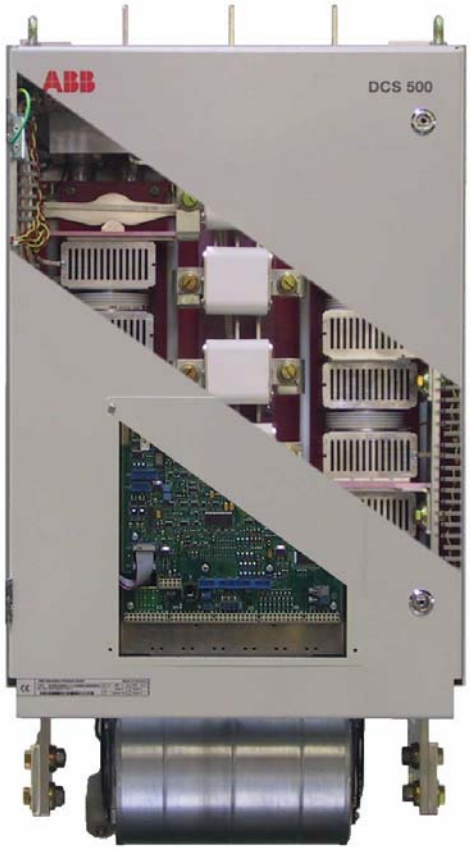
DCS Thyristor Power Converters

for DC drive systems

25 to 5200 A

Technical Data

DCS 400
DCS 500B
DCS 600
DCF 500B
DCF 600



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8 Field exciters

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

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

8.1 SDCS-FEX-1 (internal)

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

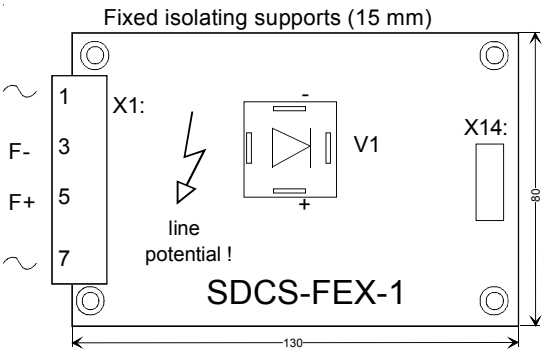

Fig. 8.1/1 Layout of the SDCS-FEX-1 field exciter board

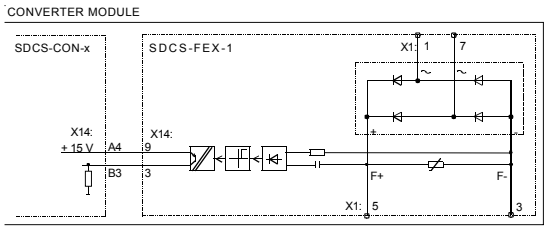

Fig. 8.1/2 Diode field exciter with field loss monitoring

8.1.1 Electrical data of FEX-1

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

The AC share of the output DC voltage is measured with a capacitor and an auxiliary rectifier and used for current monitoring.
Transistor relay is closed when the DC current is flowing (>0.02 A).

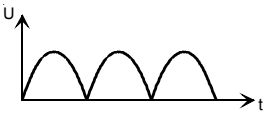

Fig. 8.1/3 Output voltage with inductive or resistive load - **High-signal at X14:B3**

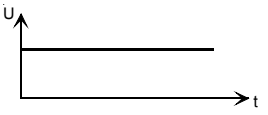

Fig. 8.1/4 Output voltage without load
Low-signal at X14:B3

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

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

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

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

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

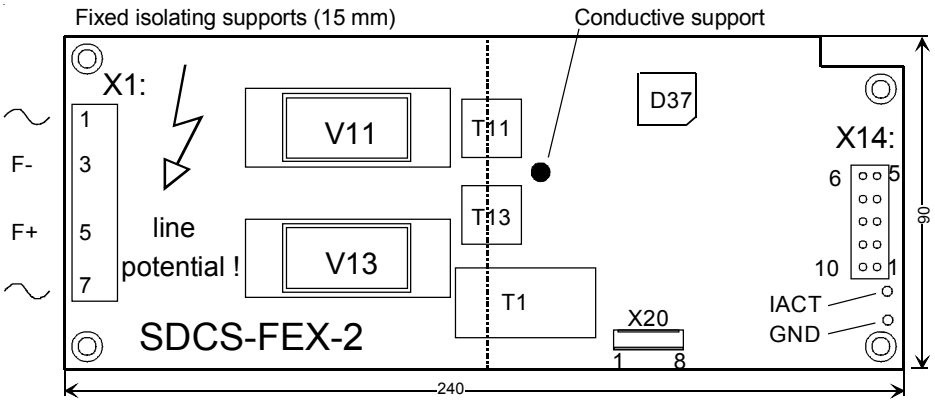

Fig. 8.2/1 Layout of the SDCS-FEX-2A field exciter board

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

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

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

8.2.2 Control unit

The control unit includes the following main blocks:

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

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

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

The terminal row X20: is used for test purposes.

8.2.3 Power section

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

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

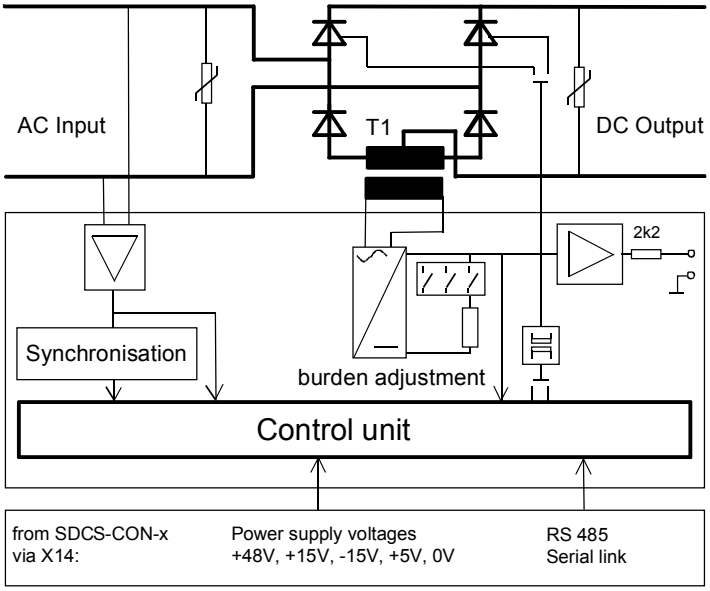

Fig. 8.2/2 Block diagram of the field exciter SDCS-FEX-2A

8.3.6 Field exciter configurations

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

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

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

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

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

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

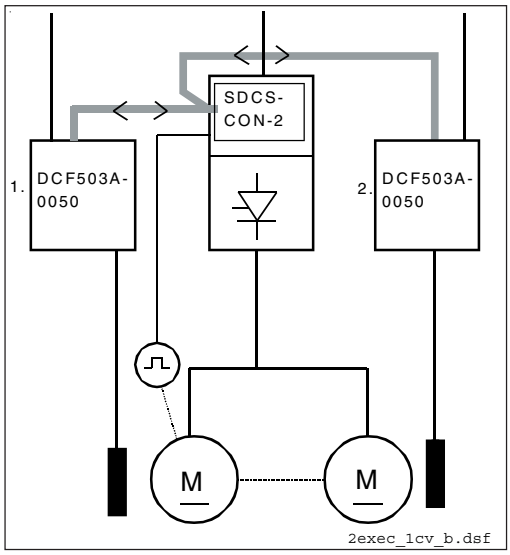

Fig. 8.3/4 Typical application example with two field exciter units and one converter (without field weakening).

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

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

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

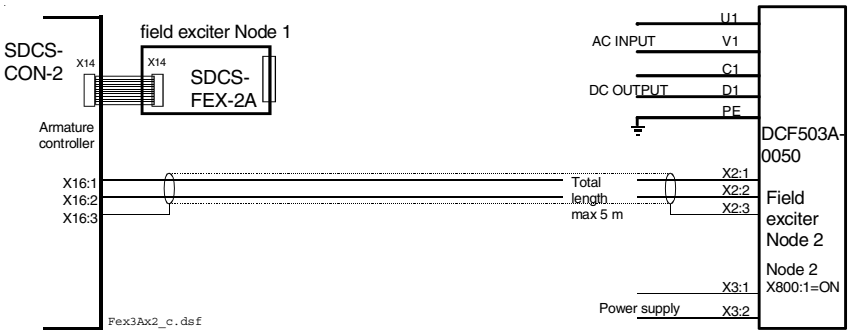

Fig. 8.3/5 Serial communication cable connection and address setting for Node 1 and field exciter Node 2, using SDCS-FEX-2A and DCF50xA-0050

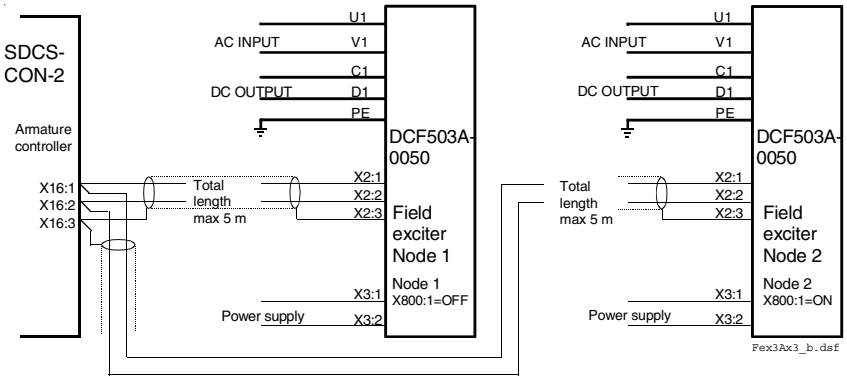

Fig. 8.3/6 Serial communication cable connection