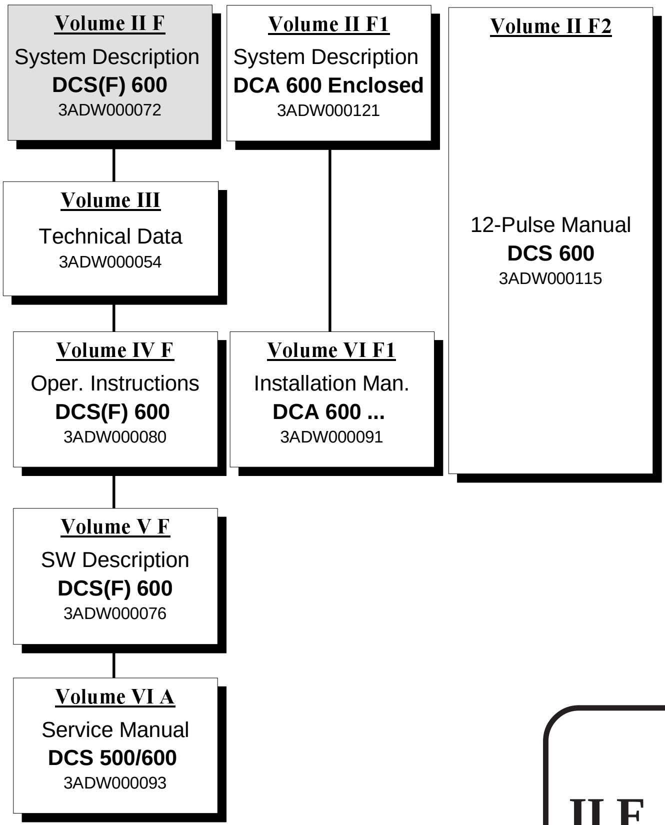
DCS Thyristor Power Converters
for DC drive systems
25 to 5150 A
6 to 4900 kW

System Description

DCS 600 converter module



How the DCS 600 MultiDrive Documentation System works

This is to give you an overview how the system of information for DCS 600 MultiDrive converters is built up. The shaded part indicates the volume within the total system you are just now working with. In addition you see all other available documents for the same system.

Remarks:

Volume II, III and IV you will receive together with every delivered converter module.
Volume V can only be ordered separately.

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1 DCS 600 MultiDrive - a new generation of power converters

❖ state-of-the-art technology
❖ flexible design
❖ user-friendliness

ABB's long years of experience with variable-speed DC drives, plus use of the latest state-of-the-art technologies, have combined to create this new product. The DCS 600 MultiDrive constitutes a complete program for ratings between 25 A and 5150 A as a power converter module, suitable for all commonly used three-phase systems.

Our products of course have **CE approvals**, and also comply with the stipulations laid down in the DIN EN **ISO 9001** quality management system.

NRTL /C

DCS 500 Drives are approved according to CSA (**C**anadian **S**tandards **A**ssociation) and NRTL /C.

DCS 600 MultiDrive converter units are suitable for system drive applications.

Appropriate **PC programs** ensure that the drives are human-engineered for user-friendly operator control.

Unit range

The range comprises of 4 sizes, C1, C2, C3 and C4. We can deliver both modules and standard cubicles in MNS-design.

Basic hardware complements

- ❋ Thyristor bridge(s) (from 900 A with leg fuses installed)
- ❋ Temperature monitor for the thyristor bridge(s)
- ❋ Fan
- ❋ Power supply for the electronics
- ❋ Microprocessor board
- ❋ AMC (**A**pplication **M**otor **C**ontrol) board with DSP (**D**igital **S**ignal **P**rocessor) for drive control and DDCS link

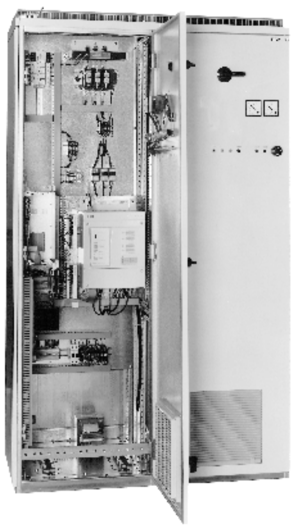
Additional components for integration in the module

- ❋ Field supply converter
  - – uncontrolled full wave diode bridge, 6A or
  - – half-controlled diode/thyristor bridge, 16A
- ❋ Control panel

Moreover, the accessories listed below can be used to individually customize the drive package in accordance with the application intended

- ❋ External field supply units
- ❋ 12-Pulse parallel configuration
- ❋ 12-Pulse serial configuration
- ❋ Additional I/O boards
- ❋ Interface modules for various communication protocol
- ❋ EMC filter(s)
- ❋ PC programs

C1 - Module



Switchgear cubicle

Basic functions

All units are provided with the same digital control board and software. The DCS 600 Multi-Drive flexibility allows the user to configure functions of the drive easily suitable for different applications. Functions of the DCS 600 Multi-Drive are normally activated by selecting a certain value to the function activation parameter.

The basic software includes the following options:

- Processing the speed reference value with speed ramp generator (S-ramp capability, accel/decel ramp)
- Processing the speed feedback
- Speed controller
- Torque reference processing (ramp function)
- Current regulator
- Selectable field weakening for constant power-applications
- Automatic/manual field reversal
- Automatic adjustment for armature-circuit controller
- Speed monitor
- Drive control logic
- Remote/local operation
- Emergency stop
- Electronic circuits are not sensitive to line phase sequence
- Electrical and mechanical brake control
- Motor overload sensing
- Dual field supply software
- Programmable analogue outputs
- Field supply
- Master-follower

Controlling and operating

via **I/O terminals**

analogue and digital inputs and outputs

via **communication data bus**

e.g.: Profibus, Modbus Plus, AF100 etc.

via **MMI** (man-machine interface)

Outputting:

Alarms
Errors
Status information

Parameter setting
Controlling the drive

Design and commissioning tools

Drives Window

PC program for Commissioning and maintenance under Windows® platform for:

Parameter setting
Error detection
Trending - capability of all signals
Data logger
Fault logger
Local operation (Drives Panel)

CDP 312 removable control and display panel with plain text display for:

Parameter setting
Error detection
Parameter uploading and downloading
Local operation

Monitoring functions

Self-test

Non-volatile fault memory

Motor protection

In the event of:

- speed feedback error
- overtemperature
- overload
- overspeed
- zero speed
- armature-circuit overcurrent
- armature-circuit ripples
- armature-circuit overvoltage
- minimum field current
- field overcurrent

Power converter protection

- overtemperature
- software errors (watchdog function)

Incorrect supply protection

- mains interruption
- auxiliary supply undervoltage
- incorrect mains phase sequence (only inform.)

2 DCS 600 MultiDrive Components Overview

DCS 600 Armature current converter

The DCS 600 MultiDrive power converter range is a system of components and complete standard switchgear cubicles for controlling DC power motors. It comprises a system of individual components, based on the DCS 600 power converter modules. This chapter provides a brief description of the DCS 600 MultiDrive components available for matching the drive to the conditions on site.

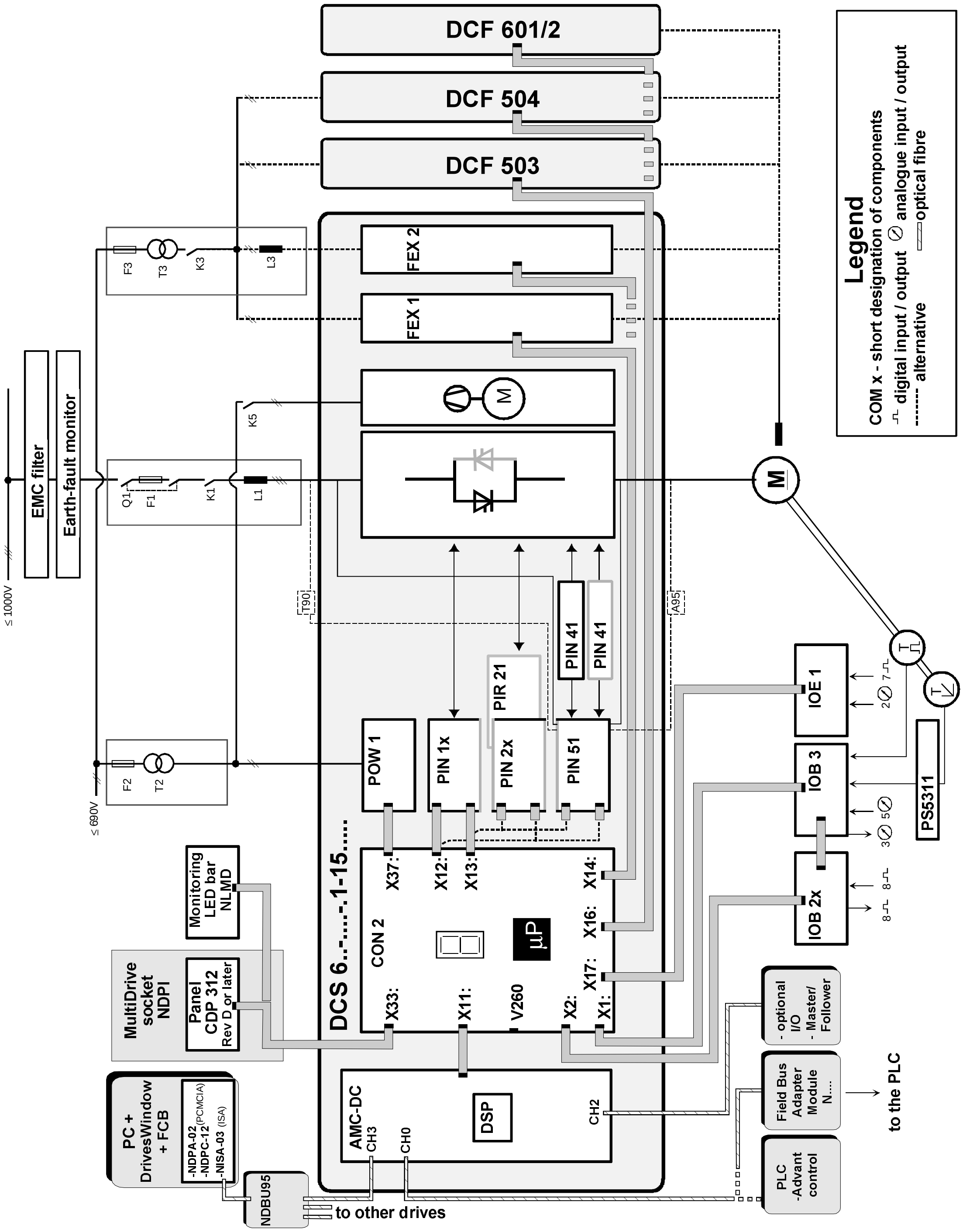


Fig. 2/1: DCS 600 MultiDrive Components overview for **armature current converters**

This overview has been designed to help you to familiarize yourself with the system; its main components are shown in the diagram above.
The system's heart is the DCS 600 converter module.

DCF 600 Field supply converter

The **DCF 600 field supply converter** range is a system of components and complete standard switchgear cubicles for controlling the field supply of DC motors. It comprises a system of individual components, based on the DCS 600 power converter modules. The difference to the armature current converter is only the modified power interface board SDCS-PIN-1x / SDCS-PIN-2x and the reduced range of current and voltage types (see table 2.2/2). The function for field supply will be selected by software parameters.

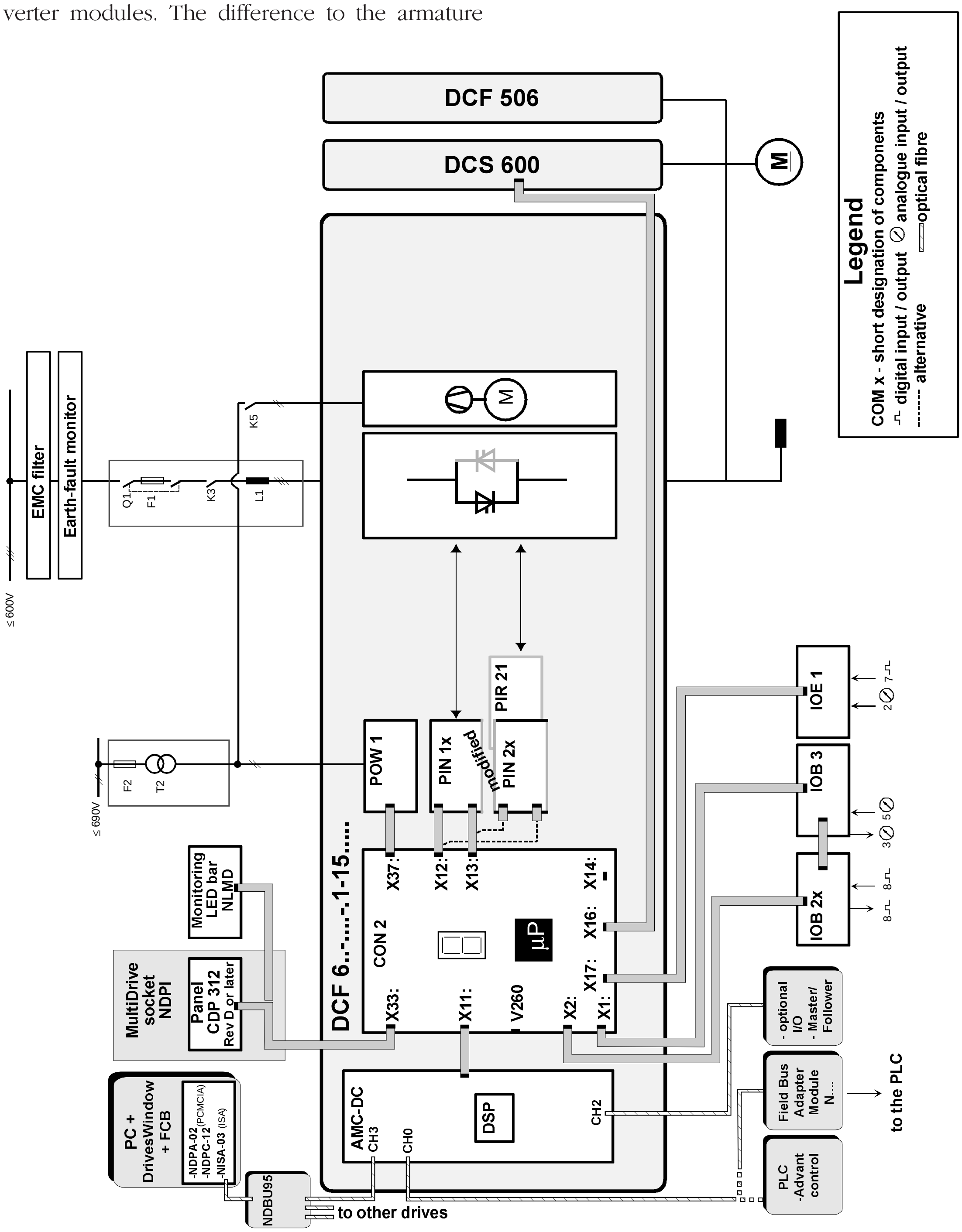


Fig. 2/2: DCS 600 MultiDrive Components overview for **field supply converters**

This overview has been designed to help you to familiarize yourself with the system; its main components are shown in the diagram above. The system's heart is the DCF 600 field supply converter module.

2.1 Environmental Conditions

System connection

Voltage, 3-phase:	230 to 1000 V to IEC 38
Voltage deviation:	±10% continuous; ±15% short-time *
Rated frequency:	50 Hz or 60 Hz
Static frequency deviation:	50 Hz ±2 %; 60 Hz ±2 %
Dynamic: frequency range:	50 Hz: ±5 Hz; 60 Hz: ± 5 Hz
df/dt:	17 % / s

* = 0.5 to 30 cycles.
Please note: Special consideration must be taken for voltage deviation in regenerative mode.

Degree of protection

Converter Module:	IP 00
Enclosed converters:	IP 20/21/31/41

Paint finish

Converter module:	NCS 170 4 Y015R
Enclosed converter:	light grey RAL 7035

Environmental limit values

Permissible ambient temp. with rated I_{DC}:	+5 to +40°C
Ambient temp. converter module:	+40°C to 55°C; s. Fig. 2.1/2
Change of the ambient temp.:	< 0.5°C / minute
Storage temperature:	-40 to +55°C
Transport temperature:	-40 to +70°C
Relative humidity:	5 to 95%, no condensation
Pollution degree:	Grade 2

Site elevation:

<1000 m above M.S.L.:	100%, without current reduction
>1000 m above M.S.L.:	with current reduct., see Fig. 2.1/1

Vibration converter module: 0.5 g, 5 Hz to 55 Hz

Noises: (1 m distance)	Size	as module	in the ABB standard cabinet
	C1	59 dBA	57 dBA
	C2	71 dBA	64 dBA
	C3	71 dBA	70 dBA
	C4	83 dBA	76 dBA

Current reduction to (%)

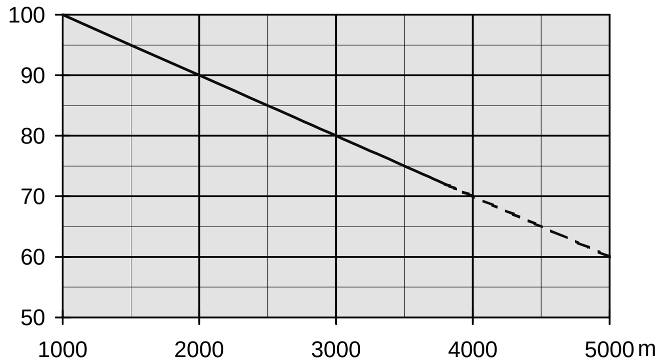


Fig. 2.1/1: Effect of the site elevation above sea level on the converter's load capacity.

Current reduction to (%)

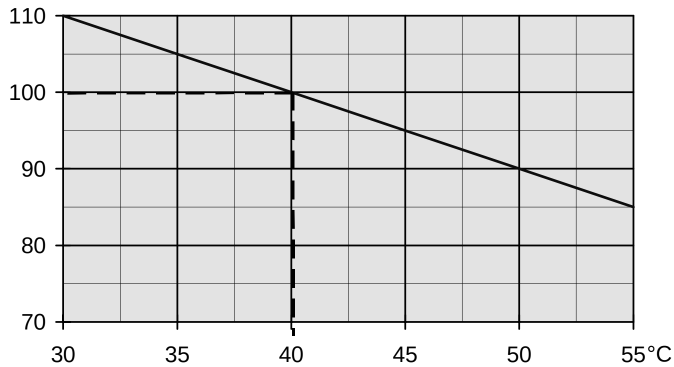


Fig. 2.1/2: Effect of the ambient temperature on the converter module load capacity.

Regulatory Compliance
The converter module and enclosed converter components are designed for use in industrial environments. In EEA countries, the components fulfil the requirements of the EU directives, see table below.

European Union Directive	Manufacturer's Assurance	Harmonized Standards	
		Converter module	Enclosed converter
Machinery Directive 89/392/EEC 93/68/EEC	Declaration of Incorporation	EN 60204-1 [IEC 204-1]	EN 60204-1 [IEC 204-1]
Low Voltage Directive 73/23/EEC 93/68/EEC	Declaration of Conformity	EN 60146-1-1 [IEC 146-1-1] EN 50178 [IEC --] see additional IEC 664	EN 60204-1 [IEC 204-1] EN 60439-1 [IEC 439-1]
EMC Directive 89/336/EEC 93/68/EEC	Declaration of Conformity Provided that all installation instructions concerning cable selection, cabling and EMC filters or dedicated transformer are followed.	EN 61800-3 ① [IEC 1800-3]	EN 61800-3 ① [IEC 1800-3]
		were limits are under consideration EN 50081-2 / EN 50082-2 has been supplied	
		① in accordance with 3ADW 000 032	① in accordance with 3ADW 000 032/ 3ADW 000 091
		The Technical Construction File to which this declaration relates has been assessed by Report and Certificate from ABB EMC Certification AB being the competent Body according to EMC Directive.	

North American Standards
In North America the system components fulfil the requirements of the table below.

Safety for Power conversion Equipment ≤ 600 V	under preparation Standard for module UL 508 C
Industrial control Equipment: industrial products ≤ 600 V	CSA C 22.2. No.1495

Note:
Only for Converter Modules

2.2 DCS 600 Power Converter Modules

The power converter modules are modular in construction. They are based on the casing, which houses the power section with the RC snubber circuit. There are 4 different sizes, graduated in terms of current and voltage ranges. All units are fan-cooled.

The power section is controlled by the unit's electronic system, which is identical for the entire range. Parts of the unit's electronic system can be installed in the unit, depending on the particular application involved, e.g. a field supply for the motor, or an interface board. A control/display panel is available for the operator. It can be snapped into place on the power converter module or installed in the switchgear cubicle door by means of a mounting kit.

Accessories such as external fuses, line reactors and the like are also available, for putting together a complete drive system.

Reference variables

The voltage characteristics are shown in Table 2.2/1. The DC voltage characteristics have been calculated using the following assumptions:

- U_{VN} = rated input terminal voltage, 3-phase
- Voltage tolerance ±10 %
- Internal voltage drop approx. 1%
- If a deviation or a voltage drop has to be taken into consideration in compliance with IEC and VDE standards, the output voltage or the output current must be reduced by the actual factor according to the table on the right.

System connection voltage U_v	DC voltage (max. Motor voltage) U_d 2Q ①	DC voltage (max. Motor voltage) U_d 4Q	Ideal DC voltage without load U_{di0}	Recommended DCS 600 Voltage class y=
230	265	240	310	4
380	440	395	510	4
400	465	415	540	4
415	480	430	560	4
440	510	455	590	5
460	530	480	620	5
480	555	500	640	5
500	580	520	670	5
525	610	545	700	6
575	670	600	770	6
600	700	625	810	6
660	765	685	890	7
690	800	720	930	7
790	915	820	1060	8
1000	1160	1040	1350	9

① in case of a 2-Q converter, which is used in regenerative mode, please use 4-Q voltage values

Table 2.2/1: DCS 600 max. DC voltages achievable with a specified input voltage.

Converter type ➔ / y →	I_{DC} [A]		I_{AC} [A]		y=4 (400 V) P [kW]		y=5 (500 V) P [kW]		y=6 (600 V) P [kW]		y=7 (690 V) P [kW]		y=8 (790 V) P [kW]		y=9 (1000V) P [kW]	
➔ x=1 → 2-Q; x=2 → 4-Q	4Q	2Q	4Q	2Q	4Q	2Q	4Q	2Q	4Q	2Q	4Q	2Q	4Q	2Q	4Q	2Q
DCS60x-0025-y1	25	25	20	20	10	12	13	15								
DCS60x-0050-y1	50	50	41	41	21	23	26	29								
DCS60x-0050-61	50	50	41	41					31	35						
DCS60x-0075-y1	75	75	61	61	31	35	39	44								
DCS60x-0100-y1	100	100	82	82	42	47	52	58								
DCS60x-0110-61	110	100	90	82					69	70						
DCS60x-0140-y1	140	125	114	102	58	58	73	73								
DCS60x-0200-y1	200	180	163	147	83	84	104	104								
DCS60x-0250-y1	250	225	204	184	104	105	130	131								
DCS60x-0270-61	270	245	220	200					169	172						
DCS60x-0350-y1	350	315	286	257	145	146	182	183								
DCS60x-0450-y1	450	405	367	330	187	188	234	235	281	284						
DCS60x-0520-y1	520	470	424	384	216	219	270	273								
DCS60x-0700-y1	700	700	571	571	291	326	364	406								
DCS60x-0900-y1	900	900	734	734	374	419	468	522	563	630	648	720				
DCS60x-1200-y1	1200	1200	979	979	498	558	624	696								
DCS60x-1500-y1	1500	1500	1224	1224	623	698	780	870	938	1050	1080	1200				
DCS60x-2000-y1	2000	2000	1632	1632	830	930	1040	1160								
DCS60x-2050-y1	2050	2050	1673	1673					1281	1435	1476	1640	1681	1876	2132	2378
DCS60x-2500-y1	2500	2500	2040	2040	1038	1163	1300	1450	1563	1750	1800	2000				
DCS60x-2650-y1	2650	2650	2162	2162											2756	3074
DCS60x-3200-y1	3200	3200	2611	2611									2624	2928	3328	3712
DCS60x-3300-y1	3300	3300	2693	2693	1370	1535	1716	1914	2063	2310	2376	2640				
DCS60x-4000-y1	4000	4000	3264	3264	1660	1860	2080	2320	2500	2800	2880	3200	3280	3660	4160	4640
DCS60x-4750-y1	4750	4750	3876	3876					2969	3325	3420	3800	3895	4346		
DCS60x-5150-y1	5150	5150	4202	4202	2137	2395	2678	2987								

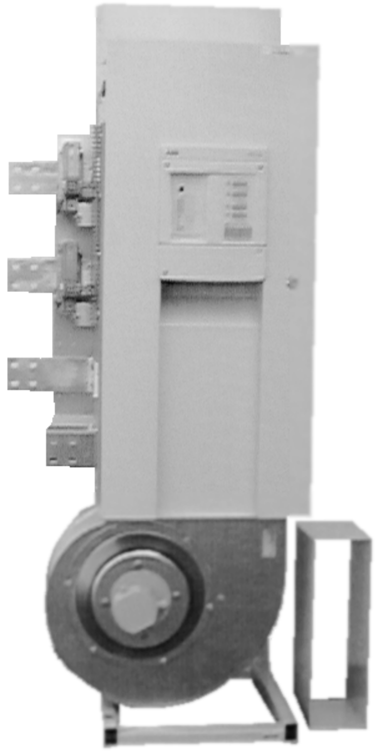
Table 2.2/2: Table of DCS 600 unit types

also available as DCF 60x field supply converters

Construction type C1

Construction type C2

Construction type C3



Construction type C4
Left busbar connection ①

Converter type ③	Dimensions H x W x D [mm]	Weight [kg]	Clearances top/bottom/side [mm]	Construct. type	Power loss at 500V P_V [kW]	Fan connection	Semiconductor Fuses
DCS60x-0025-y1	420x273x195	7.1	150x100x5	C1	< 0.2	230 V/1 ph	extern
DCS60x-0050-y1	420x273x195	7.2	150x100x5	C1	< 0.2	230 V/1 ph	extern
DCS60x-0050-61	420x273x195	7.6	150x100x5	C1	-	230 V/1 ph	extern
DCS60x-0075-y1	420x273x195	7.6	150x100x5	C1	< 0.3	230 V/1 ph	extern
DCS60x-0100-y1	469x273x228	11.5	250x150x5	C1	< 0.5	230 V/1 ph	extern
DCS60x-0110-61	469x273x228	11.5	250x150x5	C1	-	230 V/1 ph	extern
DCS60x-0140-y1	469x273x228	11.5	250x150x5	C1	< 0.6	230 V/1 ph	extern
DCS60x-0200-y1	505x273x361	22.3	250x150x5	C2	< 0.8	230 V/1 ph	extern
DCS60x-0250-y1	505x273x361	22.3	250x150x5	C2	< 1.0	230 V/1 ph	extern
DCS60x-0270-61	505x273x361	22.8	250x150x5	C2	-	230 V/1 ph	extern
DCS60x-0350-y1	505x273x361	22.8	250x150x5	C2	< 1.3	230 V/1 ph	extern
DCS60x-0450-y1	505x273x361	28.9	250x150x10	C2	< 1.5	230 V/1 ph	extern
DCS60x-0520-y1	505x273x361	28.9	250x150x10	C2	< 1.8	230 V/1 ph	extern
DCS60x-0700-y1	652x273x384	57	250x150x10	C2	< 2.5	230 V/1 ph	extern
DCS60x-0900-y1	1493x548x447	150	300x100x20	C3	< 4.8	400/690 V/3 ph④	intern
DCS60x-1200-y1	1493x548x447	150	300x100x20	C3	< 6.2	400/690 V/3 ph④	intern
DCS60x-1500-y1	1493x548x447	150	300x100x20	C3	< 6.3	400/690 V/3 ph④	intern
DCS60x-2000-y1	1493x548x447	150	300x100x20	C3	< 8.2	400/690 V/3 ph④	intern
DCS60x-2050-y1	2330x820x624 ① ②	350	to be installed in cubicle	C4	-	400/690 V/3 ph④	intern
DCS60x-2500-y1	2330x820x624 ①	350		C4	< 12	400/690 V/3 ph④	intern
DCS60x-2650-y1	2330x820x624 ① ②	350		C4	-	400/690 V/3 ph④	intern
DCS60x-3200-y1	2330x820x624 ① ②	350		C4	-	400/690 V/3 ph④	intern
DCS60x-3300-y1	2330x820x624 ①	350		C4	< 15	400/690 V/3 ph④	intern
DCS60x-4000-y1	2330x820x624 ① ②	350		C4	< 16	400/690 V/3 ph④	intern
DCS60x-4750-y1	2330x820x624 ①	350		C4	-	400/690 V/3 ph④	intern
DCS60x-5150-y1	2330x820x624 ①	350		C4	< 20	400/690 V/3 ph④	intern

① The dimensions for modules with busbar connection on the right side are 2330x800x624 mm
(Busbar connect. on the right side is optionally, Example for the type designat.: connection left DCS60x-2050**-**y1; connection right DCS60x-2050**+**y1)
② The depth of 1000 V units is 654 mm
③ **x=1** → 2-Q; **x=2** → 4-Q; **y=4...9** → 400...1000 V supply voltage
④ On supply voltages up to 400 V in delta connection; from 415 V on in star connection
also available as field supply converter DCF60x (for 500 V s. also table 2.2/2). Data are the same as the armature current converter DCS60x
Table 2.2/3: Table of DCS 600 unit types

2.3 DCS 600 Overload Withstand Capability

To match a drive system's components as efficiently as possible to the driven machine's load profile, the power converters can be dimensioned by means of the load cycle. Load cycles for driven machines have been defined in the IEC 146 or IEEE specifications, for example.

The currents for the DC I to DC IV types of load (see diagram on the following page) for the power converter modules are listed in the table below.

Unit type	$I_{DC\ I}$	$I_{DC\ II}$		$I_{DC\ III}$		$I_{DC\ IV}$	
	contin-uous	100 % 15 min	150 % 60 s	100 % 15 min	150 % 120 s	100 % 15 min	200 % 10 s
400 V / 500 V	[A]	[A]		[A]		[A]	
DCS60x-0025-41 / 51	25	24	36	23	35	24	48
DCS60x-0050-41 / 51	50	44	66	42	63	40	80
DCS60x-0075-41 / 51	75	60	90	56	84	56	112
DCS60x-0100-41 / 51	100	71	107	69	104	68	136
DCS601-0140-41 / 51	125	94	141	91	137	90	180
DCS602-0140-41 / 51	140	106	159	101	152	101	202
DCS601-0200-41 / 51	180	133	200	132	198	110	220
DCS602-0200-41 / 51	200	149	224	146	219	124	248
DCS601-0250-41 / 51	225	158	237	155	233	130	260
DCS602-0250-41 / 51	250	177	266	173	260	147	294
DCS601-0350-41 / 51	315	240	360	233	350	210	420
DCS602-0350-41 / 51	350	267	401	258	387	233	466
DCS601-0450-41 / 51	405	317	476	306	459	283	566
DCS602-0450-41 / 51	450	352	528	340	510	315	630
DCS601-0520-41 / 51	470	359	539	347	521	321	642
DCS602-0520-41 / 51	520	398	597	385	578	356	712
DCS60x-0700-41 / 51	700	556	834	534	801	524	1048
DCS60x-0900-41 / 51	900	684	1026	670	1005	594	1188
DCS60x-1200-41 / 51	1200	888	1332	872	1308	764	1528
DCS60x-1500-41 / 51	1500	1200	1800	1156	1734	1104	2208
DCS60x-2000-41 / 51	2000	1479	2219	1421	2132	1361	2722
DCS60x-2500-41 / 51	2500	1830	2745	1740	2610	1725	3450
DCS60x-3300-41 / 51	3300	2416	3624	2300	3450	2277	4554
DCS60x-4000-41 / 51	4000	2977	4466	2855	4283	2795	5590
DCS60x-5150-41 / 51	5150	3800	5700	3669	5504	3733	7466
600 V / 690 V							
DCS60x-0050- 61	50	44	66	43	65	40	80
DCS601-0110- 61	100	79	119	76	114	75	150
DCS602-0110- 61	110	87	130	83	125	82	165
DCS601-0270- 61	245	193	290	187	281	169	338
DCS602-0270- 61	270	213	320	207	311	187	374
DCS601-0450- 61	405	316	474	306	459	282	564
DCS602-0450- 61	450	352	528	340	510	313	626
DCS60x-0900-61 / 71	900	684	1026	670	1005	594	1188
DCS60x-1500-61 / 71	1500	1200	1800	1104	1656	1104	2208
DCS60x-2050-61 / 71	2050	1502	2253	1426	2139	1484	2968
DCS60x-2500-61 / 71	2500	1830	2745	1740	2610	1725	3450
DCS60x-3300-61 / 71	3300	2416	3624	2300	3450	2277	4554
DCS60x-4000-61 / 71	4000	3036	4554	2900	4350	2950	5900
DCS60x-4750-61 / 71	4750	3734	5601	3608	5412	3700	7400
790 V							
DCS60x-2050-81	2050	1502	2253	1426	2139	1484	2968
DCS60x-3200-81	3200	2655	3983	2540	3810	2485	4970
DCS60x-4000-81	4000	3036	4554	2889	4334	2933	5866
DCS60x-4750-81	4750	3734	5601	3608	5412	3673	7346
1000 V							
DCS60x-2050-91	2050	1577	2366	1500	2250	1471	2942
DCS60x-2650-91	2650	2000	3000	1900	2850	1922	3844
DCS60x-3200-91	3200	2551	3827	2428	3642	2458	4916
DCS60x-4000-91	4000	2975	4463	2878	4317	2918	5836

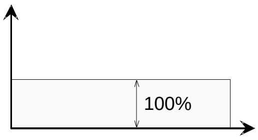
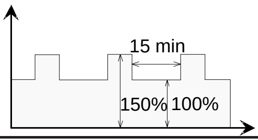
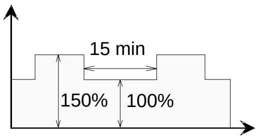
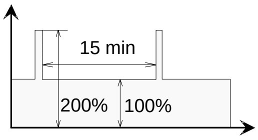
x=1 → 2-Q; **x=2** → 4-Q

also available as field supply converter DCF60x with the appropriate voltage class marked. Data are the same as the armature current converter DCS60x

Table 2.3/1: The power converter modules' currents with the corresponding load cycles.

The characteristics are based on an ambient temperature of max. 40°C and an elevation of max. 1000 meters.

Types of load

Operating cycle	Load for converter	Typical applications	Load cycle
DC I	$I_{DC\ I}$ continuous (I_{dN})	pumps, fans	
DC II	$I_{DC\ II}$ for 15 min and 1,5 * $I_{DC\ II}$ for 60 s	extruders, conveyor belts	
DC III *	$I_{DC\ III}$ for 15 min and 1,5 * $I_{DC\ III}$ for 120 s	extruders, conveyor belts	
DC IV *	$I_{DC\ IV}$ for 15 min and 2 * $I_{DC\ IV}$ for 10 s		

* Load cycle is not identical to the menu item *Duty cycle* in the DCSize program !
The example load cycle show one case of DC standard
Table 2.3/2: Definition of the load cycles

If the driven machine's load cycle does not correspond to one of the examples listed, you can determine the necessary power converter using the DCSize software program.

This program can be run under Microsoft® Windows, and enables you to dimension the motor and the power converter, taking types of load (load cycle), ambient temperature, site elevation, etc. into account. The design result will be presented in tables, charts, and can be printed out as well.

To facilitate the start-up procedure as much as possible, every power converter has been provided with a current measuring feature, which can be adjusted to the high current required by means of software parameters.

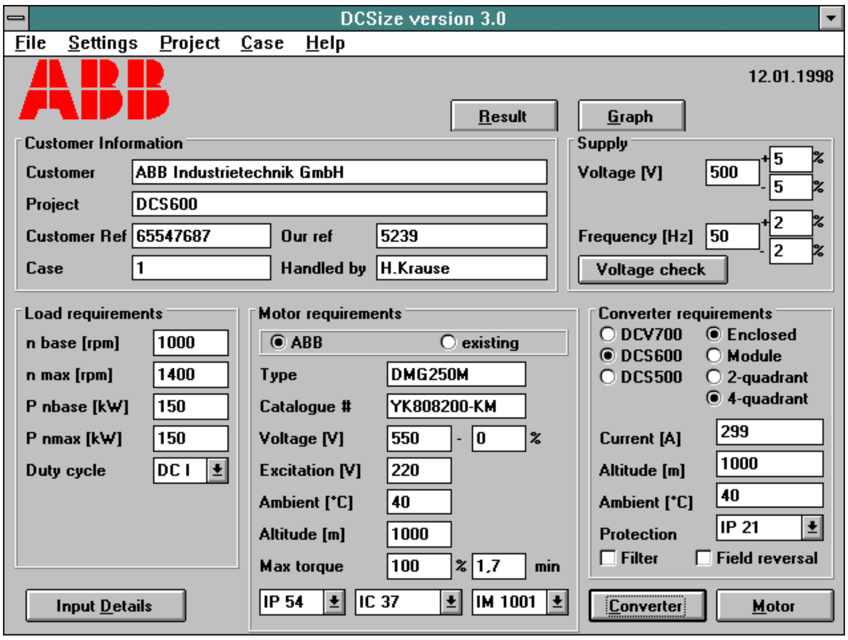


Fig. 2.3/1: Entry mask on the computer screen for the dimensioning program DCSize.

Microsoft is a registered trademark. Windows is a designation of the Microsoft Corporation.

2.4 Field Supplies

General data

- Currents from 6 to 500 A
- Minimum field current monitor
- Integrated external field power converter or completely separate switchgear cubicle
- 2-phase or 3-phase model
- Fully digital control (except for the SDCS-FEX-1)

We recommend integrating an autotransformer in the field power converter's supply circuit to adjust the AC input voltage and reduce the voltage ripple in the field circuit.

All field power converters (except for the SDCS-FEX-1) are controlled by the armature-circuit converter via a serial interface at a speed of 62.5 kBaud. This interface serves to parameterize, control and diagnose the field power converter and thus provides an option for exact control. Moreover, it enables you to control an internal (SDCS-FEX-2) and an external (DCF 503/504) or two external field supply units (2 x DCF 503/504). The respective software function required is available in every DC power converter.

Field power converter types

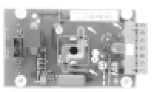
SDCS-FEX-1

- Diode bridge
- 6 A rated current
- Internal minimum field current monitor, requiring no adjustment.
- Construction and components have been designed for an insulation voltage of 600 V AC.
- Output voltage U_A:

$$U_A = U_V * \left(\frac{100\% + TOL}{100\%}\right) * 0,9$$

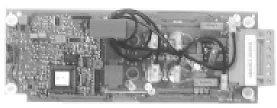
TOL = tolerance of line voltage in %

- Recommendation:
  Field voltage ~ 0,9 * U_V



SDCS-FEX-2

- Half-controlled thyristor/diode bridge (1-Q)
- Microprocessor control, with the electronic system being supplied by the armature-circuit converter.
- Construction and components have been designed for an insulation voltage of 600 V AC.
- Output voltage U_A:
  see SDCS-FEX-1
- Recommendation:
  Field voltage 0.6 to 0.8 *U_V



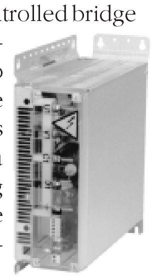
DCF 503

- Half-controlled thyristor/diode bridge (1-Q)
- Microprocessor control with the control electronics being supplied separately (115/230 V/1-ph).
- Construction and components have been designed for an insulation voltage of 690 V AC.

DCF 504

- like DCF 503, but
- fully-controlled antiparallel thyristor bridges (4-Q)
- Output voltage/Recommendation:
  see SDCS-FEX-2

This unit provides an option for field reversal and fast-response excitation. In the steady-state condition, the fully-controlled bridge runs in half-controlled mode so as to keep the voltage ripple as low as possible. With a quickly alternating field current, the bridge runs in fully-controlled mode.



DCF 601/602

This field power converter is used mainly for armature-circuit converters with rated currents of 2050 to 5150 A. In this case the DCF 600 has to be activated for field supply by the software. The rated currents are the same as with the DCS 600-0025/0520 A units with 500 V/3-ph supply voltage.

- Output voltage U_A respectively U_{di0} :
  see table 2.2/1
- Recommendation:
  Field voltage 0.5 to 1.1 *U_V

Unit type	Output current I_{DC} ① [A]	Supply voltage [V]	Installation site	Remarks
SDCS-FEX-1-0006	0.02...6	110V -15%...500V/1-ph +10%	internal	external fuse, 6 A ⇒ I_{Frated}
SDCS-FEX-2-0016	0.3...16	110V -15%...500V/1-ph +10%	internal	ext. fuse, reactor; for C1: 0.3 ... 8 A ①, not to be used for C4 mod.!
DCF 503-0050	0.3...50	110V -15%...500V/1-ph +10%	external	auxiliary supply (115/230V) if necessary via matching transformer;
DCF 504-0050	0.3...50	110V -15%...500V/1-ph +10%	external	fuse external; Dimensions HxWxD: 370x125x342 [mm]
DCF 60x-xxxx-x1-15 xxxxx needs additional overvoltage components (DCF 505/506). For more infformation see publication *Technical Data.*				

① Current reduction see also *2.1 Environmental conditions Fig.: 2.1/1 and 2.1/2*

Table 2.4/1: Table of field power converter unit types

2.5 Options for power converter modules

In-/output signals

The converter 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.

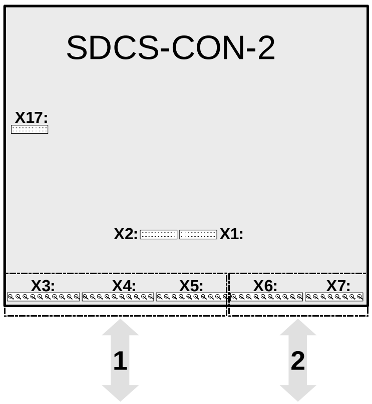


Fig. 2.5/1: I/O´s via SDCS-CON2

Analogue I/O´s: standard
Digital I/O´s: not isolated
Encoder input: not isolated

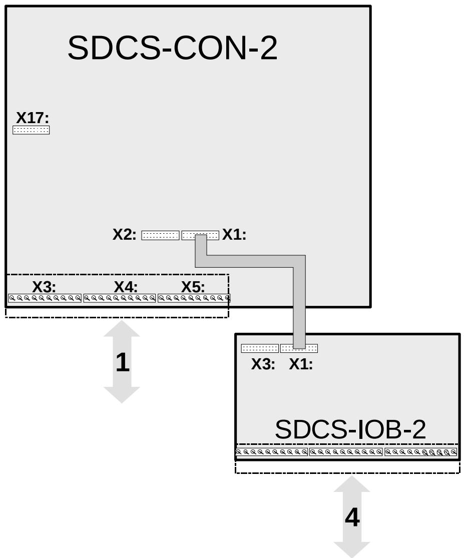


Fig. 2.5/2: I/O´s via SDCS-CON2 and SDCS-IOB2

Analogue I/O´s: standard
digital I/O´s: all isolated by means of optocoupler/relay, the signal status is indicated by LED

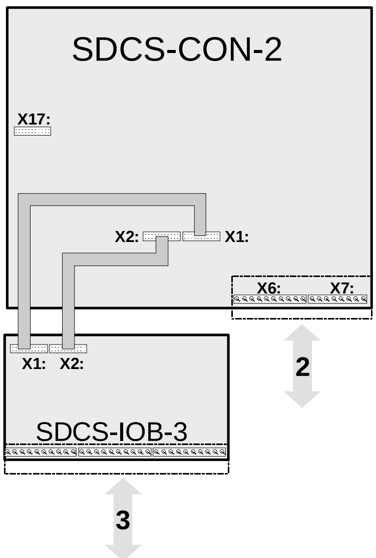


Fig. 2.5/3: I/O´s via SDCS-CON2 and SDCS-IOB3

Analogue I/O´s: more input capacity
digital I/O´s: not isolated
encoder input: isolated
current source for: PT100/PTC element

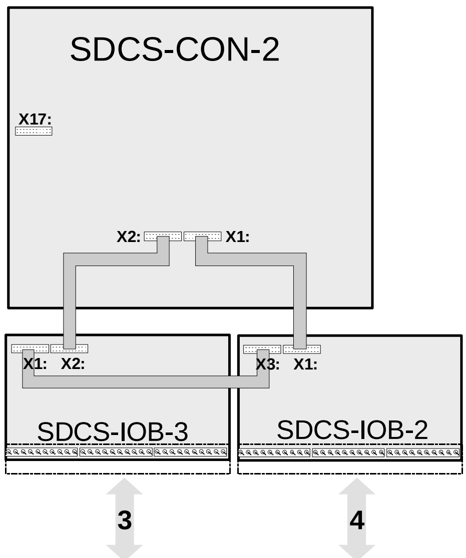


Fig. 2.5/4: I/O´s via SDCS-IOB2 and SDCS-IOB3

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

Description of I/O signals **SDCS-CON-2**

Mechanical system installed in the basic unit

Terminals

Screw-type terminals for finely stranded wires up to max. 2.5 mm² cross-sectional area

Functionality

⇨ **1 tacho input**
Resolution: 12 bit + sign; differential input; common-mode range ±20 V
3 ranges from 8...30...90...270 V- with n_{max}

⇨ **4 analogue inputs**
Range -10...0...+10 V, 4...20 mA, 0...20 mA
All as differential inputs; R_E = 200 kΩ; time constant of smoothing capacitor ≤2 ms
Input 1: Resolution: 12 bit + sign.; common-mode range ±20 V
Inputs 2, 3, 4: Resolution: 11 bit + sign; common-mode range ±40 V

⇦ **2 outputs**
+10 V, -10 V, I_A ≤ 5 mA each; sustained-short-circuit-proof
for reference potentiometer voltage supply

⇦ **1 analogue output**
bipolar current feedback - from the power section; decoupled
IdN ⇒ ±3 V; I_A≤ 5 mA, short-circuit-proof

⇦ **2 analogue outputs**
Range -10...0...+10 V; I_A ≤ 5 mA
Output signal and scaling can be selected by means of the software
Resolution: 11 bit + sign

⇨ **1 pulse generator input**
Voltage supply for 5 V/12 V/24 V pulse generators (sustained-short-circuit-proof)

Output current with	5 V:	I_A ≤ 0.25 A
	12 V:	I_A ≤ 0.2 A
	24 V:	I_A ≤ 0.2 A
Input range:	12 V/24 V:	asymmetrical and differential
	5 V:	differential

Pulse generator as 13 mA current source: differential
Line termination (impedance 120Ω), if selected
max. input frequency ≤300 kHz

⇨ **8 digital inputs**
The functions can be selected by means of the software
Input voltage: 0...8 V ⇒"0 signal", 16...60 V ⇒ "1 signal"
Time constant of smoothing capacitor: 10 ms
R_E = 15 kΩ
The signal refers to the unit casing potential
Auxiliary voltage for digital inputs: +48 V-, ≤ 50 mA, sustained-short-circuit-proof

⇦ **7+1 digital outputs**
The function can be selected by means of the software
7 outputs: relay driver with free-wheel diode, total current limitation ≤ 160 mA, short-circuit-proof
1 relay output - on power pack board SDCS-POW-1 (N.O. contact element: **AC**: ≤250 V/ ≤3 A / **DC**: ≤24 V/ ≤3 A or ≤115/230 V/ ≤0.3 A) protected by VDR component.

Description of I/O signals **SDCS-IOB-2x** & **SDCS-IOB-3**

Mechanical system always external, outside the basic unit

Terminals

Screw-clamp terminals for finely stranded wires up to max. 2.5 mm² cross-sectional area

Functionality of SDCS-IOB-3

⇨ **1 tacho input**
Resolution: 12 bit + sign; differential input; common-mode range ±20 V
Range 8 V- with n_{max}; if higher tacho voltages are in use the tacho adaptation board PS 5311 is needed.

⇨ **4 analogue inputs**
All as differential inputs; time constant of smoothing capacitor ≤2 ms
Input 1: Range -10 V/-20 mA...0...+10 V/+20 mA; 4... 20 mA unipolar; R_E = 200 kΩ/ 500Ω/ 500Ω; Resolution: 12 bit + sign; common-mode range ±20 V
Inputs 2+3: Range as with input 1, in addition -1 V...0...+1 V
R_E = 200 kΩ/ 500Ω/ 500Ω/ 20kΩ; Resolution: 11 bit + sign; common-mode range with -1 V...0...+1 V range ±10 V, otherwise ±40 V
Input 4: Range as with input 1
R_E = 200 kΩ/ 500Ω/ 500Ω; Resolution: 11 bit + sign; common-mode range ±40 V

⇨ **Error current detection** in combination with analogue input 4
(sum of phase currents ≠ 0)

⇦ **2 outputs**
+10 V, -10 V, I_A ≤ 5 mA each; sustained-short-circuit-proof
for reference potentiometer voltage supply

⇦ **1 analogue output**
Bipolar current feedback - from the power section; decoupled
IdN ⇒ ±3 V (at gain = 1); I_A≤ 5 mA, U_{Amax} = 10 V, gain can be adjusted by means of a potentiometer between 0.5 and 5, short-circuit-proof

⇦ **2 analogue outputs**
Range -10...0...+10 V; I_A ≤ 5 mA; short-circuit-proof
Output signal and scaling can be selected by means of the software
Resolution: 11 bit + sign

⇦ **Current source** for PT 100 or PTC element evaluation
I_A = 5 mA / 1.5 mA

⇨ **1 pulse generator input**
Voltage supply, output current, input range: **as with IOB1**
Inputs electrically isolated from 0 V (casing earth) by means of optocoupler and voltage source.

Functionality of SDCS-IOB-2x

3 different designs available:

- **SDCS-IOB-21** inputs for 24...48 V-; R_E = 4.7 kΩ
- **SDCS-IOB-22** inputs for 115 V AC; R_E = 22 kΩ
- **SDCS-IOB-23** inputs for 230 V AC; R_E = 47 kΩ

Terminals

Screw-clamp terminals up to max. 4 mm² cross-sectional area

⇨ **8 digital inputs**
The functions can be selected by means of the software
The signal status is indicated by an LED
all isolated by means of optocouplers

Input voltage:	IOB-21:0...8 V ⇒"0 signal", 18...60 V	⇒"1 sig."
	IOB-22:0...20 V ⇒"0 signal", 60...130 V	⇒"1 sig."
	IOB-23:0...40 V ⇒"0 signal", 90...250 V	⇒"1 sig."

Filter time constant: 10 ms (channels 1...6), 2 ms (channels 7+8)
Auxiliary voltage for digital inputs: +48 V-, ≤ 50 mA, sustained- short-circuit-proof; referenced to the unit casing potential

⇦ **8 digital outputs**
The functions can be selected by means of the software
The signal status is indicated by an LED
6 of them potential-isolated by relay (N.O. contact element: **AC**: ≤250 V/ ≤3 A / **DC**: ≤24 V/ ≤3 A or ≤115/230 V/ ≤0.3 A) , protected by VDR component.
2 of them potential-isolated by optocoupler, protected by Zener diode (open collector) 24 V DC external, I_A ≤ 50 mA each.

Serial interfaces

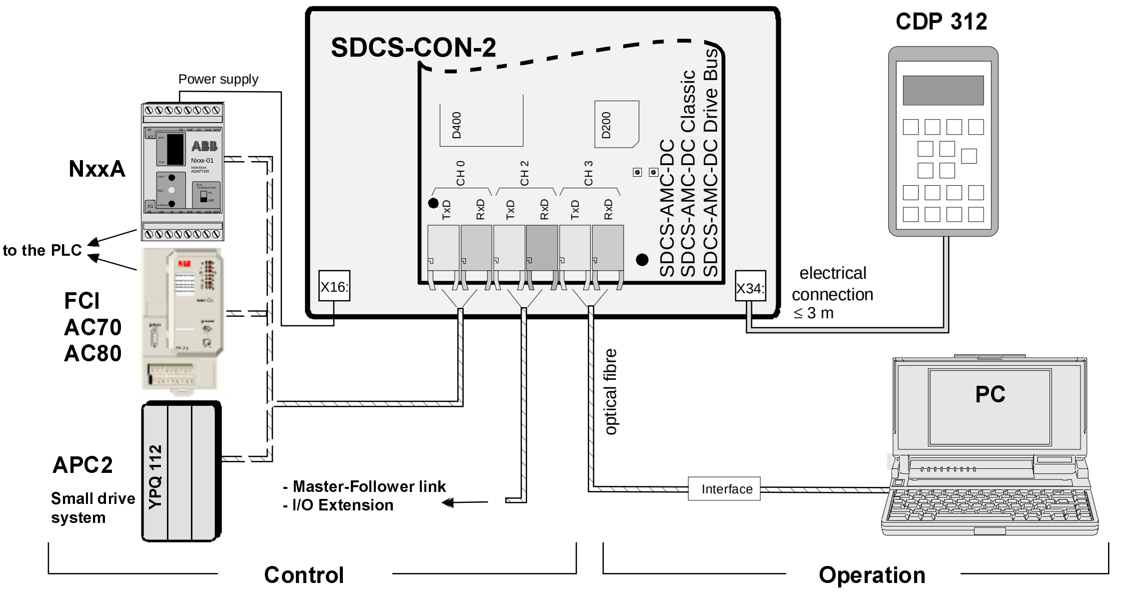
There are various serial interface options available for operation, commissioning and diagnosis, plus for controlling. For the control and display panel CDP 312 there is a serial connection X33:/ X34: on the SDCS-CON-2. Three further serial interfaces are available on the SDCS-AMC-DC board.

These interfaces use plastic or HCS optical fibres. One channel is used for drive/PC interfacing. Another for fieldbus module interfacing. The third channel is provided for Master-Follower link or for I/O extension. All three serial interfaces are independent from each other.

Some different SDCS-AMC boards are available to adapt optical cables, cable length and serial interfaces. The different SDCS-AMC boards are equipped with 10 or 5 Mbaud optical transmitter and receiver devices.

A few basic rules must be considered:

- Never mix of 5 Mbd and 10 Mbd devices at the same cable
- 5 Mbd can handle only plastic fibre optic
- 10 Mbd can handle plastic or HCS silicat cable
- The branching unit NDBU 95 can enlarge the maximum distance
- The maximum distance and suitable configuration can be select in the manual *Configuration instructions NDBU 85-95* - Doc no.: (3ADW000100)



Remark:
Fieldbus modules NxxA (CH0) require the SDCS-AMC-DC ***Classic*** board - all others (FCI, APC2...) require the SDCS-AMC-DC or SDCS-AMC-DC Drive Bus board.

Fig. 2.5/5: Options for serial communication

Operation by panel

Panel location

There are different possibilities for mounting the panel:

- in the provided aperture of the converter module
- with MultiDrive door mounting kit

LED Monitoring Display

If the MultiDrive door Mounting kit is used it is possible to insert up to three LED monitoring displays for indicating status as Run, Ready and Fault and a selectable parameter indicator (0...150%) per drive. The display is connected to the SDCS-CON-2 board X33:/X34: or to panel socket NDPI through a universal Modbus link.

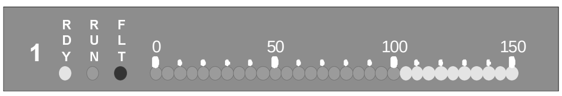


Fig. 2.5/6: LED Monitoring Display

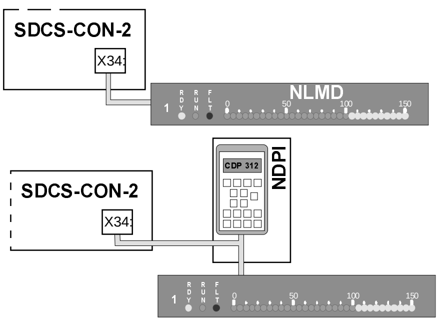


Fig. 2.5/7: Connection of the LED Monitoring Display

Panel (control and display panel)

The CDP 312 control and display panel communicates with the power converter via a serial connection in accordance with the RS 485 standard at a transmission rate of 9.6 kBaud. It is an option for the converter unit. After completion of the commissioning procedure, the panel is not necessarily required for diagnostic routines, because the basic unit incorporates a 7-segment display for indicating errors, for example.

Equipment

- 16 membrane push-button in three function groups
- LCD display comprising four lines with 20 characters each
- Controlling and monitoring up to 31 drives
- Language: English
- Options for the CDP 312:
  - cable, separated from the power converter for utilization
  - kits for mounting the panel in the switchgear cubicle door

Parameters
For selecting and adjusting all parameters and signals.

Group and name / Subgroup and name / Value

```
  0 L    0,0 rpm   00
17 RAMP GENERATOR
08 ACCEL 1
 20.0 s
```

Actual
Selects the display of feedback values plus the signal group and the error memory group.

ID number of the drive selected / Control location L = local = remote / Speed reference rpm / Main contactor status 0 = open 1 = closed / Run status 1 = Run 0 = Stop

Status row / Actual signal name and value / Cursor shows the row selected

```
  0 L   0,0 rpm     00
SPEEED ACT     0,0 rpm
CONV CUR         0 A
U ARM ACT        0 V
```

Twin arrow keys
are used to change the group. In the parameter and reference presetting modes, you can alter the parameter value or the reference setting ten times faster by means of the twin arrow keys than by means of the single arrow key.

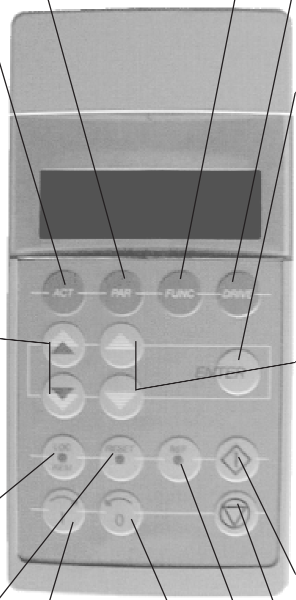
Local/Remote
is used to select local (control panel) or remote control.

Reset
Error acknowledgement key.

1 = last fault / 2 = last-but-one fault / 99 = last-but-98 fault / Name of Fault or alarm / Total time after switch-on HHHH:MM:SS.ss

```
  0 L   0,0 rpm    00
1 LAST FAULT
Emergency stop
3212:59:35:56
```

On
in local mode switches the main contactor on.



Function
Selects the “functions” operating mode; can be used to perform special functions such as uploading and downloading or application programming.

Status row / Functions to be selected / Display contrast setting

```
  0 L    0,0 rpm   00
UPLOAD      <==
DOWNLOAD    ==>
CONTRAST
```

Drive
for subsequent extensions

Enter
is used in the following modes:

Parameter setting:	enter new parameter value
Feedback value signal display:	enter the current signal selection mode
Signal selection:	accept selection and return to the feedback value signal display mode

Arrow keys
are used to select parameters within a group. You alter the parameter value or the reference setting in the parameter and reference presetting modes. In the feedback signal display mode, you select the line you want.

Start
starts the drive in local mode.

Stop
shuts the drive down if you are in local mode.

Reference
is used to activate the reference presetting mode.

Off
in local mode switches the main contactor off.

Fig. 2.5/8: Function keys and various displays on the removable control and display panel. The panel can also be used to load the same program on different power converters.

Operation by PC

Components required:

- plastic optical fibre for distances up to 20 m
- Monitoring network up to 200 drives (same as for ACS 600)
- HCS optical fibre cable up to 200 m.
  see separate manual *Configuration instructions NDBU 85-95* - Doc no.: (3ADW000100)

Functionality:

- Drives Window software package① for commissioning, diagnosis, maintenance and trouble-shooting; structure of connections see *Technical Data*

System requirements/recommendation:

- PC (IBM-compatible) with 486 processor or higher (min. 50 MHz)
- 8 MB RAM
- DOS version 5.0 or later
- Windows 3.1, 3.11, Windows95; Windows NT4.0
- VGA monitor
- 3 1/2" floppy disk drive
- PCMCIA or ISA card slot

In addition to the options provided by the CDP 312 control and display panel, there are further functions available, and these are described on the following page.

① For further information see the specific publications

Drive control

Components required:

- plastic optical fibre for distances up to 15 m
- field bus module NxxA-0x; FCI (CI810); AC70 (PM810); AC80 (PM825)
- Star configuration up to 12 drives for FCI, AC70 and AC80

alternative:

- APC2 + YPQ112 (max. 4 drives)①

Functionality:

Depends on the field bus module used, interface e.g. to:

- PROFIBUS with NPBA-02
- MODBUS+ with NMBP-01
- CS31 with NCSA-01
- AF100 with FCI (CI810) or AC70 (PM810)/ AC80 (PM825) ①
- further modules on request

You will find more detailed information on data exchange in the specific fieldbus module documentation.

Operation by PC (continued)

Drives Window

Drives Window is the most comprehensive commissioning and maintenance tool available for ABB products. Drives Window is a PC tool designed for on-line commissioning and maintenance of ABB products. It provides several different displays to effectively and easily utilise the tool. Drives Window is able to connect to various target devices through several different types of communication links.

System Configuration Display

The System Configuration Display provides an overview of the system as well as the type and status of each product on the communication link(s). Included in the System Configuration Display are previously saved files located on the hard disk of the computer. This display is built automatically by the Drives Window tool by scanning the communication links to find the configuration of the system.

Drives Panel Display

The Drives Panel Display is used for controlling the operation of a selected drive within the system. You can control different drives by changing the target drive selection. The following commands are available with the Drives Panel:
- Start and Stop
- Set the speed reference value
- Change the reference direction
- Reset the active fault
- Change to Local/Remote control mode

Signals and Parameters Display

The Signals and Parameters Display is used for handling signals and parameters of the target drive. The signal and parameter list is uploaded from the drive and can be viewed, saved to a file or compared to another parameter set. Previously saved values can be downloaded to a matching drive. You can also set the parameter values in either off-line or on-line mode.

Monitor Display

The Monitoring Display is used for monitoring graphically the actual values of the target. The following functions are also supported:
- Zoom-in and Zoom-out
- Scaling the graphs
- Setting the sampling interval
- Setting the time window

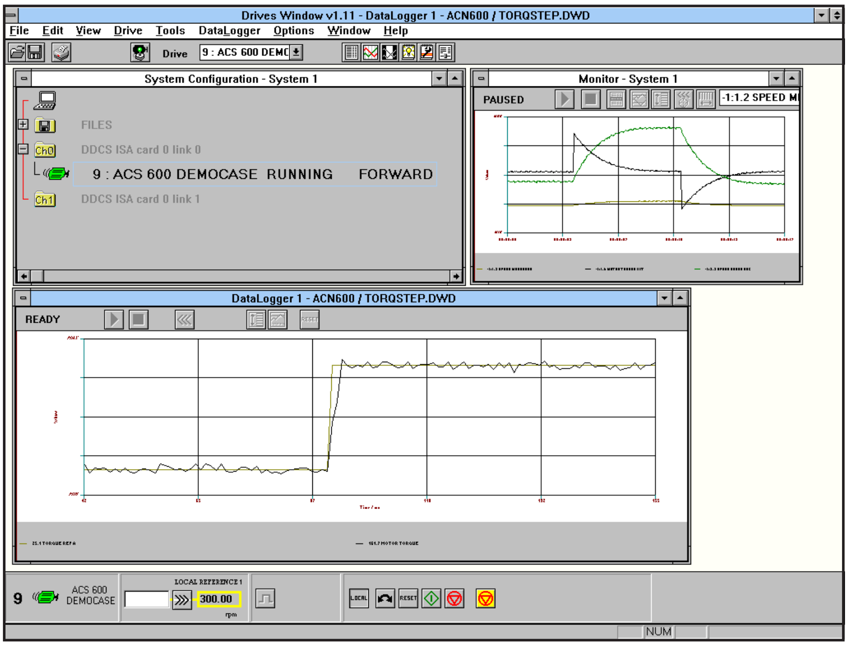


Fig. 2.5/9: Display of Drives Window

- Triggering on specific conditions
- Signals from multiple drives can be displayed in the same view

Data Logger Display

The Data Logger Display provides facilities for viewing the contents of the data loggers in the drive. You can display the data in either graphical or numerical form as well as setting-up the data logger triggering conditions.

Event Logger Display

The contents of the Event Logger can be viewed and cleared by using this display.

Fault Logger Display

The contents of the Fault Logger can be viewed and cleared by using this display.

Application Display

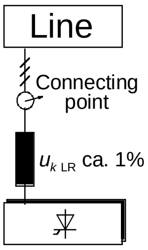
Application programs can be downloaded and debugged with this display.

Please note:
For more information of the Drives Window software package there is an own documentation available describing the possibilities and the handling of the program.

Line reactors
for armature-circuit supply

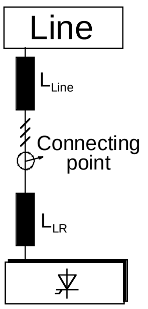
When power converters are operated with thyristors, the line voltage is short-circuited during commutation from one thyristor to the next. This operation causes voltage dips in the mains. For the connection of a power converter system to the mains, a decision is made between the following configurations:

Configuration A



When using the power converter, a minimum of 1% impedance is required to ensure proper performance of the snubber circuit. A line reactor can be used to meet this minimum impedance requirement. The value must therefore not drop below 1% u_k (relative impedance voltage). It should not exceed 10% u_k, due to considerable voltage drops which would then occur.

Configuration B



If special requirements have to be met at the connecting point, different criteria must be applied for selecting a line reactor. These requirements are most often defined as a voltage dip in percent of the nominal supply voltage.
The combined impedance of Z_{Line} and Z_{LR} constitute the total series impedance of the installation. The ratio between the line impedance and the line reactor impedance determines the voltage dip at the connecting point.

$$Voltage\,dip = \frac{Z_{Line}}{Z_{Line} + Z_{LR}} * 100\%$$

Example:
Maximum allowable voltage dip is 20% at the power converter's connecting point. Above equation used and simplified to:

$$Z_{LR} = 4 * Z_{Line} \quad (1)$$

Since the line impedance is seldom known (it can be determined by means of a measuring routine), and the short-circuit power at the same point is more frequently available, the line reactor can be calculated by means of this value.

Assumption: The system short-circuit power at the power converter's connecting point is 180 times the power converter's rated power.

- The system's relative impedance voltage u_k can thus be determined:

$$u_{k\,Line} = \frac{1}{180} * 100\% = 0.55\%$$

- In accordance with equation (1), the following applies for the line reactor:

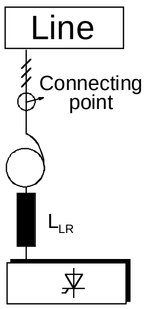
$$u_{k\,LR} = 4 * U_{K\,Line} = 2.2\%$$

- Since the line reactor has to be sized specific to a power converter , the relative variable U_k must be converted into an absolute value. For this purpose, the following equation applies:

$$u_k = \frac{I_{dN} * \sqrt{\frac{2}{3}} * \sqrt{3} * 2\pi * f_N * L_{LR}}{U_N}$$

I_{dN}: rated direct current
f_N: rated frequency of the system
U_N: rated line voltage
L_{LR}: line reactor inductance

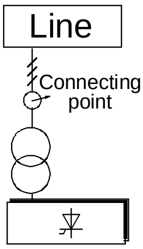
Configuration C



In the case of high power converter outputs or high currents, a power converter transformer must frequently be used for voltage matching. If an autotransformer is used for this purpose, a commutating reactor must additionally be used if special conditions must be complied with as per Configuration B, the reason for this being that the u_k of commonly used autotransformers is generally too small. If you do not have to allow for special conditions of this kind, you must nevertheless check whether the u_k of the autotransformer concerned is sufficient for satisfying Configuration A.

An examination of volume and costs results in the following configuration:

Configuration D



If an isolation transformer is used, it is often possible to comply with certain connecting conditions per Configuration B without using an additional line reactor. The condition described in Configuration A will then likewise be satisfied, since the u_k is >1 %.

Line reactors L1

DCS Type 400V-690V	Line choke type	Fig.
DCS60x-0025-41/51	ND01	1
DCS60x-0050-41/51	ND02	1
DCS60x-0050-61	ND03	1
DCS60x-0075-41/51	ND04	1
DCS60x-0100-51	ND06	1
DCS60x-0110-61	ND05	1
DCS60x-0140-41/51	ND06	1
DCS60x-0200-41/51	ND07	2
DCS60x-0250-41/51	ND07	2
DCS60x-0270-61	ND08	2
DCS60x-0350-41/51	ND09	2
DCS60x-0450-41/51	ND10	2
DCS60x-0450-61	ND11	2
DCS60x-0520-41/51	ND10	2
DCS60x-0700-41/51	ND12	2
DCS60x-0900-41/51/61/71	ND13	3
DCS60x-1200-41/51	ND14	3
DCS60x-1500-41/51/61/71	ND15	3
DCS60x-2000-41/51	ND16	3

Table 2.6/1: Line reactors (for more information see publication *Technical Data)*

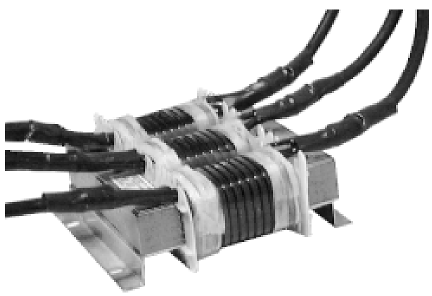


Fig. 1

With reference to the power converter:

- The line reactors listed in the table below have been allocated to the units in accordance with a load cycle, and are independent of the units' voltage classification. Note that the same reactors are used for line voltages ≤690 V!
- For units >2000 A or >690 V, we recommend using one isolation transformer per power converter.

DCF 600

The line reactors in table 2.6/1 are suitable for DCF 600 three-phase field supply converters. For full load current of the module choose the next higher reactor type because the reactors are dimensioned for 80% of armature current of the DCS 600 converters.

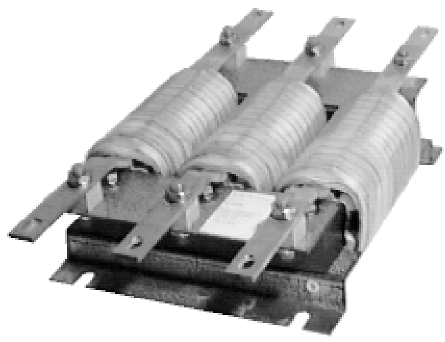


Fig. 2

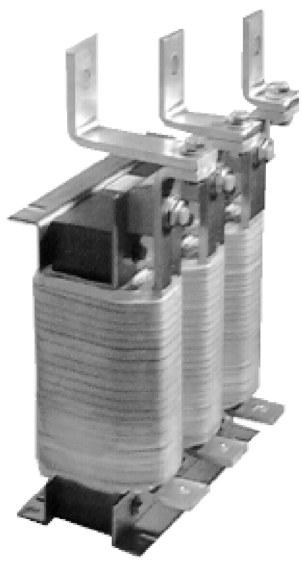


Fig. 3

Unit configuration

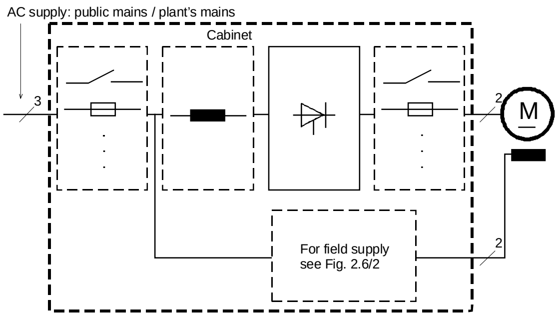


Fig. 2.6/1 Arrangement of the switch-off elements in the armature-circuit converter

Switching elements such as fuses or overcurrent trips are used whenever overcurrents cannot entirely be ruled out. In some configurations, this will entail the following questions: firstly, at what point should which protective element be incorporated? And secondly, in the event of what faults will the element in question provide protection against damage?
Possible sources of faults are:

Faults within the unit electronics

- The power converter's working mode will usually be current-limiting; the maximum current corresponds to the current limitation set; if this limitation feature or one of the requisite components fails, then the current will frequently rise sharply;
  output current $I >> I_{RATED}$; Fault: 1
- If one or more than one false firing pulses are produced, e.g. due to component faults or other influencing factors, then the current will likewise rise sharply;
  output current $I >> I_{RATED}$; Fault: 2
- If (with four-quadrant units) thyristors of both bridges become conductive, circulating current is the consequence; the causes involved may be component defects or other influencing factors; the current on the three-phase side will rise substantially;
  $I_{AC} >> I_{RATED}$; Fault: 3

Defective system conditions leading to commutation failure

- In the case of regeneration, the ratio of motor voltage and line voltage rises above 1.05, which is followed by a situation called "shoot-through"; the current rises substantially;
  output current $I >> I_{RATED}$; Fault: 4

  Possible causes include:
  - network malfunctions (line undervoltage)
  - overspeed due to the load involved (load accelerates motor) or due to a control error
  - field supply generates a field current larger than IF_{RATED} or control error in the field weakening range

Faults caused by components

- Semiconductor faults can be manifested in that a thyristor no longer fires, for example, (5a) or in that it is permanently conductive (5b). Depending on the system condition (four-quadrant operation, regeneration, etc.), these two cases will then exhibit similar symptoms to those of cases 3 and 4.
  Faults: **5a, 5b**
- Insulation faults may occur within the cabling of the mains supply, the power converter and the motor. These can be subdivided into faults finally resulting in a short-circuit and those leading to an earth fault.
  - In the event of a short-circuit, the following generally applies: $I >> I_{RATED}$
  - In the event of an earth fault, depending on where the fault has occurred, the current may range between $I = I_{RATED}$ and $I >> I_{RATED}$.

  Fault: 6

Fusing of the armature-circuit supply

The table below shows the fault cases in which semiconductor fuses (super-quick-acting) can protect the drive system consisting of motor and unit. Those cases marked (X) would protect the motor only, and not the unit.

	Semiconductor fuses	
Fault	on the **AC** side	on the **DC** side
1	X	(X)
2	X	(X)
3	X	
4		X
5a ⇒ 3	X	
5b ⇒ 4		X
6	X	X

Before deciding whether fuses are going to be incorporated only on the DC side, you must first check in which working points the drive is used how often (proportion of time as compared to the overall duration of operation). The fault listing is independent of the electronics used.

The following general rule applies:
- Analogue systems are more sensitive and more susceptible to malfunctions than digital systems.
- Digital systems are able to detect critical situations much easier and deliver facilities to prevent the equipment from shut down.

Supply and fusing for the field supply

Basically, similar conditions apply for both field supply and armature-circuit supply. Depending on the power converter used (diode bridge, half-controlled bridge, fully controlled 4-quadrant bridge), some of the fault sources may not always be applicable. Due to special system conditions, such as supply via an autotransformer or an isolating transformer, new protection conditions may additionally apply.

In contrast to the armature-circuit supply, fuses are **never** used on the DC side for the field supply, since a fuse trip might under certain circumstances lead to greater damage than would the cause tripping the fuse in the first place (small, but long-lasting overcurrent; fuse ageing; contact problems; etc.).

Fault No. 4 can also occur in the case of field supply units, but will not cause such a rapid and substantial current rise as encountered with an armature-circuit supply; this is due to the significantly higher inductance of the field winding.

If conditions similar to those for armature-circuit supply are to apply, like for example protection of the field supply unit and the field winding, then a semiconductor fuse (super-quick-acting F3.1) must be used.

The following configurations are relatively frequent:

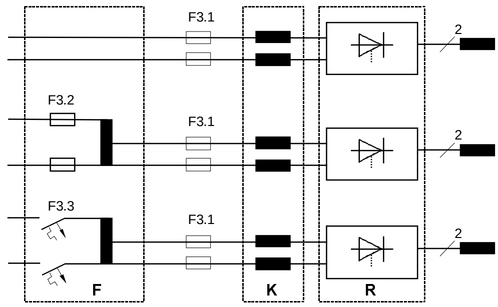


Fig 2.6/2 Configurations for field supplies

R Possible field supply units:
- SDCS-FEX-1: uncontrolled diode bridge; Fault: **5a, 6**
- SDCS-FEX-2: half-controlled bridge, 1Q; Fault: **1, 5a, 6**
- DCF 503: half-controlled bridge, 1Q; Fault: **1, 5a, 6**
- DCF 504: fully controlled bridge, 4Q; Fault: **1, 3, 4, 6**

The faults listed here are described under “Aspects of fusing for the armature-circuit and field supplies”.

Note: in the case of 1, 4, and 6, the current is limited to relatively small overcurrents due to the ohmic content of the field winding, so that the fuses may perhaps not be tripped.

K See the text below in the “Commutating reactor” section

F The F3.2 and F3.3 fuse types serve as line protectors and cannot protect the field supply unit. Only pure HRC fuses or miniature circuit-breakers may be used. Semiconductor fuses would be destroyed, for example, by the transformer’s starting current inrush.

Fuses and fuse holders for armature supply

The converter units are subdivided into two groups:

– Unit sizes C1 and C2 with rated currents up to 700 A require external fuses.
– In unit sizes C3 and C4 with rated currents of 900 A to 5150 A, the semiconductor fuses are installed internally (no additional external semiconductor fuses are needed).

The semiconductor fuses for the C1 and C2 unit sizes are blade fuses. The relevant data is listed in the table below. The fuses' type of construction requires special fuse holders. Fuse holders of the OFAX/OFAS type series are available.

Fuse F1 and fuse holders

Type of converter	Manufacturer / Type	Fuse holder
DCS60x-0025-41/51	Bussman 170M 1564	OFAX 00 S3L
DCS60x-0050-41/51	Bussman 170M 1566	OFAX 00 S3L
DCS60x-0050-61	Bussman 170M 1568	OFAX 00 S3L
DCS60x-0075-41/51	Bussman 170M 1568	OFAX 00 S3L
DCS60x-0100-51	Bussman 170M 3815	OFAX 1 S3
DCS60x-0110-61	Bussman 170M 3815	OFAX 1 S3
DCS60x-0140-41/51	Bussman 170M 3815	OFAX 1 S3
DCS60x-0200-41/51	Bussman 170M 3816	OFAX 1 S3
DCS60x-0250-41/51	Bussman 170M 3817	OFAX 1 S3
DCS60x-0270-61	Bussman 170M 5810	OFAX 2 S3
DCS60x-0350-41/51	Bussman 170M 5810	OFAX 2 S3
DCS60x-0450-41/51/61	Bussman 170M 6811	OFAS B 3
DCS60x-0520-41/51	Bussman 170M 6811	OFAS B 3
DCS60x-0700-41/51	Bussman 170M 6813	OFAS B 3

Table 2.6/2: Fuses and fuse holders (for more information see publication *Technical Data)*

Additional components for field supply

The field supply units' insulation voltage is higher than the rated operating voltage (see Chapter *Field supplies*), thus providing an option in systems of more than 500 V for supplying the power section of the converter directly from the mains for purposes of armature supply, and using an autotransformer to match the field supply to its rated voltage. Moreover, you can use the autotransformer to adjust the field voltage (SDCS-FEX-1 diode bridge) or to reduce the voltage ripple. Different types (primary voltages of 400...500 V and of 525...690 V) with different rated currents each are available.

Transformer T3

Field converter type	for field current I_F	Transformer type
		U_{prim} = **≤500 V**
SDCS-FEX-1	≤6 A	T 3.01
SDCS-FEX-2	≤12 A	T 3.02
SDCS-FEX-2	≤16 A	T 3.03
DCF503/4-0050	≤30 A	T 3.04
DCF503/4-0050	≤50 A	T 3.05
		U_{prim} = **≤600 V**
SDCS-FEX-1	≤6 A	T 3.11
SDCS-FEX-2	≤12 A	T 3.12
SDCS-FEX-2	≤16 A	T 3.13
		U_{prim} = **≤690 V**
DCF503/4-0050	≤30 A	T 3.14
DCF503/4-0050	≤50 A	T 3.15

Table 2.6/3: Autotransformer data (for more information, e.g. fuse data, see publication *Technical Data)*

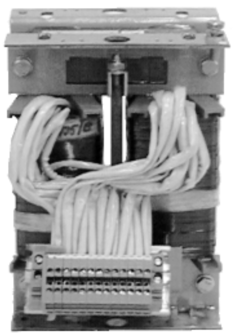


Fig. 2.6/3: T3 autotransformer

Commutating reactor

When using the SDCS-FEX-2 field power converter, you should additionally use a commutating reactor because of EMC considerations. A commutating reactor is not necessary for the SDCS-FEX-1 (diode bridge); and in the DCF 503/504 field power converters, it is already installed.

Converter	Reactor
SDCS-FEX-2	ND 30

Table 2.6/4: Commutating reactor (for more information see publication *Technical Data)*

Electronic system / 1-phase fan supply

The converter unit requires various auxiliary voltages, e.g. the unit's electronics require 115 V/ 1-ph or 230 V/1-ph, the unit fans require 230 V/ 1-ph (Size C1 and C2) or 400 V/690 V/3-ph (Size C3 and C4), according to their size. The T2 auxiliary transformer is available to supply the unit's electronic system and the single-phase fans.

Auxiliary transformer T2

Input voltage: 380...690 V/1-ph
Output voltage: 115/230 V/1-ph

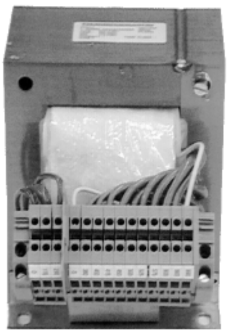


Fig. 2.6/4: T2 auxiliary transformer

Earth fault monitor

An earth fault monitor is provided by the standard software. If needed, the analogue input AI4 has to be activated, a current signal of the three phase currents should be supplied to AI4 by a current transformer. If the addition of the three current signal is different from zero, a fault is indicated (for more information, see publication *Technical Data).*

EMC Filters

Selection of electrical components in conformity the EMC Guideline is described below.

The aim of the EMC Guideline is, as the name itself implies, to achieve electromagnetic compatibility with other products and systems. The Guideline is designed to ensure that a product's emissions are so low that they do not impair the interference immunity of another product.

Within the context of the EMC Guideline, two aspects have to be considered:
- the product's **interference immunity**
- the product's **emissions**

The EMC Guideline does of course expect EMC to be taken into account while a product is being developed, but EMC cannot be designed in, only quantitatively measured.

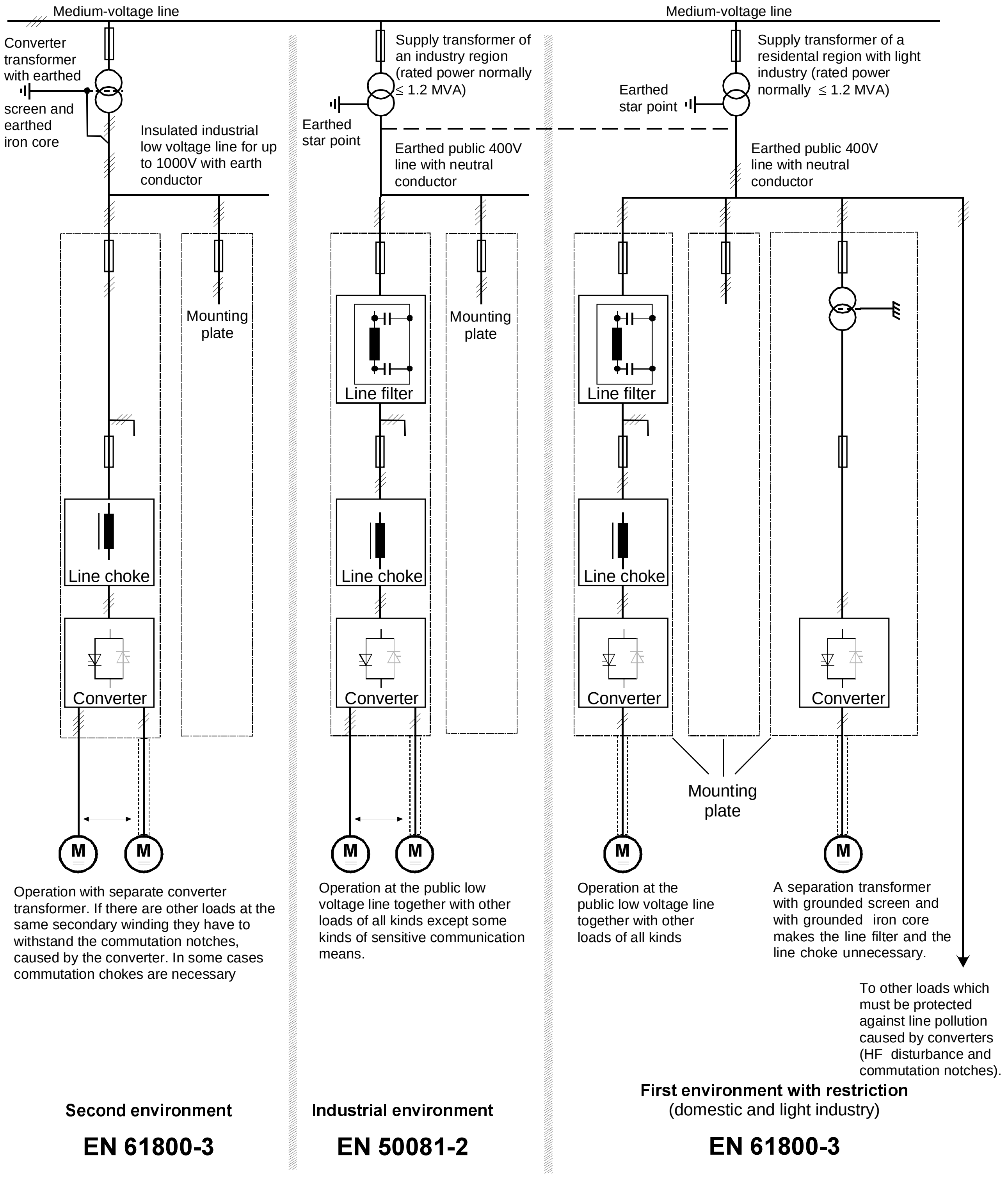
Note on EMC conformity
The conformity procedure lies within the responsibility both of ABB Industrietechnik of the machine manufacturers or system erectors concerned, according to their share in expanding the electrical equipment.

In order to comply with the protection targets of the relevant EMC legislation (EMVG in Germany) in systems and machines, the following EMC standards have to be met:

EN 50082-2	Generic standard for noise immunity **Industrial environment**
EN 50081-2	Generic standard for noise emission **Industrial environment**
EN 50081-1	Generic standard for noise emission **Light industrial environment**

You will find further information on the following pages (see as well publication ***Installation of converters for armature and field supply in accordance with EMC***).

Classification



The field supply is not shown in this synopsis drawing. The rules for the field supply cables are the same as for the armature supply cables.

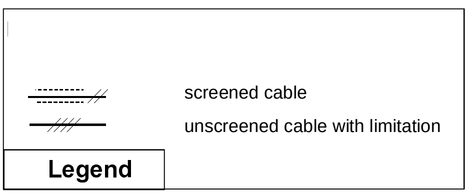


Fig. 2.6/5: Classification

Filter in a grounded line (earthed TN or TT network)

The filters are suitable for grounded lines only, for example in public European 400 V lines. According to EN 61800-3 filters are not needed in insulated industrial lines with own supply transformers. Furthermore they could cause safety risks in such floating lines (IT networks).

Three - phase filters

EMC filters are necessary to fulfill 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 a grounded 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.

Converter type	Rated dc current [A]	Filter type ❶ xxx = Voltage	Weight appr. [kg]	Dimensions L x W x H [mm]
DCS600-0025-x1	25	NF3-xxx-25	3	200x150x65
DCS600-0050-x1	50	NF3-xxx-50	3.1	200x150x65
DCS600-0075-x1	75	NF3-xxx-64	3.1	200x150x65
DCS600-0100-x1	100	NF3-xxx-80	9.5	400x170x90
DCS600-0140-x1	140	NF3-xxx-110	9.5	400x170x90
DCS600-0200-x1	200	NF3-xxx-320	28	450x285x171
DCS600-0250-x1	250	NF3-xxx-320	28	450x285x171
DCS600-0350-x1	350	NF3-xxx-320	28	450x285x171
DCS600-0450-x1	450	NF3-xxx-600	49	590x305x158
DCS600-0520-x1	520	NF3-xxx-600	49	590x305x158
DCS600-0700-x1	700	NF3-xxx-600	49	590x305x158
DCS600-0900-x1	900	NF3-xxx-1000	90	610x305x198
DCS600-1200-x1	1200	NF3-xxx-1000	90	610x305x198
DCS600-1500-x1	1500	NF3-xxx-1600	130	840x465x210
DCS600-2000-x1	2000	NF3-xxx-1600	130	840x465x210
DCS600-2500-x1	2500	NF3-xxx-2500	200	955x520x293

The filters 25... 2500 A are available for 440 V and 500 V, and the filters 600...2500 A are available for 690 V too.

❶ The filters can be optimized for the real motor currents: $I_{Filter} = 0.8 \cdot I_{MOT\ max}$; the factor 0.8 respects the current ripple.

Single - phase filters for field supply

Many field supply units are single - phase converters for up to 50 A excitation current. They can be supplied by two of the three input phases of the armature supply converter. Then a field supply unit does not need its own filter.

If the phase to neutral voltage shall be taken (230 V in a 400 V line) then a separate filter is necessary. ABB offers such filters for 250 V and 6...30 A.

Converter type of field supply unit	dc current [A]	Filter type ❶ U_{max} = 250 V	Weight appr. [kg]	Dimensions L x W x H [mm]
SDCS-FEX-1	6	NF1-250-8	0.7	139x105x59
SDCS-FEX-2	8	NF1-250-8	0.7	139x105x59
SDCS-FEX-2	16	NF1-250-20	1.0	139x105x59
DCF 503-0050	50	NF1-250-55	1.8	230x115x60
DCF 504-0050	50	NF1-250-55	1.8	230x115x60
further filters for	12	NF1-250-12	0.9	139x105x59
	30	NF1-250-30	1.0	148x105x57

❶ The filters can be optimized for the real field currents: $I_{Filter} = I_{Field}$

Commutation and line chokes

(see also Section ***Line reactors*** in this chapter) Due to the maximum power of public 400 V transformers (P_{MAX} = 1.2 MVA ⇒ I_{MAX} = 1732 A) and due to their relative voltage drop 6% or 4% the maximum AC current which is available for a converter is 346 A or 520 A ($I_{DC} \leq$ 422 A or 633 A).

Separation transformers

A separation transformer makes line chokes unnecessary because of its leakage inductance, and a grounded screen between its windings saves an EMC filter. The screen and the iron core must be well connected with the mounting plate of the converter.

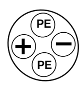
Converter transformers

A converter transformer transfers high power directly from a medium voltage line to a single large converter or to a local low voltage line for several converters. Furthermore it acts as separation transformer.

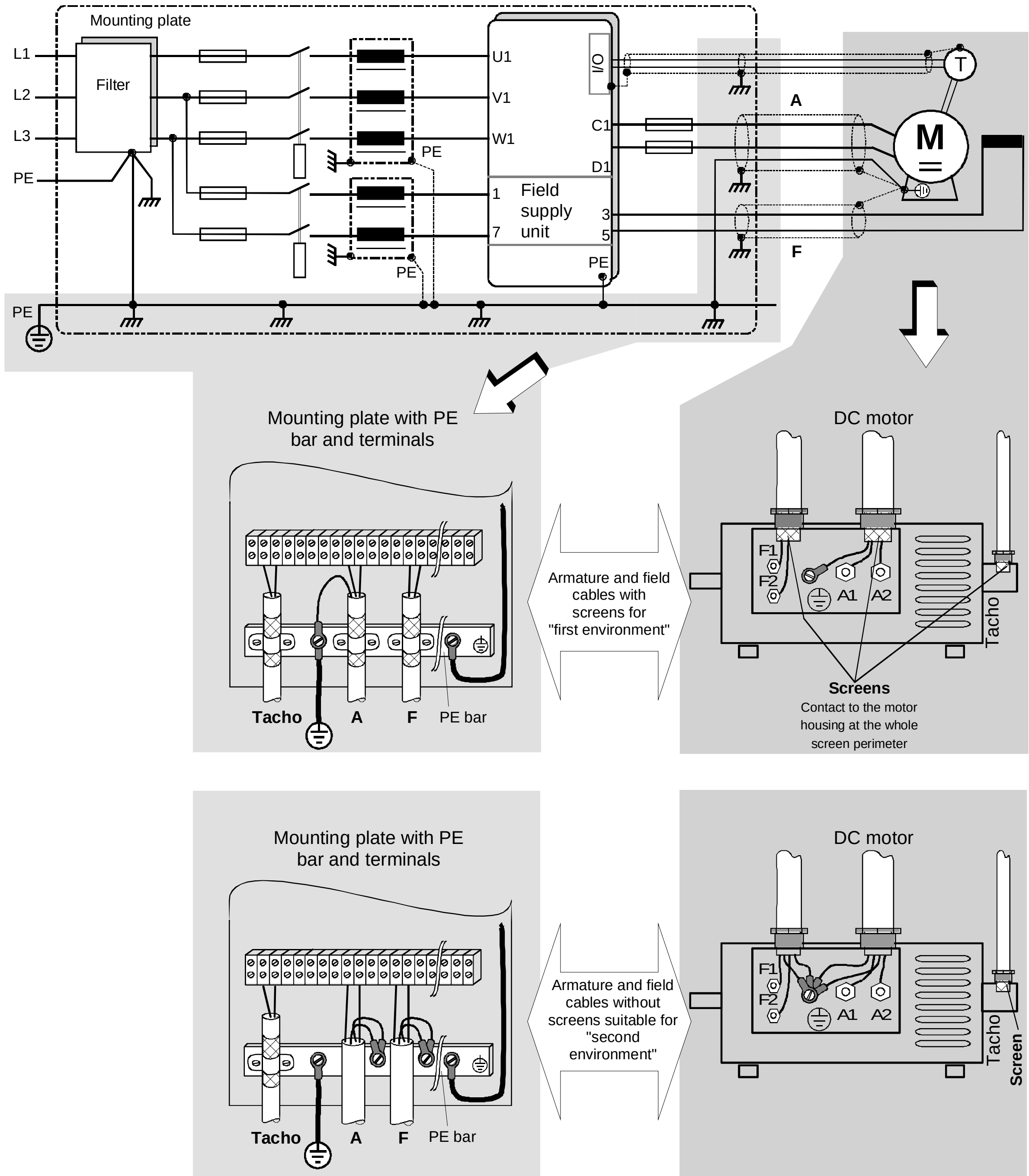
If such a converter transformer has no screen the EMC demands are nevertheless fulfilled in most cases because the RF interference energy can hardly get via the medium-voltage line and the transformer of the public line to the loads which must be protected against pertubances.

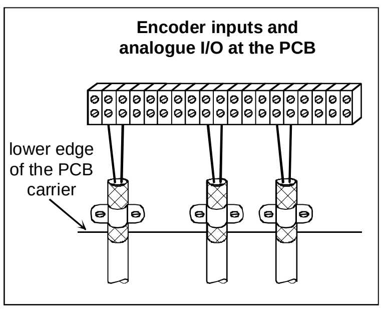
Installation hints

- All metal cubicles available on the market can be used.
- The mounting plate must be made from steel with zinc surfaces and without any painting. It shall be connected with the PE copper bar by several bolts.
- The converter, the line choke, fuses, contactors and the EMC filter are to be placed on the mounting plate so that the connections can be made as short as possible, especially those from the converter via the line choke to the filter.
- The cables for digital signals which are longer than 3m and all cables for analogue signals must be screened. Each screen must be connected at **both** ends by metal clamps or comparable means directly on clean metal surfaces. In the converter cubicle this kind of connection must be made directly on the sheet metal close to the terminals.
- The necessity of a screen depends on the length of the cable and on the environmental demands. If a screen is necessary then it must be pressed by a well conducting metal clamp directly against the mounting plate or the PE bar of the converter cubicle.
- Screened cables to the armature and to the excitation winding cause the lowest noise level. The armature current cable must contain a third wire for a PE connection if the copper cross section of the screen cannot fulfil the PE safety demands.
- If a screen is not necessary the armature current cable must be a four-wire cable because two wires are needed as conductors for the parasitic RF currents from the motor to the RF filter in the cubicle.



Connection example in accordance with EMC





Important hint:
The example shows the principle structure of a DC drive and its connections. It is a not binding recommendation, and it cannot respect all conditions of a plant. Therefore each drive must be considered separately and with respect to the special application. Additionally the general installation and safety rules must be taken in account.

Fig. 2.6/6: Connection example in accordance with EMC

3.1 Basic structure of DCS 600 MultiDrive

The control hardware of DCS 600 MultiDrive consists of 2 parts:
- converter control board SDCS-CON-2
- drive control board SDCS-AMC-DC (AMC = Application Motor Control)

Accordingly, the software is split into 2 parts:
- All control functions superimposed to the torque reference are done inside the AMC board. In addition, all MMI (Man Machine Interface) and communication functions are part of the AMC-board's software. Also the Start/Stop functions ('Drive Logic') are realized by the AMC-board's software. All parameters and signals of the drive are accessed via an AMC-board residing data structure called 'AMC-table'.

- All converter related functions and the handling of standard I/O are done by the SDCS-CON-2 software:
  - Armature current control
  - Field weakening
  - Motor protection
  - I/O handling

In general, the software functions are distributed to the SDCS-CON-2 board and the SDCS-AMC-DC board according to the following diagram:

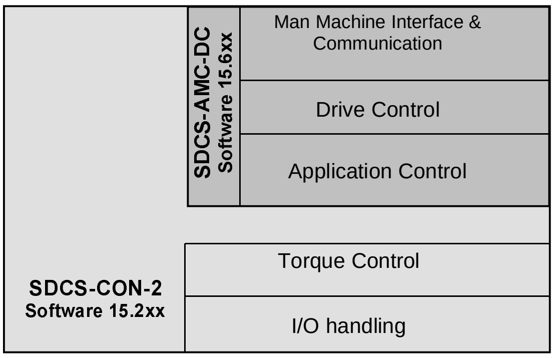


Fig. 3.1/1: Distribution of software functions

3.2 Control Modes

The Control mode selects the source of control word and references.

Local Mode
Commissioning tool Drives Window is connected to a DDCS channel (channel 3) of the AMC Board and has entered local mode. Local mode is also available on the panel CDP 312.

Remote Mode
Reference and control word are supplied by the APC or a field bus adapter connected to the DDCS channel 0.

Master/Follower Mode
Reference and control word are supplied by the master drive via DDCS channel 2.

3.3 Start, Stop and Fault Reactions

During operation, the drive is in one of the following states (ABB Drive profile):

ONINHIBIT	After emergency stop (OFF3_N) or emergency off (OFF2_N) this state is entered until ON = 0
OFF	Main contactor is off, OFF3_N or OFF2_N active
RDY_ON	Main contactor is off
RDY_RUN	Main, field and fan contactor are closed, field control activated, ready for run command
RDY_REF	Drive is running
TRIPPED	Drive is faulted
OFF_2_STA	Drive is coasting due to emergency off command; the states ZERO_A_AND_F → ONINHIBIT are entered.
OFF_3_STA	Drive stops according to the programmed emergency stop ramp and the programmed emergency stop mode; at zero speed, the state ON_INHIBIT is entered.

Table 3.1/1: States of the drive

Power up
When the electronics power supply is switched on the drive stays in the ONINHIBIT state until ON = 0 is detected. In case of a fault the drive stays in the FAULT state.

Normal start
Status bit RDY_ON = 1 signals that no faults are pending and that the device is ready to close the fan and field contactor.
A rising edge of the ON command closes fan, field and main contactor and activates the field control.
Status bit RDY_RUN = 1 indicates that the field converter is active and that the drive is ready to generate torque.
A rising edge of the RUN command activates speed and torque control.
Status bit RUNNING = 1 indicates that the drive is in normal operation.

Normal stop
RUN = 0 sets the speed reference to zero and the drive decelerates.
After the actual speed has reached zero the status bit RUNNING is reset, the armature converter set to alpha_max and the state RDY_RUN is entered, when the current has reached zero.
ON = 0 sets RDY_RUN = 0 and the field current reference to zero. The field converter is set to alpha_max and the contactors are opened, when the current has reached zero.
ON = 0 internally forces RUN = 0.

Emergency off
Field and armature current are removed as fast as possible. Then the contactors are opened. The normal start command is accepted when OFF2(_N) (EME_OFF_N) = 1.

Emergency stop
Command EME_STOP = 0 gives the same procedure as RUN = 0 (normal stop) except that the ramp is switched from deceleration to emergency stop and the state ON_INHIBIT is entered when the speed has reached zero.
The normal start command is accepted when OFF3(_N) (EME_STOP_N) = 1.
The reference handling and current limitation is controlled by EME_STOP_MODE.

Fault reaction
Depending on the actual fault the armature and or field current is reduced to zero as fast as possible with single pulses and firing angle = alpha_max. Contactors are opened when the current has reached zero.
Then the state TRIPPED is entered and after a successful reset the state ONINHIBIT.

The following state diagram shows the transitions between the different states.

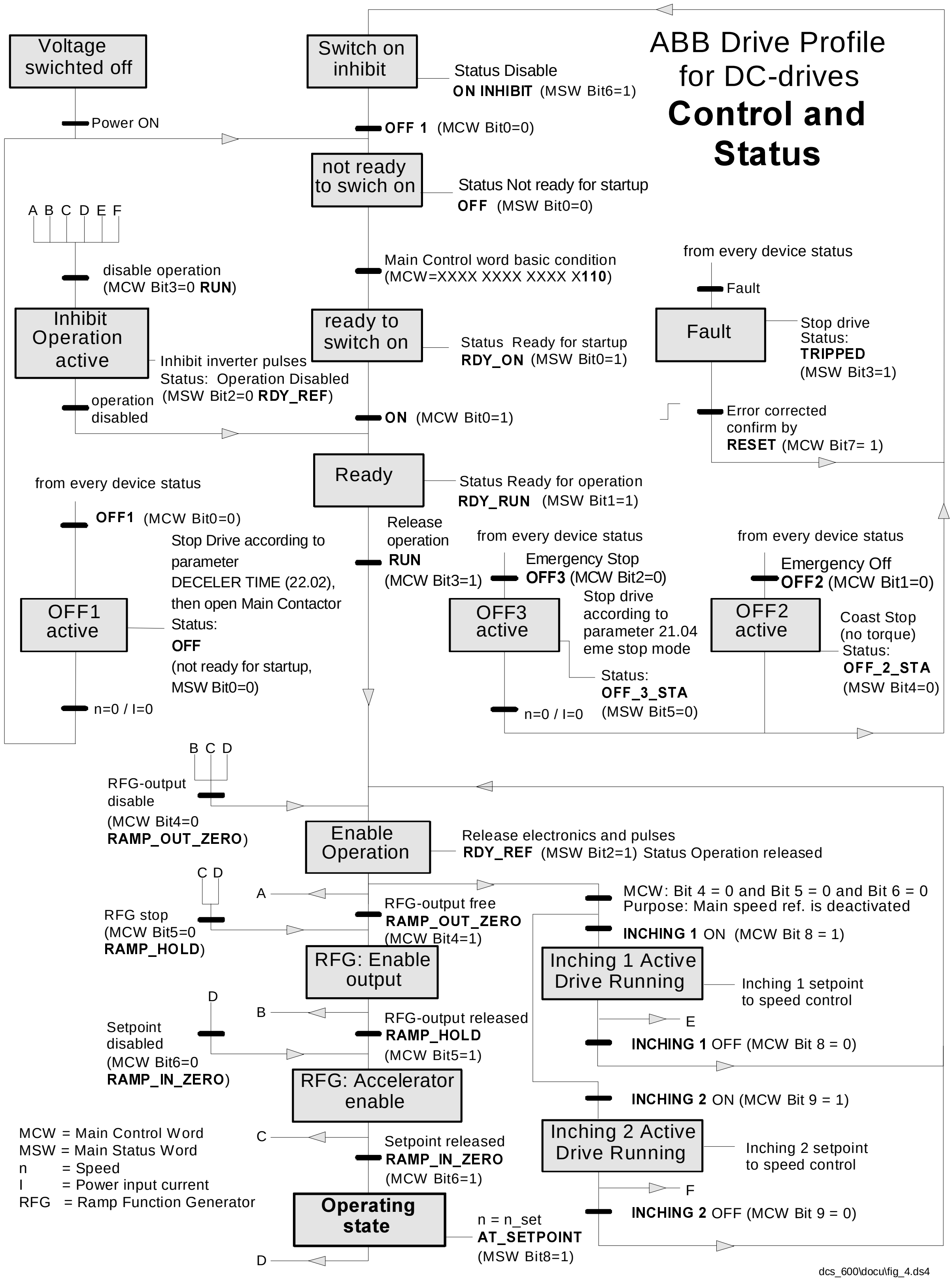


Fig. 3.3/1: Control and status

3.4 Speed Control

The speed controller is located in the AMC Board.

Speed reference

The source of the reference is depending on the operating mode.

Advant control, Field bus interface	➔ remote mode, DDCS on AMC Board
DrivesWindow	➔ local mode, DDCS on AMC Board
Panel CDP312	➔ local mode, connector on CON-2
Analogue inputs	➔ local I/O mode

Speed reference features:
- Speed reference limiter
- Speed ramp with emergency stop
- Variable slope rate
- Speed correction
- Reference for inching before the ramp
- 2 different references for inching behind the ramp

Speed measurement

The actual speed may be calculated from armature voltage and flux (field current) or measured with analogue tacho or pulse encoder.

Controller part features

- PID controller
- 2 first order low pass filters
- Window control
- Acceleration compensation
- Speed and torque adaptation
- Droop
- Additional torque references
- Torque limitation and gear backlash function (the integral part of the controller is set to a suitable value on limitation)
- Oscillation damping (band rejection filter for speed error)

The diagram Fig. 3.7/2 shows the functionality of the speed reference chain as well as of the speed controller.

3.5 Torque Control

Flux and Torque Calculation

These are generally open loop. The flux is adjusted by the field current. The reference of the field current is generated by the superimposed armature voltage control.
The torque is adjusted by the armature current. The conversion from torque to current reference is done by means of the calculated flux (based on the field current and saturation characteristic).

Torque reference features:
- Torque reference A with 1st order filter and load share
- Torque reference B with torque ramp
- Torque reference limiter
- Torque correction and torque step
- Torque correction by means of analogue input 1

A good behaviour in the field weakening requires speed measurement by tacho or encoder.

A simplified scheme of the torque reference chain is given in diagram fig. 3.7/2.

3.6 Torque Generation

Interface between SDCS-AMC-DC board and DC control board SDCS-CON-2

The major signals exchanged each 2 ms between the CON-2 and the AMC-DC board are:

SPEED_ACTUAL	speed actual value from CON-2
TORQ_USED_REF	active torque reference to CON-2

In addition, the calculated torque limits from the CON-2 are read from the CON-2 each 8 ms:

TC_TORQMAX
TC_TORQMIN

The addition of the torque correction TQ_CORR from an analogue input of CON-2 is done by the CON-2 software.

Armature voltage Control

This controller enables operation in the field weakening range. It outputs the field current reference. At low speed the field current is constant and armature voltage is roughly proportional to the speed. At higher speed the field current reference is reduced so that the armature voltage doesn't exceed its reference.

Field Current Control

Two field exciters can be operated simultaneously for two different motors.
The second field exciter has a fixed current reference. However, it may be reduced for field heating purposes.
The first field exciter can be operated with fixed current reference, the output of the armature voltage controller (field weakening) or with a reduced reference for field heating.
A field reversal control is available for the first field exciter. This is needed in case of a four quadrant drive with a single direction armature converter.
Optitorque is a special control method where the flux is reduced at small torque reference. This is available for drives with and without field reversal.

Armature Current Control

The armature current reference is calculated from torque reference and flux. Then it is processed by a ramp, limitation and speed dependent limitation.
The actual value of the armature current is the measured mean value between two firing pulses.
The armature voltage reference is generated by a PI controller.
The firing angle is calculated from this voltage reference depending on the actual line voltage and the conduction time (adaptation between continuous and discontinuous state of the converter current).

A simplified scheme of the armature current control is given in diagram fig. 3.7/3.

3.7 Software diagrams

Introduction

The designation of parameters and signals consist of a group and a index.

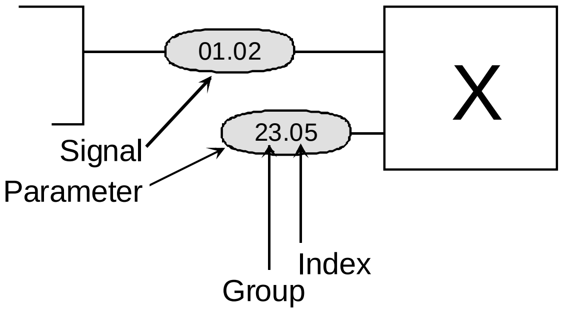


Fig. 3.7/1: Parameter/signal designation

The structure of the software is fix. Changes of the functions or pointers are realized through adjusting a parameter.

This can be done by the panel, Drives Window (PC utility) or the fieldbus.

Changed parameters or pointers are stored in the non-volatile flash PROM immediately.

All parameters can be transferred to the PC and stored at a data medium by using the PC program DrivesWindow.

In the following the software structure is shown through simplified diagrams. After that there are specific tables for:

- **Main Control Word**
- **Auxiliary Control Words**
- **Main Status Word**
- **Auxiliary Status Word**
- **Digital Inputs** (Armature converter mode)
- **Digital Inputs** (Field converter mode)
- **Digital Outputs** (Armature converter mode)
- **Digital Outputs** (Field converter mode)
- **Analogue Inputs** (Armature converter mode)

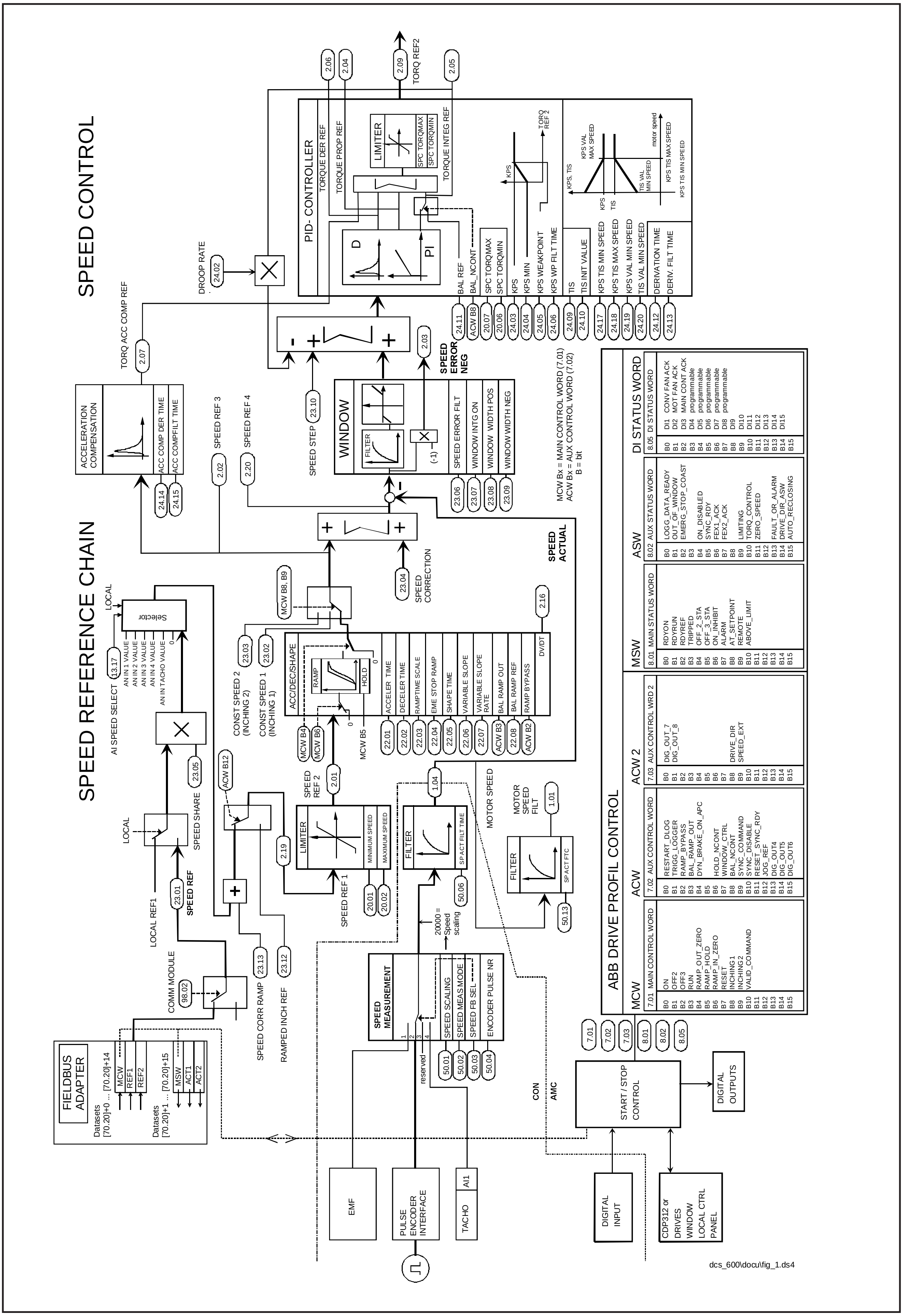


Fig. 3.7/2: Software structure - Speed reference chain

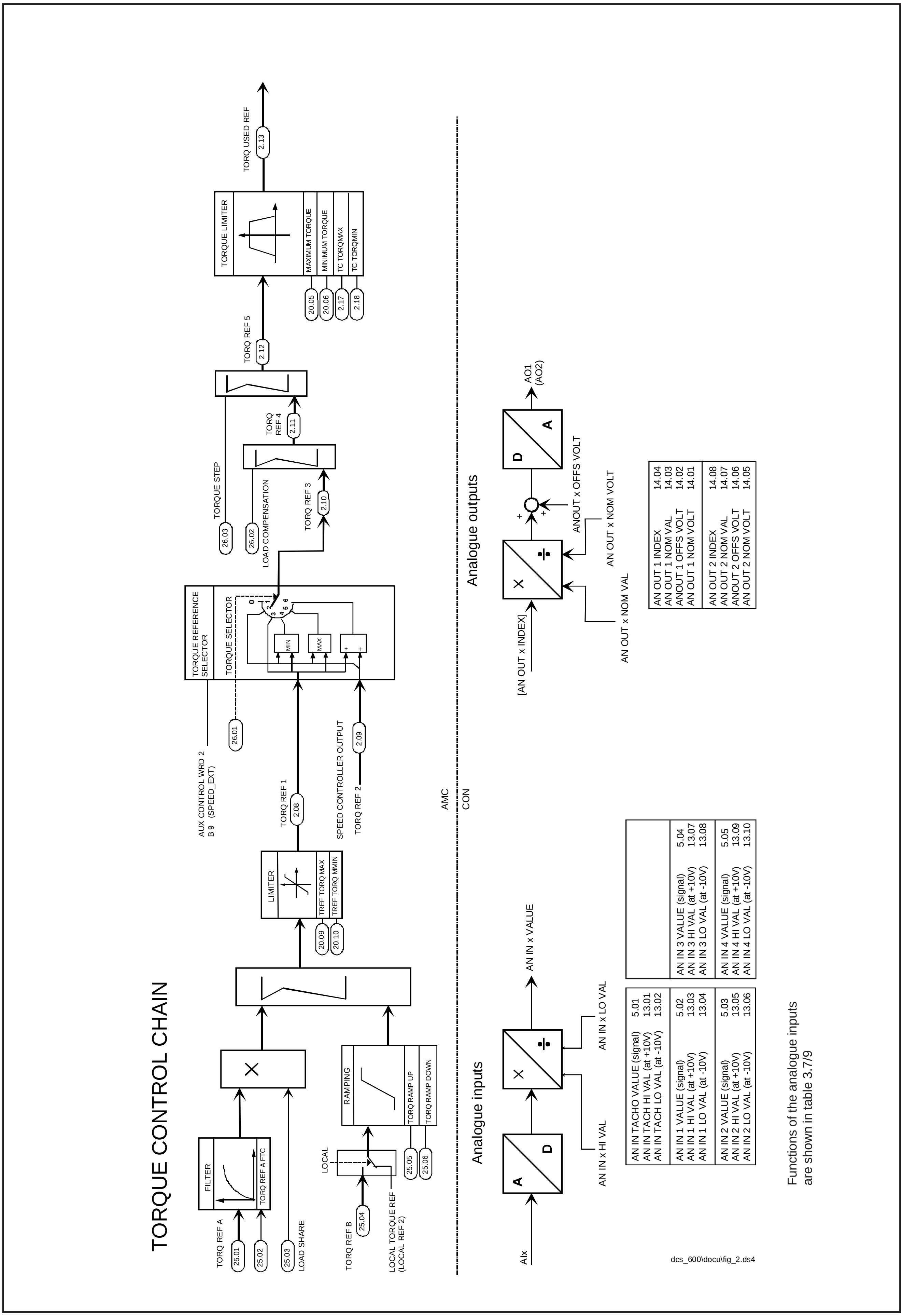


Fig. 3.7/3: Software structure - Torque control chain

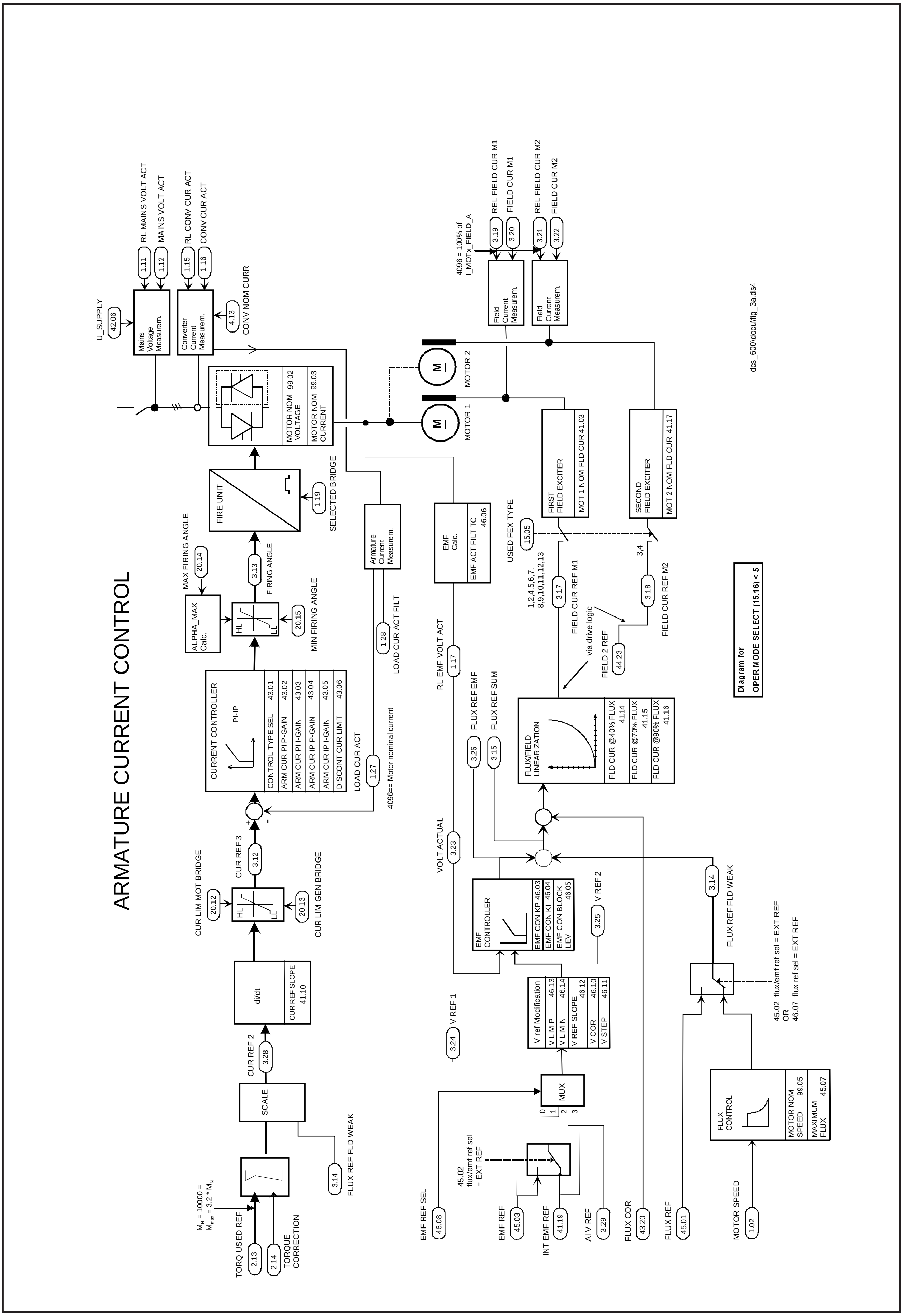


Fig. 3.7/4: Software structure - Armature current control

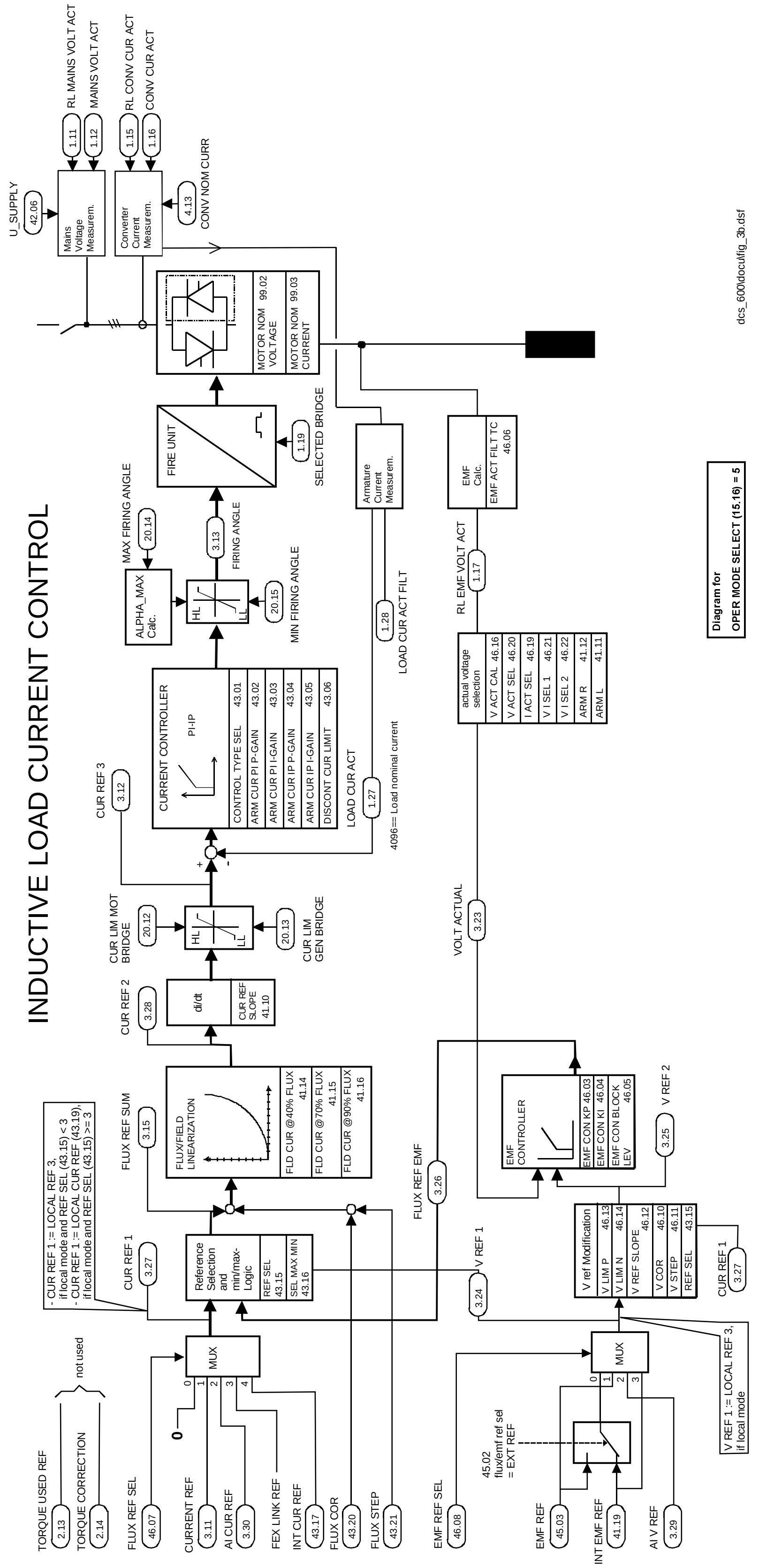


Fig. 3.7/5: Software structure - Inductive load current control

Main Control Word (7.01) ABB Drive Profile Control Word		
Bit	Name	Function
0	ON (OFF1_N)	start fans, field and close main contactor
1	OFF2_N	coast stop
2	OFF3_N	reserved for emergency stop
3	RUN	run with selected reference
4	RAMP_OUT_ZERO	Speed ramp output is forced to zero
5	RAMP_HOLD	Speed ramping is stopped
6	RAMP_IN_ZERO	Speed ramp input is forced to zero
7	RESET	acknowledge a fault indication
8	INCHING_1	Constant speed 1 (23.2) selected
9	INCHING_2	Constant speed 2 (23.3) selected
10	VALID_CMD	0: Freeze main control word 1: Main control word is valid
11	reserved	(reserved)
12	reserved	(reserved)
13	reserved	(reserved)
14	reserved	(reserved)
15	reserved	(reserved)

Table 3.7/1: Main Control Word

Auxiliary Control Word (7.02) ABB Drive Profile Control Word		
Bit	Name	Function
0	RESTART_DLOG	Restart of data logger (not available)
1	TRIG_LOGGER	Data logger triggering (see Note 1)
2	RAMP_BYPASS	Speed ramp is bypassed
3	BAL_RAMP_OUT	Forcing of ramp output
4	DYN_BRAKE_ON_-APC	activate dynamic braking
5	reserved	(reserved)
6	HOLD_NCONT	Holding of the speed controller's integrator
7	WINDOW_CTRL	Torque selector (26.1) is forced to ADD
8	BAL_NCONT	Forcing of speed controller's integrator
9	SYNC_COMMAND	synchronising command
10	SYNC_DISABLE	synchronising is disabled
11	RESET_SYNC_RDY	reset synchronised ready
12	JOGSPEED	Switch speed ramp input to jog speed (23.12)
13	DIG_OUT4	digital output 4
14	DIG_OUT5	digital output 5
15	DIG_OUT6	digital output 6

Table 3.7/2: Auxiliary Control Word

Auxiliary Control Word 2 (7.03) Drive-specific control word of DCS 600 MultiDrive		
Bit	Name	Function
0	DIG_OUT_7	digital output 7
1	DIG_OUT_8	digital output 8
2	DIG_OUT_1	digital output 1
3	DIG_OUT_2	digital output 2
4	DIG_OUT_3	digital output 3
5..7	reserved	(reserved)
8	DRIVE_DIR	**0**: drive direction positive * **1**: drive direction negative *
9	SPEED_EXT	**0**: torque reference according to min/max evaluation in torque selector modes 4 and 5 **1**: force speed controller output according in torque selector modes 4 and 5
10 to	reserved	(reserved)
15	reserved	(reserved)
* Changes of the commanded drive direction get actice only in the state RDY_REF; reversal of a running drive by means of this control bit is not possible.		

Table 3.7/3: Auxiliary Control Word 2

Control and Status Words

In remote mode, the drive is controlled by the main control word and the auxiliary control. The drive's status is read from the main status word and the auxiliary status word. The layout of the control and status words is given below.

Note 1

To activate the external triggering of the datalogger, signal (3.05) must be selected as trigger source; the trigger level should be set between -30000 and +30000. The selected edge of the trigger signal (3.05) equals the trigger edge of bit 1 (of 7.02).

Main Status Word (8.01) ABB Drive Profile Control Word		
Bit	Name	Function
0	RDY_ON	ready to close the contactor
1	RDY_RUN	ready to generate torque
2	RDY_REF	torque control operating (running)
3	TRIPPED	indication of fault in DC Device
4	OFF_2_STA_N	1: No OFF2 active
5	OFF_3_STA_N	1: No OFF3 active
6	ON_INHIBITED	Switch on inhibited
7	ALARM	indication of alarm in DC Device
8	AT_SETPOINT	Setpoint/act.value monitoring in the tolerance
9	REMOTE	1:Remote control / 0:Local control
10	ABOVE_LIMIT	speed treshold value (50.10) reached
11	reserved	(reserved)
12	reserved	(reserved)
13	reserved	(reserved)
14	reserved	(reserved)
15	reserved	(reserved)

Table 3.7/4: Main Status Word

Auxiliary Status Word (8.02) ABB Drive Profile Control Word		
Bit	Name	Function
0	LOGG_DATA_READY	
1	OUT_OF_WINDOW	
2	EMERG_STOP_CO-AST	
3	reserved	(reserved)
4	ON_DISABLED	External interlocking OFF1_N (Digital input selected by 15.14) prevents the run
5	SYNC_RDY	Position counter synchronous ready status
6	FEX1_ACK	FEX 1 acknowledge
7	FEX2_ACK	FEX 2 acknowledge
8	reserved	(reserved)
9	LIMITING	see signals 8.03, 8.04
10	TORQ_CONTROL	Drive is torque controlled
11	ZERO_SPEED	Motor speed actual is zero
12	EMF-SPEED	EMF speed feedback selected
13	FAULT_OR_ALARM	Fault or alarm of drive
14	DRIVE_DIR_ASW	Negative drive direction active
15	AUTO_RECLOSING	auto reclosing logic activated

Table 3.7/5: Auxiliary Status Word

DI Status Word (8.05) Digital input status word of DCS 600 MultiDrive		
Bit	Name	Function
0	DI 1	configurable
1	DI 2	configurable
2	DI 3	configurable
3	DI 4	configurable
4	DI 5	configurable
5	DI 6	configurable
6	DI 7	configurable
7	DI 8	configurable
8	DI 9	programmable Drive, if SDCS-IOE-1 is present
9	DI 10	programmable Drive, if SDCS-IOE-1 is present
10	DI 11	programmable Drive, if SDCS-IOE-1 is present
11	DI 12	programmable Drive, if SDCS-IOE-1 is present
12	DI 13	programmable Drive, if SDCS-IOE-1 is present
13	DI 14	programmable Drive, if SDCS-IOE-1 is present
14	DI 15	programmable Drive, if SDCS-IOE-1 is present
15	IOE1	1: SDCS-IOE-1 is connected to SDCS-CON-1
configurable: The DI can be selected for several converter functions; inversion function is available; in addition, it may be used for application running. **available for programmable Drive**: The DI is not selectable for converter functions, but is available for application programming.		

Table 3.7/6: DI Status Word

Digital inputs/outputs

Depending on the drive modes there are different possibilities for digital inputs and outputs.

<table>
<tr><th colspan="2">Digital Inputs</th><th colspan="2">Armature converter mode</th></tr>
<tr><th>Input</th><th>Signal</th><th>use</th><th>Description</th></tr>
<tr><td>DI 1</td><td>DI 1</td><td rowspan="8">configurable
→</td><td rowspan="8">12.13 ACK Converter fan
12.14 ACK Motor fan
12.15 ACK Main contactor
12.16 Emergency STOP
15.13 electrical disconnect
15.18 ACK DC breaker
15.20 ACK DYN brake
28.18 Klixon (motor 1 trip)
15.14 Main CONT ON
logical AND with
MCW 7.01 B0
15.15 Coast STOP
28.25 Klixon (motor 2 trip)</td></tr>
<tr><td>DI 2</td><td>DI 2</td></tr>
<tr><td>DI 3</td><td>DI 3</td></tr>
<tr><td>DI 4</td><td>DI 4</td></tr>
<tr><td>DI 5</td><td>DI 5</td></tr>
<tr><td>DI 6</td><td>DI 6</td></tr>
<tr><td>DI 7</td><td>DI 7</td></tr>
<tr><td>DI 8</td><td>DI 8</td></tr>
<tr><td colspan="4">if COMMAND SEL 15.22 = 1 (local I/O) then
DI 6 = Reset; DI 7 = ON; DI 8 = RUN</td></tr>
</table>

Table 3.7/7: Digital inputs Armature converter mode (**DCS 600**)

<table>
<tr><th colspan="2">Digital Inputs</th><th colspan="2">Field converter mode</th></tr>
<tr><th>Input</th><th>Signal</th><th>use</th><th>Description</th></tr>
<tr><td>DI 2</td><td>ACK_OVERVOLT</td><td>fix</td><td>Acknowledge overvoltage protection DCF 505/506</td></tr>
<tr><td>DI 1</td><td>DI 1</td><td rowspan="7">configurable
→</td><td rowspan="7">12.13 ACK Converter fan
12.14 ACK Motor fan
12.15 ACK Main contactor
12.16 Emergency STOP
15.13 electrical disconnect
15.18 ACK DC breaker
15.20 ACK DYN brake
28.18 Klixon (motor 1 trip)
15.14 Main CONT ON
logical AND with
MCW 7.01 B0
15.15 Coast STOP
28.25 Klixon (motor 2 trip)

Note: Do not select DI 2 for these functions!</td></tr>
<tr><td>DI 3</td><td>DI 3</td></tr>
<tr><td>DI 4</td><td>DI 4</td></tr>
<tr><td>DI 5</td><td>DI 5</td></tr>
<tr><td>DI 6</td><td>DI 6</td></tr>
<tr><td>DI 7</td><td>DI 7</td></tr>
<tr><td>DI 8</td><td>DI 8</td></tr>
<tr><td colspan="4">if COMMAND SEL 15.22 = 1 (local I/O) then
DI 6 = Reset; DI 7 = ON; DI 8 = RUN</td></tr>
</table>

Table 3.7/8: Digital inputs Field converter mode (**DCF 600**)

<table>
<tr><th colspan="2">Digital Outputs</th><th colspan="2">Armature converter mode</th></tr>
<tr><th>Output</th><th>Signal</th><th>use</th><th>Description</th></tr>
<tr><td>DO 1</td><td>DIG_OUT 1</td><td rowspan="8">configurable
→</td><td>free / program. by 12.02
default: Command fans on</td></tr>
<tr><td>DO 2</td><td>DIG_OUT 2</td><td>free / program. by 12.05
default: Command field exciter on</td></tr>
<tr><td>DO 3</td><td>DIG_OUT 3</td><td>free / program. by 12.08
default: Command main contactor on</td></tr>
<tr><td>DO 4</td><td>DIG_OUT 4</td><td>free / program. by 14.10</td></tr>
<tr><td>DO 5</td><td>DIG_OUT 5</td><td>free / program. by 14.13</td></tr>
<tr><td>DO 6</td><td>DIG_OUT 6</td><td>free / program. by 14.16</td></tr>
<tr><td>DO 7</td><td>DIG_OUT 7</td><td>free / program. by 14.19</td></tr>
<tr><td>DO 8</td><td>DIG_OUT 8</td><td>free / program. by 14.22</td></tr>
</table>

Table 3.7/9: Digital outputs Armature converter mode (**DCS600**)

<table>
<tr><th colspan="2">Digital Outputs</th><th colspan="2">Field converter mode</th></tr>
<tr><th>Output</th><th>Signal</th><th>use</th><th>Description</th></tr>
<tr><td>DO 1</td><td>DIG_OUT 1</td><td rowspan="8">configurable
→</td><td>free / program. by 12.02
default: Command fans on</td></tr>
<tr><td>DO 2</td><td>DIG_OUT 2</td><td>free / program. by 12.05
default: Command field exciter on</td></tr>
<tr><td>DO 3</td><td>DIG_OUT 3</td><td>free / program. by 12.08
default: Command main contactor on</td></tr>
<tr><td>DO 4</td><td>DIG_OUT 4</td><td>free / program. by 14.10</td></tr>
<tr><td>DO 5</td><td>DIG_OUT 5</td><td>free / program. by 14.13</td></tr>
<tr><td>DO 6</td><td>DIG_OUT 6</td><td>free / program. by 14.16</td></tr>
<tr><td>DO 7</td><td>DIG_OUT 7</td><td>free / program. by 14.19</td></tr>
<tr><td>DO 8</td><td>DIG_OUT 8</td><td>free / program. by 14.22</td></tr>
</table>

Table 3.7/10: Digital outputs Field converter mode (**DCF600**)

Analogue inputs

Depending on the drive modes there are different possibilities for analogue inputs.

Analogue Inputs					**Armature converter mode**
	Channel used for signal through:				
Channel	**AITAC**	**AI1**	**AI2**	**AI3**	**AI4**
Accuracy	± 4096	± 4096	± 2048	± 2048	± 2048
Signal					
FIELD_CUR_ACT 3.19 (used for Rebuild Appl.)	FEXC_SEL 15.05=9	FEXC_SEL 15.05=10	FEXC_SEL 15.05=11	FEXC_SEL 15.05=12	FEXC_SEL 15.05=13
SPEED_ACT 1.02	SPEED_MEAS_MODE 50.03=4				
MOT1_MEAS_TEMP 1.22			MOT1_TEMP_AI_SEL 28.09=1...5		
MOT2_MEAS_TEMP 1.23				MOT2_TEMP_AI_SEL 28.12=1...5	
EARTH_CURRENT (Fault)					EARTH_CUR_SEL 28.19=1
TQCORR 2.14		AI1_VAL_SEL 13.16=1			
Speed ref	AI SPEED SELECT 13.17=5	AI SPEED SELECT 13.17=1	AI SPEED SELECT 13.17=2	AI SPEED SELECT 13.17=3	AI SPEED SELECT 13.17=4

Table 3.7/11: Analogue inputs Armature converter mode (**DCS600**)

4 Connection examples

4.1 Armature current converter DCS 600

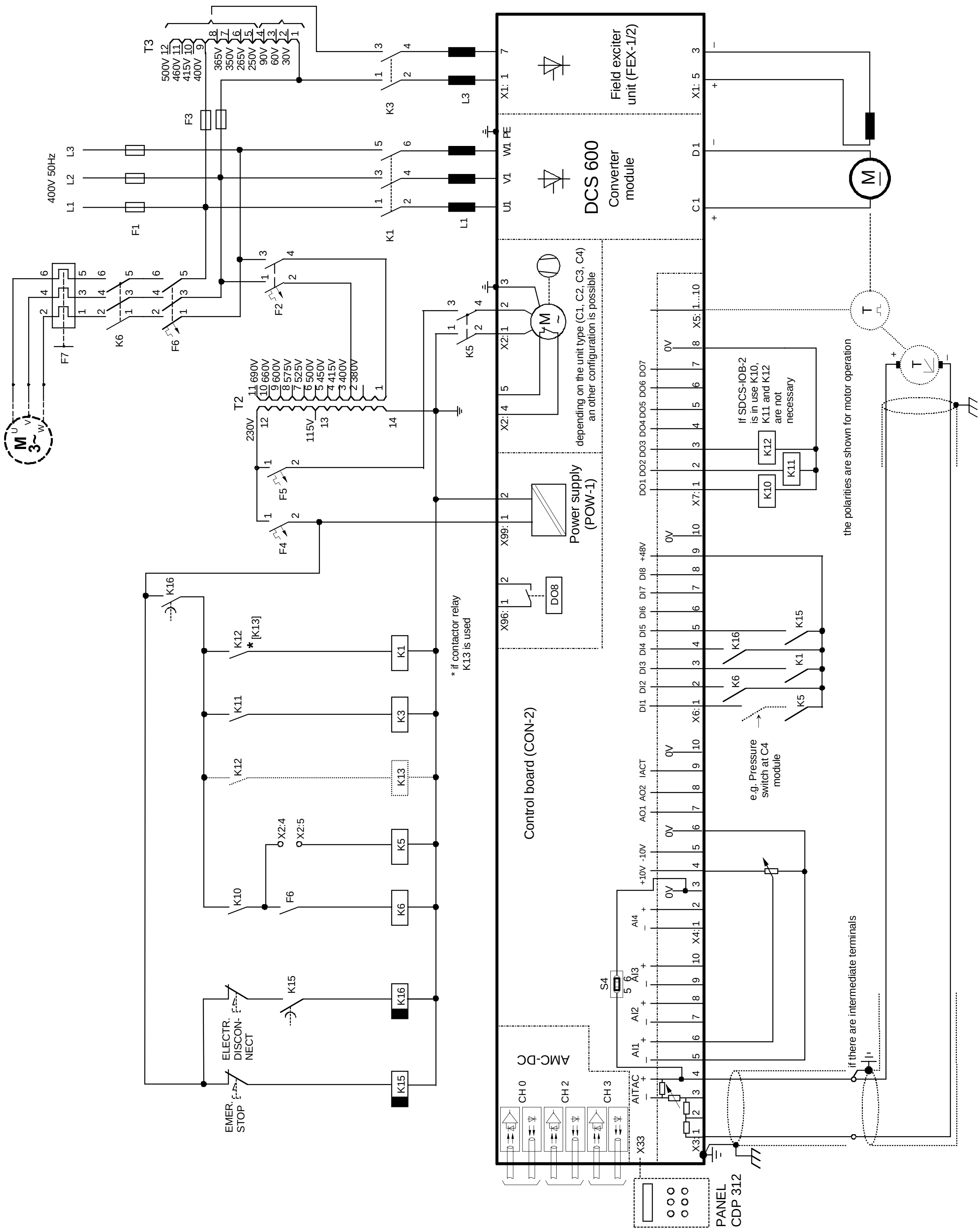


Fig. 4.1/1: DCS 600 Armature current converter wiring diagram

4.2 Field supply converter DCF 600

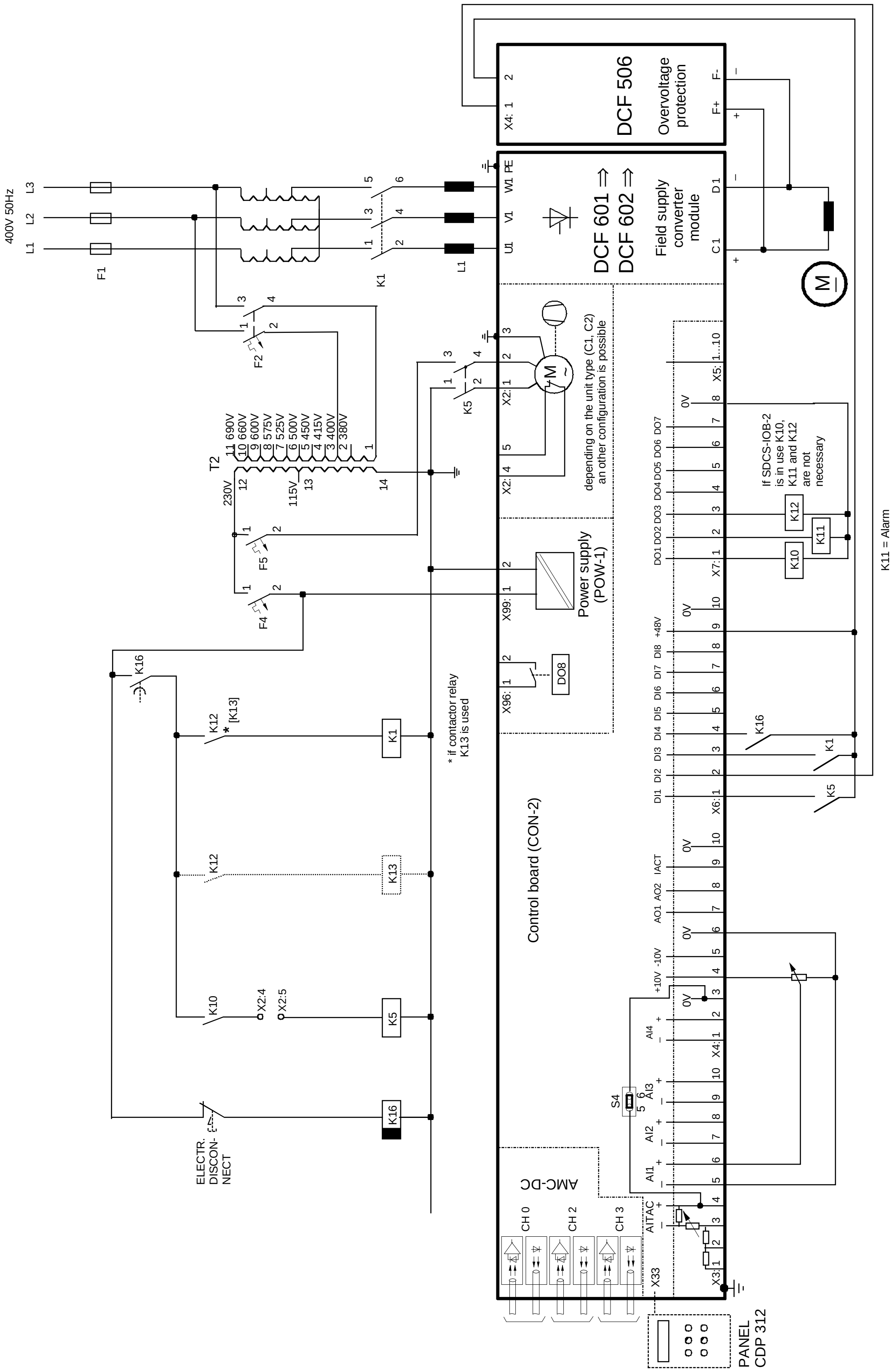


Fig. 4.2/1: DCF 600 Field supply converter wiring diagram

Notes

Notes

Notes

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.

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