DCS 500 Thyristor Power Converter
for DC drive systems
25 to 5200 A
6 to 5000 kW

System Description
DCS 500B / DCF 500B

Hints for printing:
A4-format from page 1...56 (System description + Software structure diagrams A4)
A3-format from page 57...60 (Software structure diagrams)
A1-format page 61 (Software structure overview)

These hints will not be printed!

ABB

Latest Technology, High Performance and a User Friendly Concept

The **DCS 500** series is a complete range of DC converters with high performance and reliability intended for the supply and control of DC machine armatures.

DCA 500 is a DCS 500 converter module mounted in a converter enclosure called "Common Cabinet" (see separate documentation).

DCF 500 is a DCS 500 module modified in a way to supply other consumers than armature circuits of DC machines (e.g. inductive loads like motor field windings, magnets etc.).

For revamp projects ABB has created a special "Rebuild Kit" called **DCR 500** to polish up your old DC power stack with a new modern digital front end (see separate documentation).

A selection of options is available to provide the user with a system meeting the most demanding technical requirements and performance expectations as well as many safety standards.
Common control electronics throughout the whole range reduce spare parts, inventory and training.

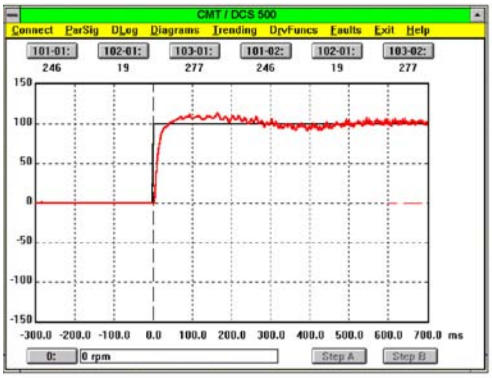
Wide Variety of Industrial Applications

The DCS, DCA, DCF and DCR converters can handle most demanding applications like:

- Metals
- Pulp & Paper
- Material handling
- Test Rigs
- Food & Beverage
- Printing
- Plastic & Rubber
- Oil Rigs
- Vessels
- Ski lifts
- Magnets
- MG Sets
- Electrolysis
- Battery Chargers
- and more

TOOLS

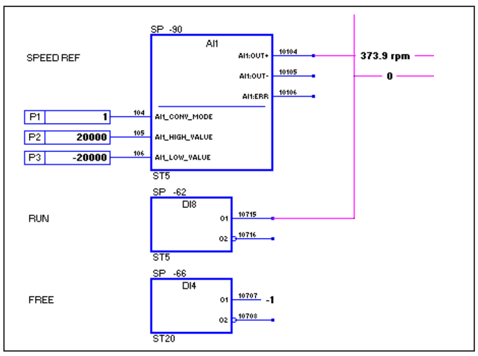
- Effort, time and cost will be saved with the user-friendly **CMT-Tool** (Commissioning and Maintenance Tool) for drive programming, commissioning, monitoring and maintenance.



• Data Logger • Trending • Fault Logger
• Parameter/Signals • Local operation

- **GAD Tool (Graphical Application Designer)** contains an extensive library of standard function blocks for the creation of customized software solutions creating conveniently the documentation during programming.

Both, CMT and GAD, represent a powerful set for each design, commissioning and service engineer to achieve best results and performance.



1 DCS 500 - a State-of-the-art technology

❖ **flexible design**
❖ **user-friendliness**

DCS 500 is a freely programmable drive to meet almost every application. Templates like Master-Follower, Winder etc. can be obtained.
The DCS 500 constitutes a complete program for ratings between 25 A and 5200 A as a power converter module (for 12-pulse parallel connection, up to approx. 10,000 A), suitable for all commonly used three-phase systems.

All our products are **CE** marked.

DIN EN ISO 9001

DIN EN ISO 14001

The DC drives factory of ABB Automation Products, Drives Division in Lampertheim has implemented and maintains a quality management system according to DIN EN **ISO 9001** and an environmental management system according to DIN EN **ISO 14001**.

DCS 500 Drives are also approved according to UL (**U**nderwriters **L**aboratory).

They also comply with the relevant EMC standards for Australia and New Zealand and are C-Tick marked.

DCS 500 converter units are suitable for both, standard drive applications as well as demanding applications.

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

Unit range

The range comprises of 5 sizes, C1, C2, A5, A6 and A7. We can deliver both modules and standard cubicles.

Basic hardware complements

- ❋ Thyristor bridge(s) (from size A5 with leg fuses installed)
- ❋ Temperature monitor for the thyristor bridge(s)
- ❋ Fan
- ❋ Power supply for the electronics
- ❋ Microprocessor board

Additional components for integration in the module

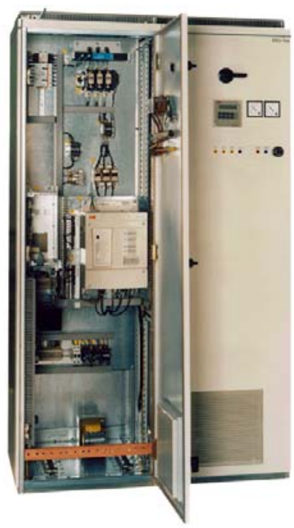
- ❋ Field power converter
  - – uncontrolled full wave diode bridge, 6A or
  - – half-controlled diode/thyristor bridge, 16A
- ❋ Communication board
- ❋ Control panel

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

- ❋ External field supply units
- ❋ Additional I/O boards
- ❋ Interface modules for various communication protocol
- ❋ EMC filter(s)
- ❋ Application software packages
- ❋ PC programs

The drive system functionality can be integrated with various fieldbus control systems from simple to factory-wide control.

C1 - Module



DCA cubicle

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II D SYSTEM DESCRIPTION

2 DCS 500B components overview

Description of the converter

Volume II D
System Description
DCS 500B
3ADW000066

Volume III
Technical Data
3ADW000165

Volume IV D
Operating Instructions
DCS 500B
3ADW000055

The **documentation** in hand describes the functionality of DCS 500 converter units as well as the cooperation of all single components belonging to a complete drive system.
As additional documentation is available:
DCS 500 **Technical Data** giving information about all direct technical data for components used inside and outside the converter module.
DCS 500 **Operating Instructions** including information and advise to commission the drive.
If three phase DCF 500 field supply units are needed please use the same documents as for DCS 500 armature converters.

Supplementary documentation

Volume II D1
System Description
DCA 500 / DCA 600
3ADW000121

DCA 500 / DCA 600 Enclosed converters **System description** for standard cubicles equipped with DC drives.

Volume V D2
Application Blocks
DCS 500B
3ADW000048

Volume V D1
SW Description
DCS 500B
3ADW000078

For those, who want to reprogram or adapt the software of their drive a detailed comprehensive description of the **software structure** of the drive as well as of all available **function blocs** can be delivered.

Volume VII A
Technical Guide
DCS
3ADW000163

Volume VI A
Service Manual
DCS 500(B)/600
3ADW000093

A DCS 500 **Service Manual** is available for service engineers.
Engineering and design people for drive systems can get a separate collection of information with regard to installation, sizing, fusing etc. of DC drives called "**Technical guide**".

Scope of delivery

The delivery consists of a converter module and some accessories. The document Quick Guide and a CD ROM with all the converter related documentation in different languages and screws to allow the wiring acc. to EMC are always included. For C1 and C2 converters a plug to connect the fan and screws to fix the power cables are added. Depending on the construction type screws for the power cables (A5), a key to open the door (all) and a tool to exchange thyristors will be delivered with the converter.

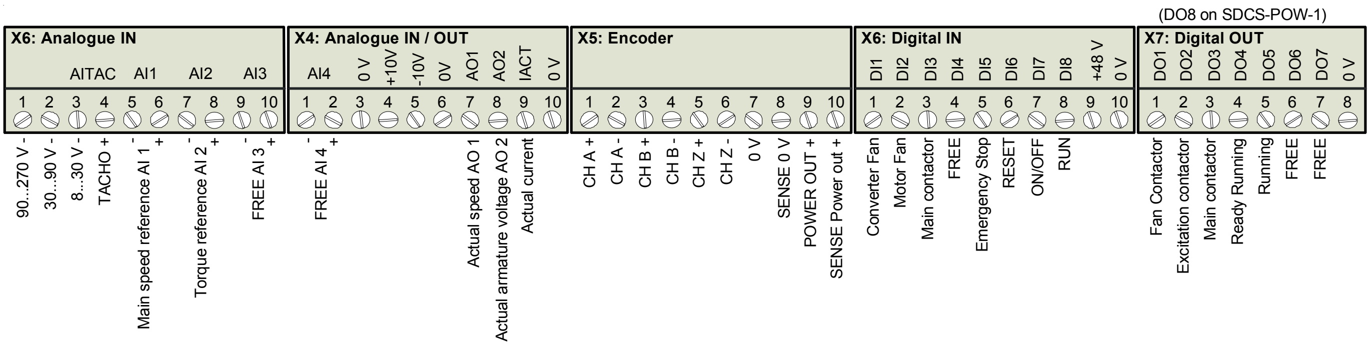

additional parts C1, C2


additional parts A5, A6, A7

Drive configuration

DCS 500 drives are freely programmable and therefore also terminals with their in and outs can be modified in their functionality.
When you receive your converter all terminals from X3: to X7: are set to a default configuration as shown below. This enables you to connect your drive according to connection example (see *chapter 3*) without any changes.

In case you want to re-configure terminals by means of software, please read the software description first and inform yourself about the possibilities you have before you start. (Never change any terminal while your drive is still connected to the mains!). After that you need to make sure that the correct signals are provided to your terminals.



Armature converter components overview

The DCS 500B power converter together with the options or accessories is designed to control DC motors as well as other DC loads. In case of DC motors the DCS 500B converter itself is used for the armature supply and a build-in or external field supply to control the field current.

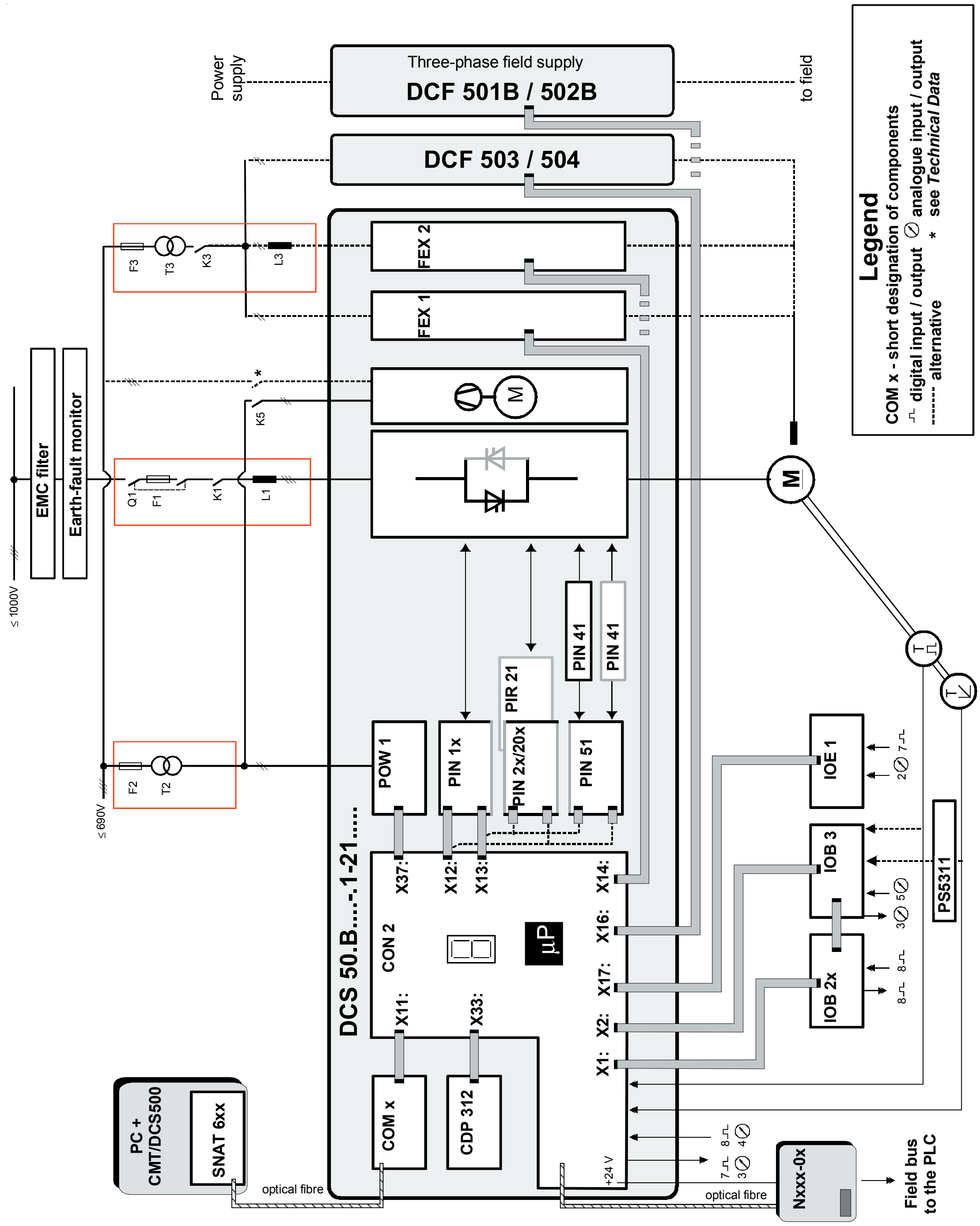


Fig. 2/1: DCS 500B Components overview

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 500B power converter module.

Field converter components overview

The hardware of a DCS 500B converter had been taken as a basis to get the DCF 500B converter which is used to control high inductive loads. Both converters use the same software. Looking on a complete system these two converters differ in some boards, the options and the wiring (the option CZD-0x is not needed in every case; see manual *Technical Data*).

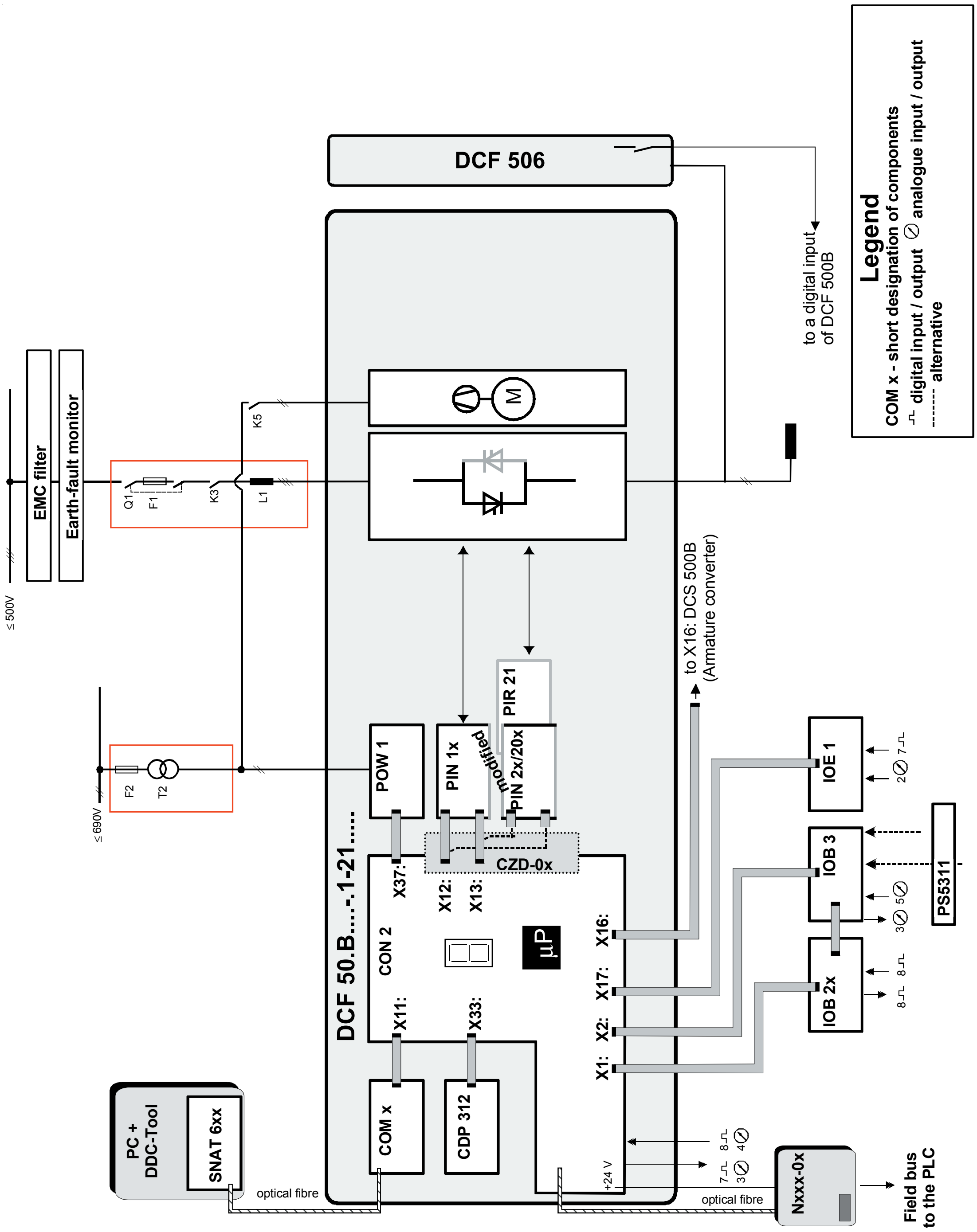


Fig. 2/2: DCF 500B Components overview

2.1 Environmental Conditions

System connection

Voltage, 3-phase:	230 to 1000 V acc. to IEC 60038
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 and options (line chokes, fuse holder, field supply unit, etc.):	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 cooling air temperature

- at converter module air inlet:	0 to +55°C
with rated DC current:	0 to +40°C
w. different DC curr. acc. Fig. 2.1/2:	+30 to +55°C
- Options:	0 to +40°C
Relative humidity (at 5...+40°C):	5 to 95%, no condensation
Relative humidity (at 0...+5°C):	5 to 50%, no condensation
Change of the ambient temp.:	< 0.5°C / minute
Storage temperature:	-40 to +55°C
Transport temperature:	-40 to +70°C

Pollution degree (IEC 60664-1, IEC 60439-1): 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

Size	Sound pressure level L_P (1 m distance)		Vibration
	as module	enclosed conv.	as module
C1	59 dBA	57 dBA	0.5 g, 5...55 Hz
C2	75 dBA	77 dBA	
A5	73 dBA	78 dBA	1 mm, 2...9 Hz 0.3 g, 9...200 Hz
A6	75 dBA	73 dBA	
A7	82 dBA	80 dBA	

Current reduction to (%)

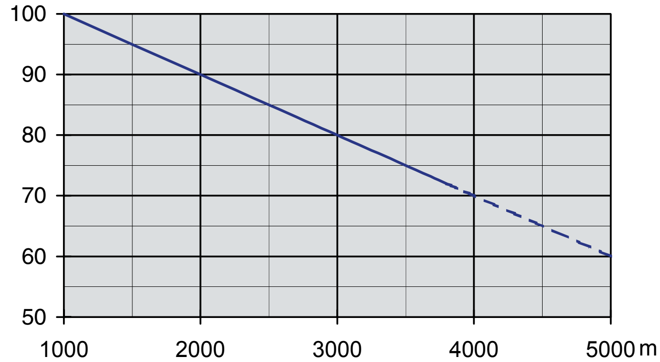


Fig. 2.1/1: Effect of the site elevation above sea level on the converter's load capacity.

Current reduction to (%)

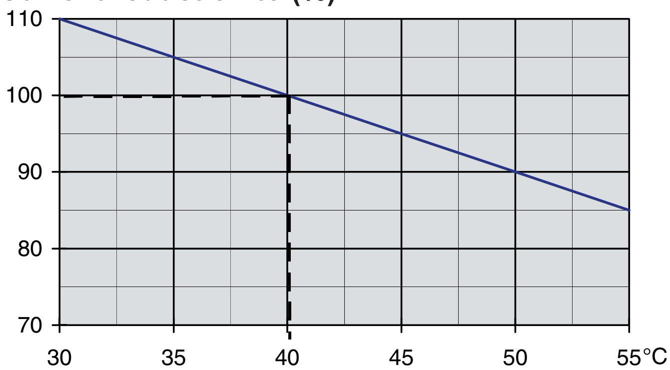


Fig. 2.1/2: Effect of the ambient temperature on the converter module load capacity.

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 98/37/EEC 93/68/EEC	Declaration of Incorporation	EN 60204-1 [IEC 60204-1]	EN 60204-1 [IEC 60204-1]
Low Voltage Directive 73/23/EEC 93/68/EEC	Declaration of Conformity	EN 60146-1-1 [IEC 60146-1-1] (EN 50178 [IEC --] see additional IEC 60664)	EN 60204-1 [IEC 60204-1] (EN 60439-1 [IEC 60439-1])
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 61800-3] ① in accordance with 3ADW 000 032	EN 61800-3 ① [IEC 61800-3] ① in accordance with 3ADW 000 032/ 3ADW 000 091

North American Standards

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

Rated supply voltage	Standards	
	Converter module	Enclosed converter
to 600 V	UL 508 C Power Conversion Equipment CSA C 22.2 No. 14-95 Industrial Control Equipment, Industrial Products Available for converter modules including field exciter units. Types with UL mark: • see UL Listing www.ul.com / certificate no. E196914 • or on request	UL/CSA types: on request
> 600 V to 1000 V	EN / IEC xxxxx see table on the left Available for converter modules including field exciter units.	EN / IEC types: on request (for details see table on the left)

2.2 DCS 500B 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 different sizes (C1a/b, C2a/b, A5, A6, A7), 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 etc. are also available, to compose 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_{VN}	DC voltage (recommended) $U_{dmax\ 2\text{-}Q}$	$U_{dmax\ 4\text{-}Q}$	Ideal DC voltage without load U_{di0}	Recommended DCS 500B 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
1190	1380	1235	1590	1

Table 2.2/1: DCS 500B max. DC voltages achievable with a specified input voltage.

If armature voltages higher than recommended are requested, please check carefully, wether your system is still working under safe conditions.

Application	Armature converter	Max. permitted armature voltage depending on **Field exciter type**: SDCS-FEX-1	SDCS-FEX-2A DCF 503A/504A DCF 501B	DCF 504A DCF 502B
Power always positive (U_a **and** I_a pos.). ***Extruder***	2-Q	$U_{dmax\ 2\text{-}Q}$	$U_{dmax\ 2\text{-}Q}$	-
Power often or always negative. ***Unwinder, suspended load***	2-Q	$U_{dmax\ 4\text{-}Q}$	$U_{dmax\ 4\text{-}Q}$	$U_{dmax\ 4\text{-}Q}$
Power sporadically negative. ***Printing machine at electrical stop***	2-Q	-	-	$U_{dmax\ 2\text{-}Q}$ + change software parameter
Power positive or negative. ***Test rig***	4-Q	$U_{dmax\ 4\text{-}Q}$	$U_{dmax\ 4\text{-}Q}$	-
Power positive, sporadically negative.	4-Q	$U_{dmax\ 4\text{-}Q}$	$U_{dmax\ 2\text{-}Q}$ + change software parameter	-

Table 2.2/2: Maximum permitted armature voltage

Converter type ➔ ⬇ x=1 → 2-Q x=2 → 4-Q	I_{DC} [A] 4Q	I_{DC} [A] 2Q	I_{AC} [A] 4Q	I_{AC} [A] 2Q	y=4 (400 V) P [kW] 4Q	y=4 (400 V) P [kW] 2Q	y=5 (500 V) P [kW] 4Q	y=5 (500 V) P [kW] 2Q	y=6 (600 V) P [kW] 4Q	y=6 (600 V) P [kW] 2Q	y=7 (690 V) P [kW] 4Q	y=7 (690 V) P [kW] 2Q
DCS50xB0025-y1	25	25	20	20	10	12	13	15				
DCS50xB0050-y1	50	50	41	41	21	23	26	29				
DCS50xB0050-61	50	50	41	41					31	35		
DCS50xB0075-y1	75	75	61	61	31	35	39	44				
DCS50xB0100-y1	100	100	82	82	42	47	52	58				
DCS50xB0110-61	110	100	90	82					69	70		
DCS50xB0140-y1	140	125	114	102	58	58	73	73				
DCS50xB0200-y1	200	180	163	147	83	84	104	104				
DCS50xB0250-y1	250	225	204	184	104	105	130	131				
DCS50xB0270-61	270	245	220	200					169	172		
DCS50xB0350-y1	350	315	286	257	145	146	182	183				
DCS50xB0450-y1	450	405	367	330	187	188	234	235	281	284		
DCS50xB0520-y1	520	470	424	384	216	219	270	273				
DCS50xB0680-y1	680	610	555	500	282	284	354	354				
DCS50xB0820-y1	820	740	670	605	340	344	426	429				
DCS50xB1000-y1	1000	900	820	738	415	418	520	522				
DCS50xB0903-y1	900	900	734	734					563	630	648	720
DCS50xB1203-y1	1200	1200	979	979	498	558	624	696				
DCS50xB1503-y1	1500	1500	1224	1224	623	698	780	870	938	1050	1080	1200
DCS50xB2003-y1	2000	2000	1632	1632	830	930	1040	1160		1400		1600
DCF50xB0025-y1	25	25	20	20	10	12	13	15				
DCF50xB0050-y1	50	50	41	41	21	23	26	29				
DCF50xB0075-y1	75	75	61	61	31	35	39	44				
DCF50xB0100-y1	100	100	82	82	42	47	52	58				
DCF50xB0200-y1	200	180	163	147	83	84	104	104				
DCF50xB0350-y1	350	315	286	257	145	146	182	183				
DCF50xB0450-y1	450	405	367	330	187	188	234	235				
DCF50xB0520-y1	520	470	424	384	216	219	270	273				

Table 2.2/3: Table of DCS 500B / DCF 500B units - construction types C1, C2, A5

Converter type ➔	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]	y=1 (1190V) P [kW] ①
2-Q converters									
DCS501B1903-y1	1900	1550					1740		
DCS501B2053-y1	2050	1673		1190	1430	1640			
DCS501B2503-y1	2500	2040	1160	1450	1750	2000	2300		
DCS501B3003-y1	3000	2448	1395	1740	2090	2400	2750		
DCS501B2053-y1	2050	1673						2390	
DCS501B2603-y1	2600	2121						3030	*on request*
DCS501B3303-y1	3300	2693	1540	1925	2310	2660	3040	3850	*on request*
DCS501B4003-y1	4000	3264	1870	2330	2800	3220	3690	4670	*on request*
DCS501B4803-y1	4800	3917			3360	3860	4420		
DCS501B5203-y1	5200	4243	2430	3030					
4-Q converters									
DCS502B1903-y1	1900	1550					1560		
DCS502B2053-y1	2050	1673		1070	1280	1470			
DCS502B2503-y1	2500	2040	1040	1300	1560	1800	2060		
DCS502B3003-y1	3000	2448	1250	1560	1880	2150	2470		
DCS502B2053-y1	2050	1673						2390	
DCS502B2603-y1	2600	2121						3030	*on request*
DCS502B3303-y1	3300	2693	1375	1720	2060	2370	2720	3440	*on request*
DCS502B4003-y1	4000	3264	1670	2080	2500	2875	3290	4170	*on request*
DCS502B4803-y1	4800	3917			3000	3450	3950		
DCS502B5203-y1	5200	4243	2170	2710					

① These converters are equipped with additional components. More information on request

Table 2.2/4: Table of DCS 500B units - construction type A6 / A7

Higher currents up to 15,000 A are achieved by paralleling converters - information on request.

Construction type C1

Construction type C2

Construction type A5

Construction type A6

Construction type A7
left busbar connection

Converter type ②	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
DCS50xB0025-y1	420x273x195	7.1	150x100x5	C1a	< 0.2	230 V/1 ph	external
DCS50xB0050-y1	420x273x195	7.2	150x100x5	C1a	< 0.2	230 V/1 ph	external
DCS50xB0050-61	420x273x195	7.6	150x100x5	C1a	-	230 V/1 ph	external
DCS50xB0075-y1	420x273x195	7.6	150x100x5	C1a	< 0.3	230 V/1 ph	external
DCS50xB0100-y1	469x273x228	11.5	250x150x5	C1b	< 0.5	230 V/1 ph	external
DCS50xB0110-61	469x273x228	11.5	250x150x5	C1b	-	230 V/1 ph	external
DCS50xB0140-y1	469x273x228	11.5	250x150x5	C1b	< 0.6	230 V/1 ph	external
DCS50xB0200-y1	505x273x361	22.3	250x150x5	C2a	< 0.8	230 V/1 ph	external
DCS50xB0250-y1	505x273x361	22.3	250x150x5	C2a	< 1.0	230 V/1 ph	external
DCS50xB0270-61	505x273x361	22.8	250x150x5	C2a	-	230 V/1 ph	external
DCS50xB0350-y1	505x273x361	22.8	250x150x5	C2a	< 1.3	230 V/1 ph	external
DCS50xB0450-y1	505x273x361	28.9	250x150x10	C2a	< 1.5	230 V/1 ph	external
DCS50xB0520-y1	505x273x361	28.9	250x150x10	C2a	< 1.8	230 V/1 ph	external
DCS50xB0680-y1	652x273x384	42	250x150x10	C2b	< 1.6	230 V/1 ph	external
DCS50xB0820-y1	652x273x384	42	250x150x10	C2b	< 2.0	230 V/1 ph	external
DCS50xB1000-y1	652x273x384	42	250x150x10	C2b	< 2.5	230 V/1 ph	external
DCS50xB0903-y1	1050x510x410	110	300x100x20	A5	-	230 V/1-ph	internal
DCS50xB1203-y1	1050x510x410	110	300x100x20	A5	< 5.2	230 V/1-ph	internal
DCS50xB1503-y1	1050x510x410	110	300x100x20	A5	< 5.5	230 V/1-ph	internal
DCS50xB2003-y1	1050x510x410	110	300x100x20	A5	< 6.6	230 V/1-ph	internal
DCS50xB1903-81	1750x460x410	180	③ x0x50	A6	-	400...500 V/3-ph	
DCS50xB2053-y1	1750x460x410	180	③ x0x50	A6	< 7.9	at y = 4, 5, 8	internal
DCS50xB2503-y1	1750x460x410	180	③ x0x50	A6	< 9.3	500...690 V/3-ph	
DCS50xB3003-y1	1750x460x410	180	③ x0x50	A6	< 11.9	at y = 6, 7	
DCS50xB2053-y1L①	1750x770x570	315	to be installed in cubicle	A7	-	400/690 V/3-ph	
DCS50xB2603-y1L①	1750x770x570	315		A7	-	400/690 V/3-ph	internal
DCS50xB3203-y1L①	1750x770x570	315		A7	-	400/690 V/3-ph	
DCS50xB3303-y1L①	1750x770x570	315		A7	< 15	400/690 V/3-ph	
DCS50xB4003-y1L①	1750x770x570	315		A7	< 16	400/690 V/3-ph	
DCS50xB4803-y1L①	1750x770x570	315		A7	-	400/690 V/3-ph	
DCS50xB5203-y1L①	1750x770x570	315		A7	< 20	400/690 V/3-ph	

① Busbar connection on the right side is optional
Example for the type designation: connection left DCS50xB5203-y1**L**; connection right DCS50xB5203-y1**R**)

② **x=1** → 2-Q; **x=2** → 4-Q; **y=4...9/1** → 400...1000 V/1190 V supply voltage
③ Exhaust air must leave enclosure via air channel

[grey box] also available as field supply converter DCF50xB (for 500 V s. also table 2.2/3). Data are the same as the armature current converter DCS50xB

Table 2.2/5: Table of DCS 500B units

2.3 DCS 500B Overload Capability

To match a drive system's components as efficiently as possible to the driven machine's load profile, the armature power converters DCS 500B 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.

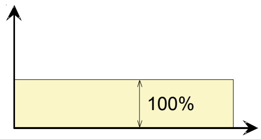
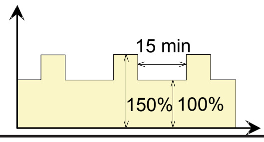
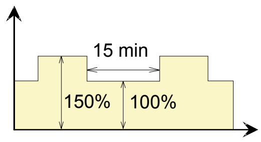
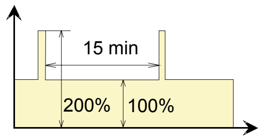
The currents for the DC I to DC IV types of load (see diagram on the following page) for the power converter modules are listed in the table below.

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]	
DCS 50xB0025-41/51	25	24	36	23	35	24	48
DCS 50xB0050-41/51	50	44	66	42	63	40	80
DCS 50xB0075-41/51	75	60	90	56	84	56	112
DCS 50xB0100-41/51	100	71	107	69	104	68	136
DCS 501B0140-41/51	125	94	141	91	137	90	180
DCS 502B0140-41/51	140	106	159	101	152	101	202
DCS 501B0200-41/51	180	133	200	132	198	110	220
DCS 502B0200-41/51	200	149	224	146	219	124	248
DCS 501B0250-41/51	225	158	237	155	233	130	260
DCS 502B0250-41/51	250	177	266	173	260	147	294
DCS 501B0350-41/51	315	240	360	233	350	210	420
DCS 502B0350-41/51	350	267	401	258	387	233	466
DCS 501B0450-41/51	405	317	476	306	459	283	566
DCS 502B0450-41/51	450	352	528	340	510	315	630
DCS 501B0520-41/51	470	359	539	347	521	321	642
DCS 502B0520-41/51	520	398	597	385	578	356	712
DCS 501B0680-41/51	610	490	735	482	732	454	908
DCS 502B0680-41/51	680	544	816	538	807	492	984
DCS 501B0820-41/51	740	596	894	578	867	538	1076
DCS 502B0820-41/51	820	664	996	648	972	598	1196
DCS 501B1000-41/51	900	700	1050	670	1005	620	1240
DCS 502B1000-41/51	1000	766	1149	736	1104	675	1350
DCS 50xB1203-41/51	1200	888	1332	872	1308	764	1528
DCS 50xB1503-41/51	1500	1200	1800	1156	1734	1104	2208
DCS 50xB2003-41/51	2000	1479	2219	1421	2132	1361	2722
DCS 50xB2053-51	2050	1550	2325	1480	2220	1450	2900
DCS 501B2503-41/51	2500	1980	2970	1880	2820	1920	3840
DCS 502B2503-41/51	2500	2000	3000	1930	2895	1790	3580
DCS 501B3003-41/51	3000	2350	3525	2220	3330	2280	4560
DCS 502B3003-41/51	3000	2330	3495	2250	3375	2080	4160
DCS 50xB3303-41/51	3300	2416	3624	2300	3450	2277	4554
DCS 50xB4003-41/51	4000	2977	4466	2855	4283	2795	5590
DCS 50xB5203-41/51	5200	3800	5700	3669	5504	3733	7466
600 V / 690 V							
DCS 50xB0050-61	50	44	66	43	65	40	80
DCS 501B0110-61	100	79	119	76	114	75	150
DCS 502B0110-61	110	87	130	83	125	82	165
DCS 501B0270-61	245	193	290	187	281	169	338
DCS 502B0270-61	270	213	320	207	311	187	374
DCS 501B0450-61	405	316	474	306	459	282	564
DCS 502B0450-61	450	352	528	340	510	313	626
DCS 50xB0903-61/71	900	684	1026	670	1005	594	1188
DCS 50xB1503-61/71	1500	1200	1800	1104	1656	1104	2208
DCS 501B2003-61/71	2000	1479	2219	1421	2132	1361	2722
DCS 50xB2053-61/71	2050	1520	2280	1450	2175	1430	2860
DCS 501B2503-61/71	2500	1940	2910	1840	2760	1880	3760
DCS 502B2503-61/71	2500	1940	2910	1870	2805	1740	3480
DCS 501B3003-61/71	3000	2530	3795	2410	3615	2430	4860
DCS 502B3003-61/71	3000	2270	3405	2190	3285	2030	4060
DCS 50xB3303-61/71	3300	2416	3624	2300	3450	2277	4554
DCS 50xB4003-61/71	4000	3036	4554	2900	4350	2950	5900
DCV 50xB4803-61/71	4800	3734	5601	3608	5412	3700	7400
790 V							
DCS 50xB1903-81	1900	1500	2250	1430	2145	1400	2800
DCS 501B2503-81	2500	1920	2880	1820	2730	1860	3720
DCS 502B2503-81	2500	1910	2865	1850	2775	1710	3420
DCS 501B3003-81	3000	2500	3750	2400	3600	2400	4800
DCS 502B3003-81	3000	2250	3375	2160	3240	2000	4000
DCS 50xB3303-81	3300	2655	3983	2540	3810	2485	4970
DCS 50xB4003-81	4000	3036	4554	2889	4334	2933	5866
DCS 50xB4803-81	4800	3734	5601	3608	5412	3673	7346
1000 V							
DCS 50xB2053-91	2050	1577	2366	1500	2250	1471	2942
DCS 50xB2603-91	2600	2000	3000	1900	2850	1922	3844
DCS 50xB3303-91	3300	2551	3827	2428	3642	2458	4916
DCS 50xB4003-91	4000	2975	4463	2878	4317	2918	5836
1190 V				Data on request			

x=1 → 2-Q; **x=2** → 4-Q

Table 2.3/1:
Power converter module currents with corresponding load cycles.
The characteristics are based on an ambient temperature of max. 40°C and an elevation of max. 1000 m a.s.l.

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 DriveSize program !
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 DriveSize 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 the converter´s software is structured similar as the inputs made at the program. Because of that many of the data can be directly utilized at the converter like high current, line voltage and others.

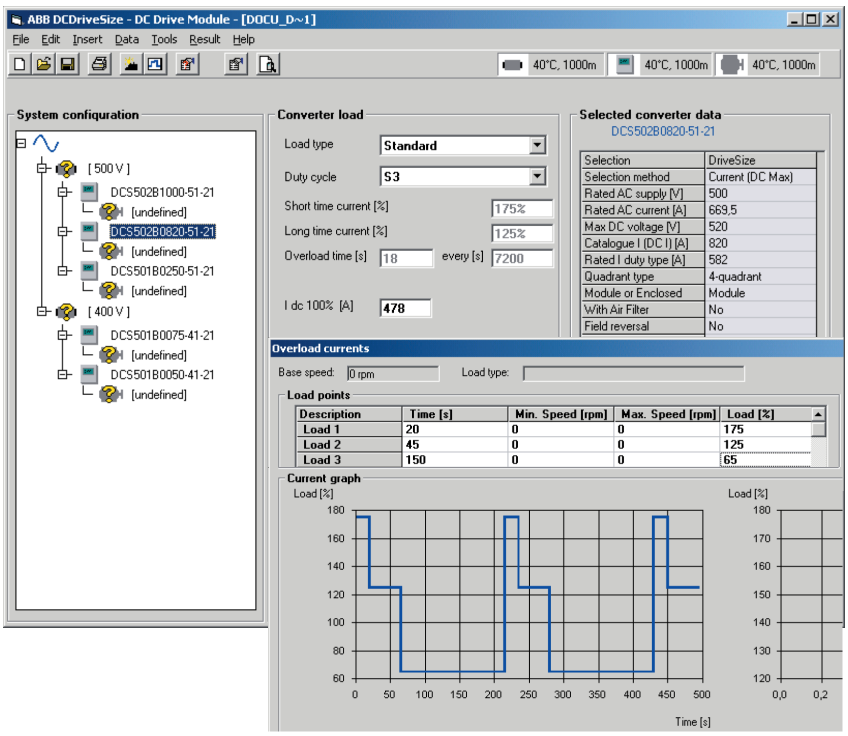


Fig. 2.3/1: Entry screen of the PC for the dimensioning program.

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

General data

- Currents from 6 to 520 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 SDCS-FEX-1)

We recommend integrating an autotransformer in the field power converter's supply circuit to adjust the AC input voltage to the field voltage and for reducing 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-2A) and an external (DCF 501B/2B/3A/4A) or two external field supply units (2 x DCF 501B/2B/3A/4A). The respective software function required is available in every DC power converter.

Field converter types

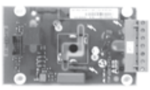
SDCS-FEX-1

- 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 %
U_V = Line voltage

- Recommendation:
  Field voltage ~ 0,9 * U_V



SDCS-FEX-1

SDCS-FEX-2A

- 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.
- Fast-response excitation is possible with an appropriate voltage reserve; de-excitation takes place by field time constant.
- Output voltage U_A:

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

TOL = tolerance of line voltage in %
U_V = Line voltage

- Recommendation:
  Field voltage 0.6 to 0.8 * U_V

SDCS-FEX-2A

DCF 503A

- 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.
- Output voltage U_A:

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

TOL = tolerance of line voltage in %
U_V = Line voltage

- Recommendation:
  Field voltage 0.6 to 0.8 * U_V

DCF 504A

- Fully-controlled antiparallel thyristor bridges (4-Q)
- This unit is permissible -in difference to the SDCS-FEX-2- for fast-response excitation / de-excitation as well as field reversal. For fast-response excitation an appropriate voltage reserve is necessary.
  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.
- Same design as DCF 503A

DCF 500B

This field power converter is used mainly for armature-circuit converters with rated currents of 2050 to 5200 A. It consists of a modified armature-circuit converter.

- Output voltage U_A respectively $U_{dmax\ 2\text{-}Q}$:
  see table 2.2/1
- Recommendation:
  Field voltage 0.5 to 1.1 * U_V
- The three-phase field supply converters DCF 501B/502B need a separate active Overvoltage Protection unit DCF 506 for protecting the power part against inadmissibly high voltages.
  The overvoltage protection unit DCF 506 is suitable for 2-Q converters DCF 501B and for 4-Q converters DCF 502B.

Assignment Field supply converter to Overvoltage protection unit

Field supply converter for motor fields	Overvoltage Protection
DCF50xB0025-51 ... DCF50xB0140-51	DCF506-0140-51
DCF50xB0200-51 ... DCF50xB0520-51	DCF506-0520-51

DCF 503A / 504A

DCF501B/502B

DCF506-140-51, without cover

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-2A-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 A6/A7 mod.!
DCF 503A-0050	0.3...50	110V -15%...500V/1-ph +10%	external	auxiliary supply (115...230V) if necessary via matching transformer; fuse external; Dimensions HxWxD: 370x125x342 [mm]
DCF 504A-0050	0.3...50	110V -15%...500V/1-ph +10%	external	
DCF 50xBxxxx-51	see table 2.2/3	200V...500V/3-ph	external	are based on the hardware of the DCS 500B and additional hardware components (DCF 506); auxiliary supply (115/230V)

① Current reduction see also *2.1 Environmental conditions Fig.: 2.1/1 and 2.1/2*
Table 2.4/1: Table of field converter units

2.5 Options for DCS 500B / DCF 500B 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. In addition to this an extension of I/O´s by SDCS-IOE 1 is possible.

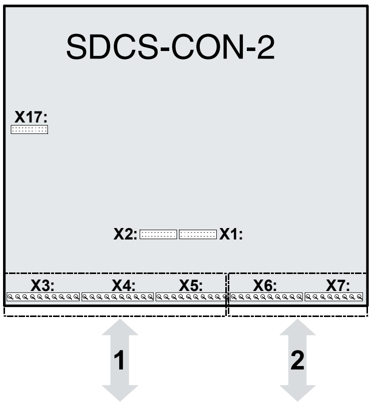


Fig. 2.5/1: I/O´s via SDCS-CON2

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

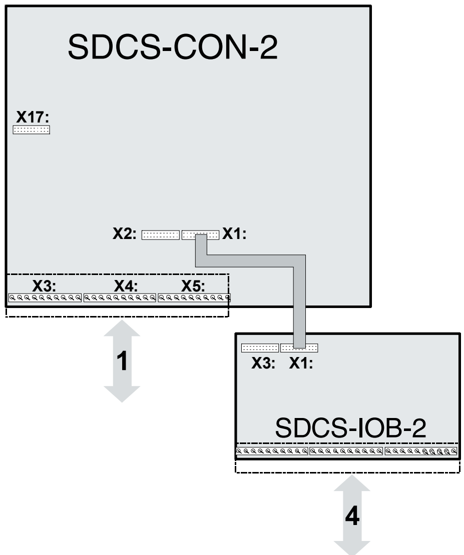


Fig. 2.5/2: I/O´s via SDCS-CON2 and SDCS-IOB2

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

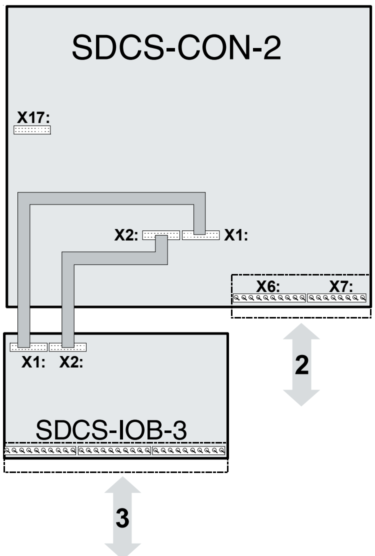


Fig. 2.5/3: I/O´s via SDCS-CON2 and SDCS-IOB3

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

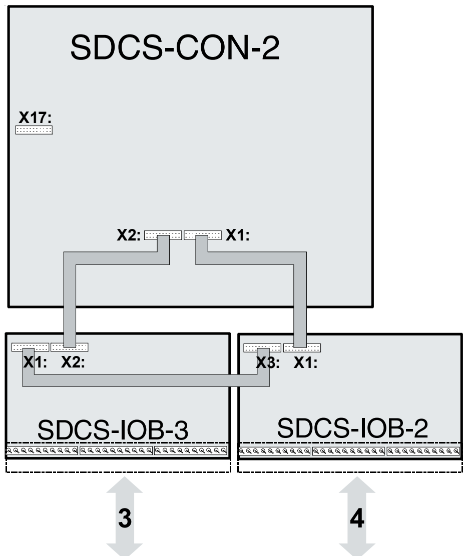


Fig. 2.5/4: I/O´s via SDCS-IOB2 and SDCS-IOB3

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
Current source for PTC element evaluation via jumper and input 2

⇦ **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

⇨ **Residual 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.

The digital and analogue inputs can be extended by means of the SDCS-IOE1 board. This is in addition to the a.m. solutions.

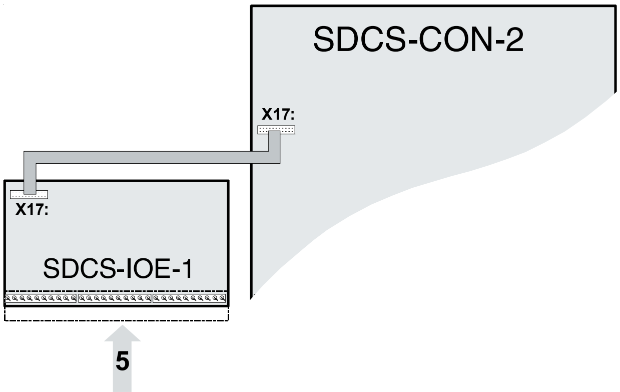


Fig. 2.5/5: Additional Inputs via SDCS-IOE1

Analogue inputs:	extended
Digital inputs:	all isolated by means of optocoupler, the signal status is indicated by LED
current source for:	PT100/PTC element

Description of input signals **SDCS-IOE-1**

Mechanical system always external, outside the basic unit

Terminals

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

Functionality

⇨ **7 digital inputs**
The functions can be selected by means of the software
The signal status is indicated by an LED
Input voltage: 0...8 V ⇒ "0 signal", 16...31 V ⇒ "1 signal"
Isolated from the unit's electronics by optocouplers
Potentialwise arranged in two groups (DI 9...DI 12 and DI 13...DI 15)
Time constant of smoothing capacitor: 2 ms

⇨ **2 analogue inputs**
All as differential inputs; common-mode range ±40 V
Range -10 V/-20 mA...0...+10 V/+20 mA; 4... 20 mA unipolar
R_E = 200 kΩ /500 Ω /500 Ω
Resolution: 11 bit + sign
Input 2: range as for input 1,
in addition -1 V/-2 mA...0...+1 V/+2 mA, then common-mode range ±40 V, R_E = 20 kΩ

⇦ **Current source** for PT 100 or PTC element evaluation
I_A = 5 mA / 1.5 mA
The signals are referenced to the unit casing potential

Please note:

Unless otherwise stated, all signals are referenced to a 0 V potential. Within the power pack subassembly (SDCS-POW-1) and on all other PCBs, this potential is firmly connected to the unit's casing by means of plating-through at the fastening points.

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 pushbuttons in three function groups
- LCD display comprising four lines with 20 characters each
- Language: German, English, French, Italian, Spanish
- Options for the CDP 312:
  - cable, separated from the power converter for utilization; 3 m long
  - kit for mounting the panel in the switchgear cubicle door

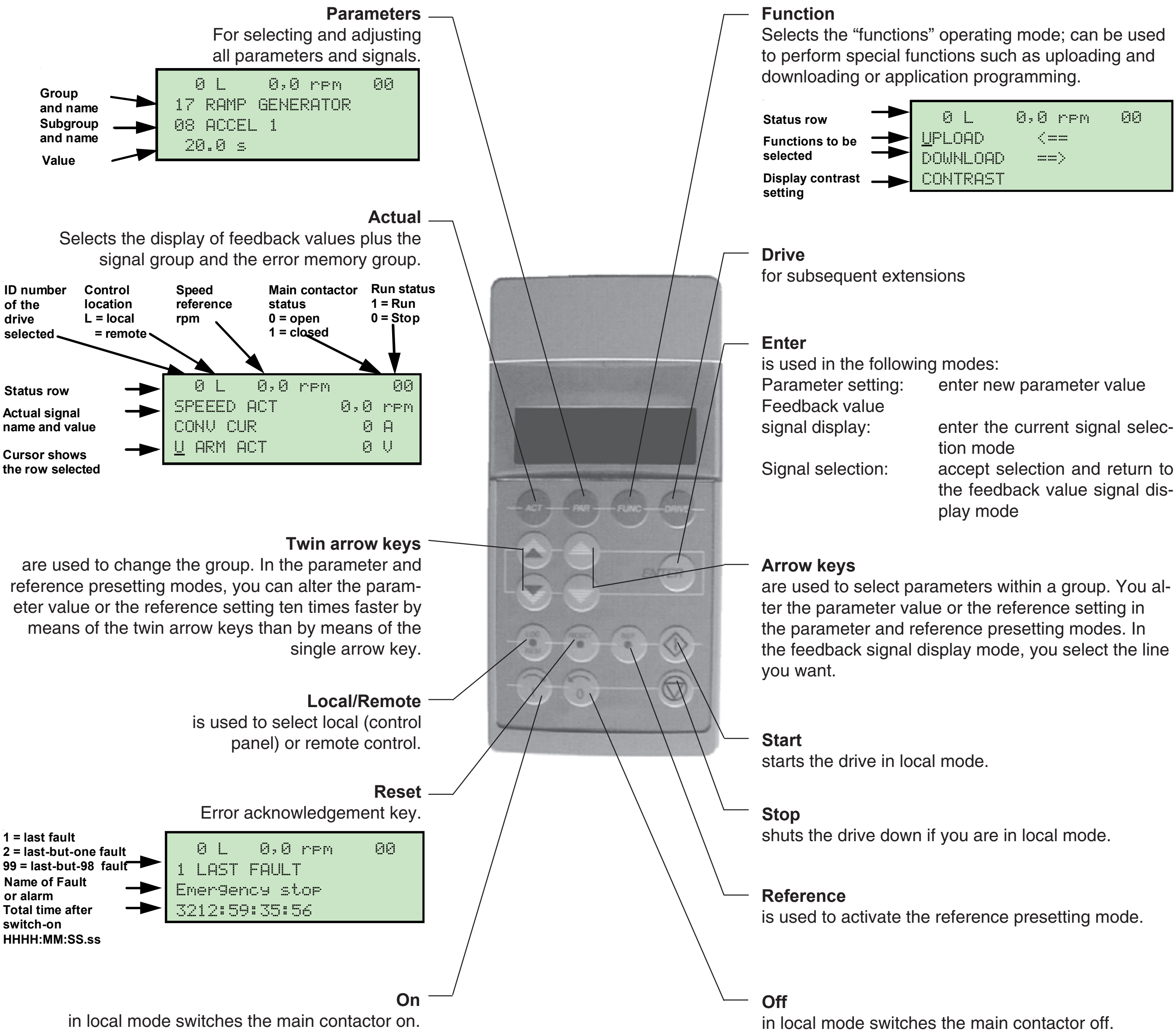


Fig. 2.5/6: Function keys and various displays on the removable control and display panel. The panel can also be used to load the same program on different power converters.

Serial interface

There are various serial interface options available for operation, commissioning and diagnosis, plus for controlling. According to the description in the previous section, there is a serial connection to the control and display panel (X33:/X34: on the SDCS-CON-2 control board). Installing the optional SDCS-COM-5 communication board on the SDCS-CON-2 control board creates additional serial interfaces.
Both interfaces use optical fibres. One channel is used for drive/PC interfacing. The other for fieldbus module interfacing. All three serial interfaces are independent from each other.

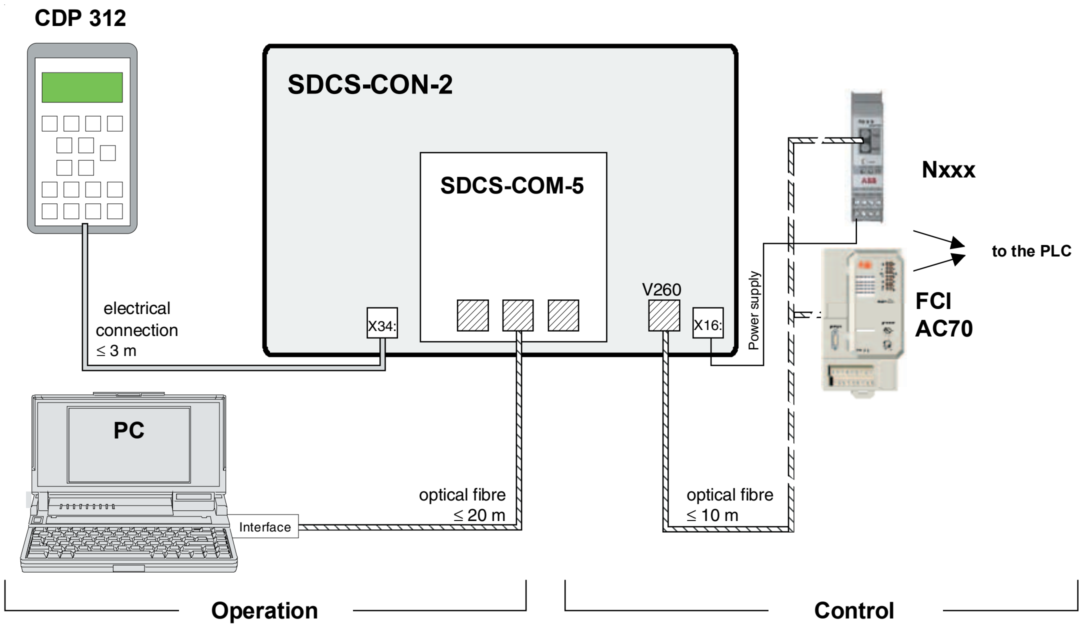


Fig. 2.5/7: Options for serial communication

Operation by PC

System requirements/recommendation:

- Laptop PC with Windows NT ™ or Windows 2000 ™ operating system (desktop PC on request)
- hard disk with 4MB free memory; each graph recorded requires additional 500 kB of free memory.
- CD rom drive
- PCMCIA slot

Components required:

- SDCS-COM-5 as an option
- DDCTool 4.x package for Windows NT ™ or DDCTool 4.x package for Windows 2000 ™ (DDCTool 4.0 package for Windows XP ™ on request)

  The package contains of:
  - CD rom with installation software
  - SNAT624 PCcard (PCMCIA)
  - NDPC-02 connector (interface from SNAT624 to plastic optical fibre cable)
  - plastic optical fibre cable (10m)

Functionality:

- DDCtool starts program part CMT/DCS 500, when a DCS500B is connected
- CMT/DCS 500 is the core program (this name will be used further on as a cross-reference) for commissioning, diagnosis, maintenance and trouble-shooting based on point-to-point connection. In addition to the functionality provided by the CDP 312 control panel, there are further functions available described on next page.

Control

components required:

- plastic optical fibre for distances up to 20 m (longer distances on request)
- field bus module Nxxx-0x

Functionality:

Field bus	Module	Number of cyclic words from/ to drive	Parameter exchange possible	Baudrate
Profibus	NPBA-12	≤ 6 ①②	Yes	≤ 12 MB
CANopen	NCAN-02	≤ 6 ①	Yes	≤ 1 MB
DeviceNet	NDNA-02	≤ 6 ①	Yes	≤ 1 MB
ControlNet	NCNA-01	≤ 6 ①	Yes	≤ 5 MB
ModBus	NMBA-01	≤ 6 ①	Yes	≤ 19.2 KB
AC70 / FCI	-----	≤ 6 ①	No	≤ 4 MB

① Four of them are predefined via the profile variable speed drives done by the Profibus user organization; they can be altered, if necessary.
② The module supports the PPO types 1 to 5; depending on the PPO type in use less words will be transferred or they will be empty.

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

Operation by PC (continued)

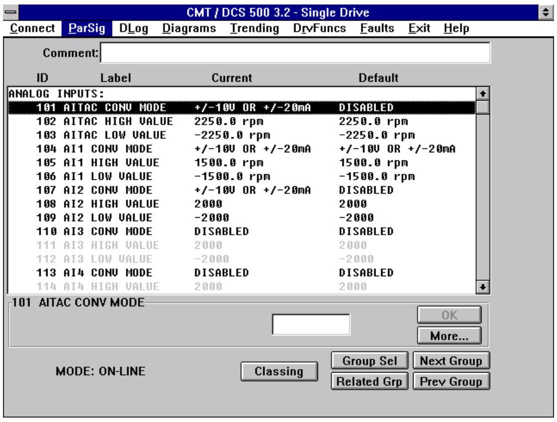
The program incorporates nine different function windows which can be used to alter the application program on-line, to monitor the drive's functionality, to alter the parameter values, to control the drive and to monitor its status. You will find below a brief description of the individual menu options, some of which are shown as a screen display to serve as examples.

Connect

This option is used to trigger special functions such as establishing the connection to the power converter or configuring the program.

ParSig

The parameter and signal display enables the user to view parameter or signal values in a table and to alter them. One of the functions available for the user is to allocate each parameter or each signal to self-defined groups. He/she can then select only special groups, and trace or alter the values of parameters or signals in this group.

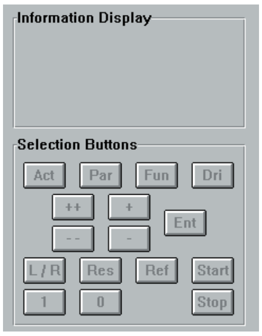


Dlog

The DC power converter is able to continuously log up to six signals and to store them in non-volatile memory from a trigger condition to be set (level, pre-event and post-event history). These values can then be read out by the program in chronological sequence and processed further. They are available as a table or as a diagram, in forms similar to those with the "Trending" option, and can also be printed out in these forms.

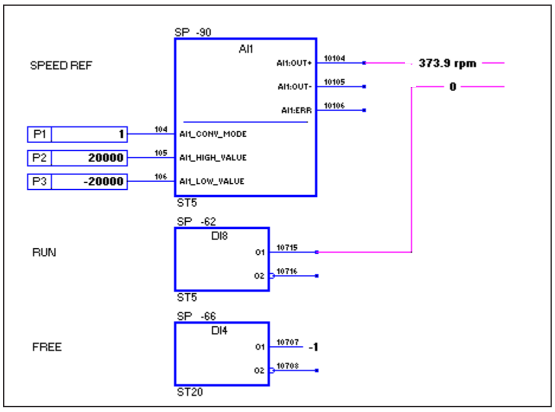
DrvFuncs

This display provides the same display and the same pushbuttons for the user as the CDP 312 display and control panel. For that reason, the drive functions are also identical.



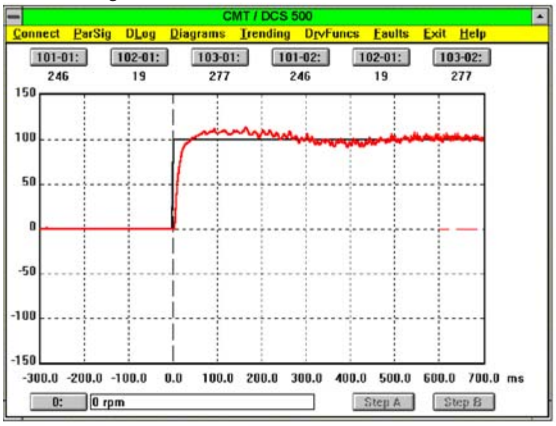
Diagrams

This window shows the function block diagram created by means of the GAD program. If necessary, the user can also use this window to view the values of selected parameters or connections.



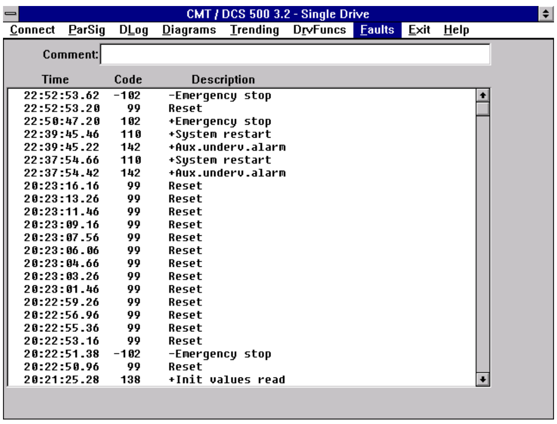
Trending

This window can be used to trace the signal characteristics of specified parameters or signals. Up to six parameters or signals can be monitored. The window shows the values in a curve diagram.



Faults

This display shows the current fault messages last fed into the fault logger in chronological sequence.



Exit

Quitting the program.

Help

Descriptions of the parameters.

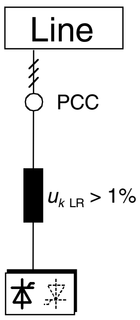
Please note:

For more information of the CMT/DCS 500 software package there is an own documentation available describing the possibilities and the handling of the program.

Line reactors

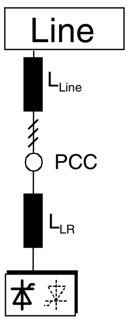
for armature (DCS 50xB) and field (DCF 50xB) supply

When thyristor power converters operate, the line voltage is short-circuited during commutation from one thyristor to the next. This operation causes voltage dips in the mains (point of common coupling). For the connection of a power converter system to the mains, one of the following configurations can be applied:



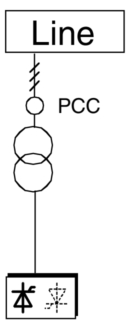
Configuration A

When using the power converter, a minimum of 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 short circuit 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 PCC (standards like EN 61 800-3, DC and AC drives at the same line, etc), different criteria must be applied for selecting a line reactor. These requirements are 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. In such cases line chokes with an impedance around 4% are often used.

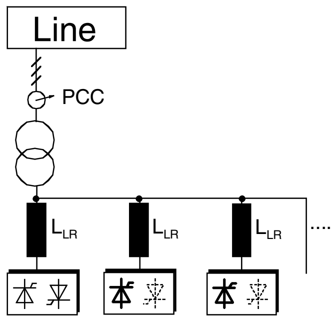


Configuration C

If an isolation transformer is used, it is 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 %.

Configuration C1

If 2 or more converters should be supplied by one transformer the final configuration depends on the number of drives in use and their power capability. Configuration A or B has to be used which are based on commutation chokes, if the drive system consists of any of the converters (C1, C2, A5, A6, A7). In case **only two** converters type A7 are involved **no** commutation chokes are necessary because the design of these converters is adapted to that wiring.



Netzdr_f.dsf

With reference to the power converter:

The line reactors listed in table (2.6/1)

- have been allocated to the units nominal current
- are independent of converter's voltage classification; at some converter types the same line choke is used up to 690 V line voltage
- are based on a duty cycle
- can be used for DCS 500B as well as for DCF 500B converters

You will find further information in publication:
Technical Guide *chapter: Line reactors*

Line reactors L1

DCS Type 400V-690V 50/60 Hz	Line choke type for **configur. A**	Design Fig.	Line choke type for **configur. B**	Design Fig.
DCS50xB0025-41/51	ND01	1	ND401	4
DCS50xB0050-41/51	ND02	1	ND402	4
DCS50xB0050-61	ND03	1	on request	-
DCS50xB0075-41/51	ND04	1	ND403	5
DCS50xB0100-41/51	ND06	1	ND404	5
DCS50xB0110-61	ND05	1	on request	-
DCS50xB0140-41/51	ND06	1	ND405	5
DCS50xB0200-41/51	ND07	2	ND406	5
DCS50xB0250-41/51	ND07	2	ND407	5
DCS50xB0270-61	ND08	2	on request	-
DCS50xB0350-41/51	ND09	2	ND408	5
DCS50xB0450-41/51	ND10	2	ND409	5
DCS50xB0450-61	ND11	2	on request	-
DCS50xB0520-41/51	ND10	2	ND410	5
DCS50xB0680-41/51	ND12	2	ND411	5
DCS501B0820-41/51	ND12	2	ND412	5
DCS502B0820-41/51	ND13	3	ND412	5
DCS50xB1000-41/51	ND13	3	ND413	5
DCS50xB0903-61/71	ND13	3	on request	-
DCS50xB1203-41/51	ND14	3	on request	-
DCS50xB1503-41/51/61/71	ND15	3	on request	-
DCS50xB2003-41/51	ND16	3	on request	-
DCS501B2003-61/71	ND16 *	3	on request	-

* with forced cooling

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

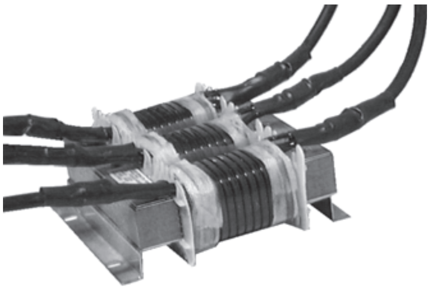


Fig. 1

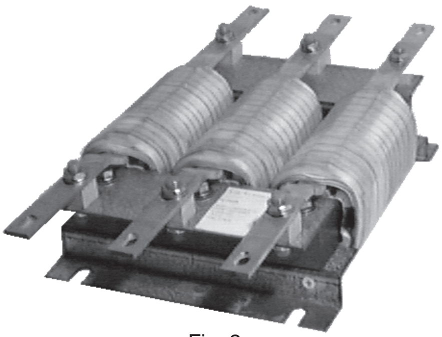


Fig. 2

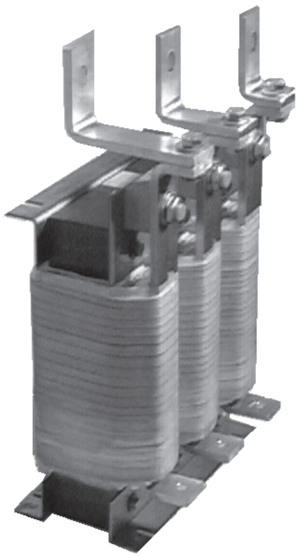


Fig. 3

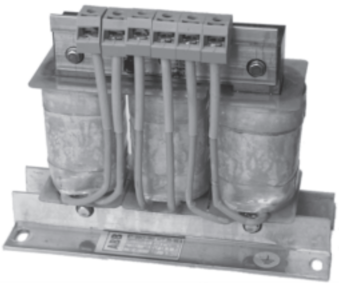


Fig. 4

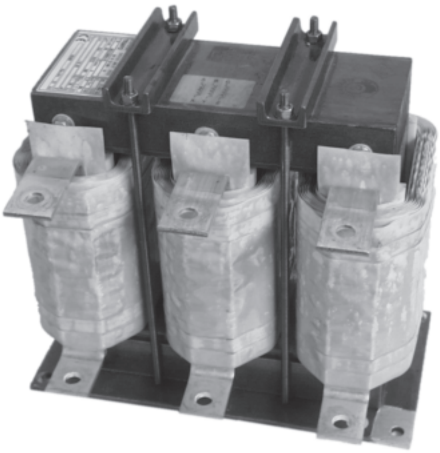


Fig. 5

Aspects of fusing for the armature-circuit and field supplies of DC drives

General

Unit configuration
Protection 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?

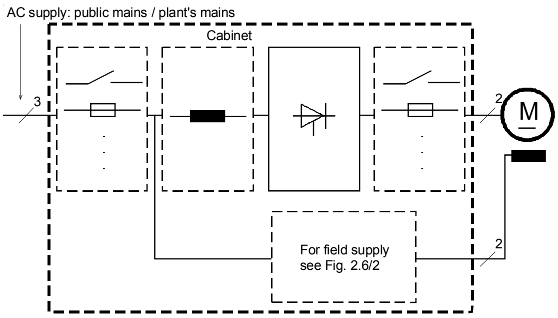


Fig. 2.6/1 Arrangement of the switch-off elements in the armature-circuit converter

You will find further information in publication:
Technical Guide *chapter: Aspects for fusing*

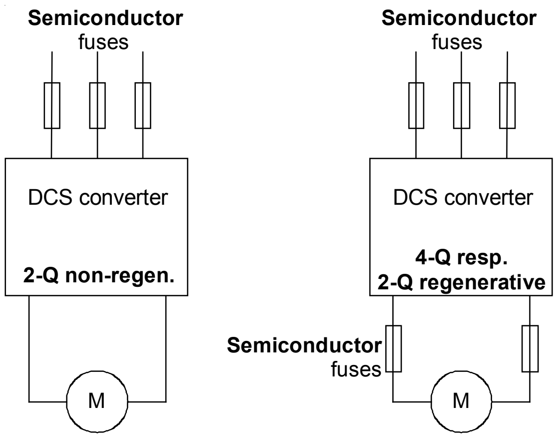
Conclusion for the armature supply

Due to cost saving standard fuses are used instead of the more expensive semiconductor fuses at some applications. Under normal and stable operating conditions, this is understandable and comprehensible, as long as **fault scenarios can be ruled out**.

In the **event of a fault** , however, the saving may cause very high consequential costs. Exploding power semiconductors may not only destroy the power converter, but also **cause fires**.

Adequate protection against **short-circuit** and **earth fault**, as laid down in the **EN50178** standard, is possible only with **appropriate semiconductor fuses**.

ABB's recommendations



Complies with Basic Principles on:

1 – Explosion hazard	yes
2 – Earth fault	yes
3 – “Hard“ networks	yes
4 – Spark-quenching gap	yes
5 – Short-circuit	yes
6 – 2Q regenerative	yes

Conclusion 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.

The following configurations are relatively frequent:

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.).

Semiconductor fuse F3.1 (super-fast acting) should be used, 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.

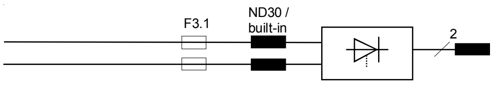


Fig 2.6/2 Configuration for field supplies

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.

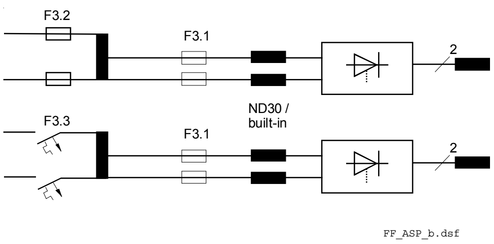


Fig 2.6/3 Configurations for field supplies

Semiconductor type F1 fuses and fuse holders for AC and DC power lines (DCS 501B /DCS 502B - DCF 501B/DCF 502B)

The converter units are subdivided into two groups:

– Unit sizes C1 and C2 with rated currents up to 1000 A require external fuses.
– In unit sizes A5, A6 and A7 with rated currents of 900 A to 5200 A, the semiconductor fuses are installed internally (no additional external semiconductor fuses are needed).

The table on the right assigns the AC fuse type to the converter type. In case the converter should be equipped with DC fuses according to the hints use the same type of fuse used on the AC side now in the plus and minus line. Blade type fuses are used for all the converters construction type C1 and C2 except the biggest one.

Type of converter	Type	Fuse holder
DCS50xB0025-41/51	170M 1564	OFAX 00 S3L
DCS50xB0050-41/51	170M 1566	OFAX 00 S3L
DCS50xB0050-61	170M 1566	OFAX 00 S3L
DCS50xB0075-41/51	170M 1568	OFAX 00 S3L
DCS50xB0100-51	170M 3815	OFAX 1 S3
DCS50xB0110-61	170M 3815	OFAX 1 S3
DCS50xB0140-41/51	170M 3815	OFAX 1 S3
DCS50xB0200-41/51	170M 3816	OFAX 1 S3
DCS50xB0250-41/51	170M 3817	OFAX 1 S3
DCS50xB0270-61	170M 3819	OFAX 1 S3
DCS50xB0350-41/51	170M 5810	OFAX 2 S3
DCS50xB0450-41/51/61	170M 6811	OFAX 3 S3
DCS50xB0520-41/51	170M 6811	OFAX 3 S3
DCS50xB0680-41/51	170M 6163	3x 170H 3006
DCS50xB0820-41/51	170M 6163	3x 170H 3006
DCS50xB1000-41/51	170M 6166	3x 170H 3006

Table 2.6/2: Fuses and fuse holders (details see *Technical Data)*

Fuses F3.x and fuse holders for 2-phase field supply

Depending on the protection strategy different types of fuses are to be used. The fuses are sized according to the nominal current of the field supply device. If the field supply unit is connected to two phases of the network, two fuses should be used; in case the unit is connected to one phase and neutral only one fuse at the phase can be used. Table 2.6/3 lists the fuses currents with respect to table 2.6/2.
The fuses can be sized according to the maximum field current. In this case take the fuse, which fits to the field current levels.

Field conv.	Field current	F3.1	F3.2	F 3.3
SDCS-FEX-1 SDCS-FEX-2A	$I_F \leq 6$ A	170M 1558	OFAA 00 H10	10 A
SDCS-FEX-2A	$I_F \leq 12$ A	170M 1559	OFAA 00 H16	16 A
SDCS-FEX-2A DCF 503A DCF 504A	$I_F \leq 16$ A	170M 1561	OFAA 00 H25	25 A
DCF 503A DCF 504A	$I_F \leq 30$ A	170M 1564	OFAA 00 H50	50 A
DCF 503A DCF 504A	$I_F \leq 50$ A	170M 1565	OFAA 00 H63	63 A
Type of protection elements		Semiconduct. type fuse for fuse holder type OFAX 00	LV HRC type for 690 V; fuse hold. OFAX 00	circuit breaker for 500 V or 690 V

Table 2.6/3: Fuses and fuse holders for 2-phase field supply

Transformer T3 for field supply to match voltage levels

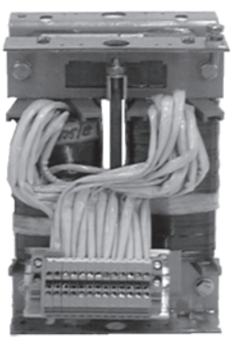


Fig. 2.6/4: T3 autotransformer

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.

Field converter type ≤500 V; 50/60 Hz	for field current I_F	Transformer type 50/60 Hz
		U_{prim} = **≤500 V**
SDCS-FEX-1	≤6 A	T 3.01
SDCS-FEX-2A	≤12 A	T 3.02
SDCS-FEX-2A	≤16 A	T 3.03
DCF503A/4A-0050	≤30 A	T 3.04
DCF503A/4A-0050	≤50 A	T 3.05
		U_{prim} = **≤600 V**
SDCS-FEX-1	≤6 A	T 3.11
SDCS-FEX-2A	≤12 A	T 3.12
SDCS-FEX-2A	≤16 A	T 3.13
		U_{prim} = **≤690 V**
DCF503A/4A-0050	≤30 A	T 3.14
DCF503A/4A-0050	≤50 A	T 3.15

Table 2.6/4: Autotransformer data (details see *Technical Data)*

Commutating reactor

When using the SDCS-FEX-2A 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). With DCF 503A/504A field power converters, it is already installed.

Converter ≤500 V; 50/60 Hz	Reactor
SDCS-FEX-2A	ND 30

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

Auxiliary transformer T2 for electronic system / 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 or 400 V/690 V/3-ph, according to their size. The T2 auxiliary transformer is designed to supply the unit's electronic system and all the single-phase fans including the fan of the A5 converter.

Input voltage: 380...690 V/1-ph; 50/60 Hz
Output voltage: 115/230 V/1-ph
Power: 1400 VA

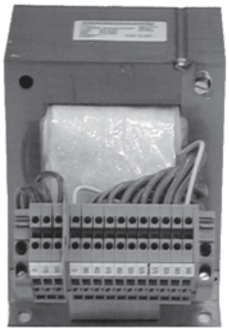


Fig. 2.6/5: T2 auxiliary transformer

Residual current detection

This function 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 message is indicated (for more information, see publication *Technical Data).*

EMC filters

You will find further information in publication:
Technical Guide chapter: EMC Compliant Installation and Configuration for a Power Drive System

The paragraphs below describe selection of the electrical components in conformity with the EMC Guideline.

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

In the context of the EMC Guideline, two aspects must be borne in mind:

- the product's **interference immunity**
- the product's actual **emissions**

The EMC Guideline expects EMC to be taken into account when a product is being developed; however, EMC cannot be designed in, it can only be quantitatively measured.

Note on EMC conformity

The conformity procedure is the responsibility of both the power converter's supplier and the manufacturer of the machine or system concerned, in proportion to their share in expanding the electrical equipment involved.

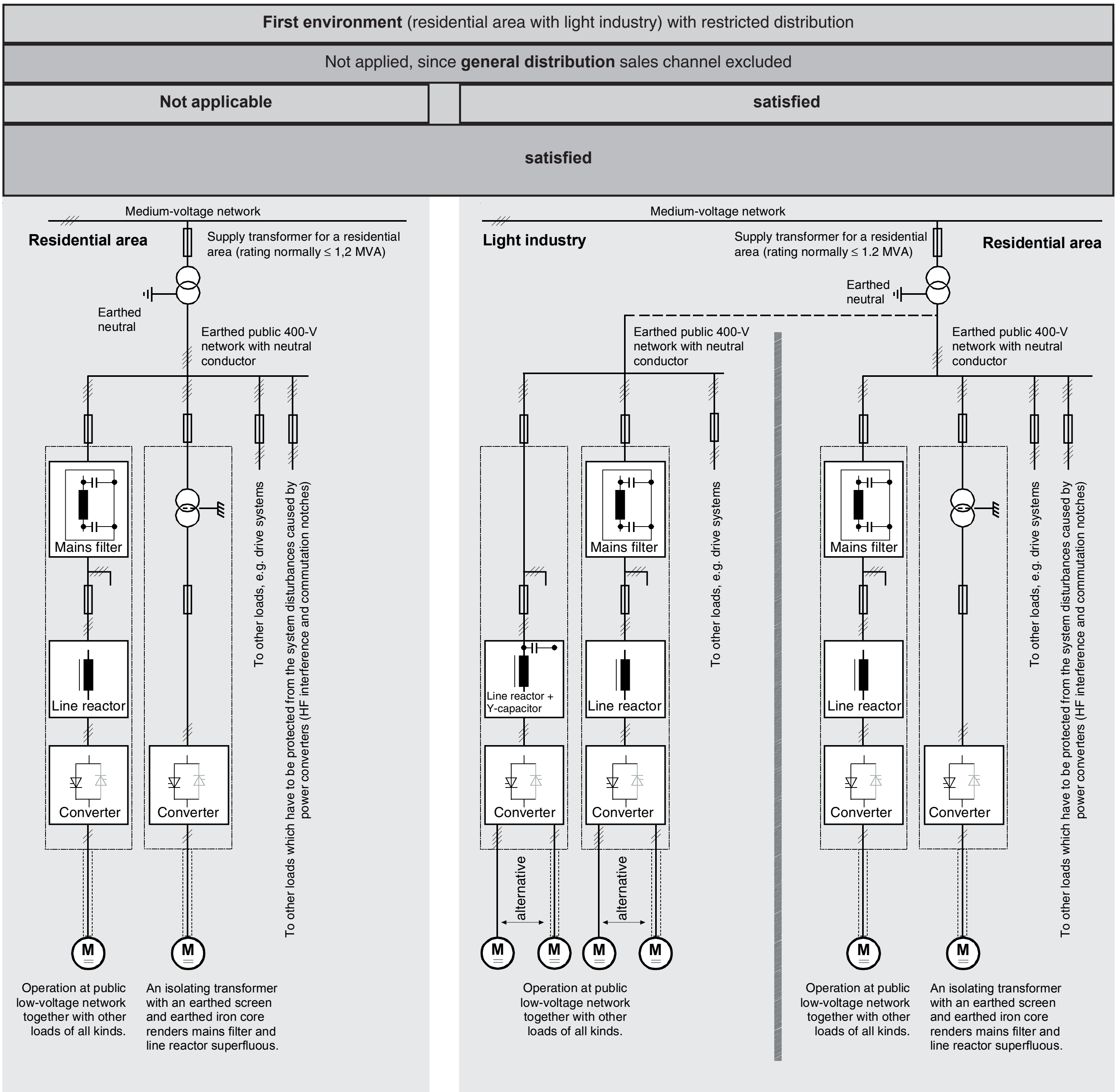


Fig. 2.6/5: Classification

For compliance with the protection objectives of the German EMC Act (EMVG) in systems and machines, the following EMC standards must be satisfied:

Product Standard EN 61800-3
EMC standard for drive systems (**P**ower**D**rive**S**ystem), interference immunity and emissions in residential areas, enterprise zones with light industry and in industrial facilities.

This standard must be complied with in the EU for satisfying the EMC requirements for systems and machines!

For emitted interference, the following apply:

EN 61000-6-3 Specialised basic standard for emissions in **light industry** can be satisfied with special features (mains filters, screened power cables) in the lower rating range *(EN 50081-1).

EN 61000-6-4 Specialised basic standard for emissions in **industry** *(EN 50081-2)

For interference immunity, the following apply:

EN 61000-6-1 Specialised basic standard for interference immunity in **residential areas** *(EN 50082-1)

EN 61000-6-2 Specialised basic standard for interference immunity in **industry**. If this standard is satisfied, then the EN 61000-6-1 standard is automatically satisfied as well *(EN 50082-2).

* The generic standards are given in brackets

Classification

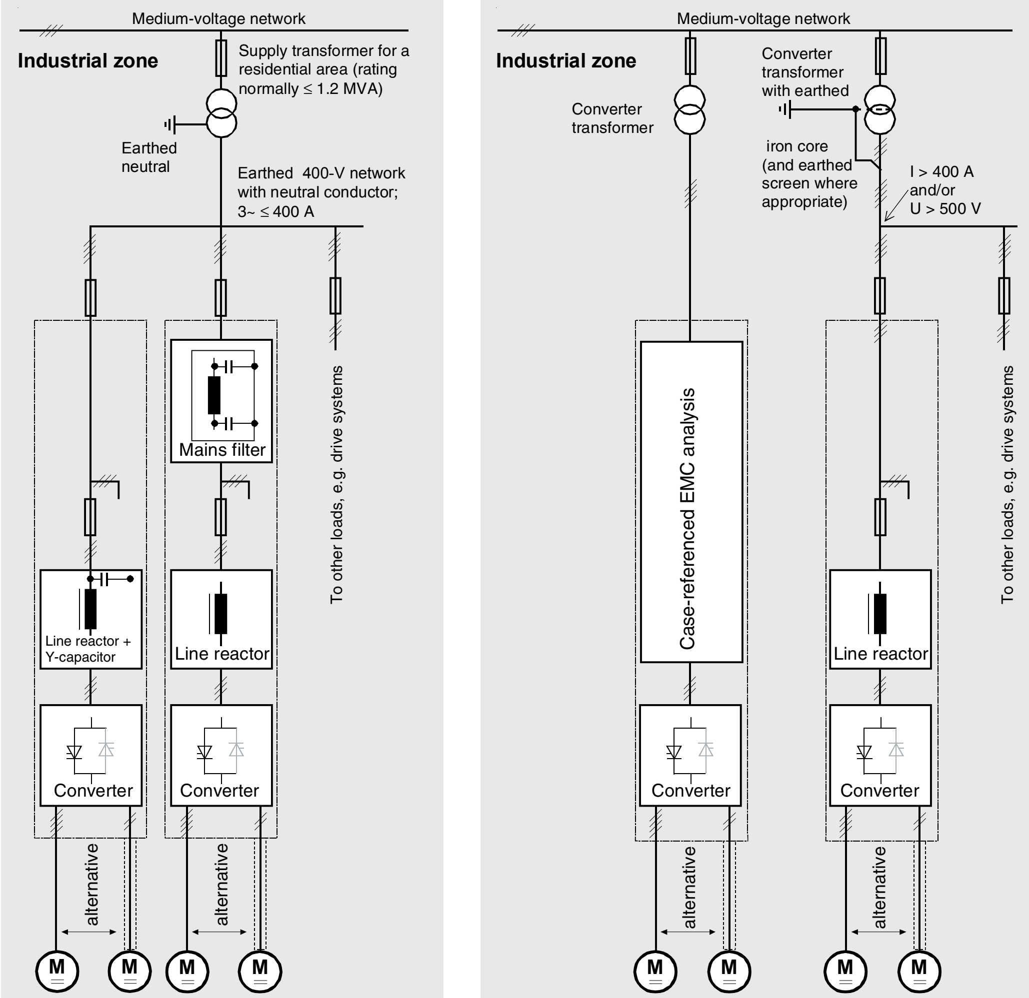
The following overview utilises the terminology and indicates the action required in accordance with Product Standard EN 61800-3

For the DCS 500B series, the limit values for emitted interference are complied with, provided the action indicated is carried out. This action is based on the term ***Restricted Distribution*** used in the standard (meaning a sales channel in which the products concerned can be placed in the stream of commerce only by suppliers, customers or users which individually or jointly possess technical EMC expertise).

For power converters without additional components, the following warning applies:

This is a product with restricted distribution under IEC 61800-3. This product may cause radio interference in residential areas; in this case, it may be necessary for the operator to take appropriate action (see adjacent diagrams).

Standards			
EN 61800-3	**Second environment** (industry) with restricted distribution		
EN 61000-6-3	**Not applicable**		
EN 61000-6-4	**satisfied**	**on customer's request**	**satisfied**
EN 61000-6-2 EN 61000-6-1	**satisfied**		



Operation at low-voltage network together with other loads of all kinds, apart from some kinds of sensitive communication equipment.

Operation with separate power converter transformer. If there are other loads at the same secondary winding, these must be able to cope with the commutation gaps caused by the power converter. In some cases, commutating reactors will be required.

The field supply is not depicted in this overview diagram. For the field current cables, the same rules apply as for the armature-circuit cables.

Legend

(dashed line)	Screened cable
(solid line)	Unscreened cable with restriction

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 fulfil the standard for emitted interference 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.

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

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	I_{DC} [A]	Const. type	Filter type for y=4	Filter type for y= 5	Filter type for y=6 or 7
DCS50xB0025-y1	25A	C1a	NF3-440-25	NF3-500-25	---
DCS50xB0050-y1	50A	C1a	NF3-440-50	NF3-500-50	---
DCS50xB0075-y1	75A	C1a	NF3-440-64	NF3-500-64	---
DCS50xB0100-y1	100A	C1b	NF3-440-80	NF3-500-80	---
DCS50xB0140-y1	140A	C1b	NF3-440-110	NF3-500-110	---
DCS50xB0200-y1	200A	C2a	NF3-500-320	NF3-500-320	---
DCS50xB0250-y1	250A	C2a	NF3-500-320	NF3-500-320	---
DCS50xB0270-61	250A	C2a	NF3-500-320	NF3-500-320	NF3-690-600 ①
DCS50xB0350-y1	350A	C2a	NF3-500-320	NF3-500-320	---
DCS50xB0450-y1	450A	C2a	NF3-500-600	NF3-500-600	NF3-690-600 ①
DCS50xB0520-y1	520A	C2a	NF3-500-600	NF3-500-600	---
DCS50xB0680-y1	680A	C2b	NF3-500-600	NF3-500-600	---
DCS501B0820-y1	740A	C2b	NF3-500-600	NF3-500-600	---
DCS502B0820-y1	820A	C2b	NF3-690-1000 ①	NF3-690-1000 ①	---
DCS50xB1000-y1	1000A	C2b	NF3-690-1000 ①	NF3-690-1000 ①	---
DCS50xB0903-y1	900A	A5	NF3-690-1000 ①	NF3-690-1000 ①	NF3-690-1000 ①
DCS50xB1203-y1	1200A	A5	NF3-690-1000 ①	NF3-690-1000 ①	NF3-690-1000 ①
DCS50xB1503-y1	1500A	A5	NF3-690-1600 ①	NF3-690-1600 ①	NF3-690-1600 ①
DCS50xB2003-y1	2000A	A5	NF3-690-1600 ①	NF3-690-1600 ①	NF3-690-1600 ①
	≤ 3000A	A6	NF3-690-2500 ①	NF3-690-2500 ①	NF3-690-2500 ①

① Filter only available on request

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
SDCS-FEX-1	6	NF1-250-8
SDCS-FEX-2A	8	NF1-250-8
SDCS-FEX-2A	16	NF1-250-20
DCF 503A-0050	50	NF1-250-55
DCF 504A-0050	50	NF1-250-55
further filters for	12	NF1-250-12
	30	NF1-250-30

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

3 How to engineer your drive

This chapter will give engineering **hints for different drive configurations**. In the first place converters are shown with all possible field supply options using wiring diagrams. Afterwards wiring diagrams are only shown for the most common configurations.

- **Standard drive configuration using an internal field** (see *chapter 3.1*)
  The first configuration shows a speed controlled drive, using a very flexible external wiring and a build in field supply. With these components, it will fit to most drives of the smaller power range .
  This configuration can only be used together with construction types C1 - A5, because bigger power stacks (C4, A6, A7) do not allow to incorporate an internal field supply.

- **Drive configuration using the internal field with reduced external components** (see *chapter 3.2)*
  The second configuration uses the same basic components as the one first, but a reduced external wiring schematics.
  This configuration can only be used together with construction types C1 - A5, because bigger power stacks (C4, A6, A7) do not allow to incorporate an internal field supply.

- **Standard drive configuration using an external half-controlled field (1-ph)** (see *chapter 3.3*)
  The third configuration uses the external wiring of the first one, but a more powerful and flexible field supply unit.
  This configuration can be used for all construction types.

- **Standard configuration using a fully-controlled field (3-ph) without armature converter** (see *chapter 3.4*)
  The fourth configuration shows a 3-phase field supply unit DCF 501B/2B as stand alone unit.
  This configuration shows a system in field current control mode and is used, if any type of existing DC-motor-field supply should be upgraded to a digital controlled one with all modern options like serial link etc.
  There are other than field applications, magnets for example, which can be controlled with this equipment in current or voltage control mode without any additional components.

- **Typical configuration for high power drives** (see *chapter 3.5*)
  The fifth configuration is used for quite big drives and is based on the diagrams used for configuration 3.3 and 3.4. Now all the components used for the other two are shown all together with all interconnections and interlockings needed. It is adapted to the converter construction types A5, A6 and A7.

- **Typical configuration for very high power drives using two parallel converter modules with symmetrical load share**
  Another configuration is the paralleling of converters. In this case converters of the same construction type (A7) are placed close to each other having connected their AC and DC terminals directly. They will behave like one bigger converter, which is not available as a single standard module. Such a system uses additional electronic boards for safety functions as well as interfacing and monitoring the converters.
  More information on request.

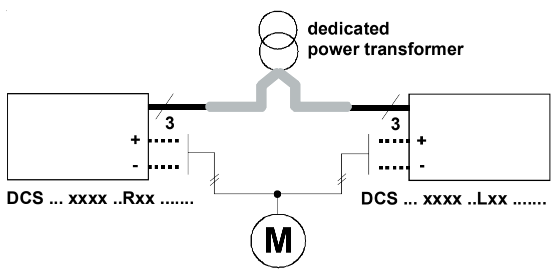


Figure 3/1: Hard paralleling for high currents

- **Revamp of existing DC Equipment**
  If existing drives need modernization in some cases brand new drives shown in one of the first configurations will replace them.
  Because of space or economical reasons in some cases the existing power stack will remain and only the control part is upgraded.
  For these cases a construction kit based on electronic boards, normally used in DCS- A7 type converters, called DCR revamp kit, is available.
  All options shown and explained in chapter 2 are suitable for this kit.
  Additional boards enable this kit to be used for power stack constructions with up to four thyristors in parallel.
  For more information please see manual *Selection, Installation and Start-up of Rebuild Kits.*

Figure 3/2: Rebuild Kit

- **Master-Follower-Applications**

- **Drives connected in Master-Follower application**
  If motors have to run with the same speed / torque they are often controlled in a way called MASTER - FOLLOWER.
  Drives used for such systems are of the same type and may differ in power, but will be supplied from the same network. Their number normally is not limited.
  From the control point of view different conditions and demands need to be matched.
  Examples are available on request from ABB Automation Products GmbH.

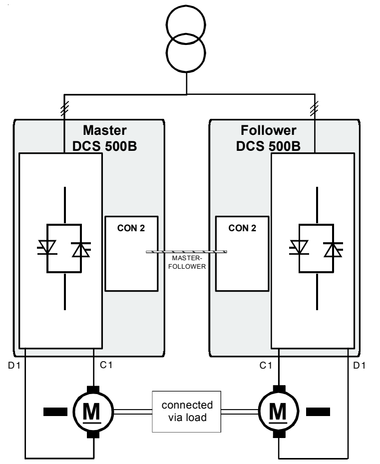


Figure 3/3: Application with two mechanically connected motors

- **Typical configuration for high power drives connected in Master-Follower application** (two motors with one common shaft)
  This configuration is often used, if two motors have to share the load half and half. They are mechanically fixed to each other via a gearbox or any other device. The converters are fed by a 12-pulse line transformer with separated secondary windings whose phase positions differ by 30°el.
  Each motor is connected to its own converter and field supply. The converters exchange signals to make sure, that each motor takes half of the load.
  This configuration delivers the same advantages concerning harmonics to the network as a standard 12- pulse application (see next item), but no T-reactor is needed.
  Depending on the mechanical configuration commissioning personal needs some experience to adapt control accordingly.

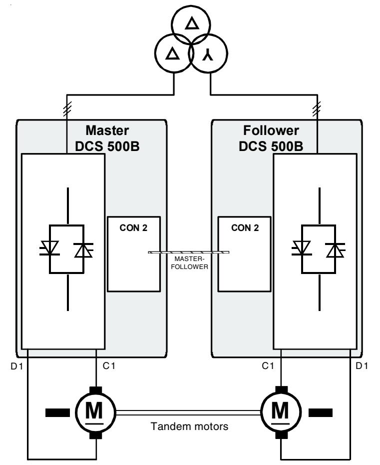


Figure 3/4: 12-Pulse application with two mechanically connected motors

- **Typical configuration for high power drives connected in 12-pulse parallel Master-Follower application**
  (see *chapter 3.6*)
  This configuration shows a 12-pulse parallel drive system. It is an easy option to increase the power of a drive system. Depending on the engineering features , redundancy or emergency operation, if one converter fails, is made available.
  Such drives use two identical 6-pulse converters and an especially designed choke called T-reactor or 12-pulse choke or interface reactor. The converters are fed by a 12-pulse line transformer with separated secondary windings whose phase positions differ by 30°el.
  An example is the transformer configuration △/⅄/△. This configuration gives a reduced level and a reduced order number of harmonics on the AC side. Only the 11^{th} and 13^{th}, the 23^{rd} and 25^{th}, the 35^{th} a.s.o. are existing. The harmonics on the DC side are reduced too, which gives a higher efficiency. (The field supply is not shown on the wiring diagram 3.6. Depending on the field supply selected, the connections to the network, the interlocking and the control connections can be taken from any other wiring diagram showing the selected field supply.)
  It is not possible to connect two 12-pulse systems (2 converters, T-reactor and 1 motor) to one 12-pulse transformer.

For more information, please see *manual 12-pulse operation*.

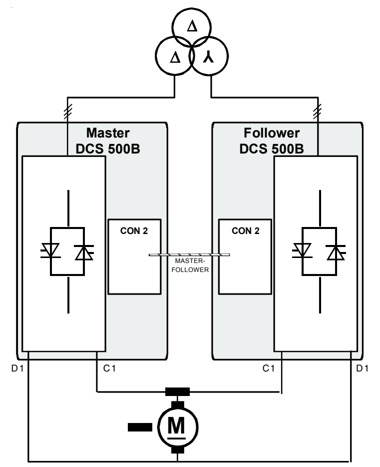


Figure 3/5: 12-Pulse parallel application

3.1 Standard drive configuration using an internal field

Wiring the drive according to this diagram gives the most flexibility and offers the highest degree of standard monitoring functions done by the drive. There are no software modifications to adapt the drive to the external wiring.

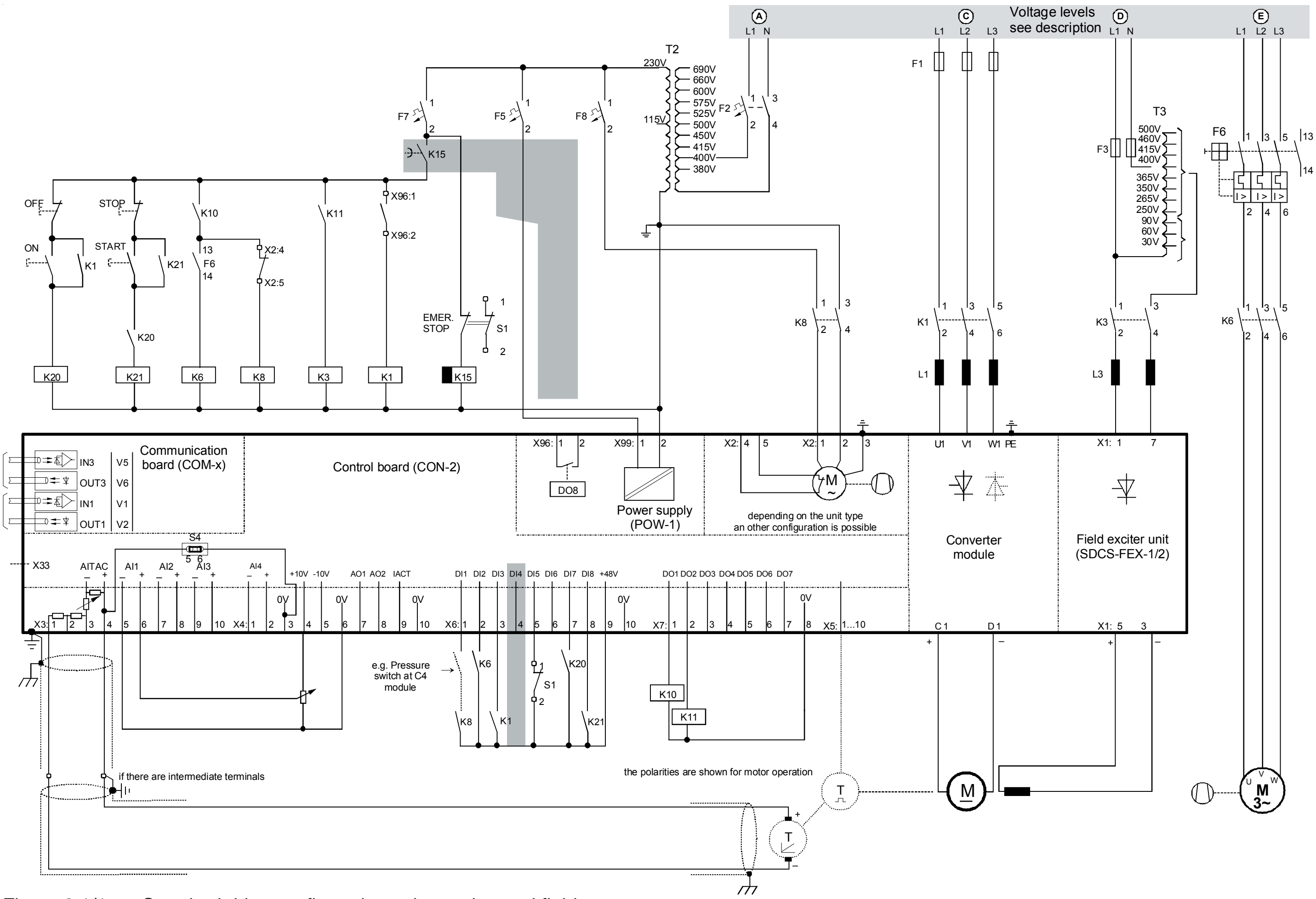


Figure 3.1/1: Standard drive configuration using an internal field

- **Selection of components**

For this wiring diagram a DCS 500B converter construction type C1 / C2 / A5 (for A7 types, please use diagram 3.3 or higher) was selected together with a SDCS-FEX-1 or 2A field supply. This field supply can be used at line voltages up to 500V and will give field current up to 6 / 16A. For higher field currents, use the next bigger field supply unit DCF 503A/4A (wiring is shown at 3.3/1) or a 3-phase supply DCF 500B (wiring is shown at 3.5/2).

- **Power supply**

There are several components, which need a power supply:

- Converter´s power part:	200 V to 1000 V, depending on converter type; *see chapter 2*
- Converter´s electronics power supply:	115V or 230V, selectable by jumper
- Converter cooling fan:	230V 1-ph; *see Technical Data*
- Power part field supply:	115 V to 500 V; together with an isolating / auto transformer up to 600 V; *see chapter 2 and / or Technical Data*
- Motor cooling fan:	depending on motor manufacturer / local demands
- Relay logic:	depending on local demands

The fuses F1 are used because the converter construction type C1 and C2 don´t have them build in. All components, which can be fed by either 115/230 V have been combined and will be supplied by one isolating transformer T2. All components are set to 230 V supply or selected for this voltage level. The different consumers are fused separate. As long as T2 has the right tappings it can be connected to the power supply, used to feed the converter´s power part.
The same can be applied to the field supply circuit. There are two different types of matching transformers available. One can be used for supply voltages up to 500 V, the other for voltages up to 690 V. Do not use the 690 V primary tapping together with the SDCS-FEX-1/2A field supply!
Depending on the motor fan voltage the power can be taken from the same source which is used for the converter´s power part.
In case the power for **A**, **D** and **E** should be taken from the source, used for **C**, a decision must be made, whether the fuses F1 can be used for two reasons (protection of the power part + auxiliary power supply) or not.In addition it has to be checked, if the consumers can be supplied with this voltage wave form (see chapter *Line Chokes*) before connecting to **C**. If the converter is supplied directly by a high-voltage converter transformer at point **C**, additional conditions are to be considered during engineering of the drive (more details on request).

- **Control**

The relay logic can be split into three parts:

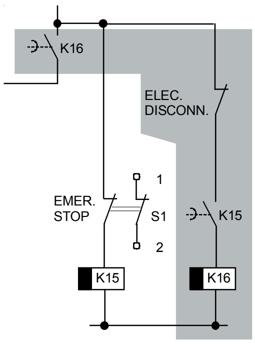
a: Generation of the ON/OFF and START/STOP command:
The commands represented by K20 and K21 (latching interface relay) can be generated by a PLC and transferred to the terminals of the converter either by relays, giving galvanic isolation or directly by using 24V signals. There is no absolute need to use hardwired signals. These commands can be transferred via a serial link system too. Even a mixed solution can be realized by selecting the one or the other possibility for the one or the other signal.

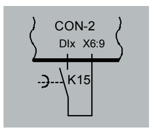
b: Generation of control and monitoring signals:
The main power contactor K1 for the armature circuit is controlled by a dry contact located on the electronic power supply board. The status of this contactor is checked by the converter via binary input 3. The field supply contactor K3 is controlled by the auxiliary contact K11 connected to a binary output of the converter. The binary outputs consist of relay drivers, capable to give appr. 50 mA each and a current limitation of around 160 mA for all of the outputs. The contactors K6 and K8 control the fans of the drive system. They are controlled by the auxiliary contact K10 (similar to K11). In series with K6 is an auxiliary contact of the circuit breaker F6, which monitors the motor fan supply. For the converter fan supply monitoring the contact of the temperature detector is used in series with K8. Auxiliary contacts K6 and K8 are used and connected to the binary inputs 1 and 2 to monitor the status of the fan supplies by the converter. The function of K15 is described at the next point.

c: Stop mode beside ON/OFF and START/STOP:
This chapter tries to explain the reaction of the drive when the input named EMERGENCY_STOP (906) or COAST_STOP (905) is operated. Please take the external wiring used for this explanation as an example only!
For EMERGENCY STOP different preconditions have to be taken into account. This description focus on the functionality and does not take special safety conditions depending on the type of machine into account.
In this case, if emergency stop is hit, the information is transferred to the converter via binary input 5. The converter will act according to the function programmed (stop by ramp, current limit or coasting). If the converter will not manage to get the drive to standstill within the time set at K15, the auxiliary contact will switch off the control power. Because of this the main power contactors K1 and all the others will be switched off. This may result in failure of components (*see Operating Instructions*). This danger can be minimized by adding another time delay (grey-shaded parts below). By doing so another stop mode is available.

- Emergency stop signal initializes the ramp down function inside the converter in that way described before. If the drive comes to standstill within the time specified by K15, the converter will switch off the main power contactor K1. If the converter doesn´t manage to get the drive to standstill within this time, K15 will start the function ELECTRICAL DISCONNECT with the time delay specified by K16. This information will be transferred to the converter to a free binary input. This input has to be connected to the COAST_STOP input of the drive logic. The COAST_STOP input forces the current down to zero as fast as possible. The delay time of K16 has to be slightly higher than the time needed by the current controller to get the current to zero. When the time K16 has elapsed the control voltage will be switched off and all power contactors will drop off.

- If no care should be taken to the speed of the drive the function of K16 can be initialized by the command ELECTRICAL DISCONNECT.





d: Main contactor handling by the PLC only because of safety reasons:
This mode is not recommended to be used as a standard switch on or switch off sequence. Nevertheless it is sometimes used to fulfill safety regulations or other needs. In such cases it´s recommended to follow the next guidelines:

- It´s assumed that the PLC´s contact is in serial with the K1 (underneath the terminals named X96: 1 and 2) or in serial with the auxillary contact of K16 or replaces this one
- Switching off the main power contactor in regenerative mode may result in failure of components (see Operating Instruction)
- The PLC generates the command “main contactor off”. Two types of contacts are needed:
- A pretriggered contact should then be connected to an unused binary input of the converter; this input has to be connected to the signal START_INHIBIT (908). This will block the controllers, trying to get the current to zero and switch off the main contactor from the converter point of view (independent, if the converter´s command is used or not).
- A normal contact can then handle the main contactor.
- Caused by the final timing alarms or error may be detected; they should be reset or bypassed (e.g. by the auto reclosing function

- **Sequencing**

When the ON command is given to the converter and there is no error signal active, the converter closes the fan, field and main contactor, checks the supply voltage and the status of the contactors and without error messages, releases the regulators and starts waiting for the RUN command. When the RUN command is given, the speed reference is released and speed control mode is active (for more details, *see Software Description*).

3.2 Drive configuration using the internal field with reduced external components

Wiring the drive according to this diagram gives the same control performance, but a lower degree of flexibility and nearly no external monitoring functions done by the drive. The software has to be adapted to the external wiring.

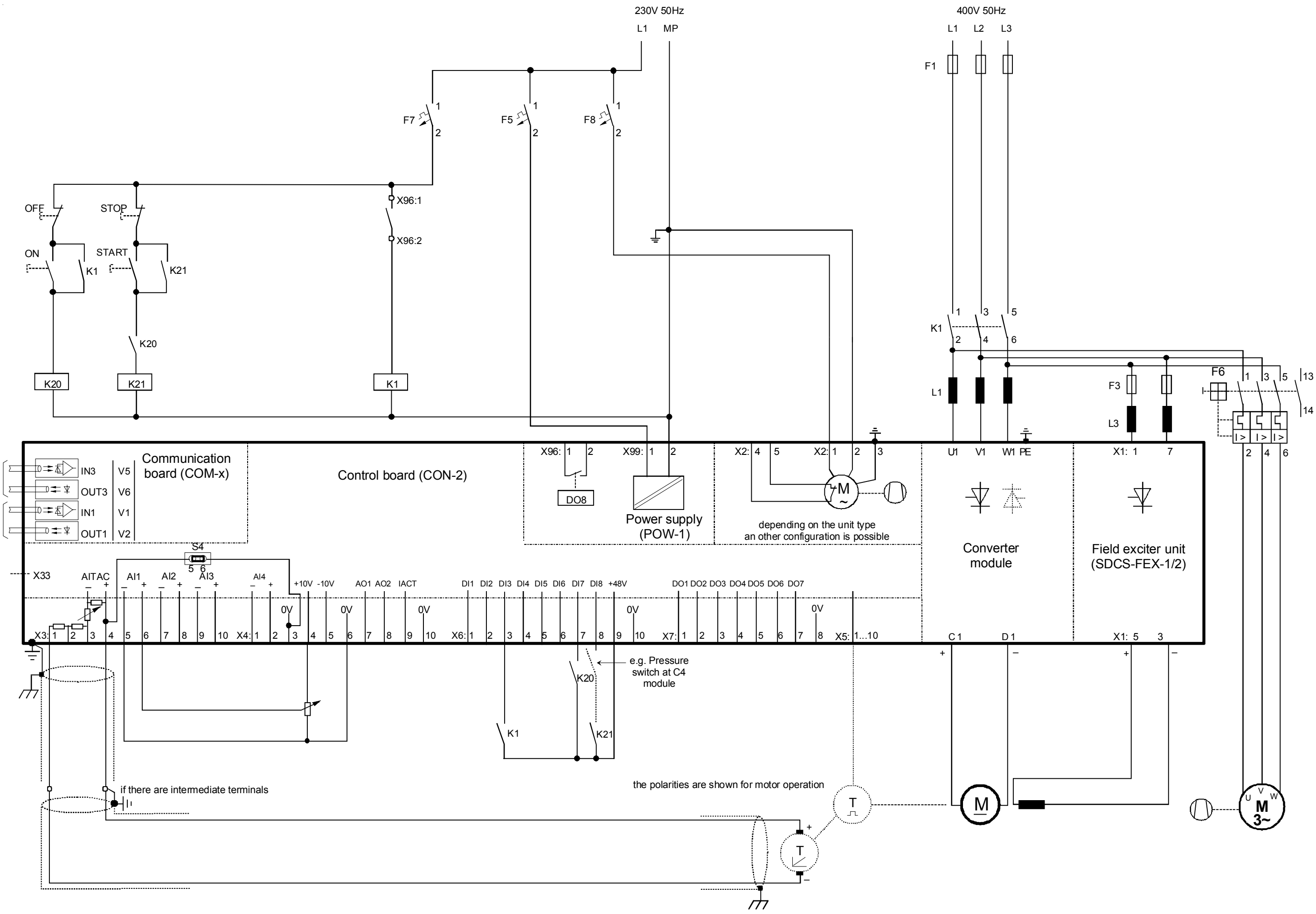


Figure 3.2/1: Drive configuration using the internal field with reduced external components

- **Selection of components**

same as figure 3.1/1

- **Power supply**

There are several components, which need a power supply. Because of the wiring preconditions have to be taken into account:

- Converter´s power part:	200 V to 500 V, depending on converter type; *see chapter 2*
- Converter´s electronics power supply:	use only 230 V possibility, selected by jumper
- Converter cooling fan:	230V 1-ph; *see Technical Data*
- Power part field supply:	200 V to 500 V; *see chapter 2 and / or Technical Data*
- Motor cooling fan:	select the motor voltage acc. to the voltage used for the armature supply
- Relay logic:	select the components for 230 V!

This configuration is basically identical to the one shown at figure 3.1/1. Please check the sizing of F1 for the additional load like field and motor fan. All components are either selected for 230V or set to 230V to be able to combine them and to supply them by an auxiliary power supply. The different consumers are fused separately.

- **Control and safety**

The relay logic can be split into three parts:

a: Generation of the ON/OFF and START/STOP command: same as figure 3.1/1

b: Generation of control and monitoring signals:
The main power contactor K1 is handled in the same way it was done at figure 3.1/1. The field and motor fan supply is picked up at the output of K1. So all 3 consumers are controlled in the same way.
The fan monitoring is not taken into consideration. Because of this these parameter settings have to be made:

Connection (default)	**must be changed to:**
910 from 10701	10908
911 from 10703	10908
906 from 10709	12502

c: Stop mode beside ON/OFF and START/STOP: Not taken into consideration!

- **Sequencing**

When the ON command is given to the converter and there is no error signal active, the converter closes the fan, field and main contactor, checks the supply voltage and the status of the contactors and without an error messages, releases the regulators and starts waiting for the RUN command. When the RUN command is given, the speed reference is released and speed control mode is active (for more details, *see Software Description*).

3.3 Standard drive configuration using an external half-controlled field (1-ph)

Wiring the drive according to this diagram gives the most flexibility and offers the highest degree of standard monitoring functions done by the drive. There are no software modifications to adapt the drive to the external wiring.

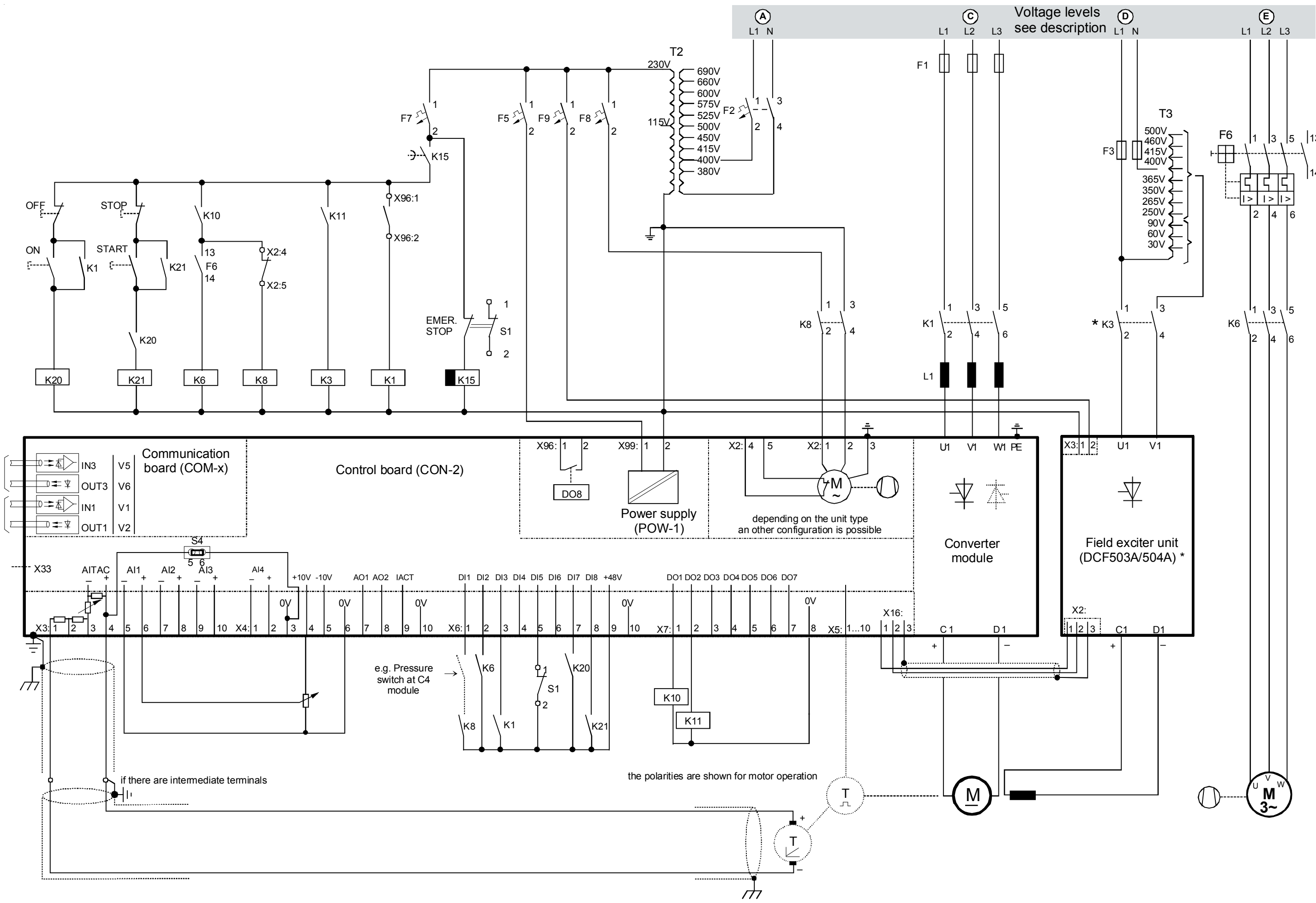


Figure 3.3/1: Standard drive configuration using an external half-controlled field (1-ph)

- **Selection of components**

For this wiring diagram a DCS 500B converter was selected together with a DCF 503A/4A field supply. If a DCF 504A is used for field supply, field reversal is possible. Then a DCS 501B (2-Q) for the armature supply is sufficient for low demanding drives. This field supply can be used at line voltages up to 500 V and will give field current up to 50 A. For higher field currents, a 3-phase supply DCF 500B (wiring is shown at 3.5/2).

- **Power supply**

There are several components, which need a power supply:

- Converter´s power part:	200 V to 1000 V, depending on converter type; *see chapter 2*
- Converter´s electronics power supply:	115 V or 230 V, selected by jumper
- Converter cooling fan:	230 V 1-ph; 400 V / 690 V 3-ph. at A6/A7; *see Technical Data*
- Power part field supply:	115 V to 500 V; together with an isolating/auto transformer up to 690 V; *s. chap. 2 and/or Technical Data*
- Electronics supply of field unit:	115 V to 230 V
- Motor cooling fan:	depending on motor manufacturer / local demands
- Relay logic:	depending on local demands

This configuration is basically identical to the one shown at figure 3.1/1. In addition to figure 3.1/1 the field supply unit needs an electronic power supply, which is separately fused and taken from the 230V level, generated by T2. This field controller is controlled via a serial link, connected to X16: at the armature converter. The 690V primary tapping can be used together with this type of field supply!

In case the power for **A**, **D** and **E** should be taken from the source, used for **C**, a decision must be made, whether the fuses F1 can be used for two reasons (protection of the power part + auxiliary power supply) or not. In addition it has to be checked, if the consumers can be supplied with this voltage wave form (see chapter *Line Chokes*) before connecting to **C**.

- **Control**

The relay logic can be split into three parts as decribed in figure 3.1/1. Basically the logic shown at figure 3.2/1 could be used for this configuration. The size of the drive and/or it´s value may be a criteria to select the logic according to figure 3.1/1 or to figure 3.2/1 or a combination of both.

*** *Recomendation***: Keep the control of K3 as shown, if a DCF 504A field supply is used!

- **Sequencing**

same as figure 3.1/1

3.4 Standard configuration using a fully-controlled field (3-ph) without armature converter

The DCS 500B converter is used as a DCF 500B version in a non-motoric application. If the drive should be wired according to this example or to the one shown at figure 3-2.1 it has to be decided depending on the application and it´s demands. The software structure has to be adapted and is described within the Operating Manual.

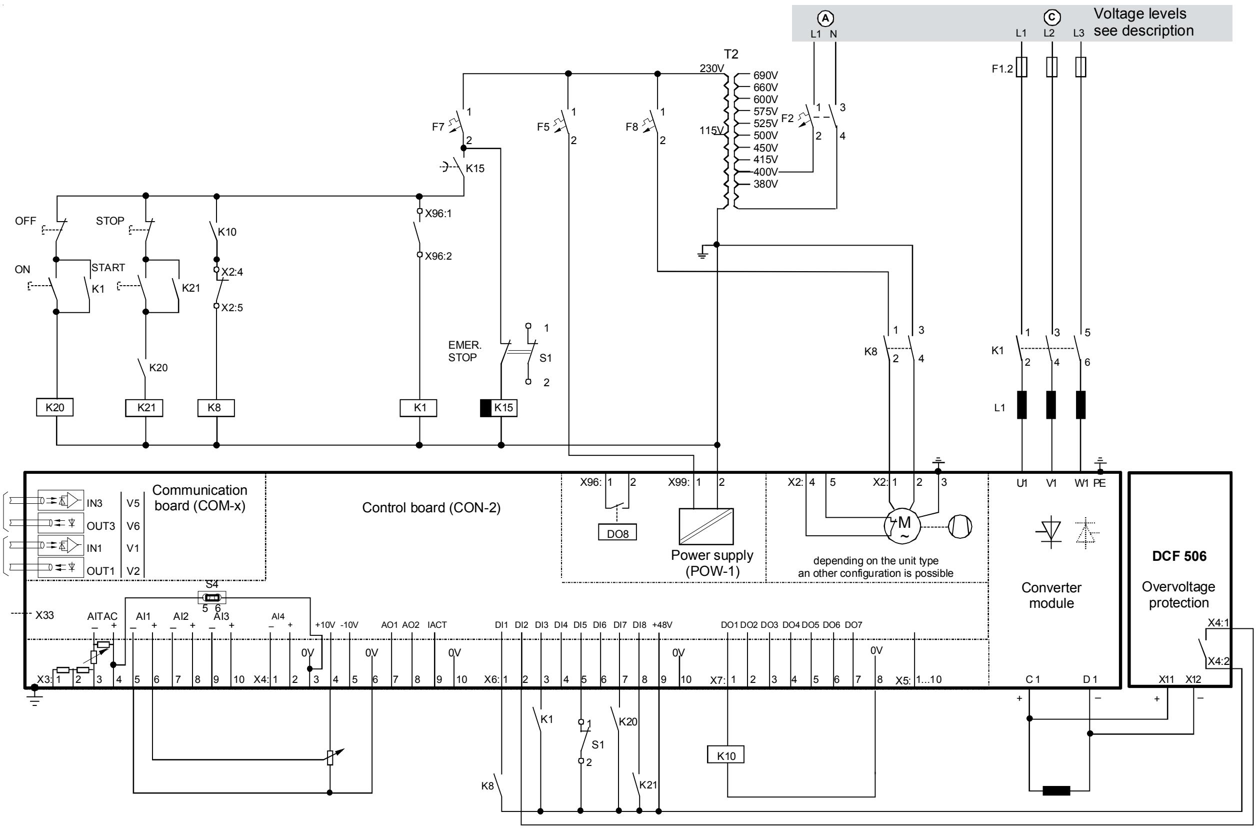


Figure 3.4/1: Standard configuration using a fully-controlled field (3-ph) without armature converter

- **Selection of components**

For this wiring diagram a DCF 500B converter construction type C1 or C2 was selected together with a DCF 506 unit, which serves as an overvoltage protection.

- **Power supply**

There are several components, which need a power supply:

- Converter´s power part:	200 V to 500 V, depending on converter type; *see chapter 2*
- Converters electronics power supply:	115 V or 230 V, selected by jumper
- Converter cooling fan:	230 V 1-ph at C1 + C2; *see Technical Data*
- Relay logic:	depending on local demands

Basically according to figure 3.1/1. If the converter is supplied directly by a high-voltage converter transformer at point **C** , make sure that the high voltage switch is not opened, as long as field current flows. Additional conditions are to be considered during engineering of the drive (further information on request).

- **Control**

The relay logic can be split into three parts.

a: Generation of the ON/OFF and START/STOP command: same as figure 3.1/1

b: Generation of control and monitoring signals: Basically identical to figure 3.1/1.
Instead of the monitoring of the motor fan at binary input 2, which is not existing here but may exist as a cooling device for the inductance, the over-voltage protection DCF 506 is monitored by the same input. If any type of additional cooling device should be monitored extra function blocks can be used.

c: Stop mode beside ON/OFF and START/STOP: Basically identical to figure 3.1/1
In this case it may be much more important to focus on a reduction of the current than on something else. If so, select coasting at the parameter EMESTOP_MODE.

- **Sequencing**

same as figure 3.1/1

3.5 Typical configuration for high power drives

This wiring diagram has been generated to show the configuration for big drives with preferably more than 2000 A for the armature supply and a 3-phase field supply. For such drives the converter construction type A6 or A7 is used. The basic idea is identical to figure 3.1/1.

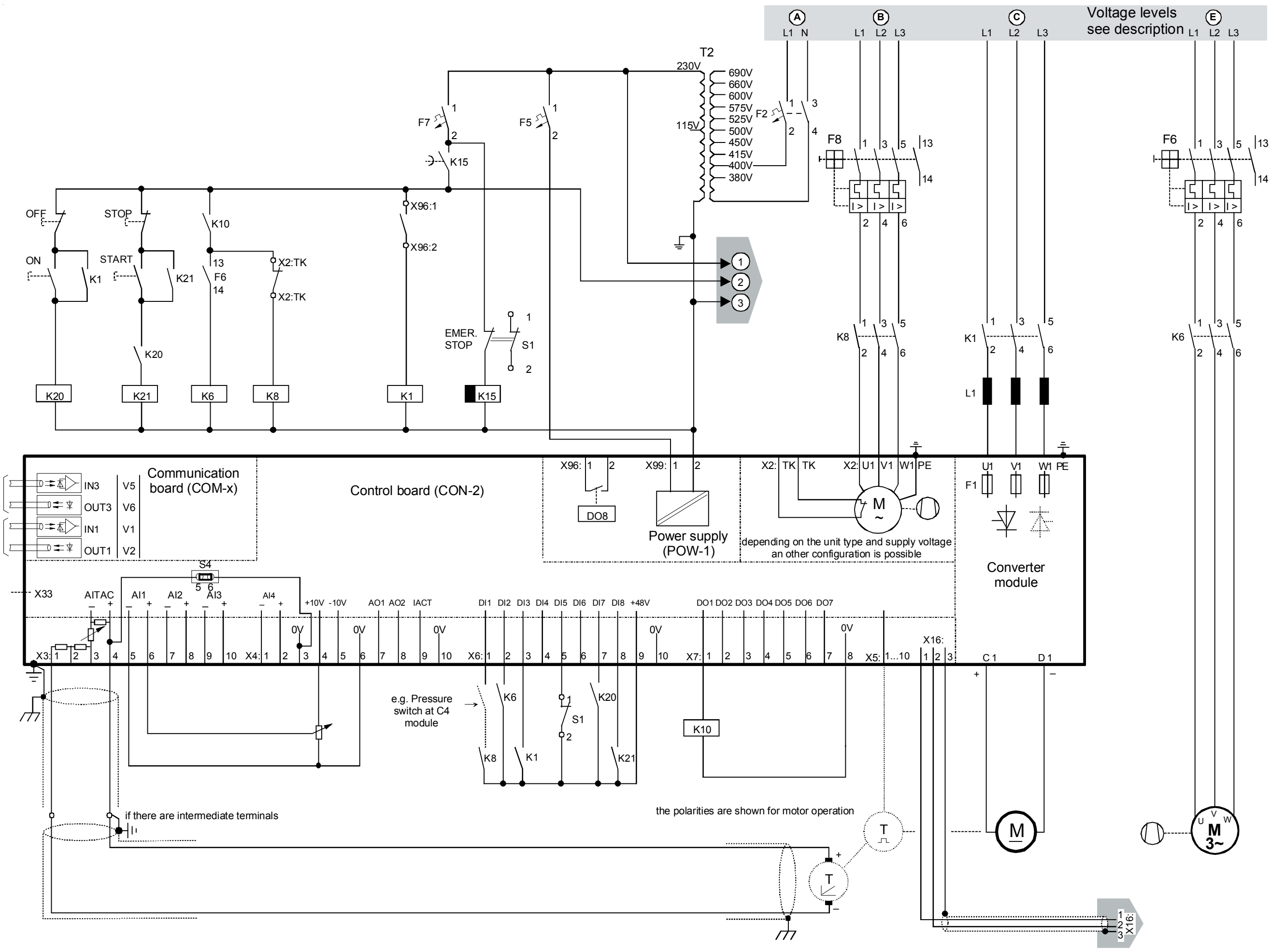


Figure 3.5/1: Typical configuration for high power drives (armature unit DCS 500B)

- **Selection of components**

For this wiring diagram a DCS 500B converter construction type A6 or A7 was selected together with a 3-phase field supply. This field supply can be used at line voltages up to 500 V and will give field current up to 540 A.

- **Power supply**

There are several components, which need a power supply:

- Armature converter´s power part: 200 V to 1000 V, depending on converter type; *see chapter 2*
- Field converter´s power part: 200 V to 500 V
- Converters electronics power supply: 115 V or 230 V, selected by jumper
- Converter cooling fan: 230V 1-ph at A5 (armature), C1 + C2 (field); 400 V / 690 V 3-ph. at A6/A7 (armature); *see Technical Data*
- Motor cooling fan: depending on motor manufacturer / local demands
- Relay logic: depending on local demands

This configuration is basically identical to the one shown at figure 3.1/1. The converters in use here are much bigger than before. They are equipped with fuses in the legs of the power part. That´s the reason F1 is drawn within the square of the power part. If additional fuses are needed between supply transformer or not, has to be decided case by case. The field supply transformer T3 cannot be used for this configuration! See also power supply fig. 3.4/1 (*fully-controlled field*).

In case the power for **A**, **B, D** and **E** should be taken from the source, used for **C**, a decision must be made, whether the fuses F1 can be used for two reasons (protection of the power part + auxiliary power supply) or not. In addition it has to be checked, if the consumers can be supplied with this voltage wave form (see chapter *Line Chokes*) before connecting to **C**.

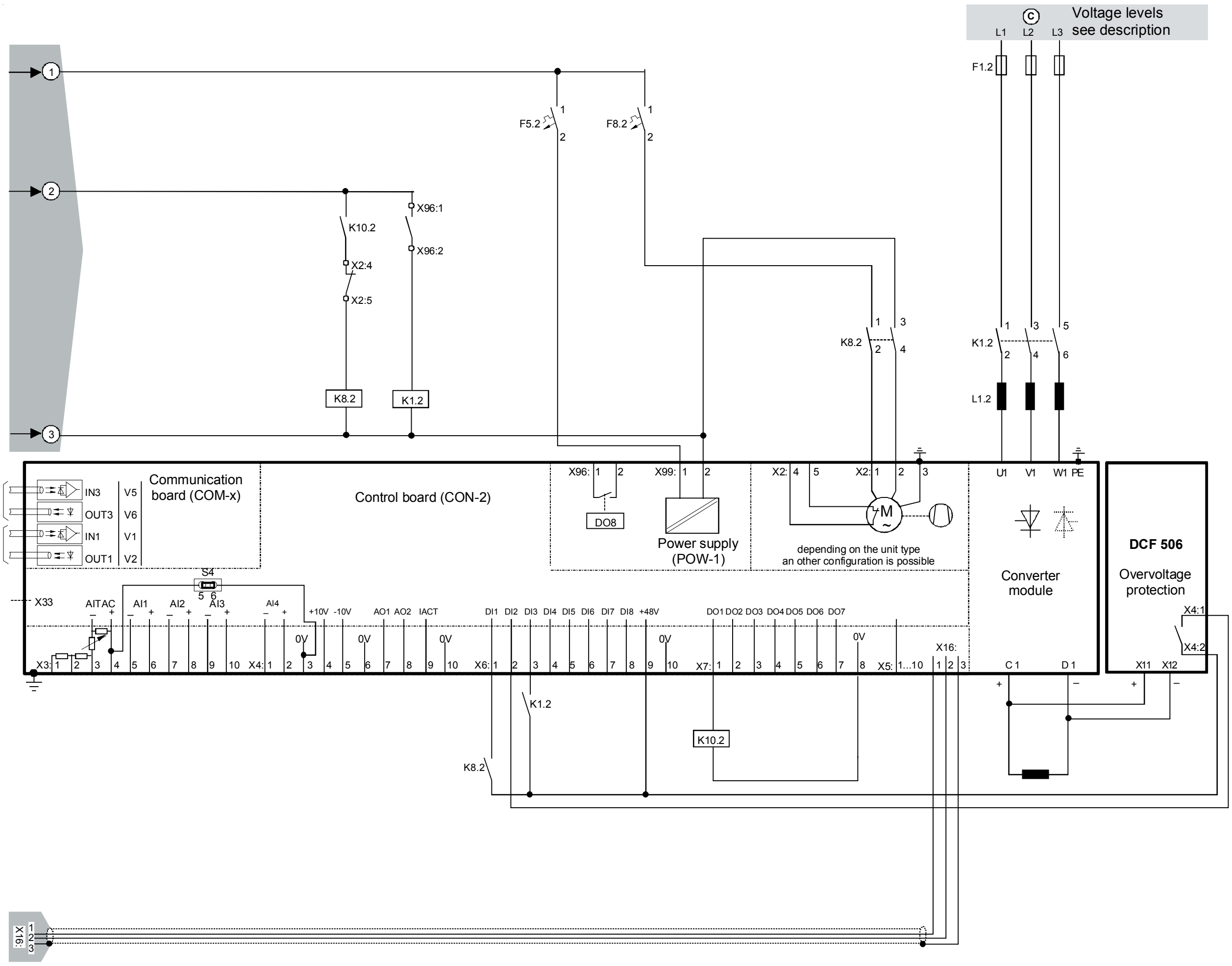


Figure 3.5/2: Typical configuration for high power drives (field unit DCF 500B)

- **Control**

The relay logic can be split into three parts. Basically the logic shown at figure 3.2/1 could be used for this configuration. Because of the size of the drive and it´s value the logic shown is recommended:

a: Generation of the ON/OFF and START/STOP command: same as figure 3.1/1
b: Generation of control and monitoring signals: same as figure 3.1/1
Each converter is monitoring his main contactor and his fan supply by himself.
c: Stop mode beside ON/OFF and START/STOP: same as figure 3.1/1
It is recommended to use the additional safety provided by the use of the ELECTRICAL DISCONNECT function at such type of drives.

- **Sequencing**

It is basically the same than the one described for figure 3.1/1. The 3-phase field exciter is equipped with much more detailed service functionallity compared to the single phase types (SDCS-FEX-2A or DCF 503A/4A). Nevertheless from the control point of view (binary signals given to the armature converter) it will act in exactly the same way as a single phase one!
When the ON command is given to the armature converter and there is no error signal active, the converter transfers this command via the serial link to the field converter. Afterwards, each converter closes the fan and main contactor, checks the supply voltage and the status of the contactors and without any error messages, releases the regulators. Then the same actions take place described at fig. 3.1/1.
In case the field unit records an error a common error signal is send to the armature converter. In parallel an error indication is displayed on the field unit´s 7-segment display and at its binary output, if programmed. The armature converter will indicate the field unit´s error message with F39 on its display. The drive will be switched off by itself if it was running. The control system should then send a Reset command to the armature converter after having removed the ON/OFF and RUN commands. The error message should no longer be shown. With a new start command the armature converter will at first send a Reset command to the field converter. The field unit will then reset its error message, if the reason for it is no longer present. After that the field unit receives the start command from the armature converter and will switch on its main contactor.
It's not necessary to exchange information like commands, actual values or error message within field converter and control system based on a serial link like PROFIBUS or others. In case the more comfortable servicing capabilities of a 3-phase field unit should be used it´s no problem to do so either via hardware (terminal row) or via a serial link.

3.6 Typical configuration for high power drives connected in 12-pulse parallel Master-Follower application

This wiring diagram can be used for 12-pulse parallel systems. It´s is based on the configuration shown at firgure 3.1/1, too. Such a configuration can be done with two 25 A converters as well as with two 5200 A types. Most often this configuration is selected because of the total power. That´s the reason why the wiring is already adapted to A5 (converter fan 1-phase) or A7 type converters. For the field supply, please take the field wiring at figure 3.5/2. If a smaller type is used, pick up the part of interest shown at one of the figures before.

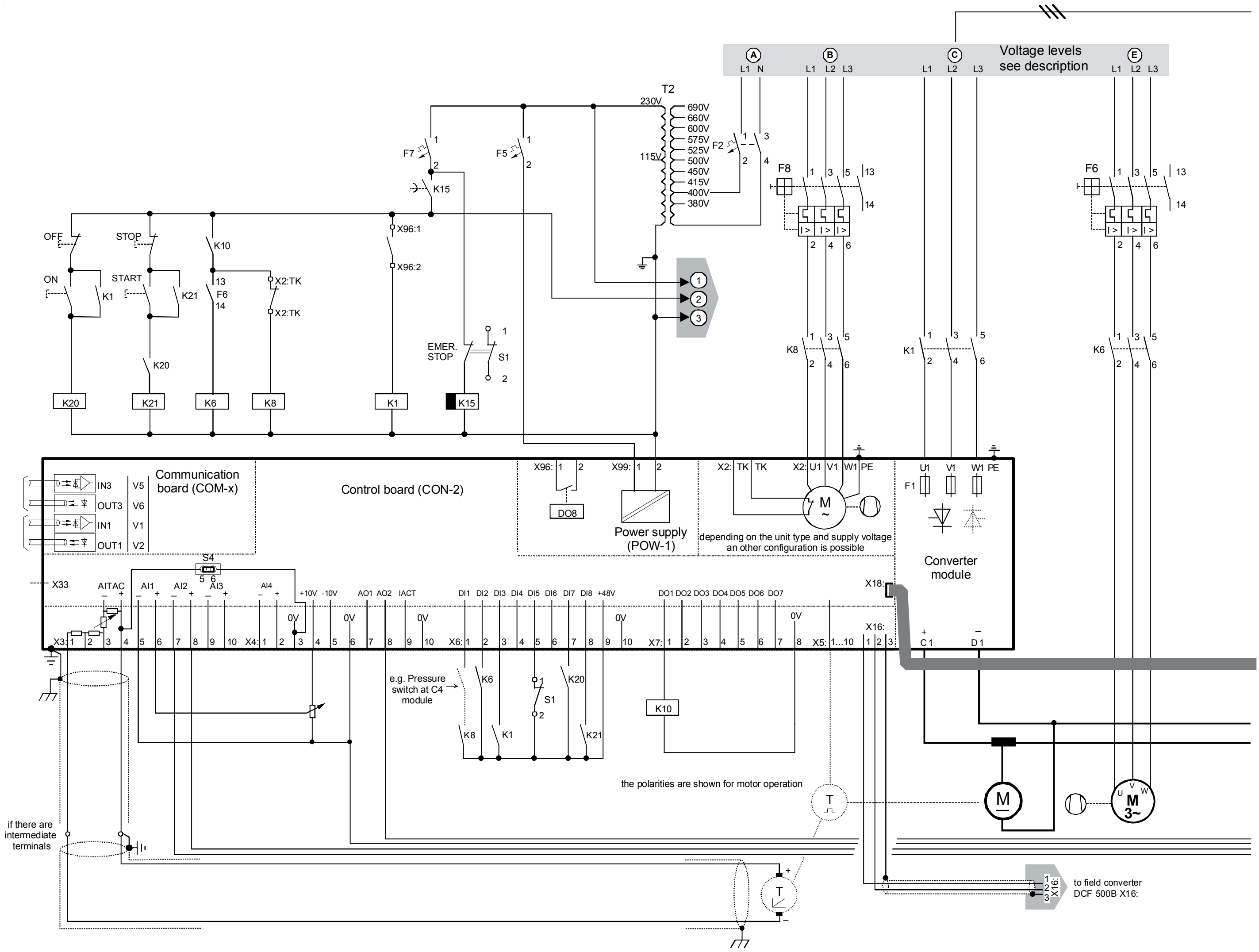


Figure 3.6/1: Typical configuration for high power drives connected in 12-pulse parallel (MASTER)

- **Selection of components**

See remarks above.

- **Power supply**

There are several components, which need a power supply:

- Armature converter´s power part:	200 V to 1000 V, depending on converter type; *see chapter 2*
- Converters electronics power supply:	115 V or 230 V, selected by jumper
- Converter cooling fan:	230V 1-ph at C1 + C2, A5; 400 V / 690 V 3-ph. at A6/A7; *see Technical Data*
- Motor field supply:	see fig. 3.5/2
- Motor cooling fan:	depending on motor manufacturer / local demands
- Relay logic:	depending on local demands

This configuration is basically identical to the one shown at figure 3.5/1. The drive system is supplied by a 12-pulse transformer, which has got two secondary windings with a phase shift of 30 degrees. In this case a decision has to be made, how the auxiliary voltage levels **A, B, C**, **D**=field and **E** are generated. Attention has to be paid to the auxiliary voltage **A**:

- is the power of transformer T2 sufficient to supply all consumers? Consumers are electronics of all the converters, possibly fans of the two 12-pulse converters and the field supply unit, main contactors, monitoring circuits, etc.
- is redundancy required, and/or flexibility to be able to operate master and follower independent of one another?

If necessary several auxiliary voltage levels (A, A', A'' etc.) should be constructed.

- **Power supply (continuation)**

Afterwards it has to be decided how the different consumers will be protected against any type of failure. If circuit breakers are used, take their interruption capacity into account. Take the hints given before as a rough idea. See also power supply fig. 3.4/1 (*fully-controlled field*).

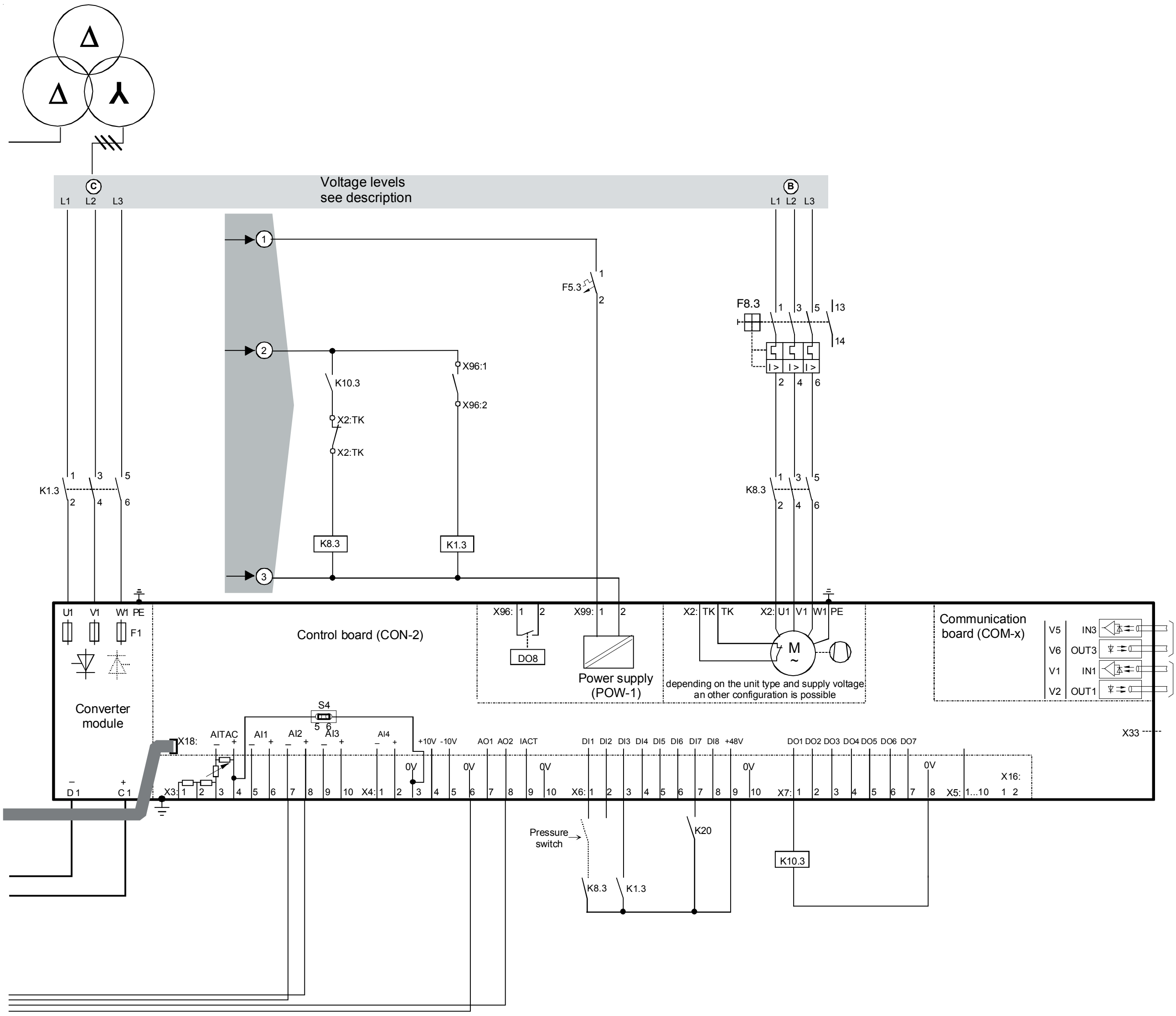


Figure 3.6/2: Typical configuration for high power drives connected in 12-pulse parallel (FOLLOWER)

- **Control**

The relay logic can be split into three parts. Basically the logic shown at figure 3.2/1 could be used for this configuration. Because of the size of the drive and it´s value the logic shown is recommended:

a: Generation of the ON/OFF and START/STOP command: same as figure 3.1/1

b: Generation of control and monitoring signals: same as figure 3.1/1
Each converter is monitoring his main contactor and his fan supply by himself.

c: Stop mode beside ON/OFF and START/STOP: same as figure 3.1/1
It is recommended to use the additional safety provided by the use of the ELECTRICAL DISCONNECT function at such type of drives.

- **Sequencing**

The circuit diagram is based on a permanent 12-pulse mode without any adaptation concerning redundancy and on one converter working as a Master and taking care for the field control. All remarks given in chapter 3.5 can be applied to this configuration too. The converters exchange binary signals for bridge reversal and for fast monitoring via the flat cable connection X18:. Analogue signals like current reference and actual current are exchanged via terminal row X3: / X4:. Parameters at group 36 have to be set within Master and Slave converter to get the data exchange via flat cable connection X18: and connected inputs / outputs working. Parameters to be set at group 1 and 2 within Master and Slave make sure the data exchange of current values analogue inputs and outputs will take place. Additional information and a detailed parameter list are available within the manual *Planning and Start-up for 12-pulse Power Converters*.

- **Engineering hint**

If the drive system has to be available in case of a failure redundancy is needed and basically possible! Basically errors and failures can happen to all components any time, depending on the single component affected the result will have a different severity. Because of that errors and faults resulting in a redundancy mode have to be specified at first. Errors and faults causing severe break down are found at the power supply / 12-pulse transformer, at the two converters, supplying the armature, at the field supply unit, at the 12-pulse interphase reactor or at the motor. Precautions can be made to increase the availability of the drive in case the load condition and the motor data allow to use the system with reduced power. This can be made for example by using two transformers instead of one single 12-pulse transformer, by enabling 6-pulse mode at the converters (only one converter is switched on; the other is still kept switched off), by a second installed field supply unit in case of hardware failures there or by enabling the field control done by either the one or the other converter and by a possibility to bypass the 12-pulse interphase choke.

4 Overview of software (Version 21.2xx)

4.1 GAD Engineering-Program

The standard diagram of the DCS500 Software Structure is added to this chapter as folder.

In addition to all the function blocks presented there (called "Standard Function Blocks") additional blocks (called "Application blocks") are available, like **ABS**olute value, **ADD**er with 2 and 4 inputs, **AND** gates with 2 and 4 inputs, **COMP**arators, **CONV**ersion blocks, **COUNT**er, **DIV**ider, **FILT**er, **FUNG** (x-y function generator, **LIM**iter, **MUL**iplier, **OR** gates with 2 and 4 inputs, **PAR**ameter function block, **PI** controller, **SR** memory, **SUB**traction, **XOR** gates and others.
Both types are stored in the converter and delivered with every converter. The application function blocks as well as the standard function blocks are available as a library in file format. **This library serves as a basis for your customized modifications.**
As a library is always a copy of the one available within the converter former libraries are automatically included in the latest one.

Commissioning and Maintenance Tools for DCS500 (Panel or DDC/CMT Tool) are able to connect or disconnect function blocks and therefore can produce customized software applications. Both these tools however are not able to produce a documentation of the changes in software other than in a table. Therefore ABB offers another special tool to develop extended software structures as drawings and deliver a data file with these informations to be transferred into the drive control section via the CMT Tool.
This tool is called **GAD** (Graphical Application Designer). The GAD is for off-line use only and needs a CMT tool to transfer the changed software structure into the drive.

The GAD PC program features the following functions:

- application design and programming
- graphics editor for drawing and altering program diagrams
- user-controlled document depiction
- compilation of the application file to be downloaded into the converter by using CMT tool
- compilation of the diagram file to be loaded into the CMT tool window to see actual values on-line

System requirements / recommendation:

- min. 486 PC, 4 MB RAM, 40MB free hard disk space
- operating system: Windows 3.x, 95, 98, NT, 2000 or XP

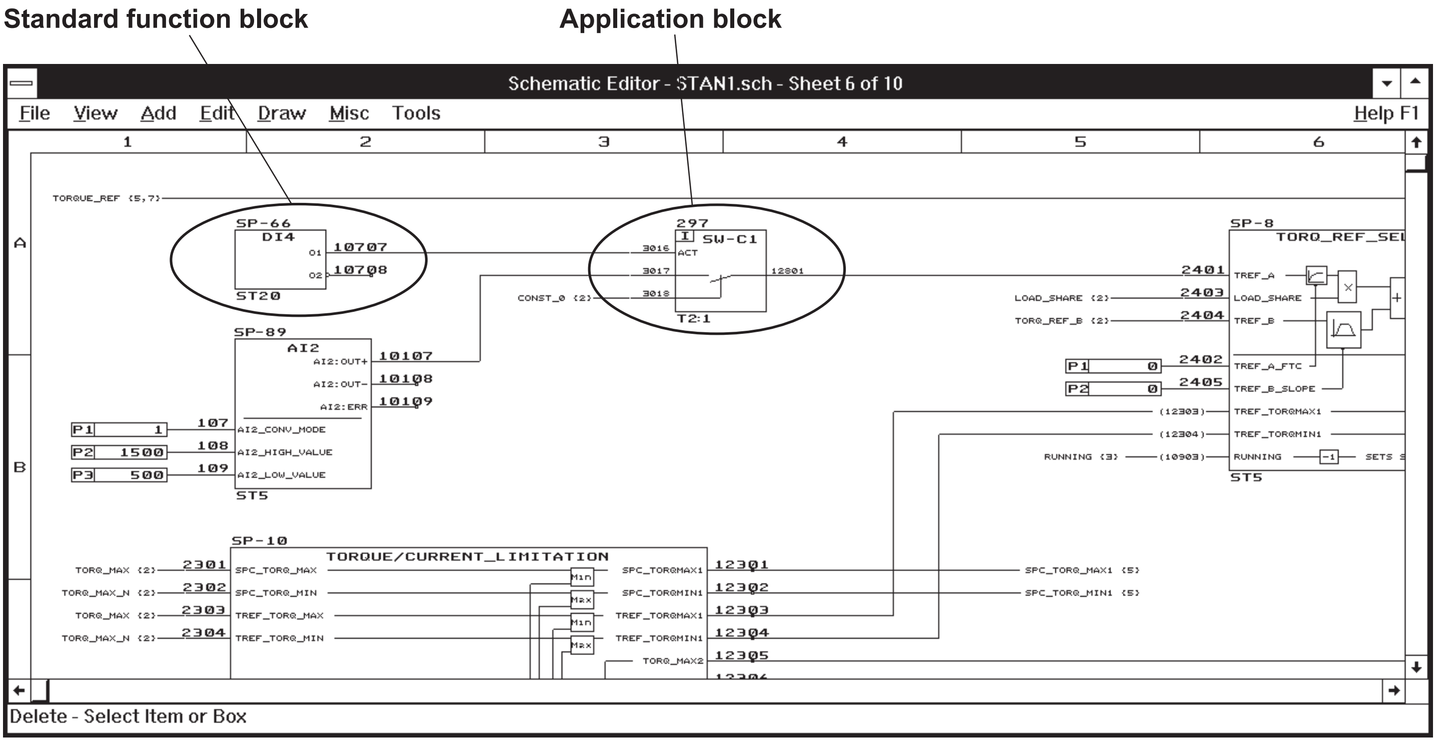


Fig. 4.1/1 Standard and Applications function blocks utilized with GAD

Please note:
For more information of the GAD PC program and the library there are manuals available describing the possibilities and the handling of the program.

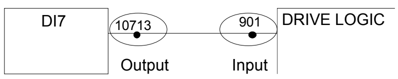
The entire software is made up of connected function blocks. Each of these individual function blocks constitutes a subfunction of the overall functionality. The function blocks can be subdivided into two categories:

- **Function blocks** which are **permanently active**, are almost always in use; these are described on the following pages.
- **Function blocks** which, although they are available within the software as standard features, have **to be expressly activated** when they are needed for special requirements. These include, for example:
  AND gates with 2 or 4 inputs,
  OR gates with 2 or 4 inputs,
  adders with 2 or 4 inputs,
  multipliers/dividers, etc.

or closed-control-loop functions, such as
  integrator,
  PI controller,
  D-T1 element, etc.

All function blocks are characterized by input and output lines, equipped with numbers. These inputs/outputs can likewise be subdivided into two categories:

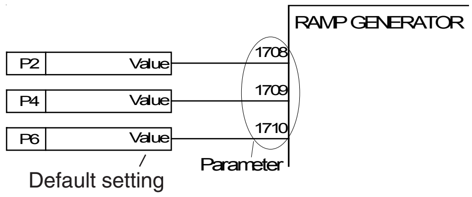
Inputs for designating connections



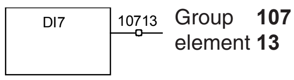
When you want to alter connections between function blocks, proceed as follows:
- first select the input
- and then connect to output

All those connections possessing one dot each at their beginning and end can be altered.

Parameters for setting values
(such as ramp-up time / ramp-down time, controller gain, reference values and others)



For input / parameter selection, the following applies:
- Ignore the two right-hand digits; the remaining digits are the group and to be selected
- The two right-hand digits are the element and to be selected

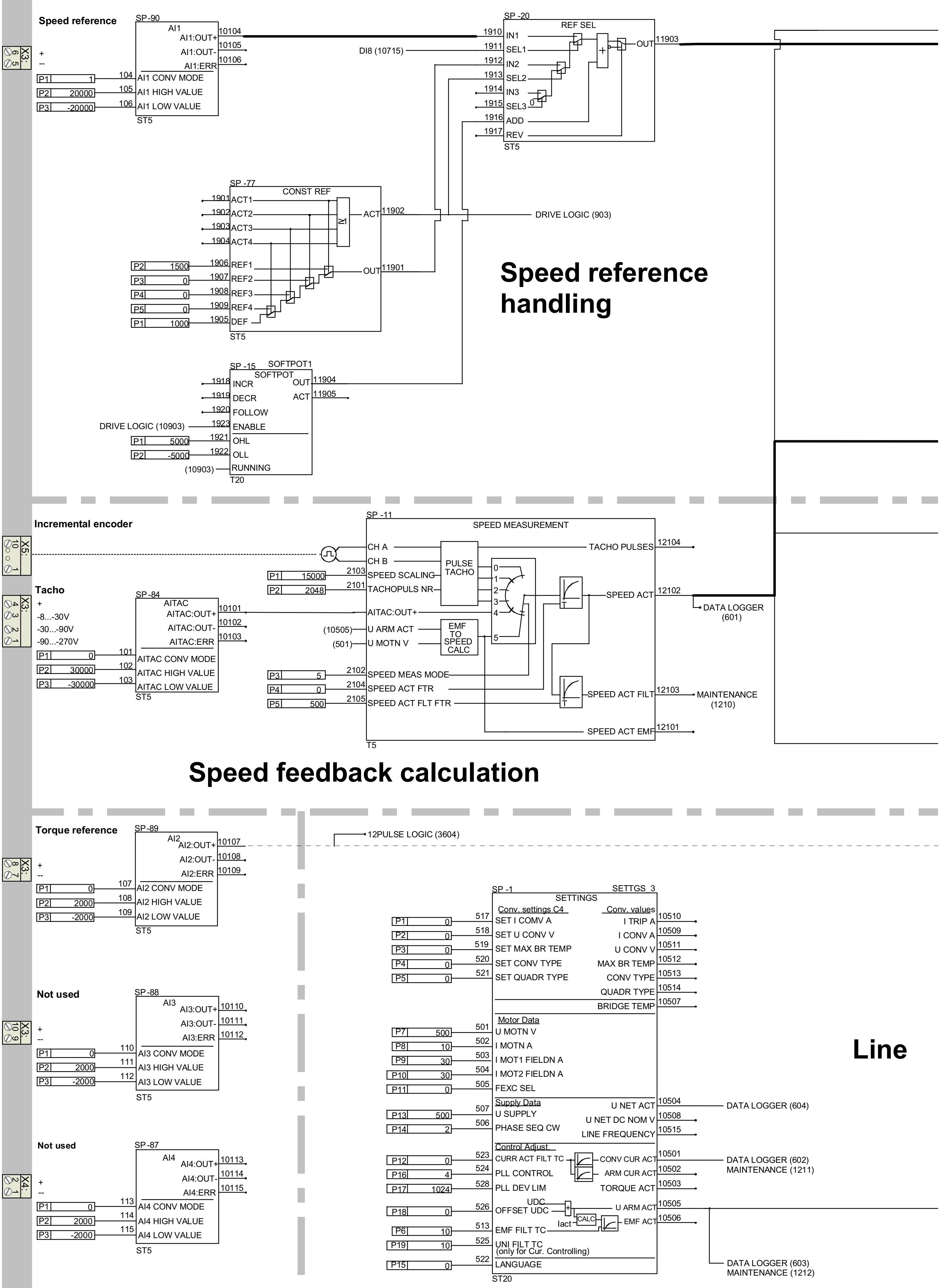


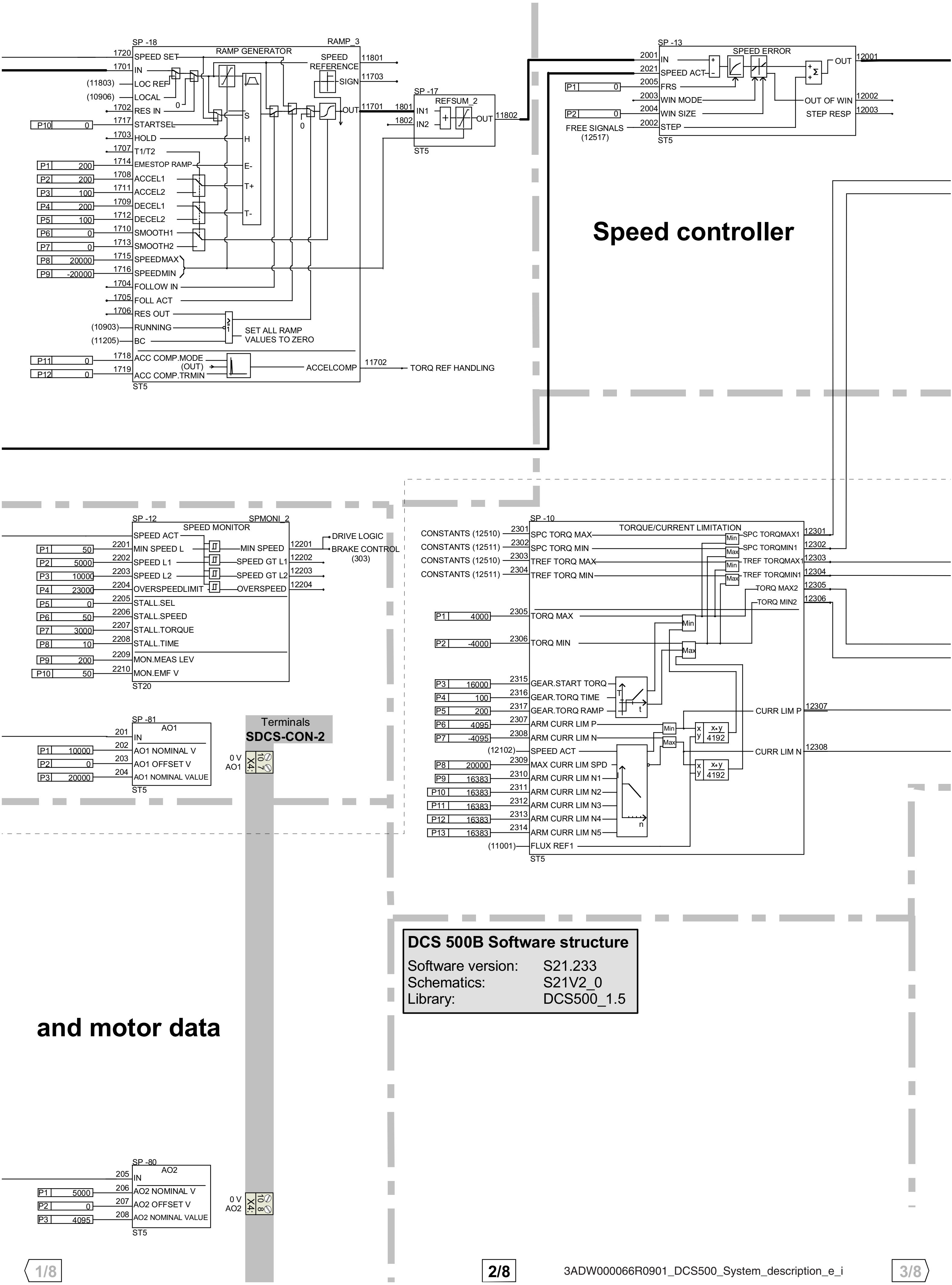
The selection can be done with the control panel CDP312, using the (double-up-down) for the group and the (single-up-down) for the element or a PC-based tool program CMT/DCS500B.

The following pages correspond to what you get printed from the GAD tool with additional explanations based on software 21.233 which is identical with software 21.234.

Please note:
The following pages describe the as-delivered **wired** functionality. If a desired signal or a certain function seems to be missing, it can in most cases be implemented very easily:

- Either the desired signal does already exist, but - due to its complexity - is not easy to describe, which is why it appears in a signal listing given in the software description.
- Or it can be generated with available signals and additionally available function blocks.
- In addition to that please note that the functionality described on the next pages is available a second time for Motor Set 2. There are two parameter sets (groups 1 to 24) available within the drive's memory.
- The values of the parameters are displayed in GAD-Tool format.


Speed reference handling
Speed feedback calculation
Line
Speed reference
SP -90
AI1
AI1:OUT+ 10104
AI1:OUT- 10105
AI1:ERR 10106
P1 1 104 AI1 CONV MODE
P2 20000 105 AI1 HIGH VALUE
P3 -20000 106 AI1 LOW VALUE
ST5
SP -20
REF SEL
1910 IN1
1911 SEL1
1912 IN2
1913 SEL2
1914 IN3
1915 SEL3
1916 ADD
1917 REV
OUT 11903
DI8 (10715)
SP -77
CONST REF
1901 ACT1
1902 ACT2
1903 ACT3
1904 ACT4
P2 1500 1906 REF1
P3 0 1907 REF2
P4 0 1908 REF3
P5 0 1909 REF4
P1 1000 1905 DEF
ACT 11902
OUT 11901
DRIVE LOGIC (903)
SP -15 SOFTPOT1
SOFTPOT
1918 INCR
1919 DECR
1920 FOLLOW
1923 ENABLE
P1 5000 1921 OHL
P2 -5000 1922 OLL
(10903) RUNNING
OUT 11904
ACT 11905
DRIVE LOGIC (10903)
T20
Incremental encoder
Tacho
+
-8...-30V
-30...-90V
-90...-270V
SP -84
AITAC
AITAC:OUT+ 10101
AITAC:OUT- 10102
AITAC:ERR 10103
P1 0 101 AITAC CONV MODE
P2 30000 102 AITAC HIGH VALUE
P3 -30000 103 AITAC LOW VALUE
SP -11
SPEED MEASUREMENT
CH A
CH B
P1 15000 2103 SPEED SCALING
P2 2048 2101 TACHOPULS NR
AITAC:OUT+
(10505) U ARM ACT
(501) U MOTN V
P3 5 2102 SPEED MEAS MODE
P4 0 2104 SPEED ACT FTR
P5 500 2105 SPEED ACT FLT FTR
PULSE TACHO
EMF TO SPEED CALC
TACHO PULSES 12104
SPEED ACT 12102
SPEED ACT FILT 12103
SPEED ACT EMF 12101
DATA LOGGER (601)
MAINTENANCE (1210)
T5
Torque reference
SP -89
AI2
AI2:OUT+ 10107
AI2:OUT- 10108
AI2:ERR 10109
P1 0 107 AI2 CONV MODE
P2 2000 108 AI2 HIGH VALUE
P3 -2000 109 AI2 LOW VALUE
12PULSE LOGIC (3604)
Not used
SP -88
AI3
AI3:OUT+ 10110
AI3:OUT- 10111
AI3:ERR 10112
P1 0 110 AI3 CONV MODE
P2 2000 111 AI3 HIGH VALUE
P3 -2000 112 AI3 LOW VALUE
Not used
SP -87
AI4
AI4:OUT+ 10113
AI4:OUT- 10114
AI4:ERR 10115
P1 0 113 AI4 CONV MODE
P2 2000 114 AI4 HIGH VALUE
P3 -2000 115 AI4 LOW VALUE
SP -1 SETTGS_3
SETTINGS
Conv. settings C4
P1 0 517 SET I COMV A
P2 0 518 SET U CONV V
P3 0 519 SET MAX BR TEMP
P4 0 520 SET CONV TYPE
P5 0 521 SET QUADR TYPE
Conv. values
I TRIP A 10510
I CONV A 10509
U CONV V 10511
MAX BR TEMP 10512
CONV TYPE 10513
QUADR TYPE 10514
BRIDGE TEMP 10507
Motor Data
P7 500 501 U MOTN V
P8 10 502 I MOTN A
P9 30 503 I MOT1 FIELDN A
P10 30 504 I MOT2 FIELDN A
P11 0 505 FEXC SEL
Supply Data
P13 500 507 U SUPPLY
P14 2 506 PHASE SEQ CW
U NET ACT 10504
U NET DC NOM V 10508
LINE FREQUENCY 10515
DATA LOGGER (604)
Control Adjust.
P12 0 523 CURR ACT FILT TC
P16 4 524 PLL CONTROL
P17 1024 528 PLL DEV LIM
P18 0 526 OFFSET UDC
P6 10 513 EMF FILT TC
P19 10 525 UNI FILT TC (only for Cur. Controlling)
P15 0 522 LANGUAGE
CONV CUR ACT 10501
ARM CUR ACT 10502
TORQUE ACT 10503
U ARM ACT 10505
EMF ACT 10506
DATA LOGGER (602)
MAINTENANCE (1211)
DATA LOGGER (603)
MAINTENANCE (1212)
ST20



DCS 500B Software structure

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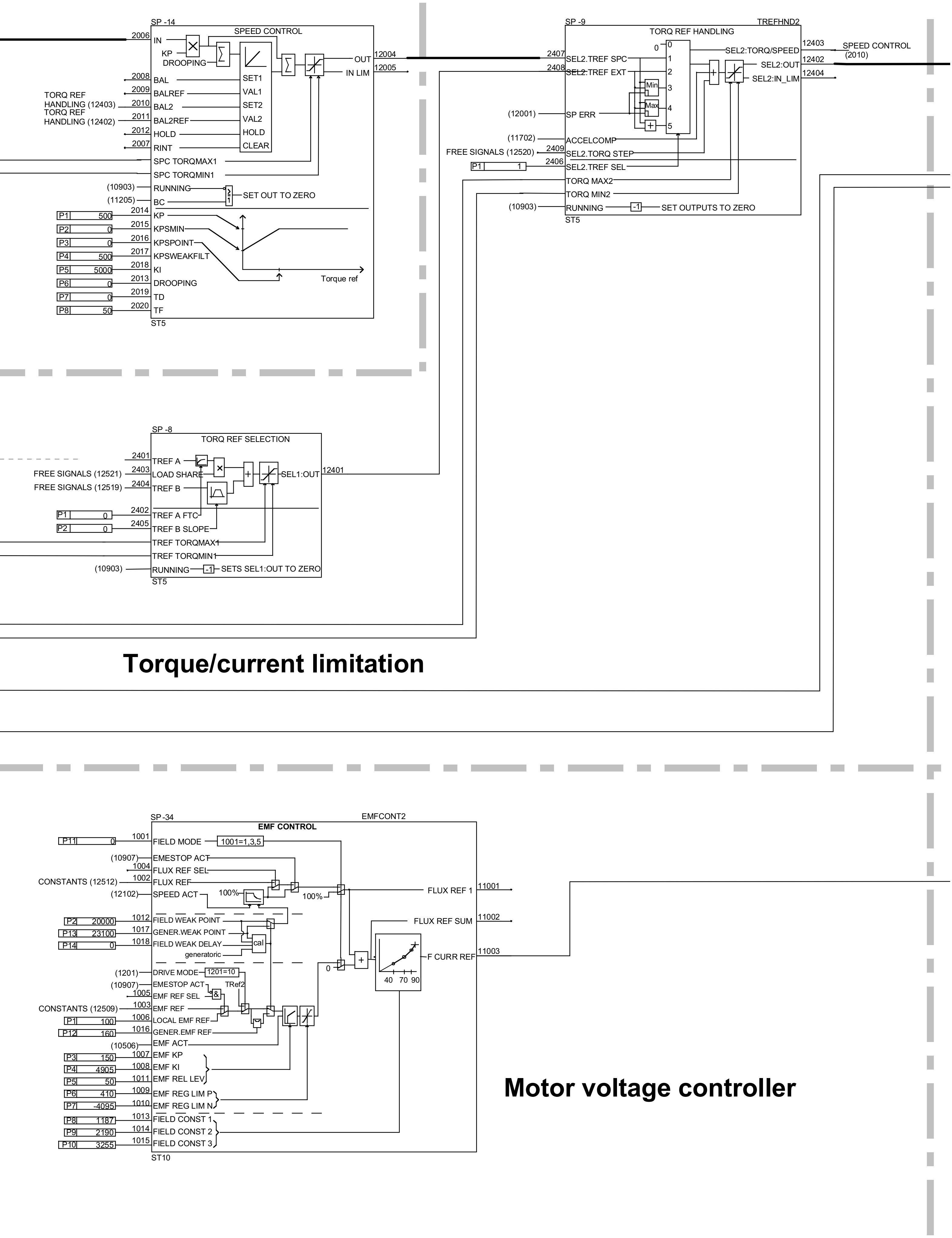
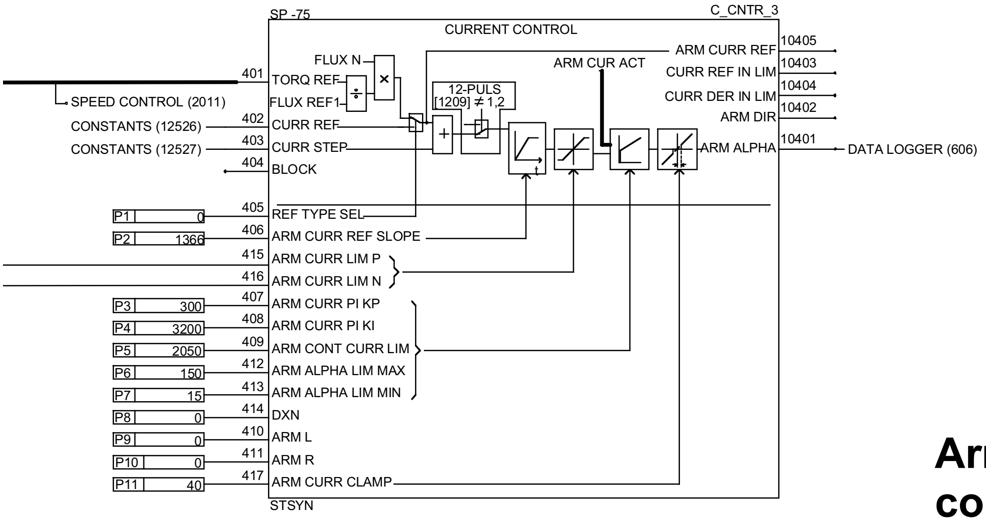
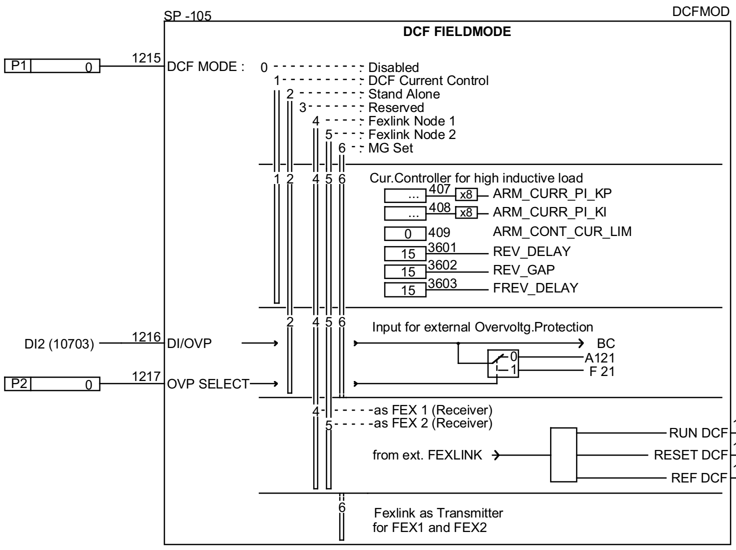
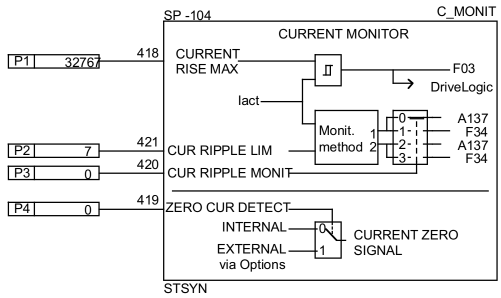
Schematics: S21V2_0
Library: DCS500_1.5

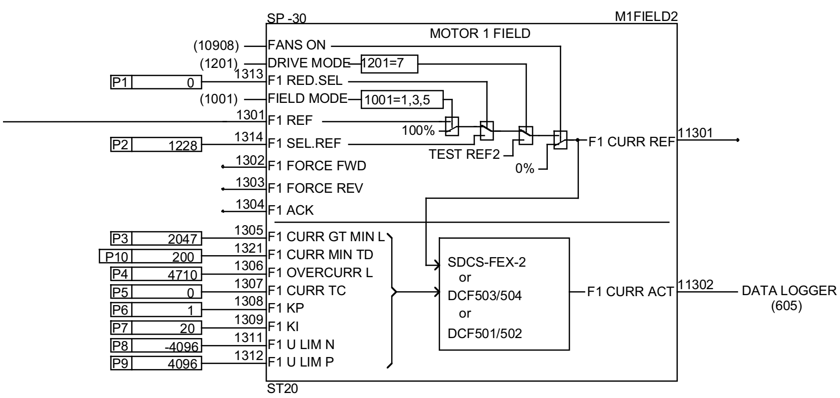

SP -14
SPEED CONTROL
IN
KP
DROOPING
OUT
IN LIM
12004
12005
2006
2008 BAL
2009 BALREF
2010 BAL2
2011 BAL2REF
2012 HOLD
2007 RINT
SET1
VAL1
SET2
VAL2
HOLD
CLEAR
TORQ REF HANDLING (12403)
TORQ REF HANDLING (12402)
SPC TORQMAX1
SPC TORQMIN1
(10903) RUNNING
(11205) BC
SET OUT TO ZERO
P1 500 2014 KP
P2 0 2015 KPSMIN
P3 0 2016 KPSPOINT
P4 500 2017 KPSWEAKFILT
P5 5000 2018 KI
P6 0 2013 DROOPING
P7 0 2019 TD
P8 50 2020 TF
Torque ref
ST5
SP -9
TREFHND2
TORQ REF HANDLING
2407 SEL2.TREF SPC
2408 SEL2.TREF EXT
Min
Max
(12001) SP ERR
(11702) ACCELCOMP
FREE SIGNALS (12520) 2409 SEL2.TORQ STEP
P1 1 2406 SEL2.TREF SEL
TORQ MAX2
TORQ MIN2
(10903) RUNNING
-1
SET OUTPUTS TO ZERO
SEL2:TORQ/SPEED 12403
SEL2:OUT 12402
SEL2:IN_LIM 12404
SPEED CONTROL (2010)
ST5
SP -8
TORQ REF SELECTION
2401 TREF A
FREE SIGNALS (12521) 2403 LOAD SHARE
FREE SIGNALS (12519) 2404 TREF B
P1 0 2402 TREF A FTC
P2 0 2405 TREF B SLOPE
TREF TORQMAX1
TREF TORQMIN1
(10903) RUNNING
SETS SEL1:OUT TO ZERO
SEL1:OUT 12401
ST5
Torque/current limitation
SP -34
EMFCONT2
EMF CONTROL
P11 0 1001 FIELD MODE
1001=1,3,5
(10907) EMESTOP ACT
1004 FLUX REF SEL
CONSTANTS (12512) 1002 FLUX REF
(12102) SPEED ACT
100%
P2 20000 1012 FIELD WEAK POINT
P13 23100 1017 GENER.WEAK POINT
P14 0 1018 FIELD WEAK DELAY
generatoric
cal
(1201) DRIVE MODE
1201=10
(10907) EMESTOP ACT
TRef2
1005 EMF REF SEL
CONSTANTS (12509) 1003 EMF REF
P1 100 1006 LOCAL EMF REF
P12 160 1016 GENER.EMF REF
(10506) EMF ACT
P3 150 1007 EMF KP
P4 4905 1008 EMF KI
P5 50 1011 EMF REL LEV
P6 410 1009 EMF REG LIM P
P7 -4095 1010 EMF REG LIM N
P8 1187 1013 FIELD CONST 1
P9 2190 1014 FIELD CONST 2
P10 3255 1015 FIELD CONST 3
FLUX REF 1 11001
FLUX REF SUM 11002
F CURR REF 11003
40 70 90
ST10
Motor voltage controller

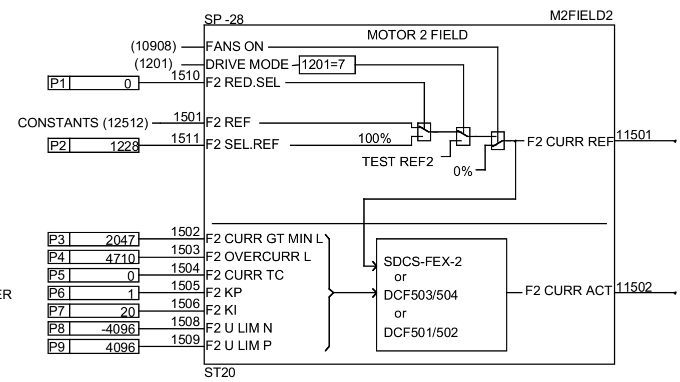


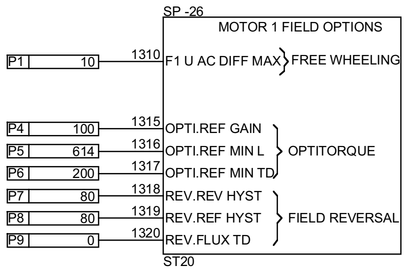
Armature current controller

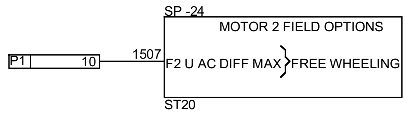








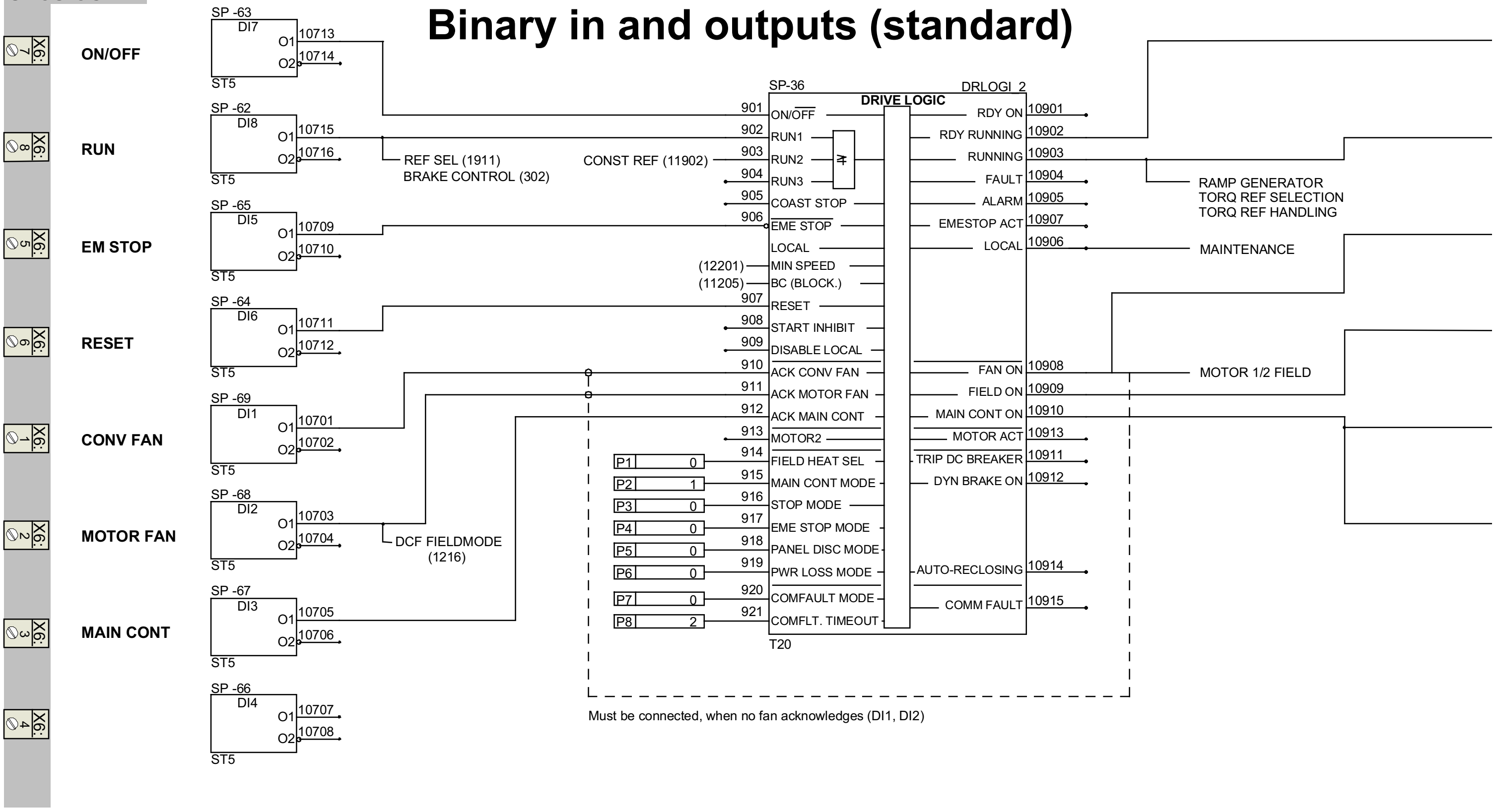




Field current controller 1 and 2

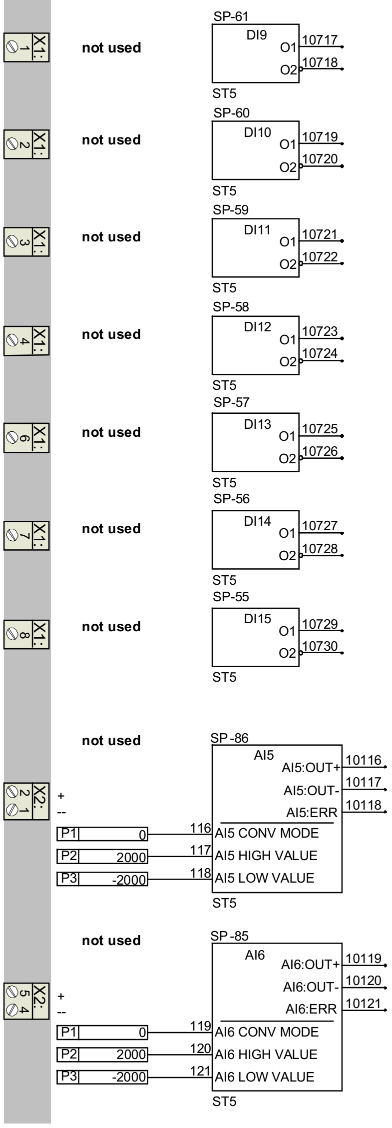
Terminals
SDCS-CON-2

Binary in and outputs (standard)

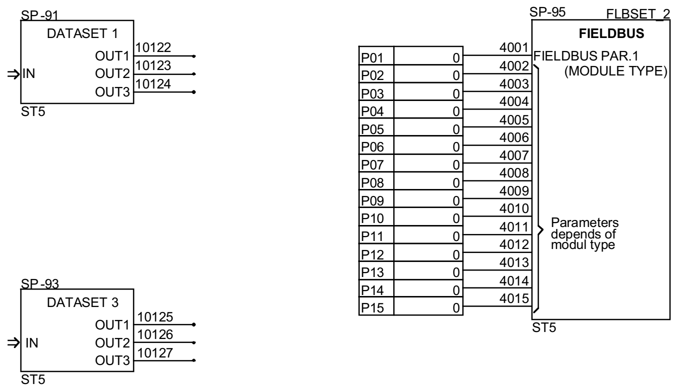


Terminals
SDCS-IOE-1

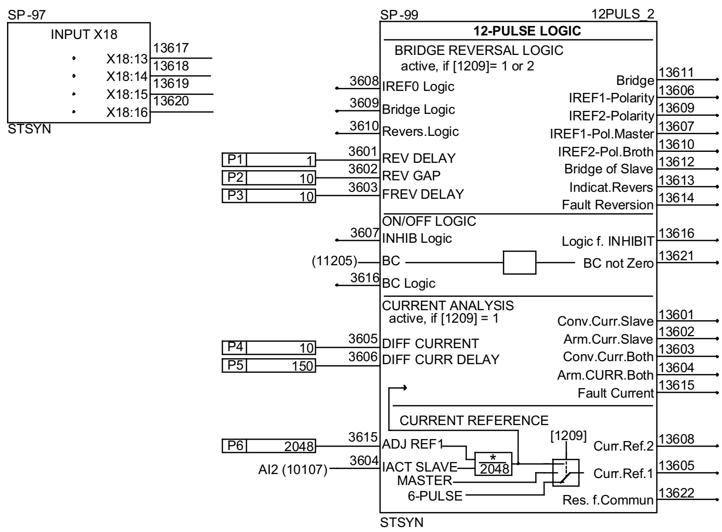
Additional binary inputs

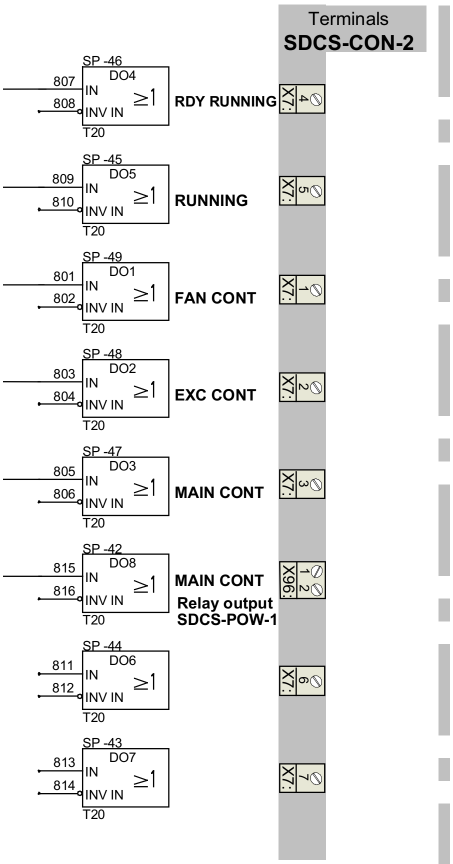


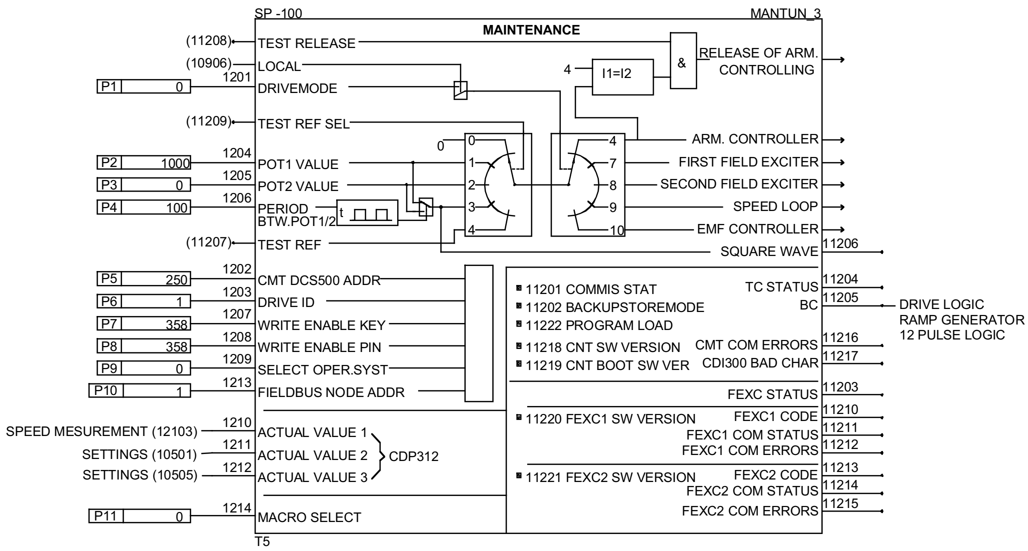
Inputs and outputs for fieldbus



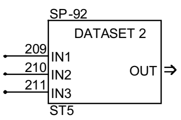
Inputs and outputs for 12 pulse



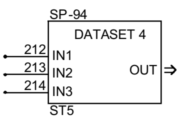


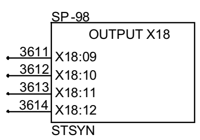


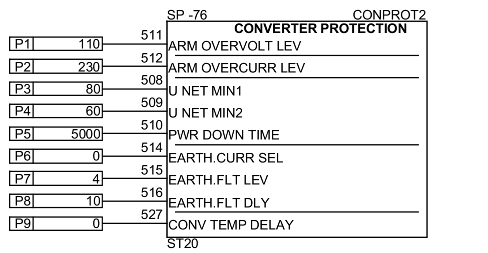
Maintenance

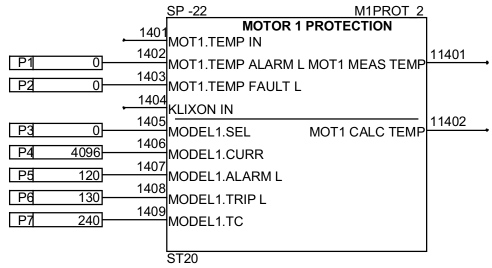


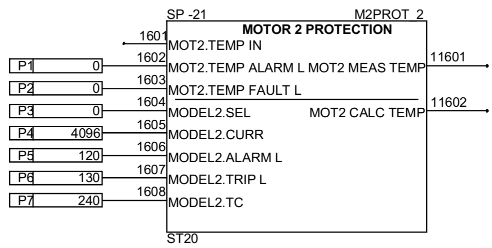
Monitoring

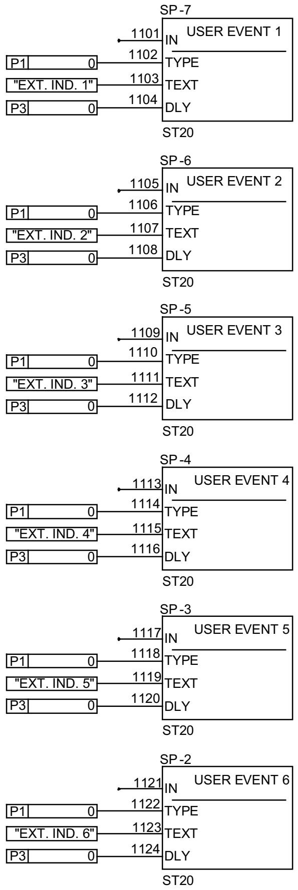




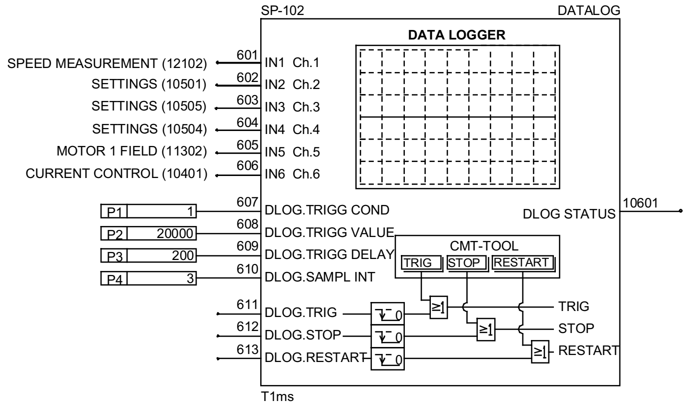






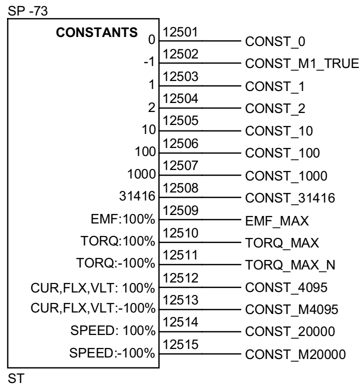


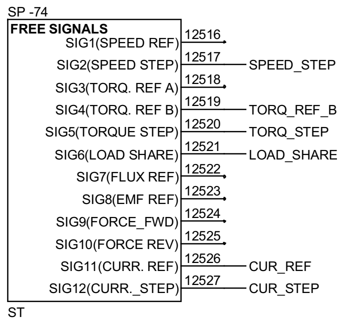
User events

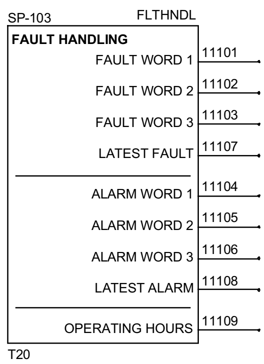


Data logger

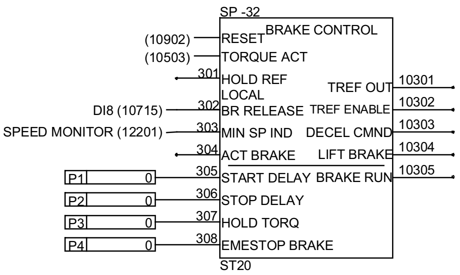
Additional signals







Brake control



Speed reference handling
The speed reference for the ramp function generator is formed by the REF SEL blocks, which can be used to select the reference value required, the CONST REF block, which generates a maximum of 4 permanently settable reference values, the SOFTPOT block, which reproduces the function of a motorpotentiometer in conjunction with the block RAMP GENERATOR, or by the AI1 block (analogue input 1).
The RAMP GENERATOR block contains a ramp function generator with 2 ramp-up and ramp-down ramps, 2 times for the S-curve, limitation for upper and lower limits, hold function and the functions for "Follow" the speed reference or "Follow" the speed feedback. There is a special signal available for the treatment of acceleration and deceleration.
The REF SUM block enables the output of the ramp function generator and a user-definable signal to be added.

Speed feedback calculation
This page depicts the conditioning routine for speed feedback and reference values. The AITAC block is used to read in the speed feedback from an analogue tacho The SPEED MEASUREMENT block processes the 3 possible feedback signals: analogue tacho, pulse generator or the converter's output voltage (SPEED_ACT_EMF) - conditioned by the EMF TO SPEED CALC block **(if 2102=5 , no field weakening function possible)**. Parameters are used for activating smoothing functions, selecting the feedback value and where applicable for setting the maximum speed. This parameter also serves for scaling the speed control loop.
The SPEED MONITOR block contains motor stalled - and tacho monitoring function, and compares a selected speed feedback value against overspeed, minimum speed and 2 settable thresholds.
The AO1 block represents a scalable analogue output.

Speed controller
The result is compared to the speed feedback from the SPEED MEASUREMENT block, using the SPEED ERROR block, and then passed to the speed controller. This block permits evaluation of the system deviation by means of a filter. Moreover, it is possible here to make a few settings which are needed for the "Window" operating mode. If the drive's speed feedback is within a window around the reference value, then the speed controller is "bypassed" (provided "Window Mode" has been activated; the drive is controlled by means of a torque reference value at the TORQ REF HANDLING block). If the speed feedback is outside the window, the speed controller will be activated, and will lead the drive's actual speed back into the window.
The SPEED CONTROL block contains the speed controller with P, I and DT1 contents. For adaptation it receives a variable P-amplification.

Torque / current limitation
The "torque reference" generated by the speed controller is passed to the input of the CURRENT CONTROL block via the TORQ REF HANDLING block, and there it is converted into a current reference value and used for current regulation. The TORQUE / CURRENT LIMITATION block is used for generating the various reference values and limitations; this block contains the following functions: "speed-dependent current limitation", "gear backlash compensation", "generation of the values for static current limitation" and "torque limitation". The values for the various limitations are used again at some other points, for instance at the following blocks: SPEED CONTROL, TORQ REF HANDLING, TORQ REF SELECTION, and CURRENT CONTROL.
The AI2 block (analogue input 2) is used for reading in an analogue signal.
The TORQ REF SELECTION block contains a limitation with upstream addition of two signals, one of which can be routed through a ramp function generator; the other signal's evaluation can be dynamically altered using a multiplier.
The TORQ REF HANDLING block determines the drive's operating mode. When in position 1, the speed control mode has been activated, whereas in position 2 it is torque control mode (no closed-loop control since there is no "genuine" torque feedback available in the unit). In both cases, the reference value required comes from outside. Positions 3 and 4 are a combination of the first two options stated above. Note that with position 3 the smaller value out of external torque reference and speed controller output is passed to the current controller whereas with position 4 it is the larger one. Position 5 uses both signals, corresponding to the method of functioning of "Window Mode".

Armature current controller
The CURRENT CONTROL block contains the current controller with a P and I content, plus an adaptation in the range of discontinuous current flow. This block also contains functions for current-rise limitation, the conversion of torque reference value into current reference value by means of the field crossover point, and some parameters describing the supply mains, and the load circuit.
At applications with high inductive load and high dynamic performance a different hardware is used to generate the signal current equal to zero. This hardware is selected by the CURRENT MONITOR block. The functions monitoring the current can now be adapted to the needs of the application. This gives easier handling and a higher degree of safety at high performance drives, like test rigs.
The DCF mode can be activated via the block DCF FIELDMODE. The functionality within this mode can be specified. If one of these functions is selected the current controller gets a different characteristic, the overvoltage protection DCF 506 is monitored and the field current reference via the X16: terminals is routed.

Line and motor data
The SETTINGS block serves for scaling all important signals, such as line voltage, motor voltage, motor current and field current. Parameters are available to adjust the control to special conditions like weak networks or interactions with harmonic filter systems. The language, in which you want to read your information on the panel, can be selected.
The AO2 block represents a scalable analogue output.

Motor voltage controller
The EMF CONTROL block contains the armature-circuit voltage controller (e.m.f. controller). It is based on a parallel structure comprising a PI controller and a precontrol feature, generated with a characteristic of 1/x. The ratio between the two paths can be set. The output variable of this block is the field current reference value, which is produced from the flux reference value by another characteristic function using linearization. To enable the drive to utilize a higher motor voltage even with a 4 quadrant system two different field weakening points can be set by parameter.

Field current controller 1 and 2
Since a DCS power converter can control 2 field units, some of the function blocks are duplicated. This means that, depending on the mechanical configuration of the drives concerned, you can control 2 motors either in parallel or alternatively. The requisite configuration of the software structure can be generated by designing the blocks appropriately during the commissioning routine.
The MOTOR1 FIELD / MOTOR2 FIELD block reads in the field current reference value and all values which are specific to the field supply unit, and transfers these to the field power converter via an internal serial link; the field power converter is scaled to suit its hardware, and performs field current regulation. The field current direction for motor 1 can be determined using binary commands, while for motor 2 it can be generated in the course of an application upstream of the block concerned.
The MOTOR1 FIELD OPTIONS / MOTOR2 FIELD OPTIONS block controls the freewheeling function in the event of line undervoltage, and the field current reversal function with field reversal drives (only for motor 1). In case of field reversal drives, there is an option for selectively influencing the moment of armature-circuit and field current reduction and build-up.

Binary in and outputs (standard)
The DRIVE LOGIC block reads in various signals from the system via digital inputs DIx, processes them, and generates commands, which are outputted to the system via digital outputs DOx, e.g. for controlling the power converter's line contactor, the field-circuit contactor or contactors for various fans, or for outputting status messages.

Additional binary inputs
The AI3 and AI4 blocks represent another 2 analogue inputs which have as yet not been assigned to any particular functions. The blocks A15 and A16 represent another 2 additional inputs which are only active, if the board SDCS-IOE1 is connected. Another 7 digital inputs DI 9 .. DI15 are available with this additional hardware.

Inputs and outputs for fieldbus
A fieldbus module with serial communicated references should be used, if analogue and digital signals are not sufficient for the control of the drive (equipment for the installation of Profibus, CS31, Modbus etc. is available). This type of module is activated by means of the block FIELDBUS. The data transferred from the control to the converter are stored in the blocks DATASET1 and DATASET3 as 16-bit-information. Depending on the application the output pins of these blocks have to be connected to input pins of other blocks in order to transport the message. The same procedure is valid for blocks DATASET2 and DATASET4, if they are connected. These blocks are transmitting information from the converter to the control system.

Inputs and outputs for 12 pulse
The converter is able to be configurated in a 12-pulse parallel application. In this case you need: two identical armature converters; one field supply unit; one T-reactor; communication via ribbon cable connected to X 18 of both converters The 12-PULSE LOGIC must be activated and guarantees a synchronous control of the MASTER and the SLAVE drive.

Maintenance
The MAINTENANCE block provides reference values and test conditions so as to enable all controllers to be adjusted in the power converter. If the panel is used as a meter in the cubicle door, an assortment of signals can be defined here.

Monitoring
The CONVERTER PROTECTION block monitors the armature circuit for overvoltage and overcurrent, and monitors the mains for undervoltage. It provides an option for reading in the total current of the 3 phases through an additional external sensor and monitoring it for "not equal to zero". Adaptations are made for rebuild applications, which keep the power part and the fan, to sense overload conditions or fan failures.
The MOTOR1 PROTECTION block, in its upper part, evaluates either the signal from an analogue temperature sensor, or from a Klixon. In its lower part, it computes motor heat-up with the aid of the current feedback value and a motor model, after which a message is outputted.
The MOTOR2 PROTECTION block works in the same way as the MOTOR1 PROTECTION block, but without Klixon evaluation.

User event
By using the block USER EVENT1 to USER EVENT6 six different messages are created, which are displayed as faults or alarms on the panel CDP312 as well as on the 7 segment display of the converter.

Brake control
The BRAKE CONTROL block generates all signals needed for controlling a mechanical brake.

Data logger
The block DATA LOGGER is able to record up to six signals. The values of these signals will be stored in a battery buffered RAM and are still available after a break down of the supply voltage. The time of recording can be influenced by a trigger signal, as well as the number of recorded values before and after the trigger signal. The function DATA LOGGER can be set with both panel and PC tool. For evaluation of the recorded values a PC tool is recommended.

Additional signals
By using the block FAULT HANDLING the faults and alarms of the drive are regrouped as 16-bit information. The CONSTANTS and FREE SIGNALS blocks can be used for setting limitations or special test conditions.

List of parameters (with column for customer-specific values)

No.	Parameter name	
101	AITAC_CONV_MODE	
102	AITAC_HIGH_VALUE	
103	AITAC_LOW_VALUE	
104	AI1_CONV_MODE	
105	AI1_HIGH_VALUE	
106	AI1_LOW_VALUE	
107	AI2_CONV_MODE	
108	AI2_HIGH_VALUE	
109	AI2_LOW_VALUE	
110	AI3_CONV_MODE	
111	AI3_HIGH_VALUE	
112	AI3_LOW_VALUE	
113	AI4_CONV_MODE	
114	AI4_HIGH_VALUE	
115	AI4_LOW_VALUE	
116	AI5_CONV_MODE	
117	AI5_HIGH_VALUE	
118	AI5_LOW_VALUE	
119	AI6_CONV_MODE	
120	AI6_HIGH_VALUE	
121	AI6_LOW_VALUE	
201	AO1.[IN]	
202	AO1_NOMINAL_V	
203	AO1_OFFSET_V	
204	AO1_NOMINAL_VAL	
205	AO2.[IN]	
206	AO2_NOMINAL_V	
207	AO2_OFFSET_V	
208	AO2_NOMINAL_VAL	
209	DATASET2.[IN1]	
210	DATASET2.[IN2]	
211	DATASET2.[IN3]	
212	DATASET4.[IN1]	
213	DATASET4.[IN2]	
214	DATASET4.[IN3]	
301	[HOLD_REF]	
302	[BR_RELEASE]	
303	[MIN_SP_IND]	
304	[ACT_BRAKE]	
305	START_DELAY	
306	STOP_DELAY	
307	HOLD_TORQ	
308	EMESTOP_BRAKE	
401	[TORQ_REF]	
402	[CURR_REF]	
403	[CURR_STEP]	
404	[BLOCK]	
405	REF_TYPE_SEL	
406	ARM_CURR_REF_SLOPE	
407	ARM_CURR_PI_KP	
408	ARM_CURR_PI_KI	
409	ARM_CONT_CURR_LIM	
410	ARM_L	
411	ARM_R	
412	ARM_ALPHA_LIM_MAX	
413	ARM_ALPHA_LIM_MIN	
414	DXN	
415	[ARM_CURR_LIM_P]	
416	[ARM_CURR_LIM_N]	
417	ARM_CURR_CLAMP	
418	CURRENT_RISE_MAX	
419	ZERO_CUR_DETECT	
420	CUR_RIPPLE_MONIT	
421	CUR_RIPPLE_LIM	
501	U_MOTN_V	
502	I_MOTN_A	
503	I_MOT1_FIELDN_A	
504	I_MOT2_FIELDN_A	
505	FEXC_SEL	
506	PHASE_SEQ_CW	

No.	Parameter name	
507	U_SUPPLY	
508	U_NET_MIN1	
509	U_NET_MIN2	
510	PWR_DOWN_TIME	
511	ARM_OVERVOLT_LEV	
512	ARM_OVERCURR_LEV	
513	EMF_FILT_TC	
514	EARTH.CURR_SEL	
515	EARTH.FLT_LEV	
516	EARTH.FLT_DLY	
517	SET_I_CONV_A	
518	SET_U_CONV_V	
519	SET_MAX_BR_TEMP	
520	SET_CONV_TYPE	
521	SET_QUADR_TYPE	
522	LANGUAGE	
523	CURR_ACT_FILT_TC	
524	PLL_CONTROL	
525	UNI_FILT_TC	
526	OFFSET_UDC	
527	CONV_TEMP_DELAY	
528	PLL_DEV_LIM	
601	DLOG.[IN1]	
602	DLOG.[IN2]	
603	DLOG.[IN3]	
604	DLOG.[IN4]	
605	DLOG.[IN5]	
606	DLOG.[IN6]	
607	DLOG.TRIGG_COND	
608	DLOG.TRIGG_VALUE	
609	DLOG.TRIGG_DELAY	
610	DLOG.SAMPL_INT	
611	DLOG.TRIG	
612	DLOG.STOP	
613	DLOG.RESTART	
801	DO1.[IN]	
802	DO1.[INV_IN]	
803	DO2.[IN]	
804	DO2.[INV_IN]	
805	DO3.[IN]	
806	DO3.[INV_IN]	
807	DO4.[IN]	
808	DO4.[INV_IN]	
809	DO5.[IN]	
810	DO5.[INV_IN]	
811	DO6.[IN]	
812	DO6.[INV_IN]	
813	DO7.[IN]	
814	DO7.[INV_IN]	
815	DO8.[IN]	
816	DO8.[INV_IN]	
901	[ON/OFF]	
902	[RUN1]	
903	[RUN2]	
904	[RUN3]	
905	[COAST_STOP]	
906	[EME_STOP]	
907	[RESET]	
908	[START_INHIBIT]	
909	[DISABLE_LOCAL]	
910	[ACK_CONV_FAN]	
911	[ACK_MOTOR_FAN]	
912	[ACK_MAIN_CONT]	
913	[MOTOR 2]	
914	FIELD_HEAT_SEL	
915	MAIN_CONT_MODE	
916	STOP_MODE	
917	EME_STOP_MODE	
918	PANEL_DISC_MODE	
919	PWR_LOSS_MODE	

No.	Parameter name	
920	COMFAULT_MODE	
921	COMFAULT_TIMEOUT	
1001	FIELD_MODE	
1002	[FLUX_REF]	
1003	[EMF_REF]	
1004	[FLUX_REF_SEL]	
1005	[EMF_REF_SEL]	
1006	LOCAL_EMF_REF	
1007	EMF_KP	
1008	EMF_KI	
1009	EMF_REG_LIM_P	
1010	EMF_REG_LIM_N	
1011	EMF_REL_LEV	
1012	FIELD_WEAK_POINT	
1013	FIELD_CONST_1	
1014	FIELD_CONST_2	
1015	FIELD_CONST_3	
1016	GENER.EMF_REF	
1017	GENER.WEAK_POINT	
1018	FIELD_WEAK_DELAY	
1101	USER_EVENT1.[IN]	
1102	USER_EVENT1.TYPE	
1103	USER_EVENT1.TEXT	
1104	USER_EVENT1.DLY	
1105	USER_EVENT2.[IN]	
1106	USER_EVENT2.TYPE	
1107	USER_EVENT2.TEXT	
1108	USER_EVENT2.DLY	
1109	USER_EVENT3.[IN]	
1110	USER_EVENT3.TYPE	
1111	USER_EVENT3.TEXT	
1112	USER_EVENT3.DLY	
1113	USER_EVENT4.[IN]	
1114	USER_EVENT4.TYPE	
1115	USER_EVENT4.TEXT	
1116	USER_EVENT4.DLY	
1117	USER_EVENT5.[IN]	
1118	USER_EVENT5.TYPE	
1119	USER_EVENT5.TEXT	
1120	USER_EVENT5.DLY	
1121	USER_EVENT6.[IN]	
1122	USER_EVENT6.TYPE	
1123	USER_EVENT6.TEXT	
1124	USER_EVENT6.DLY	
1201	DRIVEMODE	
1202	CMT_DCS500_ADDR	
1203	DRIVE_ID	
1204	POT1_VALUE	
1205	POT2_VALUE	
1206	PERIOD_BTW.POT1/2	
1207	WRITE_ENABLE_KEY	
1208	WRITE_ENABLE_PIN	
1209	SELECT_OPER.SYST.	
1210	ACTUAL VALUE 1	
1211	ACTUAL VALUE 2	
1212	ACTUAL VALUE 3	
1213	FIELDBUS NODE ADDR	
1214	MACRO_SELECT	
1215	DCF MODE	
1216	DI/OVP	
1217	OVP_SELECT	
1301	[F1_REF]	
1302	[F1_FORCE_FWD]	
1303	[F1_FORCE_REV]	
1304	[F1_ACK]	
1305	F1_CURR_GT_MIN_L	
1306	F1_OVERCURR_L	
1307	F1_CURR_TC	
1308	F1_KP	
1309	F1_KI	

List of parameters (with column for customer-specific values)

No.	Parameter name	
1310	F1_U_AC_DIFF_MAX	
1311	F1_U_LIM_N	
1312	F1_U_LIM_P	
1313	F1_RED.SEL	
1314	F1_RED.REF	
1315	OPTI.REF_GAIN	
1316	OPTI.REF_MIN_L	
1317	OPTI.REF_MIN_TD	
1318	REV.REV_HYST	
1319	REV.REF_HYST	
1320	REV.FLUX_TD	
1321	F1_CURR_MIN_TD	
1401	MOT1.[TEMP_IN]	
1402	MOT1.TEMP_ALARM_L	
1403	MOT1.TEMP_FAULT_L	
1404	[KLIXON_IN]	
1405	MODEL1.SEL	
1406	MODEL1.CURR	
1407	MODEL1.ALARM_L	
1408	MODEL1.TRIP_L	
1409	MODEL1.TC	
1501	[F2_REF]	
1502	F2_CURR_GT_MIN_L	
1503	F2_OVERCURR_L	
1504	F2_CURR_TC	
1505	F2_KP	
1506	F2_KI	
1507	F2_U_AC_DIFF_MAX	
1508	F2_U_LIM_N	
1509	F2_U_LIM_P	
1510	F2_RED.SEL	
1511	F2_RED.REF	
1601	MOT2.[TEMP_IN]	
1602	MOT2.TEMP_ALARM_L	
1603	MOT2.TEMP_FAULT_L	
1604	MODEL2.SEL	
1605	MODEL2.CURR	
1606	MODEL2.ALARM_L	
1607	MODEL2.TRIP_L	
1608	MODEL2.TC	
1701	RAMP.[IN]	
1702	RAMP.[RES_IN]	
1703	RAMP.[HOLD]	
1704	RAMP.[FOLLOW_IN]	
1705	RAMP.[FOLL_ACT]	
1706	RAMP.[RES_OUT]	
1707	RAMP.[T1/T2]	
1708	ACCEL1	
1709	DECEL1	
1710	SMOOTH1	
1711	ACCEL2	
1712	DECEL2	
1713	SMOOTH2	
1714	EMESTOP_RAMP	
1715	SPEEDMAX	
1716	SPEEDMIN	
1717	STARTSEL	
1718	ACC_COMP.MODE	
1719	ACC_COMP.TRMIN	
1720	RAMP.[SPEED_SET]	
1801	REF_SUM.[IN1]	
1802	REF_SUM.[IN2]	
1901	CONST_REF.[ACT1]	
1902	CONST_REF.[ACT2]	
1903	CONST_REF.[ACT3]	
1904	CONST_REF.[ACT4]	
1905	CONST_REF.DEF	
1906	CONST_REF.REF1	
1907	CONST_REF.REF2	
1908	CONST_REF.REF3	

No.	Parameter name	
1909	CONST_REF.REF4	
1910	REFSEL.[IN1]	
1911	REFSEL.[SEL1]	
1912	REFSEL.[IN2]	
1913	REFSEL.[SEL2]	
1914	REFSEL.[IN3]	
1915	REFSEL.[SEL3]	
1916	REFSEL.[ADD]	
1917	REFSEL.[REV]	
1918	SOFTPOT.[INCR]	
1919	SOFTPOT.[DECR]	
1920	SOFTPOT.[FOLLOW]	
1921	SOFTPOT.OHL	
1922	SOFTPOT.OLL	
1923	SOFTPOT.[ENABLE]	
2001	ERR.[IN]	
2002	ERR.[STEP]	
2003	ERR.[WIN_MODE]	
2004	ERR.WIN_SIZE	
2005	ERR.FRS	
2006	SPC.[IN]	
2007	SPC.[RINT]	
2008	SPC.[BAL]	
2009	SPC.[BALREF]	
2010	SPC.[BAL2]	
2011	SPC.[BAL2REF]	
2012	SPC.[HOLD]	
2013	SPC.DROOPING	
2014	SPC.KP	
2015	SPC.KPSMIN	
2016	SPC.KPSPOINT	
2017	SPC.KPSWEAKFILT	
2018	SPC.KI	
2019	SPC.TD	
2020	SPC.TF	
2021	ERR. [SPEED_ACT]	
2101	TACHOPULS_NR	
2102	SPEED_MEAS_MODE	
2103	SPEED_SCALING	
2104	SPEED_ACT_FTR	
2105	SPEED_ACT_FLT_FTR	
2201	MIN_SPEED_L	
2202	SPEED_L1	
2203	SPEED_L2	
2204	OVERSPEEDLIMIT	
2205	STALL.SEL	
2206	STALL.SPEED	
2207	STALL.TORQUE	
2208	STALL.TIME	
2209	MON.MEAS_LEV	
2210	MON.EMF_V	
2301	[SPC_TORQ_MAX]	
2302	[SPC_TORQ_MIN]	
2303	[TREF_TORQ_MAX]	
2304	[TREF_TORQ_MIN]	
2305	TORQ_MAX	
2306	TORQ_MIN	
2307	ARM_CURR_LIM_P	
2308	ARM_CURR_LIM_N	
2309	MAX_CURR_LIM_SPD	
2310	MAX_CURR_LIM_N1	
2311	MAX_CURR_LIM_N2	
2312	MAX_CURR_LIM_N3	
2313	MAX_CURR_LIM_N4	
2314	MAX_CURR_LIM_N5	
2315	GEAR.START_TORQ	
2316	GEAR.TORQ_TIME	
2317	GEAR.TORQ_RAMP	
2401	SEL1.[TREF_A]	
2402	SEL1.TREF_A_FTC	

No.	Parameter name	
2403	SEL1.[LOAD_SHARE]	
2404	SEL1.[TREF_B]	
2405	SEL1.TREF_B_SLOPE	
2406	SEL2.TREF_SEL	
2407	SEL2.[TREF_SPC]	
2408	SEL2.[TREF_EXT]	
2409	SEL2.[TORQ_STEP]	
2501	TASK1_EXEC_ORDER	
2502	TASK2_EXEC_ORDER	
2503	TASK3_EXEC_ORDER	
2504	FB_APPL_ENABLE	
2505	FB_TASK_LOCK	
2601-	Par. f. appl. func. blocks	
2701-	Par. f. appl. func. blocks	
2801-	Par. f. appl. func. blocks	
2901-	Par. f. appl. func. blocks	
3001-	Par. f. appl. func. blocks	
3101-	Par. f. appl. func. blocks	
3201-	Par. f. appl. func. blocks	
3301-	Par. f. appl. func. blocks	
3401-	Par. f. appl. func. blocks	
3601	REV_DELAY	
3602	REV_GAP	
3603	FREV_DELAY	
3604	IACT_SLAVE	
3605	DIFF_CURRENT	
3606	DIFF_CURR_DELAY	
3607	INHIB_Logic	
3608	IREF0_Logic	
3609	Bridge_Logic	
3610	Reverse.Logic	
3611	[X18:09]	
3612	[X18:10]	
3613	[X18:11]	
3614	[X18:12]	
3615	ADJ_REF1	
3616	BC-Logic	
3701-	Par. f. appl. func. blocks	
3801-	Par. f. appl. func. blocks	
3901-	Par. f. appl. func. blocks	
4001	FIELDBUS_PAR.1	
4002	FIELDBUS_PAR.2	
4003	FIELDBUS_PAR.3	
4004	FIELDBUS_PAR.4	
4005	FIELDBUS_PAR.5	
4006	FIELDBUS_PAR.6	
4007	FIELDBUS_PAR.7	
4008	FIELDBUS_PAR.8	
4009	FIELDBUS_PAR.9	
4010	FIELDBUS_PAR.10	
4011	FIELDBUS_PAR.11	
4012	FIELDBUS_PAR.12	
4013	FIELDBUS_PAR.13	
4014	FIELDBUS_PAR.14	
4015	FIELDBUS_PAR.15	

List of signals

No.	Parameter name
10101	AITAC:OUT+
10102	AITAC:OUT-
10103	AITAC:ERR
10104	AI1:OUT+
10105	AI1:OUT-
10106	AI1:ERR
10107	AI2:OUT+
10108	AI2:OUT-
10109	AI2:ERR
10110	AI3:OUT+
10111	AI3:OUT-
10112	AI3:ERR
10113	AI4:OUT+
10114	AI4:OUT-
10115	AI4:ERR
10116	AI5:OUT+
10117	AI5:OUT-
10118	AI5:ERR
10119	AI6:OUT+
10120	AI6:OUT-
10121	AI6:ERR
10122	DATASET1:OUT1
10123	DATASET1:OUT2
10124	DATASET1:OUT3
10125	DATASET3:OUT1
10126	DATASET3:OUT2
10127	DATASET3:OUT3
10301	TREF_OUT
10302	TREF_ENABLE
10303	DECEL_CMND
10304	LIFT_BRAKE
10305	BRAKE_RUN
10401	ARM_ALPHA
10402	ARM_DIR
10403	CURR_REF_IN_LIM
10404	CURR_DER_IN_LIM
10405	ARM_CURR_REF
10501	CONV_CURR_ACT
10502	ARM_CURR_ACT
10503	TORQUE_ACT
10504	U_NET_ACT
10505	U_ARM_ACT
10506	EMF_ACT
10507	BRIDGE_TEMP
10508	U_NET_DC_NOM_V
10509	I_CONV_A
10510	I_TRIP_A
10511	U_CONV_V
10512	MAX_BR_TEMP
10513	CONV_TYPE
10514	QUADR_TYPE
10515	LINE_FREQUENCY
10601	DLOG_STATUS
10701	DI1:O1
10702	DI1:O2
10703	DI2:O1
10704	DI2:O2
10705	DI3:O1
10706	DI3:O2
10707	DI4:O1
10708	DI4:O2
10709	DI5:O1
10710	DI5:O2
10711	DI6:O1
10712	DI6:O2
10713	DI7:O1
10714	DI7:O2
10715	DI8:O1
10716	DI8:O2
10717	DI9:O1
10718	DI9:O2
10719	DI10:O1
10720	DI10:O2
10721	DI11:O1
10722	DI11:O2
10723	DI12:O1
10724	DI12:O2
10725	DI13:O1
10726	DI13:O2
10727	DI14:O1
10728	DI14:O2
10729	DI15:O1

No.	Parameter name
10730	DI15:O2
10901	RDY_ON
10902	RDY_RUNNING
10903	RUNNING
10904	FAULT
10905	ALARM
10906	LOCAL
10907	EMESTOP_ACT
10908	FAN_ON
10909	FIELD_ON
10910	MAIN_CONT_ON
10911	TRIP_DC_BREAKER
10912	DYN_BRAKE_ON
10913	MOTOR_ACT
10914	AUTO-RECLOSING
10915	COMM_FAULT
10916	RUN_DCF
10917	RESET_DCF
11001	FLUX_REF1
11002	FLUX_REF_SUM
11003	F_CURR_REF
11101	FAULT_WORD_1
11102	FAULT_WORD_2
11103	FAULT_WORD_3
11104	ALARM_WORD_1
11105	ALARM_WORD_2
11106	ALARM_WORD_3
11107	LATEST_FAULT
11108	LATEST_ALARM
11109	OPERATING_HOURS
11201	COMMIS_STAT
11202	BACKUPSTOREMODE
11203	FEXC_STATUS
11204	TC_STATUS
11205	BC
11206	SQUARE_WAVE
11207	TEST_REF
11208	TEST_RELEASE
11209	TEST_REF_SEL
11210	FEXC1_CODE
11211	FEXC1_COM_STATUS
11212	FEXC1_COM_ERRORS
11213	FEXC2_CODE
11214	FEXC2_COM_STATUS
11215	FEXC2_COM_ERRORS
11216	CMT_COM_ERRORS
11217	CDI300_BAD_CHAR
11218	CNT_SW_VERSION
11219	CNT_BOOT_SW_VERSION
11220	FEXC1_SW_VERSION
11221	FEXC2_SW_VERSION
11222	PROGRAM_LOAD
11301	F1_CURR_REF
11302	F1_CURR_ACT
11303	REF_DCF
11401	MOT1_MEAS_TEMP
11402	MOT1_CALC_TEMP
11501	F2_CURR_REF
11502	F2_CURR_ACT
11601	MOT2_MEAS_TEMP
11602	MOT2_CALC_TEMP
11701	RAMP:OUT
11702	ACCELCOMP:OUT
11703	RAMP:SIGN
11801	SPEED_REFERENCE
11802	REF_SUM:OUT
11803	LOCAL_SPEED_REF
11901	CONST_REF:OUT
11902	CONST_REF:ACT
11903	REF_SEL:OUT
11904	SOFT_POT:OUT
11905	SOFT_POT:ACT
12001	ERR:OUT
12002	ERR:OUT_OF_WIN
12003	ERR:STEP_RESP
12004	SPC:OUT
12005	SPC:IN_LIM
12101	SPEED_ACT_EMF
12102	SPEED_ACT
12103	SPEED_ACT_FILT
12104	TACHO_PULSES
12201	MIN_SPEED

No.	Parameter name
12202	SPEED_GT_L1
12203	SPEED_GT_L2
12204	OVERSPEED
12301	SPC_TORQMAX1
12302	SPC_TORQMIN1
12303	TREF_TORQMAX1
12304	TREF_TORQMIN1
12305	TORQMAX2
12306	TORQMIN2
12307	CURR_LIM_P
12308	CURR_LIM_N
12401	SEL1:OUT
12402	SEL2:OUT
12403	SEL2:TORQ/SPEED
12404	SEL2:IN_LIM
12501	CONSTANT 0
12502	CONSTANT -1
12503	CONSTANT 1
12504	CONSTANT 2
12505	CONSTANT 10
12506	CONSTANT 100
12507	CONSTANT 1000
12508	CONSTANT 31416
12509	EMF: 100%
12510	TORQ: 100%
12511	TORQ -100%
12512	CUR,FLX,VLT 100%
12513	CUR,FLX,VLT -100%
12514	SPEED: 100%
12515	SPEED: -100%
12516	SIG1(SPEED REF)
12517	SIG2(SPEED STEP)
12518	SIG3(TORQ. REF A)
12519	SIG4(TORQ. REF B)
12520	SIG5(TORQUE STEP)
12521	SIG6(LOAD SHARE)
12522	SIG7(FLUX REF)
12523	SIG8(EMF REF)
12524	SIG9(FORCE FWD)
12525	SIG10(FORCE REV)
12526	SIG11(CURR. REF)
12527	SIG12(CURR. STEP)
12601-12699	Signals for application function blocks
12701-12799	Signals for application function blocks
12801-12899	Signals for application function blocks
12901-12999	Signals for application function blocks
13001-13013	Signals for application function blocks
13501	STATUS_WORD
13502	LTIME
13503	LDATE
13601	Conv.Curr.Slave
13602	Arm.Curr.Slave
13603	Conv.Curr.Both
13604	Arm.CURR.Both
13605	Curr.-Ref.1
13606	IREF1-Polarity
13607	IREF1-Pol.Master
13608	Curr.-Ref.2
13609	IREF2-Polarity
13610	IREF2-Pol.Broth.
13611	Bridge
13612	Bridge of Slave
13613	Indicat.Revers.
13614	Fault Reversion
13615	Fault Current
13616	Logik f.INHIBIT
13617	Input X18:13
13618	Input X18:14
13619	Input X18:15
13620	Input X18:16
13621	BC not Zero
13622	Reserved f.Commun
13801-13819	Function for application winder
13901-13912	Function for application winder

DC Drives Product Portfolio

DCS 400

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

DCS 500B / DCS 600

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

DCE 500 / DCE 600

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

DCS 400 / DCS 500 Easy Drive

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

DCA 500 / DCA 600

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

ABB Automation Products GmbH
Postfach 1180
68619 Lampertheim • GERMANY
Telefon +49(0) 62 06 5 03-0
Telefax +49(0) 62 06 5 03-6 09
www.abb.com/dc

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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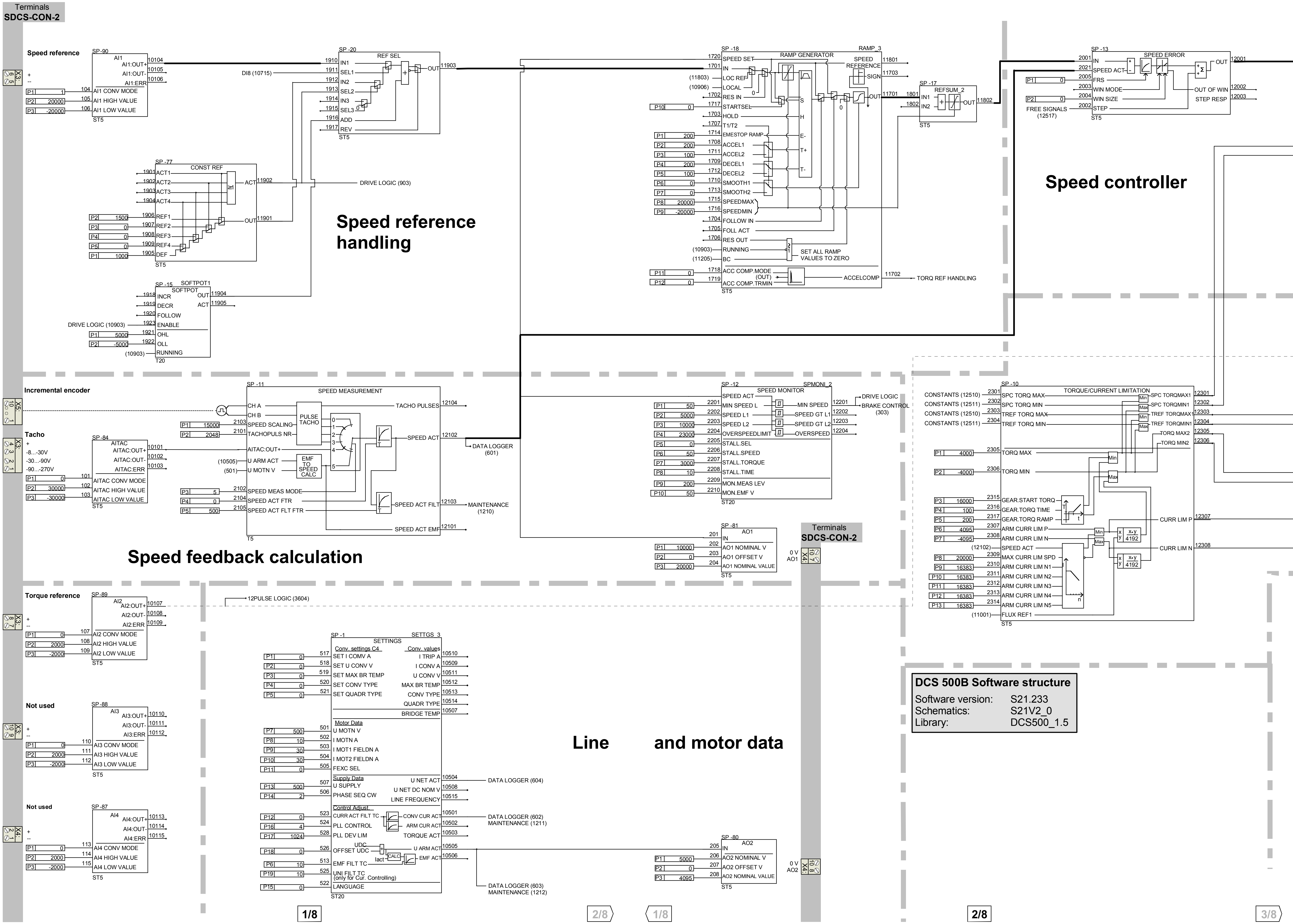

Terminals
SDCS-CON-2
Speed reference
SP-90 AI1
AI1:OUT+ 10104
AI1:OUT- 10105
AI1:ERR 10106
104 AI1 CONV MODE
105 AI1 HIGH VALUE
106 AI1 LOW VALUE
SP-20 REF SEL
1910 IN1
1911 SEL1
1912 IN2
1913 SEL2
1914 IN3
1915 SEL3
1916 ADD
1917 REV
OUT 11903
DI8 (10715)
SP-77 CONST REF
1901 ACT1
1902 ACT2
1903 ACT3
1904 ACT4
1906 REF1
1907 REF2
1908 REF3
1909 REF4
1905 DEF
ACT 11902
OUT 11901
DRIVE LOGIC (903)
SP-15 SOFTPOT1
1918 INCR
1919 DECR
1920 FOLLOW
1923 ENABLE
1921 OHL
1922 OLL
RUNNING
OUT 11904
ACT 11905
DRIVE LOGIC (10903)
Speed reference handling
SP-18 RAMP GENERATOR RAMP_3
1720 SPEED SET
1701 IN
LOC REF
LOCAL
1702 RES IN
1717 STARTSEL
1703 HOLD
1707 T1/T2
1714 EMESTOP RAMP
1708 ACCEL1
1711 ACCEL2
1709 DECEL1
1712 DECEL2
1710 SMOOTH1
1713 SMOOTH2
1715 SPEEDMAX
1716 SPEEDMIN
1704 FOLLOW IN
1705 FOLL ACT
1706 RES OUT
RUNNING
BC
SET ALL RAMP VALUES TO ZERO
1718 ACC COMP.MODE
1719 ACC COMP.TRMIN
ACCELCOMP 11702
TORQ REF HANDLING
SPEED REFERENCE 11801
SIGN 11703
OUT 11701
SP-17 REFSUM_2
1801 IN1
1802 IN2
OUT 11802
SP-13 SPEED ERROR
2001 IN
2021 SPEED ACT
2005 FRS
2003 WIN MODE
2004 WIN SIZE
2002 STEP
FREE SIGNALS (12517)
OUT 12001
OUT OF WIN 12002
STEP RESP 12003
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Incremental encoder
Tacho
-8...-30V
-30...-90V
-90...-270V
SP-84 AITAC
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AITAC:OUT- 10102
AITAC:ERR 10103
101 AITAC CONV MODE
102 AITAC HIGH VALUE
103 AITAC LOW VALUE
SP-11 SPEED MEASUREMENT
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CH B
2103 SPEED SCALING
2101 TACHOPULS NR
AITAC:OUT+
U ARM ACT
U MOTN V
PULSE TACHO
EMF TO SPEED CALC
2102 SPEED MEAS MODE
2104 SPEED ACT FTR
2105 SPEED ACT FLT FTR
TACHO PULSES 12104
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SPEED ACT FILT 12103
SPEED ACT EMF 12101
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2201 MIN SPEED L
2202 SPEED L1
2203 SPEED L2
2204 OVERSPEEDLIMIT
2205 STALL.SEL
2206 STALL.SPEED
2207 STALL.TORQUE
2208 STALL.TIME
2209 MON.MEAS LEV
2210 MON.EMF V
MIN SPEED 12201
SPEED GT L1 12202
SPEED GT L2 12203
OVERSPEED 12204
DRIVE LOGIC
BRAKE CONTROL (303)
SP-81 AO1
201 IN
202 AO1 NOMINAL V
203 AO1 OFFSET V
204 AO1 NOMINAL VALUE
SP-10 TORQUE/CURRENT LIMITATION
CONSTANTS (12510) 2301 SPC TORQ MAX
CONSTANTS (12511) 2302 SPC TORQ MIN
CONSTANTS (12510) 2303 TREF TORQ MAX
CONSTANTS (12511) 2304 TREF TORQ MIN
2305 TORQ MAX
2306 TORQ MIN
2315 GEAR.START TORQ
2316 GEAR.TORQ TIME
2317 GEAR.TORQ RAMP
2307 ARM CURR LIM P
2308 ARM CURR LIM N
SPEED ACT
2309 MAX CURR LIM SPD
2310 ARM CURR LIM N1
2311 ARM CURR LIM N2
2312 ARM CURR LIM N3
2313 ARM CURR LIM N4
2314 ARM CURR LIM N5
FLUX REF1
SPC TORQMAX1 12301
SPC TORQMIN1 12302
TREF TORQMAX1 12303
TREF TORQMIN1 12304
TORQ MAX2 12305
TORQ MIN2 12306
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SP-89 AI2
AI2:OUT+ 10107
AI2:OUT- 10108
AI2:ERR 10109
107 AI2 CONV MODE
108 AI2 HIGH VALUE
109 AI2 LOW VALUE
12PULSE LOGIC (3604)
Not used
SP-88 AI3
AI3:OUT+ 10110
AI3:OUT- 10111
AI3:ERR 10112
110 AI3 CONV MODE
111 AI3 HIGH VALUE
112 AI3 LOW VALUE
Not used
SP-87 AI4
AI4:OUT+ 10113
AI4:OUT- 10114
AI4:ERR 10115
113 AI4 CONV MODE
114 AI4 HIGH VALUE
115 AI4 LOW VALUE
SP-1 SETTINGS SETTGS_3
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517 SET I CONV A
518 SET U CONV V
519 SET MAX BR TEMP
520 SET CONV TYPE
521 SET QUADR TYPE
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501 U MOTN V
502 I MOTN A
503 I MOT1 FIELDN A
504 I MOT2 FIELDN A
505 FEXC SEL
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507 U SUPPLY
506 PHASE SEQ CW
U NET ACT 10504
U NET DC NOM V 10508
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523 CURR ACT FILT TC
524 PLL CONTROL
528 PLL DEV LIM
526 OFFSET UDC
513 EMF FILT TC
525 UNI FILT TC (only for Cur. Controlling)
522 LANGUAGE
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ARM CUR ACT 10502
TORQUE ACT 10503
U ARM ACT 10505
EMF ACT 10506
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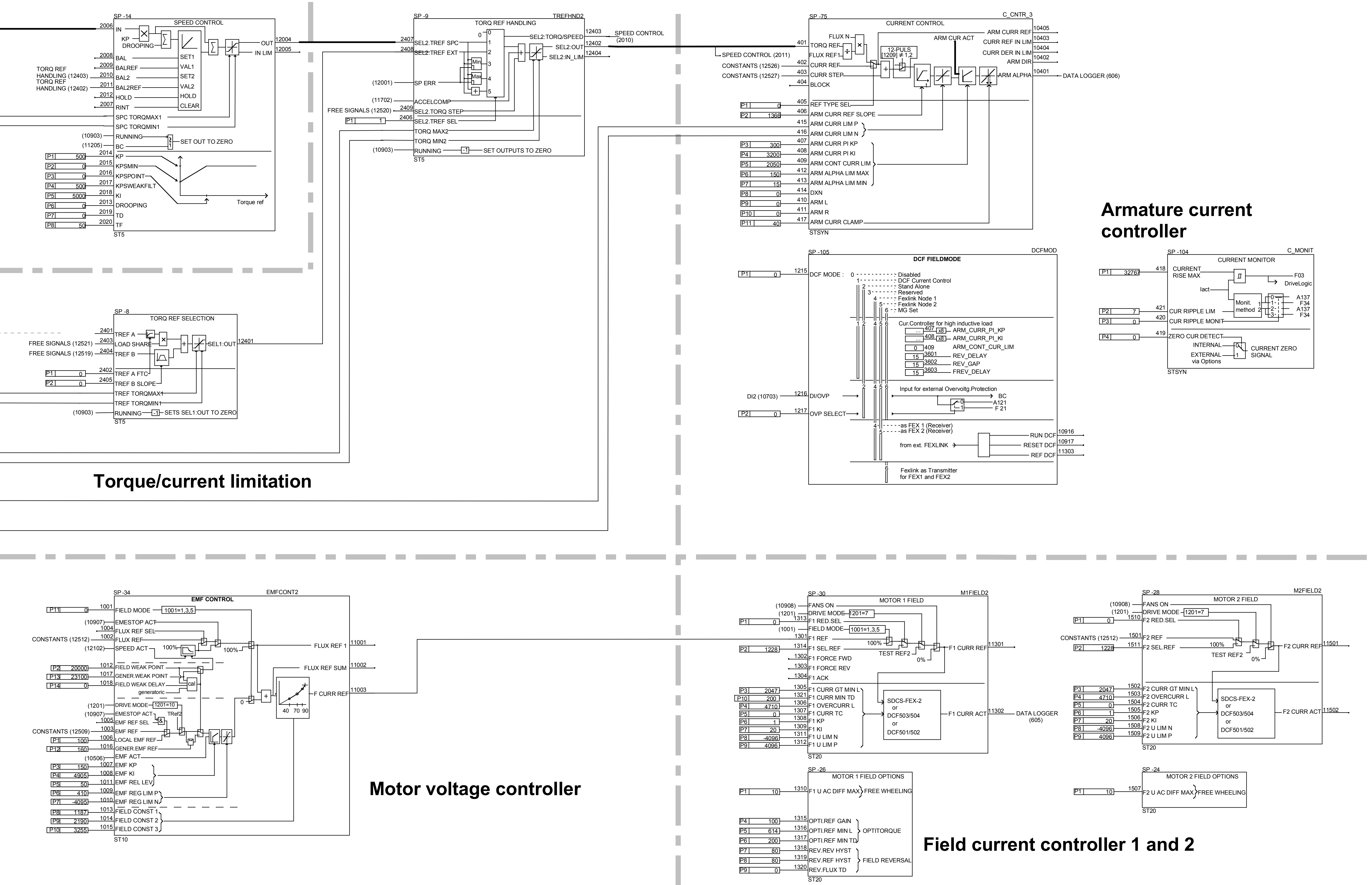
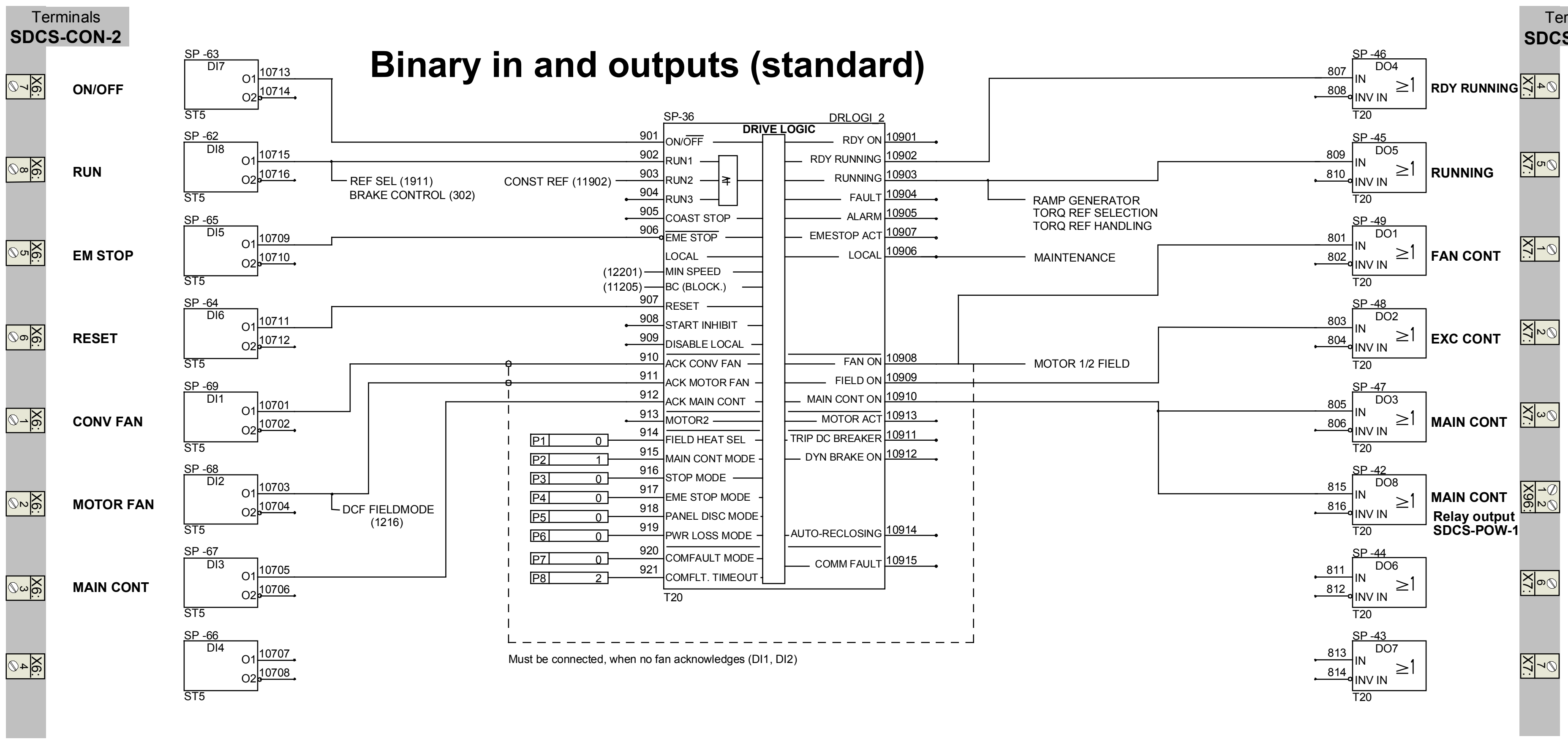
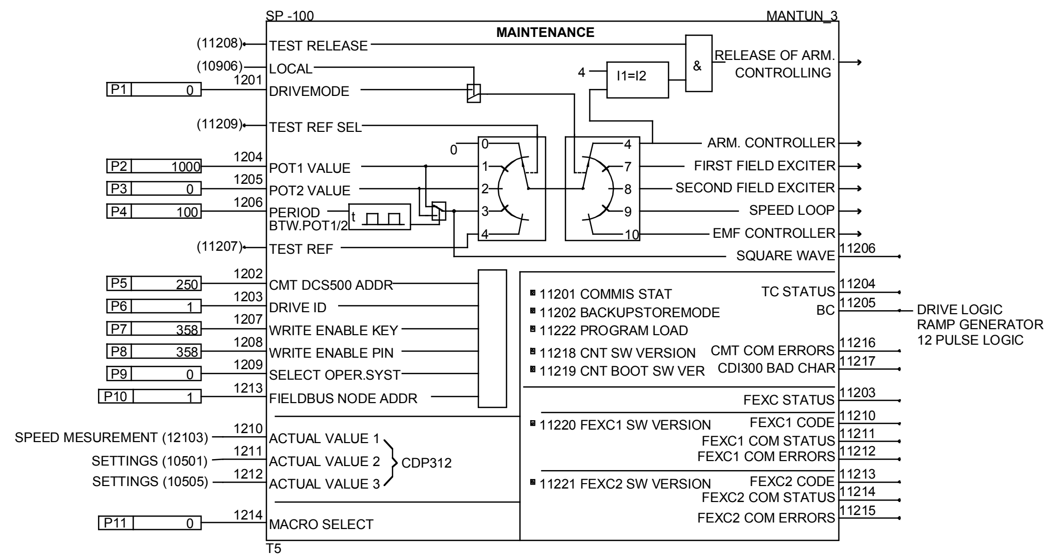
MAINTENANCE (1211)
DATA LOGGER (603)
MAINTENANCE (1212)
SP-80 AO2
205 IN
206 AO2 NOMINAL V
207 AO2 OFFSET V
208 AO2 NOMINAL VALUE
Line and motor data
DCS 500B Software structure
Software version: S21.233
Schematics: S21V2_0
Library: DCS500_1.5
1/8
2/8
3/8


SPEED CONTROL
TORQ REF HANDLING
CURRENT CONTROL
TORQ REF SELECTION
DCF FIELDMODE
CURRENT MONITOR
Torque/current limitation
Armature current controller
EMF CONTROL
MOTOR 1 FIELD
MOTOR 2 FIELD
MOTOR 1 FIELD OPTIONS
MOTOR 2 FIELD OPTIONS
Motor voltage controller
Field current controller 1 and 2

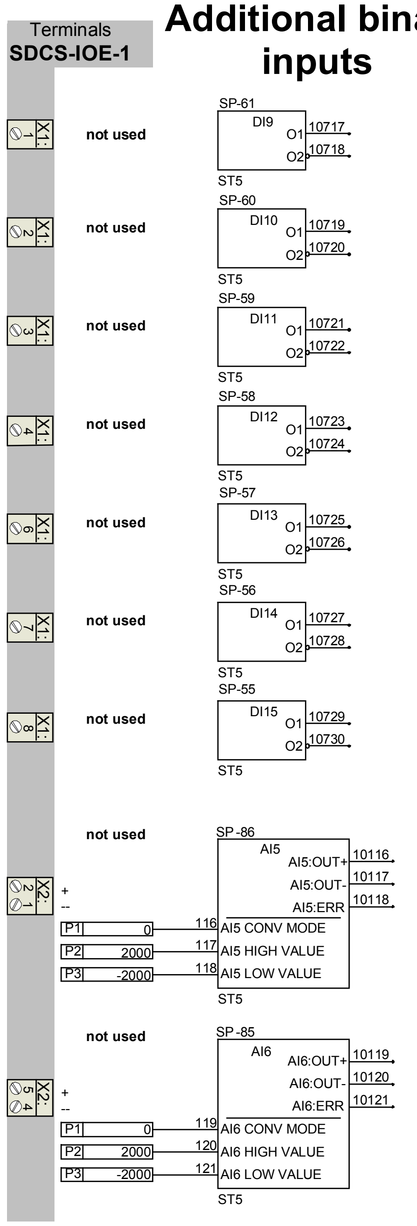
Binary in and outputs (standard)



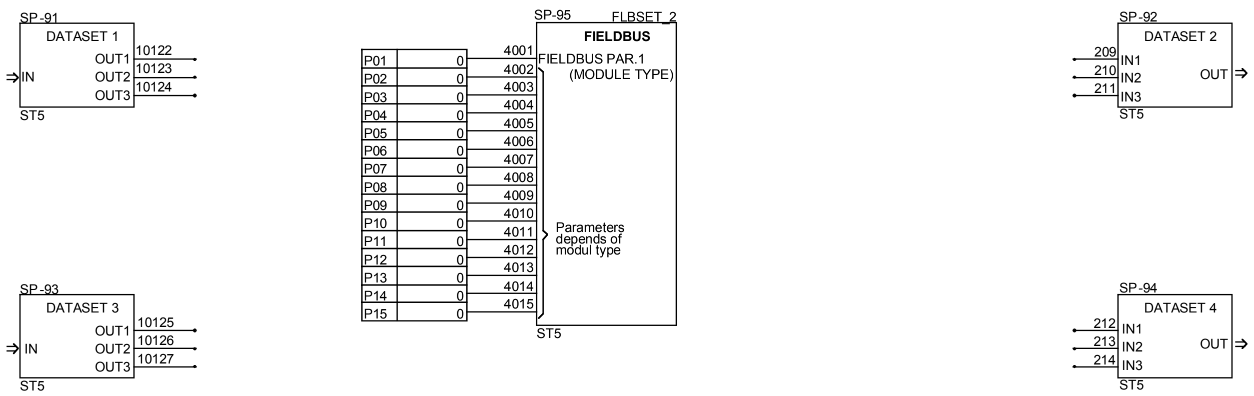


Maintenance

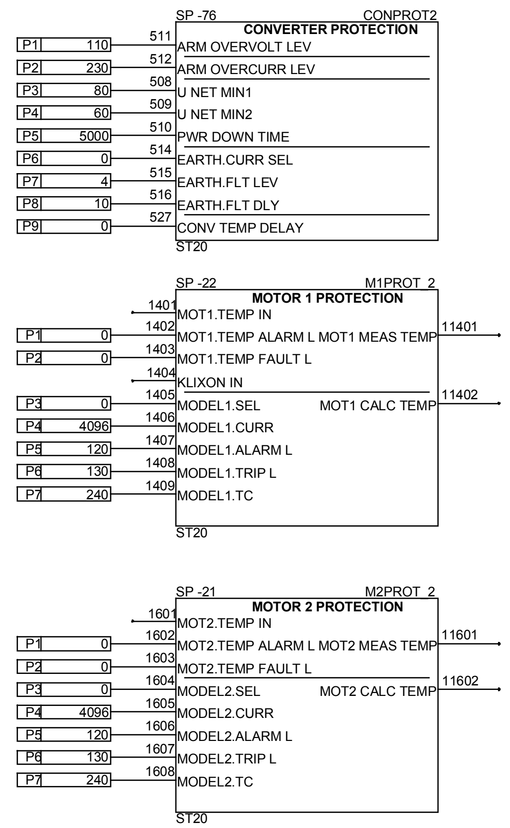
Additional binary inputs



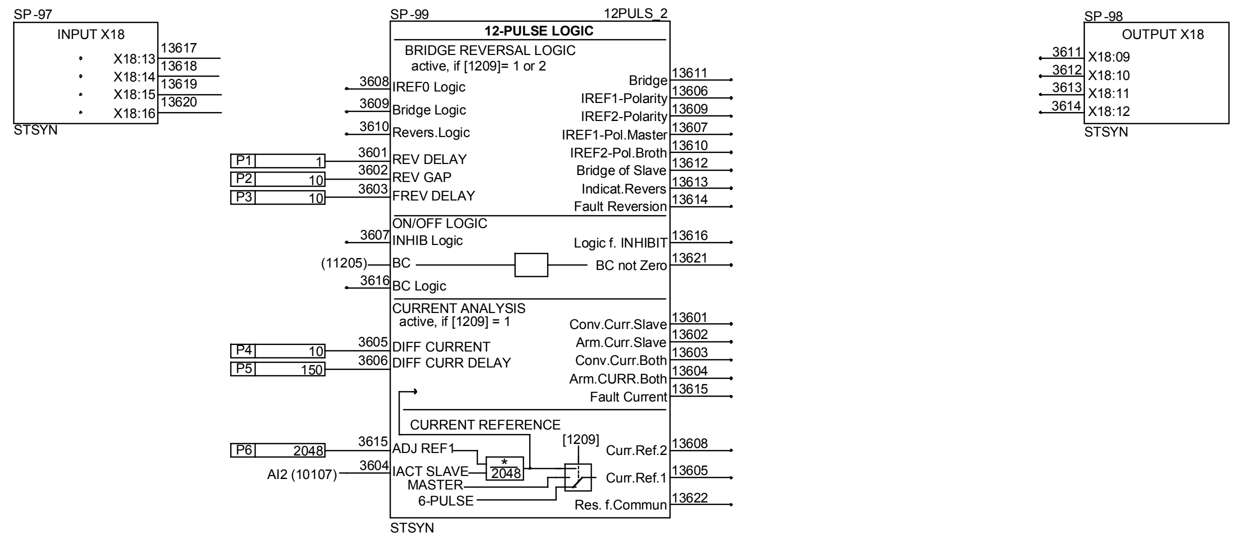
Inputs and outputs for fieldbus

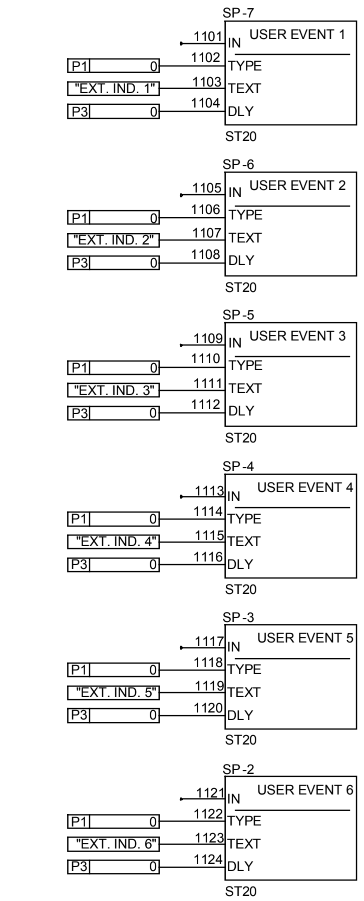


Monitoring



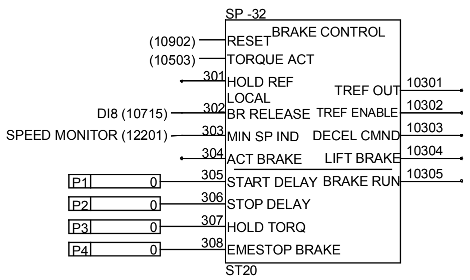
Inputs and outputs for 12 pulse

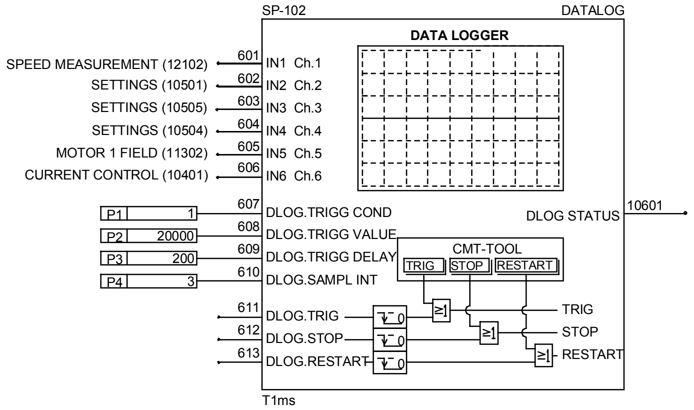




User events

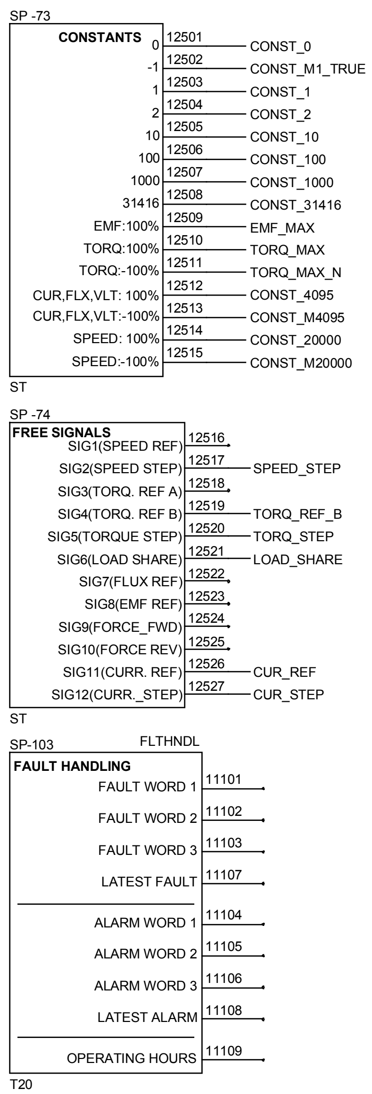
Brake control





Data logger

Additional signals



Speed reference handling

The speed reference for the ramp function generator is formed by the REF SEL blocks, which can be used to select the reference value required, the CONST REF block, which generates a maximum of 4 permanently settable reference values, the SOFTPOT block, which reproduces the function of a motorpotentiometer in conjunction with the block RAMP GENERATOR, or by the AI1 block (analogue input 1).
The RAMP GENERATOR block contains a ramp function generator with 2 ramp-up and ramp-down ramps, 2 times for the S-curve, limitation for upper and lower limits, hold function and the functions for "Follow" the speed reference or "Follow" the speed feedback. There is a special signal available for the treatment of acceleration and deceleration.
The REF SUM block enables the output of the ramp function generator and a user-definable signal to be added.

Speed feedback calculation

This page depicts the conditioning routine for speed feedback and reference values. The AITAC block is used to read in the speed feedback from an analogue tacho The SPEED MEASUREMENT block processes the 3 possible feedback signals: analogue tacho, pulse generator or the converter's output voltage (SPEED_ACT_EMF) - conditioned by the EMF TO SPEED CALC block **(if 2102=5 , no field weakening function possible)**. Parameters are used for activating smoothing functions, selecting the feedback value and where applicable for setting the maximum speed. This parameter also serves for scaling the speed control loop.
The SPEED MONITOR block contains motor stalled - and tacho monitoring function, and compares a selected speed feedback value against overspeed, minimum speed and 2 settable thresholds.
The AO1 block represents a scalable analogue output.

Speed controller

The result is compared to the speed feedback from the SPEED MEASUREMENT block, using the SPEED ERROR block, and then passed to the speed controller. This block permits evaluation of the system deviation by means of a filter. Moreover, it is possible here to make a few settings which are needed for the "Window" operating mode. If the drive's speed feedback is within a window around the reference value, then the speed controller is "bypassed" (provided "Window Mode" has been activated; the drive is controlled by means of a torque reference value at the TORQ REF HANDLING block). If the speed feedback is outside the window, the speed controller will be activated, and will lead the drive's actual speed back into the window.
The SPEED CONTROL block contains the speed controller with P, I and DT1 contents. For adaptation it receives a variable P-amplification.

Torque / current limitation

The "torque reference" generated by the speed controller is passed to the input of the CURRENT CONTROL block via the TORQ REF HANDLING block, and there it is converted into a current reference value and used for current regulation. The TORQUE / CURRENT LIMITATION block is used for generating the various reference values and limitations; this block contains the following functions: "speed-dependent current limitation", "gear backlash compensation", "generation of the values for static current limitation" and "torque limitation". The values for the various limitations are used again at some other points, for instance at the following blocks: SPEED CONTROL, TORQ REF HANDLING, TORQ REF SELECTION, and CURRENT CONTROL.
The AI2 block (analogue input 2) is used for reading in an analogue signal.
The TORQ REF SELECTION block contains a limitation with upstream addition of two signals, one of which can be routed through a ramp function generator; the other signal's evaluation can be dynamically altered using a multiplier.
The TORQ REF HANDLING block determines the drive's operating mode. When in position 1, the speed control mode has been activated, whereas in position 2 it is torque control mode (no closed-loop control since there is no "genuine" torque feedback available in the unit). In both cases, the reference value required comes from outside. Positions 3 and 4 are a combination of the first two options stated above. Note that with position 3 the smaller value out of external torque reference and speed controller output is passed to the current controller whereas with position 4 it is the larger one. Position 5 uses both signals, corresponding to the method of functioning of "Window Mode".

Armature current controller

The CURRENT CONTROL block contains the current controller with a P and I content, plus an adaptation in the range of discontinuous current flow. This block also contains functions for current-rise limitation, the conversion of torque reference value into current reference value by means of the field crossover point, and some parameters describing the supply mains, and the load circuit.
At applications with high inductive load and high dynamic performance a different hardware is used to generate the signal current equal to zero. This hardware is selected by the CURRENT MONITOR block. The functions monitoring the current can now be adapted to the needs of the application. This gives easier handling and a higher degree of safety at high performance drives, like test rigs.
The DCF mode can be activated via the block DCF FIELDMODE. The functionality within this mode can be specified. If one of these functions is selected the current controller gets a different characteristic, the overvoltage protection DCF 506 is monitored and the field current reference via the X16: terminals is routed.

Line and motor data

The SETTINGS block serves for scaling all important signals, such as line voltage, motor voltage, motor current and field current. Parameters are available to adjust the control to special conditions like weak networks or interactions with harmonic filter systems. The language, in which you want to read your information on the panel, can be selected.
The AO2 block represents a scalable analogue output.

Motor voltage controller

The EMF CONTROL block contains the armature-circuit voltage controller (e.m.f. controller). It is based on a parallel structure comprising a PI controller and a precontrol feature, generated with a characteristic of 1/x. The ratio between the two paths can be set. The output variable of this block is the field current reference value, which is produced from the flux reference value by another characteristic function using linearization. To enable the drive to utilize a higher motor voltage even with a 4 quadrant system two different field weakening points can be set by parameter.

Field current controller 1 and 2

Since a DCS power converter can control 2 field units, some of the function blocks are duplicated. This means that, depending on the mechanical configuration of the drives concerned, you can control 2 motors either in parallel or alternatively. The requisite configuration of the software structure can be generated by designing the blocks appropriately during the commissioning routine.
The MOTOR1 FIELD / MOTOR2 FIELD block reads in the field current reference value and all values which are specific to the field supply unit, and transfers these to the field power converter via an internal serial link; the field power converter is scaled to suit its hardware, and performs field current regulation. The field current direction for motor 1 can be determined using binary commands, while for motor 2 it can be generated in the course of an application upstream of the block concerned.
The MOTOR1 FIELD OPTIONS / MOTOR2 FIELD OPTIONS block controls the freewheeling function in the event of line undervoltage, and the field current reversal function with field reversal drives (only for motor 1). In case of field reversal drives, there is an option for selectively influencing the moment of armature-circuit and field current reduction and build-up.

Binary in and outputs (standard)

The DRIVE LOGIC block reads in various signals from the system via digital inputs DIx, processes them, and generates commands, which are outputted to the system via digital outputs DOx, e.g. for controlling the power converter's line contactor, the field-circuit contactor or contactors for various fans, or for outputting status messages.

Additional binary inputs

The AI3 and AI4 blocks represent another 2 analogue inputs which have as yet not been assigned to any particular functions. The blocks A15 and A16 represent another 2 additional inputs which are only active, if the board SDCS-IOE1 is connected. Another 7 digital inputs DI 9 .. DI15 are available with this additional hardware.

Inputs and outputs for fieldbus

A fieldbus module with serial communicated references should be used, if analogue and digital signals are not sufficient for the control of the drive (equipment for the installation of Profibus, CS31, Modbus etc. is available). This type of module is activated by means of the block FIELDBUS. The data transferred from the control to the converter are stored in the blocks DATASET1 and DATASET3 as 16-bit-information. Depending on the application the output pins of these blocks have to be connected to input pins of other blocks in order to transport the message. The same procedure is valid for blocks DATASET2 and DATASET4, if they are connected. These blocks are transmitting information from the converter to the control system.

Inputs and outputs for 12 pulse

The converter is able to be configurated in a 12-pulse parallel application. In this case you need: two identical armature converters; one field supply unit; one T-reactor; communication via ribbon cable connected to X 18 of both converters The 12-PULSE LOGIC must be activated and guarantees a synchronous control of the MASTER and the SLAVE drive.

Maintenance

The MAINTENANCE block provides reference values and test conditions so as to enable all controllers to be adjusted in the power converter. If the panel is used as a meter in the cubicle door, an assortment of signals can be defined here.

Monitoring

The CONVERTER PROTECTION block monitors the armature circuit for overvoltage and overcurrent, and monitors the mains for undervoltage. It provides an option for reading in the total current of the 3 phases through an additional external sensor and monitoring it for "not equal to zero". Adaptations are made for rebuild applications, which keep the power part and the fan, to sense overload conditions or fan failures.
The MOTOR1 PROTECTION block, in its upper part, evaluates either the signal from an analogue temperature sensor, or from a Klixon. In its lower part, it computes motor heat-up with the aid of the current feedback value and a motor model, after which a message is outputted.
The MOTOR2 PROTECTION block works in the same way as the MOTOR1 PROTECTION block, but without Klixon evaluation.

User event

By using the block USER EVENT1 to USER EVENT6 six different messages are created, which are displayed as faults or alarms on the panel CDP312 as well as on the 7 segment display of the converter.

Brake control

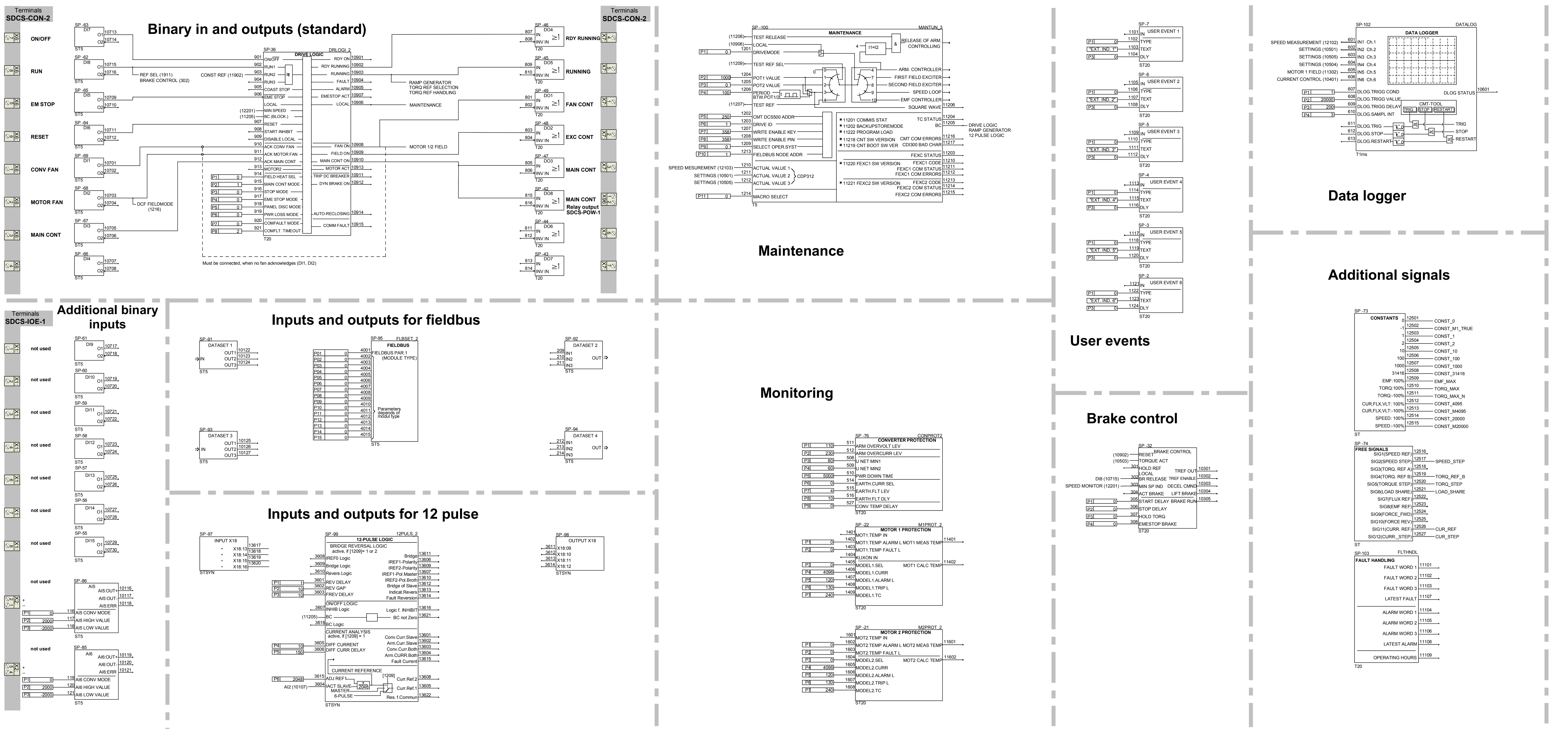
The BRAKE CONTROL block generates all signals needed for controlling a mechanical brake.

Data logger

The block DATA LOGGER is able to record up to six signals. The values of these signals will be stored in a battery buffered RAM and are still available after a break down of the supply voltage. The time of recording can be influenced by a trigger signal, as well as the number of recorded values before and after the trigger signal. The function DATA LOGGER can be set with both panel and PC tool. For evaluation of the recorded values a PC tool is recommended.

Additional signals

By using the block FAULT HANDLING the faults and alarms of the drive are regrouped as 16-bit information. The CONSTANTS and FREE SIGNALS blocks can be used for setting limitations or special test conditions.



Speed reference handling
The speed reference for the ramp function generator is formed by the REF SEL blocks, which can be used to select the reference value required, the CONST REF block, which generates a maximum of 4 permanently settable reference values, the SOFTPOT block, which reproduces the function of a motorpotentiometer in conjunction with the block RAMP GENERATOR, or by the AI1 block (analogue input 1).
The RAMP GENERATOR block contains a ramp function generator with 2 ramp-up and ramp-down ramps, 2 times for the S-curve, limitation for upper and lower limits, hold function and the functions for ”Follow” the speed reference or ”Follow” the speed feedback. There is a special signal available for the treatment of acceleration and deceleration.
The REF SUM block enables the output of the ramp function generator and a user-definable signal to be added.

Speed feedback calculation
This page depicts the conditioning routine for speed feedback and reference values. The AITAC block is used to read in the speed feedback from an analogue tacho The SPEED MEASUREMENT block processes the 3 possible feedback signals: analogue tacho, pulse generator or the converter's output voltage (SPEED_ACT_EMF) - conditioned by the EMF TO SPEED CALC block **(if 2102=5 , no field weakening function possible)**. Parameters are used for activating smoothing functions, selecting the feedback value and where applicable for setting the maximum speed. This parameter also serves for scaling the speed control loop.
The SPEED MONITOR block contains motor stalled - and tacho monitoring function, and compares a selected speed feedback value against overspeed, minimum speed and 2 settable thresholds.
The AO1 block represents a scalable analogue output.

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The result is compared to the speed feedback from the SPEED MEASUREMENT block, using the SPEED ERROR block, and then passed to the speed controller. This block permits evaluation of the system deviation by means of a filter. Moreover, it is possible here to make a few settings which are needed for the ”Window” operating mode. If the drive’s speed feedback is within a window around the reference value, then the speed controller is ”bypassed” (provided ”Window Mode” has been activated; the drive is controlled by means of a torque reference value at the TORQ REF HANDLING block). If the speed feedback is outside the window, the speed controller will be activated, and will lead the drive’s actual speed back into the window.
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