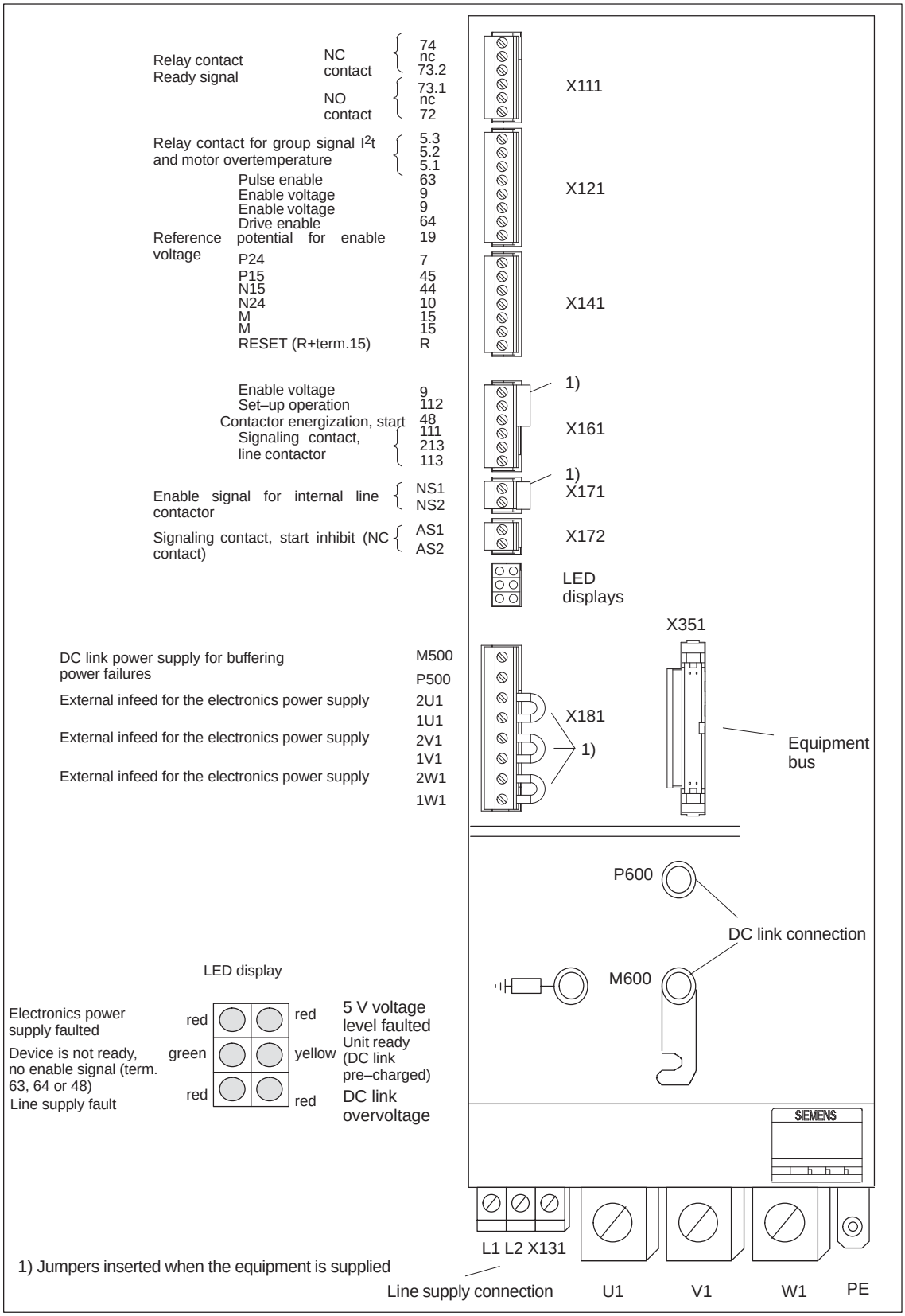


Fig. 6-3 Infeed/regenerative feedback module (80 and 120 kW I/R module) interfaces

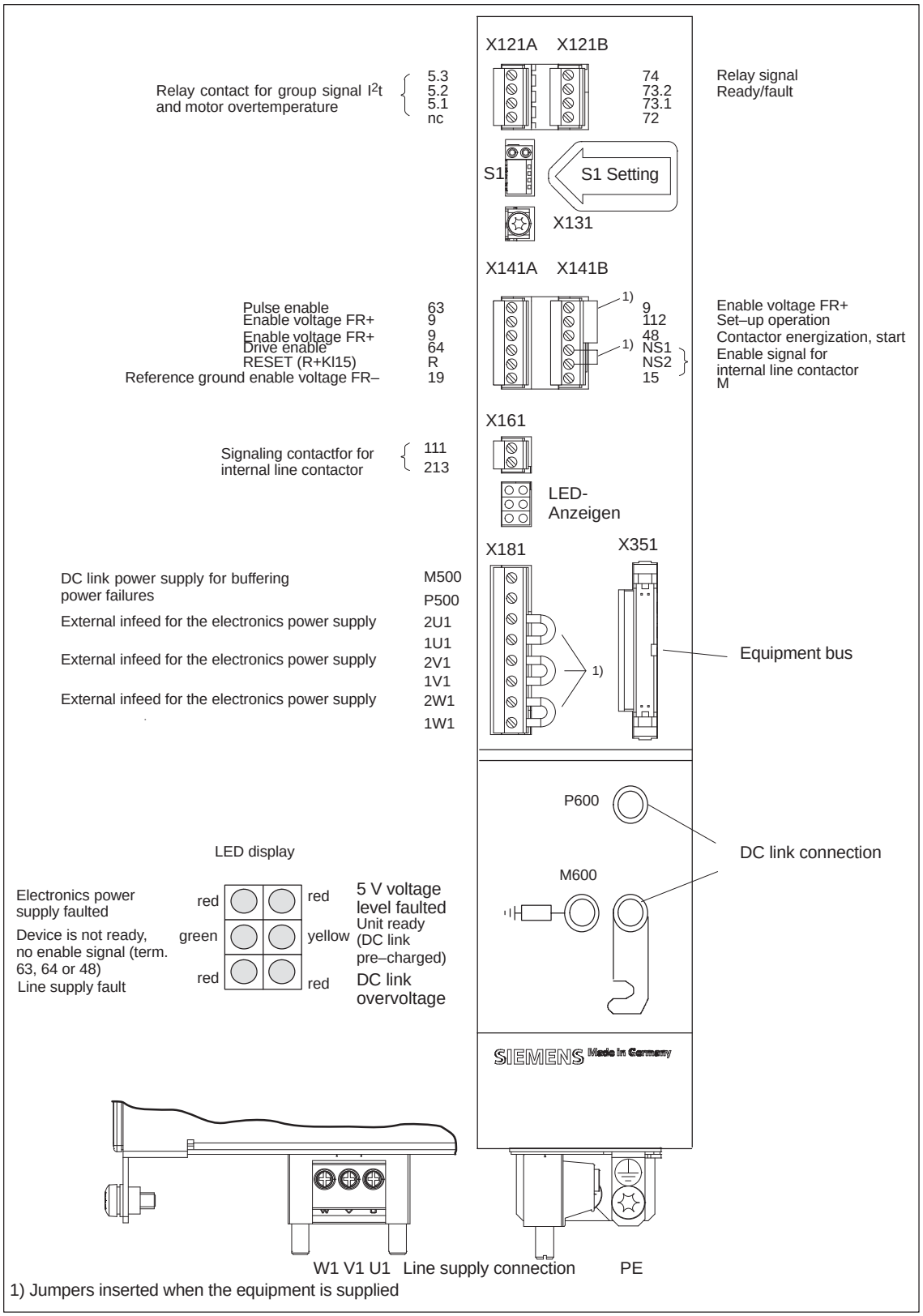


Fig. 6-4 Infeed module 5 kW UI module interfaces

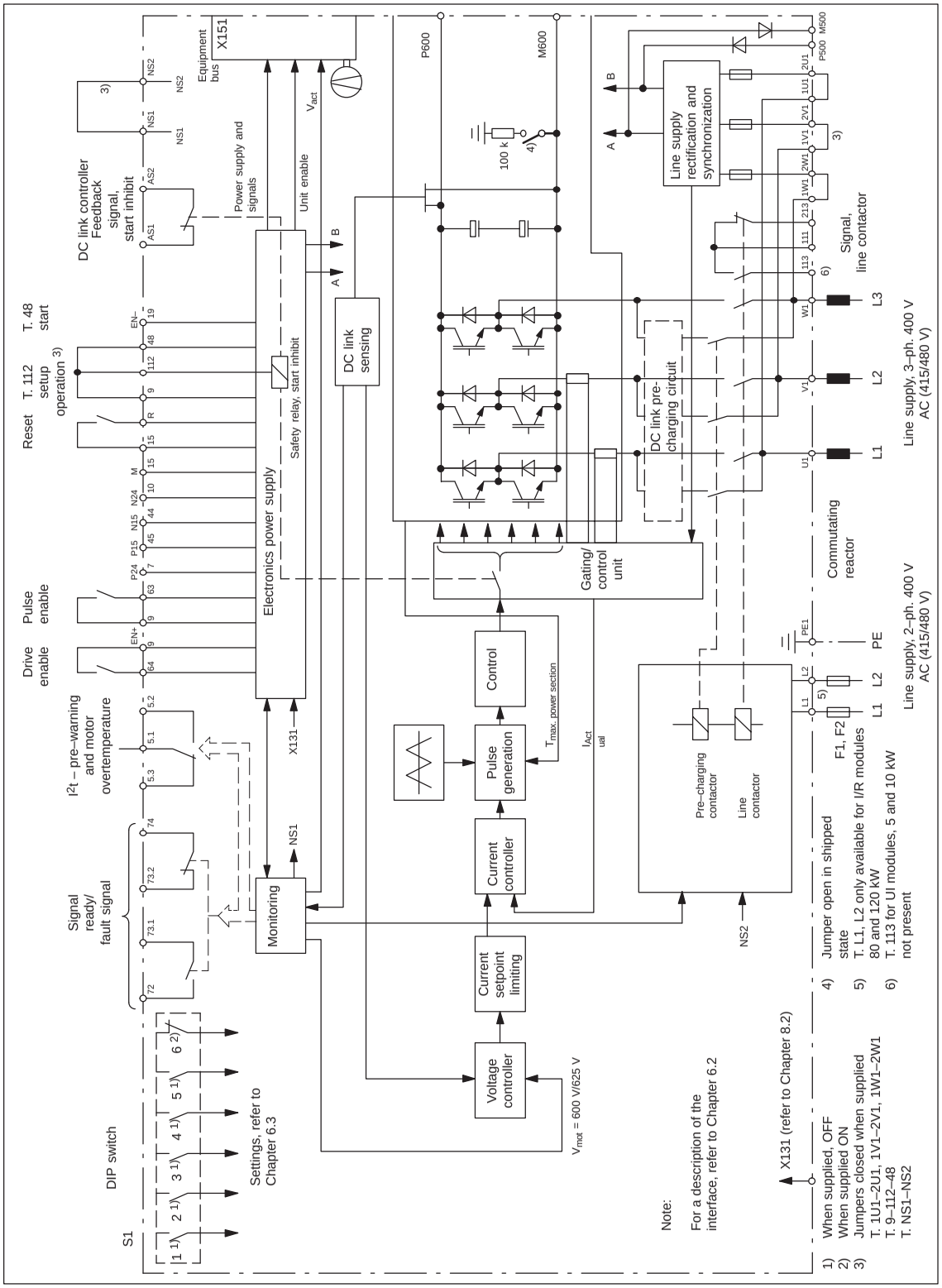


Fig. 6-5 Block diagram, line supply infeed module (I/R)

6.2 Interface overview

Danger

Protection from direct contact by means of SELV/PELV is permitted only in areas with equipotential bonding and in dry interior spaces. If these conditions are not given, other protective measures against electric shock must be taken, e.g. protection through protective impedances or limited voltage or by implementing protection class I and II.
Only PELV or SELV voltages may be connected at terminals with either PELV or SELV voltages (refer to EN 60204–1, Section 6.4).
For Order Nos. for coding connectors, refer to Catalog NC60.
Refer to the information in the following tables.

6.2.1 Interface overview, NE modules

The interface description applies to all NE modules except for the 5 kW UI module. The interface of the 5 kW UI module has a separate description (see Section 6.2.2).

Table 6-1 Interface description for NE modules

Term. No.	Designation	Function	Type 1)	Typ. voltage/limit values for V_n 400 V	Max. cross–section 10)	Terminals provided on 3)
U1, V1 W1		Line supply connection	I	3–ph. 400 V AC	refer to Section 4.2	I/R, UI
L1 L2		Line supply connection for contactor	I I	refer to Section LEERER MERKER, Table LEERER MERKER refer to Chapter 6.2.5, L1, L2	16 mm^2/10 mm^2 4) 16 mm^2/10 mm^2 4)	I/R 80 kW, 120 kW
PE P600 M600		Protective conductor DC link DC link	I I/O I/O	0 V +300 V –300 V	Screw Busbar Busbar	I/R, UI, monitoring module
		Grounding bar 5)	I/O	–300 V	Conductor bar	I/R, UI

1) I = input; O = output; NC = NC contact; NO = NO contact; (for signal, NO = high; NC = low)
P = only for PELV voltage; S = only for SELV voltage
2) Term. 19 is the reference ground (connected through 10 kΩ to the general reference ground X131/T.15 inside the module)
Terminal 15 must not be connected to PE, to terminal 19 or to external voltage sources.
Terminal 19 can be connected with X131.
The terminal may be used only for enabling the associated drive group.
3) I/R = infeed/regenerative feedback module; UI = unregulated infeed; MM = monitoring module;
PR = pulsed resistor module
4) The first data applies with pin–type cable lug. The second data is used for finely–stranded cable without end sleeve.
5) The grounding clip is used to ground the DC link M600 busbar through 100 kΩ (must be closed and must not be closed if RCCBs are used, see also Chapter 8.1;
the grounding clip must be opened if the system is subject to a high–voltage test).
6) RESET = resets the fault memory, edge–triggered for the complete drive group (terminal "R" → Terminal 15 = RESET)
7) Terminals 111–213, positively–driven opening contacts (for I/R 16 kW and UI 10 kW, only from Order No. [MLFB]: 6SN114□–1□□0**1**–0□□□)
Terminals 111–113 NO contact not positively–driven
For I/R 16 kW (from version E) and UI 10 kW (from version F) the following apply:
Terminals 111–213, positively–driven opening contacts (series circuit of NC contact, main contactor and NC contact, pre–charging contactor)
Terminals 111–113, positively–driven NO contacts
8) Max. current load of terminal 9 with respect to terminal 19: 0.5 A.
9) Only for UI 28 kW
10) For UL certification, only use copper cables dimensioned for an operating temperature ≥ 60°C
11) Max. permissible connected power: Pmax ≤ 43 kW; max. permissible current load: Imax ≤ 72 A
12) When the AS1/AS2 contacts are connected in series a contact resistance of approx. 0.20 Ohm must be taken into consideration over the lifetime of the contacts. For a 24 V switching voltage, from experience, a series circuit of up to five contacts can be used without any problems due to the non–linear contact characteristics.
13) In accordance with EN 60204–1 (machine safety), control transformers must be used for AC control voltages.

Table 6-1 Interface description for NE modules, continued

Term. No.	Designation	Function	Type 1)	Typ. voltage/limit values for V_n 400 V	Max. cross–section10)	Terminals provided on3)
P600 M600		DC link DC link	I/O I/O	+300 V –300 V	16 mm²/10 mm² 4) 16 mm²/10 mm² 4)	Monitoring module 11)
1R, 2R, 3R	TR1, TR2 9)	Connection, external resistor	I/O	300 V	6 mm²/4 mm² 4)	UI 28 kW
	X131	Electronics M	I/O	0 V	16 mm²/10 mm² 4)	I/R, UI, monitoring module
	X151	Equipment bus	I/O	Various	Ribbon cable	I/R, UI, monitoring module
M500 P500 1U1 2U1 1V1 2V1 1W1 2W1	X181 X181 X181 X181 X181 X181 X181 X181	DC link power supply DC link power supply Output L1 Input L1 Output L2 Input L2 Output L3 Input L3	I I O I O I O I	DC –300 V DC +300 V 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC	1.5 mm² 1.5 mm² 1.5 mm² 1.5 mm² 1.5 mm² 1.5 mm² 1.5 mm² 1.5 mm²	I/R, UI, monitoring module
7 45 44 10 15 2) R 6)	X141 X141 X141 X141 X141 X141	P24 P15 N15 N24 M RESET	O O O O O I	+20.4...28.8 V/50 mA +15 V/10 mA –15 V/10 mA –20.4...28.8 V/50 mA 0 V T.15/R_I = 10 kΩ	1.5 mm² 1.5 mm² 1.5 mm² 1.5 mm² 1.5 mm² 1.5 mm²	I/R, UI, monitoring module
5.3 5.2 5.1 63 2) 9 2)8) 9 2)8) 64 2) 19	X121 X121 X121 X121 X121 X121 X121 X121	} Relay contact } Group signal } I^2t/motor temp. Pulse enable Enable voltage Enable voltage Drive enable Enable voltage reference potential	NC NO I I O O I	DC 50 V/0.5 A/12 VA max DC 5 V/3 mA min +13 V...30 V/R_E = 1.5 kΩ +24 V +24 V +13 V...30 V/R_E = 1.5 kΩ 0 V	1.5 mm² 1.5 mm² 1.5 mm² 1.5 mm² 1.5 mm² 1.5 mm² 1.5 mm² 1.5 mm²	I/R, UI, monitoring module

1) I = input; O = output; NC = NC contact; NO = NO contact; (for signal, NO = high; NC = low)
P = only for PELV voltage; S = only for SELV voltage
2) Term. 19 is the reference ground (connected through 10 kΩ to the general reference ground X131/T.15 inside the module)
Terminal 15 must not be connected to PE, to terminal 19 or to external voltage sources.
Terminal 19 can be connected with X131.
The terminal may be used only for enabling the associated drive group.
3) I/R = infeed/regenerative feedback module; UI = unregulated infeed; MM = monitoring module;
PR = pulsed resistor module
4) The first data applies with pin–type cable lug. The second data is used for finely–stranded cable without end sleeve.
5) The grounding clip is used to ground the DC link M600 busbar through 100 kΩ (must be closed and must not be closed if RCCBs are used, see also Chapter 8.1;
the grounding clip must be opened if the system is subject to a high–voltage test).
6) RESET = resets the fault memory, edge–triggered for the complete drive group (terminal "R" → Terminal 15 = RESET)
7) Terminals 111–213, positively–driven opening contacts (for I/R 16 kW and UI 10 kW, only from Order No. [MLFB]: 6SN114□–1□□0**1**–0□□□)
Terminals 111–113 NO contact not positively–driven
For I/R 16 kW (from version E) and UI 10 kW (from version F) the following apply:
Terminals 111–213, positively–driven opening contacts (series circuit of NC contact, main contactor and NC contact, pre–charging contactor)
Terminals 111–113, positively–driven NO contacts
8) Max. current load of terminal 9 with respect to terminal 19: 0.5 A.
9) Only for UI 28 kW
10) For UL certification, only use copper cables dimensioned for an operating temperature ≥ 60°C
11) Max. permissible connected power: Pmax ≤ 43 kW; max. permissible current load: Imax ≤ 72 A
12) When the AS1/AS2 contacts are connected in series a contact resistance of approx. 0.20 Ohm must be taken into consideration over the lifetime of the contacts. For a 24 V switching voltage, from experience, a series circuit of up to five contacts can be used without any problems due to the non–linear contact characteristics.
13) In accordance with EN 60204–1 (machine safety), control transformers must be used for AC control voltages.

Table 6-1 Interface description for NE modules, continued

Term. No.	Designation	Function	Type [1]	Typ. voltage/limit values for V_n 400 V	Max. cross–section[10]	Terminals provided on[3]
7	X141	P24	O	+20,4...28,8 V/50 mA	1.5 mm²	I/R, UI, monitoring module
45	X141	P15	O	+15 V/10 mA	1.5 mm²	
44	X141	N15	O	–15 V/10 mA	1.5 mm²	
10	X141	N24	O	–20,4...28,8 V/50 mA	1.5 mm²	
15[2]	X141	M	O	0 V	1.5 mm²	
R[6]	X141	RESET	I	KL15/R_E = 10 kΩ	1.5 mm²	
9[2][8]	X161	Enable voltage	O	+24 V	1.5 mm²	I/R, UI, monitoring module
112[2]	X161	Setting–up operation/ normal operation	I	+21 V...30 V/R_E = 1.5 kΩ	1.5 mm²	
48[2]	X161	Contactor control	I	+13 V...30 V/R_E = 1.5 kΩ	1.5 mm²	I/R, UI
111[7]	X161	Signaling contacts, line contactor	I	+30 V/1 A (111–113)	1.5 mm²	
213[7]	X161		NC	1–ph. 250 V AC/50 V DC/ 2 A max	1.5 mm²	
113[7]	X161		NO	17 V DC/3 mA min	1.5 mm² max. cable length, 30 m	
NS1	X171	Coil contact for line supply, pre–charging contactor	O	+24 V	1.5 mm²	I/R, UI
NS2	X171		I		1.5 mm²	
AS1[12]	X172	Signaling contact	I	max. 250 V/1 A AC[13]/ 30 V/2 A DC	1.5 mm²	I/R
AS2[12]	X172	Start inhibit (T.112)	NC		1.5 mm²	

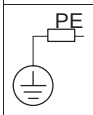
1) I = input; O = output; NC = NC contact; NO = NO contact; (for signal, NO = high; NC = low)
P = only for PELV voltage; S = only for SELV voltage
2) Term. 19 is the reference ground (connected through 10 kΩ to the general reference ground X131/T.15 inside the module)
Terminal 15 must not be connected to PE, to terminal 19 or to external voltage sources.
Terminal 19 can be connected with X131.
The terminal may be used only for enabling the associated drive group.
3) I/R = infeed/regenerative feedback module; UI = unregulated infeed; MM = monitoring module;
PR = pulsed resistor module
4) The first data applies with pin–type cable lug. The second data is used for finely–stranded cable without end sleeve.
5) The grounding clip is used to ground the DC link M600 busbar through 100 kΩ (must be closed and must not be closed if RCCBs are used, see also Chapter 8.1;
the grounding clip must be opened if the system is subject to a high–voltage test).
6) RESET = resets the fault memory, edge–triggered for the complete drive group (terminal "R" → Terminal 15 = RESET)
7) Terminals 111–213, positively–driven opening contacts (for I/R 16 kW and UI 10 kW, only from Order No. [MLFB]: 6SN114□–1□□0**1**–0□□□)
Terminals 111–113 NO contact not positively–driven
For I/R 16 kW (from version E) and UI 10 kW (from version F) the following apply:
Terminals 111–213, positively–driven opening contacts (series circuit of NC contact, main contactor and NC contact, pre–charging contactor)
Terminals 111–113, positively–driven NO contacts
8) Max. current load of terminal 9 with respect to terminal 19: 0.5 A.
9) Only for UI 28 kW
10) For UL certification, only use copper cables dimensioned for an operating temperature ≥ 60°C
11) Max. permissible connected power: Pmax ≤ 43 kW; max. permissible current load: Imax ≤ 72 A
12) When the AS1/AS2 contacts are connected in series a contact resistance of approx. 0.20 Ohm must be taken into consideration over the lifetime of the contacts. For a 24 V switching voltage, from experience, a series circuit of up to five contacts can be used without any problems due to the non–linear contact characteristics.
13) In accordance with EN 60204–1 (machine safety), control transformers must be used for AC control voltages.

Warning

In order to avoid damage to the infeed circuit of the NE modules, when controlling/energizing terminal 50 at X221 (PR module, DC link fast discharge) it should be ensured that terminal 48 of the NE module is de–energized (the module is then electrically isolated from the line supply). The feedback signal contacts from the main contactor of the NE module (X161 term. 111, term. 113, term. 213) must be evaluated.

6.2.2 5 kW UI module interface overview

Table 6-2 Interface overview, 5 kW UI modules

Term. No.	Designation	Function	Type 1)	Typ. voltage/limit values	Max. cross–section 6)
U1 V1 W1	X1	Line supply connection	I	3–ph. 400 V AC	4 mm^2 finely–stranded without conductor end sleeves 6 mm^2 with pin–type cable lug
 PE	– X131 X351	Protective conductor Electronics M Equipment bus Grounding bar 3)	I I I/O I/O	0 V 0 V Various –300 V	M5 thread M4 thread 34–core ribbon cable Busbar
P600 M600		DC link	I/O	+300 V –300 V	Conductor bar
M500 P500 1U1 2U1 1V1 2V1 1W1 2W1	X181 X181 X181 X181 X181 X181 X181 X181	DC link power supply DC link power supply Output L1 Input L1 Output L2 Input L2 Output L3 Input L3	I I O I O I O I	–300 V +300 V 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC 3–ph. 400 V AC	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2
5.3 5.2 5.1 nc	X121A X121A X121A X121A	Relay contact Group signal I^2t/motor temperature	NC NO I	1–ph. 50 V DC/0.5 A/12 VA max 1–ph. 5 V DC/3 mA min	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2
74 73.2 73.1 72	X121B X121B X121B X121B	Relay signal Ready/ fault	NC I I NO	1–ph.250 V AC/50 V DC/2 A max7) 5 V DC/3 mA min	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2
63 2) 9 2)4) 9 2)4) 64 2) R 5) 19	X141AX 141A X141A X141A X141A X141A	Pulse enable FR+ FR+ Drive enable RESET FR–, reference ground enable voltage	I O O I I O	+13 V...30 V/R_E = 1.5 kΩ +24 V +24 V +13 V...30 V/R_E = 1.5 kΩ terminal 19/R_E = 10 kΩ	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2

1) I = input; O = output; NC = NC contact; NO = NO contact
2) Term. 19 is the reference ground (connected through 10 kΩ to the general reference ground X131 inside the module)
Terminal 15 must not be connected to PE, to terminal 19 or to external voltage sources
Terminal 19 can be connected to X131.
The terminal may be used exclusively for enabling the associated drive group.
3) The grounding clip is used to ground the DC link M busbar through 100 kΩ (must be closed;
the grounding clip must be opened if the system is subject to a high–voltage test).
4) max. current load of terminal 9 – terminal 19 $\leq$ 1 A
Notice: For the 5 kW, there are no terminals 7, 45, 44 and 10.
5) RESET = resets the fault memory, edge–triggered for the complete drive group
(terminal "R" → Term. 19 = RESET)
6) For UL certification: only use copper cables dimensioned for an operating temperature $\geq$ 60°C.
7) In accordance with EN 60204–1 (machine safety),
control transformers must be used for AC control voltages.

Table 6-2 Interface overview, 5 kW UI modules, continued

Term. No.	Designation	Function	Type 1)	Typ. voltage/limit values	Max. cross–section 6)
111 213	X161 X161	} Signaling contact Line contactor	I NC	1–ph. 250 V AC/50 V DC/2 A 7) 17 V DC/3 mA min	1.5 mm^2 1.5 mm^2 max. cable length, 30 m
9 2)4) 112 48 NS1 NS2 15	X141B X141B X141B X141B X141B X141B	FR+ Setup/normal operation Contactor control } Coil contact for line supply, pre–charging contactor M	O I I O I O	+24 V +13 V...30 V/R_E = 1.5 kΩ +13 V...30 V/R_E = 1.5 kΩ +24 V 0/+24 V 0 V	1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2 1.5 mm^2

1) I = input; O = output; NC = NC contact; NO = NO contact
2) Term. 19 is the reference ground (connected through 10 kΩ to the general reference ground X131 inside the module)
Terminal 15 must not be connected to PE, to terminal 19 or to external voltage sources
Terminal 19 can be connected to X131.
The terminal may be used exclusively for enabling the associated drive group.
3) The grounding clip is used to ground the DC link M busbar through 100 kΩ (must be closed;
the grounding clip must be opened if the system is subject to a high–voltage test).
4) max. current load of terminal 9 – terminal 19 $\leq$ 1 A
Notice: For the 5 kW, there are no terminals 7, 45, 44 and 10.
5) RESET = resets the fault memory, edge–triggered for the complete drive group
(terminal "R" → Term. 19 = RESET)
6) For UL certification: only use copper cables dimensioned for an operating temperature $\geq$ 60°C.
7) In accordance with EN 60204–1 (machine safety),
control transformers must be used for AC control voltages.

Notice

There are no 7, 45, 44 and 10 terminals for the 5 kW UI module.

6.2.3 Cable cross–sections that can be connected

The cable cross–sections that can be connected are listed in Table 6-3:

Table 6-3 Cable cross–sections that can be connected at the infeed module (line supply connection)

MLFB		Connection cross–section [mm²]													1)	2)
		1,5	2,5	4	6	10	16	25	35	50	70	95	120	150		[Nm]
6SN1143–1BB00–0FA□	120 kW													X	M6	25...30
6SN1143–1BB00–0EA□	80 kW											X			M6	15...20
6SN1145–1BA01–0DA□	55 kW											X			M6	15...20
6SN1145–1BB00–0DA□	55 kW											X			M6	15...20
6SN1145–1BA02–0CA□	36 kW									X					M6	6...8
6SN1145–1BA01–0BA□	16 kW					X									M5	1,5...1,8
6SN114□–1A□01–0BA□	28 kW									X					M6	6...8
6SN1145–1AA01–0AA□	10 kW					X									M5	1,5...1,8
6SN1146–1AB00–0BA□	5 kW	X	X	X	X										M5	0,7...0,8
Key		Terminal area for flexible cable with end sleeves (with or without plastic collars)														
		Terminal area for flexible cables with terminal pin														
	X	IP20 is guaranteed when correctly used, e.g. insulated pin–type cable lugs														

1) Size of the screw for the protective conductor connection

2) Tightening torque of the terminals or connectors

6.2.4 Three–conductor connection (standard circuit)

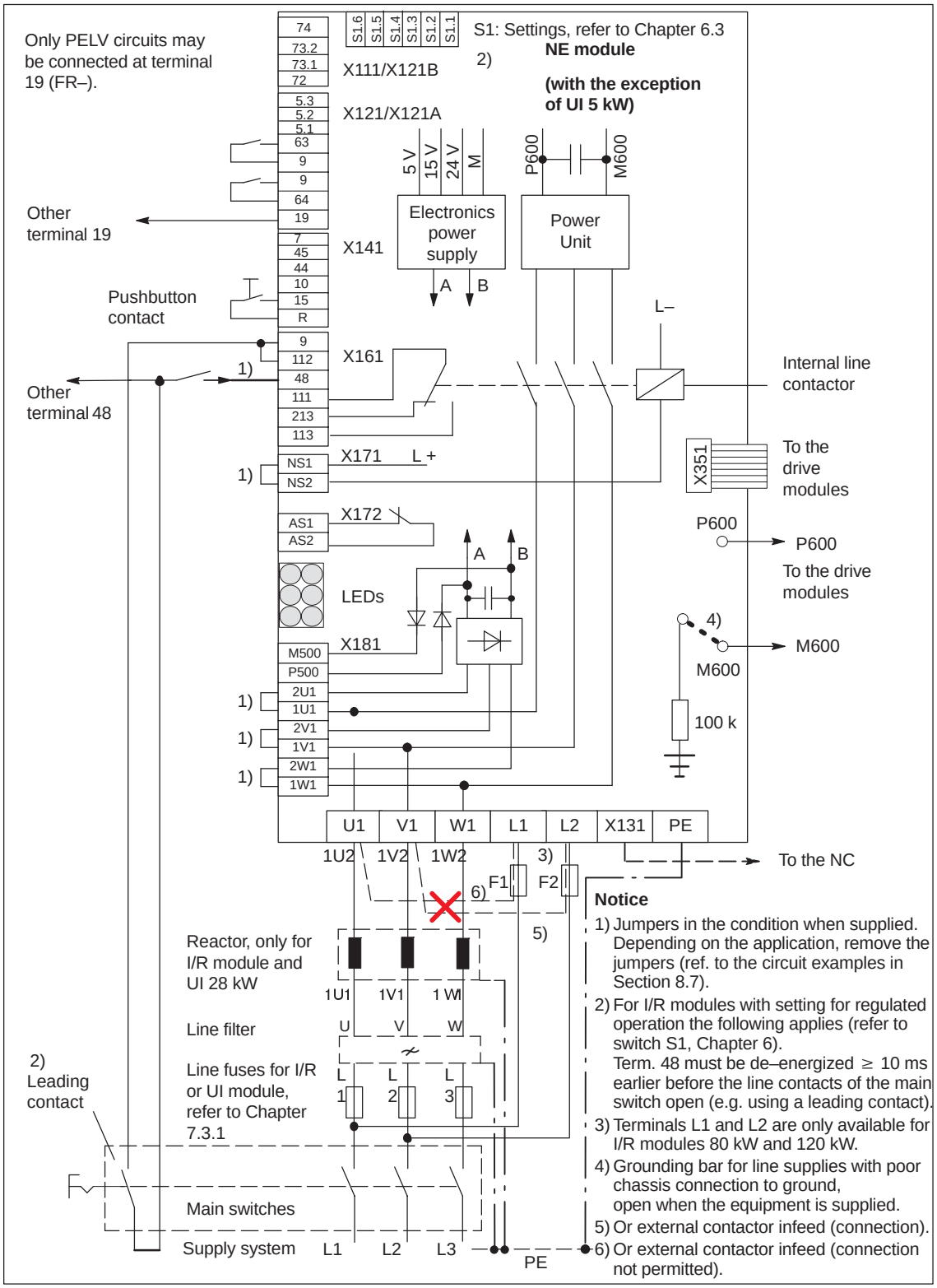


Fig. 6-6 Three–conductor connection (standard circuit)

6.2.5 Description of the interfaces and functions

Switch S1

Switch S1 to set various functions is provided on the upper side of the NE and monitoring module or on the front side/panel for the UI module 5 kW; refer to Chapter 6.3.

Terminal 19

EN–

Reference potential for the enable voltage terminal 9, non–floating (with electrical isolation) (connected to the general reference ground terminal 15 through 10 kΩ). Terminal 19 is not permitted to be connected to terminal 15. (Connect to the PE bus or X131.)

When controlling the enable signals using electronic outputs that switch to high (PLC), terminal 19 must be connected to the 0 V reference potential (ground) of the external power supply.

The circuits/power source must satisfy the requirements for PELV (Protection Extra–Low Voltage) functional extra–low voltage with safe separation in accordance with EN 60204–1; 6.4.

Terminal 9

EN+

Only use the +24 V enable voltage for the internal enable signals of the NE and drive modules.

Maximum power supply load: 500 mA
(corresponds to 8 EP; 1 optocoupler input requires 12 mA, for UI 5 kW —> 1 A)

Terminal 48

Start

This terminal has the highest priority. A defined power–on and power–off sequence of the NE module is initiated using terminal 48.

If terminal 48 is enabled (energized), then internally, the pre–charging sequence is initiated.

(interrogation $V_{DC\ link} \geq$ 300 V and $V_{DC\ link} \geq \sqrt{2} \bullet U_{line\ supply}$ – 50 V).

After the DC link has been charged, then, simultaneously

- after 500 ms —> the pre–charging contactor is opened and the main contactor is closed.
- after 1 second —> the internal enable signals are then issued.

If terminal 48 is de–energized, then initially, after approx. 1 ms, the internal pulse enable signals are inhibited and then the DC link is electrically isolated from the line supply delayed by the drop–out time of the internal line contactor.

If terminal 48 is opened (enabled) during the load operation, the load operation is first completed. The inhibit functionality for terminal 48 does not takes effect until the load operation is complete, provided terminals NS1–NS2 are jumpered.

Terminals NS1, NS2

Coil circuit of the internal line and pre–charging contactor

If the line contactor is opened (de–energized) by interrupting the coil circuit using electrically isolated (floating) contacts, then the DC link is safely and electrically disconnected from the line supply (signal contact, terminals 111–213 must be interrogated).

The terminals have a safety–relevant function. The shutdown using terminals NS1–NS2 must be realized at the same time as or delayed with respect to terminal 48 start (refer to Section 8.7 Circuit examples = 2 and = 4).

Max. cable length 50 m (2–conductor cable) for 1.5 mm^2 cross–section

Terminal 63

Pulse enable

For the pulse enable and inhibit functionality, this terminal has the highest priority. The enable and inhibit functions are effective after approx. 1 ms simultaneously for all of the modules including the NE module. When the signal is withdrawn, the drives ”coast down” unbraked.

Standby operation of the infeed:

If an infeed module is to be kept in the ready state for a longer period of time (DC link charged), then in order to avoid unnecessary switching losses and reactor losses, a pulse inhibit should be enabled! The DC link voltage then remains at the non–regulated value and is again ready in the regulated mode immediately after the pulses have been enabled.

Terminal 64

Drive Enable

The drive modules are enabled using terminal 64. The modules are simultaneously enabled or inhibited after approx. 1 ms.

If terminal 64 is inhibited, then n_{set} =0 is set for all drives and the axes brake as follows:

- For 611D/611 universal/ANA/HLA drives, the pulses are cancelled after a selectable speed has been undershot or after a selectable timer stage has expired. The axes brake along the selected limits (MD 1230, 1235, 1238).

  For spindles, a ramp can only be achieved using regenerative limiting (MD 1237).

Terminals L1, L2

External switching voltage for the coil circuit of the line contactor

Is used to supply the coil circuit of the internal line contactor only at the 80 kW and 120 kW I/R modules (do not connect between the I/R module and reactor).

Fuse: $I_r \geq 4$ A, version gL
2–ph. 360 to 457 V AC/45 to 53 Hz; 400 to 510 V/57 to 65 Hz

Table 6-4 Technical data of the internal line and pre–charging contactor

I/RF module	Type	Pull–in power [VA]		Holding power [VA]	
		50 Hz	60 Hz	50 Hz	60 Hz
6SN114□–1BB0□–0EA1	3RT1446	330	378	36	44.2
6SN114□–1BB0□–0FA1	3TK50	550	627	32	39

Matching transformer for the coil connections L1, L2 at the line supply voltage 230 V and 380 V; for two 5TK5022–0AR0 contactors.

Table 6-5 Matching transformer SIDAC 1–phase autotransformer

	For 50 Hz line supplies	For 60 Hz line supplies
Type	4AM4096–0EM50–0AA0[1)]	4AM4696–0EM70–0FA0[1)]
Throughput rating [VA]	80	80
Input voltage [V]	380/230	380/230
Output voltage [V]	415 (min. 360/max. 458)	460/415
Output current [A]	0.193	0.19...0.17
Insulating material class	T40/B	T40/B
Applicable standard	EN 61558–13	VDE 0532
Frequency [Hz]	50/60	50/60
Vector group	IA0	Ii0
Degree of protection	IP00	IP00
Dimension sketch	PD10 T8/2	LV 10
for voltage fluctuations	+10% –13.2 %	+10% –13.2 %

1) Order No.
mdexx GmbH
Richard-Dunkel-Straße 120
28199 Bremen
GERMANY
Phone: +49 421 5125-0
E-Mail: info@mdexx.de

Note

If, for the 80/104 kW or 120/156 kW I/R module, the line supply voltage at terminals L1, L2 fails or fuses F1, F2 trip, then only the pulses in the I/R module are cancelled and the internal line contactor drops–out.

This is displayed using the ”line fault” LED, the ready relay and also the contactor signaling contacts. In this case, in order to re–close the internal line contactor, terminal 48 must be inhibited (de–energized) and re–energized after ≥one second or the unit must be powered–down/powered–up.

Terminal R

Reset

The fault signal is reset using a pushbutton (pulse edge) between terminal R and terminal 15.

For the SIMODRIVE 611 universal HRS control unit, the reset is effective if, in addition, terminal 65 ”controller enable” is also inhibited.

Terminal 112

Set–up operation

Terminal 112 is jumpered by default with terminal 9 (+24 V enable voltage).

Open: The step–up converter voltage control is set to start inhibit, monitoring disabled

Terminal 112 can only be used for SIMODRIVE 611 analog and not for SIMODRIVE 611 digital/universal.

Terminals AS1, AS2

Signaling contact, start inhibit DC link controller

Terminals AS1 – AS2 closed means that ”start inhibit is effective” (i.e. terminal 112 = open, setup mode)

(not available for UI modules 5 kW, 10 kW, 28 kW)

Terminal 112 can only be used for SIMODRIVE 611 analog and not for SIMODRIVE 611 digital/universal.

Terminal X131

Reference potential, electronics

If analog setpoints are routed from an external controller to the drive group, then wire an equipotential bonding conductor via terminal X131. This cable must be routed in parallel to the speed setpoint cable.

Cross–section = 10 mm^2!

Terminals 7, 45, 44, 10, 15 (X141)

Electronics power supply

- Terminal 7: P24 +20.4 to 28.8 V/50 mA
- Terminal 45: P15 +15 V/10 mA
- Terminal 44: N15 –15 V/10 mA
- Terminal 10: N24 –20.4 to 28.8 V/50 mA
- Terminal 15: M 0 V (only for circuits of terminals 7, 45, 44 and terminal 10; max. load, 120 mA)
  - – Terminal 15 may not be connected to PE (ground loop)
  - – Terminal 15 may not be connected to terminal 19 (otherwise there will be a short–circuit through the reactor; terminal 15 is internally connected to X131).

Terminals 2U1, 2V1, 2W1

Connecting terminals to separately supply the internal electronics power supply, e.g. through fused terminals (refer to the circuit example in Section 8.3.1).

In this case, jumpers 1U1–2U1, 1V1–2V1, 1W1–2W1 must be removed.

Notice

Observe additional information and instructions under Section 8.3 Monitoring module, and Section 8.15 Six–conductor connection!

Terminal P500, M500

Connect P500 and M500 for the internal coupling of the power supply to the DC link, e.g. for power failure concepts.

Notice

With this operating mode, terminals 2U1, 2V1, 2W1 of the power supply must be supplied with the line supply voltage between the I/R module and line reactor. The jumpers at connector X181 must under all circumstances be kept!

For a six–conductor connection (refer to Section 8.15), ensure a connection X181 (P500/M500) to the the DC link P600/M600 as specified in Section 8.15.2!

Terminals 111, 113, 213

Signaling contacts, internal line contactor

111–113	NO contact
111–213	NC contact

Terminals 72, 73.1, 73.2, 74 (X111)

Ready relay

Terminals 72 – 73.1: NO contact – closed for ”Ready”

Terminals 73.2 – 74: NC contact – open for ”Ready”

In addition to the interface signals provided, the terminal signal 72/73 also includes the line supply infeed monitoring as well as signals from the watchdog and the reset controller of the closed–loop control. This signal is available to the control unit independently of the processor.

The function of terminals 72/73 is not a safety function in the sense of the Machinery Directive 98/37/EU.

For the switch position S1.2 = ON ”Fault signal” the relay pulls–in if the following conditions are fulfilled:

- Internal main contactor CLOSED (terminals NS1 – NS2 connected, terminal 48 enabled).
- No faults may be present (on any of the SIMODRIVE drives in the group).
- The NCU/CCU must have booted (SINUMERIK 840D, 810D).

For the switch position S1.2 = OFF ”Ready” the relay is activated if the following conditions are fulfilled:

- Terminal 48 is enabled.
- Terminals 63, 64 = on.
- VSA with High Standard/High Performance or resolver for the ready setting, must be enabled (terminal 663, 65)

If there is a fault, the relay drops–out.

With the exception of the line monitoring function, all of the internal monitoring functions on all of the drive modules are effective at the relevant equipment bus and also the ready signal. For line supply faults, only the I/R module pulses are inhibited.

Notice

The ready signal must be evaluated in the external NC control in order to derive enable signals, inhibit signals, fault responses, etc.

Terminals 5.1, 5.2, 5.3 (X121)

I^2t pre–warning and motor temperature monitoring

Terminals 5.1 – 5.2: NO contact open for ”no fault”

Terminals 5.1 – 5.3: NC contact closed for ”no fault”

Notice

No I^2t monitoring of the infeed!

You must ensure sufficient power of the infeed module by setting this parameter accordingly in the configuration.

Terminals 5.□ must be externally evaluated for the machine responses, for example, in the PLC. When the motor temperature monitoring responds, the user/machine manufacturer must define what the response should/must be

- Reduce the load on the machine
- Reduce the power
- Stop
- Shutdown

If the terminal is not evaluated, and the response that makes sense for this particular case is initiated in the machine control system, then this can destroy the system, converter or motor!

The relay is activated if:

- At NE module
  - Heatsink–temperature monitoring trips
- At 611D
  - Motor–temperature monitoring trips
  - Heatsink–temperature monitoring trips
  - I^2t axis limiting responds
- At 611 universal HRS
  - Motor–temperature monitoring trips
  - Heatsink–temperature monitoring trips
  - I^2t axis limiting responds

Input current, enable circuits:

Terminals 48, 63, 64, and 65: Input current, optocoupler approx. 12 mA at +24 V

Terminal 663: Input current, optocoupler and start inhibit relay approx. 30 mA at +24 V

When selecting the switching devices and the auxiliary contact on the main switch, the contact reliability when switching low currents must be carefully taken into consideration.

Switching capacity of the signaling contacts:

The max. switching power of the signaling contacts is specified in the interface overviews of the modules in Chapters 4 and 6, and must be absolutely complied with!

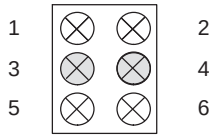
Note

All of the connected actuators, contactor coils, solenoid valves, holding brakes, etc. must be provided with overvoltage limiting elements, diodes, varistors, etc.

This is also true for switchgear/inductances controlled by a PLC output.

Display elements (LEDs)

The NE and monitoring modules have the following display elements (LEDs):



1 LED red – electronics power supply ±15 V faulted
2 LED red – 5 V voltage level faulted
3 LED green – external enable signals not present (terminal 63 and/or terminal 64 missing)
4 LED yellow – DC link charged (normal operation)
5 LED red – line supply fault (single or multi–phase power failure at terminals U1, V1, W1) 1)
– commutating reactor not available, incorrectly installed or incorrectly selected
– system fault level of the line supply or transformer too low
6 LED red – DC link overvoltage
possible causes: Regenerative feedback off, setting–up operation, line fault, for UI, PW either not operational or too small, line supply voltage too high, dynamic overload, line filter inserted between I/R and the commutating reactor

Note:
1) Detection time for line–supply failure, approx. 30 ms
Line–supply failure is detected from a 3-phase voltage < 280 V.
For a 1-phase line–supply failure, a pulse cancellation is initiated for the drive axes after approx. 1 min. (stored signal). This is valid for order number 6SN1114□–1□□0□–0□□**1**

Fig. 6-7 Display element, NE and monitoring module

Effects of the display states:

1 LED red bright: Pulses are cancelled for the complete drive group
2 LED red bright: Pulses are cancelled for the complete drive group
4 LED yellow dark: Pulses are cancelled for the complete drive group
5 LED red bright: Pulses are only cancelled for the I/R module (regenerative feedback into the line supply no longer possible. Axes initially continue to run. Ready relay drops out)
6 LED red bright: Pulses are cancelled for the complete drive group

Display, line fault

If a line fault is displayed or if the yellow LED does not light, the overvoltage limiter module must be checked.

Procedure:

1. Switch the unit into a no–voltage condition
2. Withdraw the overvoltage limiter module and insert connector X181 on the NE module.

   Does the NE module function correctly?

   Yes —> The overvoltage limiter module is defective and must be replaced.

   No —> Check the line supply and possibly the NE module/group.

Note

Operation can continue, but **without overvoltage protection** when the overvoltage limiter module is withdrawn and connector X181 has been removed from the NE module!

Operation without overvoltage limiter module is not in conformance with UL!

---

3. Insert a new overvoltage limiter module up to its endstop and reinsert connector X181 on the overvoltage limiter module.

6.3 Function overview and settings

General information

A switch S1 is provided on the upper side of the NE and monitoring module that is used to set the following functions (for UI 5 kW on the front side):

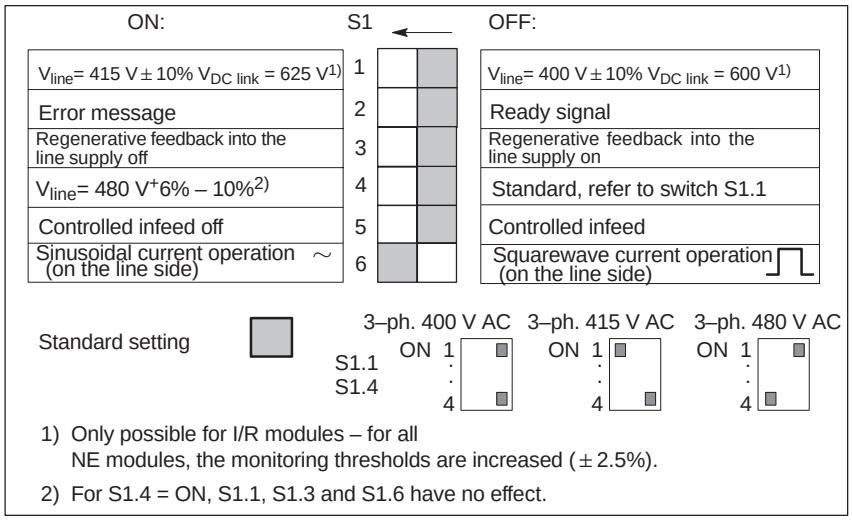


Fig. 6-8 DIL switch S1

Note

For a configuration 480 V S1.4= ON, only controlled regenerative feedback is realized, independent of the position of S1.5.

Notice

For I/R modules, sinusoidal current mode is the initial setting.

For operation with filters that are not listed in Table 6-6, the mode must be changed to squarewave current mode in order to protect the filter from thermal overload.

Before powering up or down using the main switch or a line contactor, terminal 63 (pulse enable) and/or terminal 48 (start terminal, contactor control) must be de–energized!

Switch S1.1

OFF: I/R module U_{line} = 400 V ±10%; $V_{DC\ link}$ = 600 V ±2.5%
UI module V_{line} = 400 V ±10%; $V_{DC\ link} = V_{line} \bullet 1.35$
Monitoring thresholds: (I/R, UI, monitoring modules)
PR on = 644 V; PR off = 618 V ±2.5%
$V_{DC\ link} \geq$ 695 V ±2.5%

ON: I/R module V_{line} = 415 V ±10%; $V_{DC\ link}$ = 625 V ±2.5%
UI module V_{line} = 415 V (440 V) ±10%; $V_{DC\ link} = V_{line} \bullet 1.35$
Monitoring thresholds: (I/R, UI, monitoring modules)
PR on = 670 V ±2.5%; PR off = 640 V ±2.5%
$V_{DC\ link} \geq$ 710 V ±2.5%

PR = Pulsed resistor

Switch S1.2

OFF: Ready signal (X111 ready relay)
For S1.2 = OFF, the relay pulls–in if the following conditions are fulfilled:

- Internal main contactor CLOSED (terminals NS1 – NS2 connected, terminal 48 enabled)
- Terminals 63, 64 = ON
- No fault present (also not at the FD 611 A Standard, 611 U, resolver and 611 D drives and HLA modules).
- FD with High Standard or resolver for the setting ”ready” is enabled (terminals 663, 65)
- For 840D/810D, the NCU must have run–up

ON: Fault signal (X111 ready relay)
For S1.2 = ON, the relay picks up if the following conditions are fulfilled:

- Internal main contactor CLOSED (terminals NS1 – NS2 connected, terminal 48 enabled)
- No fault present (also not at the FD 611 A Standard, 611 U, resolver and 611 D drives and HLA modules).
- FD with High Standard or resolver for the setting ”ready” is enabled (terminals 663, 65)
- For 840D and 810D the NCU must have run–up

Switch S1.3

OFF: Standard setting, regenerative feedback into the line supply active
I/R modules 16 kW to 120 kW are capable of regenerative feedback.
UI module: 5 kW, 10 kW, 28 kW: The pulsed resistor in the module is effective and active.

ON: Regenerative feedback to the line supply is switched off
I/R modules: 16 kW to 120 kW: Regenerative feedback mode is disabled
UI module: 5 kW, 10 kW: The pulsed resistor in the module is not active

Valid for
UI 5 kW, Order No.: 6SN1146–1AB00–0BA1 and
UI 10 kW, Order No.: 6SN1145–1AA01–0AA1

Not valid for UI 28 kW. In this case, the external pulsed resistor must be disconnected.

Switch S1.4

OFF: Standard setting for all NE modules, refer to S 1.1

ON: V_{line} = 480 V +6% / –10%; $V_{DC\ link} = V_{line} \bullet 1.35$ in infeed mode
$V_{DC\ link}$ = 700 to 750 V ± 2.5% in regenerative feedback mode
Monitoring thresholds: (I/R, UI, monitoring modules)
PR on = 744 V ± 2.5%; PR off = 718 V ± 2.5%
$V_{DC\ link} \geq$ 795 V ± 2.5%
S1.4 exceeds the setting of S1.1

Please note! Unregulated operation in the infeed direction.

Warning

An incorrect switch setting (”OFF”) for S1.4 when connected to U_{line} = 480 V will overload the NE module and destroy it!

Switch S1.5

This function is only applicable in conjunction with I/R modules
Order No.: 6SN114□–1B□0□–0□A**1**
OFF: regulated infeed active (default setting)

ON: Unregulated operation in the infeed direction $V_{DC\ link} = V_{line} \bullet 1.35$

Notice:
For unregulated operation of the I/R units with V_{line} = 400 V/415 V, the power must be reduced (derated) as specified in Section 5.5.

Switch S1.6

OFF: Squarewave current operation (current with a squarewave shape is drawn from the line supply)

ON: This function is only applicable in conjunction with I/R modules with Order No.: 6SN114□–1B□0□–0□A**1**
sinusoidal current operation (sinusoidal current is taken from the line supply)

Combinations of the components:

Table 6-6 Combinations (regenerative feedback into the line supply)

I/R 16 kW	**I/R 36 kW**	**I/R 55 kW**	**I/R 80 kW**	**I/R 120 kW**
For internal Cooling:	**For internal Cooling:**	**For internal Cooling:**	**For internal Cooling:**	**For internal Cooling:**
6SN1145–1BA01–0BA□	6SN1145–1BA02–0CA□	6SN1145–1BA01–0DA□	6SN1145–1BB00–0EA□	6SN1145–1BB00–0FA□
For external Cooling:	**For external cooling:**	**For external cooling:**	**For external Cooling:**	**For external cooling:**
6SN1146–1BB01–0BA□	6SN1146–1BB02–0CA□	6SN1146–1BB00–0DA□	6SN1146–1BB00–0EA□	6SN1146–1BB00–0FA□
HFD reactor 16 kW	**HFD reactor 36 kW**	**HFD reactor 55 kW**	**HFD reactor 80 kW**	**HFD reactor 120 kW**
6SL3000–0DE21–6AA□	6SL3000–0DE23–6AA□	6SL3000–0DE25–5AA□	6SL3000–0DE28–0AA□	6SL3000–0DE31–2AA□
Wideband Line Filter 16 kW	**Wideband Line Filter 36 kW**	**Wideband Line Filter 55 kW**	**Wideband Line Filter 80 kW**	**Wideband Line Filter 120 kW**
6SL3000–0BE21–6AA□	6SL3000–0BE23–6AA□	6SL3000–0BE25–5AA□	6SL3000–0BE28–0AA□	6SL3000–0BE31–2AA□
Basic Line Filter 16 kW	**Basic Line Filter 36 kW**	**Basic Line Filter 55 kW**	**-**	**-**
6SL3000–0BE21–6DA□	6SL3000–0BE23–6DA□	6SL3000–0BE25–5DA□	**-**	**-**

6.4 Technical data

6.4.1 General information

The configuring of the infeed modules requires the performance data from the Tables 6-9 and 6-10 and the following performance curves.

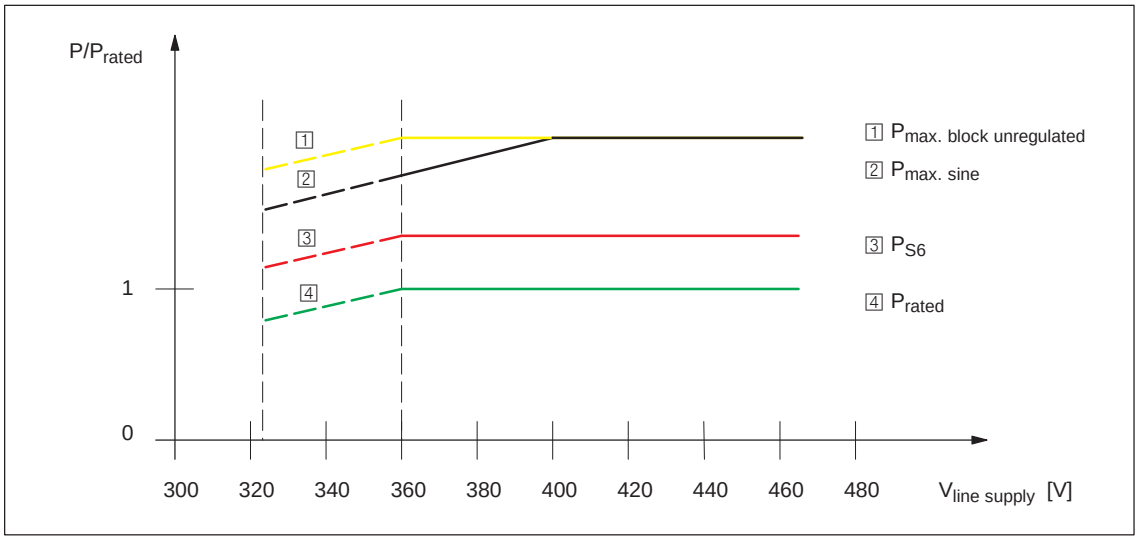


Fig. 6-9 Normalized power graph

Note

When connected to line supplies with voltage fluctuations below the rated voltage, the infeed should be overdimensioned corresponding to the above diagram (Fig. 6-9), otherwise this can lead to failures or defects.

Table 6-7 Power factory at the rated power without filter

Module	Operation on the line side	Factor cos φ[1)]	Factor λ
I/R	Sinusoidal current operation	cos φ ≈ 0.98	λ ≈ 0.97
I/R	Squarewave current operation	cos φ ≈ 0.98	λ≈ 0.89
UE	–	cos φ ≈ 0.87	λ ≈ 0.67

cos φ: The power factor only contains the basic fundamental
λ: The power factor contains the basic fundamental and harmonic components
1) Is valid for sinusoidal current operation at the rated voltage without filter

Note

With line filter, when the converter is operating at partial load, a capacitive phase shift occurs.

As line supplies in companies generally have an inductive phase shift, this capacitive component has a compensating effect in this line supply.

Supply voltage and frequency

Switches S1.1 and S1.4 (see Chapter 6.3) are used to adapt the line infeed modules to the prevailing line supply conditions.

The converter system is designed for operation on grounded line supplies TN–S and TN–C (IEC 60364–1 VDE 0100–300). For other line supply types, a transformer with separate windings in vector group yn on the secondary side must be connected upstream (refer to Chapter 7 for the dimensioning).

Table 6-8 Supply voltage and frequency

NE-Module	S1.1, S1.4 = OFF Un = 3AC 400 V	S1.1 = ON Un = 3AC 415 V	S1.4 = ON Un = 3AC 480 V
Line voltage: U1, V1, W1	3AC 400 V ± 10%	3AC 415 V ± 10%	3AC 480 V + 6% –10%
With derating P_{rated} and P_{max} 1)	3AC 380 V ± 15%		
DC link voltage	DC 600 V	DC 625 V	DC 580...710 V
Frequency	45...65 Hz		55...65 Hz

1) See Table 6-9, Technical data I/R modules
This means that the operational reliability is increased even when connected to weak line supplies!

Table 6-9 Technical specifications, I/R modules

Internal cooling **External cooling** **Hose cooling**	**6SN11 45-** **6SN11 46-** **6SN11 45-**	**1BA0□-0BA□** **1BB0□-0BA□** **-**	**1BA0□-0CA□** **1BB0□-0CA□** **-**	**1BA0□-0DA□** **1BB0□-0DA□** **1BB0□-0DA□**	**1BB0□-0EA□** **1BB0□-0EA□** **1BB0□-0EA□**	**1BB0□-0FA□** **1BB0□-0FA□** **1BB0□-0FA□**
Infeed/regenerative feedback Rated power (S1) S6 power Peak power (400 V)	 kW kW kW	 16 21 35	 36 47 70	 55 71 91	2) 80 104 131	2) 120 156 175
Sinusoidal operation input currents (AC_{RMS})	Use for dimensioning the installation, not for calculating the power!					
Rated current (400 V)	A_{rms}	27	60.5	92.5	134	202
Squarewave operation input currents (AC_{RMS})	Use for dimensioning the installation, not for calculating the power!					
Rated current (400 V)	A_{rms}	30	67	102	149	223
	Use for dimensioning the installation, not for calculating the power! (calculated)					
Rated current (400 V) unregulated operation	A_{rms}	33	74	114	165	248
Connection data Voltage (power)	 V_{rms}	refer to Chapter LEERER MERKER, Table LEERER MERKER				
Voltage (electronics)	V	refer to Chapter LEERER MERKER, Table LEERER MERKER				
Power supply	V_{rms}	At the DC link with 600/625/680 V DC or supplied in parallel, AC and DC connection or DC connection only.				
Frequency	Hz	50 to 60 ±10%				
Connection cross–section	mm^2	Max. 16	Max. 50	Max. 95	Max. 95	Max. 150
Output voltage	V	regulated: 600/625; unregulated: 490...680 (line supply–dependent)				
Module width	mm	100	200	300	300	300
Type of cooling Internal cooling (volumetric flow rate) External cooling1) Hose cooling	 m^3/h	 Fan 56 Fan –	 Fan 112 Fan –	 Fan 112 Mounting frame (Bestell-Nr. 6SN1162–0BA04–0EA□) with fan assembly and built–on fan (6SN1162–0BA02–0AA2 Kit for hose cooling with fan	 Built–on fan 400 3)	 Built–on fan 1) 400 3)
Losses Internal cooling External cooling Hose cooling	 W W (int./ext.) W (int./ext.)	 320 50/270 –	 585 50/535 –	 745 115/630 115/630	 1280 190/1090 190/1090	 1950 290/1660 290/1660
Efficiency η		0.97	0.97	0.97	0.97	0.97
Weight Internal cooling External cooling Hose cooling	 kg kg kg	 10.5 10.5 –	 15.5 15.5 –	 26 26 26	 26 26 26	 29 29 29

1) For a module width of 300 mm with external cooling, mounting frames are required that must be ordered separately. The fan assembly required to mount the built–on fan is included in the scope of supply of the mounting frame. The built–on fan must be ordered separately! Mounting frames are also available for smaller module widths. However, these are not required if openings are cut out in the rear cabinet panel for the module heatsinks as shown in this Configuration Manual.
2) External power supply for main contactor control required (see Chapter 6.2.5).
3)) Must be separately ordered: Mounted fan, 6SN1162–0BA02–0AA2
4) See the diagram with pipe cooling in Chapter 2.7.1, Fig. 2-7

Table 6-10 Technical data, UI modules

Heat dissipation **Heat dissipation** **Hose cooling**	**6SN11 45-** **6SN11 46-** **6SN11 45-**	**–** **1AB00–0BA**□ (INT./EXT.) **–**	**1AA01–0AA**□ (INT./EXT.) **–** **–**	**1AA00–0CA**□ (INT.) **1AB00–0CA**□ (EXT.) **–**
Infeed/regenerative feedback Rated power (S1) S6 power Peak power (400 V)	 kW kW kW	 5 6.5 10	 10 13 25	 28 36 50
Input currents ((AC_{RMS})	Use for dimensioning the installation, not for calculating the power!			
Rated current (400 V)	12	24	68	
Built-in pulsed resistor Continuous power/ Peak power Energy consumption, max:	 kW kWs	 0,2/10 E = 13,5	 0,3/25 E = 7,5	 – –
Connection data Voltage (power)	V	refer to Chapter LEERER MERKER, Table LEERER MERKER		
Voltage (electronics)	V	refer to Chapter LEERER MERKER, Table LEERER MERKER		
Power supply	V	At DC link with 600/625/680 V DC or parallel infeed, AC and DC connection		
Frequency	Hz	50 to 60 ±10%		
Connection cross–section, max.	mm^2	6	16	50
Output voltage	V	0...490...680 depending on the line supply voltage		
Output frequency	Hz	0...1400 depending on the control unit		
Module width	mm	50	100	200
Type of cooling Internal cooling External cooling Hose cooling		 Non–ventilated Non–ventilated –	 Universal cooling internal/external –	 Internal separately–driven fan Integrated third–party fan (volumetric flow, both 42 m^3/hr)
Losses Internal cooling External cooling Hose cooling	 W W (int./ext.) W (int./ext.)	 270 270/– –	 450 120/330 –	 250 90/160 –
Efficiency η		0.98	0.98	0.98
Weight Internal cooling External cooling Hose cooling	 kg kg kg	 6.5 6.5 –	 9.5 9.5 –	 15.5 15.5 –

Note

Temperature derating, see Chapter 5.4.2.

Installation altitude derating, see Chapter 5.4.3.

6.4.2 Permissible duty cycles/derating

Nominal load duty cycles for NE modules

For a derating, it must be analyzed as to the reason why this is required, and which component is involved. For instance, if derating is required as a result of the line voltage, then for uncontrolled infeed modules, the maximum motor speed must be correspondingly adapted.

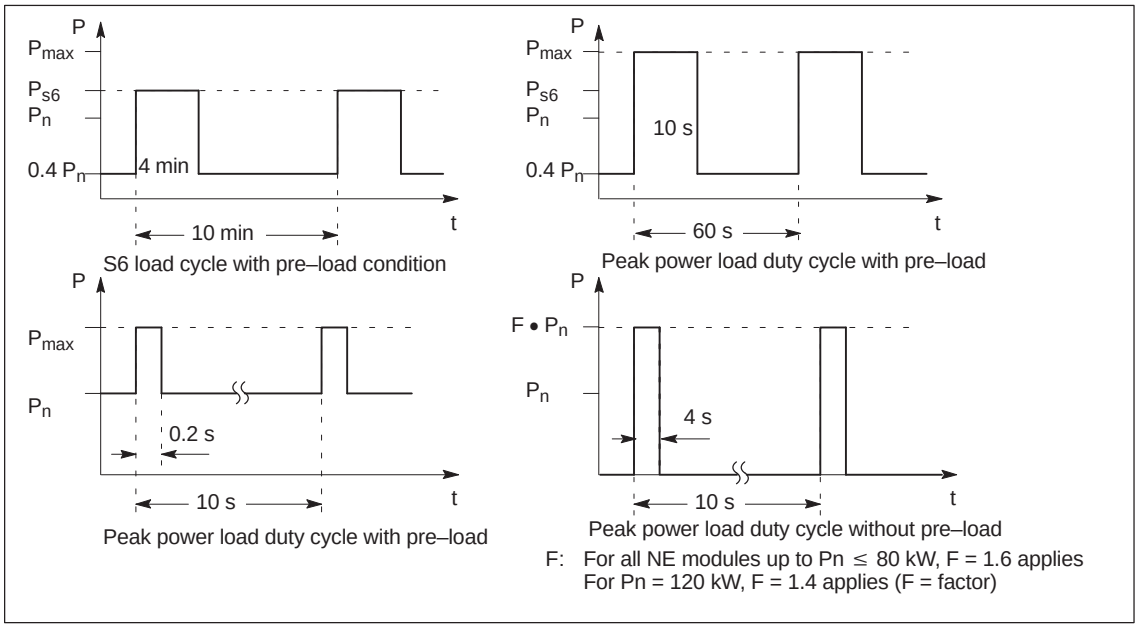


Fig. 6-10 Nominal load duty cycles for NE modules

Calculation of maximum permissible line infeed load

The effective load must be determined over a load period/cycle and this must be set to the ratio for the rated power of the module. The resulting weighting factor B must not exceed the factors of the associated time interval T indicated in Table 6-11. Note that the maximum P_{max} must not be exceeded at any time and the derating factor, depending on the pulse frequency and/or installation altitude, must be taken into account!

As a rule of thumb, the following applies for block-type load duty cycles:

$$B = \sqrt{\frac{P_1^2 \bullet t_1 + P_2^2 \bullet t_2 + \ldots + P_k^2 \bullet t_k}{T \bullet P_n^2}}$$

T	Total duration of the load duty cycle
P_n	Rated power of the I/R module
$P_1 \ldots P_k$	Magnitude of the required power
$t_1 \ldots t_k$	Duration of the corresponding power
B	Evaluation factor for the load duty cycle according to Table 6-11

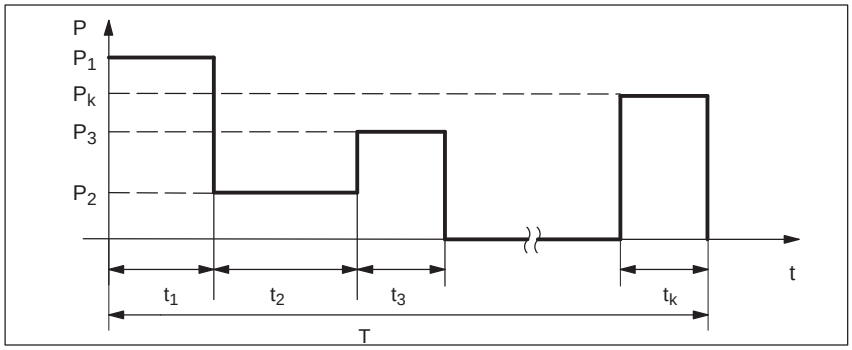


Fig. 6-11 Explanation of the rule of thumb for block–type load duty cycles

The following applies for the rules of thumb:

- The evaluation factor B, calculated for the load duty cycle, must be less than the maximum values B_{max} specified in Table 6-11.
- The maximum infeed power P_{max} of the infeed module may not be exceeded.
- The power derating as a function of the installation altitude must be taken into account.

Table 6-11 Evaluation factor for the load duty cycle

	Total duration		
	T ≤ 10 s	**10 s < T ≤ 60 s**	**60 s < T ≤ 600 s**
B_{max}	1.03	0.90	0.89

Calculation example for a block–type load duty cycle:

Evaluation/assessment factor B should be determined for the following load duty cycle:

Infeed module used: I/R 36 kW (P_n=36 kW; P_{max} =70 kW)

i	1	2	3	4	5
P [kW]	50	20	36	0	40
t [s]	1.5	1	2	1.2	1.2

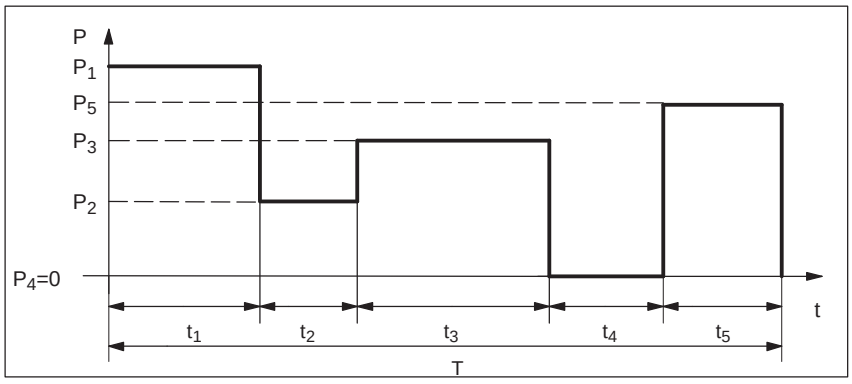


Fig. 6-12 Example, calculating a load duty cycle

1. Is the maximum infeed exceeded? —> No —> OK
2. Calculating the total duration T
   $T = \Sigma t_i = t_1 + t_2 + ... + t_k = 1.5\ s + 1\ s + 2\ s + 1.2\ s + 1.2\ s = 6.9\ s$
3. Calculating the evaluation/assessment factor B

$$B = \sqrt{\frac{P_1^2 \bullet t_1 + P_2^2 \bullet t_2 + ... + P_k^2 \bullet t_k}{T \bullet P_n^2}}$$

$$B = \sqrt{\frac{50^2 \bullet 1.5 + 20^2 \bullet 1 + 36^2 \bullet 2 \quad + 0^2 \bullet 1.2 + 40^2 \bullet 1.2}{6.9 \bullet 36^2}}$$

$$B = \sqrt{\frac{3750 + 400 + 2592 + 0 + 1920}{8942.4}}$$

$$B = \sqrt{\frac{8662}{8942.4}} = 0.98$$

4. Check, whether B is < B_{max} for the calculated load duty cycle T
   B = 0.98
   B_{max} for a load duty cycle less than 10 s = 1.03
   —> the load duty cycle is permissible.

Installation altitude over 1000 m with limitations/ secondary conditions

All of the power ratings specified apply up to an installation altitude of 1000 m above sea level. For installation altitudes > 1000 m above sea level, the specified power ratings must be reduced according to the derating characteristic as shown in Chapter 5.4.3. For installation altitudes > 2000 m, an isolating transformer must be used.

For a line supply circuit with overvoltage category III, the standard prescribes greater isolating distances at altitudes starting at 2000 m. For this reason, a non–line supply circuit must be implemented using an isolating transformer.

The isolating transformer is used for uncoupling of a line supply circuit (overvoltage category III) to form a non-line supply circuit (overvoltage category II) in which the available isolating distances are then sufficient.
See IEC 60664–1 (required for the total system).

Notice

The power ratings for P_n, P_{s6} and P_{max} must be reduced (derated) in the same way.

If the power ratings are exceeded, the devices can fail prematurely.

Note

For UI modules, it must be carefully observed that the braking energy fed in does not exceed the power rating of the pulsed resistor.
A defect does not occur; when an overload condition occurs, the resistor is shut down.
The drive unit then goes into a fault condition, with the fault ”DC link overvoltage” and the motors coast down in an uncontrolled way.

6.4.3 Technical data of the supplementary components

Cooling components

Components	Order number	Supply voltage	Supply current	Observe the rotating field!	Degree of protection	Weight [kg]
Built–on fan for internal and external cooling	6SN11 62–0BA02–0AA□	3–ph. 360..510 V AC 45...65 Hz	0.2...0.3 A	For the direction of rotation, refer to the direction of the arrow on the fan	IP 44	4
Hose cooling package 1 for an individual module comprising: • 2x module connection flange, 2000 mm hose • 1x cabinet connection flange • 1x radial fan with cabinet connection flange[1)] (refer to Fig. 2-7)	6SN11 62–0BA03–0AA1	3–ph. 360..457 V AC 47.5...62.5 Hz	1.0...1.2 A	Counter–clockwise direction of rotation when viewing the rotor	IP 54	8
Hose cooling package 2 for a 2–tier configuration of I/R 55 kW and LT 200 A: • 4x module connection flange, 2000 mm hose • 1x cabinet connection flange • 1x radial fan with cabinet connection flange[1)] (refer to Fig. 2-7)	6SN11 62–0BA03–0CA1	3–ph. 360..457 V AC 47.5...62.5 Hz	1.0...1.2 A	Counter–clockwise direction of rotation when viewing the rotor	IP 54	8
Motor circuit–breaker	Size S00: Setting value, 0.3 A Setting value, 1 A Size S0 Setting value, 0.3 A Setting value, 1 A			3RV1011–0DA10 0.22–0.32 A 3RV1011–0KA10 0.9–1.25 A 3RV1021–0DA10 0.22–0.32 A 3RV1011–0KA10 0.9–1.25 A		
Air baffle plate width 100 mm	6SN1162–0BA01–0AA0	If heat sensitive parts are located above the UI and/or PR module with a clearance < 500 mm, e.g. cable ducts, then an air baffle plate must be used (refer to Chapter 12, Dimension drawings).				

1) Replacement filter element: Order No. AFF0
Can be ordered from: Pfannenberg GmbH
Postfach 80747
D–21007 Hamburg

Warning

The fan may only be commissioned if it is electrically connected to the module housing (PE fan via module housing).

Caution

If the fan has the incorrect direction of rotation (refer to the arrow on the fan) then cooling is not guaranteed!

Connection for 3–phase fans

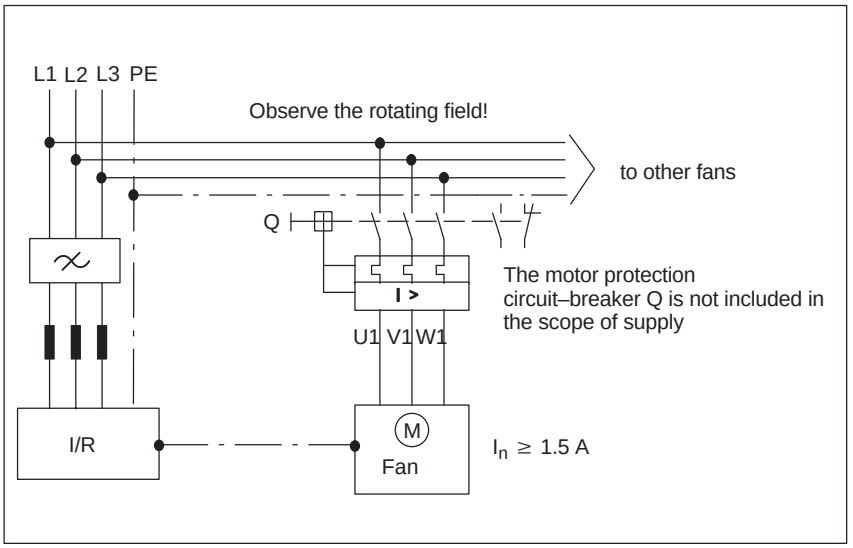


Fig. 6-13 Connection for 3–phase fans

6.5 HFD reactor

General information

For the unregulated 5 kW and 10 kW infeed modules, the commutating reactor is integrated. With 28 kW, it must be external.

For connection of the regulated infeed/regenerative feedback modules to the line supply, the HF/HFD reactor tuned to 7 kHz is required (see selection Table 6-12).

The HFD reactors perform the following functions:

- To limit the harmonics fed back into the line supply
- Energy store for the step–up operation of the infeed units
- Current limiting for line supply oscillations
- Together with a damping resistor, the HFD reactors dampen the system oscillations of the converter system. The HF reactors are replaced with the HFD reactors with damping resistor because they provide increased operational reliability and a longer lifetime.

The HFD reactor should be mounted as close as possible to the line supply infeed module.

Caution

The surface of the reactors can reach high temperatures.

The 100 mm clearance above and below the components to ensure air circulation and cooling must be carefully maintained. If this is not observed, then the components could prematurely age.

Temperature–sensitive components must be located a sufficient distance away or thermally partitioned off!

Note

The connecting cables to the NE module must be kept as short as possible (max. 5 m). For lengths exceeding 1 m, twisted shielded connection lines, with the shielding contacting ground on both side, should be used. It is preferable that the cable shield is connected close to the reactor footplate, using a clamp that completely encompasses the shield

Notice

It is not permissible to use HFD reactors in the motor cable. Operation without a damping resistor is not permissible, as high voltages (several kV) can occur if the system oscillates

Note

If commutating reactors are used that have not been released by SIEMENS for SIMODRIVE 6SN11, harmonics or switching edges not permitted for the semiconductors can occur that can damage, disturb or early age other equipment connected to the particular line supply.

6.5.1 Assignment of the HFD reactors/damping resistors to the NE modules

Table 6-12 HFD reactor/damping resistor assignment, data

	UI module 28/50 kW	**I/RF module 16/21 kW**	**I/RF module 36/47 kW**	**I/RF module 55/71 kW**	**I/RF module 80/104 kW**	**I/RF module 120/156 kW**
Type HFD reactor	28 kW	16 kW	36 kW	55 kW	80 kW	120 kW
Order No. 6SL3000– 6SN1111–	– 1AA00–0CA□	0DE21–6AA□	0DE23–6AA□	0DE25–5AA□	0DE28–0AA□	0DE31–2AA□
Pv	70 W	170 W	250 W	350 W	450 W	590 W
Degree of protection acc. to DIN EN 60529 (IEC 60529)	IP00					
Maximum permissible ambient temperature • Transport • Storage • Operation	 –25..+80 °C –25..+80 °C 0...+40 °C, for power derating, up to +55 °C					
Connection	max. 35 mm^2	max. 16 mm^2	max. 35 mm^2	max. 70 mm^2	max. 95 mm^2	
Tightening torque of terminals [Nm]	2.5	1.2	2.5	Conductor 7 PE 3...4	Spring–loaded terminals	
	Terminals of HFD resistor 1.2					
Approx. weight	6 kg	8.5 kg	13 kg	18 kg	40 kg	50 kg
Mounting position	Any	Any	Any	Any	Any	Any
Terminal placement	Input: 1U1, 1V1, 1W1					
	Output: 1U2, 1V2, 1W2					
HFD damping resistor	–	Refer to Table 6-15				
Cooling clearances (without any additional measures, HFD line reactors can become hot!): 100 mm						
Drilling template	Refer to Chapter 12 Dimension drawings					

HFD packages

The following usual HFD components can be ordered in packages:

- HFD package includes an HFD line reactor and a damping resistor

Table 6-13 Packages without Wideband Line Filter that can be ordered

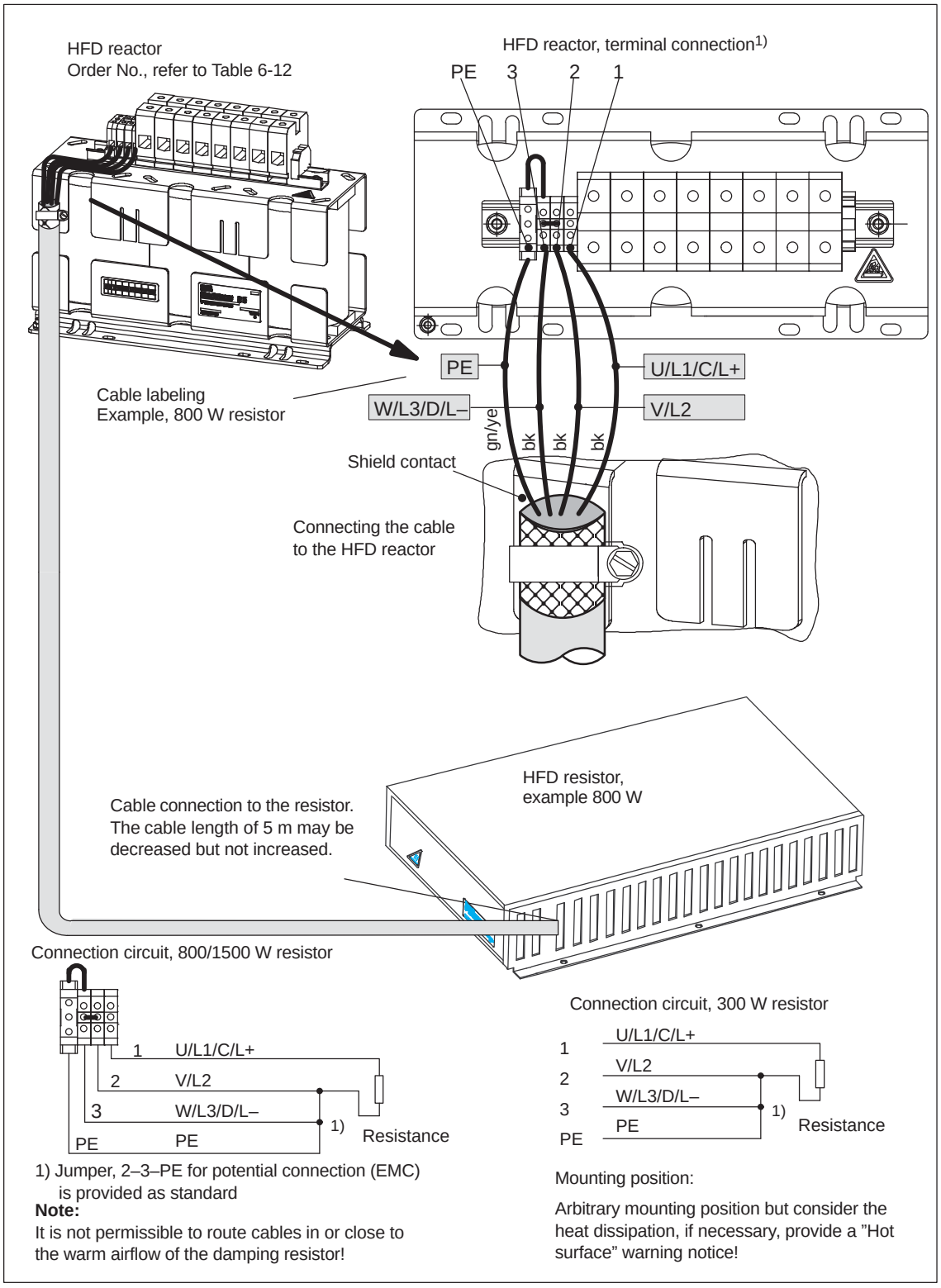
For I/R modules	HFD package	HFD line reactor	Damping resistor
16 kW	6SN1111–0AA00–0BV0	6SL3000–0DE21–6AA□	6SN1113–1AA00–0DA□ (300 W)
	6SN1111–0AA00–0BV1		6SL3100–1BE21–3AA□ (800 W)
36 kW	6SN1111–0AA00–0CV0	6SL3000–0DE23–6AA□	6SN1113–1AA00–0DA□ (300 W)
	6SN1111–0AA00–0CV1		6SL3100–1BE21–3AA□ (800 W)
55 kW	6SN1111–0AA00–0DV0	6SL3000–0DE25–5AA□	6SL3100–1BE21–3AA□ (800 W)
80 kW	6SN1111–0AA00–0EV0	6SL3000–0DE28–0AA□	6SL3100–1BE21–3AA□ (800 W)
120 kW	6SN1111–0AA00–0FV0	6SL3000–0DE31–2AA□	6SL3100–1BE21–3AA□ (800 W)

- HFD package includes an HFD line reactor, a damping resistor and a Wideband Line Filter

Table 6-14 HFD packages with Wideband Line Filter that can be ordered

For I/R modules	HFD package	HFD line reactor	Damping resistor	Wideband Line Filter
16 kW	6SN1111–0AA00–1BV0	6SL3000–0DE21–6AA□	6SN1113–1AA00–0DA□ (300 W)	6SL3000–0BE21–6AA□
	6SN1111–0AA00–1BV1		6SL3100–1BE21–3AA□ (800 W)	
36 kW	6SN1111–0AA00–0CV0	6SL3000–0DE23–6AA□	6SN1113–1AA00–0DA□ (300 W)	6SL3000–0BE23–6AA□
	6SN1111–0AA00–0CV1		6SL3100–1BE21–3AA□ (800 W)	
55 kW	6SN1111–0AA00–0DV0	6SL3000–0DE25–5AA□	6SL3100–1BE21–3AA□ (800 W)	6SL3000–0BE25–5AA□
80 kW	6SN1111–0AA00–0EV0	6SL3000–0DE28–0AA□	6SL3100–1BE21–3AA□ (800 W)	6SL3000–0BE28–0AA□
120 kW	6SN1111–0AA00–0FV0	6SL3000–0DE31–2AA□	6SL3100–1BE21–3AA□ (800 W)	6SL3000–0BE31–2AA□

HFD reactor connection



1) Jumper, 2–3–PE for potential connection (EMC) is provided as standard

Note:
It is not permissible to route cables in or close to the warm airflow of the damping resistor!

Mounting position:

Arbitrary mounting position but consider the heat dissipation, if necessary, provide a ”Hot surface” warning notice!

Fig. 6-14 Wiring, HFD reactor and damping resistor

Damping resistor

Together with the HFD reactor, an external resistor must be used for damping purposes (refer to Fig. 6-14).

Table 6-15 Technical specifications

	Pulsed resistor 0.3/25 kW[1]	**HFD damping resistor**[2]	**Pulsed resistor Plus 1.5/25 kW**[3]
Order No.	6SN1113–1AA00–0DA□	6SL3100–1BE21–3AA□	6SL3100–1BE22–5AA□
Rated power (kW)	0.3	0.8	1.5
Special low–inductance resistor	0...230 kHz ⩽3 dB		
including the connecting cable [m]	3	5	5
Connection	3 x 1.5 mm^2	4 x 1.5 mm^2	4 x 2.5 mm^2
Weight [kg]	1.45	5.5	5.6
Degree of protection acc. to DIN EN 60529 (IEC 60529)	IP 54	IP51	IP20
UL file	E–228809	E–212934	E–192450
Ambient temperature [°C]	0...55		
Dimensions (W x H x D) [mm]	80 x 210 x 53	277 x 552 x 75	193 x 410 x 240

1) The 300 W resistance can be used for HFD applications if the following is true after a warm–up run when all axes are shut down in a regulated way:
   - After an operating period of over two hours, no temperature in excess of 150 °C may occur on the surface of the 6SN1113–1AA00–0DA0 resistor.
   - This warm–up run must be repeated if the hardware configuration, e.g. motor cable lengths, is changed!
2) Preferred type
3) Alternative possible

Note

Preferably, the HFD damping resistor (6SL3100–1BE21–3AA0) should be used. It must not be connected as an external pulsed resistor on the pulsed resistor module or UI module!

The HFD damping resistor can become very hot. Consequently, it must be installed so that it cannot be touched or placed at an endangered position with an appropriate warning notice.

Danger

During operation and briefly after being switched off, the surfaces can reach temperatures that can cause burns and results in fires

Reader's note

For mounting information and instructions for external HFD resistors, refer to Fig. 6-14 and Chapter 6.7.3.

6.6 Monitoring module

6.6.1 Integration into the overall system

The monitoring module contains an electronic power supply and central monitoring functions, which are required to operate the drive modules.

6.6.2 Technical data (supplement to the general technical data)

Table 6-16 Technical data, monitoring module

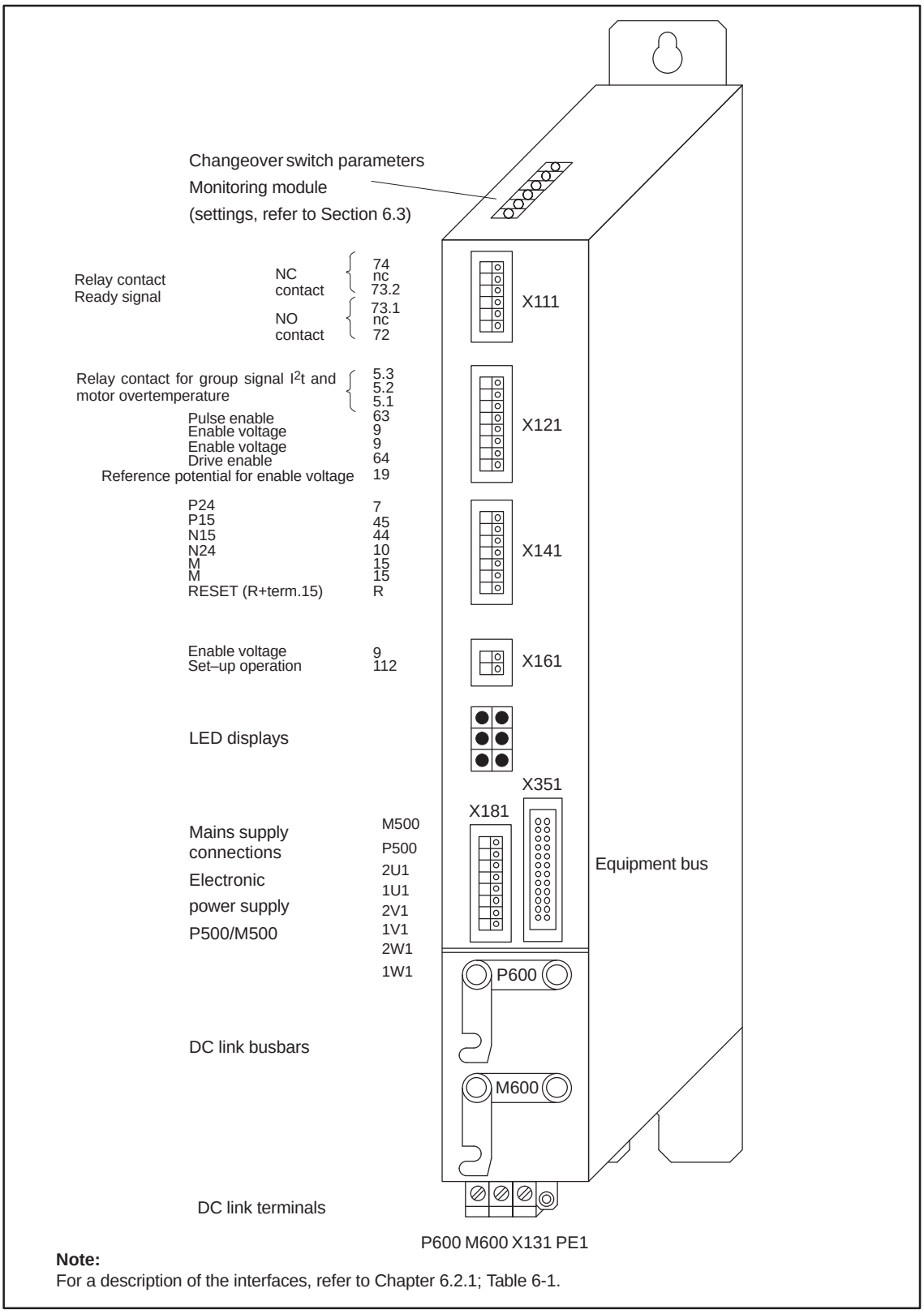
Power loss	70 W
Rated supply voltage	3–ph. 400 V – 10% up to 480 V AC + 6%
Alternatively, rated supply voltage DC link	600/625/680 V DC
Current consumption	for 3–ph. 400 V AC: approx. 600 mA
Type of cooling	Natural ventilation
Weight	approx. 5 kg
Assessment factor for the electronic points (EP)	Max. 8
Assessment factor for the gating points (AP)	Max. 17
The cross–section that can be connected to the P600, N600, X131 terminal block	• Max 10 mm^2 for cables with conductor end sleeves • Max 16 mm^2 for cables with pin–type cable lug

Reader's note

For an overview of the interfaces, refer to Section 6.2.1, Table 6-1 in the column "Terminals used" under monitoring module.

For operation of the monitoring module only on the DC link, without AC power supply, 1000 µF per monitoring module must be observed for the loading limit of the line supply.

This capacity is not included in the calculation of the permitted number of pulsed resistors, because they are de–coupled using diodes.



Note:
For a description of the interfaces, refer to Chapter 6.2.1; Table 6-1.

Fig. 6-15 Monitoring module 6SN1112–1AC01–0AA1

6.6.3 Mode of operation

Parameters critical for operation are monitored in the monitoring module – these include:

- DC link voltage
- Controller power supply (± 15 V)
- 5 V voltage level

If these parameters are in the permissible operating range, then the internal prerequisites for the ”Unit ready” signal are available. The module group connected to the monitoring module is enabled as soon as the external enable signals have been issued via terminals 63 (pulse enable) and 64 (drive enable). The total signal activates the ”Ready” relay and can be fetched potential–free using the 74/73.2 and 73.1/72 terminals. The load capability of the contacts is 250 V AC/1 A or 30 V DC/1 A.

LEDs on the front panel of the monitoring module indicate the signal states of the monitoring circuits.

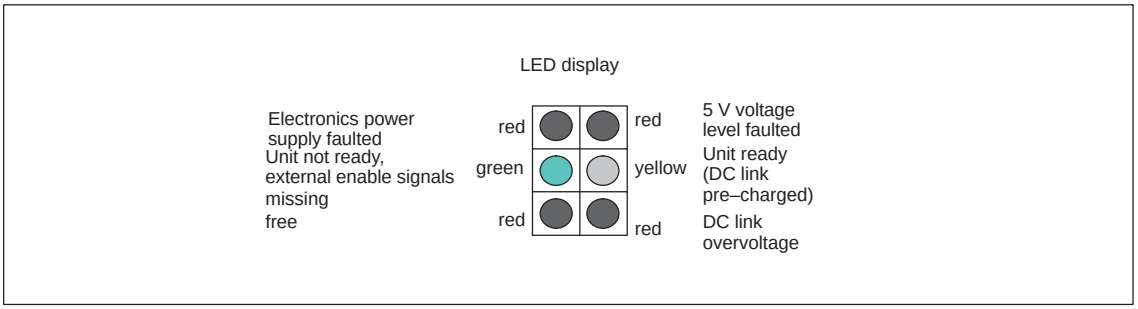


Fig. 6-16 LED display of the monitoring module

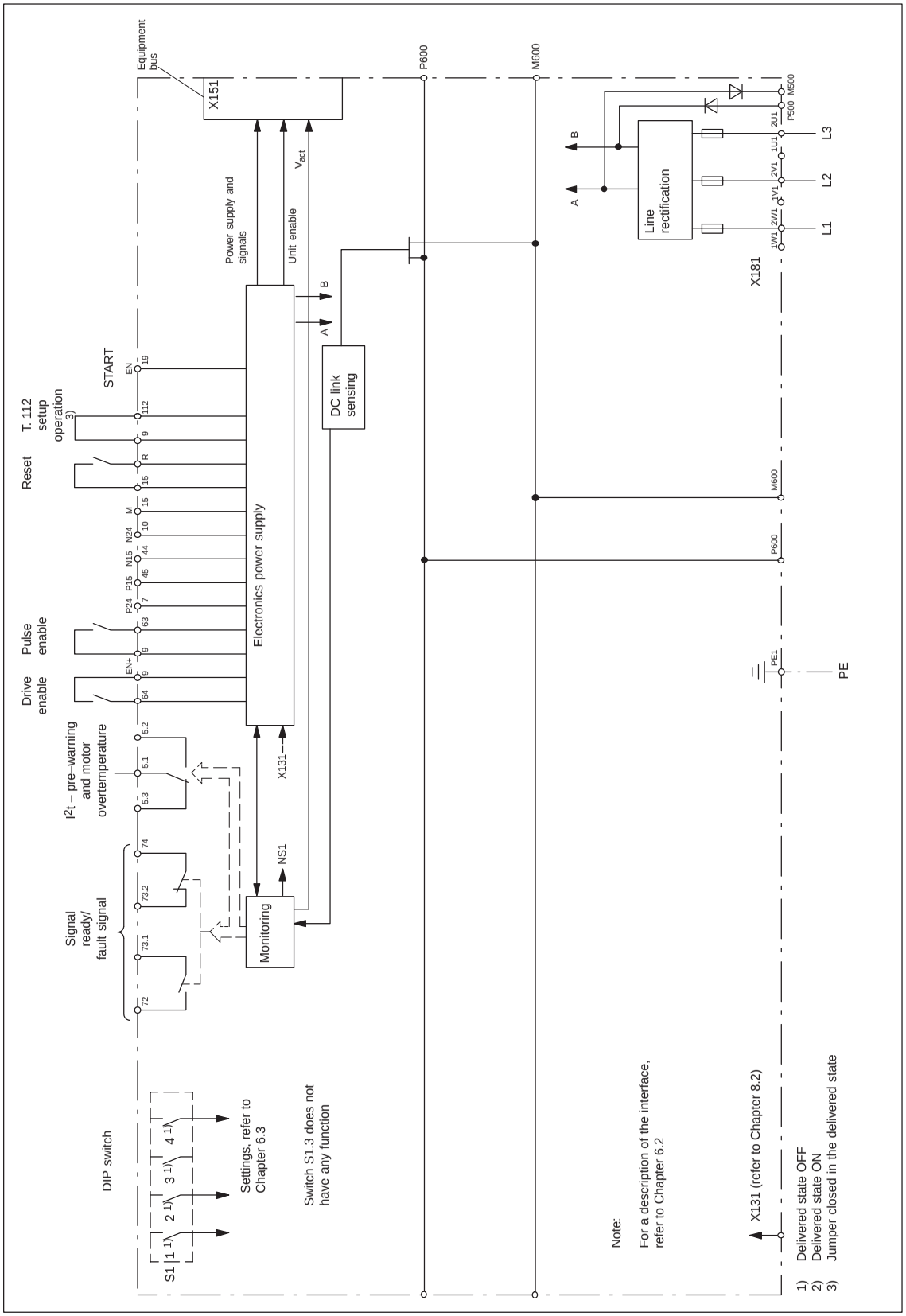


Fig. 6-17 Block diagram, monitoring module

6.7 DC link options

6.7.1 Capacitor module with 2.8 mF, 4.1 mF or 20 mF

Description

The capacitor modules are used to increase the DC link capacitance. This means that on one hand, a brief power failure can be buffered and on the other hand, it is also possible to store the braking energy.

A differentiation is made between the modules as follows:

- Modules with 2.8 mF and 4.1 mF —> are used as dynamic energy storage devices
- Module with 20 mF —> is used to buffer line supply dips

The modules are available in the following versions:

- Central modules: 4.1 mF and 20 mF
  - SIMODRIVE housing type – integrated into the system group.
- Distributed modules: 2.8 mF and 4.1 mF
  - New housing types are mounted decentrally in the control cabinet and are connected to the SIMODRIVE DC link using an adapter terminal and cable.

The capacitor modules have a ready display; this is lit from a DC link voltage of approximately 300 V and above. This also means that if an internal fuse ruptures, it can be identified. This does not guarantee safe and reliable monitoring of the charge state.

The module with 2.8 mF or 4.1 mF is implemented without pre–charging circuit and can – because it is directly connected to the DC link – absorb dynamic energy and therefore operate as dynamic energy storage device. For these modules, the charge limits of the line supply modules must be carefully taken into consideration.

For the 20 mF module, the pre–charging is realized through an internal pre–charging resistor; this is designed to limit the charge current and to de–couple the module from the central pre–charging function. This module cannot dynamically absorb any energy as the pre–charging resistor limits the charge current. When the power fails (line supply failure), a diode couples this capacitor battery to the system DC link so that it can be buffered by the capacitors.

Note

The capacitor modules may only be used in conjunction with the SIMODRIVE 611 line supply infeed units.

The central modules are suitable for internal and external cooling.

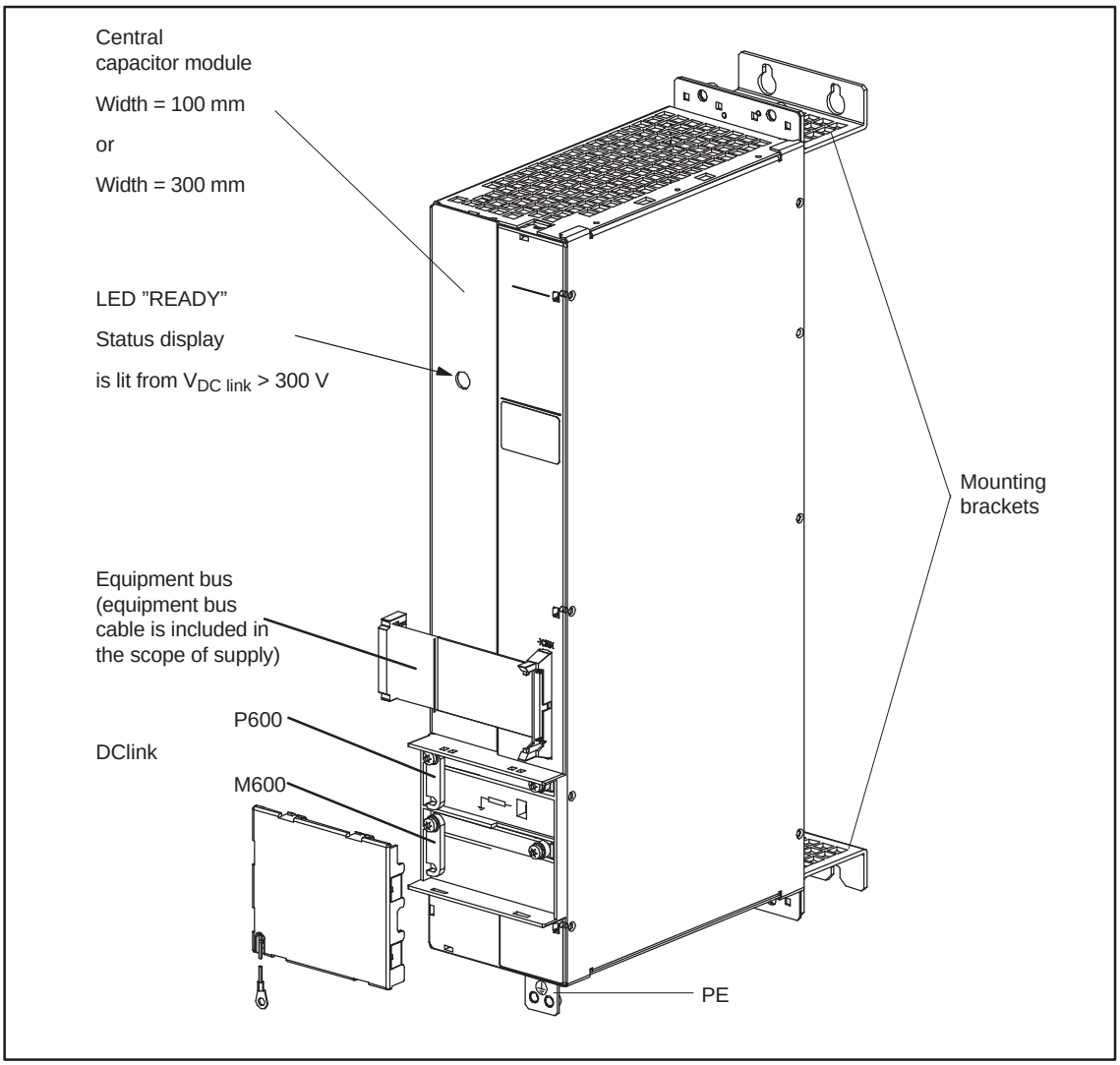


Fig. 6-18 Central capacitor module 4.1 mF

Note

The equipment bus is only looped through the capacitor module and has no function in the module itself. If capacitor modules are mounted at the end of the module lineup, then the equipment bus does not have to be wired.

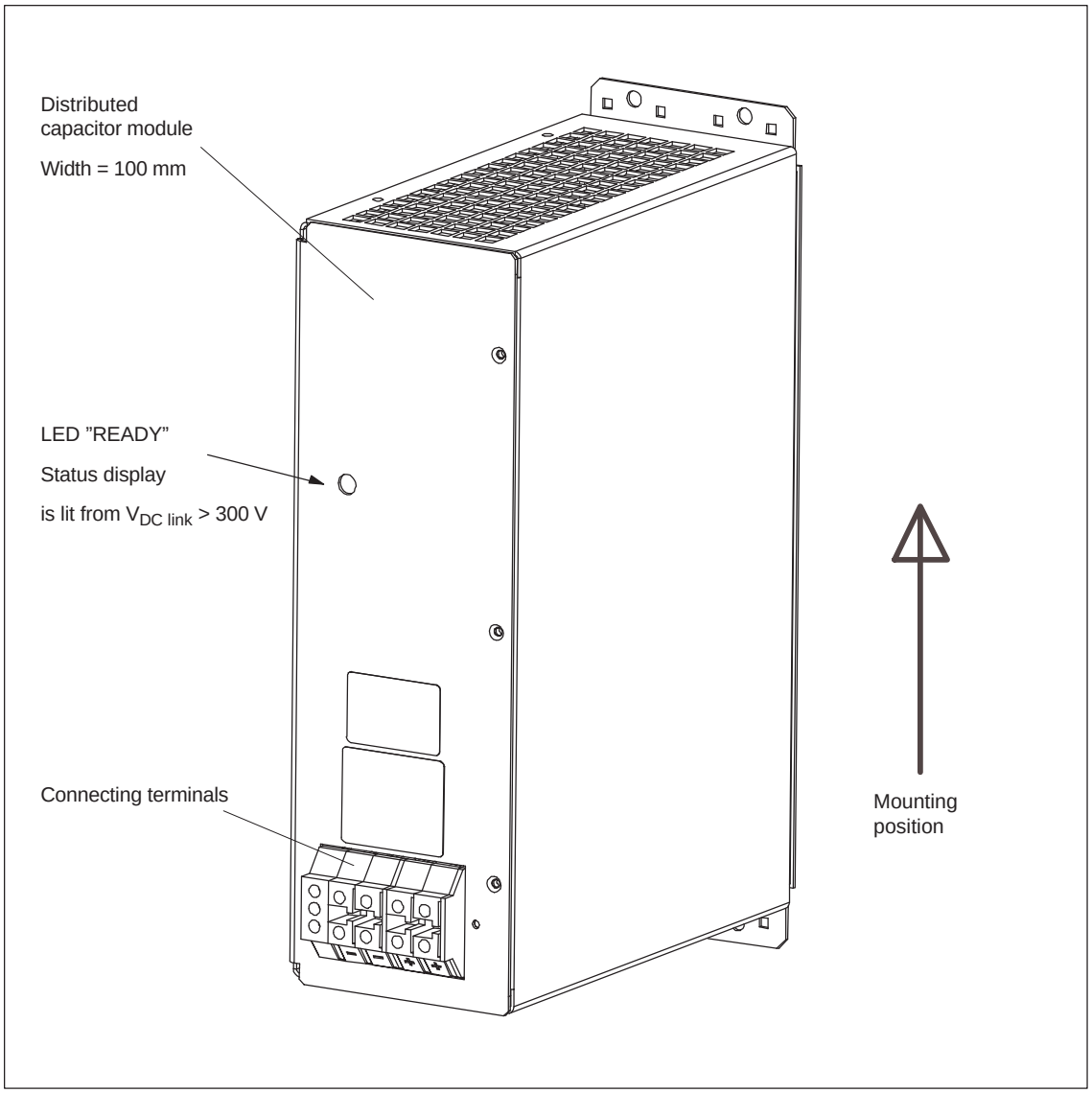


Fig. 6-19 Distributed capacitor module, 2.8 mF/4.1 mF

Technical data

The following technical data applies:

Table 6-17 Technical data of the central capacitor modules

Designation	Central modules	
	4.1 mF	**20 mF**
Order number	6SN11 12–1AB00–0BA0	6SN11 12–1AB00–0BA0
Voltage range	V_{DC} 350 ... 750 V	
Storage capacity w = 1/2 x C x V^2	$V_{DC\ steady–state}$ (examples) 600 V —> 738 Ws 680 V —> 948 Ws	$V_{DC\ steady–state}$ (examples) 600 V —> 3 215 Ws 680 V —> 4 129 Ws Note: As a result of the internal pre–charging resistor, the voltage at the capacitors is only approx. 0.94 x V_{DC}.
Temperature range	0 °C to +55 °C	
Weight	approx. 7.5 kg	approx. 21.5 kg
Dimensions	W x H x D 100 x 480 x 211 [mm]	W x H x D 300 x 480 x 211 [mm]

Table 6-18 Technical data of the distributed capacitor modules

Designation	Distributed modules	
	2.8 mF	**4.1 mF**
Order number	6SN11 12–1AB00–1AA0	6SN11 12–1AB00–1BA0
Voltage range	V_{DC} 350 ... 750 V	
Storage capacity w = 1/2 x C x V^2	$V_{DC\ steady–state}$ (examples) 600 V —> 504 Ws 680 V —> 647 Ws	$V_{DC\ steady–state}$ (examples) 600 V —> 738 Ws 680 V —> 948 Ws
Temperature range	0 °C to +55 °C	
Weight	5.3 kg	5.8 kg
Dimensions	W x H x D 100 x 334 x 231 [mm]	W x H x D 100 x 334 x 231 [mm]
Connection	AWG 12 ... AWG 6 (4 ... 16 mm^2) finely stranded	
Degree of protection	IP 20	

Examples for the calculation

The storage capacity in dynamic operation and for regenerative braking is calculated as follows:

Formula: $w = ½ \bullet C \bullet (V^2_{DC\ link\ max} – V^2_{DC\ link\ n})$

Assumptions for the example:

Capacitance of the capacitor battery C = 4.1 mF

Rated DC link voltage $V_{DClinkn}$ = 600 V

Maximum DC link voltage $V_{DClinkmax}$ = 695 V

—> $w = ½ \bullet 4.1 \bullet 10^{–3}\ F \bullet ((695\ V)^2 – (600\ V)^2) = 252\ Ws$

In addition, 252 Ws for each C = 4.1 mF module can be stored for this voltage range.

The following applies for the storage capacity of the capacitor battery when the power fails:

Formula: $w = ½ \bullet C \bullet (V^2_{DC\ link\ n} - V^2_{DC\ link\ min})$

Assumptions for the example:

Capacitance of the capacitor battery C = 20 mF

Rated DC link voltage $V_{DClinkn}$ = 600 V

Minimum DC link voltage $V_{DClinkmin}$ = 350 V

—> $w = ½ \bullet 20 \bullet 10^{-3}\ F \bullet ((600\ V)^2 - (350\ V)^2) = 2375\ Ws$

For this voltage range, a 20 mF capacitor module can supply energy for 2375 Ws.

Notice

$V_{DClinkmin}$ must be ≧ 350 V.

For voltages below 350 V, the switched–mode power supply for the electronics shuts down.

The possible buffer time $t_Ü$ is calculated as follows with the output DC link power $P_{DC\ link}$:

$t_Ü = w / P_{DC\ link}$

Dynamic energy

The DC link capacitors should be considered as being a battery. The capacitance and, thus, the storage capacity are increased as a result of the capacitor module.

In order to evaluate the required capacitance for a specific requirement in a certain application, the energy flow must be determined.

The energy flow depends on the following:

- All moved masses and moments of inertia
- Velocity, speed (and their change, acceleration, deceleration)
- Efficiencies: Mechanical system, gear units, motors, inverters (driving/braking)
- Back–up duration, buffering
- DC link voltage and the permissible change, output value, upper/lower limit value.

In practice, often there is no precise data about the mechanical system. If the mechanical system data is determined using rough calculations or estimated values, then the capacitance of the DC link capacitors required can only be determined during tests performed during the commissioning phase.

The energy for dynamic operations is obtained as follows:

The following applies for braking or accelerating operations within time t_V of a drive from one speed/velocity to another:

$$w = ½ \bullet P \bullet t_V$$

For rotary drives with

$$P = \frac{M_{Mot} \bullet (n_{Mot\ max} - n_{Mot\ min})}{9\ 550} \bullet \eta_G$$

For linear drives with

$$P = F_{Mot} \bullet (V_{Mot\ max} - V_{Mot\ min}) \bullet 10^{-3} \bullet \eta_G$$

with η_G:

Braking $\eta_G = \eta_M \bullet \eta_{INV}$

Acceleration $\eta_G = 1/(\eta_M \bullet \eta_{INV})$

w [Ws]	Energy
P [kW]	Motor power
t_V [s]	Time of the operation
M_{mot} [Nm]	Max. motor torque when braking or accelerating
F_{mot} [N]	Max. motor force when braking or accelerating
$n_{mot\ max}$ [RPM]	Max. speed at the start or the end of the operation
$n_{mot\ min}$ [RPM]	Min. speed at the start or end of the operation
$v_{mot\ max}$ [m/s]	Max. velocity at the start or end of the operation
$v_{mot\ min}$ [m/s]	Min. velocity at the start or end of the operation
η_G	Total efficiency
η_M	Motor efficiency
η_{INV}	Inverter efficiency

Torque M and force F depend on the moved masses, the load, and the acceleration in the system.

If precise data is not available for the previously specified factors, then generally rated/nominal data is used instead.

Engineering information

The central capacitor module should preferably be located at the end of the system group. The connection is made using the DC link busbar.

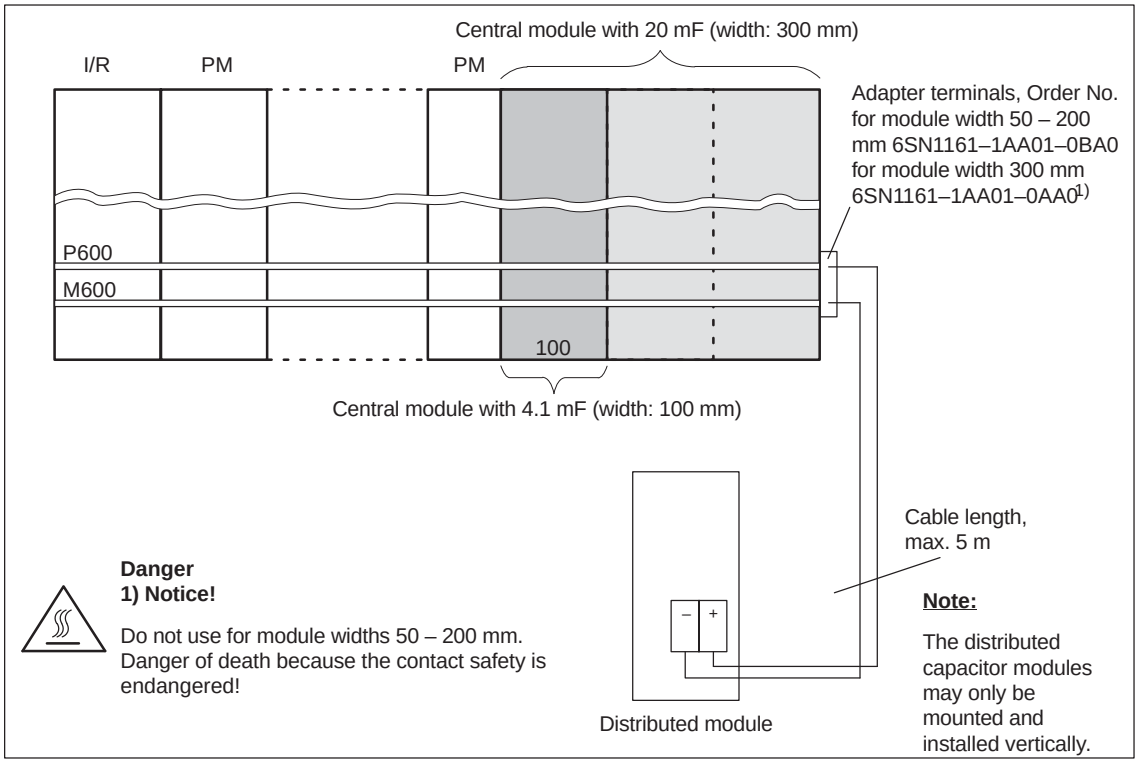


Fig. 6-20 Mounting location for the capacitor modules

Depending on the line infeed used, several capacitor modules can be connected in parallel.

For the capacitor modules with 2.8 mF and 4.1 mF, the total charge limit of the line infeed may not be exceeded (refer to Chapter 1.3).

Capacitor modules that can be connected

The capacitor modules 2.8 mF and 4.1 mF (central/distributed) must be dimensioned/selected corresponding to the engineering table 1-4 in Chapter LEERER MERKER taking into account the charge limits of the infeed.

The 20 mF capacitor modules do not have to be taken into account in the 1-4 engineering table. They must be selected as required taking into account the maximum number from Table 6-19.

Table 6-19 Maximum number of 20 mF capacitor modules

Infeed unit	Maximum that can be connected 1)
UI 5 kW	1
UI 10 kW I/R 16 kW	3
UI 28 kW I/R 36 kW...120 kW	2

1) Valid if all of the monitoring modules used are connected to the AC line supply.

Charge times Discharge times Discharge voltage

Before performing any commissioning or service work, check that the DC link is safely disconnected from the power supply.

Table 6-20 Charge/discharge times, discharge voltage

Capacitor module	The charge time depends on the total DC link capacitance	The discharge time depends on the total DC link capacitance to 60 V of the DC link voltage at 750 V DC
2.8 mF/4.1 mF	As for the power modules	approx. 30 min
20 mF	approx. 2 min	approx. 30 min

If there is a pulsed resistor in the system, in order to reduce the discharge time after opening terminal 48, the DC link can be quickly discharged via terminals X221:19 and 50 (jumpers). In this case, the electronics power supply must be implemented using a 3–phase line supply connection; this is not disconnected while discharging.

Note

Discharge through a pulsed resistor is not possible for a 5 kW UI!

Warning

The pulsed resistor modules can only convert a certain amount of energy into heat (refer to Table 6-24). The energy available to be converted depends on the voltage.

A monitoring function protects the resistance against overload. If this responds, then no additional energy is converted into heat in the resistor.

Caution

In order to avoid damage to the infeed circuit of the NE modules, when controlling/energizing terminal X221 T.19/50, it should be ensured that terminal 48 of the NE module is deenergized (the module is electrically isolated from the line supply).

The feedback signal contacts of the main contactor of the NE module must be evaluated to check whether the contactor has actually dropped out (X161 terminal 111, terminal 113 and terminal 213).

6.7.2 Pulsed resistor module and unregulated line supply infeed with pulsed resistor

The pulsed resistor module (PR module) protects the DC link from overvoltage, which, for example, would occur for UI modules when braking or for I/R modules when the power fails when stopping. The possible braking power of the total system can be increased by using one or more pulsed resistor modules.

The pulsed resistor module can be used to quickly discharge the DC link.

If the pulsed resistor (PR) module is supplied from a monitoring module, the electronics power supply must be implemented with a 3–phase AC supply system. Fast discharge is not possible if the electronics power supply is exclusively implemented through the DC link (P500/N500).

If heat–sensitive components, e.g. cable ducts, are located above the module with a clearance < 500 mm, then an air baffle plate must be provided (Order No. 6SN1162–0BA01–0AA0).

As a result of the universal housing design of the pulsed resistor module, this can be used both for internally as well as externally cooled module groups.

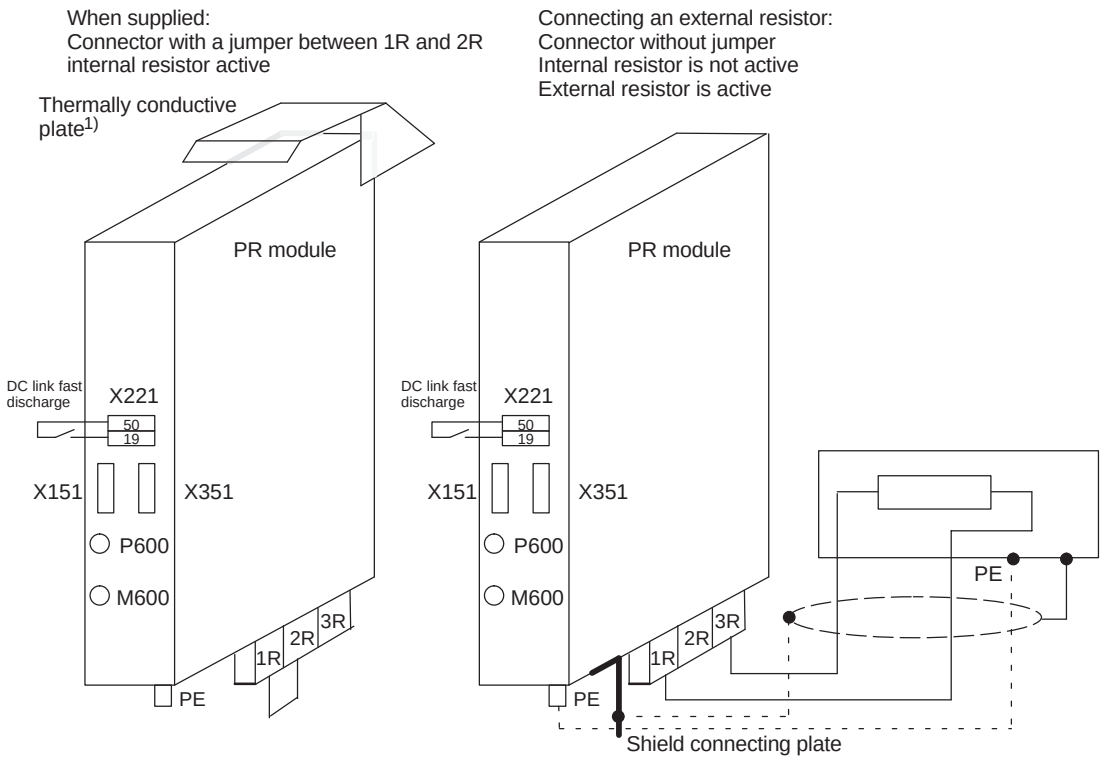
The UI and PR modules are equipped with a switch–on time monitoring; this protects the pulsed resistor from overheating.

The switch–in and switch–out thresholds depend on the setting of the line infeed switch S 1.1 or S 1.4, see Chapter 6.3.

Table 6-21 Technical data, PR module

Rated supply voltage	435/490/600/625/680 V DC
Continuous power/peak power/energy Permitted load cycle, refer to Section 6.7.4	• with internal pulsed resistor P = 0.3/25 kW; E = 7.5 kWs • with an external pulsed resistor module P = 1.5/25 kW; E = 13.5 kWs
Weight	approx. 5 kg
Module width	50 mm
Order number	6SN11 13–1AB01–0AA1

Connection
PR module



1) Installation, see Chapter 12, Fig. 12-63

Fig. 6-21 PR module, Order No.: 6SN1113–1AB01–0BA□

Note

Only the external PR 6SL3 100–1BE22–5AA0 can be connected.

Notice

Fast discharge is possible only when a 3–phase AC line supply is present!

Table 6-22 Interface description for PR modules

Term. No.	Designation	Function	Type 1)	Max. cross–section
PE P600 M600		Protective conductor DC link DC link	I I/O I/O	Screw Busbar Busbar
	X151/X351	Equipment bus	I/O	Ribbon cable
1R, 2R, 3R	TR1, – TR2	Connection of an external resistor (remove the 1R – 2R jumper!)	I/O	6 mm^2/4 mm^2 2)
19 50	X221 X221	Reference potential 0 V Fast discharge = 0 V	O,P I	1.5 mm^2 1.5 mm^2

1) I = input; O = output; P = only for PELV voltage
2) The first data is used for pin–type cable lug.
The second data is used for finely–stranded conductors without end sleeve.

6

Number of pulsed resistors used on the same DC link

The following condition must be fulfilled:

$T = R_{\Sigma N} \bullet C_{DC\ link} \geq 7.5\ ms$

$1/R_{\Sigma N} = 1/R1 + 1/R2 + 1/R3 + ... + 1/Rn$

$R_{\Sigma N}$ Resistance of the parallel–connected resistors in the system (15 ohm/resistor)

$C_{DC\ link}$ [µF] Total of all DC link capacities of the drive group
Secondary condition:
$C_{DC\ link}$ with pulsed resistor of at least 500 µF per resistor

Note

For a module group with pulsed resistor modules, they must be operated on the same power supply (device bus) of the I/R or monitoring module to ensure a simultaneous activation and deactivation of the resistors. Otherwise individual resistors/pulsed resistance modules can be overloaded.

For UI modules that use the integrated pulsed resistors, additional pulsed resistor modules must be operated on the device bus (PS) of the UI module!

An additional pulsed resistor module is not permitted for the 5 kW UI module!

6.7.3 External pulsed resistors

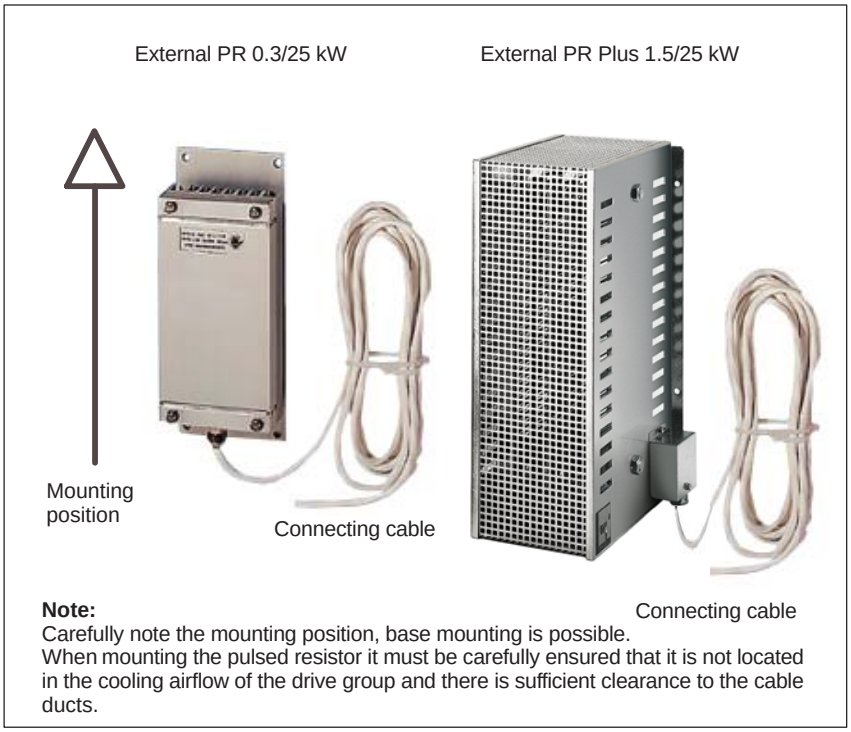
With externally attached pulsed resistors, the power loss of the resistor that occurs during braking accumulates outside the control cabinet and, thus, does not place a thermal load on the control cabinet.

The external pulsed resistors are generally required for the 28 kW UI module.

Depending on the power requirement, up to two equal pulsed resistors can be connected in the case of the 28 kW UI module. The protection function is parameterized via the connecting terminals.

Table 6-23 Technical specifications

Data	External pulsed resistor	
	0.3/25 kW (15 Ω)	**Plus 1.5/25 kW (15 Ω)**
Order number	6SN1113–1AA00–0DA0 (only for 28 kW UI module/ HFD)	6SL3100–1BE22–5AA0
Degree of protection acc. to DIN EN 60529 (IEC 60529)	IP54	IP20
Weight [kg]	3.4	5.6
Type of cooling	Natural ventilation	Natural ventilation
Dimensions (W x H x D) [mm]	80 x 210 x 53	193 x 410 x 240
including the connecting cable [m]	3	5



Note:
Carefully note the mounting position, base mounting is possible.
When mounting the pulsed resistor it must be carefully ensured that it is not located in the cooling airflow of the drive group and there is sufficient clearance to the cable ducts.

Fig. 6-22 Pulsed resistor, external

Table 6-24 Braking power of the UI and pulsed resistor modules (PR)

Description	External PR 0.3/25 kW[1)]	External PR Plus 1.5/25 kW
Order number	6SN1113–1AA00–0DA0	6SL3100–1BE22–5AA0
Can be used for	28 kW UI module	28 kW UI module PR module 6SN1113–1AB0□–0BA□ • Attenuation: 0...230 kHz $\leq$ 3 dB • Must be used together with HFD commutating reactor for damping
Pn	0.3 kW	1.5 kW
P_{max}	25 kW	25 kW
E_{max}	7.5 kWs	180 kWs
Dimension drawings, refer to Chapter 12		

1) External PR can also be used for damping after a protecting measurement on the HFD reactor.

Mounting positions

The resistor can be mounted either horizontally or vertically.

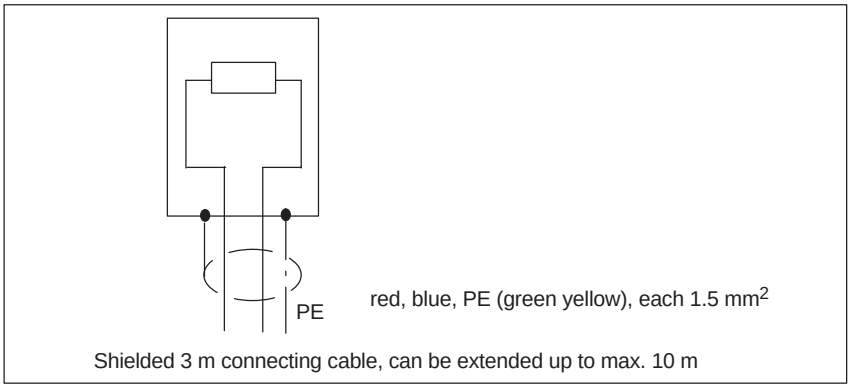


Fig. 6-23 Connection for external pulsed resistor 0.3/25 kW

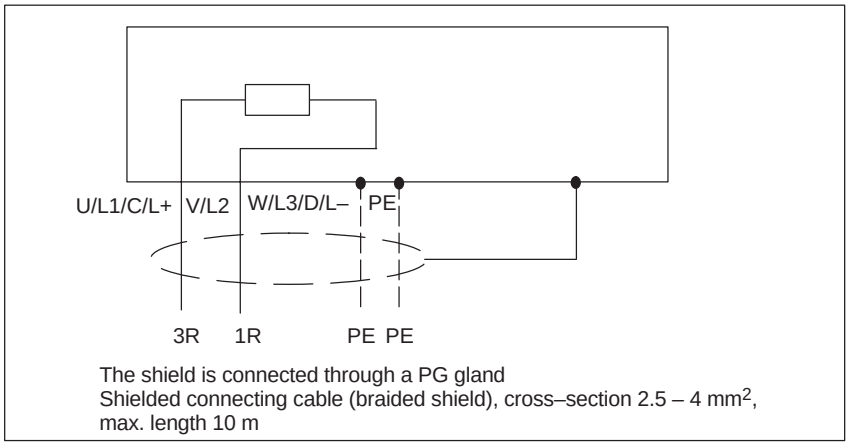


Fig. 6-24 Connection for external PR for braking power ratings up to 1.5/25 kW

Note

Conductors that are not used in multi–conductor cables must always be connected to PE at both ends.

28 kW UI module

The UI 28 kW module requires external pulsed resistors. Up to two identical resistors – with the same power rating – can be connected.

Connecting external pulsed resistors to the 28 kW module

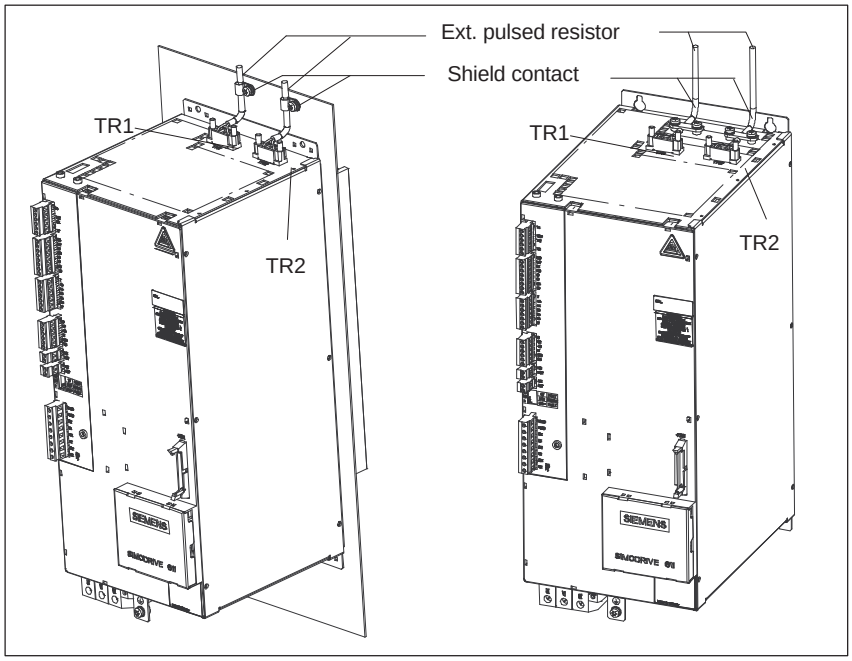


Fig. 6-25 Connecting the external pulsed resistor with shield connection

Table 6-25 Permissible ways of connecting external pulsed resistors to a 28 kW UI

PR	Terminal block TR1	Terminal block TR2
0.3/25 kW	1R 2R 3R 1) PR 0.3 kW	1R 2R 3R
2 x 0.3/25 kW=0.6/50 kW	1R 2R 3R 1) PR 0.3 kW	1R 2R 3R 1) PR 0.3 kW
1.5/25 kW	1R 2R 3R PR 1.5 kW/25	1R 2R 3R
2 x 1.5/25 kW=3/50 kW	1R 2R 3R PR 1.5 kW	1R 2R 3R PR 1.5 kW

1) Jumper for coding the thermal limit characteristic

Note

An external resistor cannot be connected to a 5 kW or 10 kW UI.

6.7.4 Engineering information is applicable for UI 5 kW, 10 kW, 28 kW and PR module

Sizing the load duty cycles with pulsed resistors

E [Ws]	Regenerative feedback energy when braking a motor from n_2 to n_1
T [s]	Period of the braking load duty cycle
A [s]	Load duration
J [kgm^2]	Total moment of inertia (including J motor)
M [Nm]	Braking torque
n [RPM]	Speed
Pn [W]	Continuous power rating of the pulsed resistor
P_{max} [W]	Peak power of the pulsed resistor
E_{max} [Ws]	Energy of the pulsed resistor for a single braking operation

Load duty cycles for braking operations

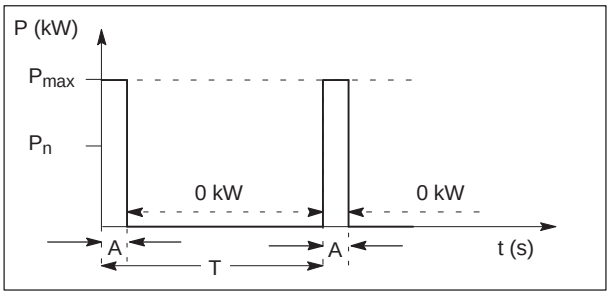


Fig. 6-26 Load duty cycle for internal and external pulsed resistors

Table 6-26 Examples

	Values	PR 0.2/10 kW	PR 0.3/25 kW	PR 1.5/25 kW
	E_{max} Pn P_{max}	13500 Ws 1) 200 W 10000 W	7500 Ws 300 W 25000 W	180000Ws 1500 W 25000 W
Example	A = T =	0.2 s 10 s	0.12 s 10 s	0.6 s 10 s
	A = T =	1.35 s 67.5 s	0.3 s 25 s	7.2 s 120 s

1) As a result of the mechanical dimensions, the resistor can absorb a relatively high level of energy.

The following conditions must be fulfilled:

1. $P_{max} \geq M \bullet 2 \bullet \pi \bullet n/60$
2. $E_{max} \geq E$; $E=J \bullet [(2 \bullet \pi \bullet n_2/60)^2 – (2 \bullet \pi \bullet n_1/60)^2]/2$
3. $P_n \geq E/T$

■