DCS Thyristor Power Converters
for DC drive systems
25 to 5200 A

Technical Data
DCS 400
DCS 500B
DCS 600
DCF 500B
DCF 600
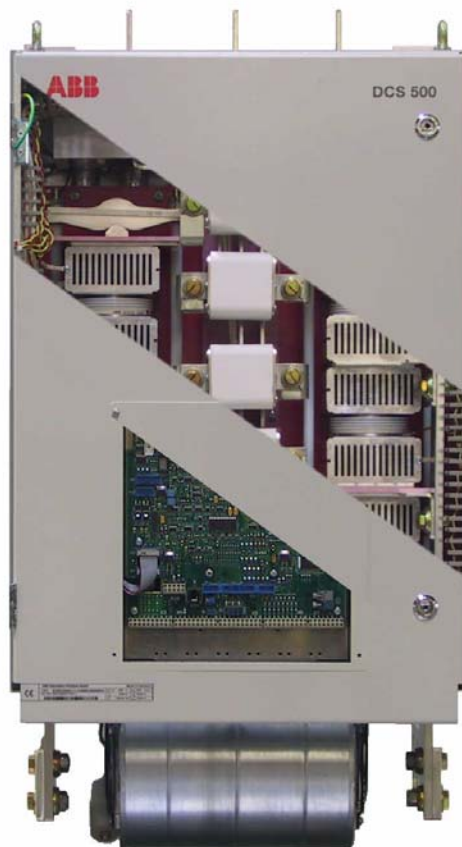
ABB

How to use the DCS Documentation System

The matrix below indicates all available product documentation and its corresponding order numbers on its left columns as well as all existing DC Drive systems on its top rows. System descriptions, Technical data and Operating instructions (as far as they are available for the corresponding drive) are the basic documents and will be delivered together with each drive. All other documentation has to be ordered separately.

DC drive systems / Product documentation	Language	Volume	System Drive Cubicle DCA 600	DCA 620	System Drive Module DCS/DCF 600 MultiDrive	DCS 600 CraneDrive	Standard Drive Cubicle DCA 500 / DCA 520	DCS 500 Easy Drive	DCS 400 Easy Drive	Standard Drive Module DCS 400	DCS/DCF 500B	DCE 400	Rebuild DCR
System description	Language	Volume											
3ADW000066	EN, DE,FR	II D					x	x		x			
3ADW000072	EN, DE	II F	x	x		x							
3ADW000121 ①	EN	II F1	x	x									
3ADW000095 (Manual) ②	EN,DE,FR,IT,SP	II K							x	x		x	
3ADW000139	EN	II F	x			x							
3ADW000071 (Flyer)	EN, DE							x					
3ADW000152	EN, DE,FR,IT,SP											x	
3ADW000173 (Flyer)	EN								x				
Technical Data	Language	Volume											
3ADW000165	EN	III			x	x					x		
Operating Instructions	Language	Volume											
3ADW000055	EN,DE,FR,SP	IV A					x	x		x			
3ADW000080	EN, DE	IV F	x	x		x							
3ADW000091 (Installation)	EN, DE	IV F1	x	x			x		x				
Software description	Language	Volume											
3ADW000078	EN	V D1					x	x		x			
3ADW000076	EN	V F	x	x		x							
3AST000953 ③	EN		x			x							
Tools	Language	Volume											
3AFE61178775 **CMT/DCS500**	EN	-					x	x		x			
EN 5926915-1 **GAD**	EN	-					x	x		x			
3ADW000048 (Application blocks)	EN	V A2					x	x		x			
3AFY61296123 **Drive *Window***	EN	-	x	x	x	x							
Service Instructions	Language	Volume											
3ADW000093	EN, DE	VI A	x	x	x	x	x	x		x			
3ADW000131	EN	VI K							x	x		x	
Fieldbus	Language	Volume											
3ADW000086	EN	-					x	x		x			
3ADW000097	EN	-	x	x	x	x							
Others	Language	Volume											
3ADW000115 12-Pulse operation	EN	VIII F2	x			x							
3ADW000092 Rebuild manual	EN	XI H1				x							
3ADW000128 Paralleling DCS Conv.	EN	VIII D1	x			x	x			x			
3ADW000040 12-Puls operation	EN, DE	VIII A2	x			x	x			x			

Rebuild column (DCR): available only for: DCS 500B / 600 drive systems

Status: 25.March.2002

① Covers information of Technical data

② Covers information of Technical data, Operating Instructions, Software Description

③ Covers information of Operating Instructions, Software Description

III ii

Contents

III TECHNICAL DATA

We recommend to use both, SYSTEM DESCRIPTION plus TECHNICAL DATA at the same time in case you are planning and engineering your drive.

You will find all necessary technical information in there to solve your problem.

III iv

1   Quick Guide

General remarks
The term "DCS thyristor power converter" is a general designation for basic DC converters from ABB. This term can be found in many parts of the relevant documentation. The precise product name in accordance with the brief descriptions given below characterizes a specific unit.

Brief description of DCS 500B
The DCS 500**B** unit range is an enhancement developed from the DCS 500 range.
The DCS 500B is an armature converter with the following standard features:
• Design and commissioning tools • Monitoring functions • Communication via databus • Human-machine interface • More than 300 additional functions blocks programmable under Windows • Graphical Application Designer • Plain text display • FOR HIGH POWER

Brief description of DCF 500B
With software release 21.232 or higher DCS 500B has a '3-phase field exciter mode'. A DCF 500B is a three-phase field exciter based on the programmable DCS 500B software and the SDCS-CON-2 control board. The interface board PIN-1x is modified; - an overvoltage protection unit DCF 505/506 is required.

Brief description of DCS 600
The DCS 600 converter family is based on the hardware developed for the DCS 500B type.
Instead of a COM-x board, the SDCS_AMC_DC board is used. PC tools will be connected there, as well as the APC (Application controller), if the APC is used as a PLC. If a different PLC is used, separate adapter modules are needed. They must be connected to the AMC-DC board, too. The software code always begins with S15.xxx for MultiDrive or S18.xxx for Crane drives.
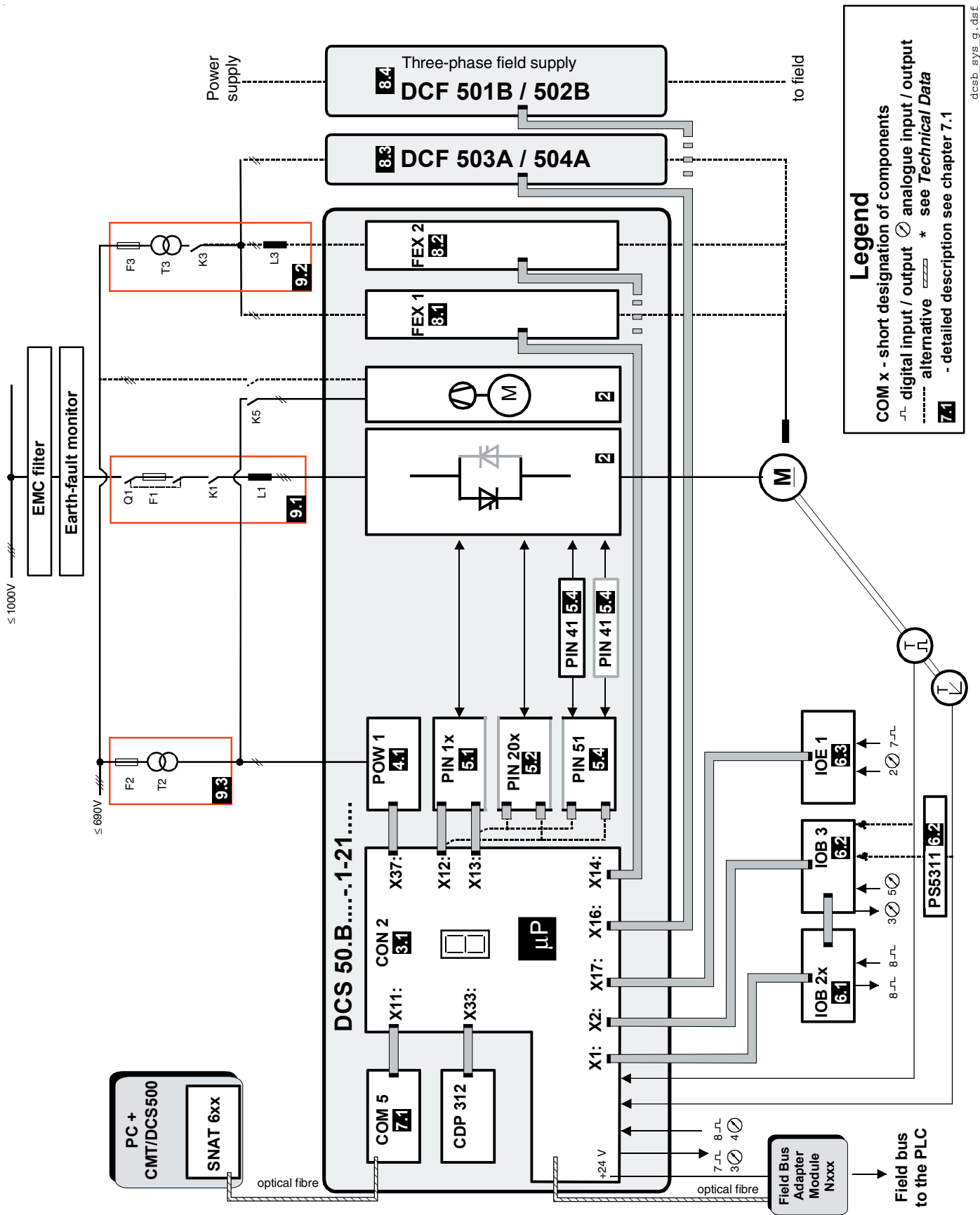
Brief description of DCF 600
The DCF 600 unit range is intended to be used for supplying motor fields and is based on the hardware and system configuration of the DCS 600 unit. The software is identical to the DCS 600 software. Similar to DCF 500B units the DCF 505/506 overvoltage protection unit is required. The same modification is applied to the PIN-1x board, compared to DCF 500B.

Brief description of DCS 400
The DCS 400 is the smallest drive in its class. The compact design has been partly achieved by a fully integrated field exciter based on IGBT technology. A commissioning wizard - available on the control panel and the PC tool - makes start-up of the drive easy. In addition, the DCS 400 contains application macros.

1.1 DCS 500B (Armature)

This functional overview of DCS 500B components makes it easy to find detailed technical data in the corresponding chapters.

III 1-2

1.2 DCF 500B (Excitation)

This functional overview of DCF 500B components makes it easy to find detailed technical data in the corresponding chapters.

III 1-3

1.3 DCS 600 (Armature)
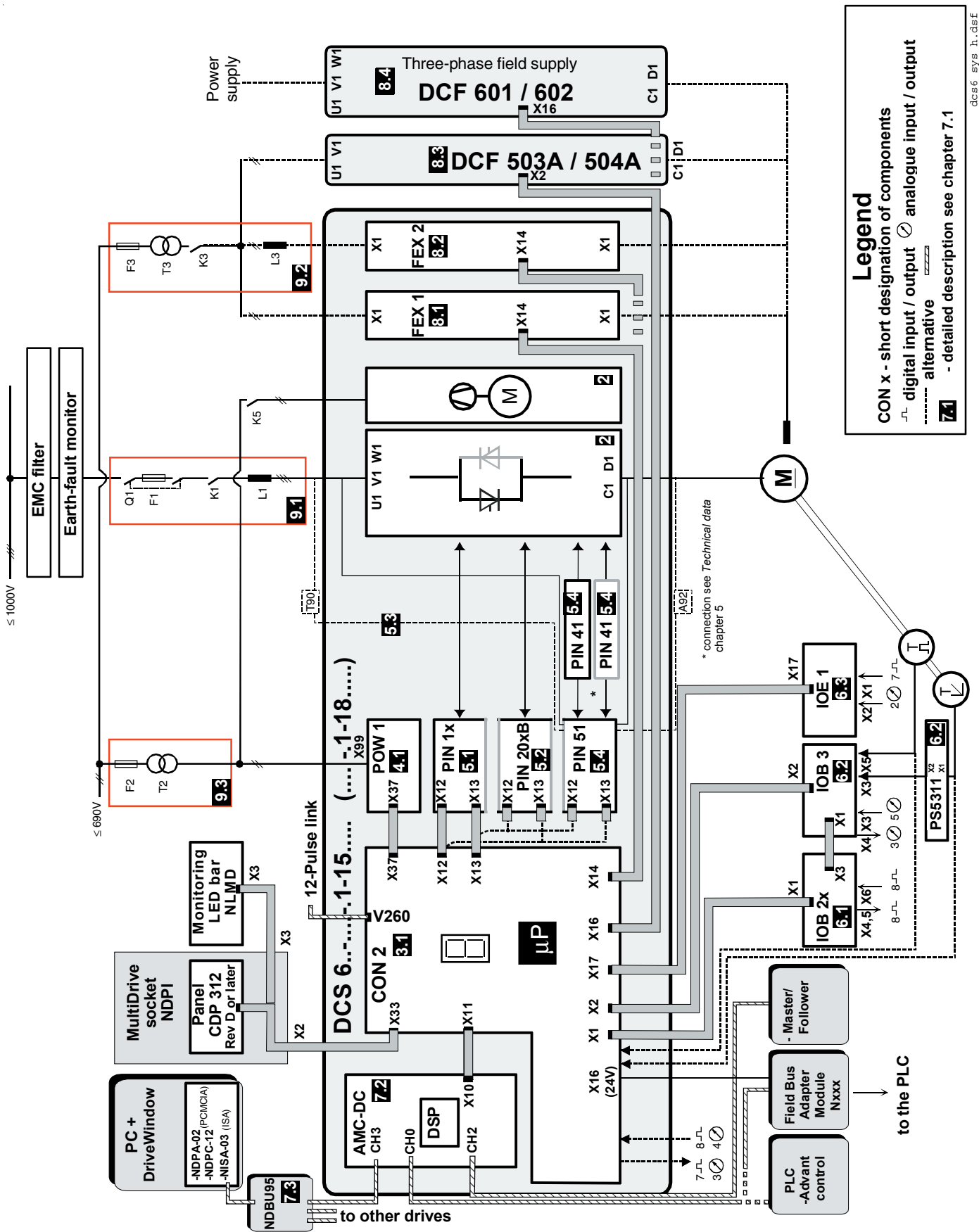
This functional overview of DCS 600 components makes it easy to find detailed technical data in the corresponding chapters.

III 1-4

1.4 DCF 600 (Excitation)

8.4 DCF 506

X4
X11
X12

DCS 600

C1 D1
X16

M

500V

EMC filter

Earth-fault monitor

Q1 F1 K3 L1 K5

9.1

U1 V1 W1 C1 D1 **2**

2

M

≤ 690V

F2 T2 **9.3**

X99

POW 1 4.1
X37

PIN 1x 5.1
X12 X13

PIN 20xB 5.2
X12 X13

modified

DCF 6...-1-15.....

X37

CZD-0x 5.6
X12 X13

X14

CON 2 3.1

μP

X16

X17

X1 X2

X1

X16 (24V)

Monitoring LED bar NLMD
X3

Panel CDP 312 Rev D or later
X3
X2

MultiDrive socket NDPI

PC + DriveWindow
-NDPA-02 (PCMCIA)
-NDPC-12 (PCMCIA)
-NISA-03 (ISA)

V260

X33

X11

AMC-DC 7.2
CH3 CH0 **DSP** CH2 X10

NDBU95 7.3

to other drives

IOE 1 6.3
X17
x2 X1
2 7

IOB 3 6.2
X2
X1
X4 X3
3 5

IOB 2x 6.1
X1
X3
X4,5 X6
8 8
8

- Master/ Follower

Field Bus Adapter Module Nxxx

PLC -Advant control

7 8
3 4

to the PLC

Legend

CON 2 - short designation of components

⌐ digital input / output ⊘ analogue input / output
━━ alternative ⫶⫶⫶ optical fibre
7.1 - detailed description see chapter 7.1

to a digital input of DCF 600

This functional overview of DCF 600 components makes it easy to find detailed technical data in the corresponding chapters.
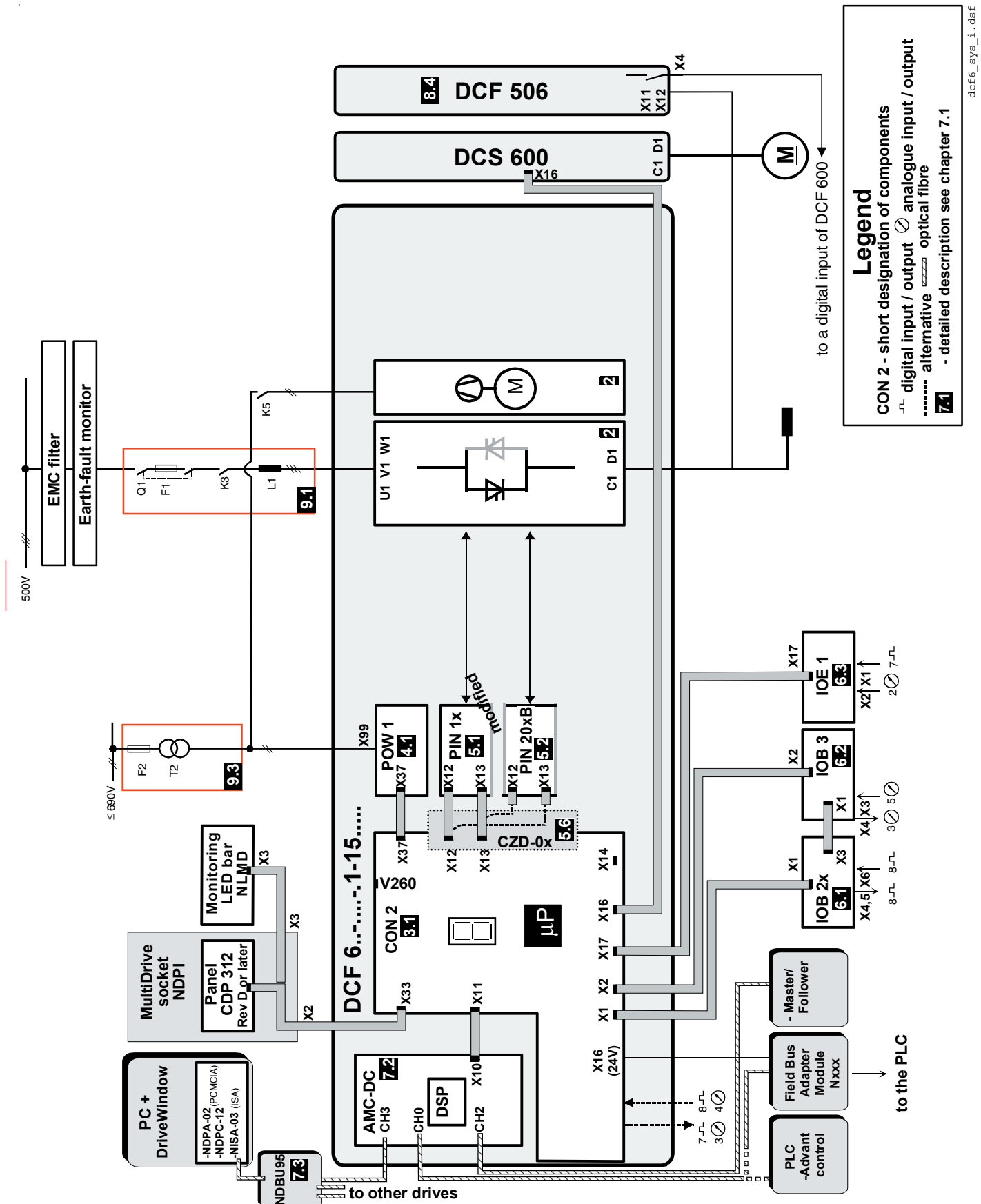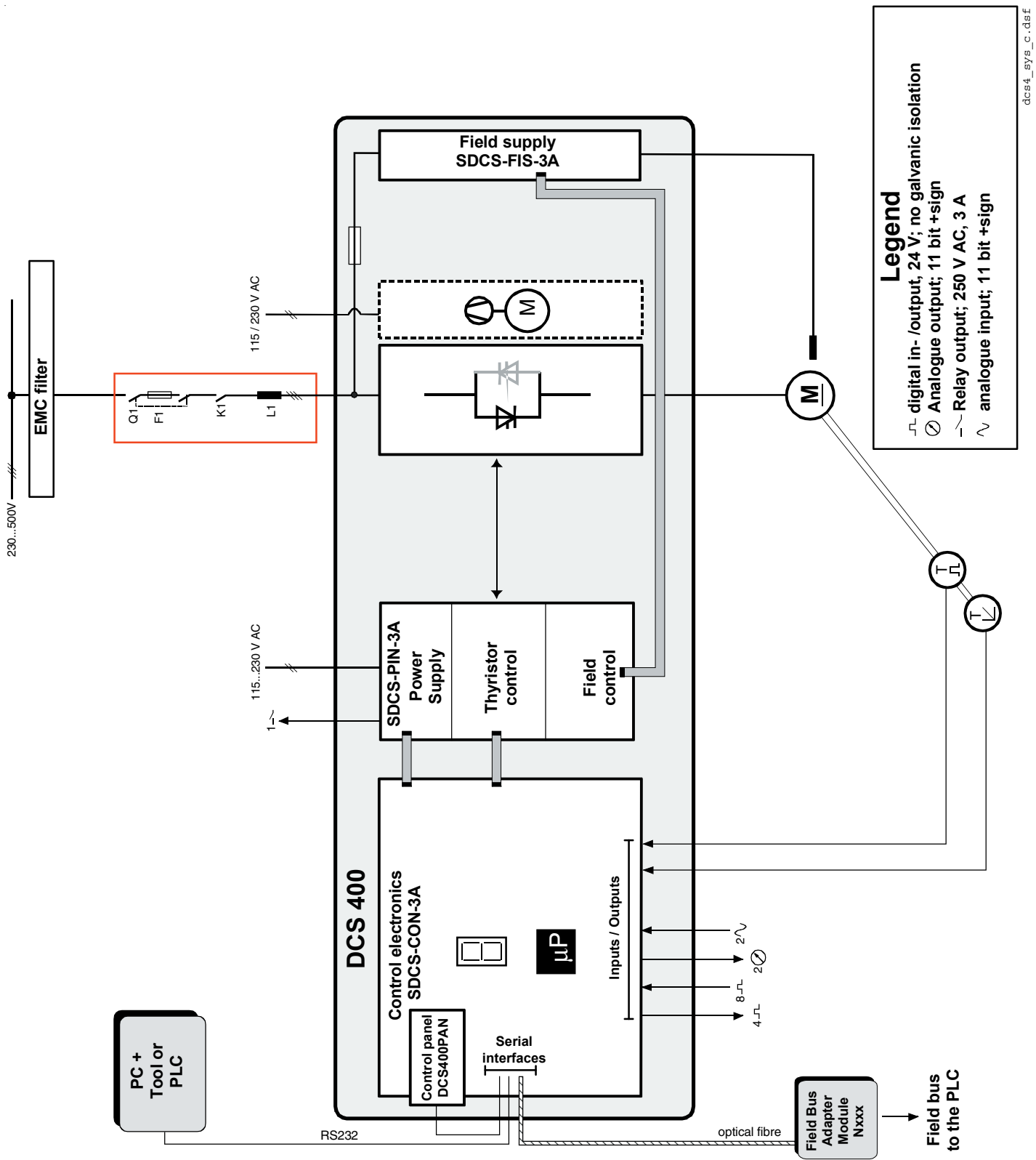
III 1-5

1.5 DCS 400 (Armature and Excitation)

Field supply
SDCS-FIS-3A

115 / 230 V AC

EMC filter

230...500V

Q1 F1 K1 L1

M

115...230 V AC

SDCS-PIN-3A
Power
Supply

Thyristor
control

Field
control

DCS 400

Control electronics
SDCS-CON-3A

µP

Inputs / Outputs

Control panel
DCS400PAN

Serial
interfaces

PC +
Tool or
PLC

RS232

optical fibre

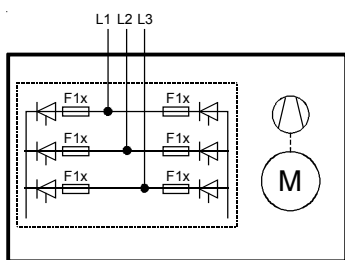Field Bus
Adapter
Module
Nxxx

Field bus
to the PLC

2
2
8
4

Legend

⊓ digital in- /output, 24 V; no galvanic isolation
⊘ Analogue output; 11 bit +sign
⌐ Relay output; 250 V AC, 3 A
∿ analogue input; 11 bit +sign

dcs4_sys_c.dsf

Remark:
All detailed information about the DCS 400 DC drive you can only find in the DCS 400
Manual (documentation no. 3ADW 000 095).

III 1-6

2 Converter modules

DCS 500 / DCS 500B / DCS 600 / DCF 500B / DCF 600

Unit range type DCF 500B and DCF 600 for output current of up to max. 520 A available

Note:
For clearness the type designation in this chapter is shown in the following way:

Designation	is valid for
DCS 500	DCS 500B DCS 600 DCF 500B DCF 600

III 2-1

2.1 Dimensions

DCS 500 valid for DCS 500B / DCS 600 / DCF 500B / DCF 600

Module C1
DCS 50x-0025
DCS 50x-0050
DCS 50x-0075

Dimensions in mm
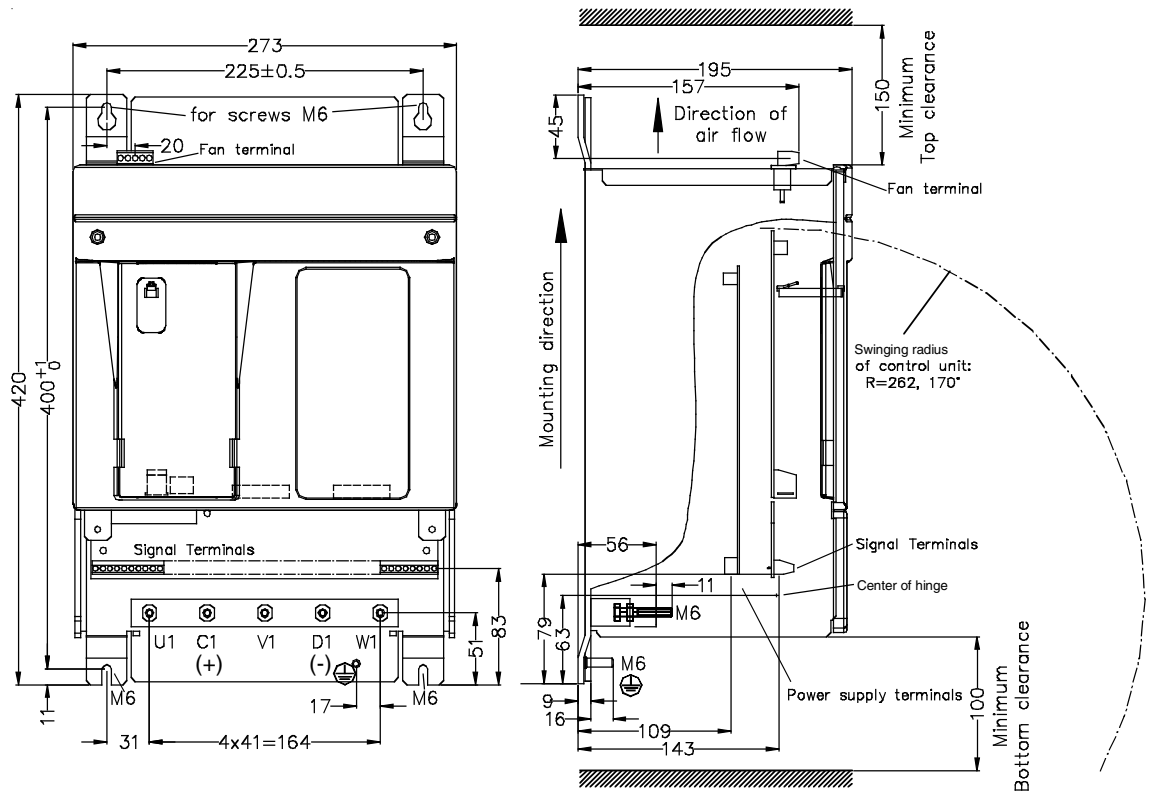Weight appr. 7.6 kg

Fig. 2.1/1: Dimension drawing C1-Module

Module C1
DCS 50x-0100
DCS 50x-0110
DCS 50x-0140

Dimensions in mm
Weight appr. 11.5 kg
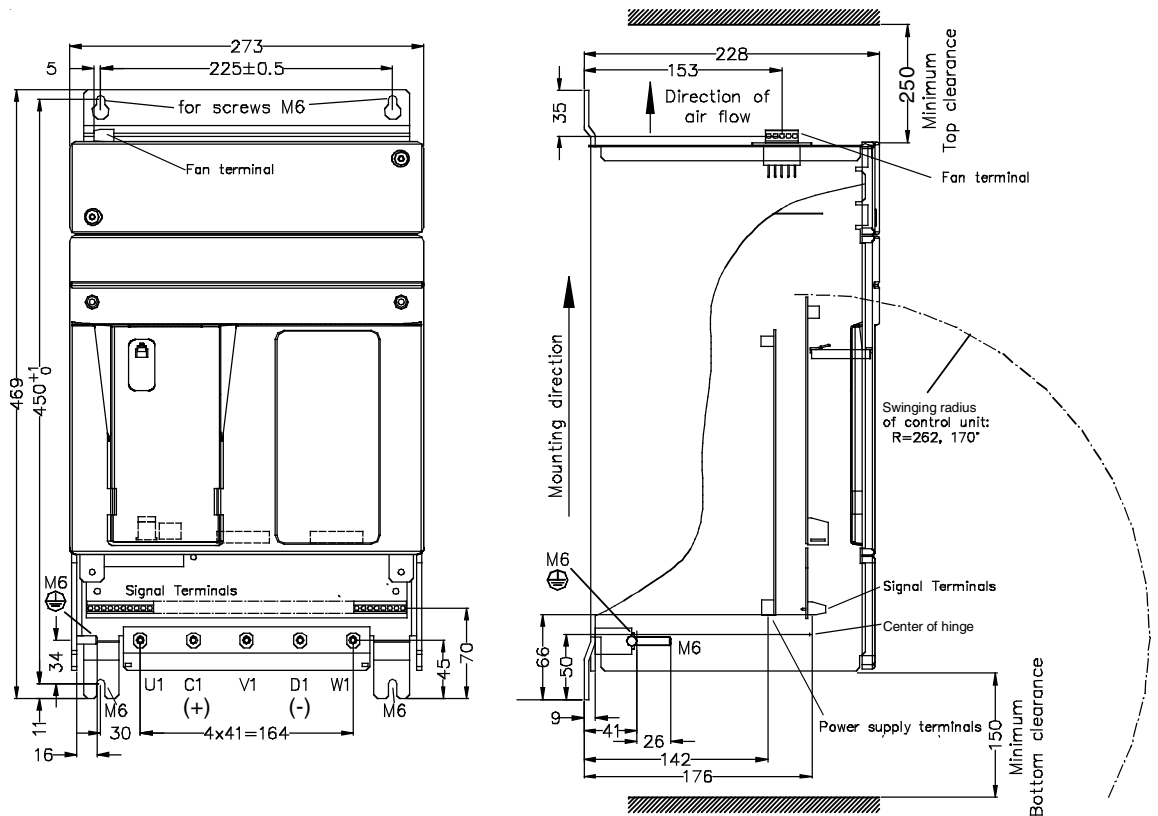
Fig. 2.1/2: Dimension drawing C1-Module

III 2-2

Module C2
DCS 50x-0200
DCS 50x-0250
DCS 50x-0270
DCS 50x-0350

Dimensions in mm
Weight appr. 22,8 kg
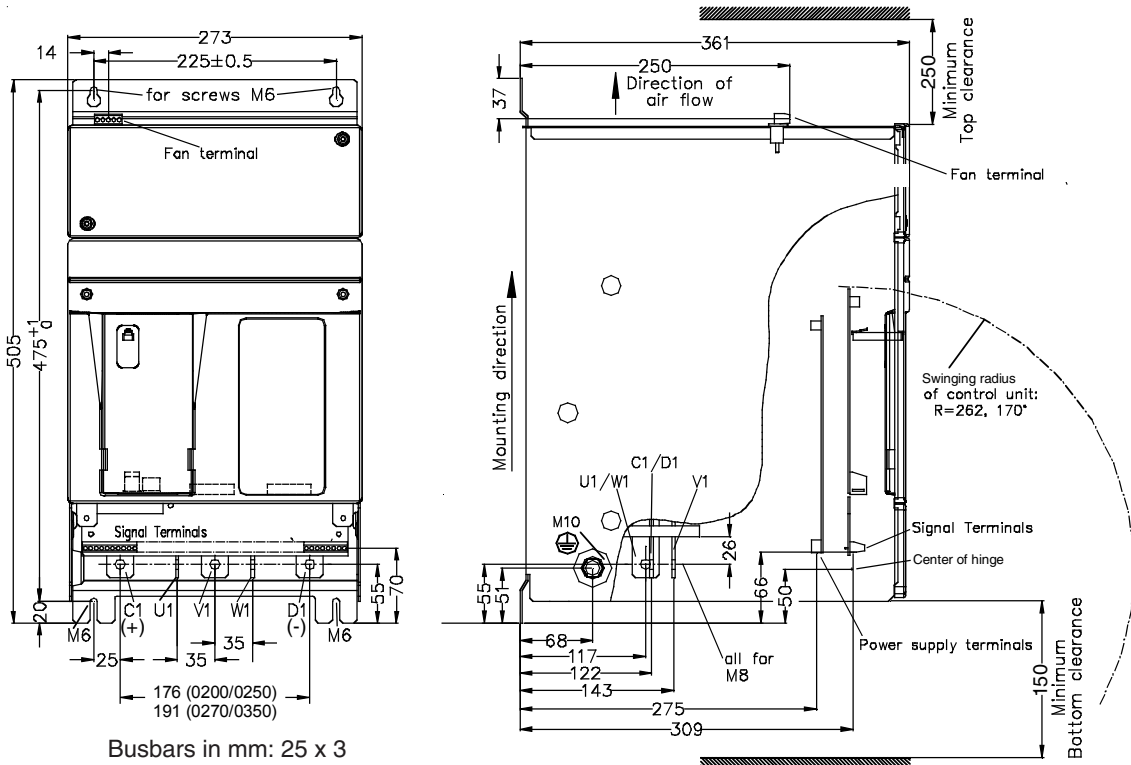
Busbars in mm: 25 x 3

Fig. 2.1/3: Dimension drawing C2-Module

Module C2
DCS 50x-0450
DCS 50x-0520

Dimensions in mm
Weight appr. 29 kg
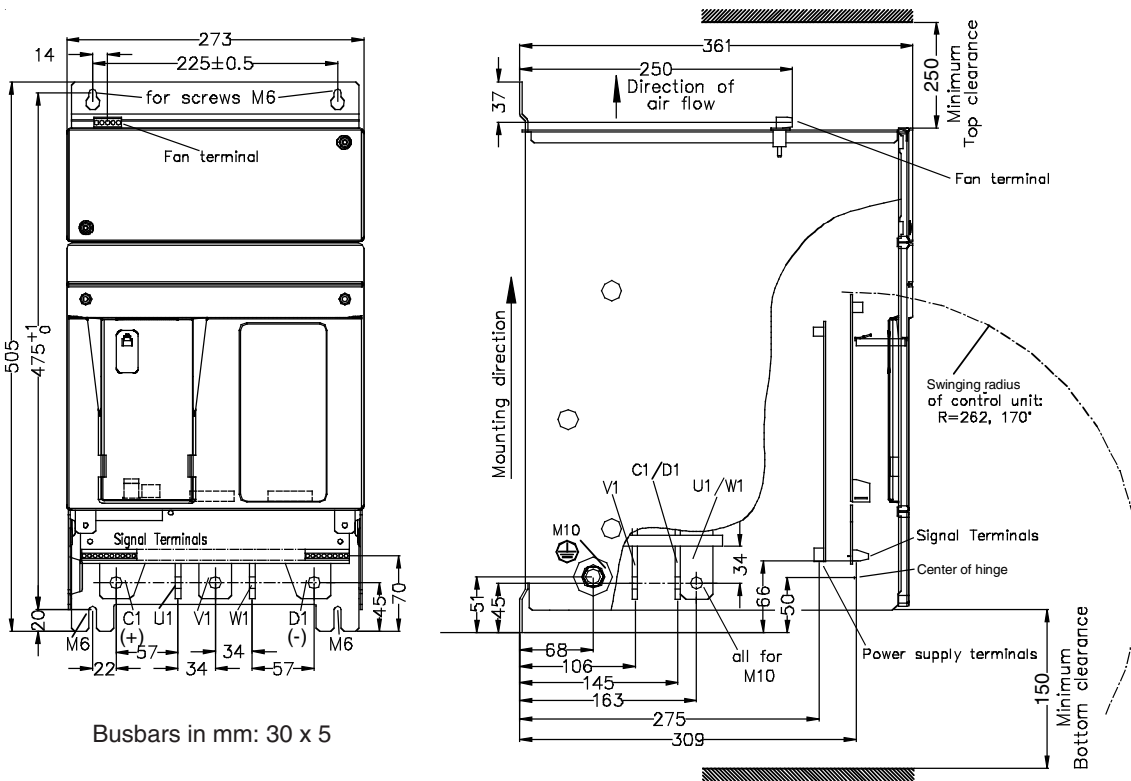
Busbars in mm: 30 x 5

Fig. 2.1/4: Dimension drawing C2-Module

III 2-3

Module C2
DCS 50x-0680
DCS 50x-0820
DCS 50x-1000

Dimensions in mm
Weight appr. 42 kg

C2_680_b.dsf

Heat sink

U1   V1   W1

C1   D1

press-in nut

Main Connections
at view from top

Busbars in mm:
AC and DC 40 x 5

Fig. 2.1/5: Dimension drawing C2-Module

C2b_terminal_cover.dsf

Terminal cover

The **plastic protection cover for C2b** serves as a protection against electric shock for the five high-power terminals at the lower end of the converter. It is equipped with a hole on each side, which will snap-in during mounting at a press-in nut at each side panel of the converter.

III 2-4

DCS 500 valid for DCS 500B / DCS 600

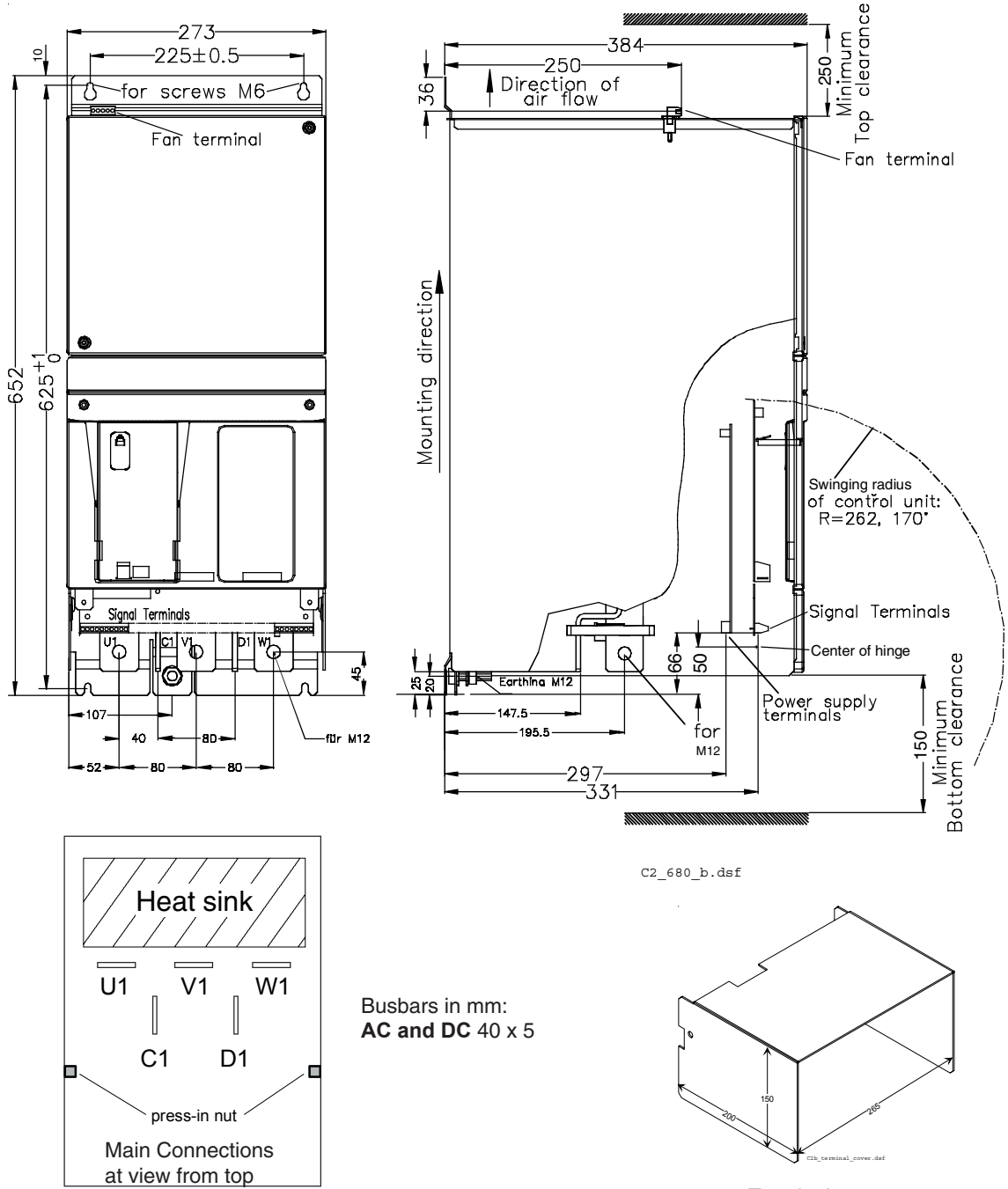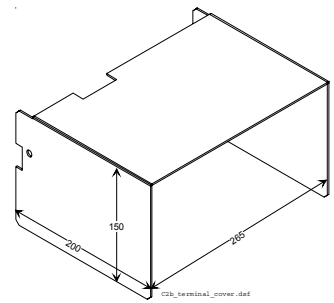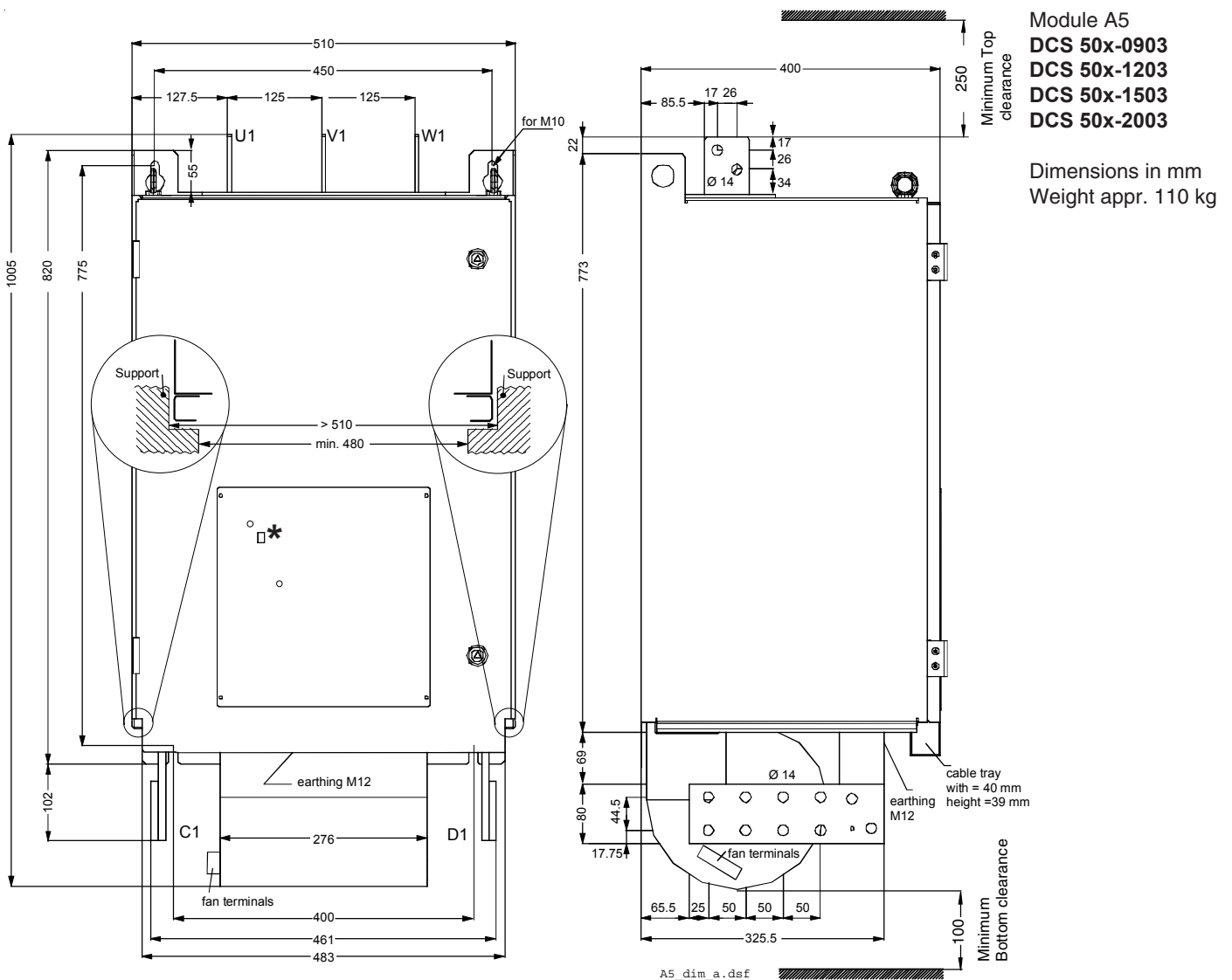Module A5
DCS 50x-0903
DCS 50x-1203
DCS 50x-1503
DCS 50x-2003

Dimensions in mm
Weight appr. 110 kg

Busbars in mm:
DC 80 x 10
AC 60 x 5

Fig. 2.1/6: Dimension drawing A5-Module

* 3 drill holes to fix the CDP312 panel on the cover; panel to be connected electrically via panel extension cable (3 m)

Mounting the converter module A5 inside an enclosure
Two supports should be mounted inside the enclosure in such a way, that they can carry the converter's weight when placing the converter later on. The minimum distance between the supports should not be less then 480 mm because of electrical clearance (DC busbars).

A L-shape support as indicated will allow to place the converter temporarily close to the front end of the support (weight still taken by a lifting device) and then push it back to the back plate of the enclosure. The upper and lower holes in the back plate of the converter should be used to fix the converter in that position.

III 2-5

DCS 500 valid for DCS 500B / DCS 600

Module A6
DCS 50x-1903
DCS 50x-2053
DCS 50x-2503
DCS 50x-3003

Dimensions in mm
Weight appr. 180 kg
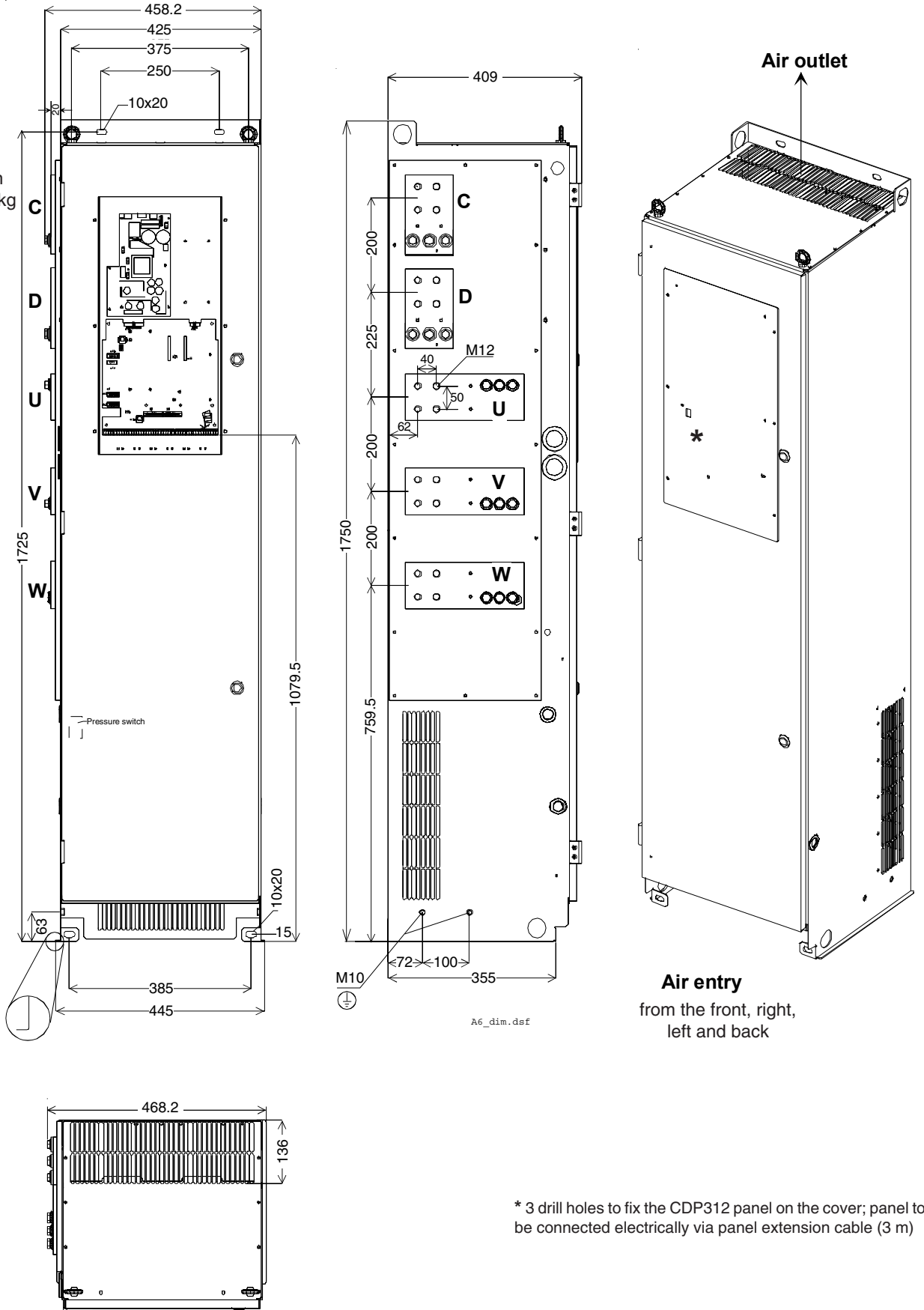
458.2
425
375
250
10x20
20

C
D
U
V
W
1725
1079.5
Pressure switch
63
10x20
15
385
445

409
C
200
D
225
M12
40
50
U
62
200
V
200
W
1750
759.5
72
100
355
M10
A6_dim.dsf

Air outlet

Air entry
from the front, right,
left and back

468.2
136

***** 3 drill holes to fix the CDP312 panel on the cover; panel to
be connected electrically via panel extension cable (3 m)

*****

Fig. 2.1/7: Dimension drawing A6-Module (as delivery state)

III 2-6

Mounting the converter module A6 inside an enclosure

The converter is designed to be placed on a bottom plate or similar and then fixed on top to the enclosure's back plate to avoid movements to the front, right or left side. In addition to that the converter should be fixed at the bottom using two brackets in front of the elongated holes.

Cooling air entry

The cooling fan takes the air from the backside, both sides and from the area underneath the converter module.
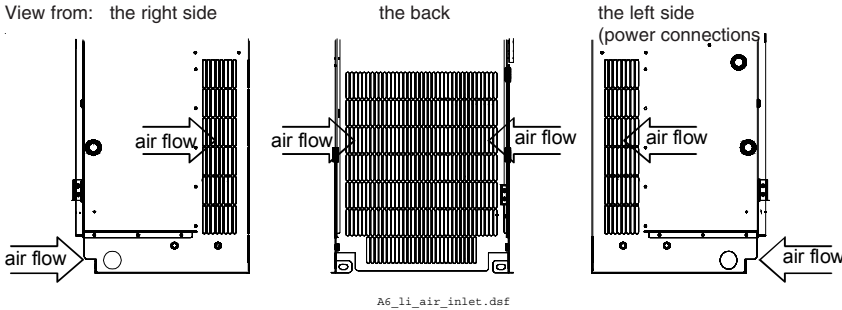
View from: the right side   the back   the left side (power connections)

Fig. 2.1/8: Cooling air flow

Free space around the converter module

optimum   compromise

Fig. 2.1/11: Free space

Cooling air outlet

To avoid circulating air inside the enclosure it is recommended to make sure the exhaust air leaves the enclosure.

Power cable connection

The power cable connection is performed via **Terminal option 01 for A6**. This option consists of five right angle copper busbars and five times four screws. The mechanical details are shown by the figure below.
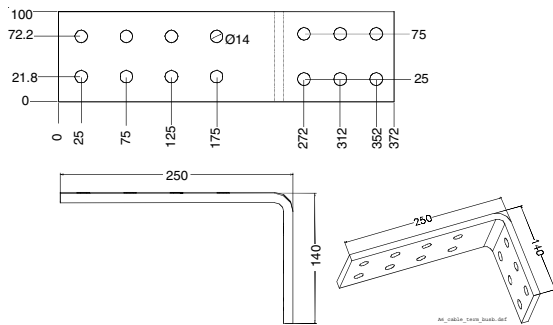
Fig. 2.1/9: Right angle copper busbar

When mounting the right angle busbars or connecting cables directly please make sure the right screws are used. The converter module is equipped with a blind hole and a nut at its end. Because of that the length of the remaining threads is limited to 35 mm (see drawing below).

max. 35mm
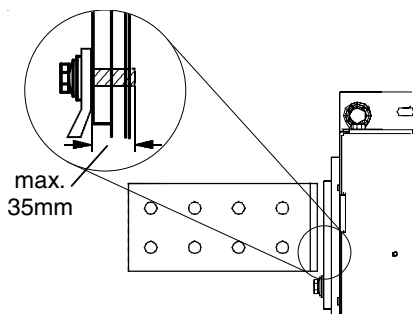
Fig. 2.1/10: Length of remaining threads

Fig. 2.1/12 gives an example, how the right angle busbars can be mounted in case all cable connections are still made at the left side of the converter module. This results in four layers for the power cables.

In case the AC or DC connection or perhaps both of them have to be made at the right side of the converter module use the space behind the converter and move the power terminals via a right angle busbar up to that point where the final connection is most suitable. In this case the busbars need to be fixed at the cubicle / enclosure, not at the converter module! Fig. 2.1/13 gives a rough example, how a right side connection can be made
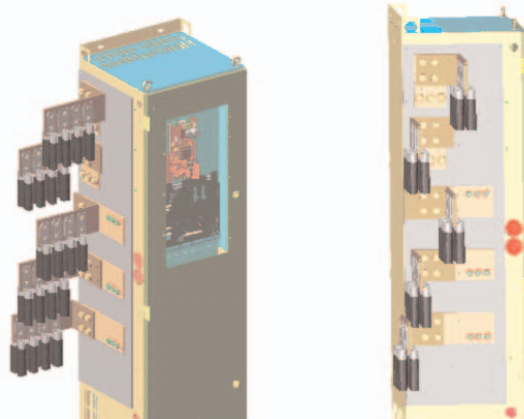
Fig. 2.1/12: Right angle busbar connection

Fig. 2.1/13: Example right side connection

Cable entries
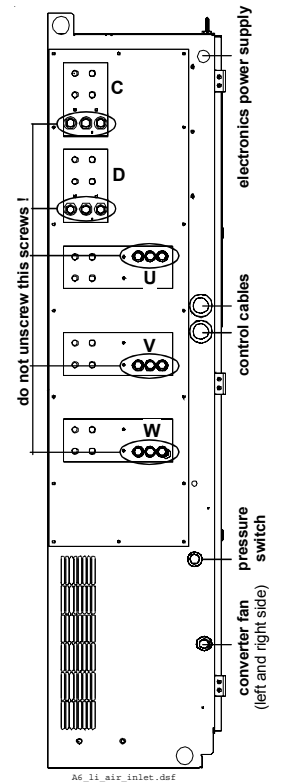
Fig. 2.1/14: Cable entries

III 2-7

DCS 500 valid for DCS 500B / DCS 600

Module A7
DCS 50x-2053 xxxL
DCS 50x-2603 xxxL
DCS 50x-3303 xxxL
DCS 50x-4003 xxxL
DCS 50x-4803 xxxL
DCS 50x-5203 xxxL

Dimensions in mm
Weight appr. 315 kg
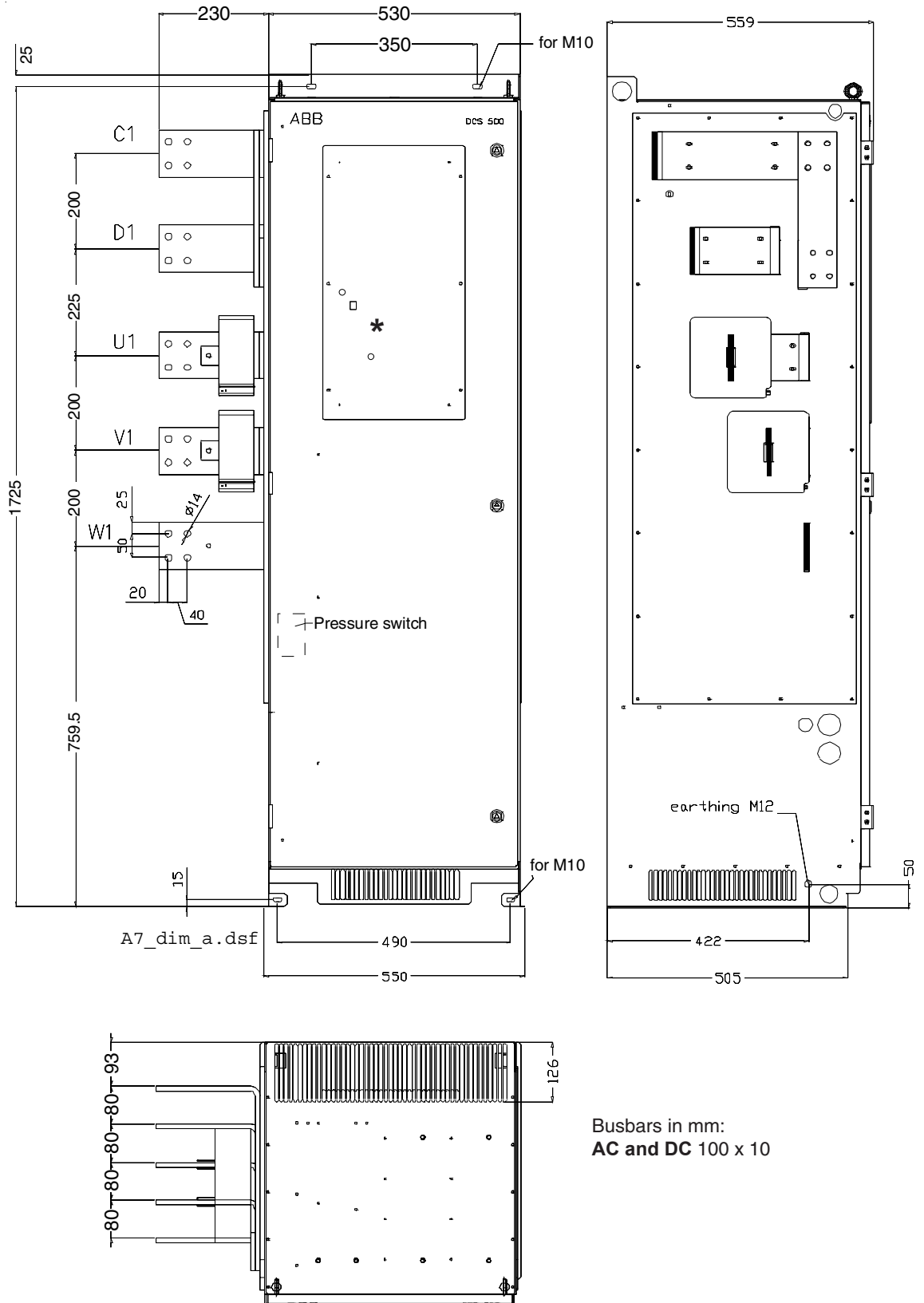
A7_dim_a.dsf

Busbars in mm:
AC and DC 100 x 10

* 3 drill holes to fix the CDP312 panel on the cover; panel to be connected electrically via panel extension cable (3 m)

Fig. 2.1/15: Dimension drawing A7-Module (left-hand connection)
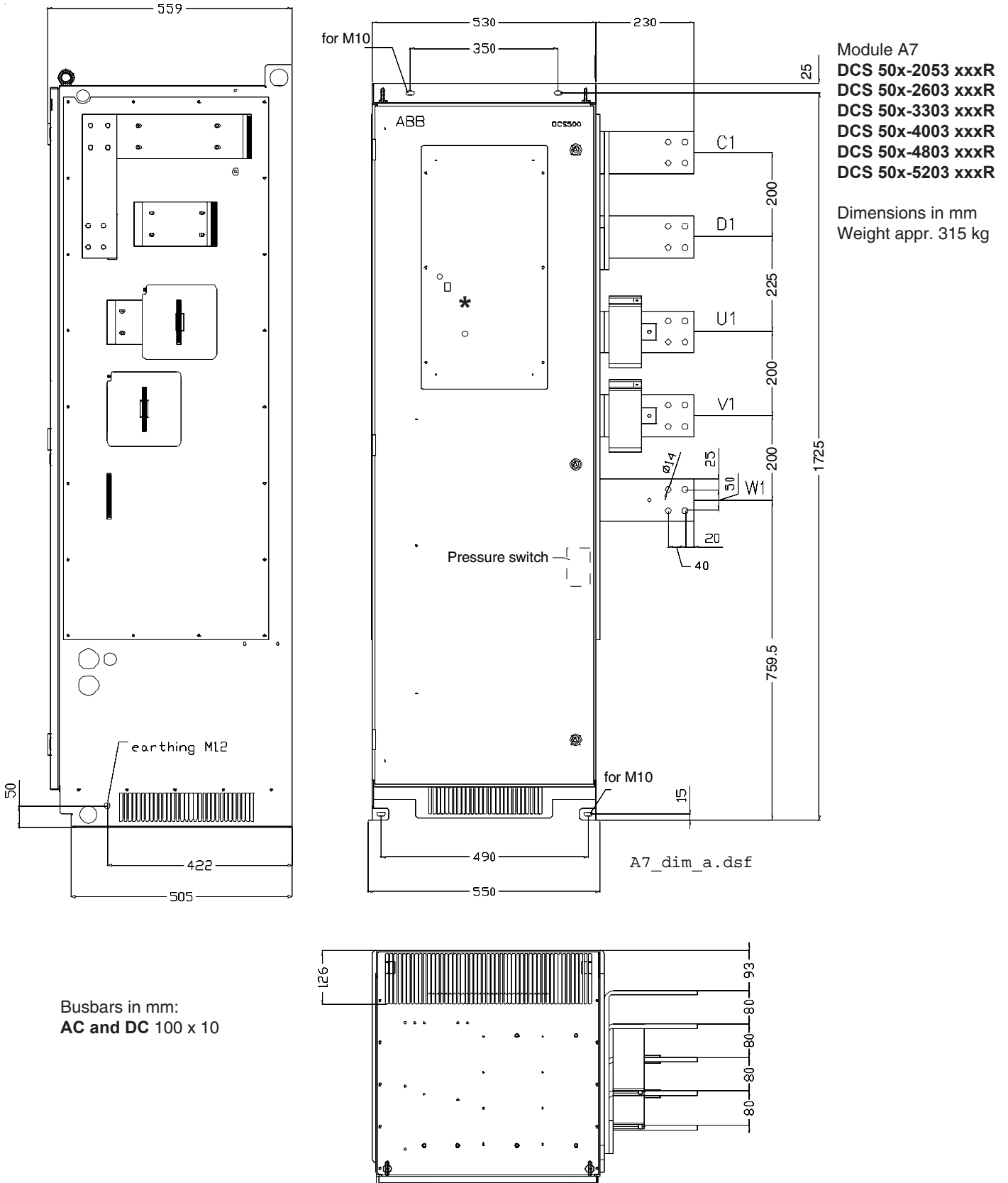
III 2-8

DCS 500 valid for DCS 500B / DCS 600

Module A7
DCS 50x-2053 xxxR
DCS 50x-2603 xxxR
DCS 50x-3303 xxxR
DCS 50x-4003 xxxR
DCS 50x-4803 xxxR
DCS 50x-5203 xxxR

Dimensions in mm
Weight appr. 315 kg

A7_dim_a.dsf

Busbars in mm:
AC and DC 100 x 10

* 3 drill holes to fix the CDP312 panel on the cover; panel to be connected electrically via panel extension cable (3 m)

Fig. 2.1/16: Dimension drawing A7-Module (right-hand connection)

III 2-9

Mounting the converter module A7 inside an enclosure

This type of converter module uses the same fixing principles as described for converter module A6!

Cooling air entry

The cooling fan takes the air from the backside, left and right side and from the area underneath the converter module.
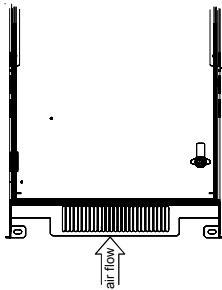
View from front   left side / (right side)
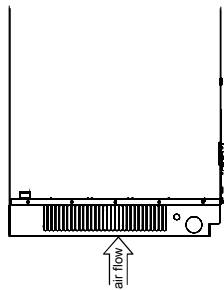
View from bottom
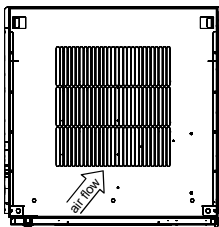
Fig. 2.1/17: Cooling air flow

Free space around the converter module

Do not place the converter module in a corner. In case the fan cannot take the air through the bottom plate of the enclosure non of the remaining entries has to be blocked.
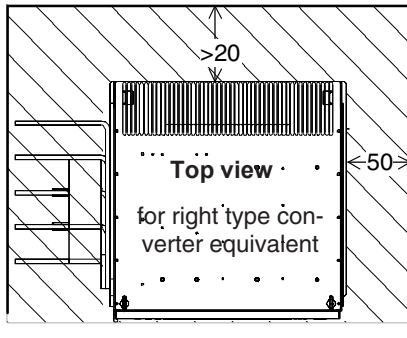
Fig. 2.1/18: Free space

Air entry through bottom plate

Make sure the converter module gets clean air, because there is no air filter in front of the fan at the converter.

Cooling air outlet

To avoid circulating air inside the enclosure it is recommended to make sure the exhaust air leaves the enclosure.

Cable entries

The cable entries are existing symmetrically on both sides. Nevertheless only the entries on the left side should be used for cables going to the electronics power supply (SDCS-POW-1) or the controller board (SDCS-CON-x).

A7_re_air_inlet.dsf

Fig. 2.1/19: Cable entries

III 2-10

2.2   Fuses - installed inside the converter

DCS 500 valid for DCS 500B / DCS 600

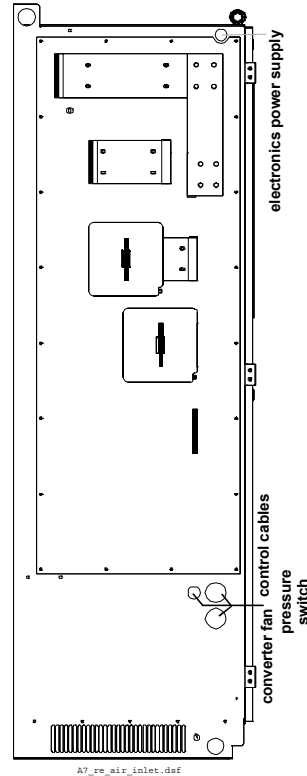| Converter type	Model	Fuse F1	Size	Type
400 V / 500 V				
DCS 50x-1203-41/51	A5	800A 660V UR	5	170M 6162
DCS 50x-1503-41/51	A5	1250A 660V UR	5	170M 6166
DCS 50x-2003-41/51	A5	1600A 660V UR	5	170M 6169
DCS 50x-2053-51	A6	1500A 660V UR	5	170M 6168
DCS 50x-2503-41/51	A6	900A 660V UR ①	5	170M 6163
DCS 501-3003-41/51	A6	1500A 660V UR ①	5	170M 6168
DCS 502-3003-41/51	A6	1250A 660V UR ①	5	170M 6166
DCS 50x-3303-41/51	A7	2500A 660V UR	7	170M 7026
DCS 50x-4003-41/51	A7	3000A 660V UR	7	170M 7028
DCS 50x-5203-41/51	A7	3500A 660V UR	7	170M 7057
600 V / 690 V				
DCS 50x-0903-61/71	A5	630A 1250V UR	6	170M 6144
DCS 50x-1503-61/71	A5	1100A 1250V UR	6	170M 6149
DCS 501-2003-61/71	A5	1400A 1100V UR	6	170M 6151
DCS 50x-2053-61/71	A6	700A 1250V UR ①	6	170M 6145
DCS 50x-2503-61/71	A6	1000A 1250V UR ①	6	170M 6148
DCS 501-3003-61/71	A6	1100A 1250V UR ①	6	170M 6149
DCS 502-3003-61/71	A6	1000A 1250V UR ①	6	170M 6148
DCS 50x-3303-61/71	A7	2500A 1000V UR	8	170M 7036
DCS 50x-4003-61/71	A7	3000A 1000V UR	8	170M 7156
DCS 50x-4803-61/71	A7	3000A 1000V UR	8	170M 7156
790 V				
DCS 50x-1903-81	A6	700A 1250V UR ①	6	170M 6145
DCS 50x-2053-81	A6	700A 1250V UR ①	6	170M 6145
DCS 50x-2503-81	A6	1000A 1250V UR ①	6	170M 6148
DCS 501-3003-81	A6	1100A 1250V UR ①	6	170M 6149
DCS 502-3003-81	A6	1000A 1250V UR ①	6	170M 6148
DCS 50x-3303-81	A7	2500A 1000V UR	8	170M 7036
DCS 50x-4003-81	A7	3000A 1000V UR	8	170M 7156
DCS 50x-4803-81	A7	3000A 1000V UR	8	170M 7156
1000 V				
DCS 50x-2053-91	A7	1800A 1250V UR	9	170M 7976
DCS 50x-2603-91	A7	1800A 1250V UR	9	170M 7976
DCS 50x-3303-91	A7	2500A 1250V UR	9	170M 7978
DCS 50x-4003-91	A7	2500A 1250V UR	9	170M 7978
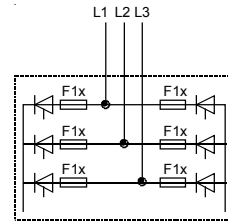
① 12 fuses per bridge (2x per F1x)

Table 2.2/1: Fuses installed inside the converter

Size 5, 6

Size	a	b	c	d
5	50	29	30	76
6	80	14	30	76
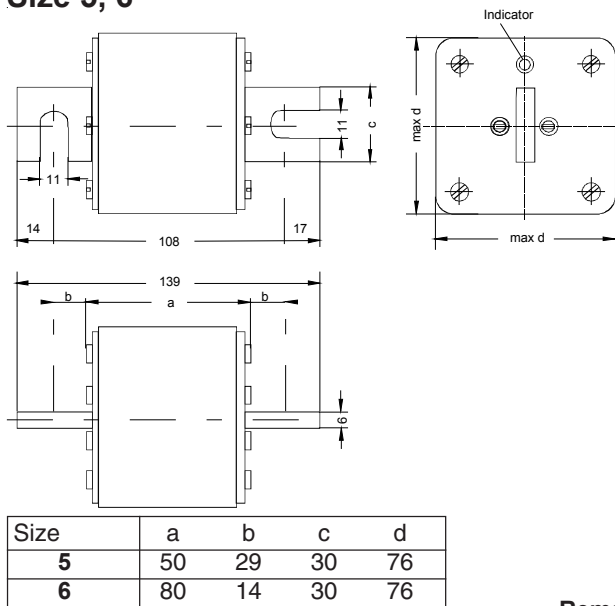
Fig. 2.2/1: Fuses size 5, 6
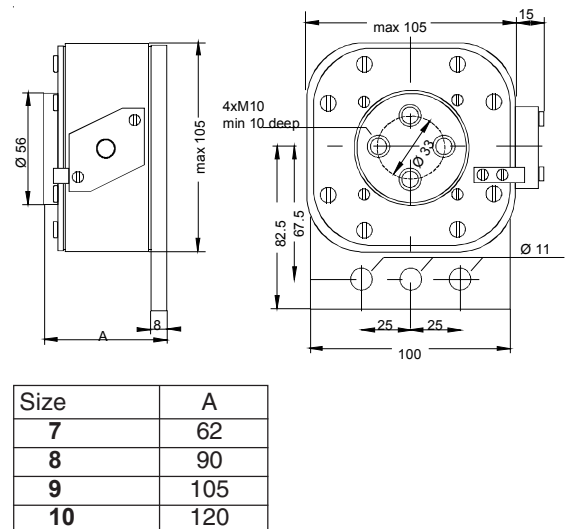
Size 7...10

Size	A
7	62
8	90
9	105
10	120

Fig. 2.2/2: Fuses size 7...10

Remark:
Given dimensions may be exceeded in some cases. Please take them only for information.

III 2-11

2.3 Cross-sectional areas - Tightening torques

DCS 500 valid for DCS 500B / DCS 600 / DCF 500B / DCF 600

Recommended cross-sectional area **to DINVDE 0276-1000 and DINVDE 0100-540 (PE)** trefoil arrangement, up to 50°C ambient temperature.

| Converter type	C1, D1 (AM1, KM1)			U1, V1, W1 (AK1, AK3, AK5)			PE		
	IDC [A-]	1. [mm²]	(2.) [mm²]	Iv [A~]	1. [mm²]	(2.) [mm²]	[mm²]		[Nm]
DCS 50x-0025-xx	25	1 x 4	-	20	1 x 4	-	1x 4	1 x M6	6
DCS 50x-0050-xx	50	1 x 10	-	41	1 x 6	-	1x 6	1 x M6	6
DCS 50x-0075-xx	75	1 x 25	-	61	1 x 25	-	1x 16	1 x M6	6
DCS 50x-0100-xx	100	1 x 25	-	82	1 x 25	-	1x 16	1 x M6	6
DCS 50x-0110-xx	110	1 x 25	-	90	1 x 25	-	1x 16	1 x M6	6
DCS 50x-0140-xx	140	1 x 35	-	114	1 x 35	-	1x 16	1 x M6	6
DCS 50x-0200-xx	200	2 x 35	1 x 95	163	2 x 25	1 x 95	1x 25	1 x M8	13
DCS 50x-0250-xx	250	2 x 35	1 x 95	204	2 x 25	1 x 95	1x 25	1 x M8	13
DCS 50x-0270-xx	270	2 x 35	1 x 95	220	2 x 25	1 x 95	1x 25	1 x M8	13
DCS 50x-0350-xx	350	2 x 70	-	286	2 x 50		1x 50	1 x M8	13
DCS 50x-0450-xx	450	2 x 95	-	367	2 x 95	-	1x 50	1 x M10	25
DCS 50x-0520-xx	520	2 x 95	-	424	2 x 95	-	1x 50	1 x M10	25
DCS 50x-0680-xx	680	2 x 120	-	555	2 x 120	-	1x120	1 x M12	50
DCS 50x-0820-xx	820	2 x 150	-	669	2 x 120	-	1x120	1 x M12	50
DCS 50x-0903-xx	900	4 x 95	3 x 150	734	4 x 70	3 x 95	1x150	2 x M12	50
DCS 50x-1000-xx	1000	2 x 185	-	816	2 x 150	-	1x150	1 x M12	50
DCS 50x-1203-xx	1200	4 x 120	-	979	4 x 95	3 x 120	1x185	2 x M12	50
DCS 50x-1503-xx	1500	4 x 185	-	1224	4 x 150	-	2x150	2 x M12	50
DCS 50x-2003-xx	2000	8 x 120	6 x 185	1632	4 x 240	-	2x240	2 x M12	50
DCS 50x-1903-xx ②	1900	8 x 120	6 x 185	1550	4 x 240		3x120	4 x M12	50
DCS 50x-2053-xx ②	2050	8 x 120	6 x 185	1673	6 x 120	5 x 150	3x120	4 x M12	50
DCS 50x-2503-xx ②	2500	7 x 185	-	2040	8 x 120	6 x 185	4x120	4 x M12	50
DCS 50x-2603-xx	2600	7 x 185	-	2122	8 x 120	6 x 185	4x120	4 x M12	50
DCS 50x-3003-xx ②	3000	8 x 185	-	2448	7 x 185	-	4x150	4 x M12	50
DCS 50x-3303-xx	3300	8 x 185	-	2693	7 x 185	-	4x150	4 x M12	50
DCS 50x-4003-xx	4000	7 x 300	-	3264	8 x 240	-	4x240	4 x M12	50
DCS 50x-4803-xx ①	4800	8 x 300	-	3876	6 x 300	-	3x300	4 x M12	50
DCS 50x-5203-xx ①	5200	8 x 300	-	4202	6 x 300	-	3x300	4 x M12	50

① Reduced ambient temperature 40°C
② Option for more flexible cable connection available

Table 2.3/1: Cross-sectional areas - tightening torques

You will find instructions on how to calculate the PE conductor's cross-sectional area in VDE 0100 or in equivalent national standards. We would remind you that power converters may have a current-limiting effect.

III 2-12

2.4 Power losses

DCS 500

The units' power loss is made up of several different components:

- current-dependent losses P_{V-I}
  - of the thyristors
  - of the fuses
  - of the busbar system

- voltage-dependent losses P_{V-U}
  - snubber circuit of the thyristors (worst case)
  - thyristors at di/dt < 20 A/µs

- almost constant losses P_{V-C}
  - unit electronics
  - unit fan
  - field supply

Depending on what you want to achieve by your power-loss study, you must make up your mind on the following points:

- **Efficiency calculation** for the drive system concerned:
  For this purpose, all the power-loss components mentioned above (and additionally the losses caused, for instance, by the motor fan, line reactor, cabling of network/power converter/motor, field supply unit and matching transformer, etc.) must be added.

- **Fan losses** can be estimated by 95% of the fan power consumption (see table 2.5/2).

Converter type →	y →		y=4 (400 V)		y=5 (500 V)		y=6 (600 V)		y=7 (690 V)		y=8 (790 V)		y=9 (1000V)	
x=1 → 2-Q	I_{DC} [A]		[W]		[W]		[W]		[W]		[W]		[W]	
x=2 → 4-Q	4Q	2Q	P_{V-I}	P_{V-U}	P_{V-I}	P_{V-U}	P_{V-I}	P_{V-U}	P_{V-I}	P_{V-U}	P_{V-I}	P_{V-U}	P_{V-I}	P_{V-U}
DCS50x-0025-y1	25	25	60	30	60	47								
DCS50x-0050-y1	50	50	123	30	123	47								
DCS50x-0050-61	50	50					108	46						
DCS50x-0075-y1	75	75	175	30	175	47								
DCS50x-0100-y1	100	100	207	50	207	70								
DCS50x-0110-61	110	100					284	100						
DCS50x-0140-y1	140	125	311	50	311	70								
DCS50x-0200-y1	200	180	488	50	488	70								
DCS50x-0250-y1	250	225	656	50	656	70								
DCS50x-0270-61	270	245					781	100						
DCS50x-0350-y1	350	315	840	50	840	70								
DCS50x-0450-y1	450	405	1040	70	1040	80	1119	110						
DCS50x-0520-y1	520	470	1238	70	1238	80								
DCS50x-0680-y1	680	610	1622	105	1622	140								
DCS50x-0820-y1	820	740	1986	125	1986	160								
DCS50x-1000-y1	1000	900	2527	125	2527	160								
DCS50x-0903-y1	900	900					4190	930	4190	1170				
DCS50x-1203-y1	1200	1200	4510	420	4510	600								
DCS50x-1503-y1	1500	1500	4740	460	4740	640	5540	850	5540	1080				
DCS50x-2003-y1	2000	2000	5950	470	5950	660	6820	1100	6820	1370				
DCS50x-1903-81	1900	1900									7150	1800		
DCS50x-2053-y1	2050	2050			7160	880	8050	1140	8050	1410	7300	1820		
DCS501-2503-y1		2500	8250	590	8250	800	8930	1220	8930	1510	8930	1830		
DCS502-2503-y1	2500		8400	900	7820	1200	8400	1510	8400	1850	8400	2210		
DCS501-3003-y1		3000	9570	450	9750	620	9430	1410	9430	1740	9430	2090		
DCS502-3003-y1	3000		9900	900	9900	1200	10300	1510	10300	1850	10300	2210		
DCS50x-2053-91	2050	2050											7090	2630
DCS50x-2603-91	2600	2600											9420	2690
DCS50x-3303-y1	3300	3300	10850	570	10850	780	11700	1190	11700	1470	11700	1780	11600	4650
DCS50x-4003-y1	4000	4000	12300	480	12300	660	13350	1520	13350	1860	13350	2230	15400	4800
DCS50x-4803-y1	4800	4800					16800	2300	16800	2750	16800	3250		
DCS50x-5203-y1	5200	5200	17250	1390	17250	1800								

Table 2.4/1: DCS 500 Power losses

Remarks on the table

- The values stated are "worst case", i.e. the values obtained under the most unfavourable conditions.
- The losses of the unit electronics can be assumed to be P_{V-C} = 30 ... 60 W, dependent on the loading involved (SDCS-COMx, number of binary inputs to "1-signal", pulse encoder used, etc.).

- The current-dependent losses can be converted as follows for the partial load range:

$$P_{V-I\,part} \approx P_{V-I} * 0.4 * \frac{x\%}{100\%} + P_{V-I} * 0.6 * \left(\frac{x\%}{100\%}\right)^2$$

- For the units ≤ 1000 A, the losses due to external semiconductor busbars, busbar systems/wiring are not included.

III 2-13

2.5 Power section cooling

DCS 500 valid for DCS 500B / DCS 600 / DCF 500B / DCF 600

Fan assignment for DCS 500

| Converter type	Model	Configuration	Fan type
DCS 50x-0025-y1 ... DCS 50x-0075-y1	C1	1	CN 52 B2
DCS 50x-0100-y1 ... DCS 50x-0140-y1	C1	2	W2E 143
DCS 50x-0200-y1 ... DCS 50x-0820-y	C2	3	W2E 200
DCS 50x-1000-y1	C2	3	W2E 250
DCS 50x-0903-y1 ... DCS 50x-2003-y1	A5	4	D2E 160
DCS 50x-1903-y4/5/8 ... DCS 50x-3003-y4/5/8	A6	5	GR31M 400...500 V
DCS 50x-1903-y6/7 ... DCS 50x-3003-y6/7	A6	5	GR31M 500...690 V
DCS 50x-3303-y1... DCS 50x-5203-y1	A7	5	GR35C 400 V / 690 V

Table 2.5/1: Fan assignment for DCS 500

Fan data for DCS 500

Fan	CN 52 B2		W2E 143		W2E 200		W2E 250		D2E 160		GR31M 380... 500 V		GR31M 525... 690 V		GR35C 400 / 690 V	
Rated voltage [V]	208...230; 1~		230; 1~		230; 1~		230; 1~		230; 1~		400...450 Δ 450...500 λ	400...500 Δ	500...690 λ	500...690 λ 500 Δ	400...500 Δ 600...690 λ	
Tolerance [%]	±10		+6/-10		+6/-10		+6/-10		±10		±10		±10		+5/-10	±10
Frequency [Hz]	50	60	50	60	50	60	50	60	50	60	50	60	50	60	50	60
Power consumption [W]	14	13	26	29	64	80	135	185	653	860	800 Δ 700 λ	1340 Δ	800 λ	1200 λ	2900 Δ 2200 λ	3600 Δ 3300 λ
Current consumpt. [A]	0.14	0.12	0.12	0.13	0.29	0.35	0.59	0.82	2.50	3.4	1.45 Δ 0.91 λ	2.0 Δ	0.9 λ	1.2 λ	6.5 Δ 2.3 λ	4.9 Δ 3.0 λ
Blocking current [A]	< 0.25	< 0.2	< 0.3	< 0,4	< 0.7	< 0.8	< 0.9	< 0.9	3.75	4.5	at 450 V Δ 8.5	at 500 V Δ 8.5	at 690 V λ 4.4	at 500 V Δ 8.5	at 400 V Δ >25	at 400 V Δ >30
Air flow [m3/h] freely blowing	156	180	375	440	925	1030	1860	1975	-		-		-			
Air flow [m3/h] at working point	-		-		-		-		800 2.5 A	750 3.2 A	1500 1.26 A (450V Δ)	1600 1.6 A (500V Δ)	1500 0.7 A (690V λ)	1600 1.65 A (500V Δ)	4200 3.6 A (400V Δ)	4250 4.1 A (400V Δ)
Max. ambient temperature [° C]	< 60		< 85		< 75		50		< 55		< 55					
Useful lifetime of grease	appr. 25000 h/60°		appr. 45000 h/60°		appr. 45000h/60°		appr. 40000 h		appr. 30000 h/40°							
Protection	Impedance ①		Temperatur detector: $U_N \le 230$ V~; $I_N \le 2.5$ A~													

① Increased losses due to increased current with a blocked rotor will not result in a winding temperature, higher than permissible for the insulation class being involved.

Table 2.5/2: Fan data for DCS 500

Fan connection for DCS 500
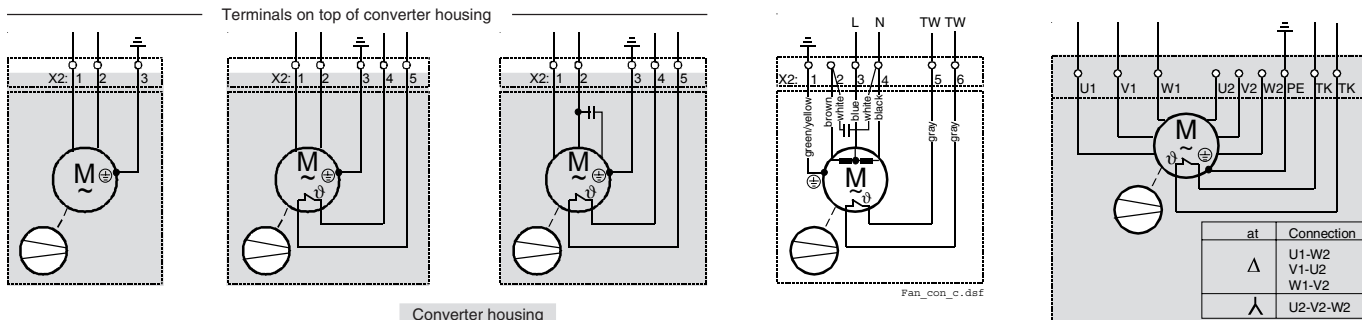
Config. 1   Config. 2   Config. 3   Config. 4   Config. 5

Monitoring the DCS 500 power section

a. The power sections of sizes C1 and C2 are monitored by an electrically isolated PTC thermistor detector, which is installed on the likewise electrically isolated heat sink near the thyristors. The resistance change proportional to the temperature is acquired and evaluated in the unit's software. If the temperature rises above a certain value predefined by the unit coding involved, then first an alarm will be outputted, and - if the temperature continues to rise - an error message. This means that changes in the rated cooling conditions, such as cooling air volume and temperature, the fan itself, overload due to an excessively high load current, etc. are detected.

b. The size-A5 power section is likewise monitored by an electrically isolated PTC thermistor detector, which is installed on the non-isolated heat sink in an isolated configuration. Evaluation of the resistance and the protection effect correspond to those mentioned for point (a.) above.

c. The size A6 and A7 power section is not directly monitored by an electrically isolated PTC thermistor detector. For this size, the same thermistor detector is used as for (a.) and (b.) above, but

it is here not mounted on a heat sink but close to the fan air outlet. The detector thus measures the power section's radiated heat and any changes in the cooling air temperature and volume. Since the cooling air volume can only be detected indirectly, a differential-pressure switch has been additionally fitted at the unit's housing, always located close to the power terminals.
The resistance change proportional to the temperature is acquired and evaluated in the unit's software. If the temperature rises above the parameterized value, then first an alarm will be outputted, and - if the temperature continues to rise - an error message. The value to be set for this parameter must not be more than 10 degrees above the permissible ambient temperature.
The differential-pressure switch compares the pressure inside the unit with the normal atmospheric pressure. If the fan has been switched on and the unit door closed (and no unit casings have been removed), the pressure switch will signal "Cooling conditions ok", which means the drive may be enabled. There is no need to set any specific differential pressure (recommendation: centre setting).

III 2-15

III 2-16

3 Control boards

3.1 Control Board SDCS-CON-2

The control board is based on the 80186EM micro-processor and the ASIC circuit DC94L01.
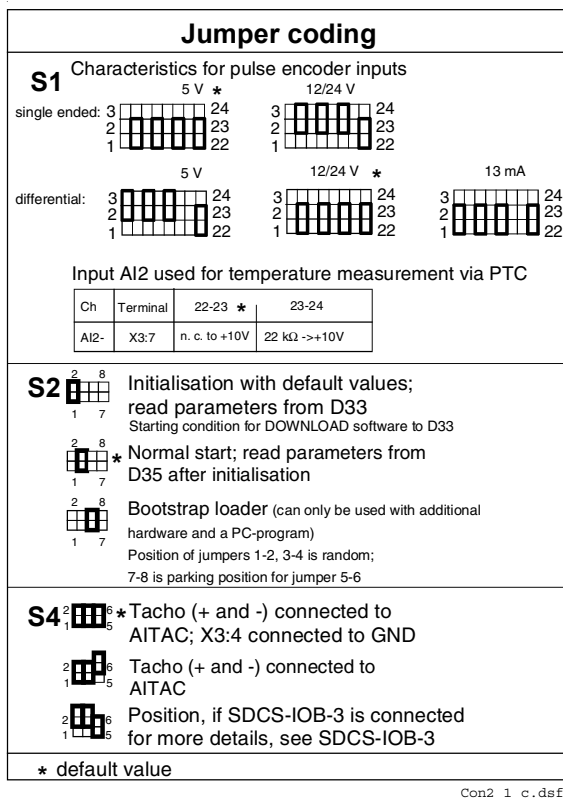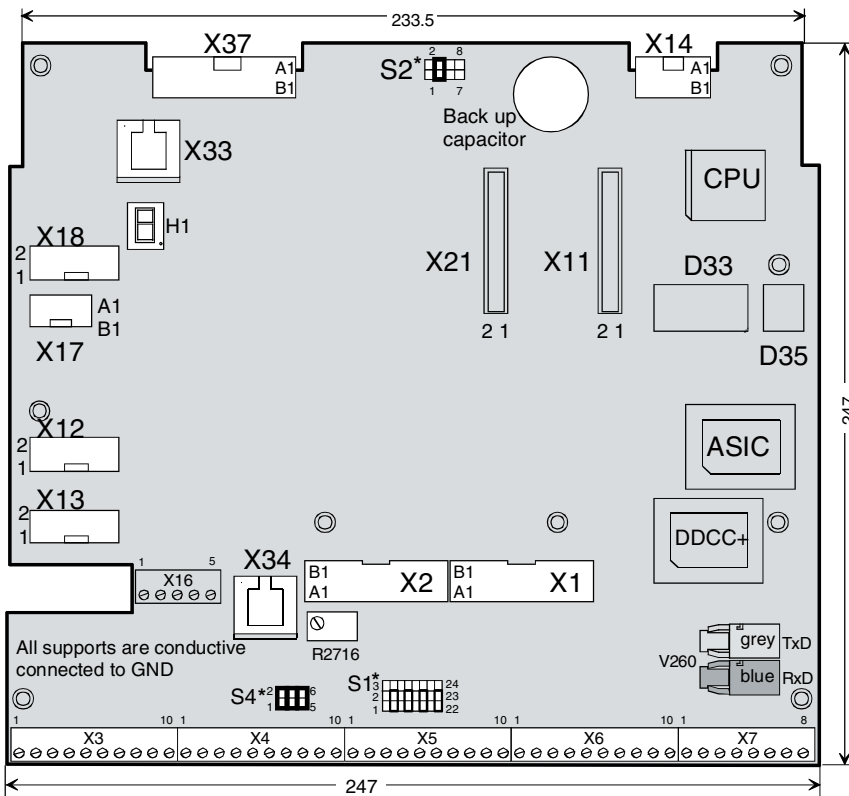

Fig. 3.1/1   Layout of the control board SDCS-CON-2

Memory circuits and the back-up

The program including system and parameter values is stored at Flash PROM D33. Different programs can be downloaded directly to these PROMs. Application functionality and parameter values are saved in the Flash PROM D35.
Fault and Alarm messages -the time of their appearance and some other values like the operating hours and so on- are stored in static RAM circuits. They have a back up capacitor of 1 F, which lasts minimum 8 hours, typically several days. It takes about 30 minutes to charge the backup capacitor.

ASIC function

ASIC = Application Specific Integrated Circuit
Most of the measurements and control functions for the DCS500 are done in the ASIC:
- communication with control panel (RS 485)
- communication with field exciters (RS 485)
- measurement
- watchdog function
- A/D and D/A-conversion control
- thyristor firing pulse generation

Watchdog function

The control board has an internal watchdog. The watchdog controls the running of the control board program. If the watchdog trips, it has the following effects:
- Writing to FPROM is disabled.
- Thyristor firing control is reset and disabled.

- Digital outputs are forced low.
- Programmable analogue outputs are reset to zero, 0V.

Seven segment display

A seven segment display is located on the control board and it shows the state of drive.
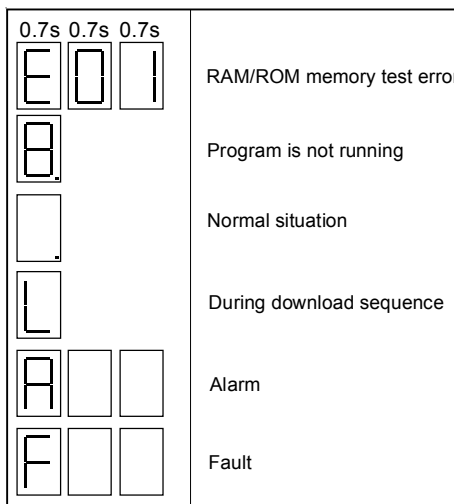

Fig. 3.1/2   Seven segment display of the SDCS-CON-2

Auxiliary power distribution

The electronic power supply board SDCS-POW-1 (see separate chapter) generates different levels of voltages. Some of them are transferred via the CON-2 board directly to the boards, where they are used, others are manipulated and then transferred.
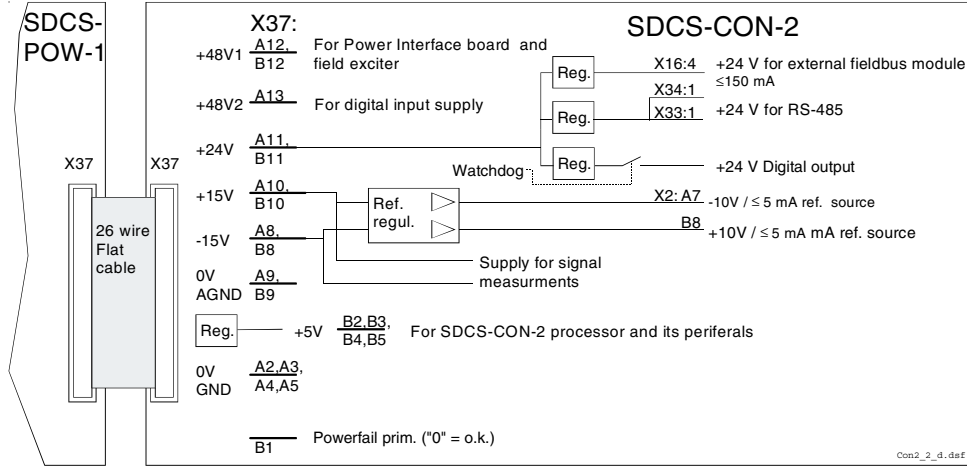

Fig. 3.1/3   Auxiliary power distribution on the board SDCS-CON-2

Supply voltage monitoring

The control board monitors the following voltage levels:

Supply voltage	+5 V	+15 V	-15 V	+24 V	+48 V1	+48 V2
Undervoltage tripping level	+4.55 V	+12.4 V	- 12.0 V	+19 V	+38 V	+38 V
Test terminals X37:	B4 / B5	B10	B8	B11	B12	--------

The electronic power supply system with the different voltage levels is monitored in two ways. There is a signal powerfail primary, which monitors the input power supply voltage of the POW-1 board and a signal powerfail secondary, which monitors the low voltage levels. If one voltage level drops below the threshold a trip signal is generated.

In addition to that there is a monitoring function for the 5 V level. If +5 V drops under the tripping level, it causes a master reset by hardware. All I/O registers are forced to 0 and the firing pulses are suppressed.

RS485 serial communication channels

The control board has two RS485 channels. The first channel is used for field exciter control of DCF 501B/502B, DCF 503A/504A or DCF 601/602 (terminals X16:1...3) and the second for the control panel (CDP) at terminals X33 or X34. The terminals X33 and X34 are wired up in parallel internally.
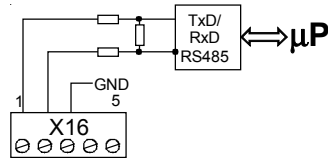
Fig. 3.1/4   Connection for field supply units DCF xxx to the RS485 Communication Interface of the SDCS-CON-2 board.

DDCS Channel integrated

The control board SDCS-CON-2 has an integrated DDCS (**D**igital **D**rive **C**ontrol **S**ystem) channel with a transfer rate up to 4 Mbits/s. This channel (V260) can be used for fieldbus modules with the DCS 500B converters or for the 12_PULE LINK with DCS 600 converters. The terminals X16:4 and 5 are provided for power supply of the modules (+24 V / ≤150 mA).

Fig. 3.1/5   Connection of the DDCS channel with power supply to the control board SDCS-CON-2

Digital and analogue I/O connection of the SDCS-CON-2

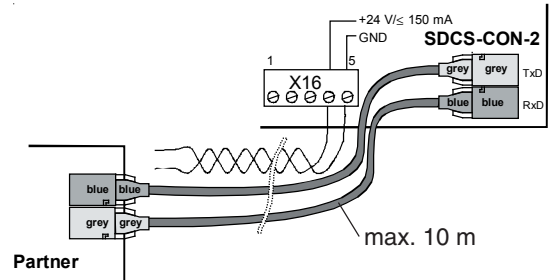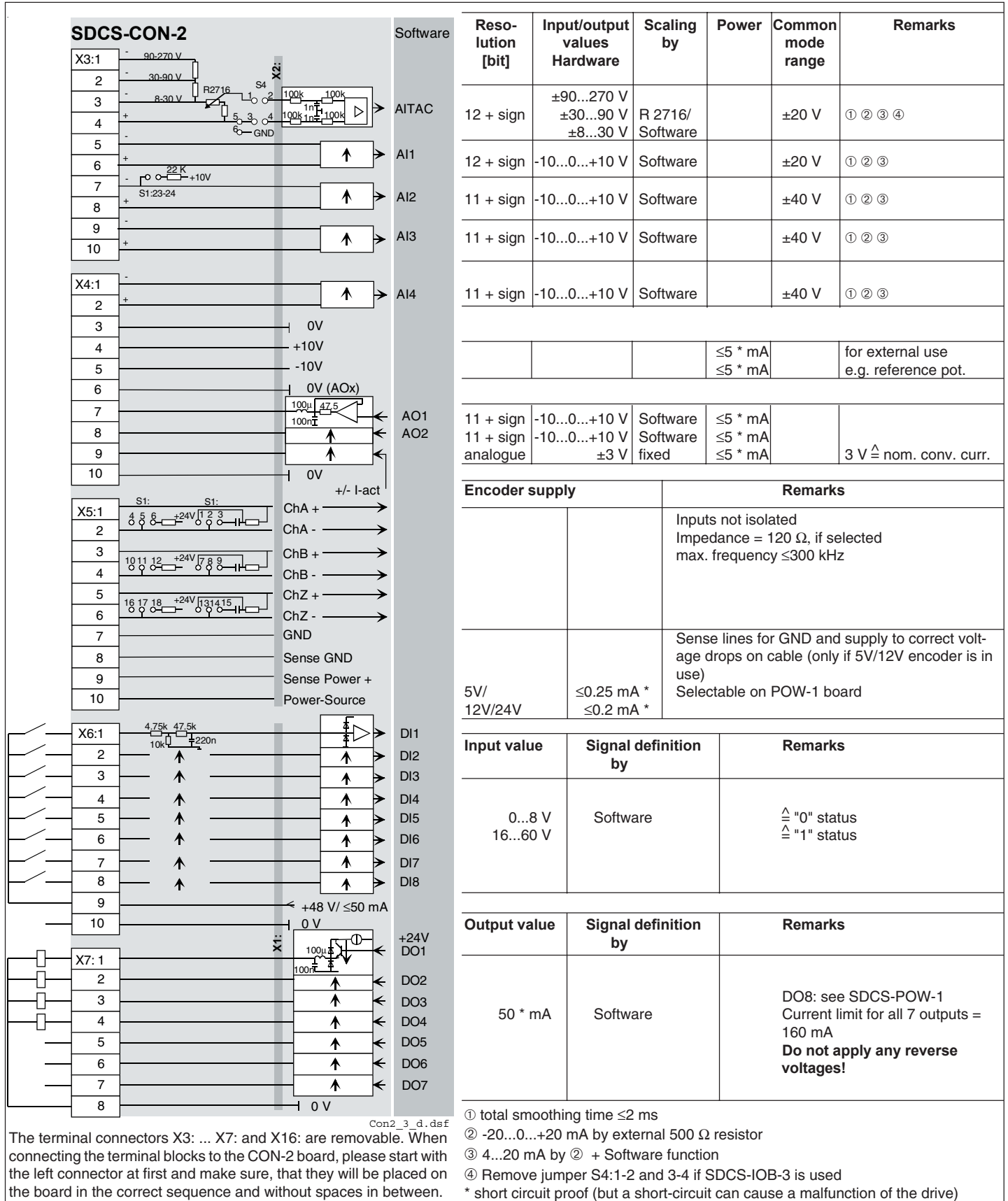| Reso-lution [bit]	Input/output values Hardware	Scaling by	Power	Common mode range	Remarks
12 + sign	±90...270 V ±30...90 V ±8...30 V	R 2716/ Software		±20 V	① ② ③ ④
12 + sign	-10...0...+10 V	Software		±20 V	① ② ③
11 + sign	-10...0...+10 V	Software		±40 V	① ② ③
11 + sign	-10...0...+10 V	Software		±40 V	① ② ③
11 + sign	-10...0...+10 V	Software		±40 V	① ② ③
			≤5 * mA		for external use
			≤5 * mA		e.g. reference pot.
11 + sign	-10...0...+10 V	Software	≤5 * mA		
11 + sign	-10...0...+10 V	Software	≤5 * mA		
analogue	±3 V	fixed	≤5 * mA		3 V $\hat{=}$ nom. conv. curr.

Encoder supply		Remarks
		Inputs not isolated Impedance = 120 Ω, if selected max. frequency ≤300 kHz
5V/ 12V/24V	≤0.25 mA * ≤0.2 mA *	Sense lines for GND and supply to correct voltage drops on cable (only if 5V/12V encoder is in use) Selectable on POW-1 board

Input value	Signal definition by	Remarks
0...8 V 16...60 V	Software	$\hat{=}$ "0" status $\hat{=}$ "1" status

Output value	Signal definition by	Remarks
50 * mA	Software	DO8: see SDCS-POW-1 Current limit for all 7 outputs = 160 mA **Do not apply any reverse voltages!**

① total smoothing time ≤2 ms
② -20...0...+20 mA by external 500 Ω resistor
③ 4...20 mA by ② + Software function
④ Remove jumper S4:1-2 and 3-4 if SDCS-IOB-3 is used
* short circuit proof (but a short-circuit can cause a malfunction of the drive)

The terminal connectors X3: ... X7: and X16: are removable. When connecting the terminal blocks to the CON-2 board, please start with the left connector at first and make sure, that they will be placed on the board in the correct sequence and without spaces in between.

Fig. 3.1/6   Terminal connection of the SDCS-CON-2 board

III 3-4

4 Power Supply Board

4.1 Power Supply Board SDCS-POW-1

The SDCS-POW-1 board is designed for DCS 500 converter modules and is mounted on the electronic support. This board is used for all types of modules independent from current or voltage range.

The SDCS-POW-1 works on a switched mode basis in fly back configuration. It generates all necessary DC voltages for the SDCS-CON-2 and all other electronic boards. The input voltage can be

selected via the switch SW1 either to 230 V AC or to 115 V AC. The following figure shows the instructions for the selection of the AC input voltage and for the selection of the encoder supply voltage.

If an SDCS-CON-2 (without I/O board SDCS-IOB-3) together with a pulse encoder is used for speed measurement, the incremental encoder supply voltage must be selected by jumpers X5, X4 and X3.
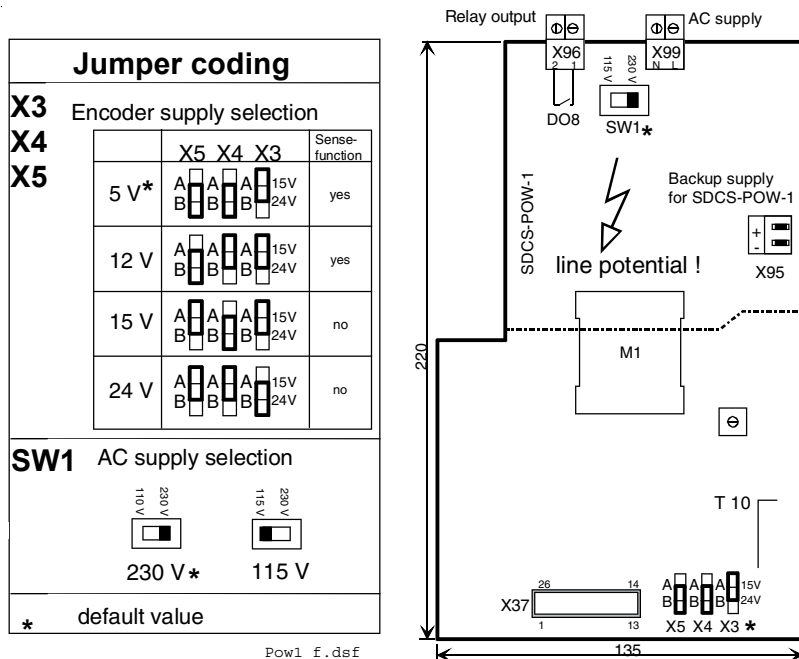

Fig. 4.1/1   Layout of the SDCS-POW-1 board

AC Supply voltage

Supply voltage	115 V AC	230 V AC
Tolerance	-15%/+10%	-15%/+10%
Frequency	45 Hz ... 65 Hz	45 Hz ... 65 Hz
Power consumption	120 VA	120 VA
Power loss	≤60 W	≤60 W
Inrush current	20 A / 20 ms	10 A / 20 ms
Mains buffering	min 30 ms	min 30 ms

Supply voltage	+5 V *	+15 V	+24 V	+48 V2
Test terminals	X 5 B	X3 A	X3 B	heat sink T 10

 * The 5 volt level can be checked, if 5 volt is selected!

Output X96-DO8
Potential isolated by relay (NO contact)
MOV- element (275 V)
Contact rating: **AC**: ≤250 V~/ ≤3 A~
                 DC: ≤24 V-/ ≤3 A-
                 or ≤115/230 V-/ ≤0.3 A-)

Backup supply
These two terminals are used to add additional capacitance (e.g. KJ 2001) to the existing ones to increase the mains buffering time. More detailed data is available on request via your ABB representative.

III 4-2

5 Power interface boards

5.1 Power Interface Board SDCS-PIN-1x

The power interface board is used for converter modules model C1. There are 2 different versions in use. The used types are:
- SDCS-PIN-11 for **25 A**, **50 A** and **75 A** converters at **500V**
- SDCS PIN-12 for **50 A** converters at **600 V**

The SDCS-PIN-1x boards consists of:
- firing pulse circuits and pulse transformers
- measurement of the armature current via current transformers
- snubber circuit for thyristors protection (consists of RC circuits and MOV elements)

- AC and DC high ohmic voltage measurement
- heat sink temperature measurement via PTC sensor
- scaling for rated current, zero current detection and HW type coding
- If the SDCS-PIN-11 connection board is installed in a **DCF**50x-0025...0075 / **DCF**60x-0025...0075, then the resistors R113, R116 and R119 are not build-in

Note:
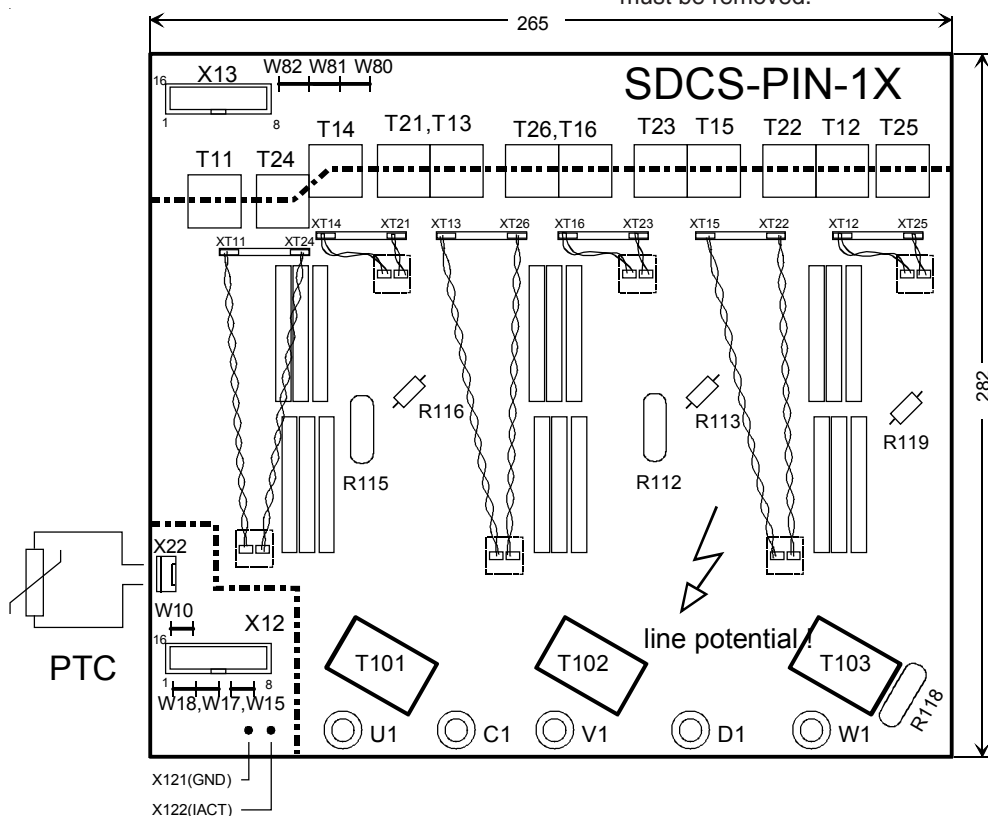If this PCB is used as a spare part for a **DCF**...., then the resistors R113/R116/R119 (value = 0 Ω) must be removed.

Fig. 5.1/1   Layout of the SDCS-PIN-1x board.

Board type		**PIN 11**			**PIN 12**
Current transformer ratio		1500:1			1500:1
Max. rated voltage [V]		500	500	500	600
Rated current [A]		25	50	75	50
W10	2Q= ○✕○; 4Q= ○—○	←	←	←	←
W15	zero current detection	○✕○	○✕○	○—○	○✕○
W17	rated current scaling	○✕○	○—○	○—○	○—○
W18	rated current scaling	○✕○	○✕○	○—○	○✕○
W80	HW type coding	○✕○	○✕○	○—○	○✕○
W81	HW type coding	○✕○	○—○	○✕○	○—○
W82	HW type coding	○—○	○—○	○—○	○—○

Table 5.1/1   Settings of the SDCS-PIN-1x board if a DCS converter is equipped with it by ABB

Board used as a spare part:
- default: all jumpers W10-W82 are in ○—○ condition
- ensure the correct converter type related settings

○✕○ indicates a removed jumper

5.2 Power interface board SDCS-PIN-20x/SDCS-PIN-20xB

The power interface board is used for DCS con-
verter modules construction type C1 and C2. There
are different versions in use. The used types are:

- SDCS-PIN-205B for **100 A...1000 A** Conv. at **500 V**
  including the 3-phase field supply converters **DCF...**
- SDCS-PIN-206B for **110 A...450 A** Conv. at **600 V**

The SDCS-PIN20xB can replace the SDCS-PIN-
20x and PIN-20xA but not vice versa.

The SDCS-PIN-20x board consists of:
- firing pulse circuits with pulse transformers
- measurement of the armature current
- snubber circuit for thyristor protection
  (consists of RC circuits in parallel of the thyristors
  and RCD network)
- AC and DC high ohmic voltage measurement
- rated current scaling with burden resistors, zero
  current detection and HW voltage type coding
- interface for heat sink temperature measurement
  with a PTC sensor
- fuses for overvoltage protection and voltage
  measuring
- the same board will be used without any modifi-
  cation at a converter used for three-phase field
  supply

Spare part
The protection of the power part is done by using
RC circuits. Snubber circuits are wired in parallel to
each thyristor with fuses in between. RCD ele-
ments are protected by the fuses F 101 to F 103.
The AC voltage measurement is taken from behind
the fuse.

Fuse data: Bussmann KTK-R-6A (600V)

The power interface board SDCS-PIN205 can be
used as a replacement of SDCS-PIN-21, 22 and
25. The board SDCS-PIN-206 can be used as a re-
placement of SDCS-PIN-23 and 24, but not vice-
versa! In case of a converter with 450 A / 520 A /
700 A at 500 V or a converter of 450 A at 600 V ad-
ditional actions have to be taken into account.

Note
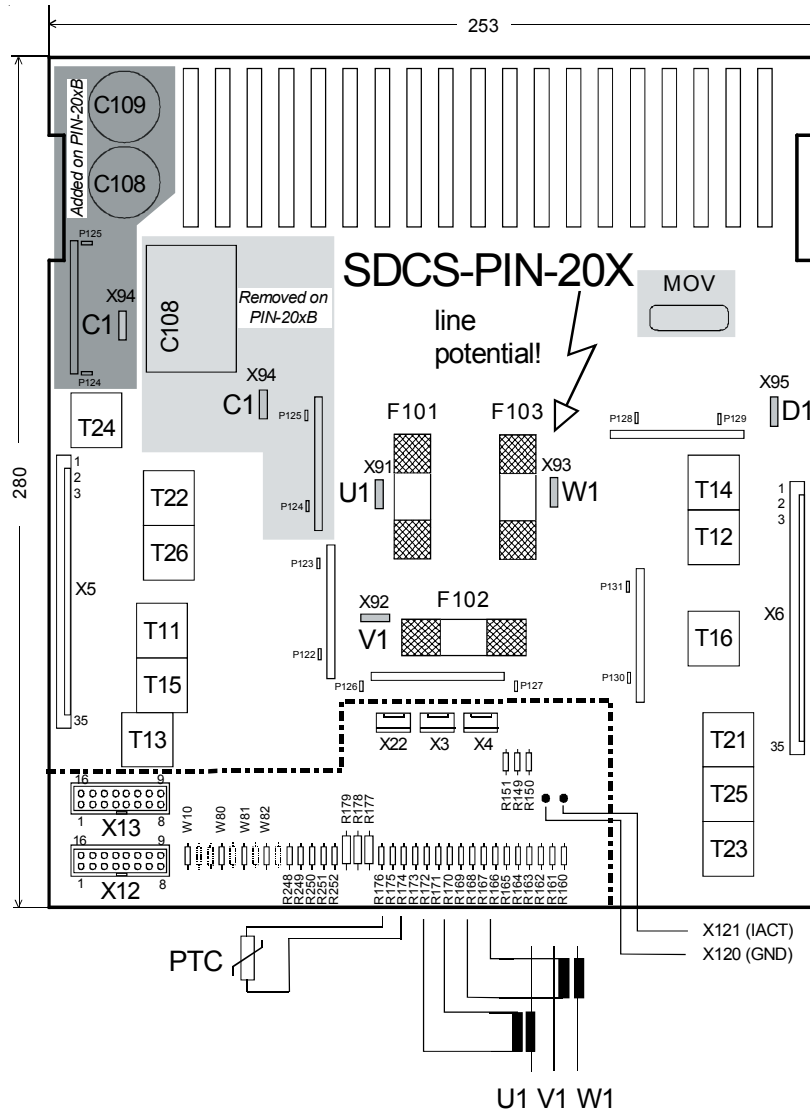If this PCB is used as a spare part for a DCF..., no
modifications are necessary!

Fig. 5.2/1   Layout of the SDCS-PIN-20x (20xA), 20xB board.

III 5-2

2-Q Converters

Table legend: in the cells below, **✕** = o✕o (a removed jumper) and **—** = o—o (jumper present / connected).

Board type		PIN 205B										PIN 206B		
Current transformer ratio		1000:1					600:1		3000:1			1000:1		600:1
Rated voltage [V]		500										600		
Rated current [A]		100	125	180	225	315	405	470	610	740	900	100	245	405
W10	2-Q/4-Q selection	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕
W80	HW type coding	—	✕	✕	—	✕	✕	—	—	✕	—	✕	✕	—
W81	HW type coding	—	—	—	✕	✕	—	✕	—	—	✕	—	✕	✕
W82	HW type coding	—	—	✕	—	—	—	—	—	—	—	—	—	—
R248	HW type coding	—	—	—	—	—	—	—	✕	✕	✕	—	—	—
R249	HW type coding	—	—	—	—	—	—	—	—	—	—	—	—	✕
R250	HW type coding	—	—	—	—	—	—	—	—	—	—	✕	✕	✕
R251	HW type coding	—	—	—	—	—	✕	✕	—	—	—	✕	✕	✕
R252	HW type coding	—	—	—	—	—	✕	✕	✕	✕	✕	✕	✕	✕
R149	33 Ω — zero current detection	✕	✕	✕	✕	—	—	—	—	✕	✕	✕	✕	—
R150	47.5 Ω — zero current detection	✕	✕	—	—	✕	—	—	—	—	—	✕	—	—
R151	100 Ω — zero current detection	—	—	✕	✕	✕	✕	✕	✕	✕	✕	—	✕	✕
R160	1k Ω — rated current scaling	✕	✕	✕	✕	✕	✕	✕	✕	—	✕	✕	—	✕
R161	1k Ω — rated current scaling	—	✕	—	—	—	✕	✕	✕	—	✕	—	—	—
R162	332 Ω — rated current scaling	—	—	✕	—	✕	✕	—	—	—	—	—	—	✕
R163	332 Ω — rated current scaling	—	✕	✕	—	✕	✕	—	—	—	—	—	—	✕
R164	332 Ω — rated current scaling	✕	✕	✕	—	✕	✕	—	—	—	—	✕	✕	✕
R165	332 Ω — rated current scaling	✕	✕	✕	✕	✕	✕	—	—	—	—	✕	✕	✕
R166	332 Ω — rated current scaling	✕	✕	✕	✕	✕	✕	—	—	✕	✕	✕	✕	✕
R167	47.5 Ω — rated current scaling	✕	—	✕	—	✕	✕	✕	✕	✕	✕	✕	✕	✕
R168	33.2 Ω — rated current scaling	—	—	—	—	—	—	—	—	—	—	—	—	—
R169	33.2 Ω — rated current scaling	—	—	—	—	—	—	—	—	—	—	—	—	—
R170	33.2 Ω — rated current scaling	✕	✕	—	—	—	—	—	—	—	—	✕	—	—
R171	33.2 Ω — rated current scaling	✕	✕	—	—	—	—	—	—	—	✕	✕	—	—
R172	33.2 Ω — rated current scaling	✕	✕	✕	✕	—	—	—	—	✕	—	✕	—	—
R173	33.2 Ω — rated current scaling	✕	✕	✕	—	—	✕	—	✕	✕	✕	✕	✕	✕
R174	33.2 Ω — rated current scaling	✕	✕	✕	—	—	✕	—	✕	✕	✕	✕	✕	✕
R175	33.2 Ω — rated current scaling	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕
R176	33.2 Ω — rated current scaling	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕
R177	10 Ω — rated current scaling	✕	✕	✕	✕	✕	—	—	✕	✕	—	✕	✕	—
R178	10 Ω — rated current scaling	✕	✕	✕	✕	✕	—	—	✕	✕	✕	✕	✕	—
R179	10 Ω — rated current scaling	✕	✕	✕	✕	✕	—	—	✕	✕	✕	✕	✕	—

Table 5.2/1   Settings of the SDCS-PIN-20xB board for 2-Q converters if a DCS converter is equipped with it by ABB

o✕o indicates a removed jumper

4-Q Converters

Board type		PIN 205B										PIN 206B		
Current transformer ratio		1000:1					600:1		3000:1			1000:1		600:1
Rated voltage [V]		500										600		
Rated current [A]		100	140	200	250	350	450	520	680	820	1000	110	270	450
W10	2-Q/4-Q selection	—	—	—	—	—	—	—	—	—	—	—	—	—
W80	HW type coding	—	—	✕	—	✕	✕	—	—	✕	—	✕	—	—
W81	HW type coding	—	—	—	—	✕	✕	—	✕	—	✕	—	✕	✕
W82	HW type coding	✕	—	✕	—	—	—	—	—	—	—	—	—	—
R248	HW type coding	—	—	—	—	—	—	—	✕	✕	✕	—	—	—
R249	HW type coding	—	—	—	—	—	—	—	—	—	—	—	—	✕
R250	HW type coding	—	—	—	—	—	—	—	—	—	—	✕	✕	✕
R251	HW type coding	—	—	—	—	—	✕	✕	—	—	—	✕	✕	✕
R252	HW type coding	—	—	—	—	—	✕	✕	✕	✕	✕	✕	✕	✕
R149	33 Ω — zero current detection	✕	✕	✕	✕	—	—	—	✕	✕	✕	✕	—	—
R150	47.5 Ω — zero current detection	✕	✕	—	—	✕	—	—	—	—	—	—	—	—
R151	100 Ω — zero current detection	—	—	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕
R160	1k Ω — rated current scaling	✕	✕	✕	—	✕	✕	✕	—	—	✕	—	✕	✕
R161	1k Ω — rated current scaling	—	—	—	—	✕	✕	✕	—	—	—	—	✕	✕
R162	332 Ω — rated current scaling	—	—	—	—	—	—	—	✕	✕	✕	—	✕	—
R163	332 Ω — rated current scaling	—	—	✕	—	—	✕	✕	✕	✕	✕	—	✕	—
R164	332 Ω — rated current scaling	✕	✕	—	—	✕	✕	—	✕	✕	—	—	✕	✕
R165	332 Ω — rated current scaling	✕	✕	—	—	✕	✕	—	✕	✕	—	—	✕	✕
R166	332 Ω — rated current scaling	✕	✕	✕	—	✕	✕	✕	✕	✕	—	✕	✕	✕
R167	47.5 Ω — rated current scaling	✕	✕	✕	✕	—	—	—	✕	✕	✕	✕	—	—
R168	33.2 Ω — rated current scaling	—	—	—	—	—	—	—	—	—	—	—	—	—
R169	33.2 Ω — rated current scaling	—	—	—	—	—	—	—	—	—	—	—	—	—
R170	33.2 Ω — rated current scaling	✕	—	—	—	—	—	—	—	—	—	✕	✕	✕
R171	33.2 Ω — rated current scaling	✕	✕	—	—	—	—	—	—	—	—	✕	✕	✕
R172	33.2 Ω — rated current scaling	✕	✕	✕	—	—	—	—	—	—	—	✕	✕	—
R173	33.2 Ω — rated current scaling	✕	✕	✕	—	—	✕	—	✕	✕	—	✕	✕	✕
R174	33.2 Ω — rated current scaling	✕	✕	✕	✕	—	✕	—	✕	✕	—	✕	✕	✕
R175	33.2 Ω — rated current scaling	✕	✕	✕	✕	✕	✕	—	✕	✕	—	✕	✕	✕
R176	33.2 Ω — rated current scaling	✕	✕	✕	✕	✕	✕	✕	✕	✕	—	✕	✕	✕
R177	10 Ω — rated current scaling	✕	✕	✕	✕	✕	—	—	✕	✕	✕	✕	—	—
R178	10 Ω — rated current scaling	✕	✕	✕	✕	✕	—	—	✕	✕	✕	✕	—	—
R179	10 Ω — rated current scaling	✕	✕	✕	✕	✕	—	—	✕	✕	✕	✕	✕	—

Table 5.2/2   Settings of the SDCS-PIN-20xB board for 4-Q converters if a DCS converter is equipped with it by ABB

Board used as a spare part:
- default: all resistors, representing a jumper Wxx / Rxx are in o——o condition
- ensure the correct converter type related settings
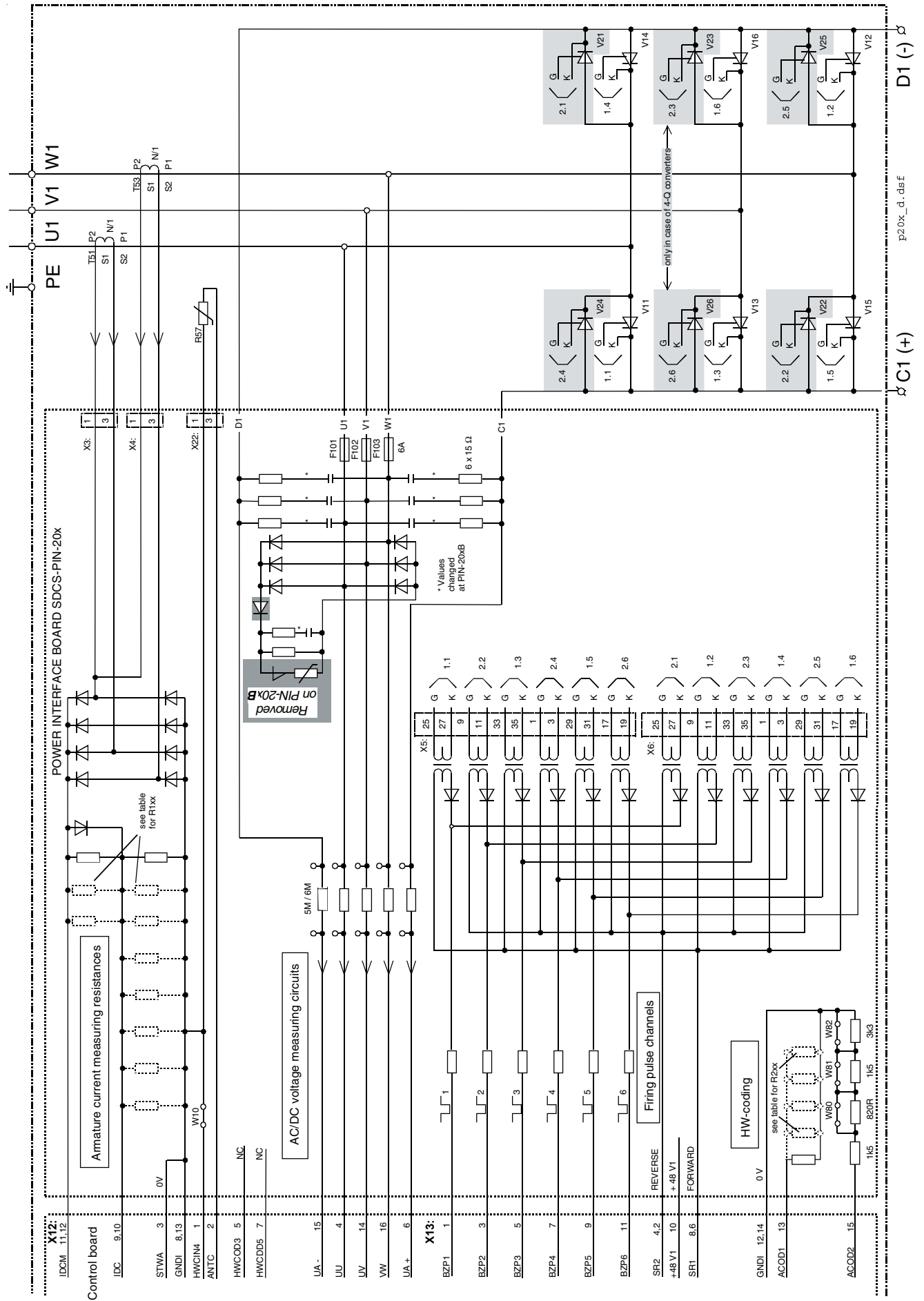
Fig. 5.2/2   Typical armature circuit thyristor converter diagram with SDCS-PIN-20x (PIN-20xA), PIN-20xB board
              for a 2Q/4Q C1/C2 type converter

III 5-4

5.3 Galvanic isolation - T90, A92

The Galvanic isolation is an option for converters in the current range 2050...5150 A and rated voltages ≤1000 V. For converters with a rated voltage of 1190 V and 12-pulse serial > 2x 500 V the galvanic isolation is a standard equipment. It is used to replace the high-ohmic resistance voltage measurement and gives the advantage of a total isolation from power part to electronic part.

The transformer T90 and the DC transducer A92 are located outside the converter module. The internal AC and DC voltage measurement channels are opened and connected to the T90 and A92 units.
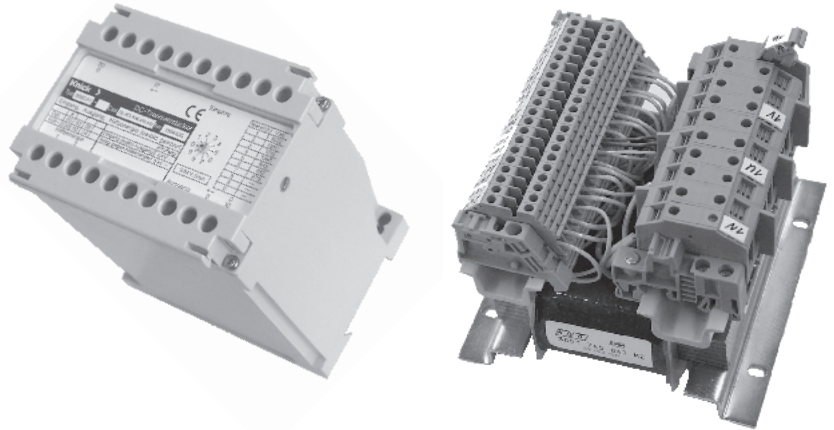
Hard and software settings:

Voltage coding on measuring board						
Construction type	A5 / A6 / A7 (C4)					
Conv. nom. voltage [V] *	Y=4 (400V) Y=5 (500V)	Y=6 (600V)	Y=7 (690V)	Y=8 (790V)	Y=9 (1000V)	Y=1 (1190V)
Rated mains voltage [V AC]	220…500	270…600	300…690	350…790	450…1000	530…1190
Value f. conv. nom. volt at SET(TINGS) block *	500	600	690	800	1000	1200
Measuring board **SDCS-**	**PIN-51**	**PIN-51**	**PIN-51**	**PIN-51**	**PIN-51**	**PIN-51**
Resistors W1…W26	⊖—⊖	⊖—⊖	⊖—⊖	⊖—⊖	⊖—⊖	⊖—⊖
	all resistors are 0 Ω					
Galvanic isolation						
Resistors Rx on PIN51	27.4 kΩ	27.4 kΩ	27.4 kΩ	27.4 kΩ	27.4 kΩ	27.4 kΩ
DC-DC transducer **A92**	8680A1					
Switch position R_G *	**7** (675 V)	**6** (810 V)	**5** (945 V)	**4** (1080 V)	**2** (1350 V)	**1** (1620 V)
Transformer **T90**	3ADT 745047					
Secondary Terminals *	2U1 2V1 2W1 2N	2U2 2V2 2W2 2N	2U3 2V3 2W3 2N	2U4 2V4 2W4 2N	2U5 2V5 2W5 2N	2U6 2V6 2W6 2N

* 12-pulse serial and sequential have a different selection between **S CONV NOM VOLT (42.08)** and the scaling of measurement channel. See *12-pulse manual for DCS 600.*
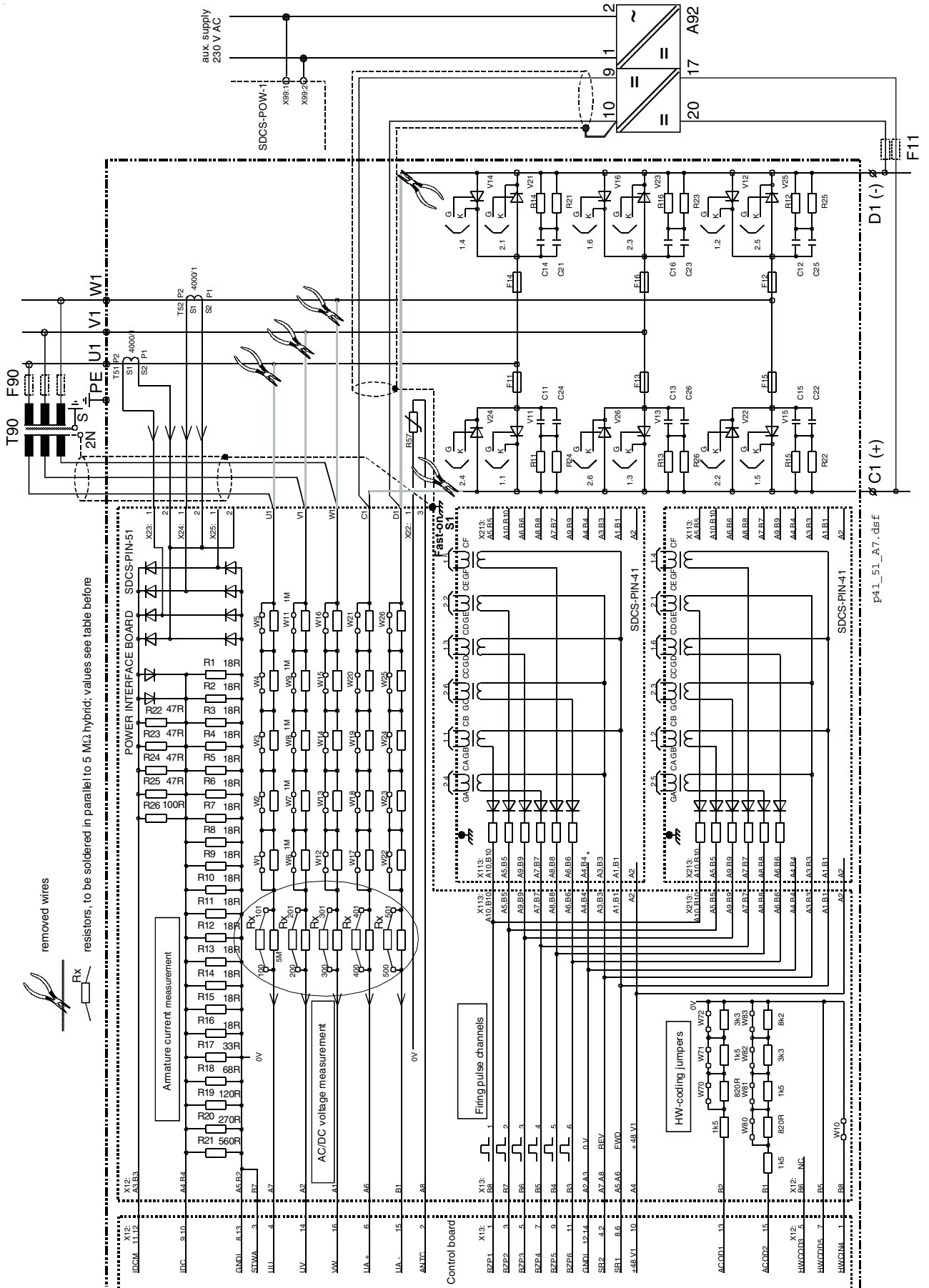
Fig. 5.3/1   Typical armature circuit thyristor converter diagram with SDCS-PIN-41 and SDCS-PIN-51 boards for a 4-Q A7 type converter with galvanic isolation

III 5-6

5.3.1 DC-DC transducer A92
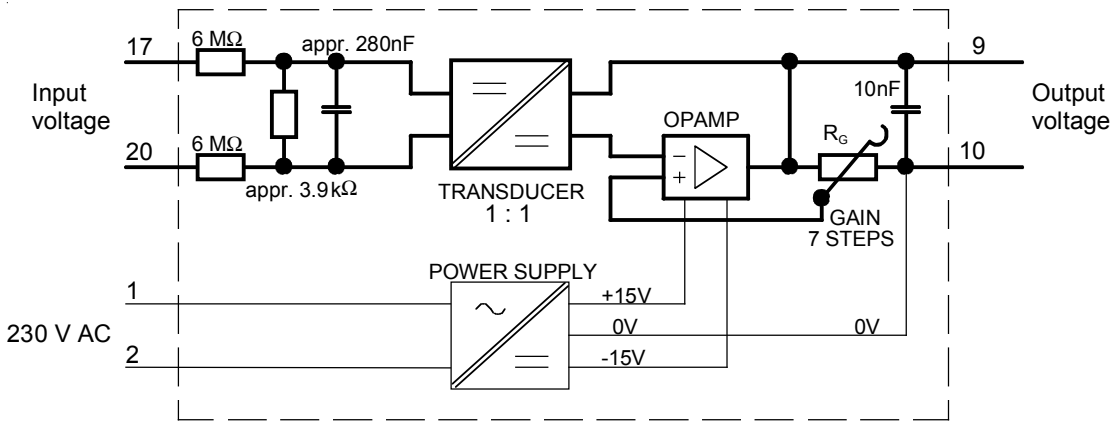
Fig. 5.3/2   Principle circuit diagram of the DC-DC transducer A92

Data

Selectable voltage gains:	675	810	945	1080	1215	1350	1620	V DC
Switch position	**7**	**6**	**5**	**4**	**3**	**2**	**1**	

Output voltage:	9,84 V / 5 mA
Auxiliary power:	230 V ± 15 %; 50/60 Hz; 3 W
Clearance in air:	Auxiliary power to Output: >13 mm
	Input/Output to Auxiliary power: >14 mm
Insulation voltage:	2000 V
Insulation test voltage:	5000 V
Ambient temperature range:	- 10 …+ 70 °C
Weight:	appr. 0.4 kg
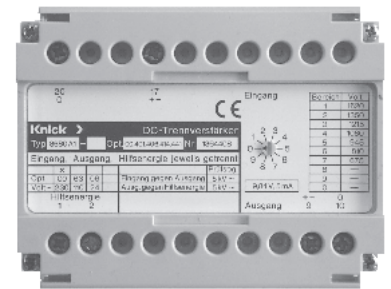
The voltage gain and frequency response is especially designed for DCS 500B and DCS 600 converters.
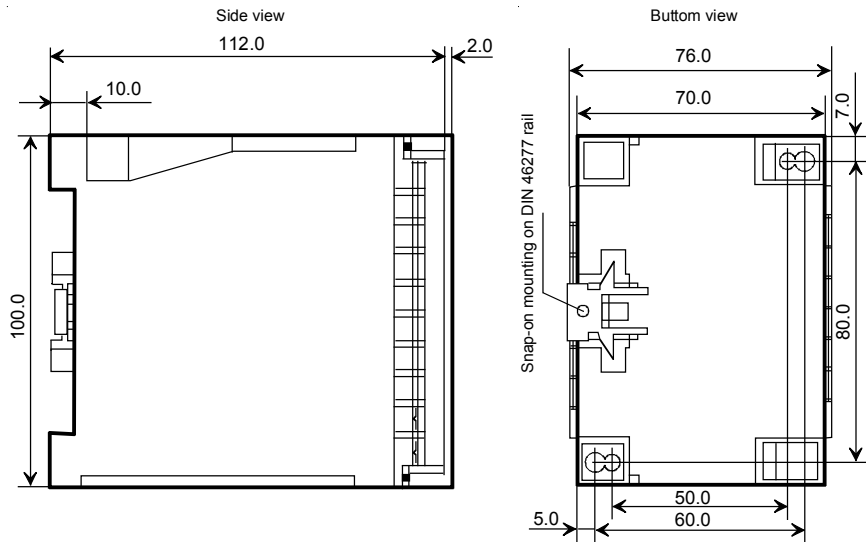
Fig. 5.3/3   Dimensions in mm
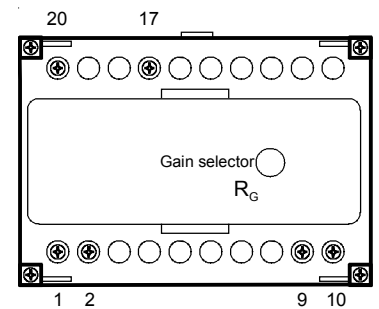
Fig. 5.3/4   Location of terminals

5.3.2 Transformer T90
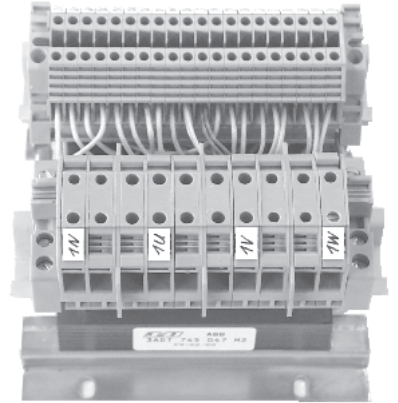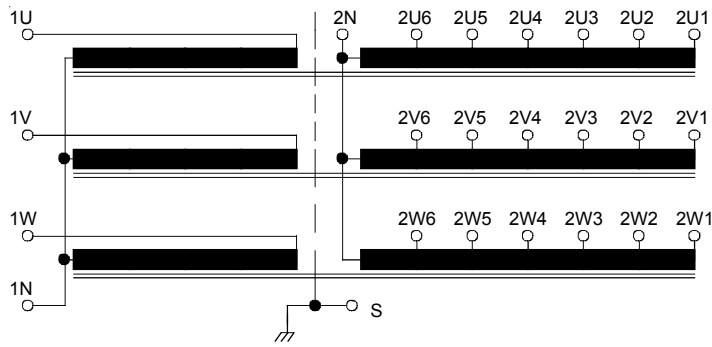
Fig. 5.3/5   Principle diagram of the transformer T90

Data

Selectable transfer ratios U_{prim}:	502, 601, 701, 800,1000, 1200 V AC rms
Output voltage:	7.3 V AC rms
Insulation voltage:	1200 V
Isolation test voltage:	3500 V
Ambient temperature range:	- 10 …+ 70 °C
Weight:	2.1 kg
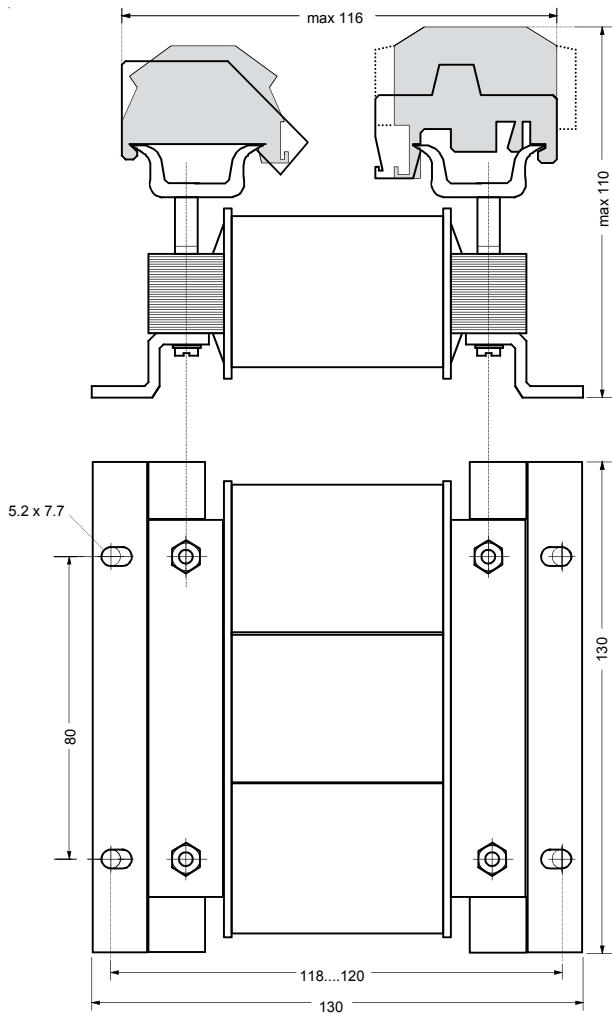
Remark

The terminals on the primary side of the transformer are in special design (lug terminals).

Handling hints: First turn the screw counter-clockwise to the end stop, then swing out the shrowding cover.

Put in the cable lug, swing in the shrowding cover and fasten the connection by turning the screw clockwise.

Fig. 5.3/6   Dimensions in mm

III 5-8

5.4 Power Interface SDCS-PIN 41/SDCS-PIN-48/SDCS-PIN-5x

The Power Interface of DCS converter modules model A5/A6/A7 and C4 from 900 A up to 5200 A consists of two boards - the Measuring board SDCS-PIN-51 and the Pulse transformer board SCDS-PIN-41.
The following figures show the different connections between the SDCS-PIN-41 and SDCS-PIN-51 board depending on the application 2- or 4-quadrant and the construction type.

Converters, delivered from 1998 on, will be equipped with SDCS-PIN-41A, which is a full replacement for converters, already in use.

Converters delivered from middle 2005 will be equipped with SDCS-PIN-48, which is a full replacement for converters already in use.
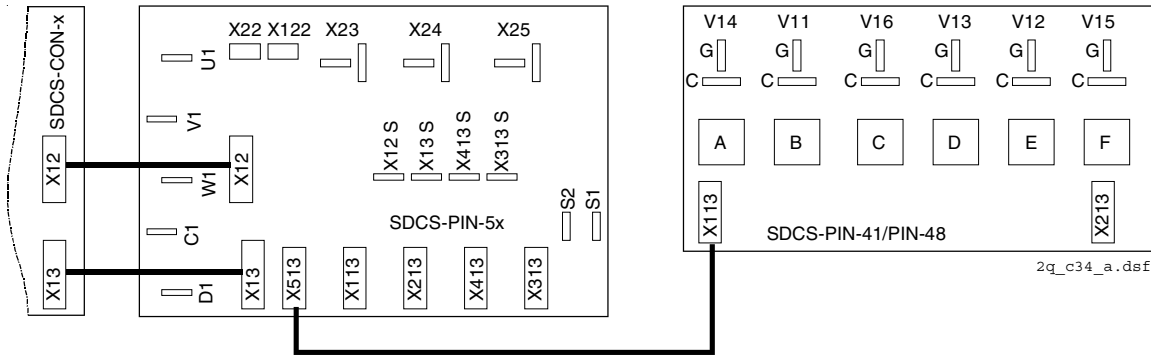
Fig. 5.4/1   **2-Quadrant** application, no parallel thyristors - Construction type **A5/A6/A7 (C4)**
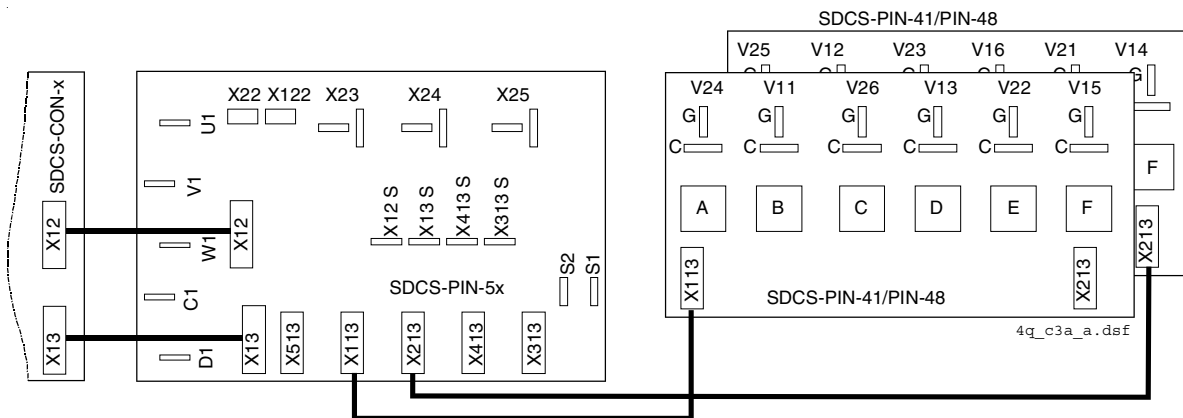
Fig. 5.4/2   **4-Quadrant** application, no parallel thyristors - Construction type **A5/A6/A7**
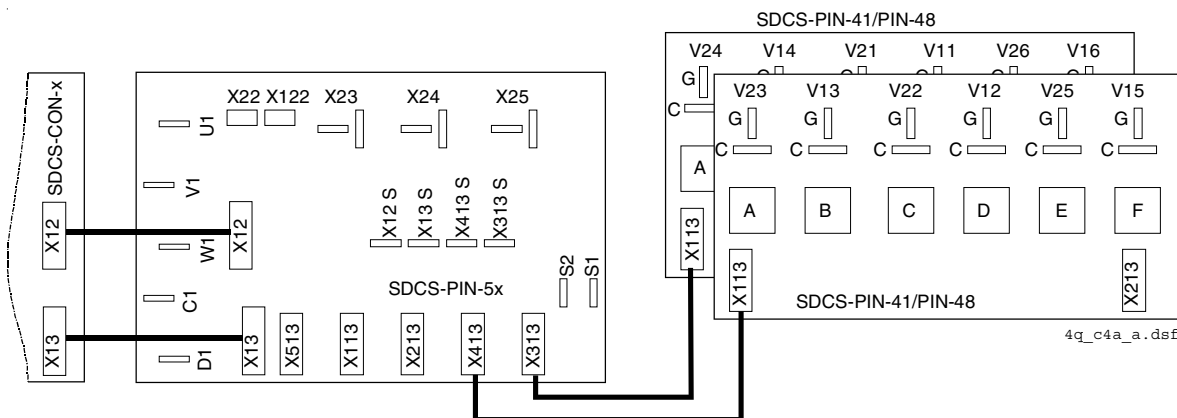
Fig. 5.4/3   **4-Quadrant** application, no parallel thyristors - Construction type **C4**

Pulse transformer board SDCS-PIN-41/PIN-41A/PIN-48
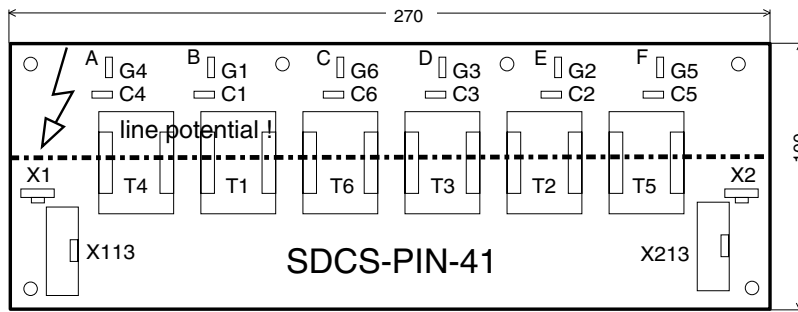
The board consists of six pulse transformers with amplifiers.

Fig. 5.4/4   Layout of the SDCS-PIN-41/PIN-41A/PIN-48 pulse transformer board

Measuring board SDCS-PIN-51
This board is always used together with SDCS-PIN-41 board. On this board there are the circuits located needed for current, voltage and temperature measuring and for hardware coding.

The current is measured by current transformers at the main AC inputs, rectified by a diode bridge and scaled with burden resistors to 1.5 V as rated current. The nominal current is adjusted by cutting out resistors (R1 ... R21) from the board according to the current coding table. The resistors R22 ... R26 are used for the current equal to zero detection. These resistors must be cut off too, according to the current coding table.

Voltages (U1, V1, W1 and C1(+) and D1(-)) are measured by using high ohm resistor chains. Scaling of AC and DC voltage is done by activating

1 MΩ resistors (= cutting out short circuit wires, which are represented by low ohmic resistors). The voltage measurement uses 5 resistor:

U1:	W1	to W5
V1:	W6	to W11
W1:	W12	to W16
C1(+):	W17	to W21
D1(-):	W22	to W26

If there is a need for voltage adaptation, all 5 chains must be handled in the same way.

> **Note!** Actual voltage signals U1, V1, W1, C1(+) and D1(-) of the main circuit are not galvanically isolated from the control board. Because of that a current of less than 1 mA will flow to earth.

When galvanically isolated measurement is needed, please contact your ABB representative.
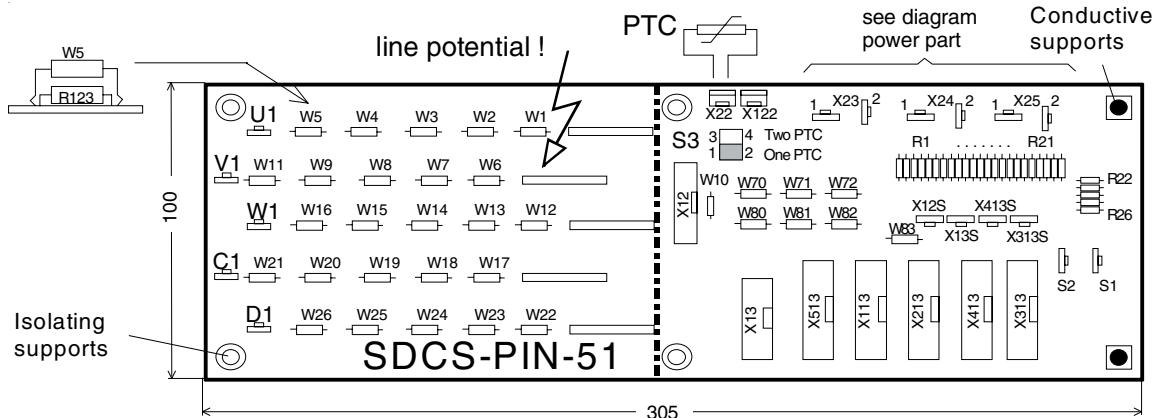
Fig. 5.4/5   Layout of the SDCS-PIN-51 board
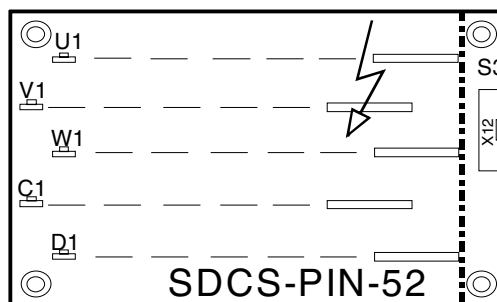
In the past some converters for line voltages lower/equal 500 V had been equipped with SDCS-PIN-52 boards. The SDCS-PIN-51 board serves as a spare part for those converters.

Figure 5.4/6   Layout of the SDCS-PIN-52

III 5-10

Current coding

Construction type		A5				A6				A7					
Current transf. ratio		2500:1				2500:1				4000:1					
Rated current [A]		900	1200	1500	2000	1900	2050	2500	3000	2050	2600	3300	4000	4800	5200
R1-R4	18 Ω	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○
R5	18 Ω	○✕○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○
R6	18 Ω	○✕○	○✕○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○
R7	18 Ω	○✕○	○✕○	○—○	○—○	○—○	○—○	○—○	○—○	○✕○	○—○	○—○	○—○	○—○	○—○
R8	18 Ω	○✕○	○✕○	○✕○	○—○	○—○	○—○	○—○	○—○	○✕○	○✕○	○—○	○—○	○—○	○—○
R9	18 Ω	○✕○	○✕○	○✕○	○—○	○—○	○—○	○—○	○—○	○✕○	○✕○	○—○	○—○	○—○	○—○
R10	18 Ω	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○—○	○—○	○✕○	○✕○	○✕○	○—○	○—○	○—○
R11	18 Ω	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○—○	○—○	○✕○	○✕○	○✕○	○—○	○—○	○—○
R12	18 Ω	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○—○	○—○	○✕○	○✕○	○✕○	○—○	○—○	○—○
R13	18 Ω	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○—○	○✕○	○✕○	○✕○	○✕○	○—○	○—○
R14	18 Ω	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○—○	○✕○	○✕○	○✕○	○✕○	○—○	○—○
R15	18 Ω	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○—○
R16	18 Ω	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○
R17	33 Ω	○✕○	○—○	○✕○	○—○	○✕○	○—○	○✕○	○—○	○✕○	○—○	○—○	○✕○	○—○	○—○
R18	68 Ω	○—○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○—○	○—○	○✕○	○✕○	○✕○	○✕○
R19	120 Ω	○✕○	○—○	○—○	○✕○	○—○	○—○	○—○	○✕○	○—○	○—○	○—○	○✕○	○✕○	○✕○
R20	270 Ω	○—○	○—○	○—○	○—○	○—○	○—○	○✕○	○—○	○—○	○—○	○✕○	○—○	○✕○	○—○
R21	560 Ω	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○—○	○✕○	○✕○	○✕○	○—○	○—○	○✕○	○✕○
R22	47 Ω	○—○	○—○	○—○	○—○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○—○
R23	47 Ω	○✕○	○✕○	○—○	○—○	○✕○	○✕○	○—○	○—○	○✕○	○✕○	○✕○	○—○	○—○	○—○
R24	47 Ω	○✕○	○✕○	○✕○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○
R25	47 Ω	○✕○	○✕○	○✕○	○✕○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○	○—○
R26	100 Ω	○✕○	○—○	○✕○	○—○	○—○	○—○	○—○	○✕○	○✕○	○✕○	○—○	○✕○	○—○	○✕○

Rows R1–R21: Rated current scaling. Rows R22–R26: Zero current detection.

code_tab_PIN1_PIN20_PIN51_d.dsf

Voltage coding

Construction type	A5		A6 / A7				A7	A7
Conv. nom. voltage [V] ①	Y=4 (400V) Y=5 (500V)	Y=6 (600V) Y=7 (690V)	Y=4 (400V) Y=5 (500V)	Y=6 (600V)	Y=7 (690V)	Y=8 (790V)	Y=9 (1000V)	Y=1 (>1000V)
Value f. conv. nom. volt at SET(TINGS) block	0 = HW type coding		500	600	690	800	1000	see chapter Galvanic isolation
Measuring board SDCS	PIN-51	PIN-51	PIN-51	PIN-51	PIN-51	PIN-51	PIN-51	
W1, 6, 12, 17, 22	○—○	○✕○	○—○	○✕○	○✕○	○✕○	○✕○	
W2, 7, 13, 18, 23	○—○	○✕○	○—○	○—○	○✕○	○✕○	○✕○	
W3, 8, 14, 19, 24	○—○	○—○	○—○	○—○	○—○	○✕○	○✕○	
W4, 9, 15, 20, 25	○—○	○—○	○—○	○—○	○—○	○—○	○✕○	
W5, 11, 16, 21, 26							○✕○	

① the converters can be used at lower line voltage then specified by the y-value without hardware modifications, if the nominal line voltage applied to the converter is not lower than 45% for y=5...9 and not lower than 55% for y=4.

HW type coding

Construction type	A5						A6 / A7
Current [A]	1200	1500	2000	900	1500	2000	>2000 *
Voltage max. [V]	500	500	500	600/690	600/690	600/690	all *
W70	○—○	○—○	○—○	○—○	○—○	○—○	○—○
W71	○✕○	○✕○	○✕○	○✕○	○✕○	○✕○	○—○
W72	○—○	○—○	○—○	○—○	○—○	○—○	○—○
W80	○—○	○✕○	○—○	○—○	○✕○	○✕○	○—○
W81	○—○	○—○	○✕○	○—○	○—○	○✕○	○—○
W82	○—○	○—○	○—○	○✕○	○✕○	○✕○	○—○
W83	○—○	○—○	○—○	○—○	○—○	○—○	○—○

* see Software description

Temp. sensor coding

R 57 as a temp. sensor for A5, A6, A7

S3: 4 ○   ○ 3 / 2 ○—○ 1

2 Q - 4 Q coding

	2-Q	4-Q
W10	○✕○	○—○

○✕○ indicates a removed jumper

Table 5.4/1   Settings of the SDCS-PIN-51 board if a DCS converter is equipped with it by ABB

Board used as a spare part:
- default: all jumpers Wxx, Rxx are in ○—○ condition
- ensure the correct converter type related settings
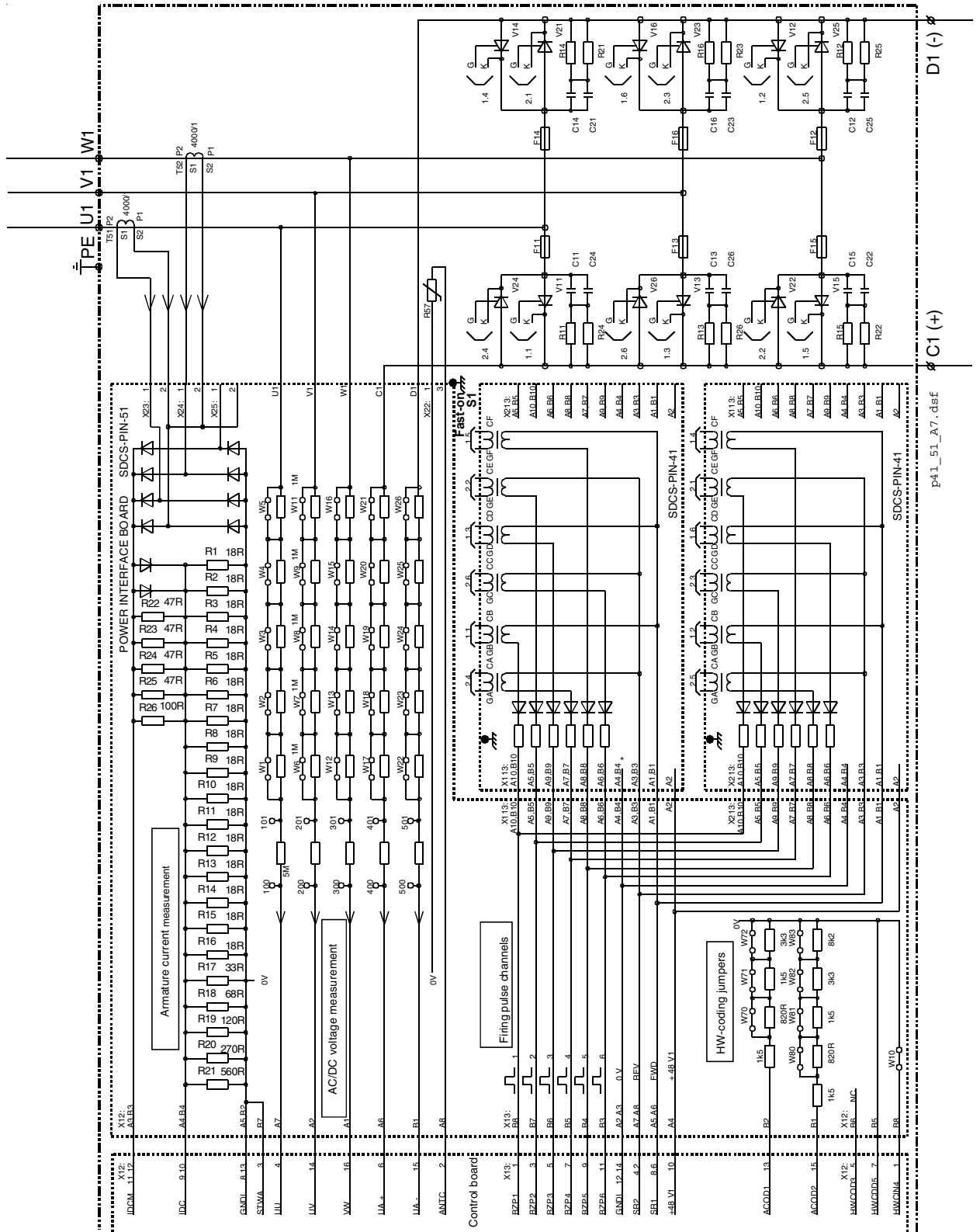
III 5-11

Fig. 5.4/7   Typical armature circuit thyristor converter diagram with SDCS-PIN-41
              and SDCS-PIN-51 boards for a 4-Q A7 type converter

III 5-12

5.5 Zero current detection SDCS-CZD-01A

This board is used for fast zero current detection especially for three phase field converter in **M**otor **G**enerator application. The board provides a safe zero current detection also for other very high inductive loads.

The board is located on SDCS-CON-2 board and plugged on X12, X13 and X17.
X17: is only used for mechanical reasons. The electrical function (connection to IOE-1) is unchanged.

All DCS/DCF converter are equipped with a zero current detection by monitoring the current signal to a certain level.

The CZD-01A board has in addition a cathode / anode voltage measurement of all thyristors. The voltage measurement provides a sharp detection of DC load condition.

Basically two conditions need to be fulfilled to get a signal current equal to zero:
• the current detection has to indicate current equal to zero AND
• the voltage detection has to indicate current equal to zero

The activation of the board must be set in the software via parameter:

| DCF500B | 4.19 | ZERO CUR DETECT |
| DCF600 | 43.14 | ZERO CUR DETECT |
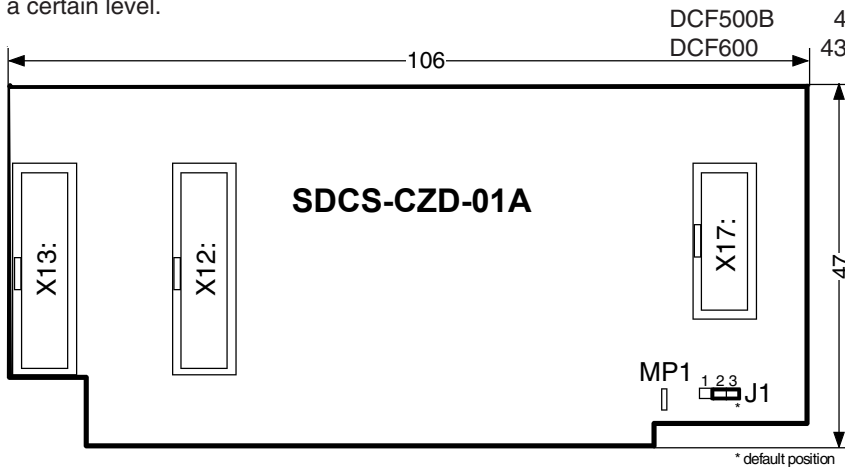
Fig. 5.5/1 Layout of the SDCS-CZD-01A board

With jumper J1 (not available with SDCS-CZD-01) the voltage detection can be set to two modes:
with J1 in position 1-2:
    all thyristors (V11/V13/V15) AND all thyristors (V12/V14/V16) must have blocking voltage
with J1 in position 2-3 (parking; default)
    all thyristors (V11/V13/V15) OR all thyristors (V12/V14/V16) must have blocking voltage
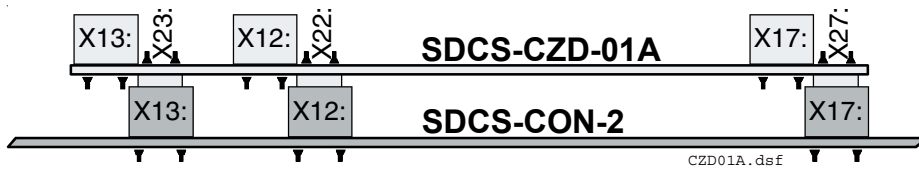
Fig. 5.5/2 Connection between the SDCS-CZD-01A and SDCS-CON-2 board
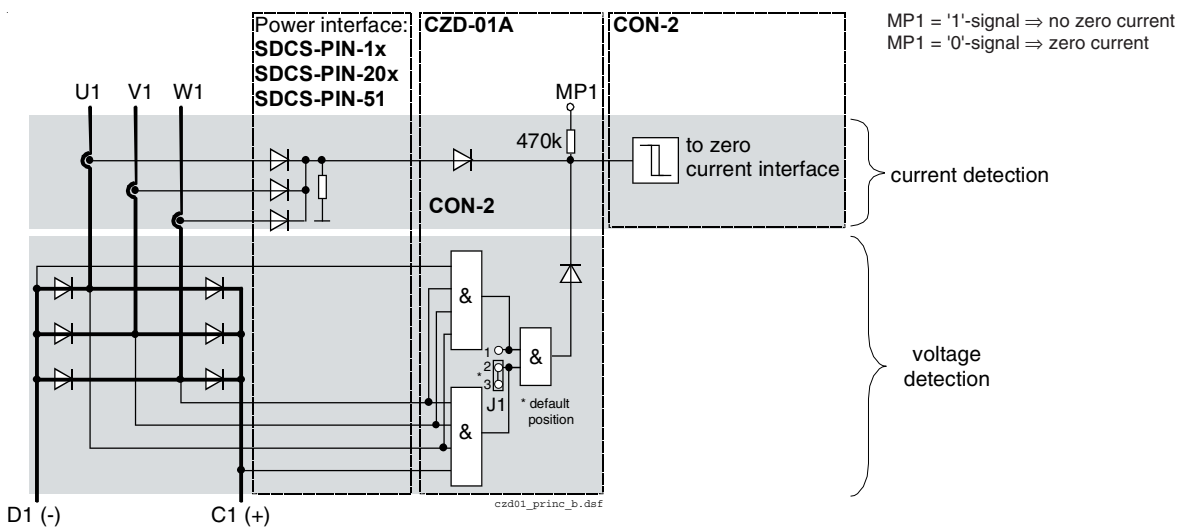
Fig. 5.5/3 Principle diagram of SDCSCZD-01A

III 5-13

5.6   Power signal measurement board SDCS-MP-1

The power signal measurement board SDCS-MP-1 is intended to be used as a service and rebuild (DCR 500 /DCR 600 commissioning) aid. Without this board it is practically impossible to measure with oscilloscope or with general purpose meter signals between the control board and the power interface board(s).

The board is plugged to the control board connectors X12, X13 and X17. The ribbon cables normally connected to the control board are connected to the measurement board connectors having the same name as the respective connector on the control board.
Measurement points for following signals are provided:
- the three phase to ground voltages U_U, U_V, U_W
- the three phase to phase voltages U_{VU}, U_{WV}, U_{UW}

- one rectified and filtered phase to phase voltage U_{AC}
- armature voltage U_{DC} with sign filtered
- armature current I_{ACT} with sign
- the six thyristor firing commands BZP1...BZP6
- the two current direction commands SR1 and SR2 (measurement points SR11 and SR21)
- the sum of pulse transformer primary currents can be measured across measurement points SR11-SR12 or SR21-SR22 depending on current direction
- the control board ground 0V.

The measurement points are separated from the control board signals either with 10 kΩ resistors or with operational amplifiers so that accidental short circuits between the measurement points do not affect the converter operation. Measurement point 0V is directly connected to control board ground.
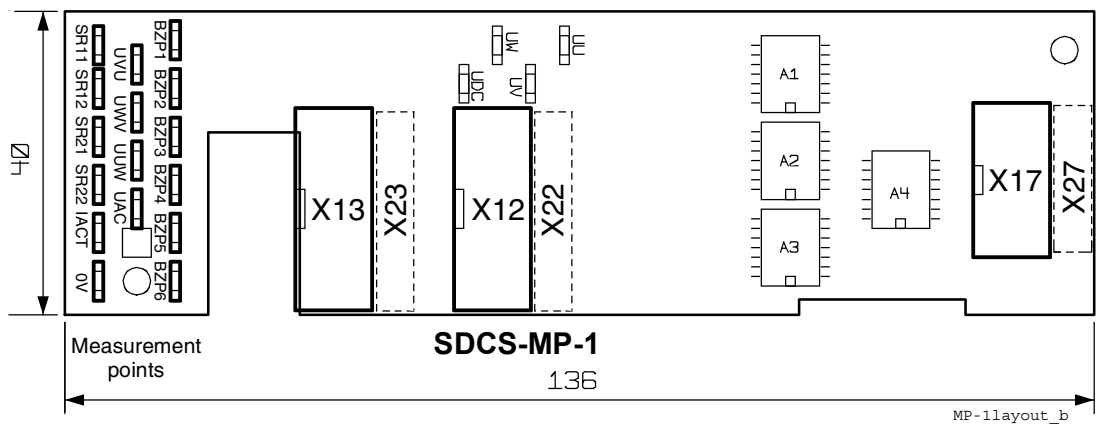
Fig. 5.6/1 Layout of the SDCS-MP-1 board
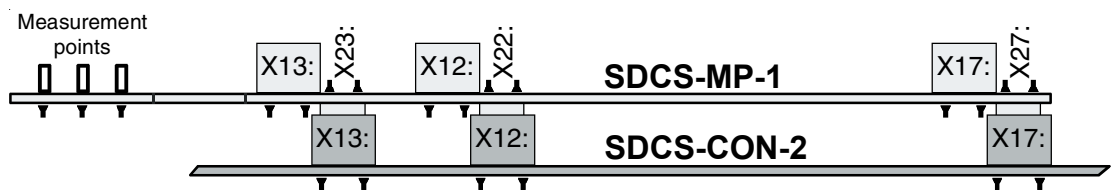
Fig. 5.6/2 Connection between the SDCS-MP-1 and SDCS-CON-2 board

6 Digital and analogue I/O boards

The converter with a control board SDCS-CON-2 can be connected in 4 different ways to a control unit via analogue/digital links. Only one of the four choices can be used at the same time (Description of the I/O's see chapter SDCS-CON-2). These possibilities doesn't increase the number of inputs or outputs. In addition to this an extension of I/O´s by SDCS-IOE-1 is possible, which increases the number of inputs.
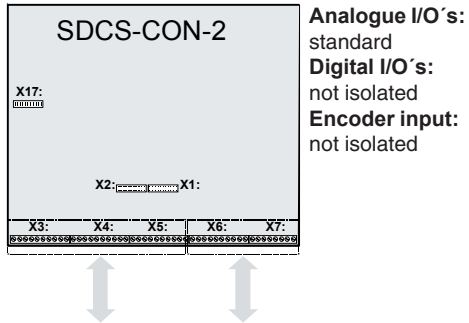
Analogue I/O´s:
standard
Digital I/O´s:
not isolated
Encoder input:
not isolated

Fig. 6/1 I/O via SDCS-CON-2
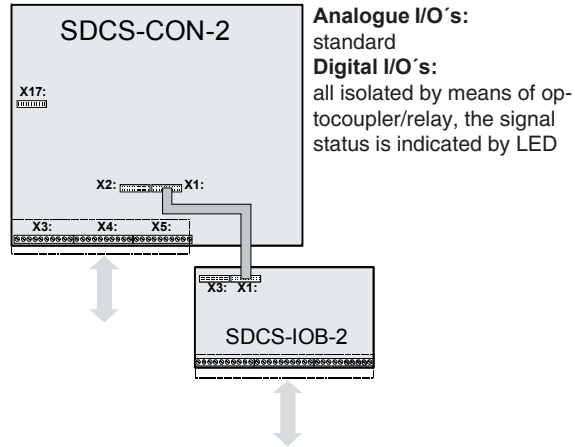
Analogue I/O´s:
standard
Digital I/O´s:
all isolated by means of optocoupler/relay, the signal status is indicated by LED

Fig. 6/2 I/O via SDCS-CON-2 and SDCS-IOB-2
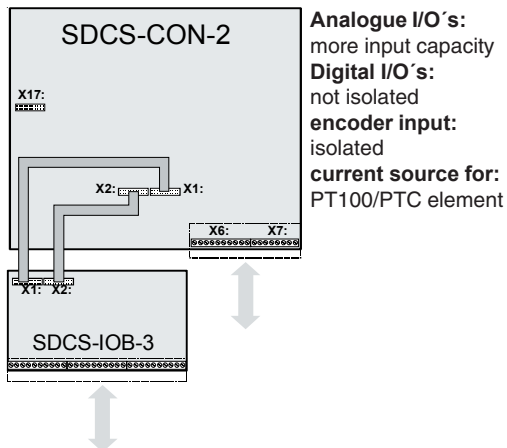
Analogue I/O´s:
more input capacity
Digital I/O´s:
not isolated
encoder input:
isolated
current source for:
PT100/PTC element

Fig. 6/3 I/O via SDCS-CON-2 and SDCS-IOB-3
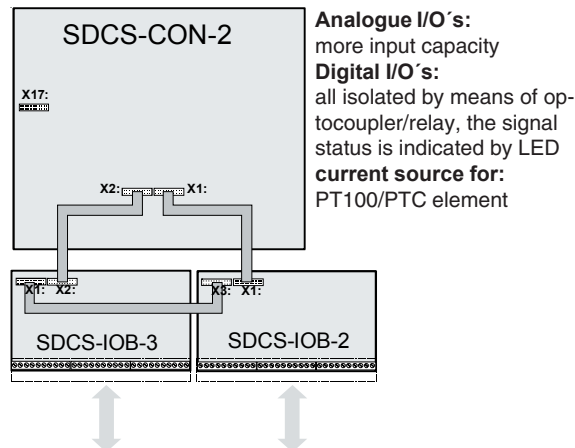
Analogue I/O´s:
more input capacity
Digital I/O´s:
all isolated by means of optocoupler/relay, the signal status is indicated by LED
current source for:
PT100/PTC element

Fig. 6/4 I/O via SDCS-IOB-2 and SDCS-IOB-3

6.1 Digital I/O board SDCS-IOB-2

As described at the beginning of the chapter, there are various options for configuring the inputs/outputs.

The board IOB-2x has 8 digital inputs and 8 digital outputs.
There are three different types existing, which differ at the input voltage level:

SDCS-IOB-21   24...48V DC
SDCS-IOB-22   115 V AC
SDCS-IOB-23   230 V AC

The inputs are filtered and galvanically isolated by using optocouplers. Inputs can form two galvanically separated groups by using either X7:1 or X7:2.

If these boards are in use, they have to be mounted outside the DCS module. They must be mounted in a way, that the conductive supports have a good connection to ground of the installation.
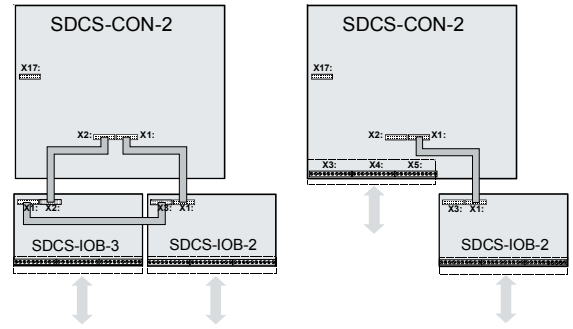
Fig. 6.1/1 I/O via SDCS-IOB-2x / IOB-3 and CON-2

The cable length between X1:/X1: and X2:/X2: is max. 1.7 m and between X1:/X3: is max. 0.5 m because of EMC reasons.
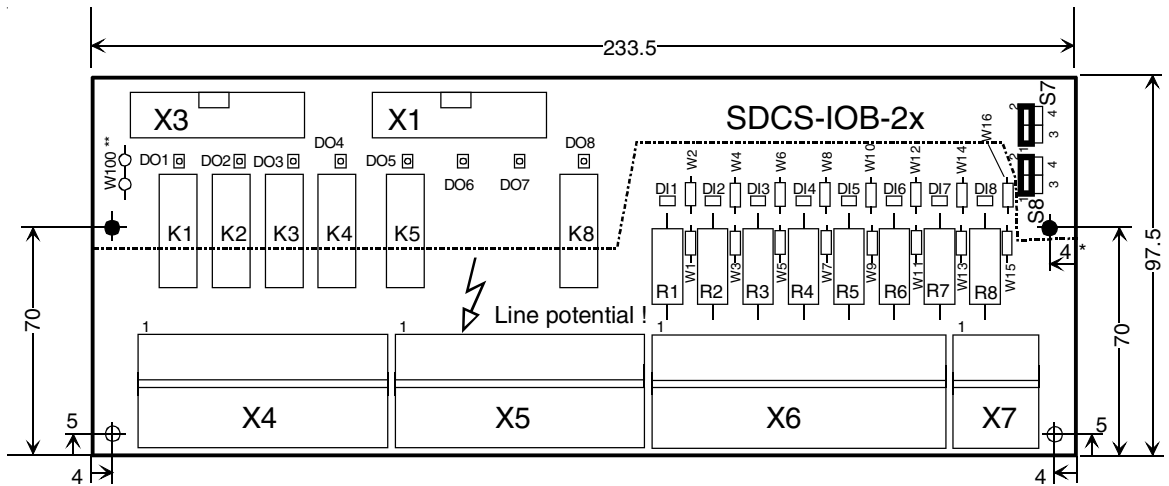
Fig. 6.1/2   Layout and jumper settings of the SDCS-IOB-2x board

SDCS-IOB-2x diagram

X4:1, 2 — K1 — DO1
3, 4 — K2 — DO2
5, 6 — K3 — DO3
7, 8 — K4 — DO4

X5:1, 2 — K5 — DO5
3, 4 — 66V — DO6
5, 6 — 66V — DO7
7, 8 — K8 — DO8

X6:1 — R1, 681, 100n, DIx, 681 — DI1
2 — W1 W2, R2 — DI2
3 — W3 W4, R3 — DI3
4 — W5 W6, R4 — DI4
5 — W7 W8, R5 — DI5
6 — W9 W10, R6 — DI6
7 — W11 W12, R7 — DI7
8 — W13 W14, R8 — DI8
— W15 W16

X7:1
2 — up to revision D
3 — from revision E on — W100, +48V
4 — conductive support

Software

iob2x2_b.dsf

Output value	Signal definition by	Remarks
K1...K5, K8	Software	potential-isolated by relays (NO contact element) Contact ratings: **AC**: ≤250 V~/ ≤3 A~ **DC**: ≤24 V-/ ≤3 A- or ≤115/230 V-/ ≤0.3 A-) MOV-protected (275 V)
K6,7	Software	potential-isolated by optocoupler Switching capacity: ≤50 mA external voltage: ≤24 V-

X4:, X5: are screw-clamp terminal types for leads up to 4 mm² cross-sectional area.
Default values are shown within the software diagrams.
The ground potential of the digital outputs may vary within ±100 V to each other.

Input value	Signal definition by	Remarks
Channel 1...8 **IOB-21:** 0...8 V 18...60 V **IOB-22:** 0...20 V 60...130 V **IOB-23:** 0...40 V 90...250 V	Software	potential-isolated by optocoupler **(24...48V-)** R1...R8 = 4.7 kΩ $\hat{=}$ "0 signal" $\hat{=}$ "1 signal" **(115V~)** R1...R8 = 22 kΩ $\hat{=}$ "0 signal" $\hat{=}$ "1 signal" **(230 V~)** R1...R8 = 47 kΩ $\hat{=}$ "0 signal" $\hat{=}$ "1 sig." including tolerance; absolute max values

X6: / X7: are screw-clamp terminal types for leads up to 4 mm² cross-sectional area
Input resistance: see diagram.
Input smoothing time constant: see diagram.
Smoothing time constant of channel 7 and 8 can be changed; see fig. 6.1/2.
The functionality of the input channels, which will be read, can be defined by software; default values are shown within the software diagrams
Power supply for digital inputs: 48V / ≤ 50mA; not galv. isolated from the DCS electronics!

If the inputs are supplied from the internal +48 V (X7:3 and/or X7:4) a connection must be done from either X7:1 and/or X7:2 to ground of the DCS 500 module. In default condition ground is identical to the converter's frame.

If the inputs are supplied by any external source (+48 V DC, 115 V AC or 230 V AC) the neutral line / - line must be connected to either X7:1 or X7:2. If the inputs should be controlled with the same voltage level, but from two different voltage sources, having probably two different ground levels, the first neutral line should be connected to X7:1 and the second to X7:2. In this case the jumpers Wx connecting the inputs to X7:2, but controlled by the source, connected to X7:1, must be cut off.
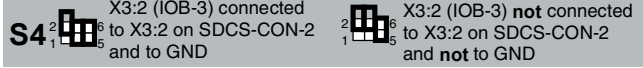The same method is needed for the other jumpers Wx.

High frequency grounding is done by 100 nF capacitor.

Fig. 6.1/3 Terminal connection of the SDCS-IOB-2x board

III 6-3

6.2 Analogue I/O board SDCS-IOB-3

As described at the beginning of the chapter, there are various options for configuring the inputs/outputs.

The board SDCS-IOB-3 consists of the 5 analogue inputs, 3 analogue outputs, the galvanical isolated pulse encoder interface and a current source for temperature measuring devices.

If these boards are in use, they have to be mounted outside the DCS module. They must be mounted in a way, that the conductive supports have a good connection to ground of the installation.

The cable length between X1:/X1: and X2:/X2: is max. 1.7 m and between X1:/X3: is max. 0.5 m because of EMC reasons.

Fig. 6.2/1 I/O via SDCS-IOB-2x / IOB-3 and CON-2

Fig. 6.2/2   Layout and jumper settings of the SDCS-IOB-3 board

III 6-4

Note:
When the SDCS-CON-2 control board with the SDCS-IOB-3 I/O board is installed, the connection via plugs S4:1-2 and 3-4 on the SDCS-CON-2 must be treated according to the diagram below:

S4 — X3:2 (IOB-3) connected to X3:2 on SDCS-CON-2 and to GND

X3:2 (IOB-3) **not** connected to X3:2 on SDCS-CON-2 and **not** to GND

Terminals X3:, X4: and X5: on the SDCS-CON-2 must not be used.

	Reso-lution [bit]	Input/output values Hardware	Scaling by	Power	Common mode range	Remarks
AITAC	12 + sign	-10...0...+10 V	Software		±20 V	① ② ③ ⑥
AI1	12 + sign	-10...0...+10 V	Software		±20 V	① ② ③
AI2	11 + sign	-10...0...+10 V	Software		±40 V	① ② ③ ④ ⑤
AI3	11 + sign	-10...0...+10 V	Software		±40 V	① ② ③ ④ ⑤
AI4	11 + sign	-10...0...+10 V	Software		±40 V	① ② ③⑦
AO1	11 + sign	-10...0...+10 V	Software	≤5 * mA		
AO2	11 + sign	-10...0...+10 V	Software	≤5 * mA		
+/- I-act	analogue	-10...0...+10 V	R 110	≤5 * mA		gain: 0.5...5
+10V				≤5 * mA		for external use
-10V				≤5 * mA		e.g. reference pot.
1.5 mA		1.5 mA				Curr. source for PTC
5 mA		5 mA				Curr. source for PT100

Encoder supply		Remarks
		Inputs isolated; Impedance = 120 Ω, if selected max. frequency ≤300 kHz
		Sense lines for GND and supply to correct voltage drops on cable (only if 5V/12V enc. is in use)
5V/ 12V/24V	≤0.25 A * ≤0.2 A *	Incremental encoder power supply

iob3x2_e.dsf

① total smoothing time ≤2 ms
② -20...0...+20 mA by setting S1
③ 4...20 mA by ② + Software function
④ -1...0...-1 V by setting S2/S3 (CMR ±10 V)
  -2...0...-2 mA by setting S2/S3 + S1 (CMR ±10 V)
⑤ designated for PT100 evaluation per software and hardware
⑥ If the input is used for tacho feedback and the tacho voltage needs to be scaled, the board PS5311 must be ordered separate. If this input is used for feedback signals, there is a need for additional margin for overshoot measurement. This margin is set by software and results e.g. in the 8 to 33 volts at PS5311.
* short circuit proof

⑦ **Residual current detection** is selected as default. The jumpers S1:11-12 and S1:13-14 are set, inputs X3:9 and X3:10 and jumper S1:9-10 must not be used and inputs X3:11 and X3:12 serve as input for the current signal taken from a current transformer. This detection is based on a sum current transformer where the secondary is connected through a diode bridge to 100 Ω resistor . Voltage will appear across the resistor, if the sum of the 3-phase current is not zero. In case AI4 should be used for a different purpose, use the inputs/jumpers accordingly and take the block diagram as a help.

Restrictions using jumper S1, S2 or S3:
The selection for the burden resistor across the input terminals can be done independent from S2 or S3 settings for inputs AITAC, AI1, AI2, AI3 and AI4.
If the gain is set to 10 by using S2 or S3 and the 500 Ω burden resistor is activated, the input signal level is changed to -2 mA...0...+2 mA.
For input AI4 there are the following configurations available:
- input range "20mA" , or
- input range "10V", or
- earth fault monitoring by Isum not equal to zero via X3:11 and X3:12

Fig. 6.2/3   Terminal connection of the SDCS-IOB-3 board

III 6-5

Connecting a pulse encoder to the DCS 500B / DCS 600 converter

The connection diagram for a pulse encoder to the electronics of a DCS converter is quite similar, if the SDCS-CON-2 or the SDCS-IOB-3 is used. The basic difference between these 2 boards is the galvanical isolated circuit on the SDCS-IOB-3 board.

Power supply for incremental encoder
There is a galvanically isolated power supply for the incremental encoder on SDCS-IOB-3. The jumper S4 on this board is used to select either +5 V, +12 V or +24 V as a supply voltage for the pulse encoder. When LED indicator (V17) is lit, the supply is OK.

The pulses generated by the pulse encoder are transferred to the pulse receivers via opto couplers.

If the **SDCS-CON-2 board** is used the supply voltage for the pulse encoder is selected on the SDCS-POW-1 board (refer to SDCS-POW-1).

In both cases the voltage regulator has a feedback control with Sense power and Sense GND signals.

Feedback connection is recommended when power supply level for differential pulse encoder is 5V. If a 12 V pulse encoder type is in use the sense function is also available. The wiring is shown on figure 6.2/4.
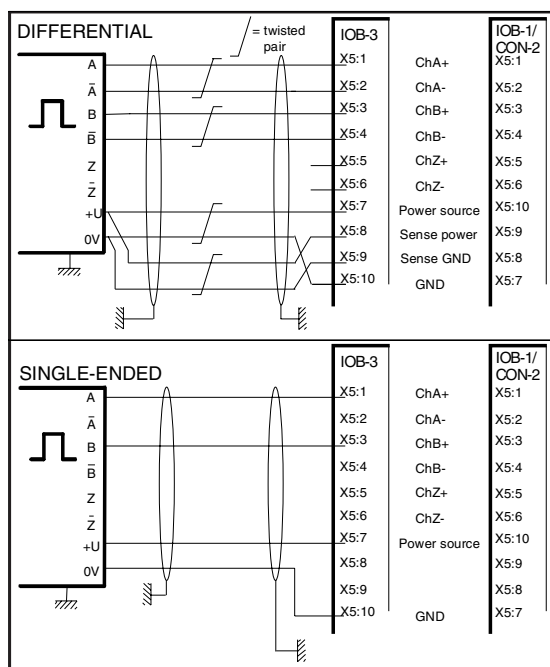
Fig. 6.2/4 Connections incremental encoder - electronics

Note:
If the drive's direction of rotation is correct (if necessary, correct by exchanging the field connections), the *Tacho error* message may appear during start-up.

If with a positive reference the TACHO_PULSES signal (with software 21.xxx: parameter 12104) does not look like the illustration below, then tracks A and Ā must be mutually exchanged with encoders with inverted signals, and tracks A and B with encoders without inverted signals.

If the TACHO_PULSES signal is missing or non-linear, the encoder's pulses are not being read correctly. Possible reasons for this may be the encoder supply, the encoder itself, or the wiring.
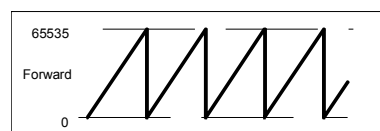
Fig. 6.2/5 TACHO_PULSES signal

III 6-6

Incremental encoder

Two different incremental encoder connections are available.
- differential connection; pulse encoders generating either voltage or current signals can be used
- single-ended (push pull) connection; voltage signals

Restrictions using jumper S1: or S10: depending on the board

Line termination via S1/S10: 2-3 / 8-9 / 14-15 should not be used at 12 V or 24 V encoders, because of the power consumption taken from the encoder. If a pulse encoder with a build in current source is used a burden resistor of 120 Ω is activated via jumper S1/S10: 1-2 a.s.o.

If a single ended 12 V / 24 V encoder is used S1/S10 should be set to 5-6 / 11-12 / 17-18 according to the layouts of the boards. This setting results in an internal threshold of appr. 5 V.

In case of a single ended 5 V encoder the jumpers will be set to a neutral position S1/S10: 4-5 / 10-11 / 16-17. To get a threshold lower than 5 V each terminal X5:2 / X5:4 / X5:6 must be connected via a resistor **R** to GND according to the table below.

R	1 kΩ	1.5 Ω	2.2 kΩ
U $_{thresh}$	1.2 V	1.8 V	2.3 V

Make sure the threshold is half of the supply voltage and the minimum voltage of the encoder output (saturation voltage U_{CE} of a transistor).

Three differential inputs are reserved for connecting the pulse encoder. CH A and CH B are the normal pulse channels having nominal 90° phase shift between the channels.

The channel CH A- (CH B-) is the inversed channel CH A (CH B). CH Z is the zero pulse channel which can be additionally used if the encoder has an output giving one "zero" pulse per revolution.

The distance between pulse encoder and interface board is dependent on the voltage drop on the connecting lines and on the output and input configuration of the used components. If cables are used according to the next table the voltage drop caused by the cable can be corrected by the voltage regulator.

Cable length	parallel wires for power source & GND	Cable used
0 ... 50 m	1x 0.25 mm²	12x 0.25 mm²
50 ... 100 m	2x 0.25 mm²	12x 0.25 mm²
100 ... 150 m	3x 0.25 mm²	14x 0.25 mm²
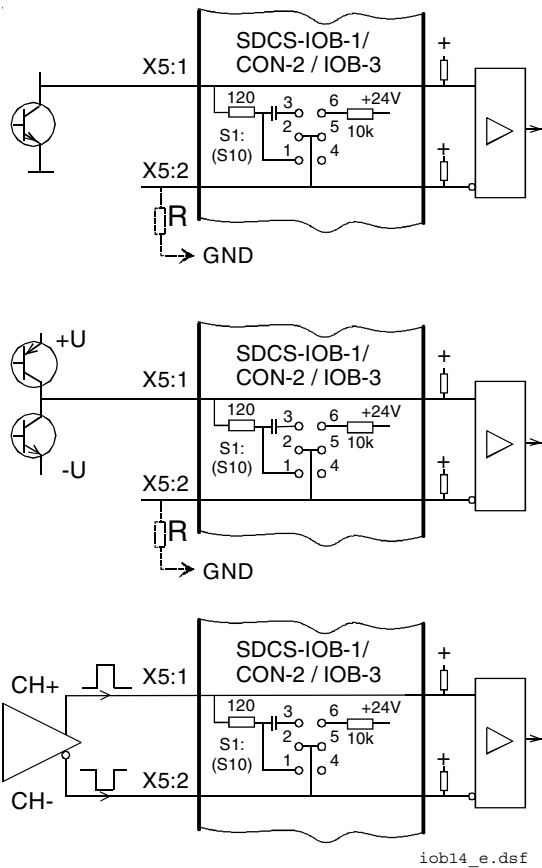
iob14_e.dsf

Fig. 6.2/6   Pulse encoder connection principles

6.3 Extension board SDCS-IOE-1

The board consists of:
  7 isolated digital inputs
  2 analogue inputs
  1 current source for the supply of PTC or PT 100 elements

The board is connected electrically via a 10 pin flat cable to the converter module electronics. The connection will be done to the SDCS-CON-2 board from terminal row X17 to X17 on SDCS-IOE-1. It has to be mounted outside of the converter module. The cable length is 2 m because of EMC reasons.

Mechanical Construction
The board is mounted on a plastic housing which has foot elements (Phoenix Contact series UMK). The foot elements permit snap-in assembly to a standard DIN EN rail (EN 50022, 50035). The dimensions are including the plastic housing.
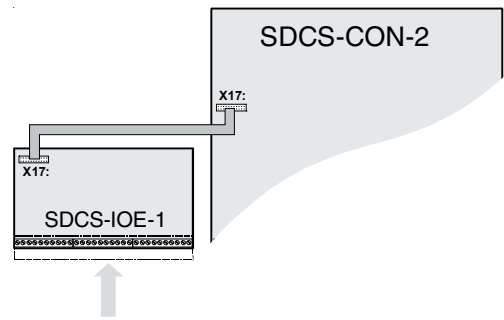
Fig. 6.3/1   Connection of the SDCS-IOE-1 board and the SDCS-CON-2 board.

Fig. 6.3/2   Layout and jumper settings of the SDCS-IOE-1 board

Input value	Signal definition by	Remarks
0...8 V 16...31 V	Software	$\triangleq$ "0" status $\triangleq$ "1" status Two potential isolated groups. Max. operating voltage between the groups and the control board is 50 V Filter time constant for all inputs is 2.2 ms

Reso-lution [bit]	Input/output values Hardware	Scaling by	Power	Common mode range	Remarks
11 + sign	-10...0...+10 V	Software		±40 V	① ② ③
11 + sign	-10...0...+10 V	Software		±40 V	① ② ③ ④
	1.5 mA 5 mA				Curr. source for PTC Curr. source for PT100 absolute accuracy including the control board is 0.7%

① total smoothing time ≤2 ms
② -20...0...+20 mA by setting S1/S2
③ 4...20 mA by ② + Software function
④ -1...0...-1 V by setting S3 (CMR ±10 V)
  -2...0...-2 mA by setting S3 + S2 (CMR ±10 V)

ioe1x1_e.dsf

Fig. 6.3/3   Terminal connection of the SDCS-IOE-1 board

III 6-10

7 Communication boards

7.1 Communication board SDCS-COM-5

This board is used for communications to DCS 500B converter modules equipped with software 21.xxx for commissioning and maintenance purposes. It consists of 3 different communication channels. All RxD channels (receiver) have blue color, all TxD channels (transmitter) have grey color. If any connections should be made always connect the same color with each other (plug and socket) .

Channel 1 is a HDLC channel of 1.5 Mbits/s and is used for the communication with a PC. Channel 2

cannot be used together with software version S21.xxx.

Channel 3 is a DDCS channel of up to 4 Mbits/s and is used if a serial link based on PROFIBUS hardware, CS31 hardware or MODBUS hardware should be realized. If one of these possibilities should be used an adaptation module is needed. This channel can only be used with software version S21.1xx (SDCS_CON-1). Please refer to the documentation which is available for the link system needed.
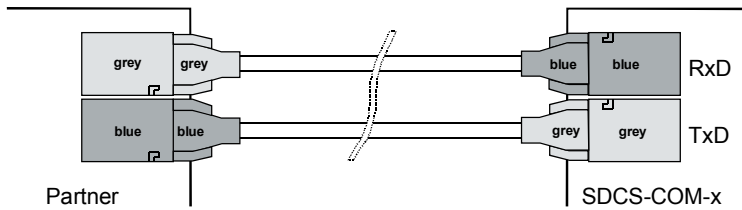
Fig. 7.1/1   Connection between SDCS-COM-x and a partner
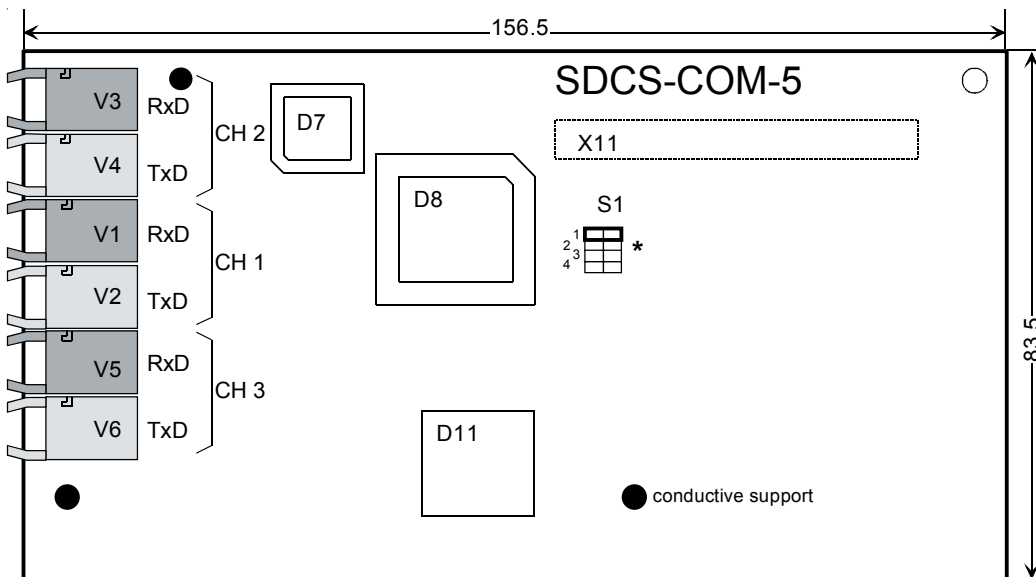
Jumper coding	
Converter number	Coding for channel 2
1	S1 $^1_{2\ 3}_4$ ▦ *
2	S1 $^1_{2\ 3}_4$ ▦
3	S1 $^1_{2\ 3}_4$ ▦
4	S1 $^1_{2\ 3}_4$ ▦
*	default value

Fig. 7.1/2   Layout and jumper settings of the SDCS-COM-5 board

III 7-1

7.2 Control and communication board SDCS-AMC-DC

This board must be used together with a DCS 600 module equipped with a SDCS-CON-2 board including software S15.xxx.

The board is equipped with an own controller with the following main functionalities:
- The software structure implemented in this board is divided in two sections. The first section is built from the speed regulator and its additional functions which is producing the torque reference.
- The second section is prepared to be programmed with its own characteristics for control and regulation.
- Evaluation of the received data to produce a torque reference to be transmitted to the controller board CON-2. Actual values from the CON-2

are read, evaluated and retransmitted to the overriding control.

Furthermore the board is equipped with three optical channels (max. data transmission speed is 4 Mb for each optical channel):
- **Channel 0** is used to communicate data from the overriding control (FCI, APC2, AC80, Nxxx-xx (adapter modules for fieldbus), AC800M) or via adapter modules from other controllers) to the DCS600-drive.
- **Channel 2** (Master-Follower) is used to operate two or more drives dependent on each other. Commands and values needed for this application are produced on this board.
- **Channel 3** is prepared to connect the PC tool for commissioning and maintenance (DriveWindow).
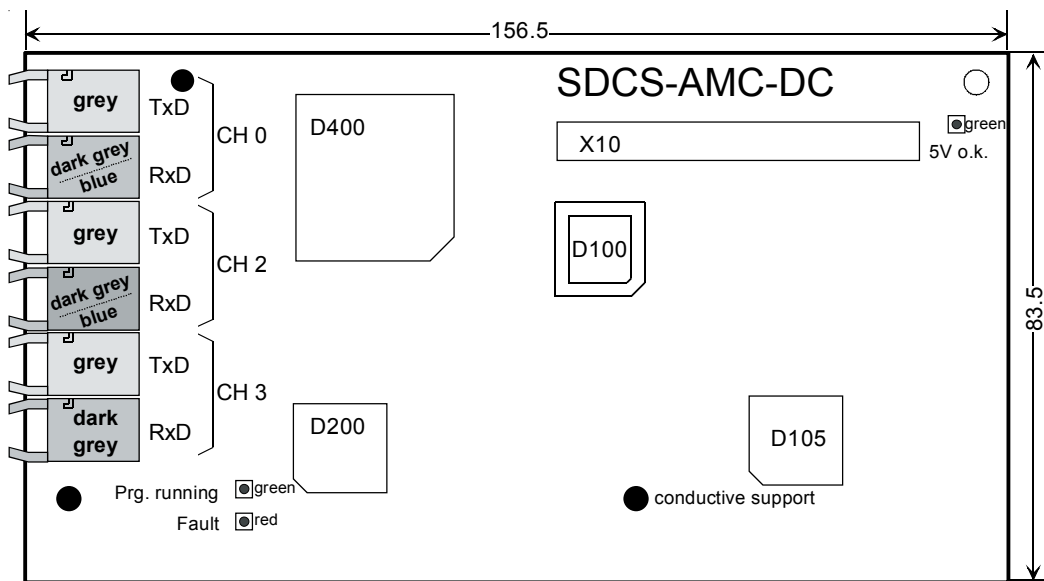
Fig. 7.2/1   Layout of the SDCS-AMC-DC / SDCS-AMC-DC Classic board / AMC-DC Drive Bus

The SDCS-AMC-DC and the SDCS-AMC-DC Classic boards are identical except the assembly of optical components for channel 0 and 2.

| | optical Components | | | Channel 0 used for | D400 | driver current CH0, CH2, CH3 | Communication ** CH0 |
	Ch 0	Ch 2	Ch 3				
SDCS-AMC-DC *	10 Mb	5 Mb	10 Mb	other interfaces	ICMC1	30 mA	DDCS
SDCS-AMC-DC Classic *	5 Mb	10 Mb	10 Mb	Fieldbus adapter modules Nxxx-xx	ICMC1	30 mA	DDCS
SDCS-AMC-DC 2	10 Mb	5 Mb	10 Mb	other interfaces	ICMC2	30/50 mA ***	DDCS/Drive Bus
SDCS-AMC-DC Classic 2	5 Mb	10 Mb	10 Mb	Fieldbus adapter modules Nxxx-xx	ICMC2	30/50 mA ***	DDCS/Drive Bus

* SDCS-AMC-DC 2, SDCS-AMC-DC Classic 2 are direct replacements of SDCS-AMC-DC and SDCS-AMC-DC Classic
** see additional parameter [71.01]

Color of optical components:
*** 5 Mb $\Rightarrow$ blue   maximum 30 mA
*** 10 Mb $\Rightarrow$ dark grey maximum 50 mA

Remark: Only channels with the same components (e.g. 10 Mb component) may be connected to each other.

III 7-2
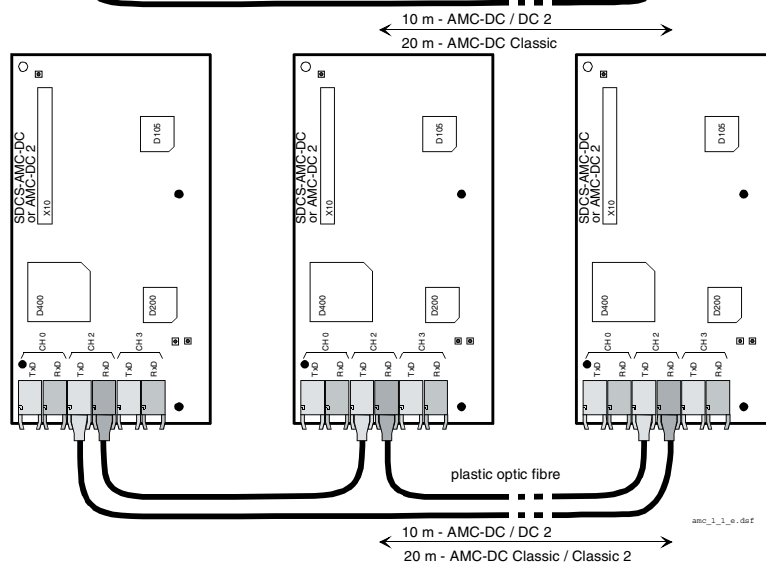
Fig. 7.2/2   Connections at Master-Follower mode

For more configuration possibilities
see publication 3AFE 63988235
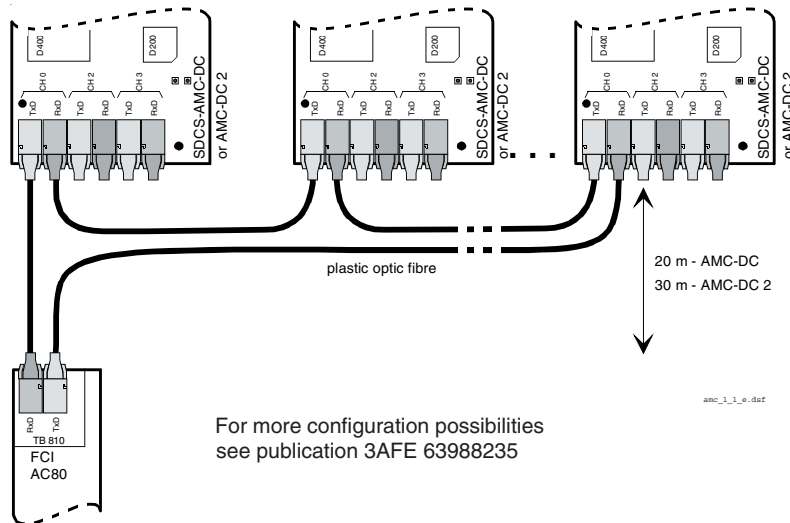
Fig. 7.2/3   Module Bus connections to Advant controllers (ring)
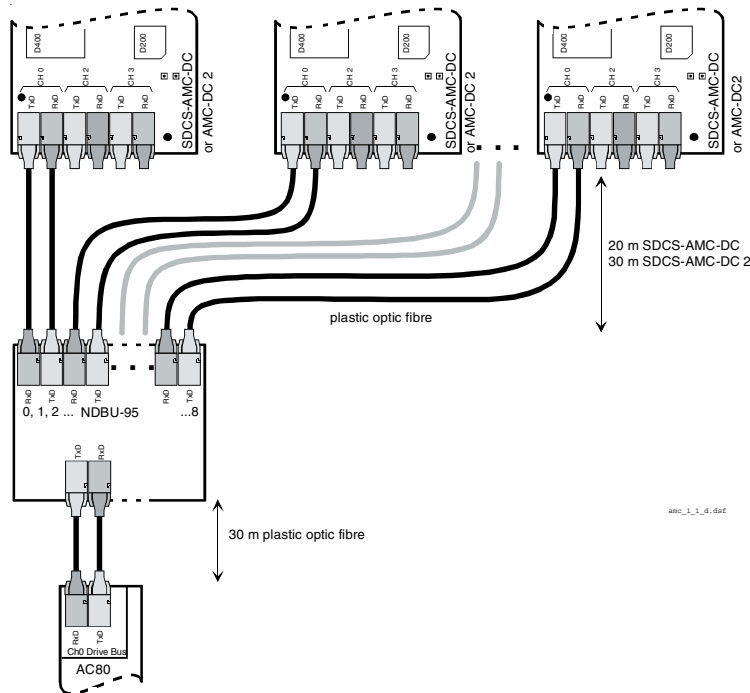
Fig. 7.2/4   Drive Bus connections to Advant Controller 80 (star)
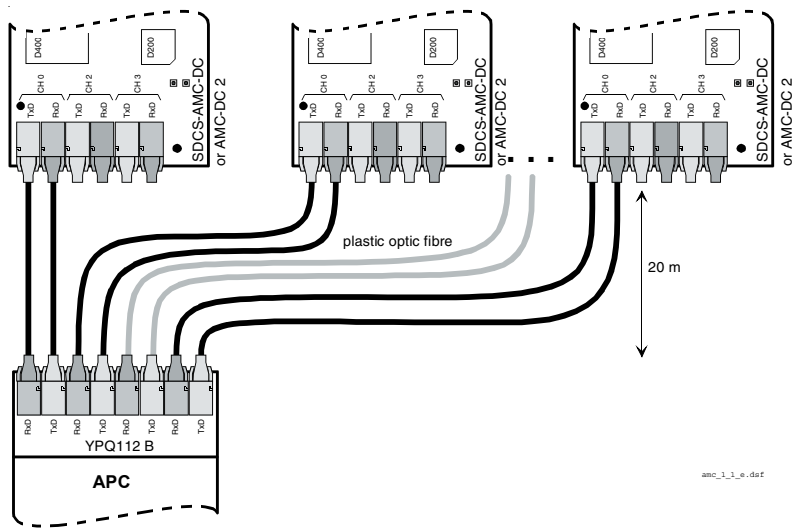
III 7-3
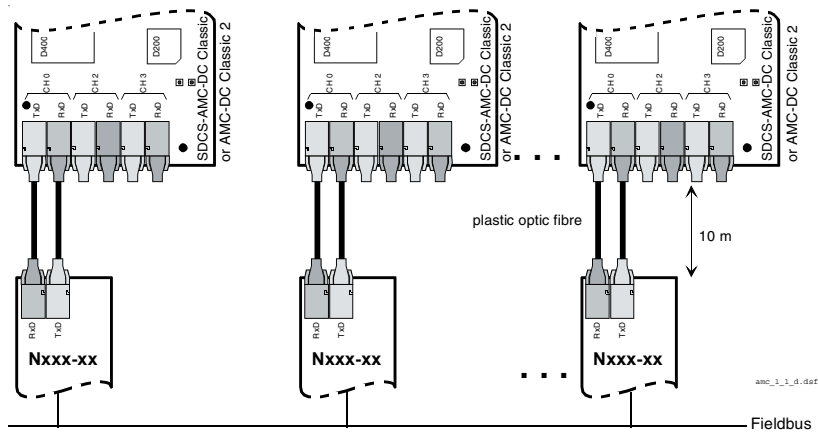
Fig. 7.2/5   Connections to higher-level system (APC)

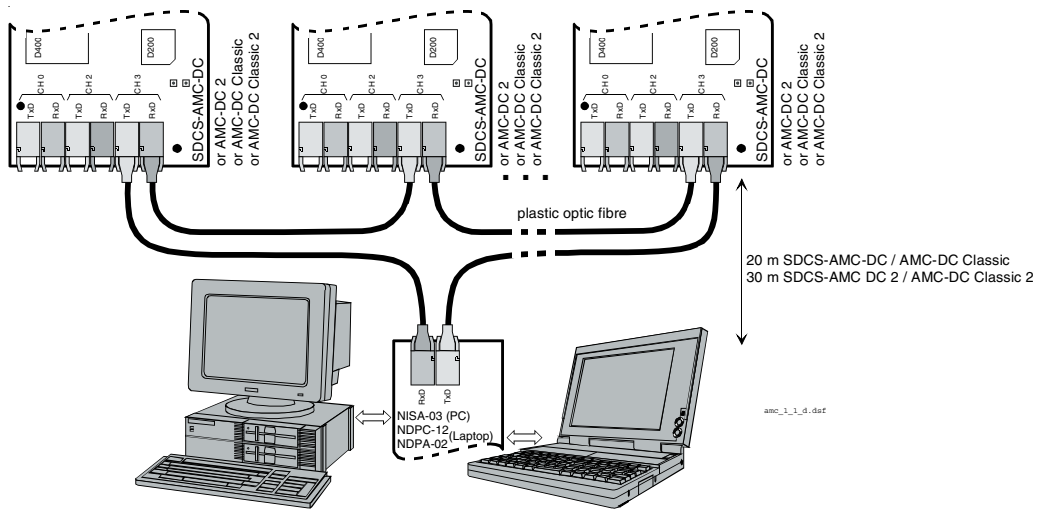Fig. 7.2/6   Connections to higher-level system (Communication modules)

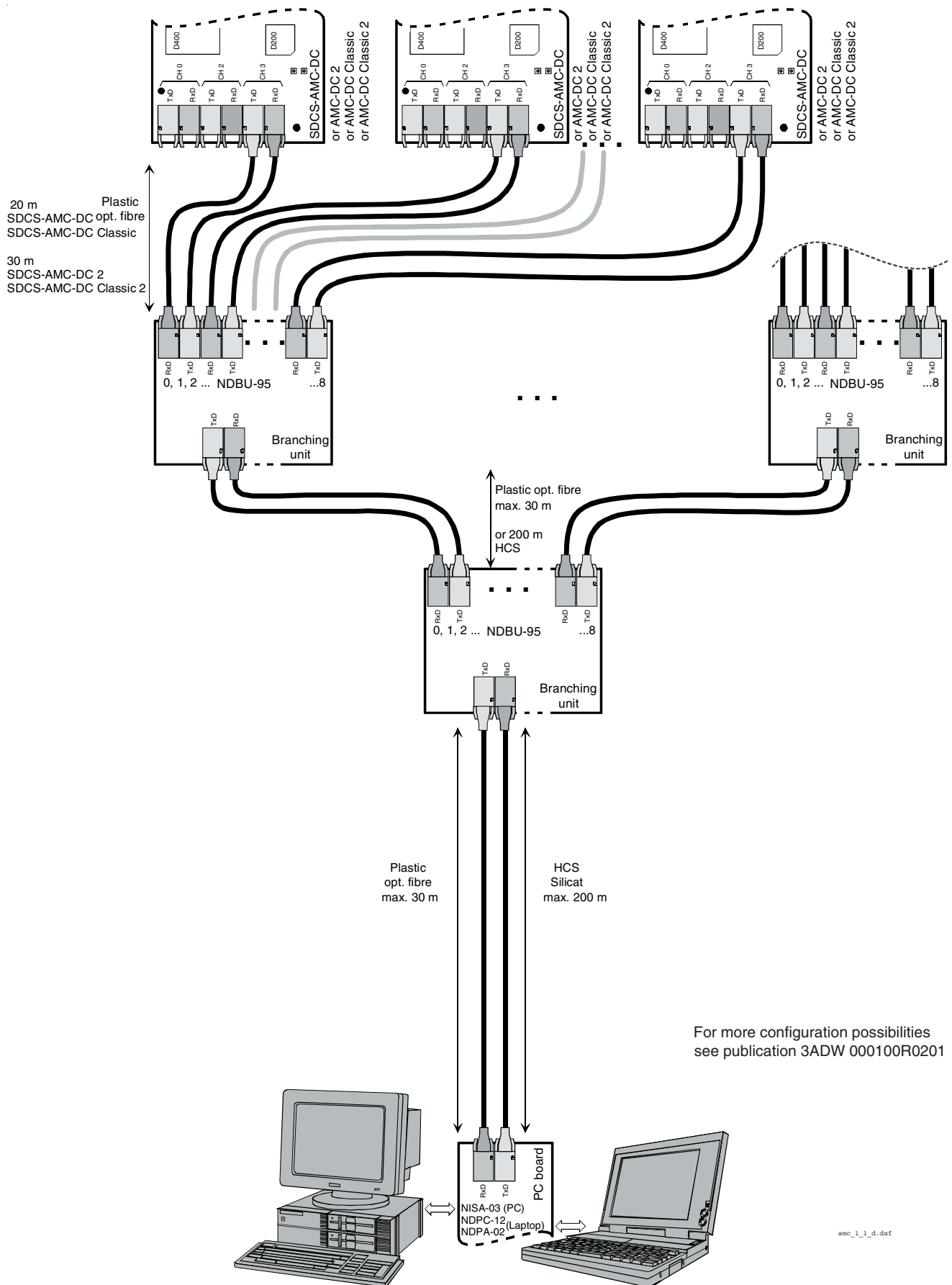Fig. 7.2/7   Connections to PC by ring (with control program **DriveWindow**)

III 7-4

Fig. 7.2/8   Connections to PC by star (with control program **DriveWindow**)

7.3 DDCS Branching unit NDBU-95

DDCS Branching Unit (DBU) is used (only for DCS 600/DCF 600) to implement the star topology of DDCS link. This allows a slave unit to fail or become unpowered without disabling the communication. The NDBU receives messages from the master (PC) and sends them to all the slave units simultaneously. Each slave unit has an individual address and only the addressed slave unit sends a reply message to the master. It is also possible to use NDBU thus enabling peer-to-peer communication.

NDBU-95 DDCS Branching Unit has nine output channels where messages from the master are sent. The reply message sent by one slave unit is delivered to the master and it can be delivered also to other slaves if necessary. Several NDBU-95s can be used in parallel, in series or in any combination of these. The maximum distance between the master and NDBU-95 as well as between two NDBU-95s, see *manual 3ADW000100R0201*.

Technical specifications

Optical links:

Master channels	1 DDCS input and 1 DDCS output
Slave channels	9 DDCS inputs and 9 DDCS outputs
Data rate	1 - 4 MBd, programmable
Driving current	20 mA, 30 mA, 50 mA + channel disabling, programmable
Monitoring	a green LED for each channel, switched on when NDBU is receiving messages
Transmission device	10 Mb component for each channel

Power supply:

Input voltage	+24 VDC ± 10%
Input current	300 mA
Monitoring	a green LED switched on when the output voltage is normal

Operating temperature: +0 ... +50 °C
PCB dimensions: s. diagram beside

Remark: Only channels with the same components (e.g. 10 Mb component) may be connected to each other.

For further information see *Appendix D in the DriveWindow User's Manual*.

Note
For addressing and automatic node numbering of the drives and branching units see *DriveWindow documentaion*.
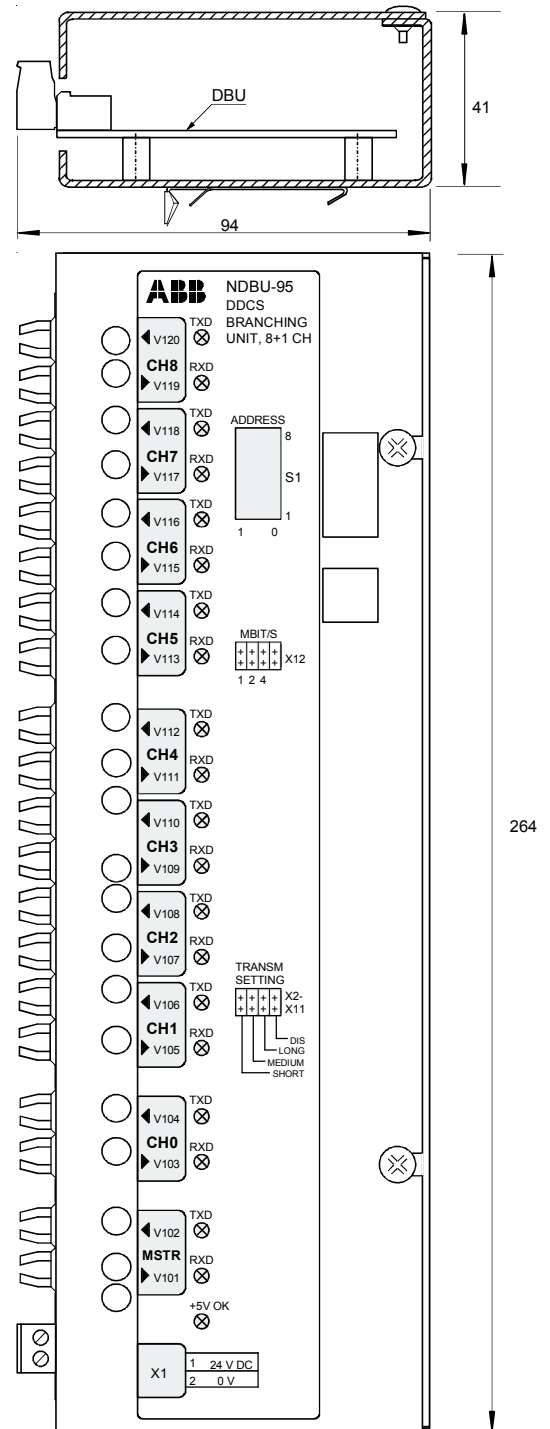
Fig. 7.3/1   Layout of the NDBU-95 branching unit

III 7-6

8   Field exciters

The DCS 500 system has different options for the field supply. There are one and three phase field exciters available, which can be either integrated (diode field exciter SDCS-FEX-1 and half controlled field exciter SDCS-FEX-2A) or externally mounted (half controlled DCF503-0050 with the SDCS-FEX-32 board and fully controlled DCF504-0050 with the SDCS-FEX-31 board).

Three phase field exciters DCF 50xB/60x are converter modules themselves, similar to the DCS 501B/601 or DCS 502B/602 additionally a overvoltage protection unit is needed see chapter 8.4.

8.1   SDCS-FEX-1 (internal)

The Diode Field Exciter board SDCS-FEX-1 is a single phase diode rectifier for an AC input voltage up to 500 V and a DC output current of 6 A. The board has to be mounted inside the armature converter module. The excitation current is defined by the DC output voltage (line voltage multiplied by 0.9) and the resistance of the field winding. By using an external resistor in series with the field winding the field current can be adapted slightly.
If the SDCS-FEX-1 board isn't already installed it must be mechanically fixed beside the electronic power part SDCS-POW-1 and connected via a flat cable to the SDCS-CON-2 by using terminal X14.
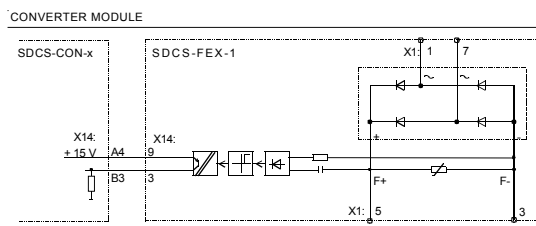
Fig. 8.1/2   Diode field exciter with field loss monitoring

8.1.1 Electrical data of FEX-1

AC input voltage:	110 V -15%...500 V +10%
max. DC output current:	6 A; $I_{F\ rated}$
DC output curr. monitoring:	20 mA...6 A
Power loss at $I_{F\ rated}$:	≤10 W
AC Isolating voltage:	600 V
Terminals X1: Cross sectional area	2,5 mm²

The AC share of the output DC voltage is measured with a capacitor and an auxiliary rectifier and used for current monitoring.
Transistor relay is closed when the DC current is flowing (>0.02 A).
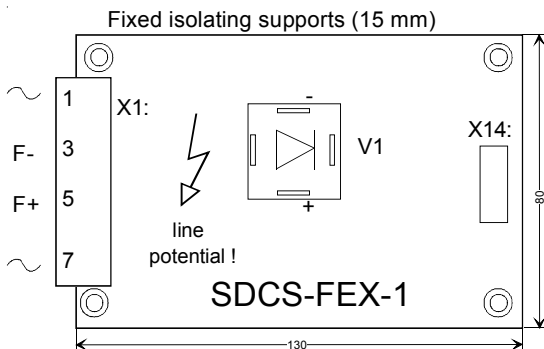
Fig. 8.1/1   Layout of the SDCS-FEX-1 field exciter board

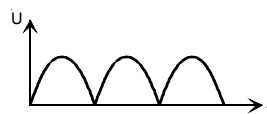
Fig. 8.1/3   Output voltage with inductive or resistive load - **High-signal at X14:B3**
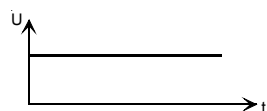

Fig. 8.1/4   Output voltage without load
                    Low-signal at X14:B3

8.2   SDCS-FEX-2 / SDCS-FEX-2A (internal)

The field exciter board SDCS-FEX-2 / FEX-2A consists of a power part and a control board, which connects all components electrically and mechanically to each other. This arrangement has to be mounted inside the armature converter module beside the electronic power supply SDCS-POW-1. This is intended to be done for DCS modules of type C1, C2 and A5, not for A6 and A7 (C4)!

The power part is build up with two power modules. Each of the modules consists of one diode and one thyristor, so they are wired up and controlled like a half controlled bridge.

The control is based on a fully digital system. The μ-processor reads all information from the power part, is supplied with all needed voltage levels and control signals via the flat cable X14 by the SDCS-CON-2 and generates the firing pulses for the power part.

The range of the single phase rated AC input voltage is 110 V to 500 V, the maximum current capability is 16 A. If this field exciter is used for smaller field current, the control unit automatically selects a lower current range between 3 A to 16 A to get the best resolution.
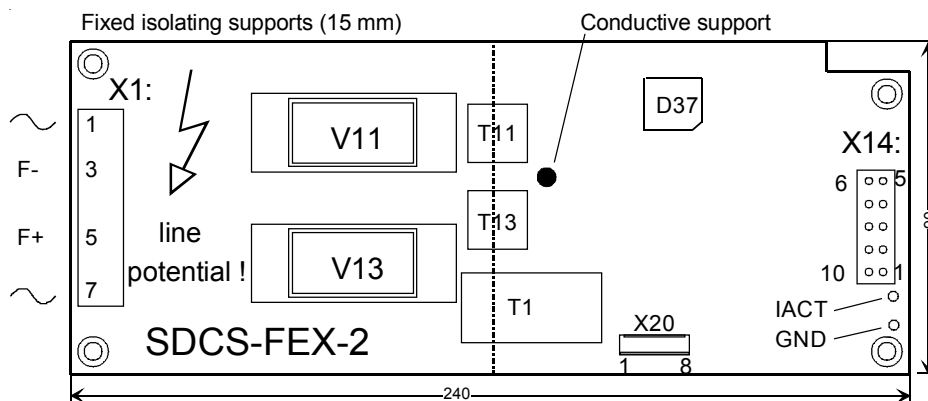
Fig. 8.2/1   Layout of the SDCS-FEX-2A field exciter board

8.2.1 Electrical data of SDCS-FEX-2 / FEX-2A

AC input voltage:	110 V -15%...500 V +10%; single phase
AC input current:	≤ output current
AC isolation voltage:	600 V
Frequency:	same as DCS converter module
DC output current: ①	0.3 A...8 A for armature converter module from 25 A to 75 A
	0.3 A...16 A for armature converter mod. from 100 A to 2000 A
Power loss at $I_{F\,rated}$:	≤40 W
Output IACT:	$U_{out} = 4\ V * I_{act} / I_{lim}$; I_{lim} = 3A, 5A, 7A, 9A, 11A, 13A, 15A, 17A
Terminal X1: Cross sectional area	4 mm²

①   If Field weakening is needed, actual field current of the motor at top speed must be higher than 0.3 A

8.2.2 Control unit

The control unit includes the following main blocks:

- Micro controller 80C198 for controlling and firing
- Actual DC current measurement with an AC current transformer.
- RS485 interface to the converter's controller board SDCS-CON-x.

The software for the field current control is stored in the ROM memory of the 80C198. The control is done by using a PI structure for the current controller. All parameters needed for the control or for scaling reasons (selection of burden resistors) are stored in the non-volatile memory of the armature converter and transferred to the field controller during each initializing process via the RS485 link. The Node number is always fix coded to Node number = 1.

The output Iact represents the actual field current, which is measured via the AC transformer, then rectified and transferred into a voltage signal with burden resistors. The burden resistors, as mentioned before, are adapted by the board itself depending on the setting of the nominal field current of the motor (see list before). The resulting burden voltage can be measured at test terminals beside X14:. The 2.2 KΩ resistor allows a short circuit at the terminals; the external measuring device should have an internal resistance higher than 1MΩ.

The terminal row X20: is used for test purposes.

8.2.3 Power section

Two diode-thyristor modules are arranged as a half-controlled single-phase rectifier. The anodes of the two diodes are not connected directly to each other as usual; they are now connected to the ends of the four turn primary winding of the current transformer. The center tap is the negative output of the rectifier. Thus it is possible to measure the DC current with an AC current transformer.

A MOV (Metal Oxide Varistor) protects the AC input against voltage spikes from the external source. Another MOV protects the DC output against voltage surges which can be caused by the field winding of a DC machine.

Fig. 8.2/2   Block diagram of the field exciter SDCS-FEX-2A

8.3   DCF503A-0050 and DCF504A-0050 (external)

The **half controlled** (2-Q) field exciter unit DCF503A-0050 consists of the SDCS-FEX-32A board, two thyristor/diode power modules and auxiliaries (power supply, line choke). The **full controlled** (4-Q) field exciter unit DCF504A-0050 consists of the SDCS-FEX-31A board, four anti-parallel thyristor/ thyristor power modules and the same auxiliaries.

The control is structured similar to the SDCS-FEX-2A field supply. A micro controller is used for controlling and firing. The DC current is measured by using an AC current transformer (same configuration than at SDCS-FEX-2A).
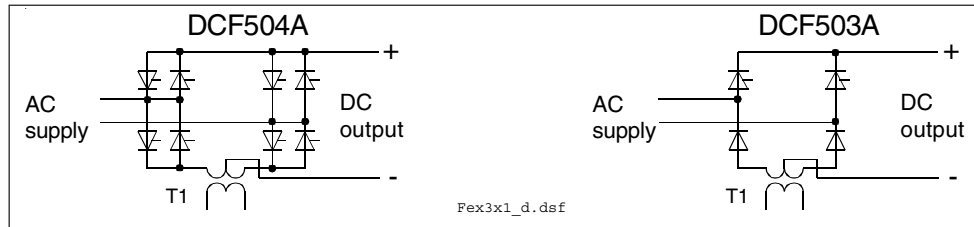
Fig. 8.3 /1   Different versions of power section of the DCF50xA-0050
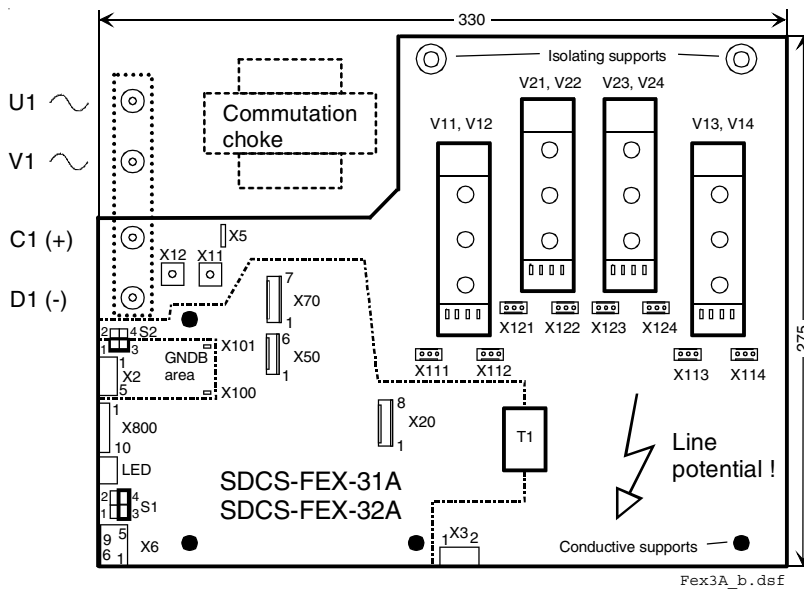
Fig. 8.3/2   Layout of the DCF504A-0050 field exciter unit

8.3.1 Electrical data of DCF50xA-0050

Power part	
AC input voltage:	110 V -15%...500 V +10%; single phase
AC input current:	≤ output current
Frequency:	same as DCS converter module
AC isolation voltage:	690 V
Line reactor:	160 µH; 45-65 Hz
DC output current: ①	0.3...50 A
Power loss at $I_{F\,rated}$:	≤180 W
Load condition	always L/R > 100 ms (saturation)
Auxiliary voltage (X3:1-2)	
AC input voltage:	110 V -15%...230 V +10%; single phase
Frequency:	45 ... 65 Hz
AC input power:	15 W; 30 VA
Inrush current:	<5 A / 20 ms
Mains buffering:	min 30 ms
Terminal row X2:	
X2: 1 RS 485	serial link to X16: 1 at SDCS-CON-1 / CON-2
X2: 2 RS 485	serial link to X16: 2 at SDCS-CON-1 / CON-2
X2: 3 Ground B	grounded via cable screen and / or grounded via S2
X2: 4	not used
X2: 5	not used

① If Field weakening is needed, actual field current of the motor at top speed must be higher than 0.3 A

III 8-4

8.3.2 Electronic power supply

There is a power supply unit on the board. Supply is connected at terminal X3. The rated AC voltages 115 V and 230 V can be applied without any modification.

The power supply unit provides the DC voltages 30 V, 15 V, 5 V and -15 V to the control electronics. Voltages can be measured by means of a multimeter from the terminal X70 (see the layout).

In addition the power supply generates 5 V for galvanic isolated RS485 communication drivers. This voltages can be measured at terminals X100/X101.

Measured voltage	Terminal positive	Ground
+5V	X70:1	X70:2 (GND)
+30V	X70:3	X70:5 (GND)
+15V	X70:4	X70:5 (GND)
-15V	X70:6	X70:5 (GND)
+ 5V	X100	X101:1 (GNDB)

8.3.3 Control unit

The control unit includes the following main blocks:
- Micro controller H8 for control and firing
- Actual DC current measurement with an AC current transformer.
- RS485 interface to the converter's controller board SDCS-CON-x.

The software for the field current control is stored in the FlashPROM memory. This software contains a
  PI current controller
  Fault/reset logic
  Synchronization and PLL function
  Bridge reversal function (only DCF 504A)

The setting and updating of all control parameters are set from armature converter via RS485 interface. Actual current, field current reference, control and status bit are cyclic sent via RS 485 communication.

The field exciter is equipped with an auto-scaling function of burden resistor based on the nominal field current of the motor.

The output I_{act} represents the actual field current, which is measured via the AC transformer, then rectified and transferred into a voltage signal with burden resistors. The burden resistors -scaled to measurement range- are adapted by the board itself depending on the setting of the nominal motor field current. The current signal can be measured U_{Cursig} at X20:3-X70:2 and is scaled to

$$4 V * I_{act} / I_{Scale}$$

I_{Scale} = 3A, 5A, 7A, 9A, 11A, 13A, 15A, 17A, 21A, 27A, 33A, 39A, 45A, 51A

8.3.4 Power section

If a DCF503A-0050 is in use two diode-thyristor modules are arranged as a half-controlled single-phase rectifier. If a DCS504A-0050 is in use four thyristor-thyristor modules are arranged as a full-controlled single-phase rectifier. The anodes of the two diodes (anodes / cathodes of the thyristors) are not connected directly to each other as usual; they are connected to the ends of the primary winding of the current transformer. The centre tap is the negative output of the rectifier. Thus it is possible to measure the DC current with an AC current transformer.

A MOV (Metal Oxide Varistor) protects the AC input against voltage spikes from the external source. Another MOV protects the DC output against voltage surges which can be caused by the field winding of a DC machine. The free wheeling function needed e.g. during network failure is "build in" because of the diodes, if the half-controlled version is in use. If the full-controlled version is used the free wheeling function is realized by using the thyristors in diode mode, triggered by a fast voltage rise.

8.3.5 RS232-Port

The RS232 interface is used for download the 'Field exciter firmware package'.

The default settings of this interface are as follows:

Signal level:	RS232 (+12V / -12V)
Data format:	UART
Message format:	Modbus-Protocol
Transmission method:	half-duplex
Baudrate:	9.600 Baud
Number of Data bits:	8
Number of Stop bits:	1
Parity-Bit:	odd

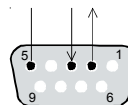| X6:	Description
1	not connected
2	TxD
3	RxD
4	not connected
5	SGND Signal ground
6...9	not connected

Fig. 8.3/3 Pin assignment of RS232-Port

The programming procedure is activated by setting S1:1-2 during auxiliary voltage is switched ON. Setting for field exciter mode is S1:3-4 (default).

8.3.6 Field exciter configurations

The data exchange between
- SDCS-CON-2 and
- field exciter SDCS-FEX-2A or
- DCF503A/504A-0050 or
- DCFx01/x02 (three-phase field exciter)

is done via a RS485 serial link, which can be configured as a bus structure. This link is used to transfer references, actual values and settings for up to two field exciter units.

The drive software located on the SDCS-CON-2 board consists of two field supply functions, first field exciter and second field exciter. The first field exciter is already connected to the EMF controller to control the motor in all points of the motor diagram. The second field exciter is accessible via the field current reference.

The RS485 interface works with a screened two-wire cable. The allowed length is 5 m. The wires have to be connected to the terminals X2:1 and X2:2 and the screen to X2:3.

Typical application of this kind is two DC motors connected to one converter. The load sharing can be done by means of adjusting the excitation current of the second DC-motor.

There are two possible configurations for two Node numbers of the field exciters:
- one SDCS-FEX-2A and one external field exciter (DCF503A-0050, DCF504A-0050 or 3-phase field exciter) or
- two external field exciter units (DCF503A-0050, DCF504A-0050 or 3-phase field exciter).
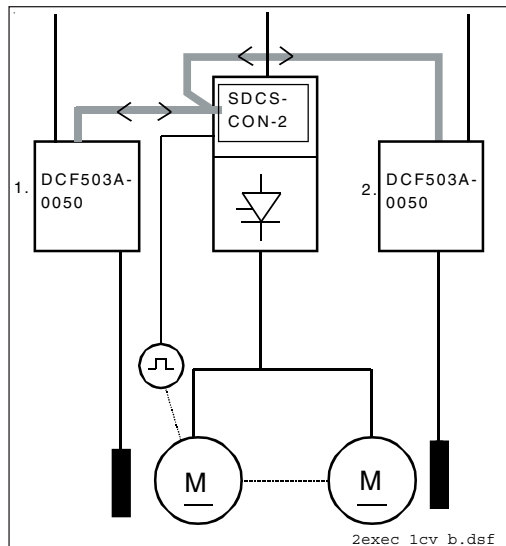

Fig. 8.3/4   Typical application example with two field exciter units and one converter (without field weakening).

If a SDCS-FEX-2A is used, it will be always recognized as the field exciter Node 1 by the software. Node 1 or Node 2 must be coded according to the table below for DCF503A/504A-0050 and for the 3-phase field exciters (via parameter). The scan time for Node 1 = 10 ms, for Node 2 = 100 ms. Field weakening is not necessarily available for Node 2.

Field exciter Node 1		Field exciter Node 2	
Unit type	Setting X800	Unit type	Setting X800
SDCS-FEX-2A	---	---	---
DCF 503A/504A	X800:1 = OFF	---	---
SDCS-FEX-2A	---	DCF 503A/504A	X800:1 = ON
DCF 503A/504A	X800:1 = OFF	DCF 503A/504A	X800:1 = ON

Procedure for field exciter Node changing of the DCF 503A/504A:
- Switch off the units voltage supply
- Set the appropriate switch according to the table
- Initialization through switch on the electronics supply voltage
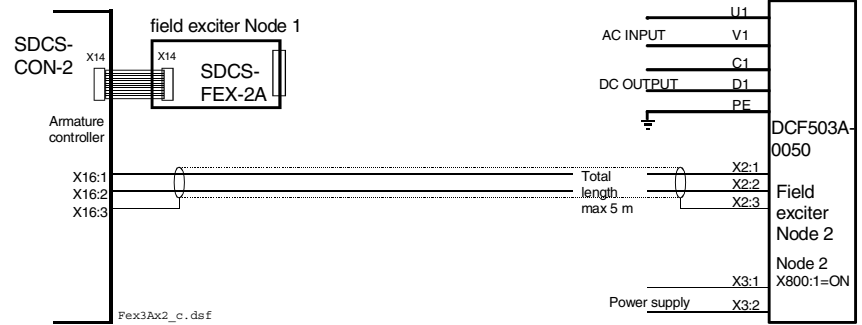

Fig. 8.3/5   Serial communication cable connection and address setting for Node 1 and field exciter Node 2, using SDCS-FEX-2A and DCF50xA-0050
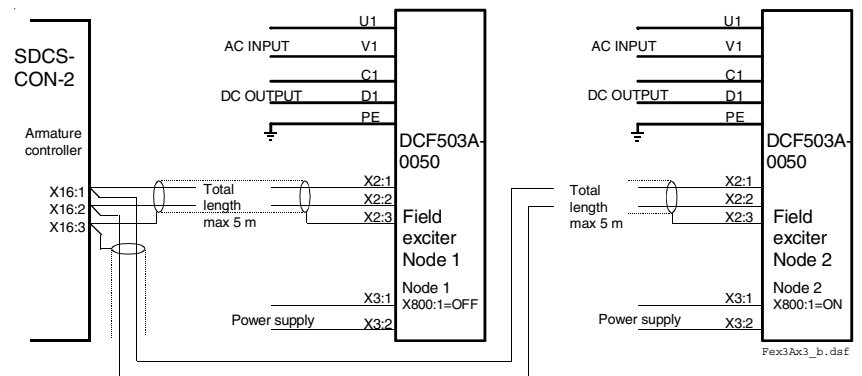

Fig. 8.3/6   Serial communication cable connection

III 8-6

8.3.7 Diagnosis

The armature converter receives via serial link the sum of all faults in "Fex status bit". A more detailed error code is given on the seven segment display of DCF 503A/ DCF 504A.

All faults are reset with the next ON command given to the armature current controller.

|	FAULT Definition
8	Boot sequence failed or Flash PROM empty
F81	Auxiliary voltage below 90 V
F82	Hardware fault
F83	Software fault
F84	Par flash read fault e.g. checksum wrong
F85	Compatibility fault Software or typecode not compatible to parameters
F86	Typecode read fault Checksum failure during typecode check
F88	Mains voltage smaller 40 V_{AC}
F89	Mains voltage higher 620 V_{AC}
F90	Mains sync. fault e.g. f < 40 Hz, f > 70 Hz
F91	Field current above 125% of selected current measurement range
F92	Fast voltage rise see parameters: DCS600: [P44.04 / P44.10] DCS500B: [P13.10 / P13.07]

	ALARMS Definition
A81	Parameters added
A88	Up / Download failed
A90	Compatibility Alarm
A91	Parameter restored

Fig. 8.3/7   DCF503A/DCF504A-0050 converter diagram

III 8-7
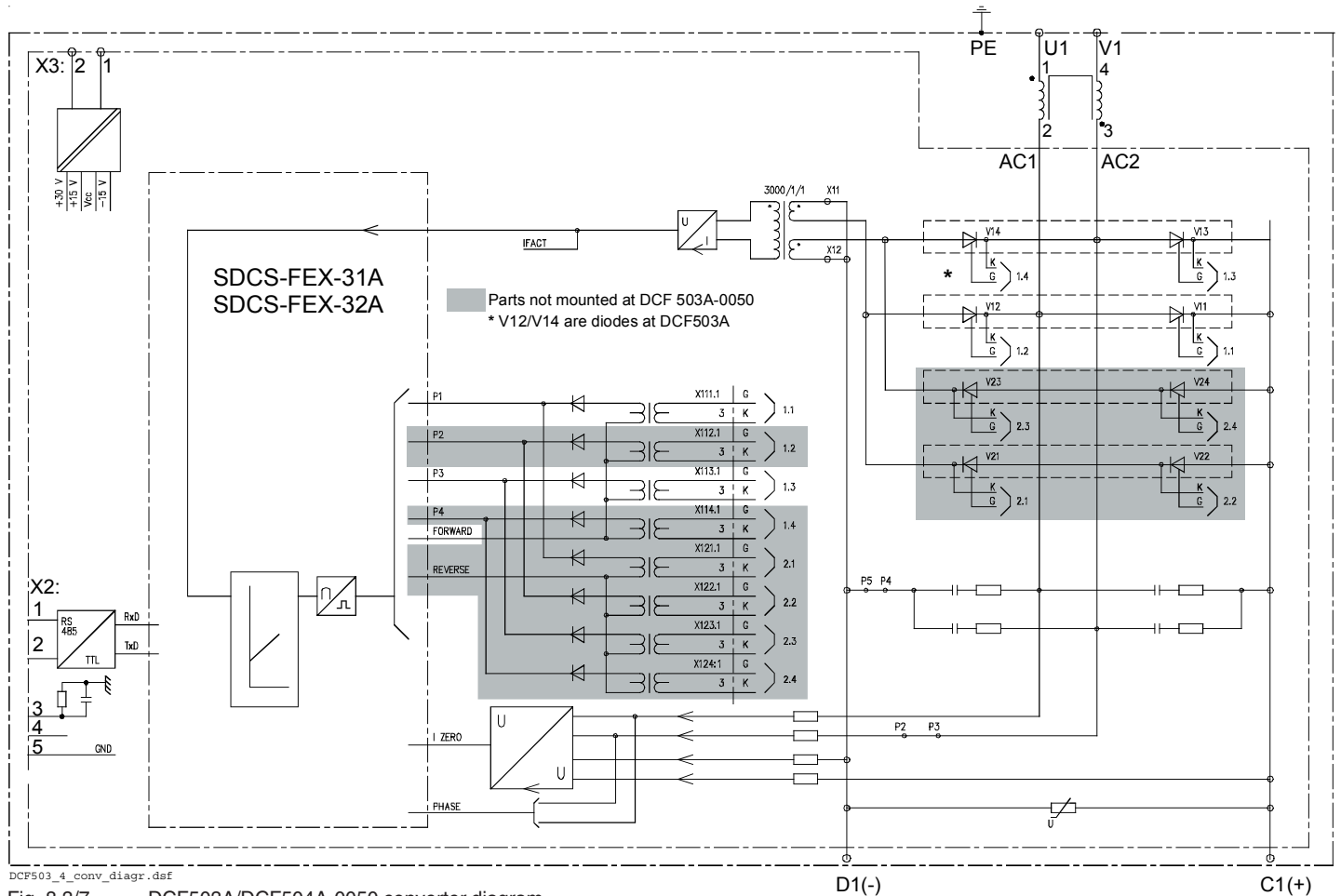
8.3.8 Dimensions

External field exciter
DCF 503A-0050
DCF 504A-0050

Dimensions in mm
Weight appr. 10 kg
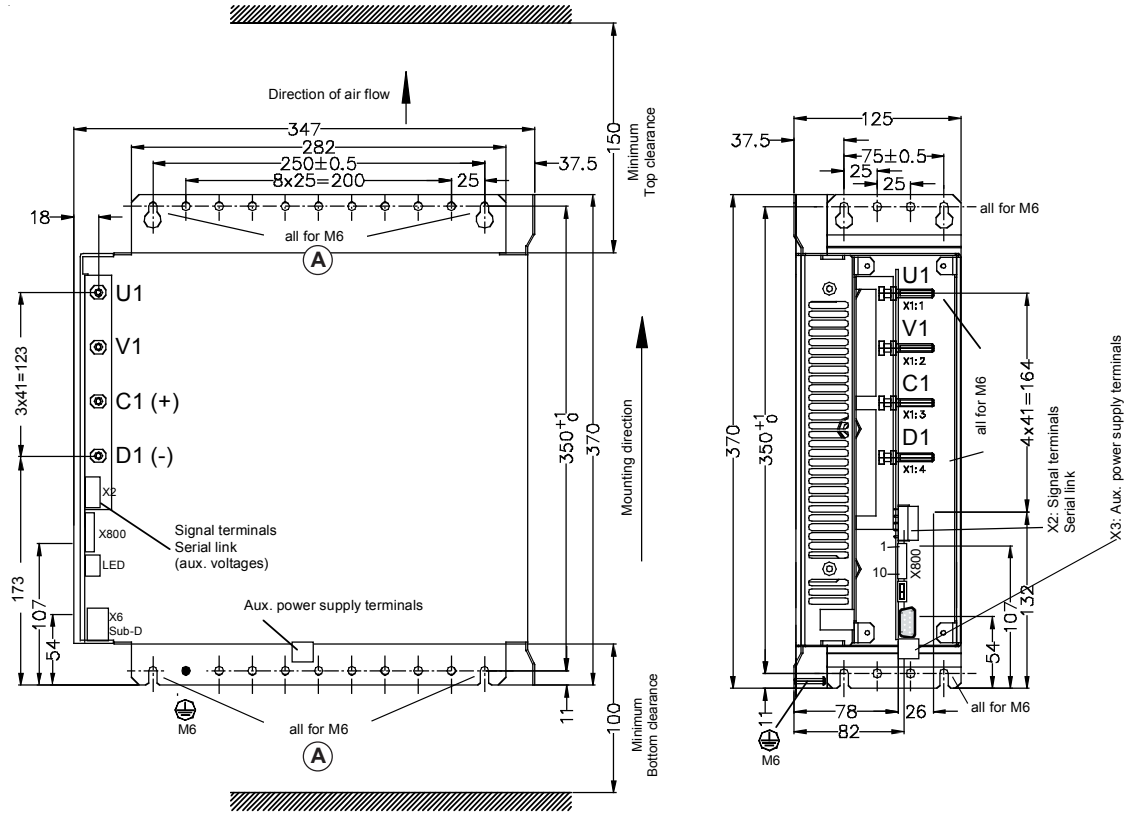
Note: In case of vibrating environments use fixing holes (A)

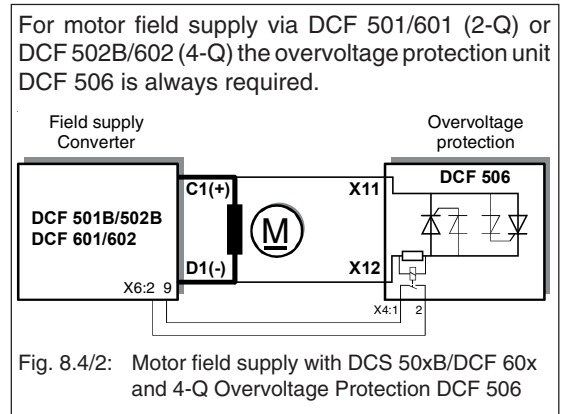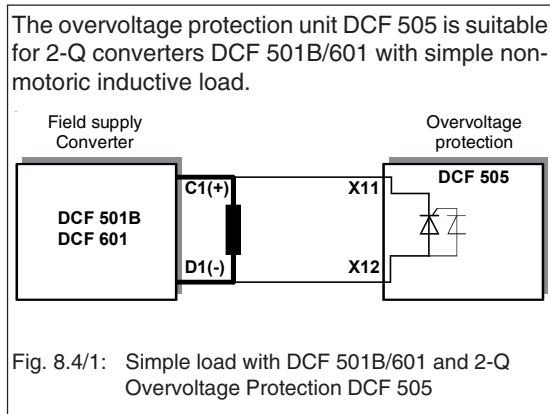Fig. 8.3/8   Dimension drawing of DCF 503/4A

III 8-8

8.4 DCF505 / DCF506 Overvoltage Protection

The three-phase field supply converter DCF 501B/502B and DCF 601/602 need a separate active Overvoltage Protection unit DCF 505 or DCF 506 to protect the power part against inadmissibly high voltages.

The protection unit activates a free-wheeling circuit between the F+ and F- connectors if an overvoltage occurs. The DCF 505/506 consists of a trigger unit

(SDCS-FEP-x) and a free-wheeling thyristor (two in anti-parallel at DCF 506).

The DCF 506 consist of a relay output to indicate a free-wheeling condition to the field supply converter. When the free-wheeling function is triggered, it will last until the DC current is less than appr. 0.5 A. During this time the relay contacts are closed.

The overvoltage protection unit DCF 505 is suitable for 2-Q converters DCF 501B/601 with simple non-motoric inductive load.

Fig. 8.4/1:   Simple load with DCF 501B/601 and 2-Q Overvoltage Protection DCF 505

For motor field supply via DCF 501/601 (2-Q) or DCF 502B/602 (4-Q) the overvoltage protection unit DCF 506 is always required.

Fig. 8.4/2:   Motor field supply with DCS 50xB/DCF 60x and 4-Q Overvoltage Protection DCF 506

Assignment Field supply converter to Overvoltage protection unit

Field supply converter for motor fields	Overvoltage Protection
2-Q, 500 V DCF501B/601-0025-51 DCF501B/601-0050-51 DCF501B/601-0075-51 DCF501B/601-0100-51	DCF506-0140-51
DCF501B/601-0200-51 DCF501B/601-0350-51 DCF501B/601-0450-51 DCF501B/601-0520-51	DCF506-0520-51
4-Q, 500V DCF502B/602-0025-51 DCF502B/602-0050-51 DCF502B/602-0075-51 DCF502B/602-0100-51	DCF506-0140-51
DCF502B/602-0200-51 DCF502B/602-0350-51 DCF502B/602-0450-51 DCF502B/602-0520-51	DCF506-0520-51
Inductive load supply for other applications	**Overvoltage Protection**
4-Q, 500V DCS502B/602-1200-51 DCS502B/602-1500-51	DCF506-1200-51 DCF506-1500-51
4-Q, 690V DCS502B/602-0900-71 DCS502B/602-1500-71	DCF506-1500-71

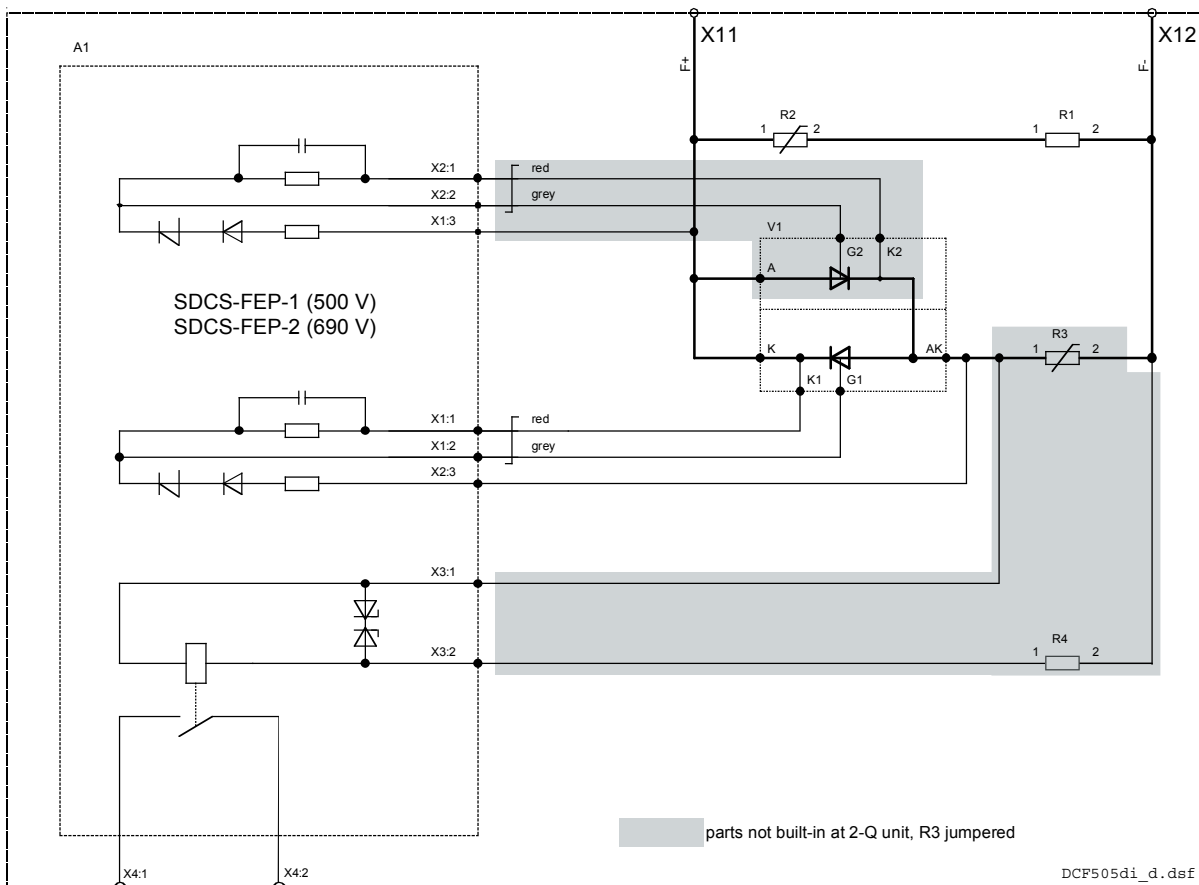Table 8.4/1:   Assignment converter to Overvoltage Protection unit

III 8-9

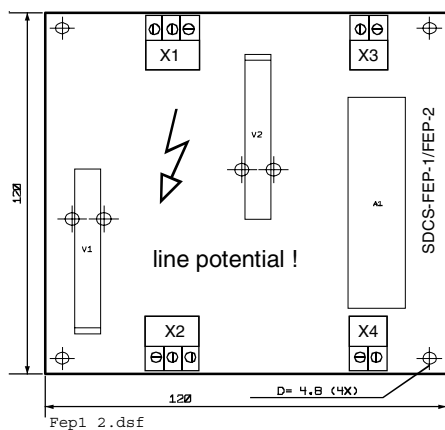## Diagram

Fig. 8.4/3: Overvoltage Protection DCF 505 / DCF 506



Fig. 8.4/4: Layout of SDCS-FEP-1/FEP-2

Output X4:1-2
Potential isolated by relay (NO contact)
Contacts no protected
Contact rating: **AC**: ≤60 V~/ ≤50 mA~
   **DC**: ≤60V-/ ≤50 mA-

There are two trigger units in use:
- SDCS-FEP-1 for systems, used at line voltages up to 500 V; this board is equipped with a 1400 V trigger diode.
- SDCS-FEP-2 for systems, used at line voltages up to 690 V; this board is equipped with a 1800 V trigger diode.

III 8-10

Dimensions

Overvoltage Protection
DCF 505-0140/0520-51
DCF 505-1200-51
DCF 506-0140/0520-51

Dimensions in mm
Weight appr. 8 kg

MB_520_a.dsf
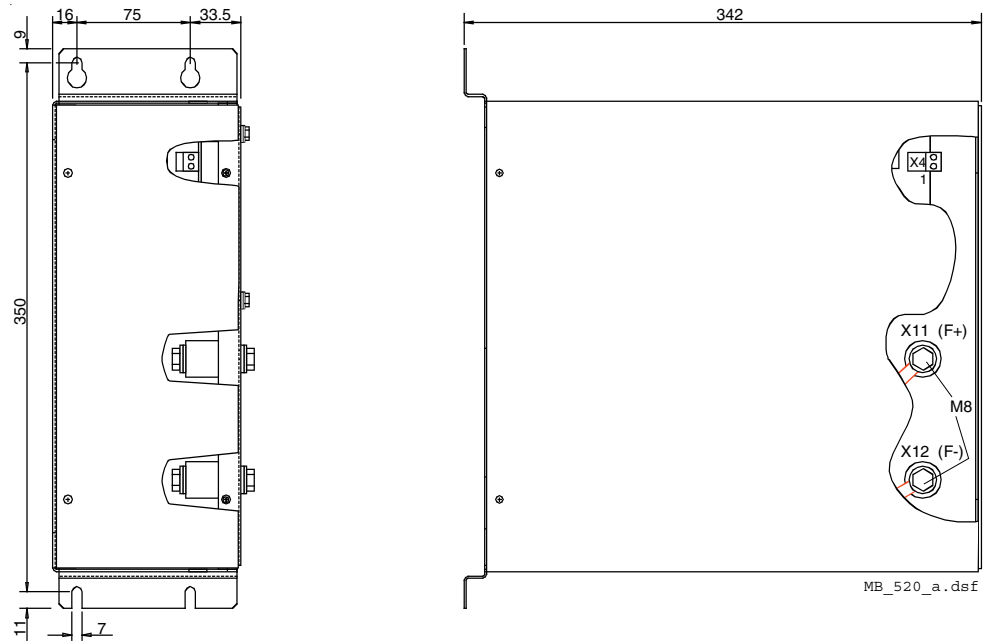
Overvoltage Protection
DCF 506-1200-51
DCF 506-1500-51
DCF 506-1500-71

Dimensions in mm
Weight appr. 20 kg

SDCS-FEP-1 (500 V)
SDCS-FEP-2 (690 V)

MB_1500_a.dsf

III 8-11

III 8-12
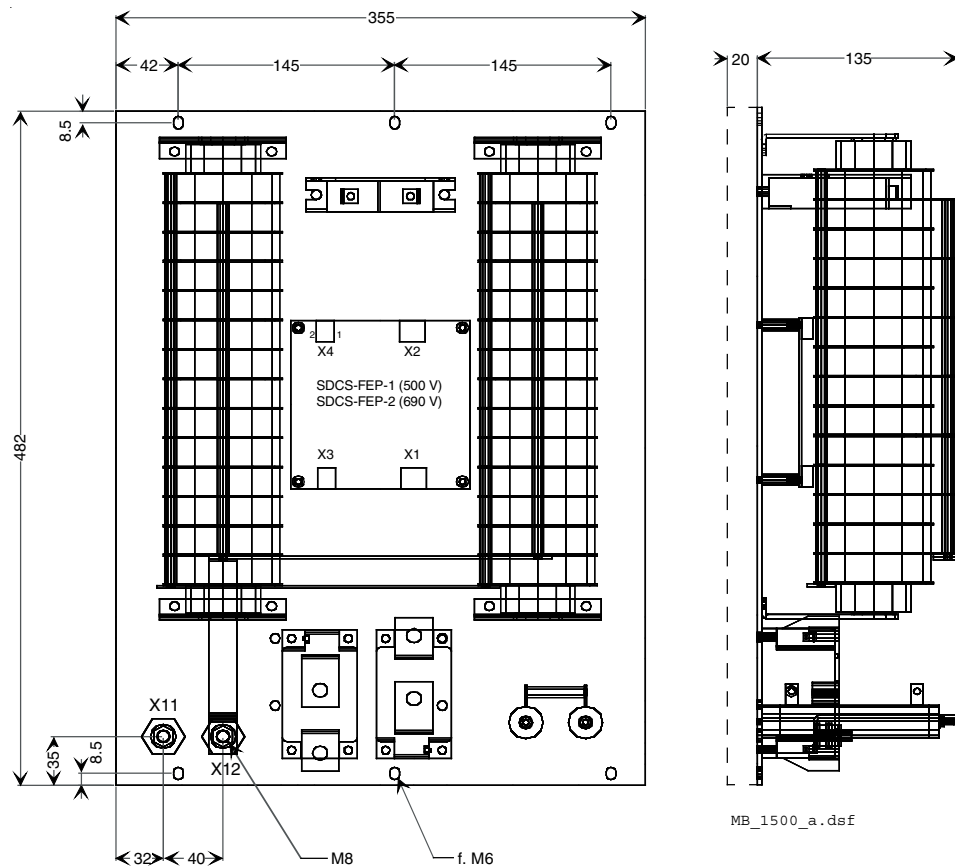
9   Accessories

9.1   Accessories - Power circuit

9.1.1 Fuses and fuse holders (Converter size C1, C2)

Type	Resistance [mΩ]	Fuse F1	Size	Fuse holder
170M 1558	30	10A 660V UR	0	OFAX 00 S3L
170M 1559	21	21A 660V UR	0	OFAX 00 S3L
170M 1561	15	25A 660V UR	0	OFAX 00 S3L
170M 1564	6	50A 660V UR	0	OFAX 00 S3L
170M 1565	4	63A 660V UR	0	OFAX 00 S3L
170M 1566	3	80A 660V UR	0	OFAX 00 S3L
170M 1568	1.8	125A 660V UR	0	OFAX 00 S3L
170M 3815	0.87	200A 660V UR	1	OFAX 1 S3
170M 3816	0.59	250A 600V UR	1	OFAX 1 S3
170M 3817	0.47	315A 660V UR	1	OFAX 1 S3
170M 3819	0.37	400A 660V UR	1	OFAX 1 S3
170M 5810	0.3	500A 660V UR	2	OFAX 2 S3
170M 6811	0.22	700A 660V UR	3	OFAX 3 S3
170M 6163	0.15	900A 660V UR	*	170H 3006
170M 6166	0.09	1250A 660V UR	*	170H 3006
170M 6811	0.22	700A 660V UR	3	OFAS B 3
170M 6813	0.15	900A 660V UR	3	OFAS B 3
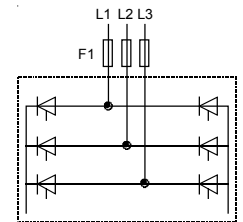
⬜ will become obsolete; new assignment of fuse holder and fuse

Table 9.1/1: Fuses and fuse holders

* drawing see chapter 2.2
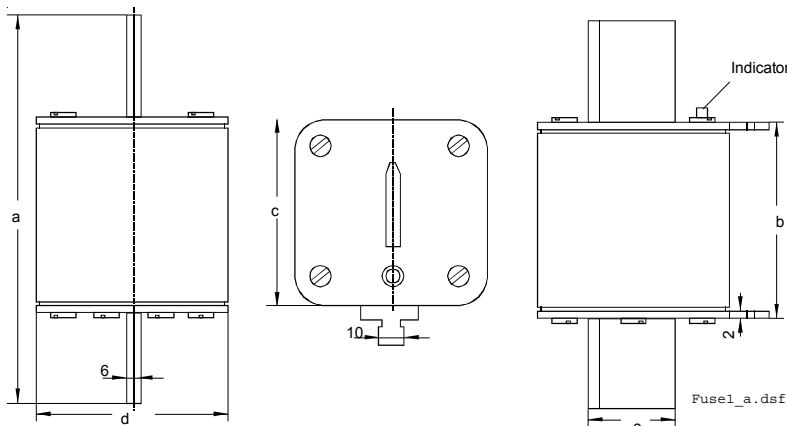
Dimensions [mm] Size 0...3

Fig. 9.1/1: Fuses size 0...3

Size	a	b	c	d	e
0	78,5	50	35	21	15
1	135	69	45	45	20
2	150	69	55	55	26
3	150	68	76	76	33

Remark:
Given dimensions may be exeeded in some cases.
Please take them only for information.

Main dimensions of fuse holders

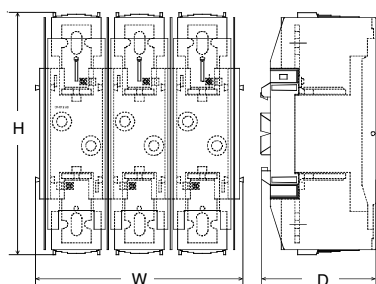| Fuse holder	HxWxD [mm]	Protection
OFAX 00 S3L	148x112x111	IP20
OFAX 1 S3	250x174x123	IP20
OFAX 2 S3	250x214x133	IP20
OFAX 3 S3	265x246x160	IP20
OFAS B 3	250x246x136	IP00

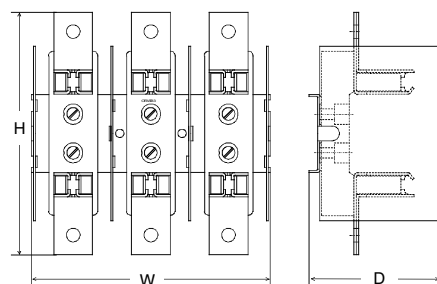Table 9.1/2: Fuse holders

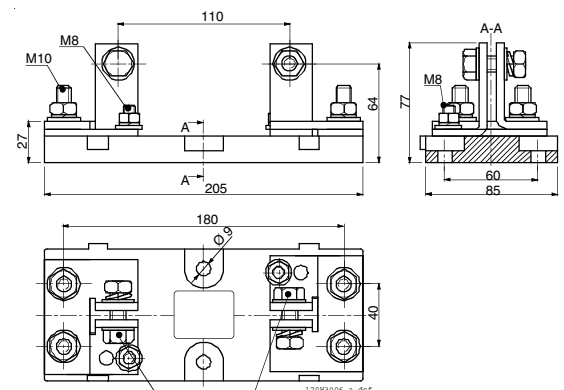Fig. 9.1/2: Fuse holder OFAX ...

Fig. 9.1/3: Fuse holder OFAS B 3

Fig. 9.1/4: Fuse holder 170H 3006

III 9-1

Line chokes type ND 01...ND 16

Line chokes for use in industrial environment (minimum requirements), low inductive voltage drop, deep commutation notches.

Line chokes ND01...ND06 are equipped with cables. The bigger ones ND07...ND16 are equipped with bus-bars. When connecting them to other components, please take relevant standards into account in case the materials are different. Don't use choke terminals as cable or busbar support!

Type	Choke L [μH]	I_{rms} [A]	I_{peak} [A]	rated Voltage [U_N]	Weight [kg]	Power loss Fe [W]	Cu [W]	recommended for armature converter type
ND 01	512	18	27	500	2.0	5	16	DCS...-0025
ND 02	250	37	68	500	3.0	7	22	DCS...-0050
ND 03	300	37	68	600	3.8	9	20	DCS...-0050
ND 04	168	55	82	500	5.8	10	33	DCS...-0075
ND 05	135	82	122	600	6.4	5	30	DCS...-0110
ND 06	90	102	153	500	7.6	7	41	DCS...-0140
ND 07	50	184	275	500	12.6	45	90	DCS...-0250
ND 08	56.3	196	294	600	12.8	45	130	DCS...-0270
ND 09	37.5	245	367	500	16.0	50	140	DCS...-0350
ND 10	25.0	367	551	500	22.2	80	185	DCS...-0520
ND 11	33.8	326	490	600	22.6	80	185	DCS...-0450
ND 12	18.8	490	734	500	36.0	95	290	DCS...-0820 (2-Q)
ND 13	18.2	698	1047	690	46.8	170	160	DCS...-0820 (4-Q)
ND 14	9.9	930	1395	500	46.6	100	300	DCS...-1200
ND 15	10.9	1163	1744	690	84.0	190	680	DCS...-1500
ND 16	6.1	1510	2264	500	81.2	210	650	DCS...-2000

Table 9.1/3: Data of line chokes

Line chokes type ND 01...ND 06

Type	a1	a	b	c	d	e	f	g	mm²
ND 01	120	100	130	48	65	116	4	8	6
ND 02	120	100	130	58	65	116	4	8	10
ND 03	148	125	157	63	80	143	5	10	10
ND 04	148	125	157	78	80	143	5	10	16
ND 05	148	125	157	78	80	143	5	10	25
ND 06	178	150	180	72	90	170	5	10	35
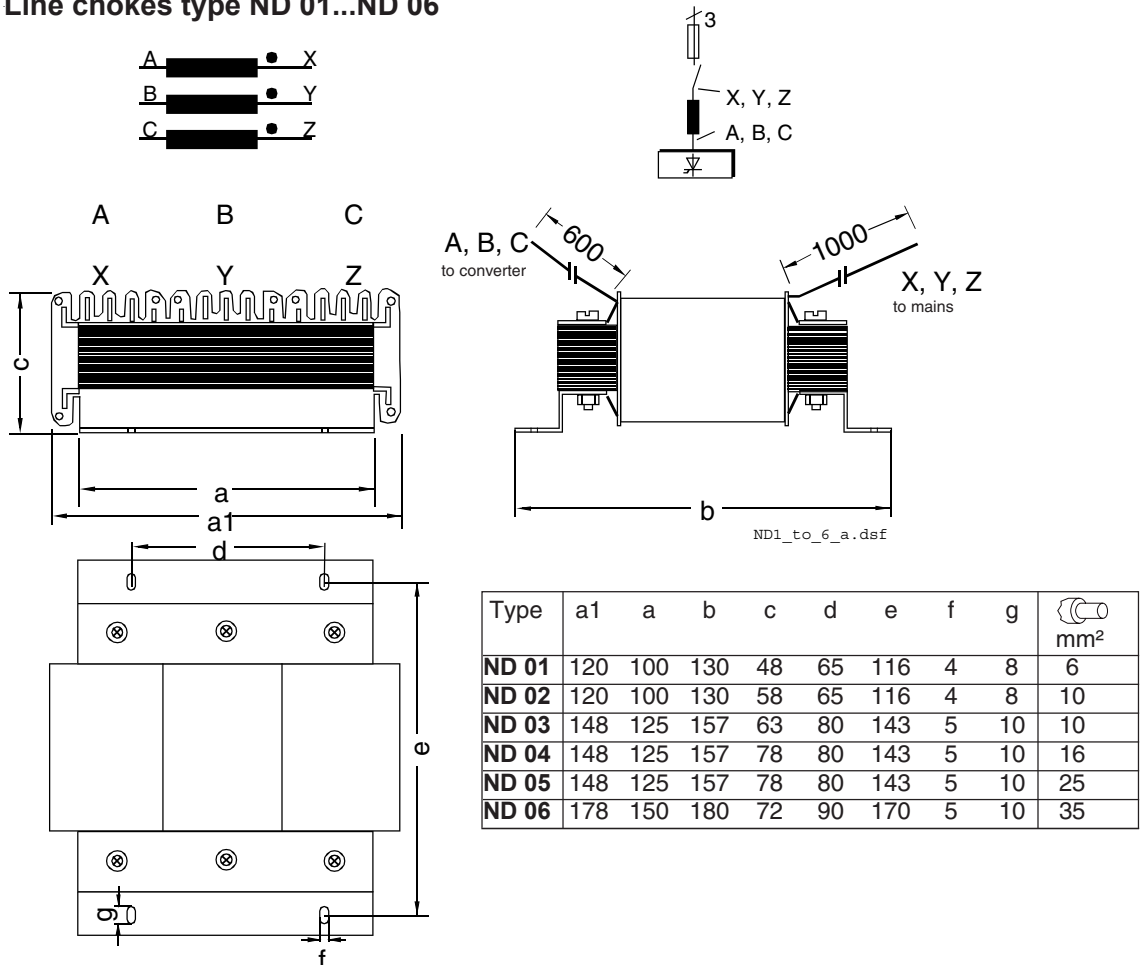
Fig. 9.1/4: Line choke type ND 01...ND 06

III 9-2

Line chokes type ND 07...ND 12

Type	A	B	C	C1	E	F	G	H	I	K	L	busbar
ND 07, 08	285	230	86	100	250	176	65	80	9x18	385	232	20x4
ND 09	327	250	99	100	292	224	63	100	9x18	423	280	30x5
ND 10, 11	408	250	99	100	374	224	63	100	11x18	504	280	60x6
ND 12	458	250	112	113	424	224	63	100	13x18	554	280	40x6

Fig. 9.1/5: Line chokes type ND 07...ND 12

Line chokes type ND 13, 14
all busbars 40x10

Fig. 9.1/6: Line chokes type ND 13, ND 14

Line chokes type ND 15, 16
all busbars 60x10

Fig. 9.1/7: Line chokes type ND 15, ND 16

III 9-3

Line chokes type ND 401...ND 413

Line chokes for use in light industrial/residential environment, high inductive voltage drop, reduced commutation notches.

These chokes are designed for drives which usually operate in speed control mode at 400 V or 500 V networks. Because of that a duty cycle has been taken into account. The percentage taken into account for that duty cycle is different for 400 V and 500 V networks:
 - for $U_{rated\ supply}$ = 400 V, DC curr. 1 ≈ 90% of nominal current
 - for $U_{rated\ supply}$ = 500 V, DC curr. 1 ≈ 72% of nominal current
For easier reading the maximum average DC load current is listed instead of the percentage in the next table.

Line chokes ND401...ND402 are equipped with terminals. The bigger ones ND403...ND413 are equipped with busbars. When connecting them to other components, please take relevant standards into account in case the materials are different.

Type	Choke L [µH]	I_{rms} Line AC [A]	I_{peak} [A]	rated Voltage [U_N]	Weight [kg]	Power loss Fe [W]	Cu [W]	Load DC curr. 1 (f. U_{supply}=400V)	Load DC curr.2 (f. U_{supply}=500V)
ND 401	1000	18.5	27	400	3.5	13	35	22.6	18
ND 402	600	37	68	400	7.5	13	50	45	36
ND 403	450	55	82	400	11	42	90	67	54
ND 404	350	74	111	400	13	78	105	90	72
ND 405	250	104	156	400	19	91	105	127	101
ND 406	160	148	220	400	22	104	130	179	143
ND 407	120	192	288	400	23	117	130	234	187
ND 408	90	252	387	400	29	137	160	315	252
ND 409	70	332	498	400	33	170	215	405	324
ND 410	60	406	609	400	51	260	225	495	396
ND 411	50	502	753	400	56	260	300	612	490
ND 412	40	605	805	400	62	280	335	738	590
ND 413	35	740	1105	400	75	312	410	900	720

Table 9.1/4: Data of line chokes type ND4

Line chokes type ND 401...ND 402

Type	A	B	C	D	E	F	Ø G	Ø H
ND 401	160	190	75	80	51	175	7	9
ND 402	200	220	105	115	75	200	7	9

Table 9.1/5: Dimensions of line chokes type ND 401...ND 402
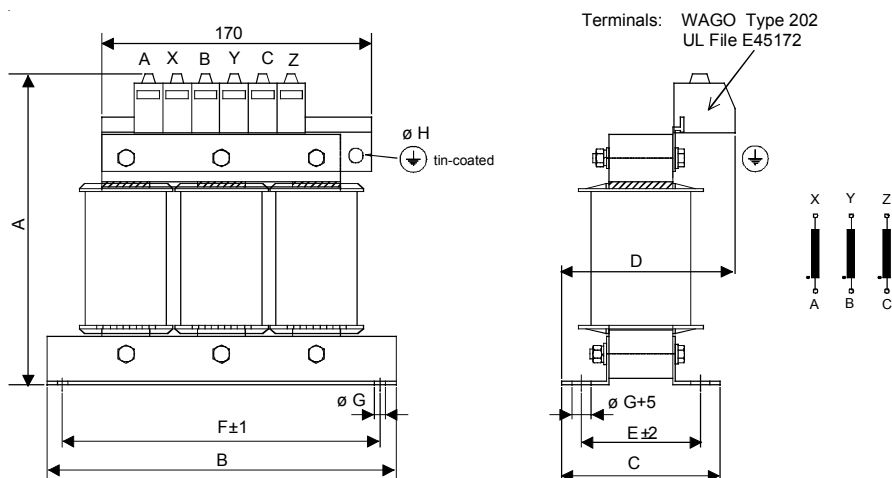
Fig. 9.1/8: Line choke type ND 401...ND 402

III 9-4

Line chokes type ND 403...ND 408

Type	A	B	C	D	E	F	Ø G	Ø H	Ø K
ND 403	220	230	120	135	100	77.5	7	9	6.6
ND 404	220	225	120	140	100	77.5	7	9	6.6
ND 405	235	250	155	170	125	85	10	9	6.6
ND 406	255	275	155	175	125	95	10	9	9
ND 407	255	275	155	175	125	95	10	9	11
ND 408	285	285	180	210	150	95	10	9	11
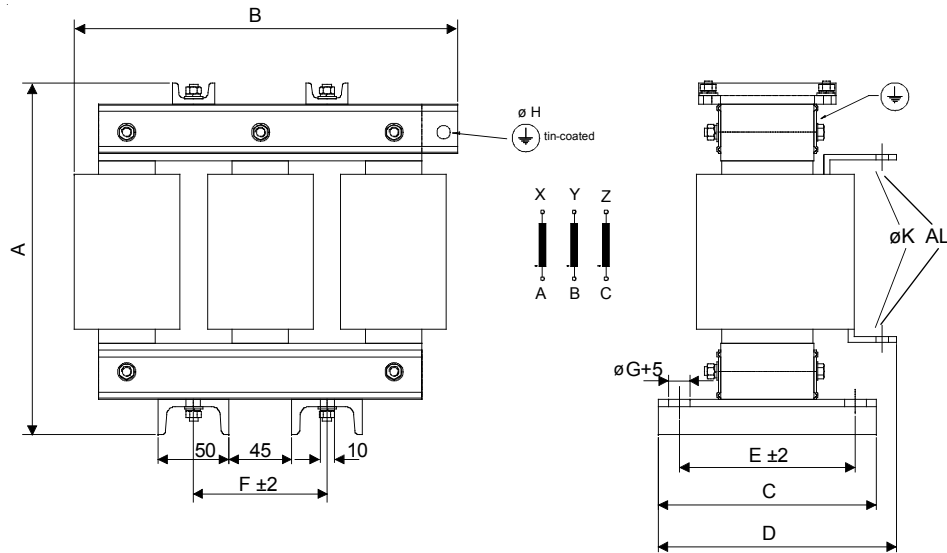
Fig. 9.1/9: Line choke type ND 403...ND 408

Line chokes type ND 409...ND 413

Type	A	B	C	D	E	F	Ø G	Ø H	Ø K
ND 409	320	280	180	210	150	95	10	11	11
ND 410	345	350	180	235	150	115	10	13	14
ND 411	345	350	205	270	175	115	12	13	2x11
ND 412	385	350	205	280	175	115	12	13	2x11
ND 413	445	350	205	280	175	115	12	13	2x11
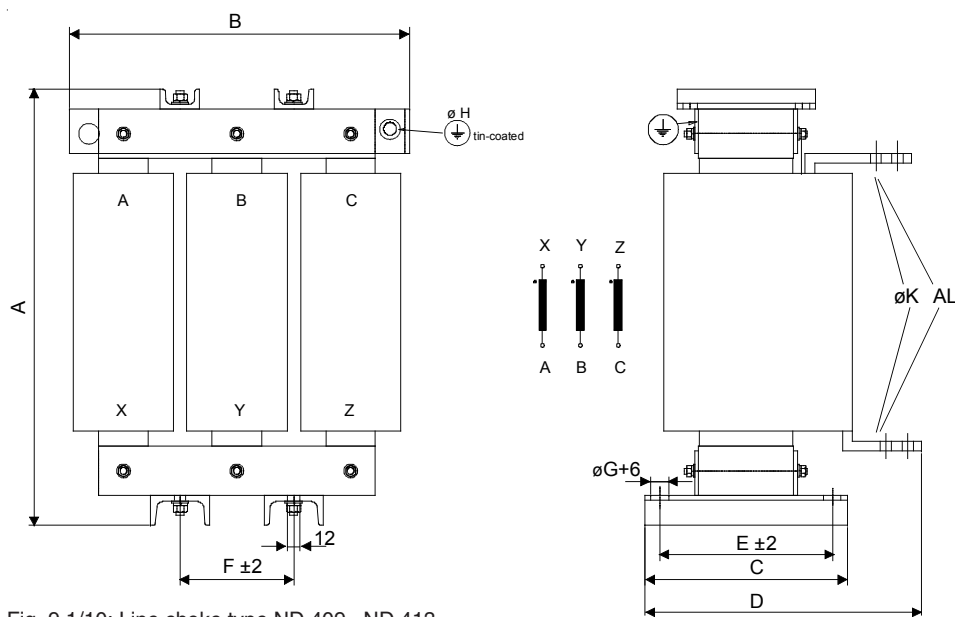
Fig. 9.1/10: Line choke type ND 409...ND 413

9.2 Accessories - Field

9.2.1 Autotransformer T3

Type	for Field curr. I_F	Transformer's secondary current I_{sec}	Weight [kg]	Power loss P_V [W]	Fuse F3 [A]
		U_{prim} = **500 V; 50/60Hz**			
T 3.01	≤6 A	≤7 A	15	65	10
T 3.02	≤12 A	≤13 A	20	100	16
T 3.03	≤16 A	≤17 A	20	120	25
T 3.04	≤30 A	≤33 A	36	180	50
T 3.05	≤50 A	≤57 A	60	250	63
		U_{prim} = **690 V; 50/60Hz**			
T 3.11	≤6 A	≤7 A ①	15	80	10
T 3.12	≤12 A	≤13 A ①	20	125	16
T 3.13	≤16 A	≤17 A ①	30	150	20
T 3.14	≤30 A	≤33 A	60	230	50
T 3.15	≤50 A	≤57 A	60	320	63

① 690 V transformer input cannot be used for the field converters SDCS-FEX-1 and SDCS-FEX-2 (isolation only 600 V max.)

Table 9.2/1: Autotransformer data
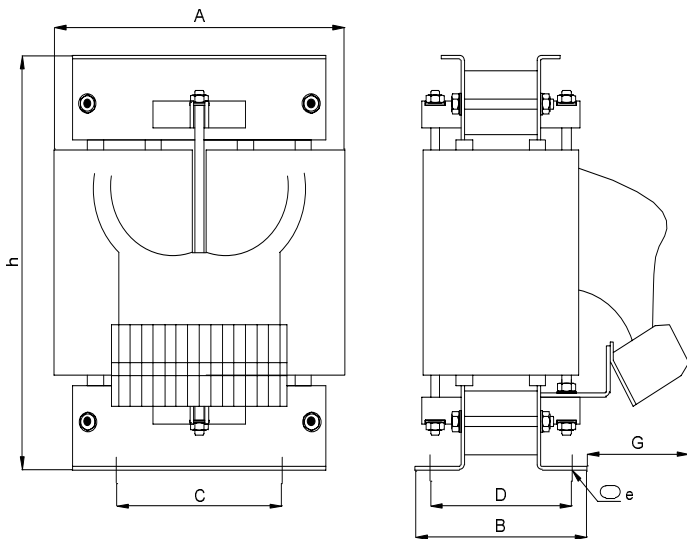
Fig. 9.2/1: Autotransformer T3
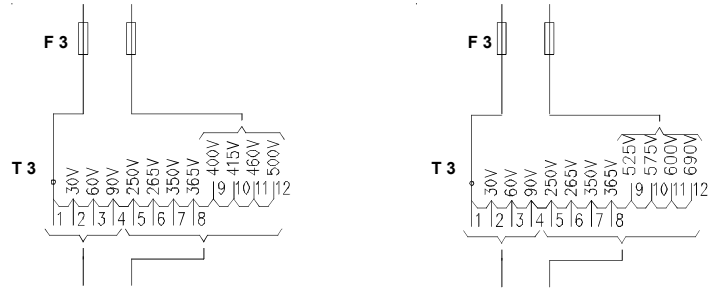
Type	A	B	C	D	h	e	G
T 3.01 / T 3.11	210	110	112	75	240	10x18	95
T 3.02 / T 3.12 T 3.03	210	135	112	101	240	10x18	95
T 3.13	230	150	124	118	270	10x18	95
T 3.04	260	150	144	123	330	10x18	95
T 3.14 T 3.05 / T 3.15	295	175	176	141	380	12x18	95

9.2.2 Line choke L3 for SDCS-FEX-2

Type	line choke data L3 L [μH]	I_{rms} [A]	I_{peak} [A]	Weight [kg]	Power loss [W]	[mm²]
ND30	2x >500	16	16	1,1	8	2

Table 9.2/2: Data of line choke for field exciter
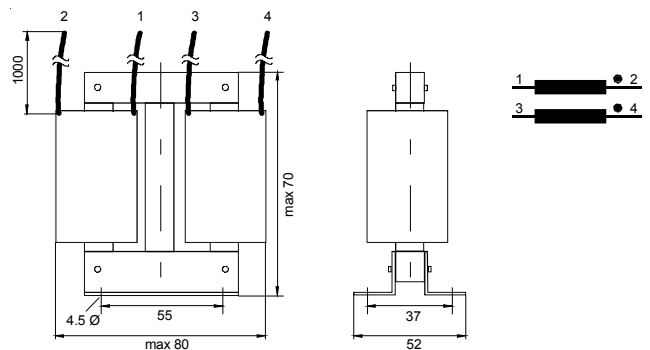
Fig. 9.2/2: Line choke L3

III 9-6

9.3   Fan, electronics

9.3.1 Supply transformer T2 for electronics and fan

The supply transformer T2 has been re-designed. The new power and current rating allows to supply then 2-phase fans and the electronics by one transformer only in case A5 converters are used in a 12-pulse configuration.
They differ in their electrical data and therefore can be identified by their name plate.
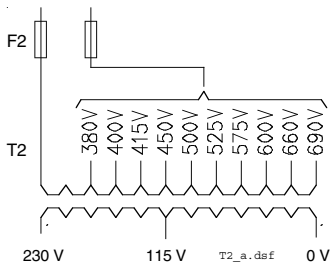
Input voltage: 230/380...690 V/1~; ±10%
Frequency: 50...60 Hz
Output voltage: 115/230 V/1~

Type	Power [VA]	Weight [kg]	Fuse F2 [A]	I_{sec} [A]	Power loss [W]
T2	1400	15	16	6 (0...230 V) 12 (0...115 V)	100

Table 9.3/1: Data supply transformer T2
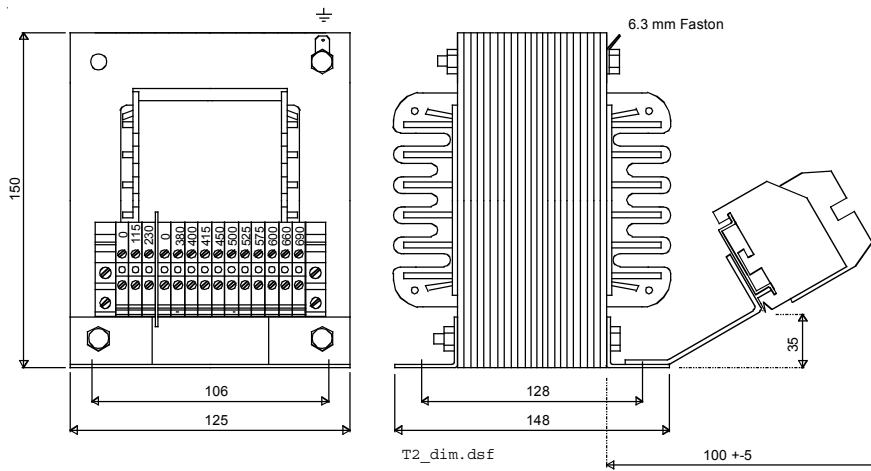
Fig. 9.3/1: Dimensions Transformer T2

Application hint:
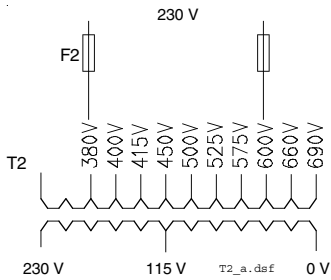
The transformer is designed to work as a 230 V / 230 V transformer to open/avoid ground loops. This is done via the 380 V and 600 V taping according to the left picture.

Transformer data T2 used in the past:

Type	Power [VA]	Weight [kg]	Fuse F2 [A]	Power loss [W]
T2	460	13	6	20

Table 9.3/2: Data supply transformer T2

9.4 Residual current detection

9.4.1 Residual current detection

The converters DCS500B and DCS600 together with the board SDCS-IOB-3 and a specially designed current transformer (CT), big enough to feed through all the cables / busbars of the three phases are already prepared to detect residual current. This option can only be used at grounded networks.

Attention
This detection cannot be used to protect persons or animals against electrical shock!

Normally the current taken from the network, passing
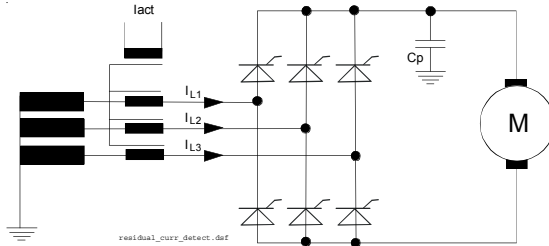
the converter on one phase, then going to the motor will leave the converter on a different phase and ending in the network. A current sample taken from different phases always will show the same amount, but a different sign at two phases and no current at the third. With all three phases feed through one current transformer, the magnetic field around each conductor will compensate each other in case the current takes the path intended and the signal measured at the signal terminals of the current transformer will be zero.

This relationship can be described by this formula:

$$\Sigma\ (I_{L1} + I_{L2} + I_{L3}) = 0$$

In case the current takes any path different to the one roughly described above the current entering the converter at one phase will be different to the one leaving the converter at another phase. The magnetic field will not compensate which results in a current signal given by the CT and which is equivalent to the current missing. Any current caused for example by stray capacitance (Cp) is measured and may need to be treated separate. This signal is read by the circuit on the SDCS-IOB-3 board and then calculated by the converter´s firmware to be available for further use.
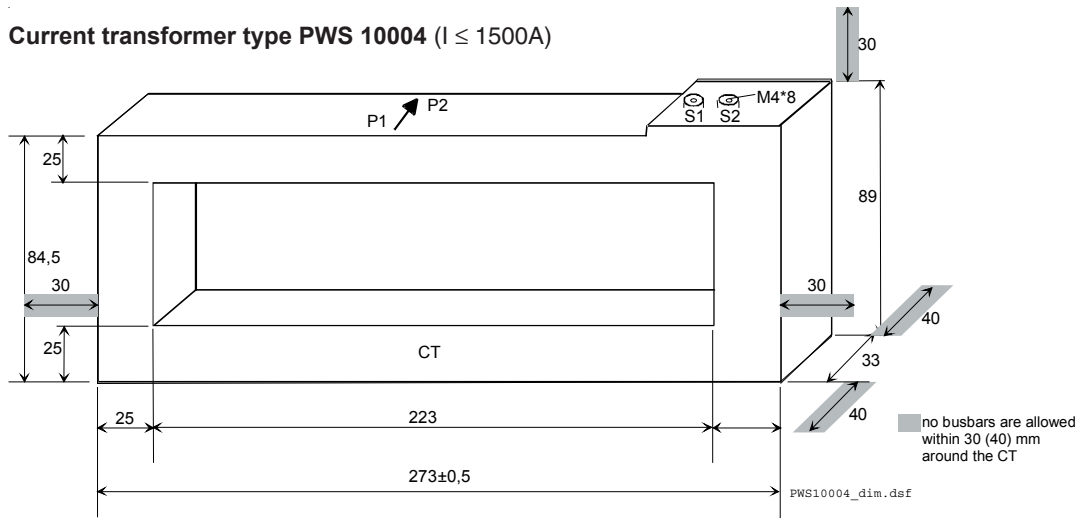
A drive system normally consists of several groups of consumers. As long as the supply for consumer(s) is taken from the three phases feed through the CT all these consumers are monitored. This is the way to monitor either only the motor´s armature circuit, or armature and field or the complete drive with all the auxillary circuits like motor fan or other consumers.

9.4.2 Electrical and mechanical data

There are 2 different current transformers available. They basically differ by their physical dimensions. Consumers connected via cables will have a lower current and therefore monitored most often by the smaller CT, specified for 1500 A. Bigger consumers or even several drives monitored as a group and supplied via busbars use the bigger one, specified for currents up to around 3300 A. Finally the cross sectional area available for the conductors for the three-phases is the criteria to use the one or the other type. Furthermore, the CTs can replace each other electrically, the value for the nominal load current should be taken as a suggestion and the overall accuracy becomes better, if the current of the load is close to the current capability of the CT.

	PWS 10004	PWS 33001
Insulation voltage	≤ 1000 V	≤ 1500 V
Load current	≤ 1500 A	appr. 1200 A…3300 A
Ambient temperat.	-25° ... +70 °C	
Ratio	400 : 1	

When doing the final mechanical work, please try to make sure the conductors are placed symmetrically within the available cross sectional area.

The current transformer has got no burden resistor build in. The CT output has to be connected to the SDCS-IOB-3 board via a shielded twisted pair cable maximum 2 m long. The circuit the CT´s output signal is connected to, consists of a diode bridge for rectification, a burden resistor to change the signal to voltage level and some elements for protection. Finally the signal equivalent of the difference in current is read by Analog Input 4. For more details, see *Software Description*.

Current transformer type PWS 10004 (I ≤ 1500A)

Fig. 9.4/1: Dimensions of current transformer type PWS 10004

III 9-8

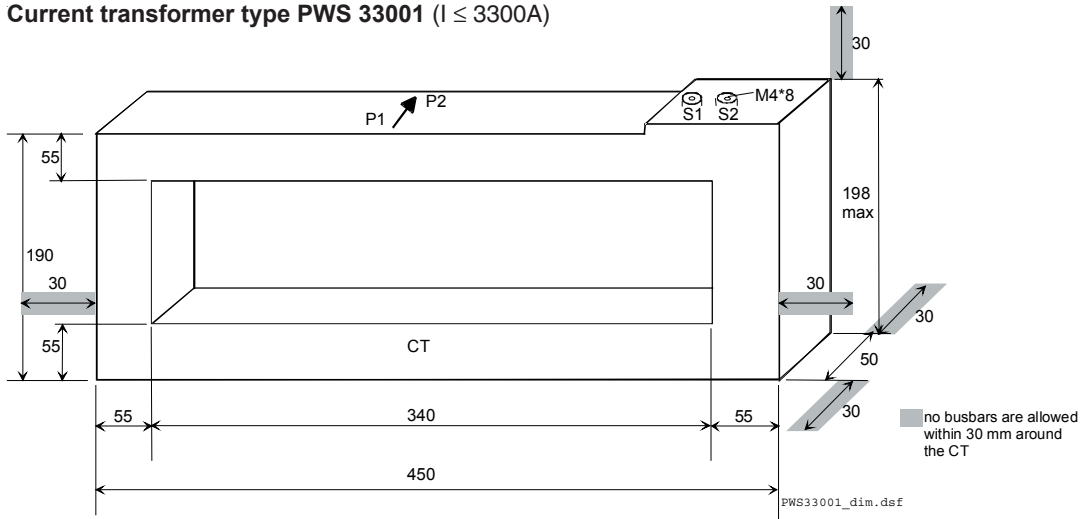**Current transformer type PWS 33001** (I ≤ 3300A)

Fig. 9.4/2: Dimensions of current transformer type PWS 33001

9.4.3 Mechanical fixing

These current transformers don´t have fixings attached to them. There are holders available for the small and the bigger one. Because of the CT´s construction a left and a right one is necessary per CT.
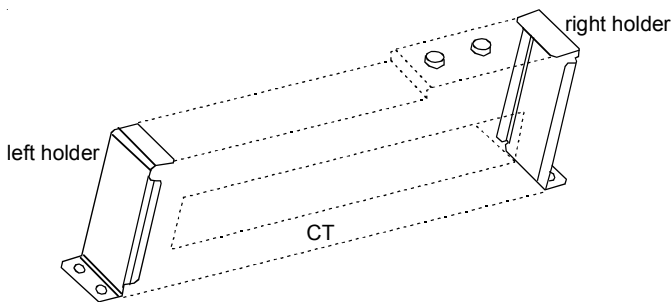
Current transformer type PWS 10004 (I ≤ 1500A)
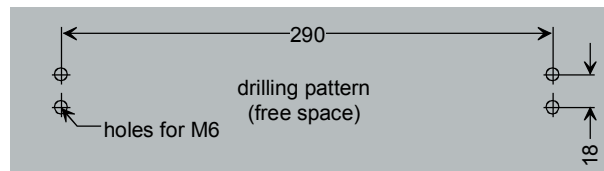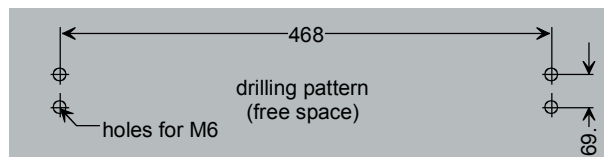

Fig. 9.4/3: Fixing of current transformer type PWS 10004

Fig. 9.4/4: Drilling pattern of current transformer type PWS 10004

Current transformer type PWS 33001 (I ≤ 3300A)
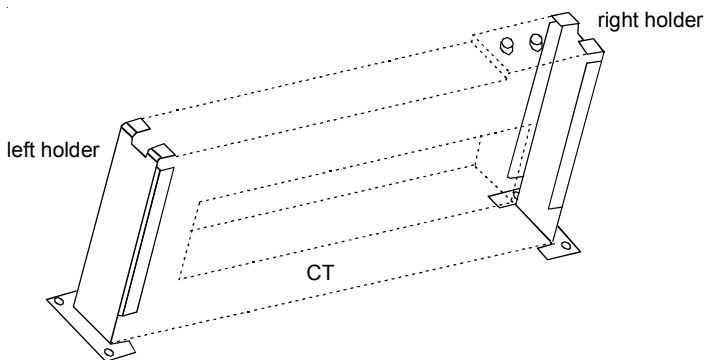
Fig. 9.4/5: Fixing of current transformer type PWS 33001

Fig. 9.4/6: Drilling pattern of current transformer type PWS 33001

Hints

After having all parts installed, please make sure:
- jumper S1 on SDCS-IOB-3 is in position 11 - 12 and 13 - 14
  no cables connected to terminals X3:9 and X3:10 at SDCS-IOB-3 board
- select AI4 for this monitoring function by parameter
  activate that monitoring function via parameter
  define the threshold in amps via parameter
  if necessary delay the error message via parameter to avoid actions caused by disturbance or similar

III 9-9

9.5.1 Three-phase filters

EMC filters are necessary to fulfil EN 50081 if a converter shall be run at a public low voltage line, in Europe for example with 400 V between the phases. Such lines have an earthed neutral conductor. ABB offers suitable three - phase filters for 400 V and 25 A...600 A and 500 V filters for 440 V lines outside Europe. Lines with 500 V to 1000 V are not public. They are local lines inside factories, and they do not supply sensitive electronics. Therefore converters do not need EMC filters if they shall run with 500 V and more.

Filter type	max. voltage	I_N	Terminals for wires with max. dimension	Weight	PE connection
	[V]	[A]	[mm²] *	[kg]	
NF3-440-25	440	25	4	3.0	M6
NF3-440-50	440	50	10/16	3.1	M6
NF3-440-64	440	64	10/16	3.1	M6
NF3-440-80	440	80	25/35	9.5	M10
NF3-440-110	440	110	50	9.5	M10
NF3-500-25	500	25	4	3.0	M6
NF3-500-50	500	50	10/16	3.1	M6
NF3-500-64	500	64	10/16	3.1	M6
NF3-500-80	500	80	25/35	9.5	M10
NF3-500-110	500	110	50	9.5	M10
NF3-500-320	500	320	Bar with 11mm hole	21.0	M10
NF3-500-600	500	600	Bar with 11mm hole	22.0	M10
NF3-690-600	690	600	Bar with 11mm hole	22.0	M10
NF3-690-1000	690	1000	Bar with 14 mm hole	28	M12
NF3-690-1600	690	1600	Bar with 2x 14 mm hole	34	M12
NF3-690-2500	690	2500	Bar with 4x 14 mm hole	105	M16
* single core / litz wire					

Table. 9.5/1: Electrical ratings of three-phase filters
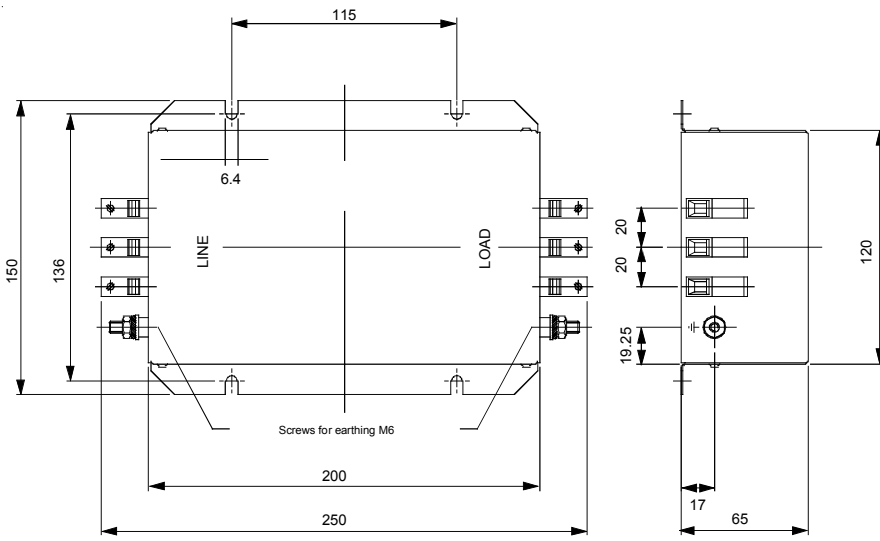
Fig. 9.5/1: Dimensions of three-phase filters NF3-xxx-25, 50, 64

Fig. 9.5/2: Dimensions of three-phase filters NF3-xxx-80, 110

III 9-11

Fig. 9.5/3: Dimensions of three-phase filters NF3-xxx-320

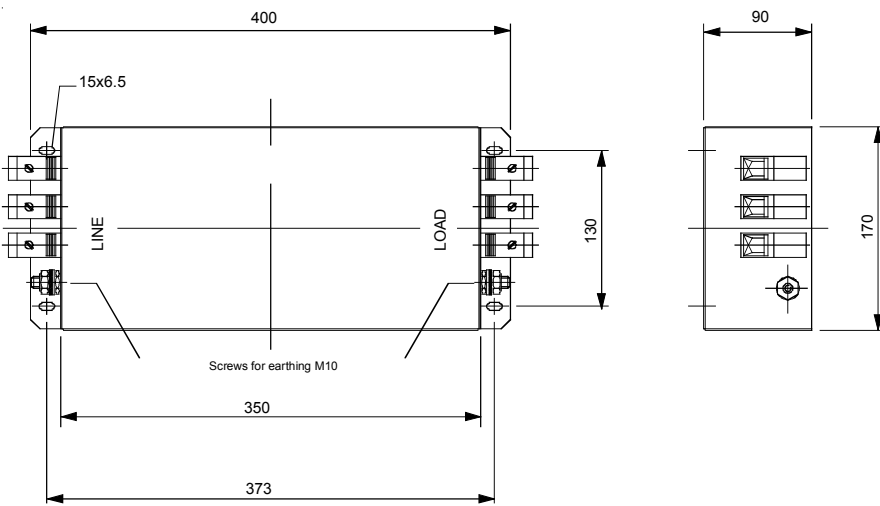Fig. 9.5/4: Dimensions of three-phase filters NF3-xxx-600
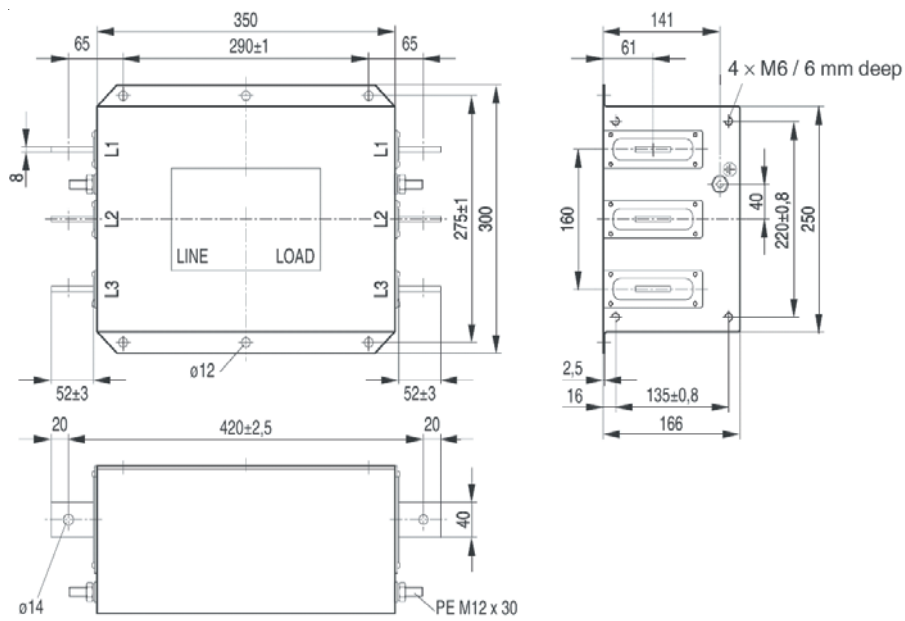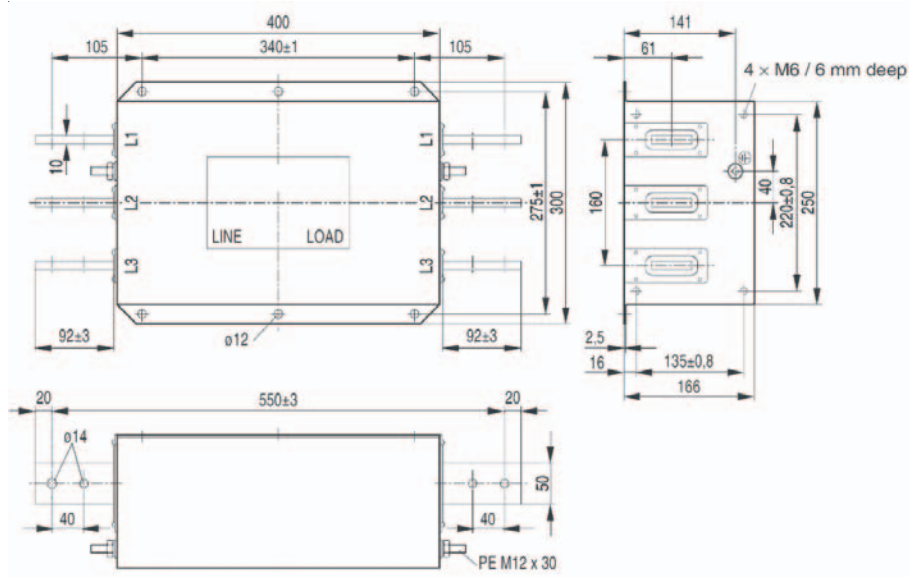
III 9-12

Fig. 9.5/5: Dimensions of three-phase filters NF3-xxx-1000

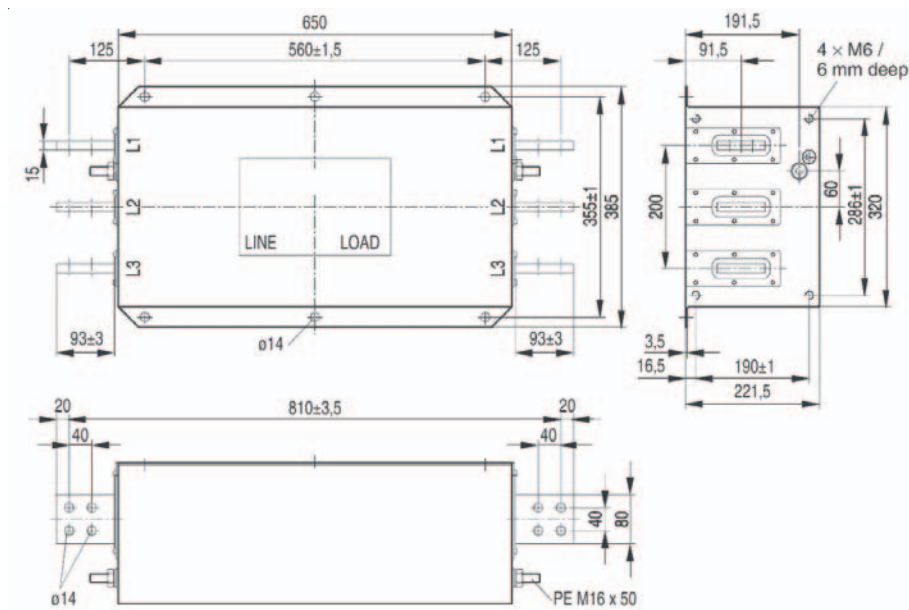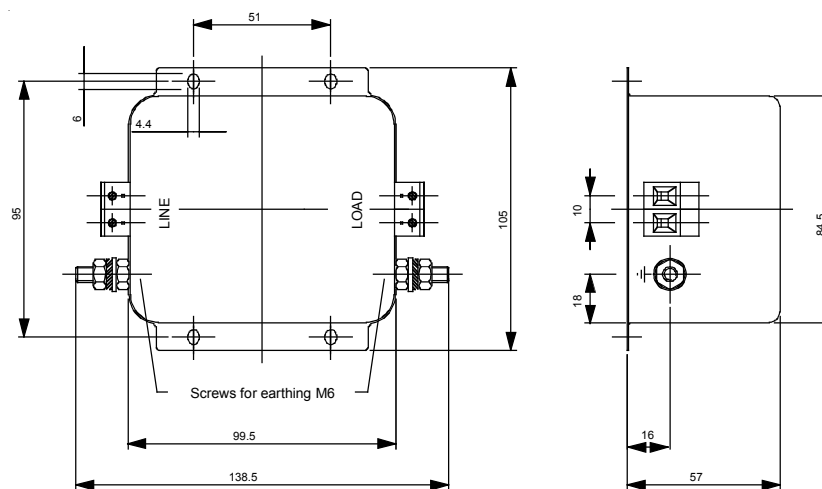Fig. 9.5/6: Dimensions of three-phase filters NF3-xxx-1600

Fig. 9.5/7: Dimensions of three-phase filters NF3-xxx-2500

III 9-13

9.5.2 Single-phase filters

Many field supply units are single - phase convert-ers for up to 50 A excitation current. They can be supplied by two of the three input phases of the ar-mature supply converter. Then a field supply unit does not need its own filter. If the phase voltage to the neutral conductor shall be taken (230 V in a 400 V line) then a separate single-phase filter is necessary. ABB offers such filters for 250 V and 6...55 A.

Filter type	max. voltage	I_N	Terminals for wires with max. dimension	Weight	PE con-necti-on
	[V]	[A]	[mm²] *	[kg]	
NF1-250-8	250	8	4	0.7	M6
NF1-250-12	250	12	4	0.9	M6
NF1-250-20	250	20	4	1.0	M6
NF1-250-30	250	30	10/16	1.0	M6
NF1-250-55	250	55	10/16	1.8	M6
* single core / litz wire					

Table 9.5/2: Electrical ratings of single-phase filters

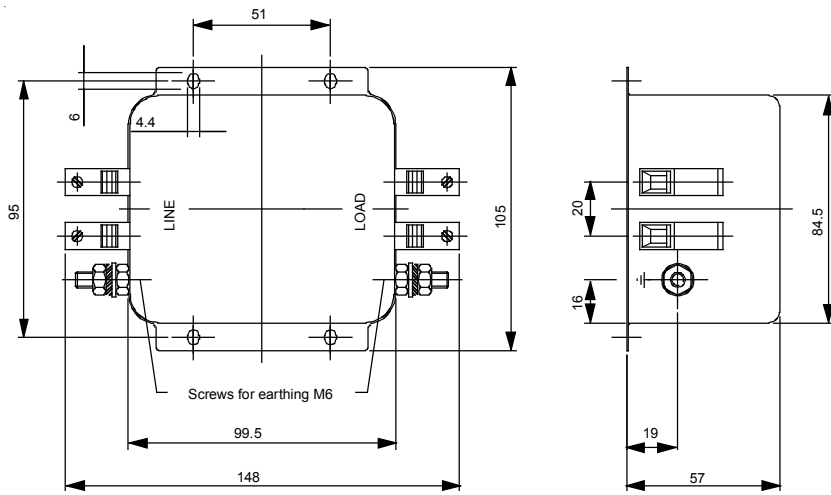Fig. 9.5/8: Dimensions of single-phase filters NF1-xxx-8, 12, 20

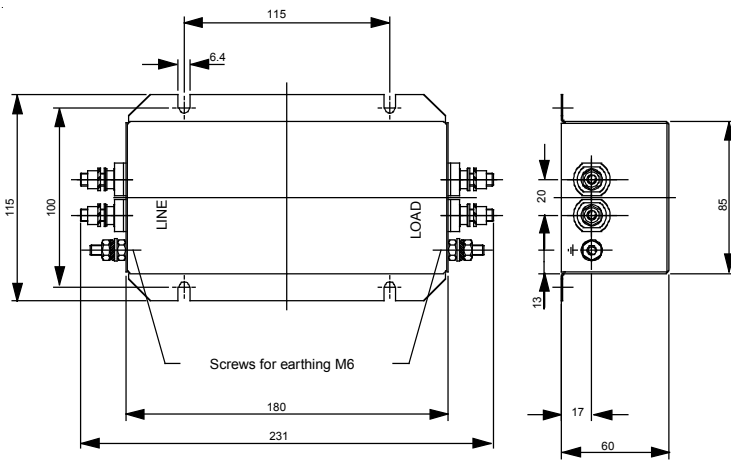Fig. 9.5/9: Dimensions of single-phase filters NF1-xxx-30

Fig. 9.5/10: Dimensions of single-phase filters NF1-xxx-55

Further Explanation of Filters

Overload Capacity

Magnetic Limit Currents (Surge Current)

Filter Type	Maximum Surge Current I_{DCmax} (average)
NF3-xxx-25	80 A
NF3-xxx-50	130 A
NF3-xxx-64	170 A
NF3-xxx-80	160 A
NF3-xxx-110	220 A
NF3-xxx-320	600 A
NF3-xxx-600	1200 A

Thermal Limit Current

The thermal time constant of the converter is smaller than the thermal time constant of the filter, if the filter is chosen according to the tables in *appendix A*.

In particular cases (e.g. a special load diagram as shown in the figure below the required filter current can be calculated with the following equation:

$$I_{filter(eff.rated)} \geq 0.82 \cdot \sqrt{\frac{1}{T} \cdot (I_1^2 \cdot t_1 + I_2^2 \cdot t_2 + ... + I_n^2 \cdot t_n)} \,.$$
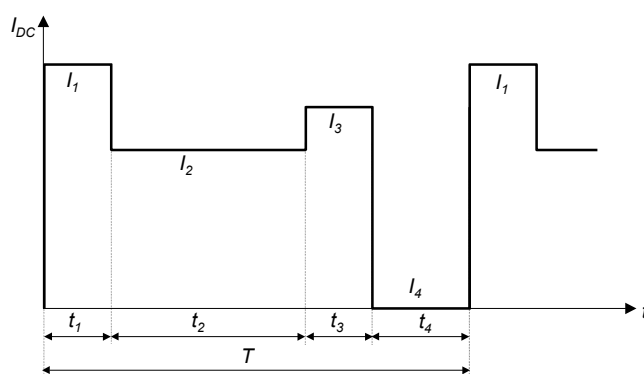
Example of load diagram

Environmental Conditions

Ambient operating temperature: 0…+40 °C

Derating: above 40 °C same derating as for the converter

Storage temperature: -25…+80 °C

Cooling method: natural air cooling

Appendix A
Optical cables

For the bus communication of the DCS converters
there are different optical cables available.

| Kind of cable	Connector	cable length	Ident. no.	Fig.
plastic fibre optic single cable	plug	0.5...20 m	3ADT 693324	1
plastic fibre optic double cable	plug	0.5...20 m	3ADT 693318	2
HCS silica (double) without plastic jacket	plug	30...50 m	3ADT 693355	3
HCS silica (double) with plastic jacket	plug	50...200 m	3ADT 693356	4
Glass fibre optic (double) reinforced	FSMA	10...100 m	3ADV 300002	5

Figure 1
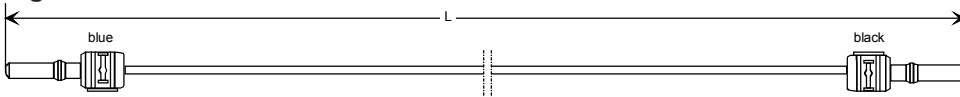
Figure 2
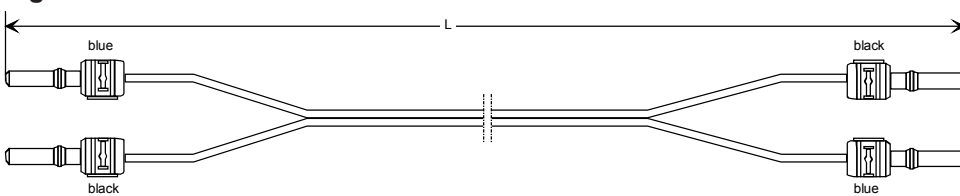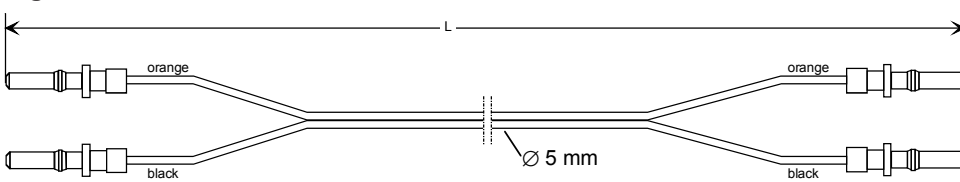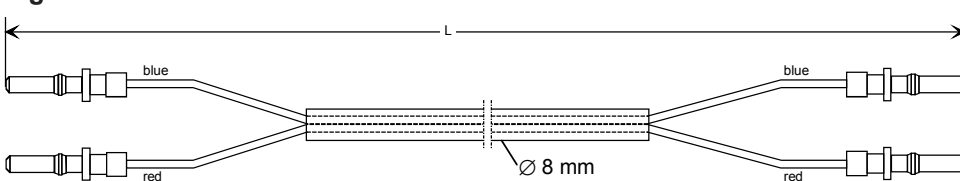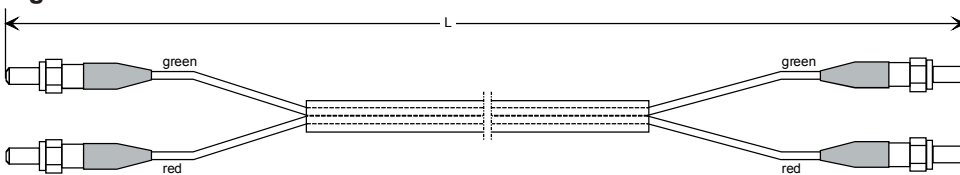
for DCS 400
DCS 500
DCS 600

Figure 3

Figure 4

for DCS 600 selected channels.
see manual NDBU 3ADW 000 100 R0201

Figure 5

for DCS 500
+ YPC115

III A-1

ABB

DC Drives Product Portfolio

DCS 400

The drive module for standard applications
- Integrated field supply (max. 20 A)
- Accurate speed and torque control
- Extremely small and compact design
- Very easy installation and commissioning
- Express delivery
- **Power range: 10...500 kW (13...670 HP)**

DCS 500B / DCS 600

The drive module for demanding applications
- Free programming of software
- 6- and 12-pulse configuration up to 10 MW/ 13,000 HP and more
- Plain text display
- **Power range: 10...5000 kW (13...6700 HP)**

DCE 500 / DCE 600

Highly integrated panel
- Excellent upgrade or revamp solution
- Contains:
  - DCS 500B / DCS 600 module
  - AC fuses
  - Auxiliary transformer
  - Motor fan starter with protection
  - Main contactor
- **Power range: 10...130 kW (26...300 HP)**

DCS 400 / DCS 500 Easy Drive

The complete standard cabinet solution
- Pre-engineered
- Easy installation and commissioning
- Protection class: IP 21
- Plain text display
- Short delivery time
- **Power range: 50...1350 kW (65...1800 HP)**

DCA 500 / DCA 600

For complex, completely engineered Drive System in common cabinet design
- Flexible and modular hardware structure
- 6- and 12-pulse configuration up to 18 MW/ 23,000 HP and more
- Pre-programmed applications: Metals, Cranes, P&P application, Mining
- **Power range: 10...18000 kW (13...23000 HP)**

Since we aim to always meet the latest state-of-the-art standards with our products, we are sure you will understand when we reserve the right to alter particulars of design, figures, sizes, weights, etc. for our equipment as specified in this brochure.

ABB

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