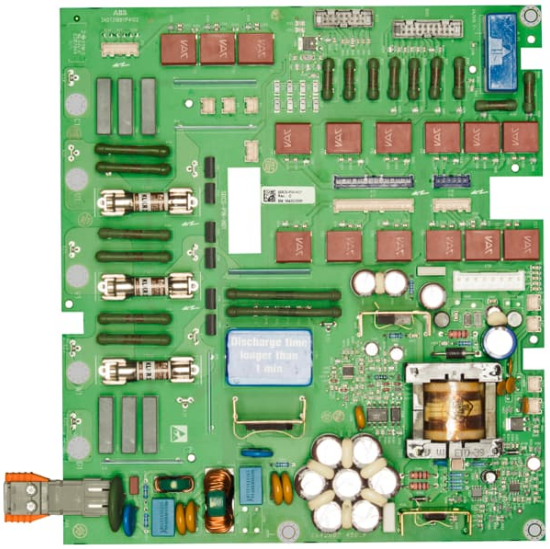
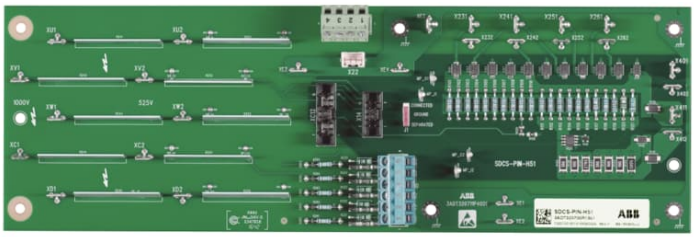
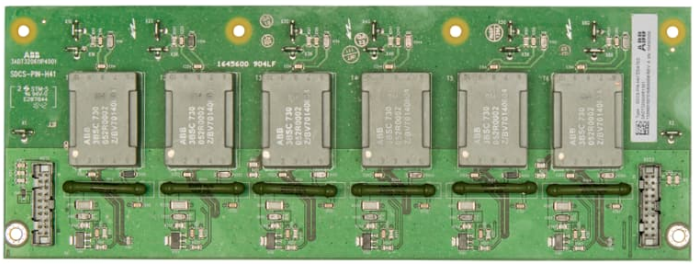
DC DRIVES

ABB industrial drives

DCS880 Drives - Service manual







DCS880 Drive Manuals

Name	Publication number	EN	DE	IT	ES	FR	PL	ZH	RU	JP
DCS880 sales toolbox	-	EN								
DCS880 Quick guide	3ADW000545	EN	DE	IT	ES	FR				
Safety instructions all languages	3ADW000481	EN	DE	IT	ES	FR	PL	ZH	RU	
DCS880 converters										
DCS880 Flyer	3ADW000475	EN	DE	IT	ES	FR		ZH	RU	
DCS880 Catalog	3ADW000465	EN	DE	IT	ES	FR	PL	ZH	RU	
DCS880 Hardware manual	3ADW000462	EN	DE	IT	ES	FR	PL		RU	JP
DCS880 Firmware manual	3ADW000474	EN	DE	IT	ES	FR	PL		RU	JP
DCS880 Service manual	3ADW000488	EN								
DCS880 Hardparallel manual (on request only)	3ADW000530	EN								
DCS880 12-pulse manual	3ADW000533	EN								
DCS880 Current measurement aid (SDCS-CMA-2) manual	3ADW000745	EN								
ACS-AP-x assistant control panels user's manual	3AUA0000085685	EN								
DCS Thyristor power converter - Technical guide	3ADW000163	EN								
DCS880 External DC voltage measurement H1 ... H5	3ADW000601	EN								
Functional safety										
Supplement for functional safety	3ADW000452	EN		IT	ES	FR	PL		RU	
FSPS-21 PROFIsafe safety functions module	3AXD50000158638	EN								
FSO-21 Safety functions module	3AXD50000015614	EN								
DCS880 STO revalidation test and repetitive function test	3ADW000835	EN								
Functional safety for cabinets										
+Q957 Prevention of unexpected Start Up	3ADW000504	EN								
+Q951 Emergency stop, category 0 with MC opening	3ADW000505	EN								
+Q952 Emergency stop, category 1 with MC opening	3ADW000506	EN								
+Q963 Emergency stop, category 0 without MC opening	3ADW000507	EN								
+Q964 Emergency stop, category 1 without MC opening	3ADW000508	EN								
DCS880 FSO-21 safety functions module supplement	3ADW000821	EN								
Cabinets										
DCS880-A Catalog	3ADW000531	EN								
DCS880-A Installation manual	3ADW000627	EN								
DCS880-A81 Hydrogen catalog	3ADW000824	EN								
DCS800-A +S880 Enclosed converters, flyer	3ADW000523	EN								
Rebuild and upgrade systems										
DCS880-R Rebuild kit manual	3ADW000599	EN								
DCS880-U1 Upgrade kits manual	3ADW000719	EN								
Door mounting kits										
DPMP-01 mounting platform for ACS-AP control panel	3AUA0000100140	EN								
DPMP-02 mounting platform for ACS-AP control panel	3AUA0000136205	EN								
Serial communication										
FCAN-01 CANopen adapter module	3AFE68615500	EN	DE							
FDNA-01 DeviceNet™ adapter module	3AFE68573360	EN								
FECA-01 EtherCAT adapter module	3AUA0000068940	EN	DE		ES					
FENA-11/-21 Ethernet adapter module	3AUA0000093568	EN						ZH		
FEPL-02 Ethernet POWERLINK adapter module	3AUA0000123527	EN	DE							
FPBA-01 PROFIBUS DP adapter module	3AFE68573271	EN	DE				PL	ZH		
FSCA-01 RS-485 adapter module	3AUA0000109533	EN						ZH		
FDCO-01/02 DDCS communication modules	3AUA0000114058	EN								
FPNO-21 PROFINET fieldbus adapter module	3AXD50000158614	EN								
Tool and maintenance manuals and guides										
Drive Composer PC tool	3AUA0000094606	EN								
Drive application programming (IEC61131-3) manual	3AUA0000127808	EN								
Adaptive programming, Application guide	3AXD50000028574	EN								
NETA-21 remote monitoring tool	3AUA0000096939	EN								
NETA-21 remote monitoring tool guide	3AUA0000096881	EN								
DDCS branching unit NDBU-95 user's manual	3BFE64285513	EN								
Extension modules										
FIO-11 Analog extension module	3AFE68784930	EN	DE	IT						
FIO-01 Digital extension module	3AFE68784921	EN	DE	IT						
FAIO-01 Analog extension module	3AUA0000124968	EN	DE							

Name	Publication number	EN	DE	IT	ES	FR	PL	ZH	RU	JP
FDIO-01 Digital extension module	3AUA0000124966	EN								
FEN-01 TTL encoder interface	3AFE68784603	EN	DE	IT				ZH		
FEN-31 HTL encoder interface	3AUA0000031044	EN						ZH		
FSE-31 pulse encoder interface module user's manual	3AXD50000016597	EN								
FEA-03 F series extension adapter	3AUA0000115811	EN								
Ethernet tool network for ACS880 drives appl. guide	3AUA0000125635	EN								
Additional Manuals										
Interface Board SDCS-SUB-4 (+S186)	3ADW000739	EN								
DCS880 Electrolyzer control manual	3ADW000736	EN								
DCS880 Galvanization bath control manual	3ADW000730	EN								
Hints										
HW Hint DCS880, DCT880 and DCS800 plus code lists	3ADW000795	EN								

Table of contents

Safety instructions

What this chapter contains

This chapter contains the safety instructions you must follow when installing, operating, and servicing the converter.
If ignored, physical injury or death may follow, or damage may occur to the converter, the motor/load or driven equipment. Read the safety instructions before you work on the converter.

To which products this chapter applies

The information is valid for the entire range of the product line DCS880, the converter modules DCS880-S0x size H1 … H8, field exciter units DCF80x, Rebuild Kit DCS880-R00, etc.

Usage of warnings and notes

There are two types of safety instructions throughout this manual: Warnings and notes.
Warnings caution you about conditions which can result in severe injury or death and/or damage to the equipment, and advice on how to avoid the danger.
Notes draw attention to a particular condition or fact or give information on a subject.
The warning symbols are used as follows:

Dangerous voltage warning warns of high voltage which can cause physical injury or death and/or damage to the equipment.

General danger warning warns about conditions, other than those caused by electricity, which can result in physical injury or death and/or damage to the equipment.

Electrostatic sensitive devices warning warns of electrostatic discharge which can damage the equipment.

Installation and maintenance work

These warnings are intended for all who work on the converter, motor/load cable or motor/load. Ignoring the instructions can cause physical injury or death and/or damage to the equipment.

WARNING

- **Only qualified electricians are allowed to install and maintain the converter!**
- Never work on the converter, motor/load cable or motor/load when mains power is applied.
- Always ensure by measuring with a multimeter (impedance at least 1 MΩ) that:
  1. The voltage between the converter mains phases U1, V1 and W1 and the frame is close to 0 V.
  2. The voltage between terminals C(+) and D(-) and the frame is close to 0 V.
- Do not work on the control cables when power is applied to the converter or to the external control circuits. Externally supplied control circuits may cause dangerous voltages inside the converter even when the mains power on the converter is switched off.
- Do not make any insulation resistance or voltage withstand tests on the converter.
- Isolate the motor/load cables from the converter when testing the insulation resistance or voltage withstand of the cables or the motor/load.
- When reconnecting the motor/load cable, always check that the C(+) and D(-) cables are connected with the proper terminal.

Notes:

- The motor/load cable terminals on the converter are at a dangerously high voltage when the mains power is on, regardless of whether the motor/load is running or not.

- Depending on the external wiring, dangerous voltages (115 V, 220 V or 230 V) may be present on the relay outputs of the converter (e.g., XRO1 … XRO3).
- DCS880 with enclosure extension: Before working on the converter, isolate the whole system from the supply.

Grounding

These instructions are intended for all who are responsible for the grounding of the converter. Incorrect grounding can cause physical injury, death and/or equipment malfunction and increase electromagnetic interference.

WARNING

- Ground the converter, motor/load, and adjoining equipment to ensure personnel safety in all circumstances, and to reduce electromagnetic emission and pick-up.
- Make sure that grounding conductors are adequately sized and marked as required by safety regulations.
- In a multiple-converter installation, connect each converter separately to protective earth (PE ⏚).
- Minimize EMC emission and make a 360° high frequency grounding of screened cable entries at the cabinet lead-through plate.
- Do not install a converter equipped with an EMC filter to an ungrounded power system or a high resistance-grounded (> 30 Ω) power system.

Notes:

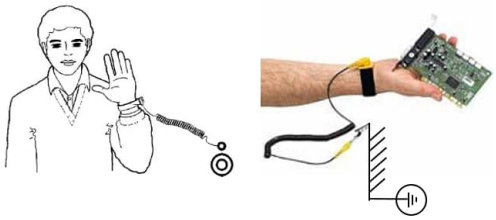
- Power cable shields are suitable as equipment grounding conductors only when adequately sized to meet safety regulations.
- As the normal leakage current of the converter is higher than 3.5 mA_{AC} or 10 mA_{DC} a fixed protective earth connection is required.
- This product can cause a DC current in the protective earthing conductor. Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in case of direct or indirect contact, only an RCD or RCM of Type B is allowed on the supply side of this product.

Printed circuit boards and fiber optic cables

These instructions are intended for all who handle the circuit boards and fiber optic cables. Ignoring the following instructions can cause damage to the equipment.

WARNING

- The printed circuit boards contain components sensitive to electrostatic discharge. Wear a grounding wristband when handling the boards. Touch the boards only when necessary.
- Grounding wristband:



- ABB order no.: 3ADV050035P0001

WARNING

- Handle the fiber optic cables with care.
- When unplugging optic cables, always grab the connector, not the cable itself.
- Do not touch the ends of the fibers with bare hands as the fiber is extremely sensitive to dirt.
- The minimum allowed bend radius is 35 mm (1.38 in.).

Mechanical installation

These notes are intended for all who install the converter. Handle the unit carefully to avoid damage and injury.

WARNING

- DCS880 sizes H4 ... H8:
  - The converter is heavy. Lift the converter by lifting lugs only.
  - The converter's center of gravity is high. Do not tilt it. It will overturn from a tilt of about 6 degrees. An overturning converter can cause physical injury.
  - Do not lift the converter by the front cover.
  - Place converters H4 … H6 only on their back.
- Make sure that dust from drilling does not enter the converter when installing. Electrically conductive dust inside the converter may cause damage or lead to malfunction.
- Ensure sufficient cooling.
- Do not fasten the converter by riveting or welding.

Operation

These warnings are intended for all who plan the operation of the converter or operate the converter. Ignoring the instructions can cause physical injury or death and/or damage to the equipment.

WARNING

- Before adjusting the converter and putting it into service, make sure that the motor/load and all driven equipment are suitable for operation throughout the speed/voltage range provided by the converter. The converter can be adjusted to operate the motor at speeds above and below the base speed.
- Do not control the motor/load with the load disconnecting device (disconnecting mains); instead, use the control panel keys  and  , or commands via the I/O board of the converter.
- Mains connection:
  You can use a disconnect switch (with fuses) to disconnect the electrical components of the converter from the mains for installation and maintenance work. The type of disconnect switch used must be as per EN 60947-3, Class B, so as to comply with EU regulations, or a circuit-breaker type which switches off the load circuit by means of an auxiliary contact causing the breaker's main contacts to open. The mains disconnect must be locked in its "OPEN" position during any installation and maintenance work.
- EMERGENCY STOP buttons must be installed at each control desk and at all other control panels requiring an emergency stop function. Pressing the STOP button on the control panel of the converter will neither cause an emergency stop of the motor/load, nor will the converter be disconnected from any dangerous potential.
- To avoid unintentional operating states, or to shut the converter down in case of any imminent danger according to the standards in the safety instructions it is not sufficient to merely shut down the converter via signals "RUN", "OFF" or "Emergency Stop" respectively "control panel" or "PC tool".
- Intended use:
  The operating instructions cannot take into consideration every possible case of configuration, operation, or maintenance. Thus, they mainly give such advice only, which is required by qualified personnel for normal operation of the machines and devices in industrial installations.
  If in special cases the electrical machines and devices are intended for use in non-industrial installations - which may require stricter safety regulations (e.g., protection against contact by children or similar) - these additional safety measures for the installation must be provided by the customer during assembly.

Note: When the control location is not set to Local (Local not shown in the status row of the display), the stop key on the control panel will not stop the converter. To stop the converter using the control panel, press the Loc/Rem key and then the stop key  .

Disclaimers

Generic disclaimers

The manufacturer shall have no obligation with respect to any product which:

- (i) Has been improperly repaired or altered.
- (ii) Has been subjected to misuse, negligence, or accident.
- (iii) Has been used in a manner contrary to the manufacturer’s instructions.
- (iv) Has failed as a result of ordinary wear and tear.

The information in this document is subject to change without notice and should not be construed as a commitment by ABB.

Cybersecurity disclaimer

This product is designed to be connected to and to communicate information and data via a network interface. The HTTP protocol, which is used between PC tool (Drive Composer) and product, is an unsecured protocol. For independent and continuous operation of the product such a connection via network to a commissioning tool is not necessary. However, it is the customer's sole responsibility to provide and continuously ensure a secure connection between the product and the customer network or any other network (as the case may be). The customer shall establish and maintain appropriate measures (such as but not limited to the installation of firewalls, prevention of physical access, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information.
Notwithstanding any other provision to the contrary and regardless, whether the contract is terminated or not, ABB and its affiliates are under no circumstances liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

User lock

For improved cybersecurity, it is highly recommended to set a master pass code to prevent e.g., the changing of parameter values and/or the loading of firmware and other files.
With several converters, set a unique pass code for each converter.

WARNING

ABB will not be liable for damages or losses caused by the failure to activate the user lock using a new pass code. See chapter Cybersecurity disclaimer.

To activate the user lock for the first time:

- Set 96.02 Pass code = 10,000,000. This will make parameters 96.100 … 96.102 visible.
- Enter a new pass code into 96.100 Change user pass code. Always use eight digits; if using Drive Composer, finish with Enter.
- Confirm the new pass code in 96.101 Confirm user pass code.

WARNING

Store the pass code in a safe place! The user lock cannot be opened, even by ABB, if the pass code is lost.

- In 96.102 User lock functionality, define the actions that you want to prevent. Our recommendation is to select all the actions unless otherwise required by the application.
- Enter an invalid (random) pass code into 96.02 Pass code.
- Use 96.08 Control board boot or cycle the auxiliary power.
- Check, that parameters 96.100 … 96.102 are hidden. If they are not, enter another random pass code into 96.02 Pass code.

To reopen the lock, enter the pass code into 96.02 Pass code. This will again make parameters 96.100 … 96.102 visible.

Introduction to this manual

Chapter overview
This chapter describes the purpose, contents, and the intended use of this manual.

Before You Start
The purpose of this service manual is to provide detailed information on how to service DCS880 power converters. The Safety instructions at the beginning of this manual needs to be studied before attempting any work on or with the converter. Read this manual before servicing the converter.

What this manual contains
The Safety instructions can be found at the beginning of this manual.

Introduction to this manual, the chapter you are currently reading, introduces you to this manual.

Fault Tracing Thyristors, this chapter describes how to detect a faulty thyristor or SDCS-BAB-F0x.

Handling the semiconductors, this chapter describes the handling of thyristors and thyristor modules.

Exchange thyristors sizes H1 … H4, this chapter describes the exchange of thyristors and SDCS-BAB-F0x in converters size H1 … H4.

Exchange thyristors size H5, this chapter describes the exchange of thyristors in converters size H5.

Exchange thyristors size H6, this chapter describes the exchange of thyristors in converters size H6.

Exchange thyristors size H7, this chapter describes the exchange of thyristors in converters size H7.

Exchange thyristors size H8, this chapter describes the exchange of thyristors in converters size H8.

Exchange the electronic tray (SDCS-CON-H01), this chapter describes the exchange of an electronic tray containing the SDCS-CON-H01.

Exchange the SDCS-PIN-H51 (+S185), this chapter describes the exchange of a SDCS-PIN-H51 used for voltage measurement via X15 (20 V_{AC} ... 100 V_{AC}).

Service, this chapter contains hardware change information, firmware download and technical hints.

Preventive Maintenance, this chapter describes preventive maintenance of the converters .

Appendix: Spare parts, the Appendix contains the spare parts information.

Target group
This manual is designed to help those responsible for planning, installing, starting up and servicing converters .
These people should possess:
- Basic knowledge of physics, electrical engineering, electrical wiring principles, components as well as symbols used in electrical engineering.
- Basic experience with DC converters and DC products.

Related documents
A list of related manuals is shown on the inside of the front cover under DCS880 Drive Manuals.
The above listed documentation can be found in the DCS880 sales toolbox.

Storage and transport

If the converter has been in storage prior to installation or is transported to another location, care must be taken to ensure that the environmental conditions are complied with, see DCS880 Hardware Manual (3ADW000462).

Terms and abbreviations

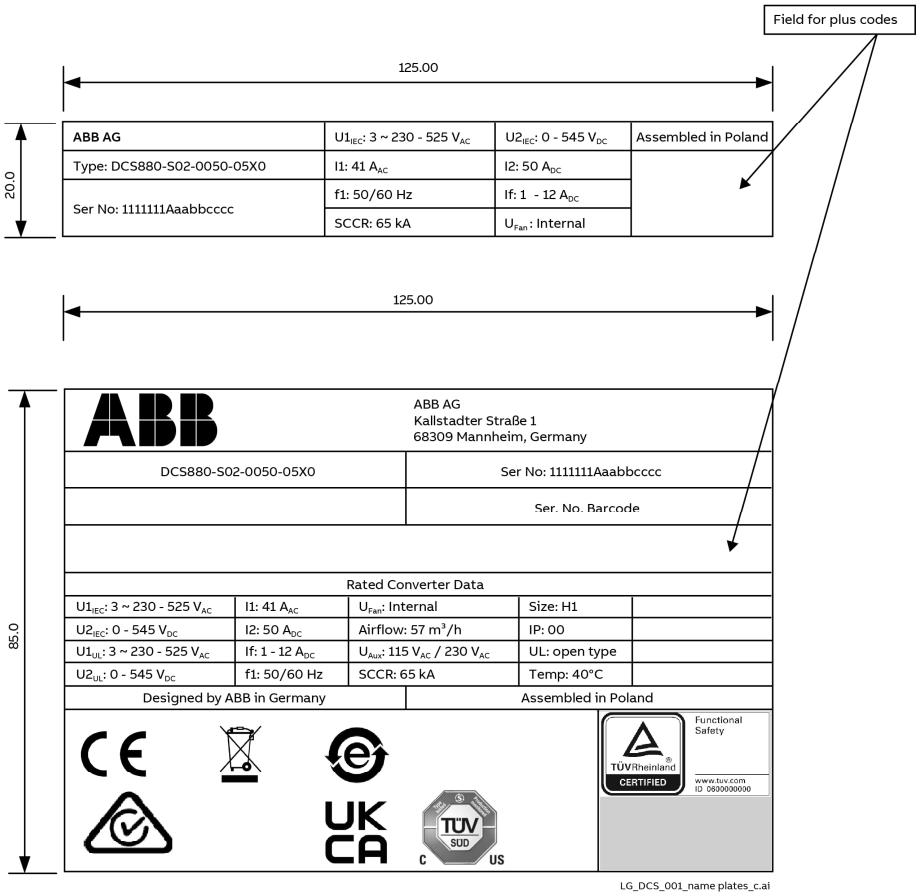
Term/Abbreviation	Definition
AC 800M	A type of programmable controller manufactured by ABB.
ACS-AP-I	Types of control panels.
ACS-AP-W	
Adaptive Program (AP)	Adaptive Program. See Adaptive programming, Application guide (3AXD50000028574)
AI	Analog input. Interface for analog input signals.
AO	Analog output. Interface for analog output signals.
Application program	Program written by the Drive Application Builder. See Drive (IEC61131-3) application programming manual (3AUA0000127808).
Control unit	It contains electronics and I/O connections. The control unit is connected to the power unit.
Converter	Converter to control DC motors/loads.
D2D	Drive-to-drive/Device-to-device link. It is a communication link between ABB equipment.
DCS580	A product family of ABB drives.
DCS880	A product family of ABB drives.
DCSLink	Communication between the armature converter and the field exciters or 12-pulse communication.
DCT880	A product family of ABB drives (thyristor power controller).
DDCS	Distributed Drives Communication System. A protocol used in communication between ABB equipment.
DI	Digital input. Interface for digital input signals.
DIO	Digital input/output. Interface that can be used as a digital input or output.
DO	Digital output. Interface for digital output signals.
Drive	Converter to control DC motors.
DriveBus	A communication link used between ABB equipment.
DriveAP	Adaptive Programming. See Adaptive programming, Application guide (3AXD50000028574).
Drive Application Builder	Tool to write application programs. See Drive (IEC61131-3) application programming manual (3AUA0000127808).
Drive Composer	PC tool for commissioning and maintenance of ABB equipment.
EFB	Embedded fieldbus.
FAIO-01	Optional analog I/O extension module.
FBA	Fieldbus adapter.
FCAN-01	Optional CANopen adapter.
FCNA-01	Optional ControlNet adapter.
FDCO-0x	Optional DDCS communication module.
FDIO-01	Optional digital I/O extension module.
FDNA-01	Optional DeviceNet adapter.
FEA-03	Optional I/O extension module.
FECA-01	Optional EtherCAT® adapter.
FEIP-21	Optional EtherNet/IP fieldbus adapter module.
FEN-01	Optional TTL encoder interface module.
FEN-11	Optional absolute encoder interface module.
FEN-21	Optional resolver interface module.
FEN-31	Optional HTL encoder interface module.
FENA-11	Optional Ethernet/IP, Modbus/TCP, and PROFINET IO adapter.
FENA-21	Optional dual-port Ethernet/IP, Modbus/TCP, and PROFINET IO adapter.
FEPL-02	Optional POWERLINK adapter.
FIO-01	Optional digital I/O extension module.

Term/Abbreviation	Definition
FIO-11	Optional analog I/O extension module.
FMBT-21	Optional Modbus/TCP adapter module.
FPBA-01	Optional PROFIBUS DP adapter.
FPNO-21	Optional PROFINET fieldbus adapter module.
FSCA-01	Optional Modbus/RTU adapter.
FSE-31	Optional HTL safety encoder interface module.
FSO-21	Optional safety functions module.
FSPS-21	Optional PROFIsafe safety functions module.
HTL	High-threshold logic.
I/O	Input/Output.
ModuleBus	A communication link used between ABB equipment. Can be connected to the optical ModuleBus link.
Network control	With fieldbus protocols based on the Common Industrial Protocol (CIP™), such as DeviceNet and Ethernet/IP, denotes the control of the connected equipment using the Net Ctrl and Net Ref objects of the ODVA AC/DC Drive Profile. For more information, see www.odva.org, and the following manuals: FDNA-01 DeviceNet adapter module User's manual (3AFE68573360). FENA-11/-21 Ethernet adapter module User's manual (3AUA0000093568).
Off3 (emergency stop)	Off3 (emergency stop) with configurable deceleration time according to cat. 1.
OPL	Optical power link. Protocol used in communication between the control unit and the power unit.
Parameter	User-adjustable operation instruction to the drive/converter.
PID controller	Proportional-integral-derivative controller. E.g., the speed/voltage/temperature control is based on a PID algorithm.
PLC	Programmable logic controller.
Power unit	It contains power electronics and power connections. The control unit is connected to the power unit.
PTC	Positive temperature coefficient.
PU	See power unit.
RFG	Ramp function generator.
RO	Relay output. Interface for a digital output signal. Implemented with a relay.
Signal	Value measured or calculated. It can also contain status information. Most signals are read-only, but some (especially counter-type signals) can be reset.
SS1	Safe stop 1.
SSI	Synchronous serial interface.
STO	Safe Torque Off.
TTL	Transistor-transistor logic.
UPS	Uninterruptible power supply. Power supply equipment with battery to maintain output voltage during power failure.
Unit	Thyristor power controller to control heating loads.

Status 04.09.2025	Rev.: G

Name plate

For purposes of identification, each converter is fitted with name plates, stating the type code and the serial number, which serve for each converter's individual identification.
The type code contains information about the characteristics and the configuration of the converter.



Ser No	0025421A**1729**4264 1729 = Production year 2017 and week 29.
$U1_{IEC}$	Rated input voltage according to IEC.
$U2_{IEC}$	Rated output voltage according to IEC.
$U1_{UL}$	Rated input voltage according to UL.
$U2_{UL}$	Rated output voltage according to UL.
I1	Rated input current.
I2	Rated output current.
If	Rated internal field exciter current.
f1	Rated frequency of mains voltage.
U_{Fan}	Rated fan voltage.
Airflow	Rated cooling air flow.
U_{Aux}	Rated auxiliary voltage.
Size	Converter size.
SCCR	Sort circuit current ratio.
IP: 00	Protection class according to ISO20653.
UL: open type	Protection class according to UL.
Temp	Max. permissible cooling air temperature.

Type code

The type code contains information on the specification and configuration of the converter. The first digits from left show the basic configuration (e.g., DCS880-S01-2000). The optional selections are given thereafter on the name plate by plus code. The main selections are described below. Not all selections are available for all types.

The converter's basic type code: **DCS880-aab-cccc-ddef + plus code**			
Product family:	DCS880		
Product type:	aa	= S0	Standard converter module
		= S9	Standard converter module (fuseless)
		= R0	Rebuild kit
		= U1	Upgrade kit
		= A	Cabinets
Bridge type:	b	= 1	Single bridge (2-Q)
		= 2	2 anti-parallel bridges (4-Q)
Module type:	cccc	=	Rated DC current (IP00)
Rated AC voltage:	dd	= 04	100 V_{AC} … 415 V_{AC}
		= 05	100 V_{AC} … 500 V_{AC} (IEC)/525 V_{AC} (UL)
		= 06	270 V_{AC} … 600 V_{AC}
		= 07	315 V_{AC} … 690 V_{AC}
		= 08	360 V_{AC} … 800 V_{AC}
		= 10	450 V_{AC} … 990 V_{AC}
		= 12	540 V_{AC} … 1190 V_{AC}
Power connection:	e	= X	Standard H1 … H7
		= L	Busbars on the left H8, H7F
		= R	Busbars on the right H8, H7F
Revision code:	f	= 0	1st generation
		= A	H7: Double fuse
		= B	H5/H6: New cooling fan R2E250-RE04-10

The technical data and specifications are valid as of going to press. ABB reserves the right to make subsequent alterations.

Voltage ratings

DC voltages

The maximum available DC voltages have been calculated using the following assumptions:

- U_{VN} = rated mains voltage, 3-phase.
- Voltage tolerance ±10 %.
- Internal voltage drop approximately 1 %.

If a deviation or a voltage drop has to be considered in compliance with IEC and VDE standards, the output voltage and/or the output current must be reduced.

Mains voltage	Maximum DC voltage		Ideal DC voltage	DC voltage class
U_{VN} [V_{AC}]	$U_{d\ max\ 2\text{-}Q}$ [V_{DC}]	$U_{d\ max\ 4\text{-}Q}$ [V_{DC}]	U_{d0} [V_{DC}]	
230	265	240	310	04
380	440	395	510	04
400	465	415	540	04
415	480	430	560	04
440	510	455	590	05
460	530	480	620	05
480	555	500	640	05
500	580	520	670	05
525	610	545	700	05
575	670	600	770	06
600	700	625	810	06
660	765	685	890	07
690	800	720	930	07
800	915	820	1060	08
990	1160	1040	1350	10
1190	1380	1235	1590	12

Field voltages

The maximum available field voltage can be calculated using following formula:

$$U_F \leq 1.35 * U_{VN} * \left(\frac{100\% * TOL}{100\%} \right)$$, with:

U_F = Field voltage.
U_{VN} = Mains voltage.
TOL = Tolerance of the mains voltage in %.

Current ratings

Converter size	2-Q rated current DCS880-01 [A_{DC}]	4-Q rated current DCS880-02 [A_{DC}]	Mains voltage [V_{AC}]						
			400	525	600	690	800	990	1190
H1	20	25	X	X					
	45	50	X	X					
	65	75	X	X					
	90	100	X	X					
H2	135	150	X	X					
	180	200	X	X					
	225	250	X	X					
	270	300	X	X					
H3	290	320			X				
	315	350	X	X					
	405	450	X	X					
	470	520	X	X					
H4	590	650			X				
	610	680	X	X					
	740	820	X	X					
	900	1000	X	X					
H5	1190 ①	1190 ①	X	X					
H6	900	900			X	X			
	1200	1200	X	X					
	1500	1500	X	X	X	X			
	2000	-	X	X	X	X			
	-	2000	X	X					
H7	1900	1900					X		
	2050	2050		X	X	X			
	2500	2500	X	X	X	X	X		
	3000	3000	X	X	X	X	X		
H8	2050	2050						X	
	2600	2600						X	X
	3300	3300	X	X	X	X	X	X	X
	4000	4000	X	X	X	X	X	X	X
	4800	4800			X	X	X		
	5200	5200	X	X					

① 1190 A_{DC} for 35°C and 1140 A_{DC} for 40°C ambient temperature.

Fault tracing thyristors

Tools

For commissioning and fault tracing

Following software tools are mandatory:

– Drive Composer pro. Includes commissioning wizard, Adaptive Program, and fast signal monitoring.

Following tools are mandatory in addition to standard tools:

– An oscilloscope including memory function with either galvanically isolating transformer or isolating amplifier (probe) for safe measurements. It can also be a handheld (portable) oscilloscope.

– A handheld tacho to measure the motor speed.

– A clamp on current probe. In case the scaling of the DC load current needs to be checked it must be a DC clamp on current probe.
– A voltmeter (at least CAT III 1000 V with possibility of capacitance measurement).

– 1000 V probes and test leads.

– An ESD-field service kit (ABB Service Finland code 0001ESD/MS-Antistatic).

– Make sure that all equipment in use is suitable for the voltage level applied to the power part!

Additionally for service and preventive maintenance:
Following additional tools are mandatory for cleaning:

– An ESD safe blower/ESD vacuum cleaner (ABB Service Finland code 0006ESD/MUNTZ 555-ESD-S-E).

How to detect a faulty thyristor

Thyristor problems can be noticed differently:

A fuse is blown

This is an indication that a strong overcurrent has happened due to one of the following reasons:

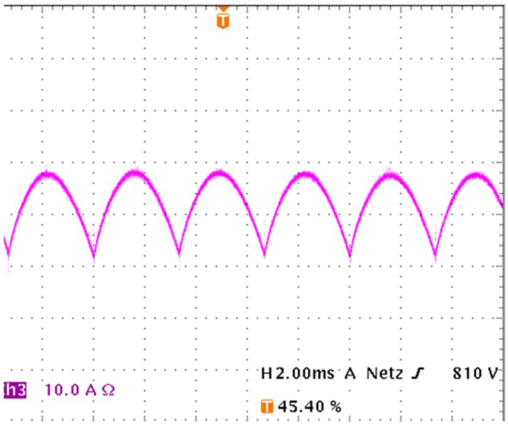
– An internal short circuit between the phases (line side/AC-side) because of a defective thyristor (short circuit inside a thyristor from anode to cathode).
– An internal short circuit between the phases (line side/AC-side) because of circulating current in a 4-Q converter (malfunction of the control electronics, no thyristor defective).
– An external short circuit at the DC terminals of the converter without sufficient impedance.
– A commutation fault during generating (active braking with high current, high EMF and with low AC voltage) of a 4-Q converter.

Notes:

– In case of parallel fuses: If one of the parallel fuses is blown, all parallel fuses have to be changed. The ‘undamaged’ fuses might be ‘half-blown’ and will blow with the next high current.
– In case of serial fuses (e.g., DC fuses): If one of the serial fuses is blown, all serial fuses have to be changed. The ‘undamaged’ fuses might be ‘half-blown’ and will blow with the next high current.

DC-current pulses measured using an oscilloscope

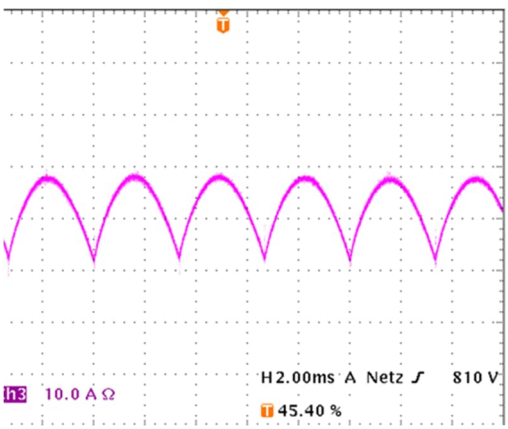
Connect an oscilloscope at the fixed AO named IACT (XAO:4/5 on the SDCS-CON-H01) and check for the proper number of current pulses:



There should be six current pulses in positive direction.
In case of a 4-Q converter additional the six current pulses for the negative current direction or other speed direction have to be checked.

Checking current bubbles using 30.44 Minimum firing angle
Drive Composer information:

- Connect an oscilloscope at the fixed AO named IACT:
  - H1 … H6: XAO:4/5 on the SDCS-CON-H01.
  - H7 … H8: X4:1/4 on the SDCS-OPL-H01.
- Connect Drive Composer to the converter and choose local mode.
- Monitor 27.02 Used current reference, 27.05 Motor current and 27.18 Firing angle.
- Set 27.22 Current reference source = 27.23 Current reference external.
- Set 99.07 M1 used field exciter type = None.
- Set 30.44 Minimum firing angle = 120°.
- Start the converter via Drive Composer.
- Set the DC current reference in 27.23 Current reference external to:
  - +50 % for positive current.
  - -50 % for negative current.
- Decrease the minimum firing angle degree by degree. At around 105° the current should start to flow. Now check the number of current bubbles. During a time of 20 ms (50 Hz mains)/16.66 ms (60 Hz mains) 6 bubble should be visible:



- Make sure the motor is not turning (**Attention:** let the converter run only for a brief time).
- Stop the converter via Drive Composer.
- Set 30.44 Minimum firing angle, 27.22 Current reference source and 99.07 M1 used field exciter type back to their original settings.

Thyristor test

Also, the thyristor test provided by the firmware can be used:

- Switch the converter to local mode (Drive Composer, control panel or local I/O).
- Start the thyristor test by means of 95.24 Service mode = Thyristor test and within 20 s set On and Run.
- During the thyristor test the mains contactor will be closed and the thyristors are checked. The field current is not released while the thyristor test is active and thus the motor should not turn.
- When the thyristor test is finished check 05.22 Diagnostic for details.
- For more information consult the DCS880 Firmware Manual (3ADW000474).

Ripple monitor

The ripple monitor indicates that the ripple of the DC current is much higher than normal. In such a case, most often one thyristor does not work. Its missing current contribution causes a deep dip in the direct current.

The structure of the current loop (current controller) will force the other thyristors to compensate the dip by a certain overcurrent in order to keep the average current constant. Such compensation results in a ripple monitoring fault during motoring mode operation with alpha ≤ 90°.

The reason for a thyristor without current may be:

- A blown line fuse. This is possible only for converters with 20 ... 1000 A.
- A fuse has disconnected one of the six thyristors. This is possible only for converters with 900 ... 5200 A (six internal branch fuses).
- A loose gate/cathode connector.
- A thyristor does not get firing pulses or does not react to firing pulses.
- The current controller may be totally mismatched to the DC load.
- The AC mains network is causing that fault message. In this case, asymmetrical phase shift, uneven phase voltage or critical designed power factor correction equipment or harmonic reduction equipment can be the reason.

How to find a faulty thyristor

If a blown fuse is suspected, the problem is caused most often by a faulty thyristor. To make sure, that a thyristor is the reason and needs to be exchanged fault tracing must be done in two different ways, depending on the size of the converter.

In general, make sure that all safety instructions given within this manual or within the Safety instructions, related to the machine or the application itself, are obeyed.

Converters size H1 … H4 (20 … 1000 A)

These converters require semiconductor fuses in the 3 AC lines.

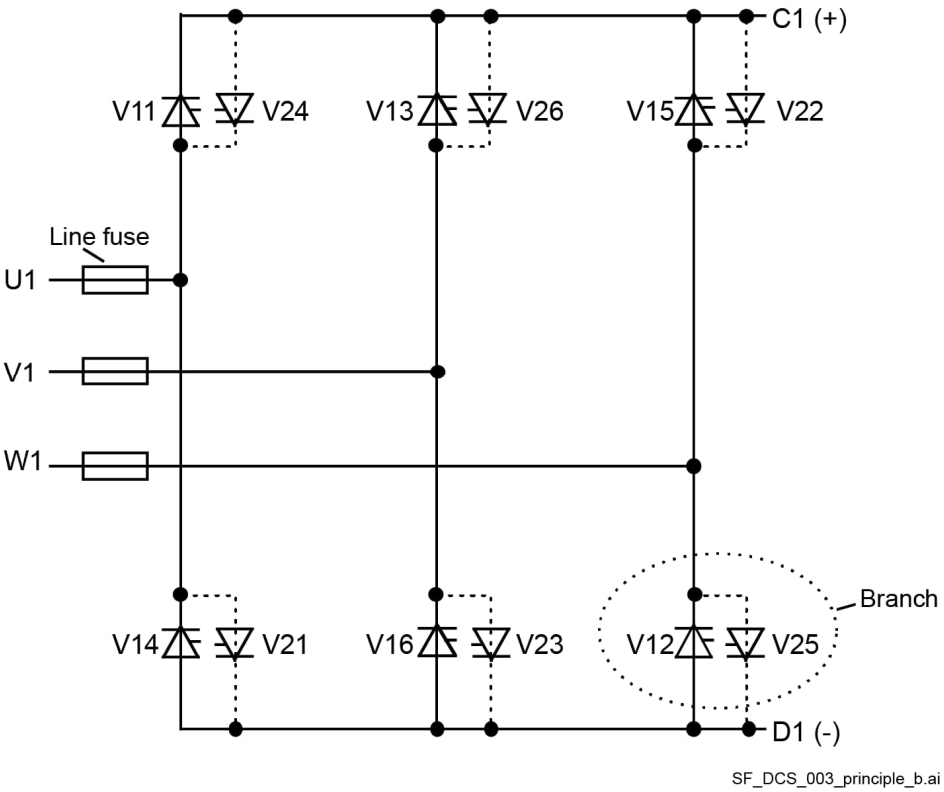
- The converter must be disconnected from the mains.
- One DC cable should be disconnected from the converter.

Blown fuses

- Make sure that the connection to the mains is open (e.g., open the mains breaker).
- Using the OHM function of a normal multimeter, measurements must be made over the line fuses.
- Normally, each measurement should show low resistance (< 1 Ohm).

Blown thyristors

- Make sure that the connection to the motor is open (e.g., disconnect motor cables).
- Using the OHM function of a normal multimeter, measurements must be made from each AC terminal to each DC terminal (U1 to C1, V1 to C1, W1 to C1, U1 to D1, V1 to D1 and W1 to D1:



Bridge configuration H1 … H4

- Normally, each measurement should show high resistance (> 1 kOhm).
- Target: Find a short circuit, indicated by low resistance (< 1 Ohm) (destroyed thyristor).
- If the converter is designed with thyristor modules, then a module consists of two thyristors. In this case it is sufficient to know which thyristor module has a defective thyristor because the complete module must be replaced.
- After a thyristor module is replaced, the above-mentioned measurement should be done another time to make sure that all faulty thyristors have been detected!

Note: The RC/snubber circuit could also cause 0 Ohm results for a short time.
The measurement, showing less resistance than 1 Ohm, should be made a second time with test leads applied to the terminals with opposite polarity; if this measurement shows the same result, one or two thyristors located on that path are faulty; they need to be replaced.

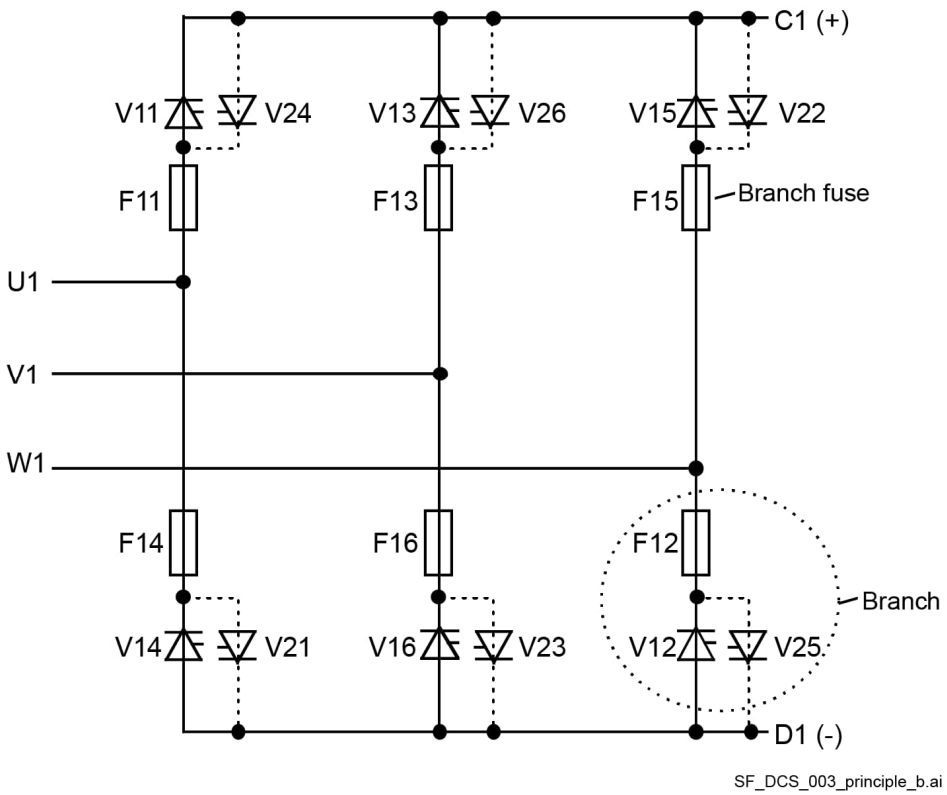
Converters size H5 … H8 (900 … 5200 A)

These converters are equipped with fuses in the branches of the power part.

– The converter must be disconnected from the mains.

Blown fuses, blown thyristors

– Make sure that the connection to the motor is open (e.g., disconnect motor cables).
– Using the OHM function of a normal multimeter, measurements must be made from each AC terminal to each DC terminal (U1 to C1, V1 to C1, W1 to C1, U1 to D1, V1 to D1 and W1 to D1.
– In case of a blown fuse, the faulty thyristor or the faulty pair of thyristors are already isolated at one side from the others and therefore the faulty branch is known:



Bridge configuration H5 … H8

– Normally, each measurement should show high resistance (> 1 kOhm).
– Target: Find a short circuit, indicated by low resistance (< 1 Ohm) (destroyed thyristor).
– Size H5 is designed with thyristor modules, then a module consists of two thyristors. In this case it is sufficient to know which thyristor module has a defective thyristor because the complete module must be replaced. Continue with related part Exchange of Thyristors for Size H5 section Find faulty thyristor.
– For sizes H6 … H8 the OHM test should be performed when the thyristor is still clamped. Outside the converter a special thyristor clamping device is needed.
  – For 4-Q converters with anti-parallel thyristors or BCT's:
    The selection of a forward or reverse thyristor or BCT (Bidirectional-Controlled-Thyristor) is done during the disassembly.

  Continue with related part Exchange of Thyristors for Size H6, H7 or H8 section Find faulty thyristor.
– After a thyristor was replaced, the OHM test should be done another time to make sure that all faulty thyristors have been detected! If the motor is still connected to the converter the result of the measurement may be wrong.

Ripple monitor

If the ripple monitor fault occurred, a fault tracing as described above must be conducted:

- Check the fuses and the thyristors, according to the statements before.
- If the power section seems to be ok, but still one or more thyristors do not take current, something went wrong in between the firing pulse generation and the thyristor's gate; in this case check:
  - Is a firing pulse present on the primary side of the firing pulse transformer?
  - Is a firing pulse present on the secondary side of the firing pulse transformer?
  - Is the firing pulse transferred to the gate of the thyristor (loose gate connector)? Are all electrical connections still healthy?
  - Can the thyristor be fired with the applied firing pulse? Is the pulse form of the firing pulse identical at all measuring positions?
- Check the settings of the current controller.
- Check the AC mains network by taking recordings of the line voltage and current at all 3 phases at the same time.

How to detect a faulty SDCS-BAB-F0x (H1 ... H4)

SDCS-BAB-F0x problems can be noticed differently:

- Fault messages related to the excitation.
- The field current is oscillating.
- A fuse F100 … F102 on the SDCS-PIN-H01 is blown (sizes H1 … H3) or a fuse F401 … F403 in the converter is blown (size H4). This is an indication that a strong overcurrent has happened due an internal short circuit in the bridge connected to the SDCS-BAB-F0x because of a defective thyristor or diode.

How to find a faulty SDCS-BAB-F0x

If a blown fuse on the SDCS-PIN-H01 or in the converter is suspected, the problem is caused most often by a faulty SDCS-BAB-F0x. To make sure that the SDCS-BAB-F0x is the reason and needs to be exchanged fault tracing must be done in two different ways, depending on the size of the converter.

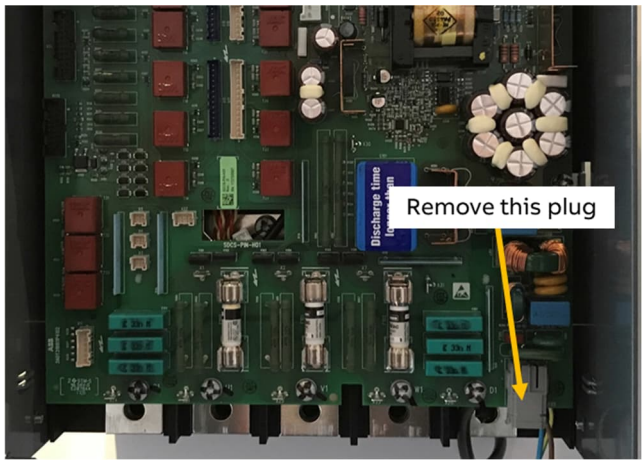
In general, make sure that all safety instructions given within this manual or within the Safety instructions, related to the machine or the application itself, are obeyed.

Converters size H1 ... H3 (20 ... 520 A)

The supply for the SDCS-BAB-F0x is passed via the SDCS-PIN-H01. Thus, fuses F100 … F102 need to be measured, before the SDCS-BAB-F0x is checked.

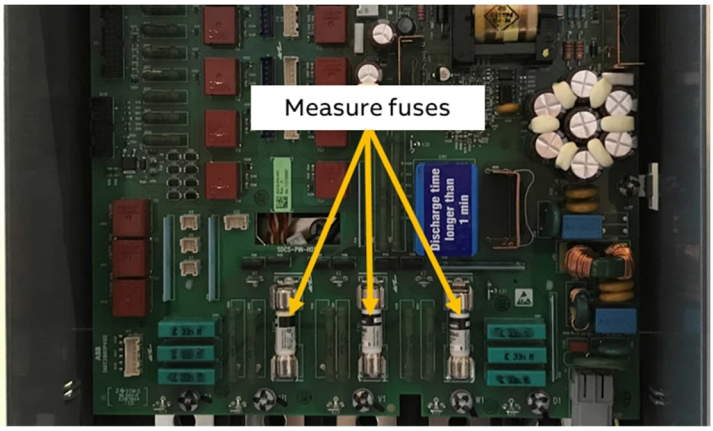
- The converter must be disconnected from the mains.
- Follow the instructions Remove faulty thyristor modules until step 8 is done.

9. Remove the marked plugs at the SDCS-PIN-H01.

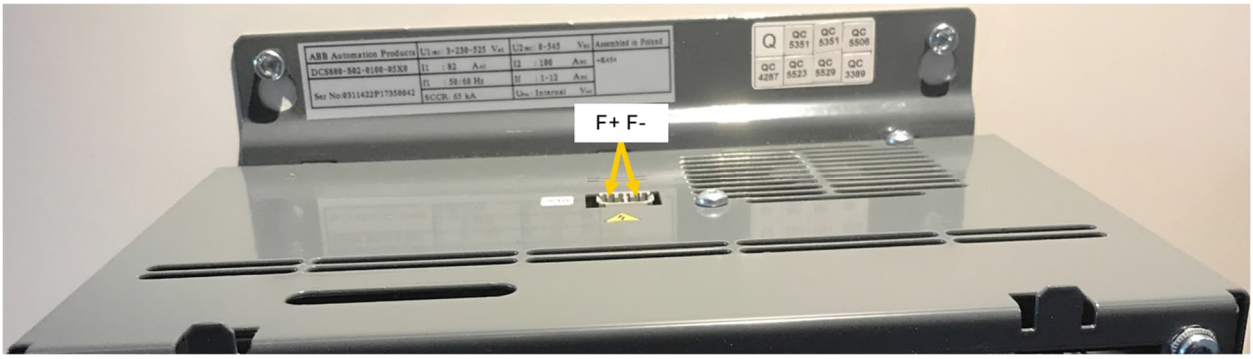


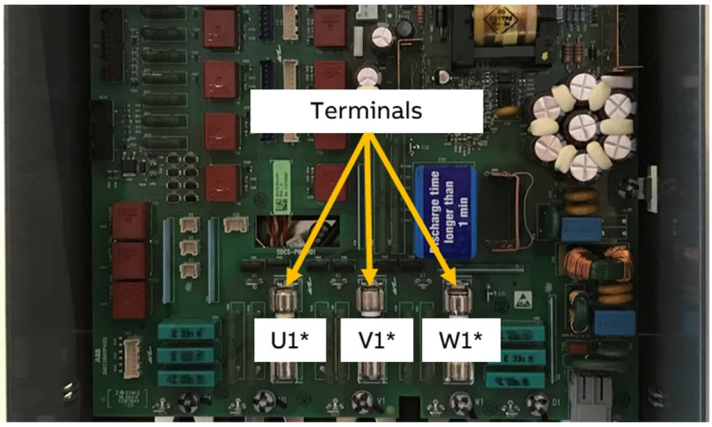
10. Remove field connection plug X10 from the top of the DCS880.

11. Measure fuses F100 … F102 using the OHM function of a normal multimeter and exchange the broken ones.



12. The SDCS-BAB-F0x contains a 3-phase half-controlled bridge (B6H).
Using the OHM function of a normal multimeter, measurements must be made from each AC terminal to each field exciter terminal (U1* - F+, V1* - F+, W1* - F+, U1* - F-, V1* F- and W1* -F-).





- Normally, each measurement should show high resistance (> 1 kΩ).
- A short circuit is indicated by a low resistance (< 1 kΩ, destroyed thyristor or diode).
- If one of the measurements shows a short circuit, replace the SDCS-BAB-F0x.
- A measurement, showing less resistance than 1 Ω should be made for a second time. Apply the test leads with opposite polarity; if this measurement shows the same result, the SDCS-BAB-F0x is faulty and needs to be replaced.
- After the SDCS-BAB-F0x is replaced, the above-mentioned measurement should be made another time to make sure that all is fine.

	Fuses (F100 … F102)	**SDCS-BAB-F0x**	**To do**
Faulty?	Yes	No	Exchange SDCS-PIN-H01
	No	Yes	Exchange SDCS-BAB-F0x
	Yes	Yes	Exchange SDCS-BAB-F0x and fuses

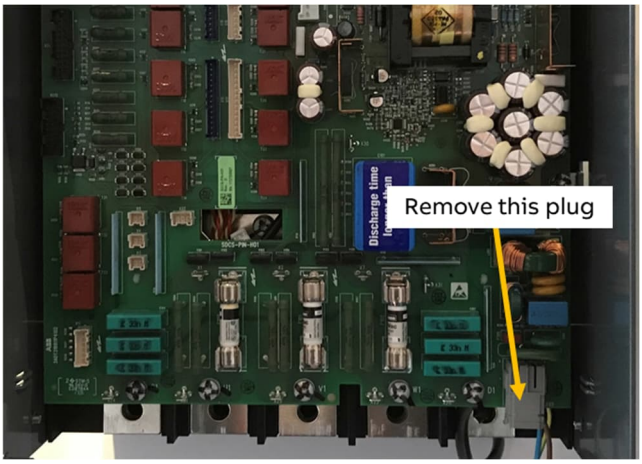
Exchange the SDCS-BAB-F0x continue with chapter Remove faulty SDCS-BAB-F0x.
Exchange the SDCS-PIN-H01 continue with step 9 of the instructions Remove faulty thyristor modules.

Converters size H4 (610 ... 1000 A)

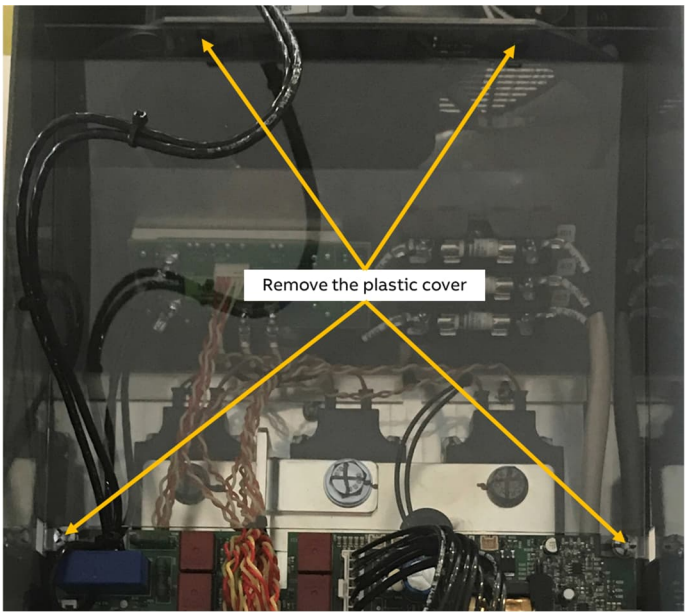
The supply for the SDCS-BAB-F0x is passed via fuses F401 … F403. Thus, fuses F401 … F403 need to be measured, before the SDCS-BAB-F0x is checked.

– The converter must be disconnected from the mains.
– Follow the instructions Remove faulty thyristor modules until step 8 is done.

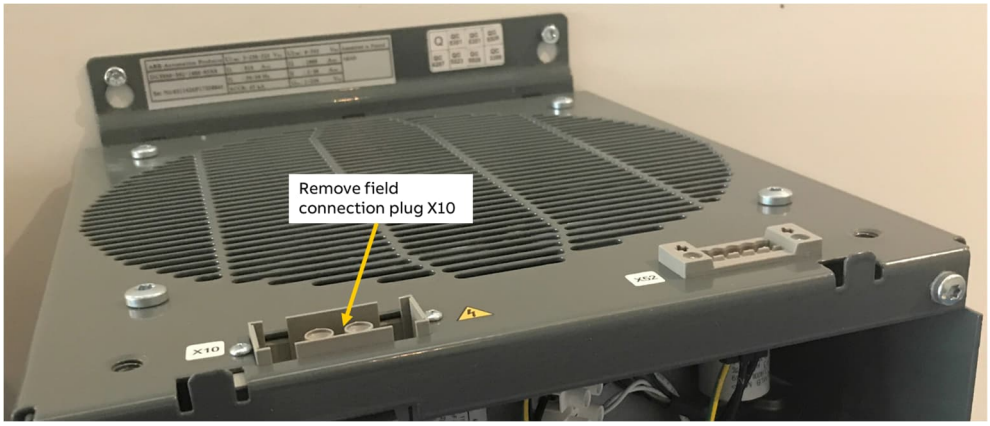
9. Remove the marked plugs at the SDCS-PIN-H01.



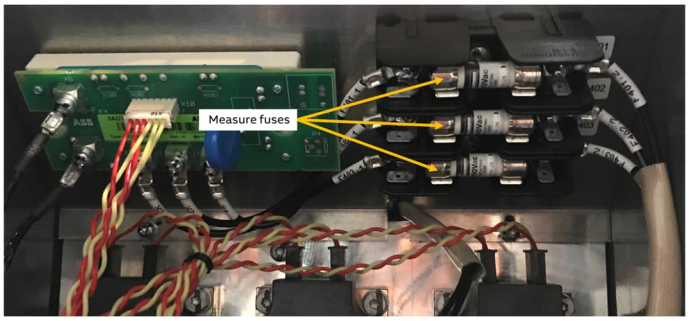
10. Remove the plastic cover.



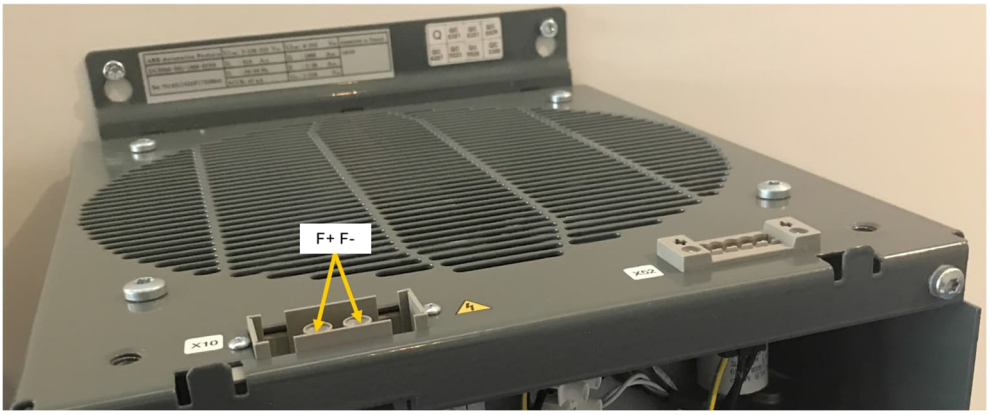
11. Remove field connection plug X10 from the top of the DCS880.

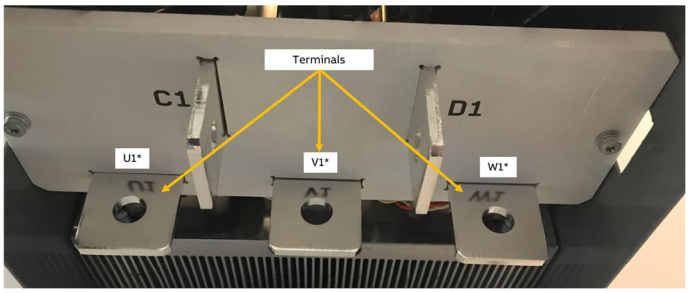


12. Measure fuses F401 … F403 using the OHM function of a normal multimeter and exchange the broken ones.



13. The SDCS-BAB-F0x contains a 3-phase half-controlled bridge (B6H).
Using the OHM function of a normal multimeter, measurements must be made from each AC terminal to each field exciter terminal (U1* to F+, V1* to F+, W1* to F+, U1* to F-, V1* to F- and W1* to F-).





- Normally, each measurement should show high resistance (> 1 kΩ).
- A short circuit is indicated by a low resistance (< 1 kΩ, destroyed thyristor or diode).
- If one of the measurements shows a short circuit, replace the SDCS-BAB-F0x.
- A measurement, showing less resistance than 1 Ω should be made for a second time. Apply the test leads with opposite polarity; if this measurement shows the same result, the SDCS-BAB-F0x is faulty and needs to be replaced.
- After the SDCS-BAB-F0x is replaced, the above-mentioned measurement should be made another time to make sure that all is fine.

	Fuses (F401 … F403)	**SDCS-BAB-F0x**	**To do**
Faulty?	Yes	No	Exchange fuses
	No	Yes	Exchange SDCS-BAB-F0x
	Yes	Yes	Exchange SDCS-BAB-F0x and fuses

Exchange the SDCS-BAB-F0x continue with chapter Remove faulty SDCS-BAB-F0x.

Handling the semiconductors

General Instruction how to handle semiconductors

Thyristor modules in converters size H1 … H5 (20 … 1190 A), busbars and fuses have to be mounted with the correct torque using a torque screwdriver or a torque wrench.
In converters size H6 (900 ... 2000 A), H7 (1900 ... 3000 A) and H8 (2050 ... 5200 A) the mounting force is indicated by an indicating spring welded to the mounting clamp, which is inside the converter.
Always mark suspected damaged components clearly after removing them from the circuit, to avoid confusion with "good" components.
When removing a damaged semiconductor, write down how and where it was installed (direction, location, connected gate leads and with BCT’s the position of the gate connectors).
Check that the new and old components have the same type designation or that the new component can replace the old one. A semiconductor can be replaced by different compatible semiconductors according to the codes in the manufacturers' table.
Semiconductor components are high-precision products. All unnecessary used tools and objects might damage the easily dented and scratched surfaces of the semiconductors.

1. Keep new semiconductors as long as possible in their original packages.
2. Use protective gloves if possible.
3. Clean work area and hands frequently.
4. Use good illumination.

Exchange thyristors sizes H1 … H4

Installation of thyristor modules/SDCS-BAB-F0x in converters size H1 … H4 (20 … 1000 A)

All DCS880 size H1 … H4 are equipped with thyristor modules and a SDCS-BAB-F0x for excitation. In order to keep the operating temperature of the semiconductor module low, the joint between the heat sink and the module should have good heat conducting ability. The electrical conductivity of the connectors must also be good. For this reason, the following instructions must be observed with particular care.

Required tools

Special tools or material needed in addition to standard tools for the exchange of thyristor modules:

– Torx screwdrivers:	TX10, TX20, TX25
– Torque spanner:	Mounting torques for the thyristor modules and SDCS-BAB-F0x to heat sink and electrical connections see table Nominal mounting torque for thyristor modules and SDCS-BAB-F0x.
– Torque spanner for electrical connections:	13Nm (M8) 25 Nm (M10) 50 Nm (M12)
– Screws are metric type; use appropriate nuts.	
– Tissue paper.	
– Solvent (e.g., ethanol).	
– Thermal joint compound (non-conducting) for thyristor modules: or	GHSN390011P0010 Type Berulub FZ1 E3
– Thermal joint compound (conducting) for thyristor modules and disk type thyristors:	GHSN390001P0001 Type Berulub FK-SU 2

Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

Find faulty thyristor modules

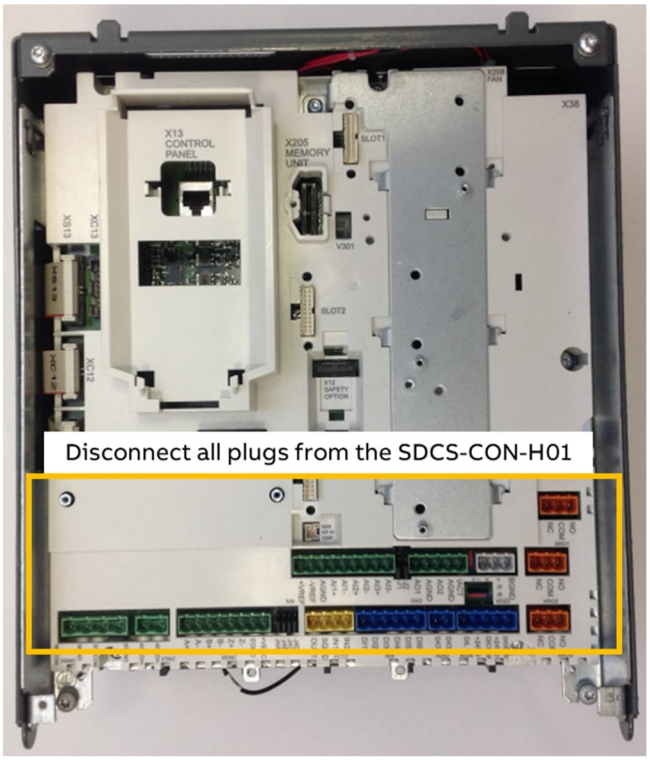
See Fault Tracing Thyristors of this publication.

Remove faulty thyristor modules

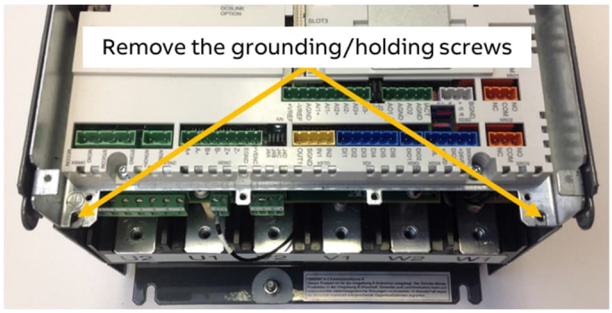
Recommendation:
Use safety equipment to protect your hands.

1. Remove control panel and design cover.

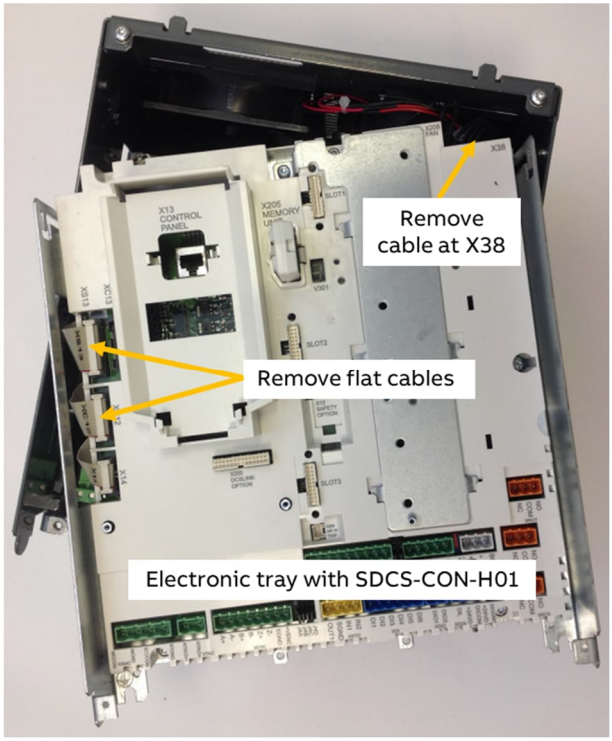
2. Disconnect all I/O plugs from the electronic tray.
3. Disconnect all connections from present plug-in options.



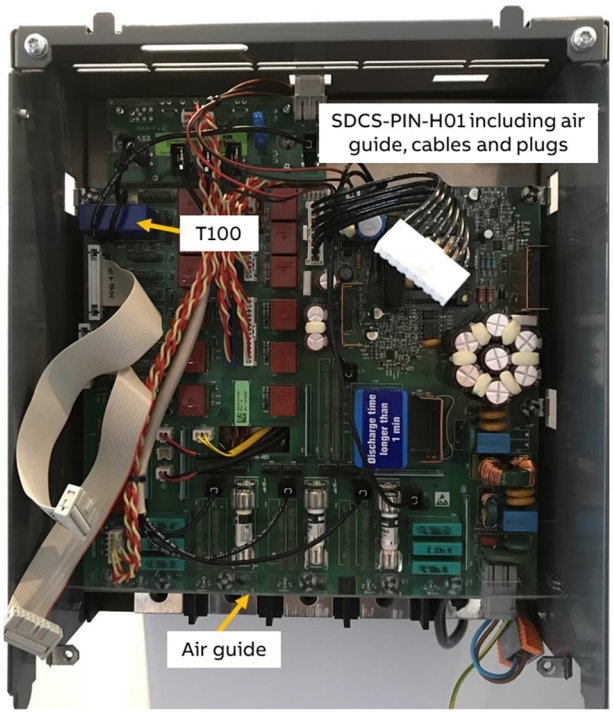
4. Remove the grounding/holding screws from the electronic tray.



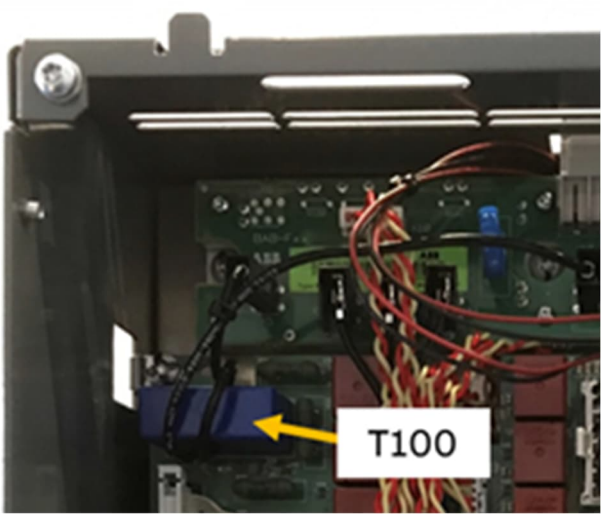
5. To unhinge the electronic tray pull it up and then out.
6. Before removing the electronic tray completely unplug the flat cables (XC12, XS13) and the cable connected at X38.
7. Remove the electronic tray completely.



8. The result looks like this.
9. Remove the air guide, all cables and plugs at the SDCS-PIN-H01.
   - X99 auxiliary power supply.
   - XC12, XS13, X38 flat cables/cable from SDCS-CON-H01 to SDCS-PIN-H01.
   - X4, X5/X6, X15/X10 on the SDCS-BAB-F0x.
   - X30, X31 snubber resistor.
   - X41 … X44 fans supply.
   - X1, X2, X7 line voltage for SDCS-BAB-F0x.
   - X11 firing pulses for SDCS-BAB-F0x.
   - X15 … X18 gate leads.
   - X3 … X5 current transformers.
   - X22 temperature sensor.



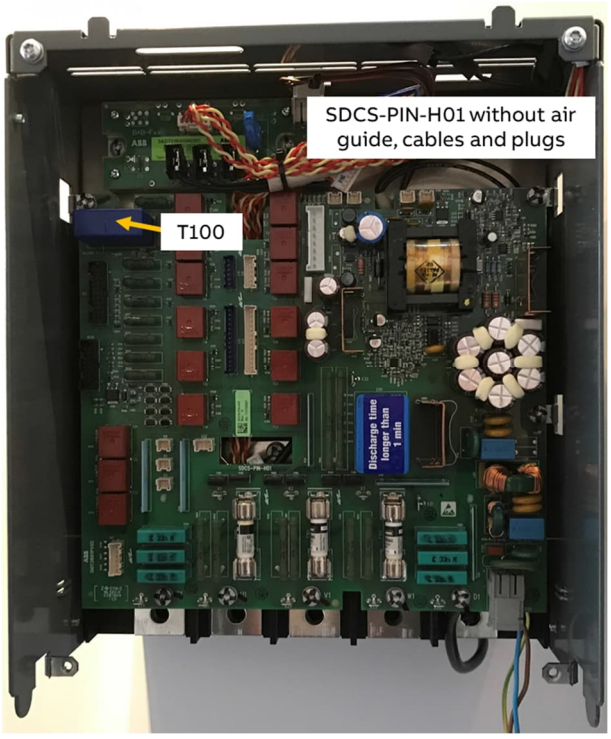
10. Keep the winding direction and the number of windings through T100 in mind:



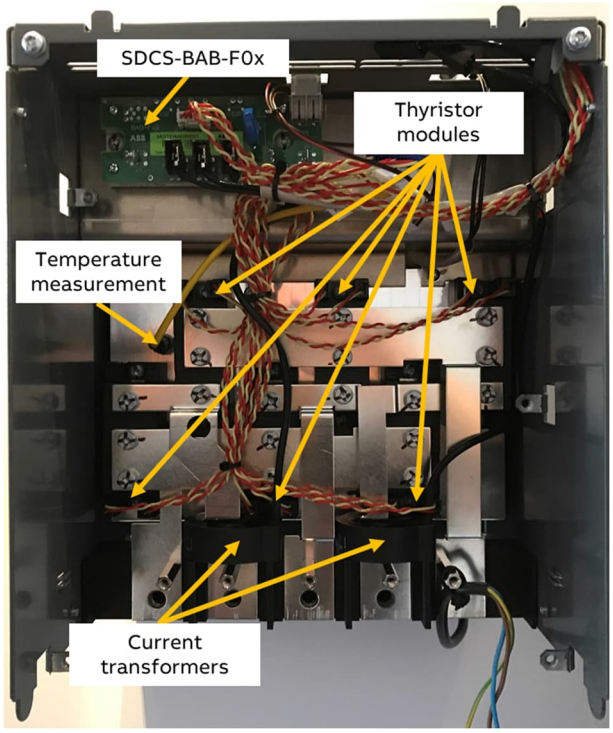
Size	Converter type	Used type	Used fuses	T100 threads	I_F [A]
H1	DCS880-S01-0020 … DCS880-S02-0025	SDCS-BAB-F01	F100 … F102 on SDCS-PIN-H01 KTK 25 = 25 A	4 ①	0.3 … 6
H1	DCS880-S01-0045 … DCS880-S02-0100	SDCS-BAB-F01	F100 … F102 on SDCS-PIN-H01 KTK 25 = 25 A	3 ①	1 … 12
H2	DCS880-S01-0135 … DCS880-S02-0300	SDCS-BAB-F01	F100 … F102 on SDCS-PIN-H01 KTK 25 = 25 A	2 ①	1 … 18
H3	DCS880-S01-0315 … DCS880-S02-0520	SDCS-BAB-F02	F100 … F102 on SDCS-PIN-H01 KTK 25 = 25 A	1 ①	2 … 25
H4	DCS880-S01-0610 … DCS880-S02-1000	SDCS-BAB-F02	F401 … F403 in the converter KTK 30 = 30 A	1 ①	2 … 30

① Number of threads through the hole in the T100 (e.g., 3 threads equal 2 loops).

11. The result should look like this.



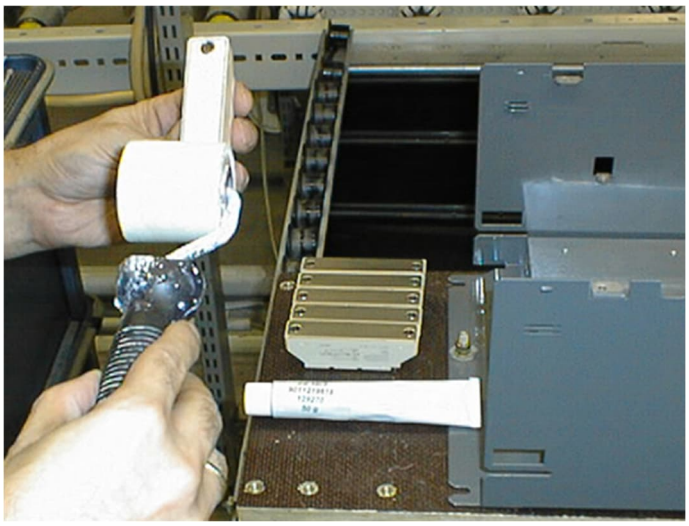
12. Remove the SDCS-PIN-H01.



13. Remove the gate leads from the faulty thyristor module and mark the connectors clearly.
14. Remove the busbars necessary to get full access to the faulty thyristor module.
15. If a current transformer must be removed, mark its position, direction, and the connections clearly.
    Note: Remove only as many parts as needed around the faulty thyristor module.
16. Remove the faulty thyristor module and mark it clearly as defective.

Install new thyristor modules

1. Ensure that the new thyristor module is of the correct type.
2. Remove old heat-conducting compound (grease) from the heat sink. Clean the mounting surfaces (heat sink and thyristor module) with an appropriate solvent (e.g., ethanol) by means of tissue paper. When the heat sink is clean, spread out the heat-conducting compound with a rubber spatula or by hand.
3. Apply a **thin** layer of heat-conducting compound to the new thyristor module.



4. Spread the heat-conducting compound evenly by moving the thyristor module forward and backward on the heat sink.
5. Tighten all clamping screws by hand until the screw heads touch the bottom of the thyristor module. Then pre-torque the screws to 2.0 Nm.

Note: If the thyristor module is mounted by means of four screws, tighten the screws crosswise.

6. Tighten the screws to nominal torque according to table Nominal mounting torque for thyristor modules and SDCS-BAB-F0x.

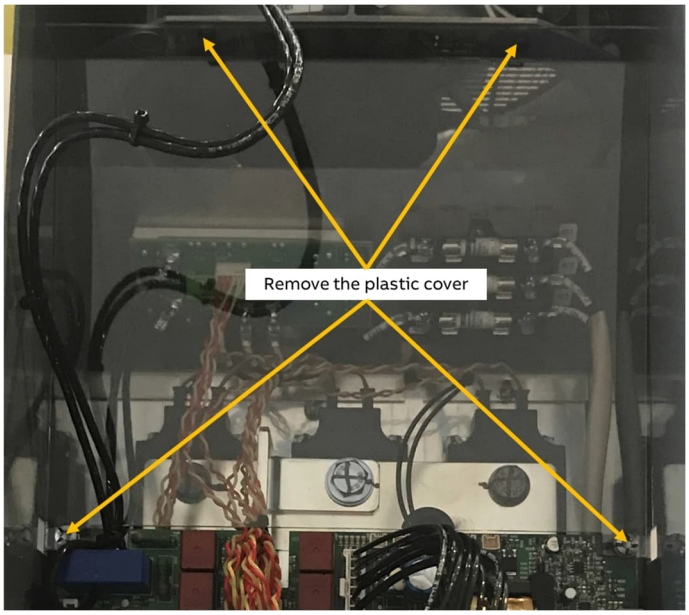
Thyristor modules and SDCS-BAB-F0x		Nominal mounting torque	
Size (width)	**Type**	**Electrical connections**	**Thyristor module to heat sink**
20 mm block	SKKT27, 57, 106	2.6 … 3.4 Nm	4.25 … 5.75 Nm
20 mm block	MCC26, 56, 95	2.5 … 4 Nm	2.5 … 4 Nm
34 mm block	MCC162, 200	4.5 … 5.5 Nm	2.25 … 2.75 Nm
50 mm block	MCC255, 312	11 … 13 Nm	4.5 … 7 Nm
50 mm block	TT250	10.8 … 13.2 Nm	4.25 … 5.75 Nm
60 mm block	MCC501	10.2 … 13.8 Nm	4.25 … 5.75 Nm
60 mm block	MT3	10.8 … 13.2 Nm	5.1 … 6.9 Nm
60 mm block	TT425	10.8 … 12.6 Nm	5.1 … 6.9 Nm
-	SDCS-BAB-F01	-	2.7 … 3.3 Nm
-	SDCS-BAB-F02	1.9 … 2.1 Nm	2.7 … 3.3 Nm

7. Reinstall the current transformer. Make sure its position and direction is correct.
8. Reinstall the busbars. Make sure, the correct torque is applied according to table Nominal mounting torque for thyristor modules and SDCS-BAB-F0x.
9. Reconnect all gate leads to the thyristor module.
10. Perform an OHM test to make sure the thyristor is ok.
11. Reinstall the SDCS-PIN-H01 board.
12. Reconnect all cables and plugs at the SDCS-PIN-H01:
    - X22 temperature sensor.
    - X3 … X5 current transformers.
    - X15 … X18 gate leads.
    - X11 firing pulses for SDCS-BAB-F0x.
    - X1, X2, X7 line voltage for SDCS-BAB-F0x.
    - X41 … X44 fans supply.
    - X30, X31 snubber resistor.
    - X4, X5/X6, X15/X10 on the SDCS-BAB-F0x.
    - XC12, XS13, X38 flat cables/cable from SDCS-CON-H01 to SDCS-PIN-H01.
    - X99 auxiliary power supply.
13. At the SDCS-CON-H01 reconnect the flat cables (XC12, XS13), the cable connected at X38 and rehinge the electronic tray.
14. Reconnect the grounding/holding screws at the electronic tray.
15. Reconnect all I/O plugs with the electronic tray and all connections with the present plug-in options.
16. Reinstall the design cover and the control panel.

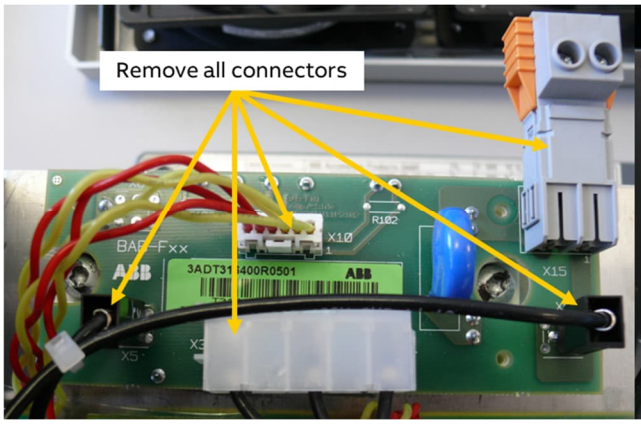
Remove faulty SDCS-BAB-F0x

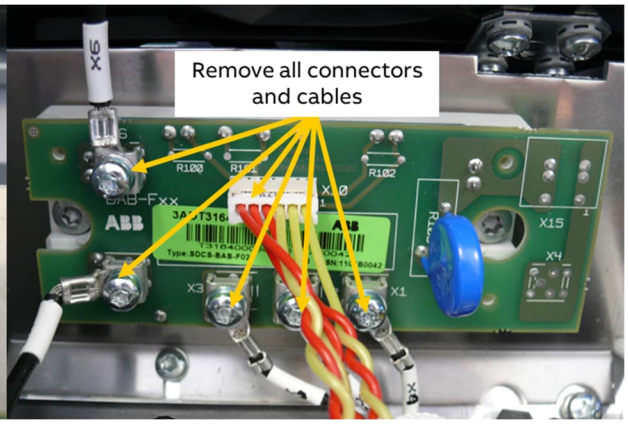
– Follow the instructions Remove faulty thyristor modules until step 8 is done.

9. If it exists, remove the plastic cover.

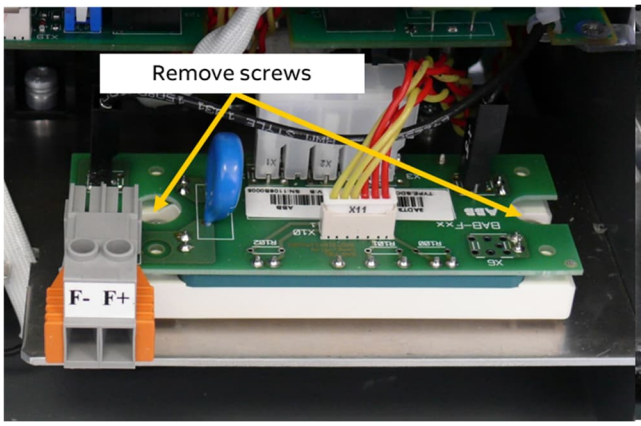


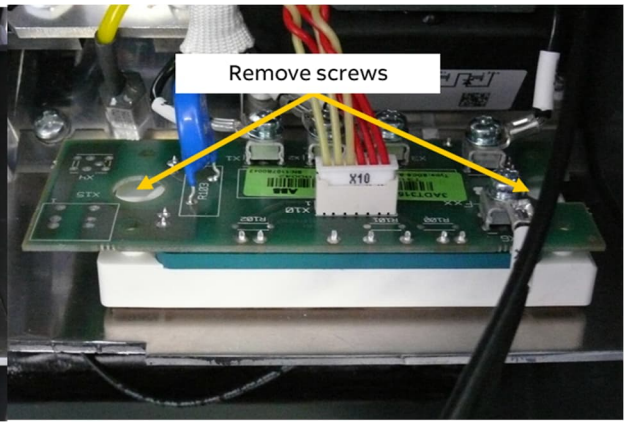
10. Remove all connectors (SDCS-BAB-F01) or cables (SDCS-BAB-F02) from the faulty SDCS-BAB-F0x and mark them clearly.





11. Remove the faulty SDCS-BAB-F0x and mark it clearly as defective.



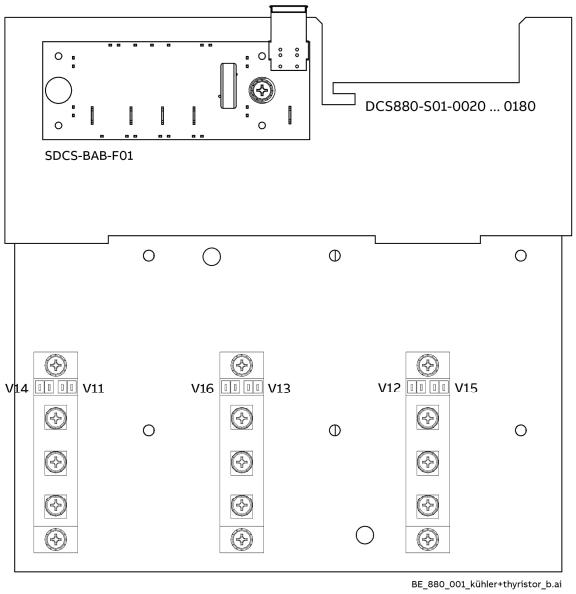


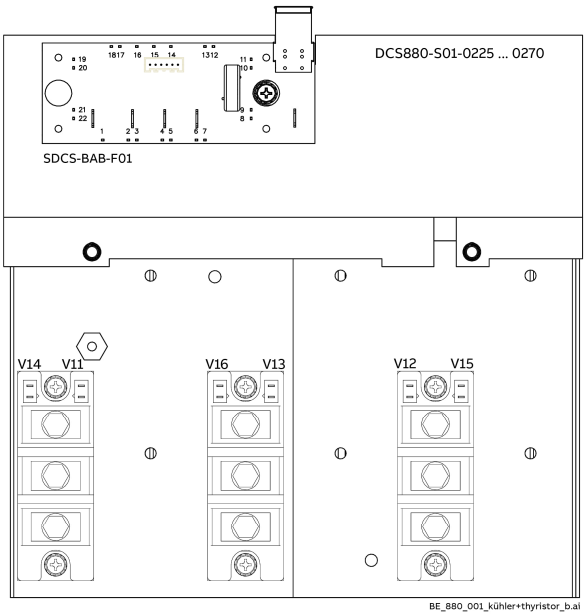
Install new SDCS-BAB-F0x

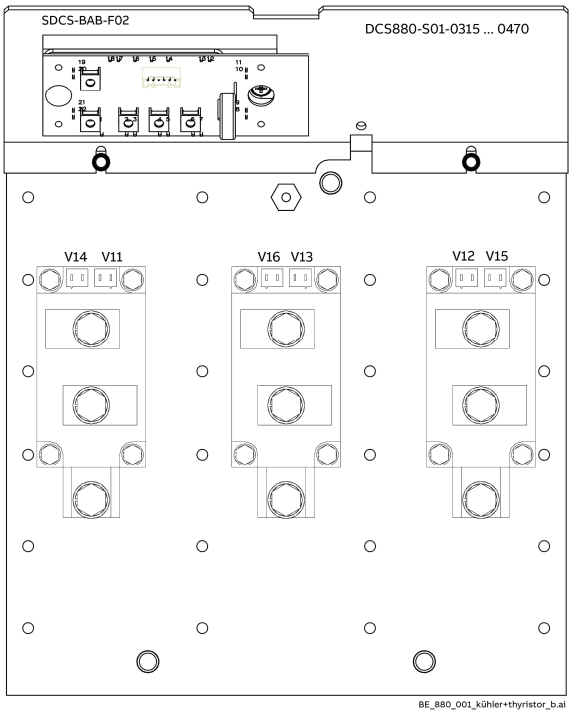
1. Ensure that the new SDCS-BAB-F0x is of the correct type, either SDCS-BAB-F01 or SDCS-BAB-F02.
2. Remove old heat conducting compound (grease) from the heat sink. Clean the mounting surfaces (heat sink and SDCS-BAB-F0x bridge) with an appropriate solvent (e.g., ethanol) by means of tissue paper. When the heat sink is clean, spread out the heat conducting compound with a rubber spatula or by hand.
3. Apply a thin layer of heat conducting compound to the new SDCS-BAB-F0x bridge.
4. Spread the heat conducting compound evenly by moving the SDCS-BAB-F0x forward and backward on the heat sink.
5. Tighten all clamping screws by hand until the screw heads touch the bottom of the thyristor module. Then tighten the screws to 2.0 Nm torque.
6. Tighten the screws to nominal torque according to table Nominal mounting torque for thyristor modules and SDCS-BAB-F0x.
7. Reconnect all connectors or cables to the SDCS-BAB-F0x.
8. If existing, reconnect the plastic cover.
9. Follow the instructions Install new thyristor modules beginning with step 13.

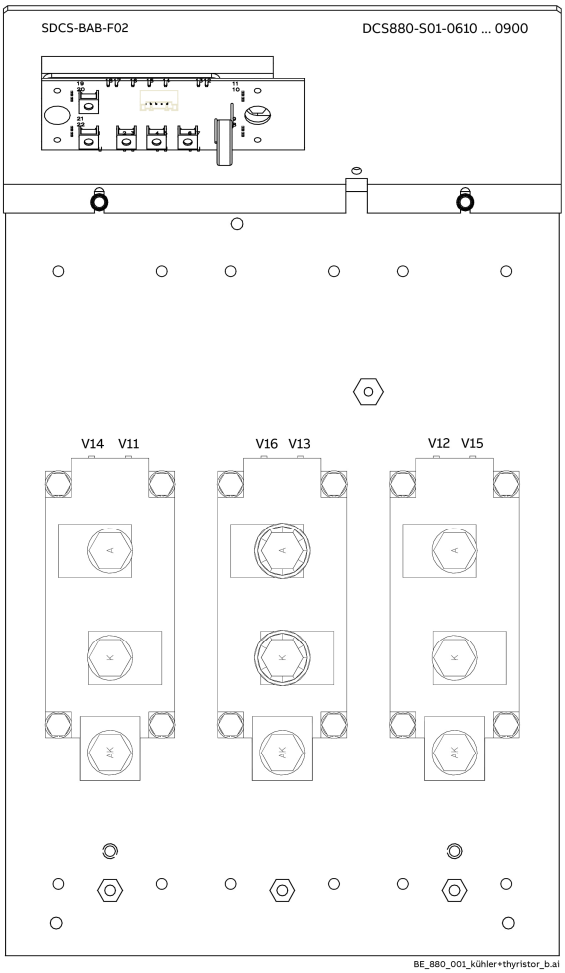
Thyristor module and SDCS-BAB-F0x location in DCS880-S01 (2-Q) converters

400 V_{AC} and 525 V_{AC} types:

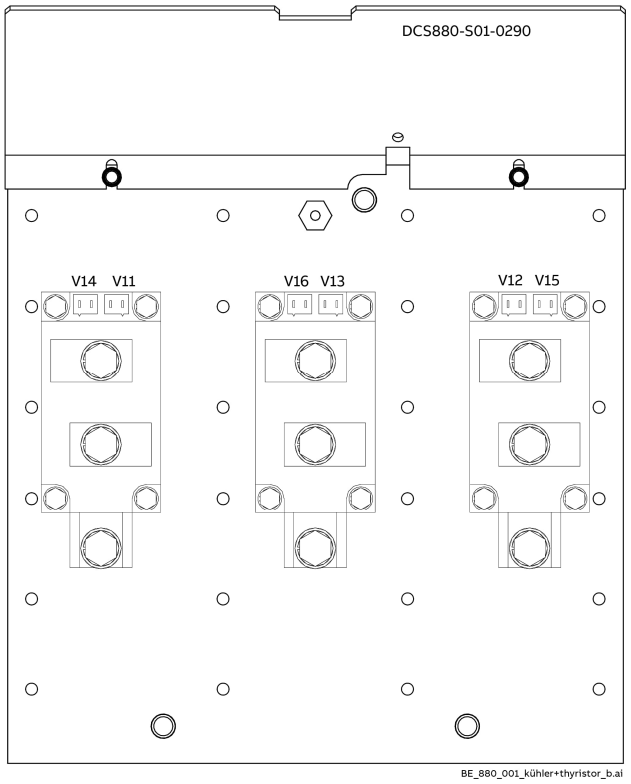


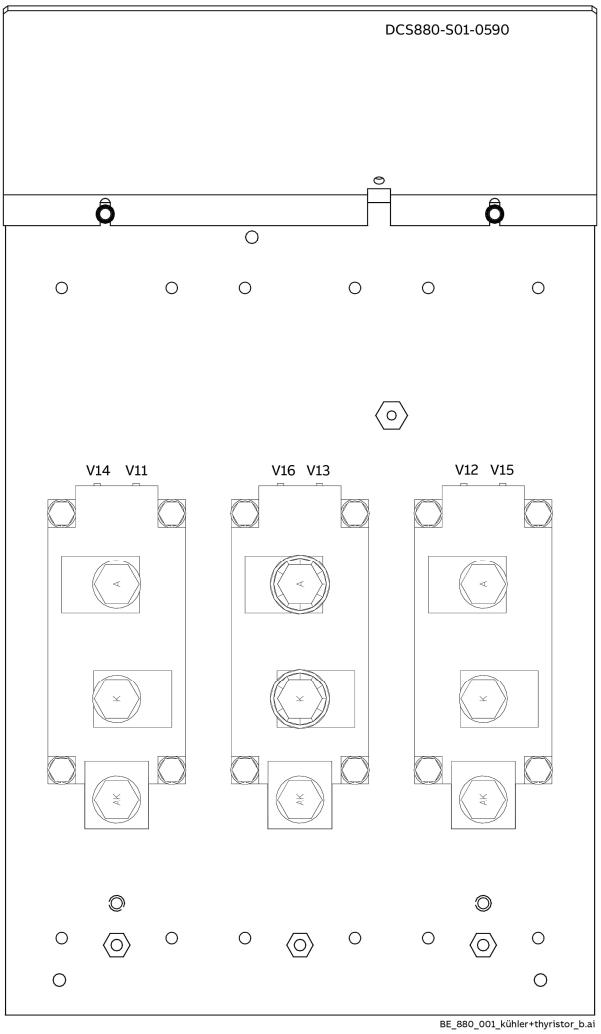






600 V_{AC} types:

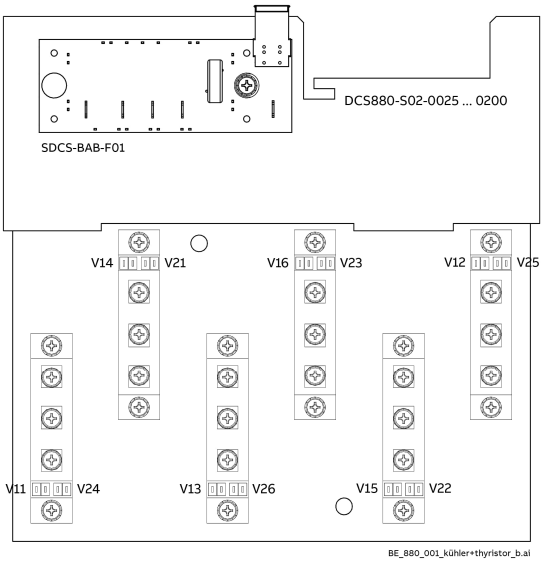


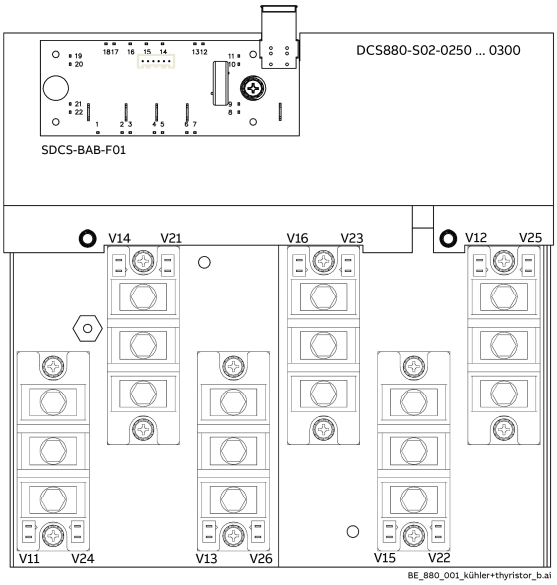


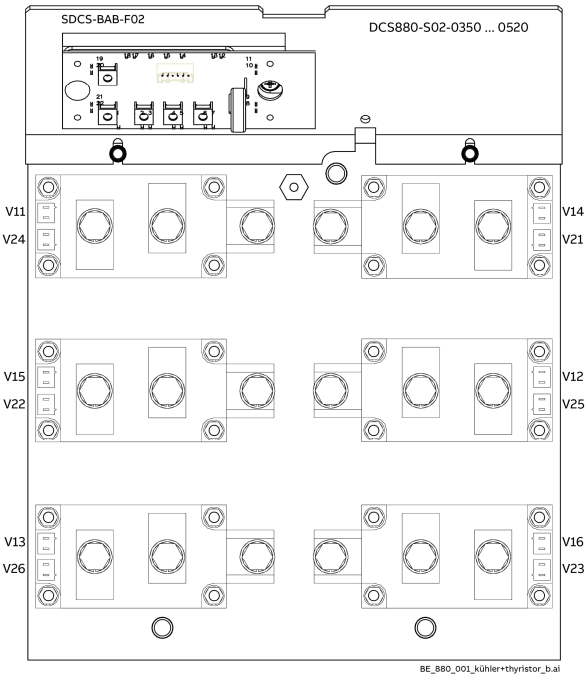
Note: These drawings only show the location of the thyristor modules and the SDCS-BAB-F0x, the actual sizes in the converters are different!

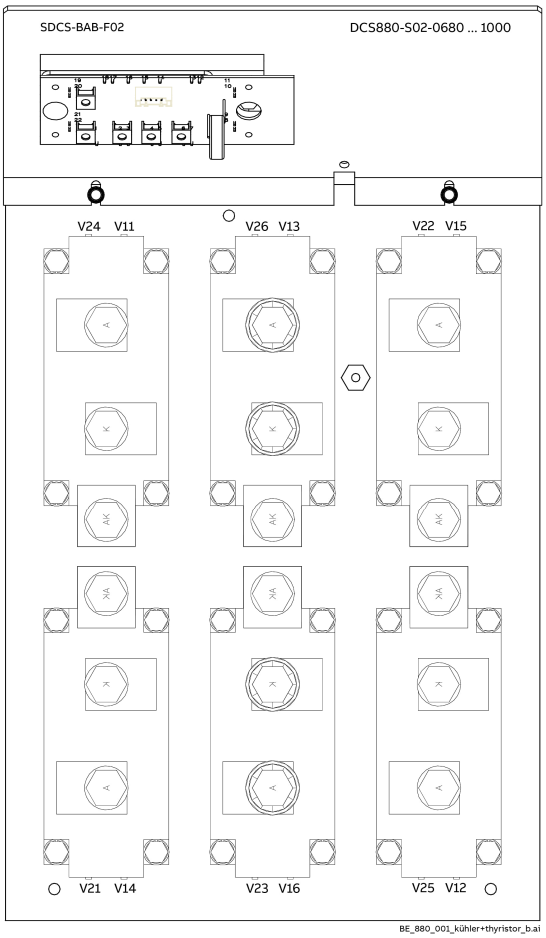
Thyristor module and SDCS-BAB-F0x location in DCS880-S02 (4-Q) converters

400 V_{AC} and 525 V_{AC} types:

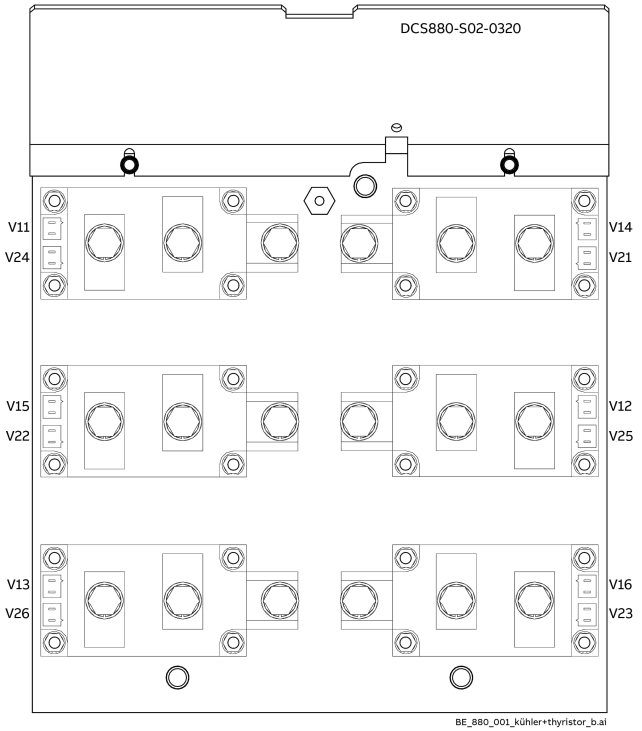


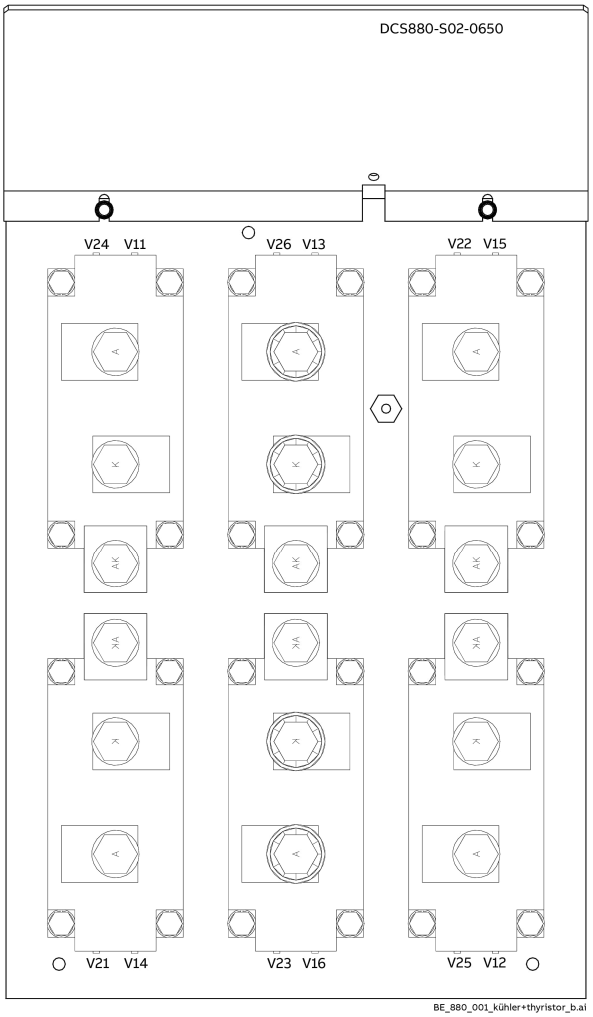






600 V_{AC} types:





Note: These drawings only show the location of the thyristor modules and the SDCS-BAB-F0x, the actual sizes in the converters are different!

Thyristor module terminals and SDCS-BAB-F0x

The terminal description is stamped or marked by a sticker on all thyristor modules and the bridge connected at the SDCS-BAB-F0x.
For all firing pulse cables is valid:

– **Yellow** is gate lead.
– **Red** is cathode lead.

Exchange thyristors sizes H5

Installation of thyristor modules in converters size H5 (1190 A)

All DCS880 size H5 are equipped with thyristor modules. In order to keep the operating temperature of the semiconductor module low, the joint between the heat sink and the module should have good heat conducting ability. The electrical conductivity of the connectors must also be good. For this reason, the following instructions must be observed with particular care.

Required tools

Special tools or material needed in addition to standard tools for the exchange of thyristor modules:

– Torx screwdrivers:	TX10, TX20, TX25
– Torque spanner:	Mounting torques for the thyristor modules to heat sink and electrical connections see table Nominal mounting torque for H5 thyristor modules.
– Torque spanner for electrical connections:	13Nm (M8) 25 Nm (M10) 50 Nm (M12)
– Screws are metric type; use appropriate nuts.	
– Tissue paper.	
– Solvent (e.g., ethanol).	
– Thermal joint compound (non-conducting) for thyristor modules: or	GHSN390011P0010 Type Berulub FZ1 E3
– Thermal joint compound (conducting) for thyristor modules and disk type thyristors:	GHSN390001P0001 Type Berulub FK-SU 2

Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

Find faulty thyristor modules

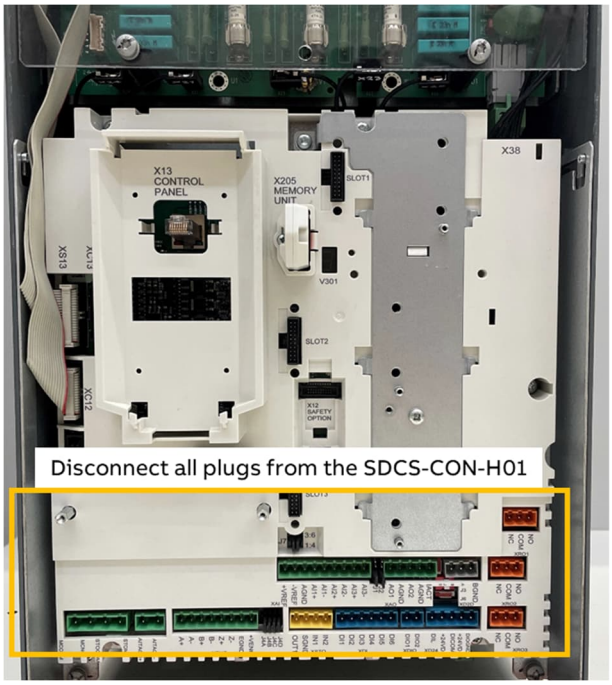
See Fault Tracing Thyristors of this publication.

Remove faulty thyristor modules

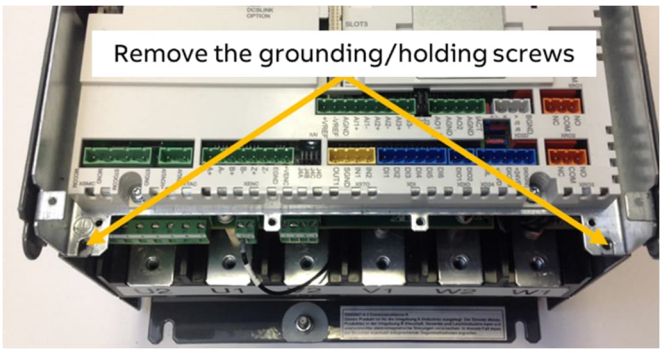
Recommendation:
Use safety equipment to protect your hands.

1. Remove control panel and design cover.

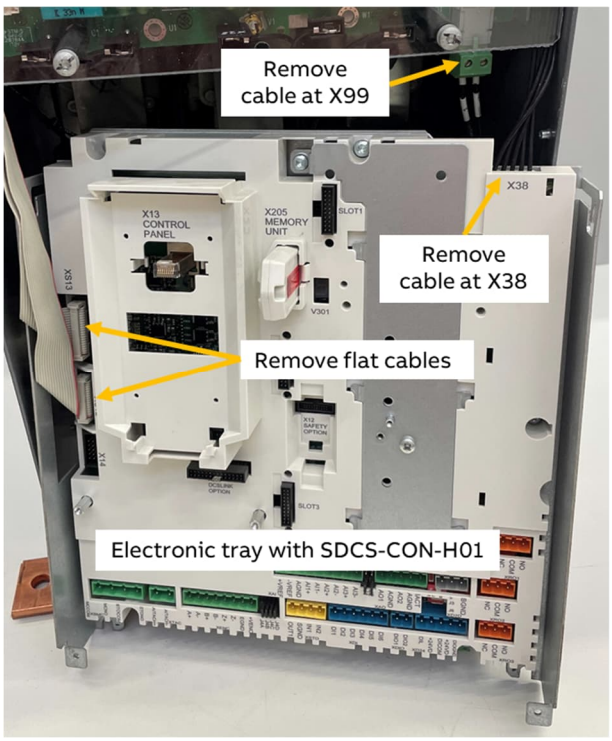
2. Disconnect all I/O plugs from the electronic tray.
3. Disconnect all connections from present plug-in options.



4. Remove the grounding/holding screws from the electronic tray.

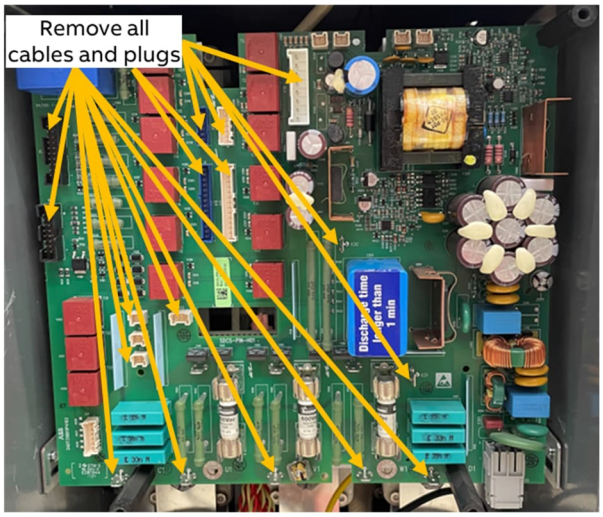


5. To unhinge the electronic tray pull it up and then out.
6. On the electronic tray unplug the flat cables (XC12, XS13) and the cable connected at X38.
7. On the SDCS-PIN-H01 unplug the cable at X99.
8. Remove the electronic tray completely.

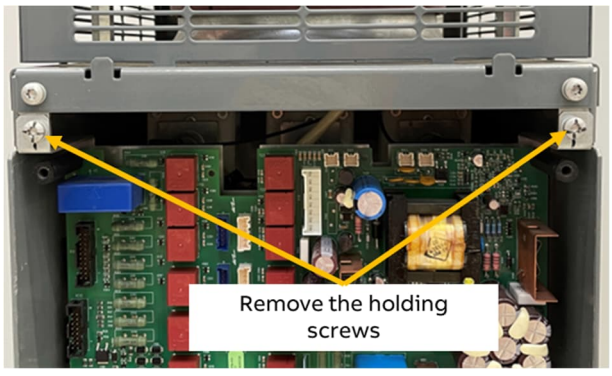


9. Remove the plastic cover.

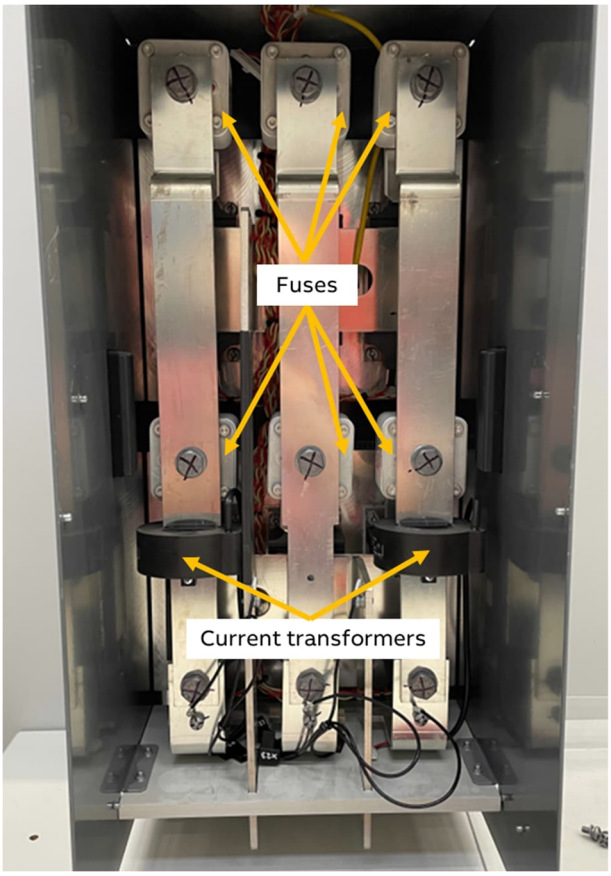
10. Remove all cables and plugs at the SDCS-PIN-H01.



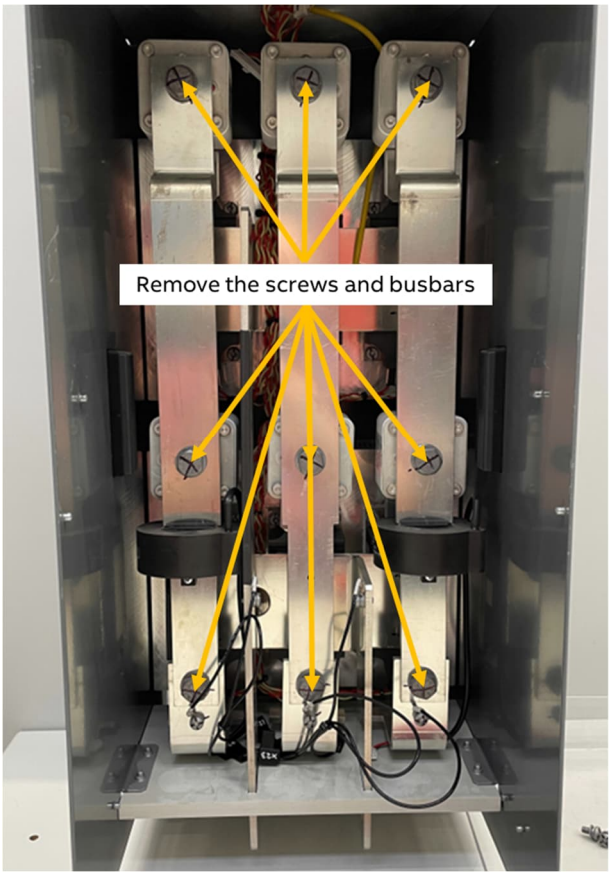
11. Remove the holding screws.
12. To unhinge the electronic tray including the SDCS-PIN-H01 pull it up and then out.



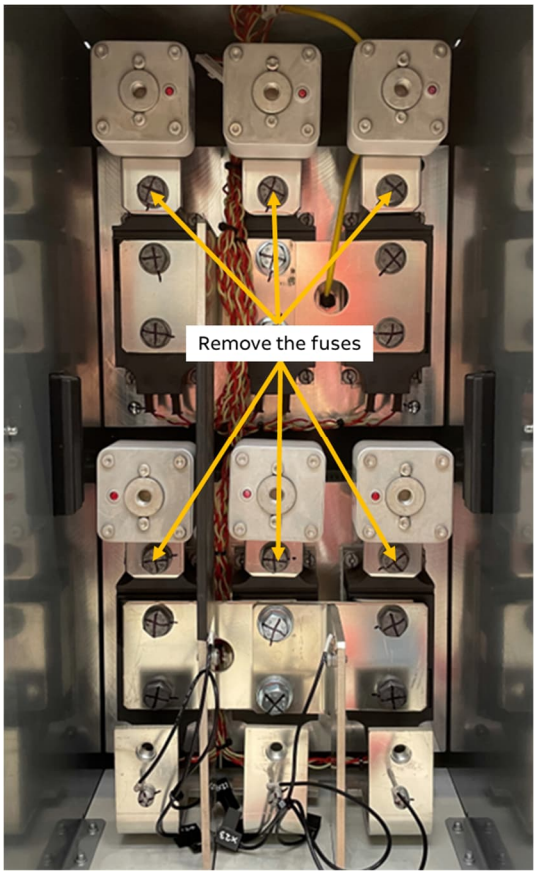
13. After the electronic tray including the SDCS-PIN-H01 is removed.



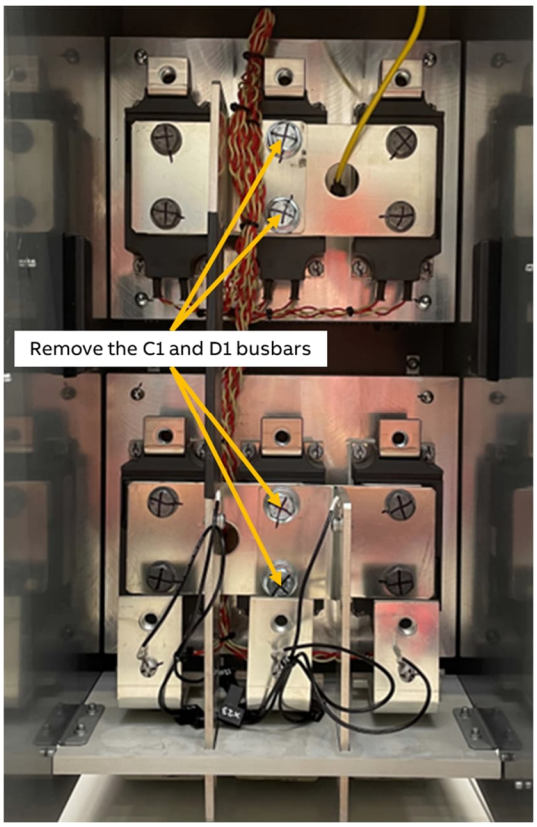
14. To remove the U1, V1 and W1 busbars, loosen the screws using a spanner (nut size 17).



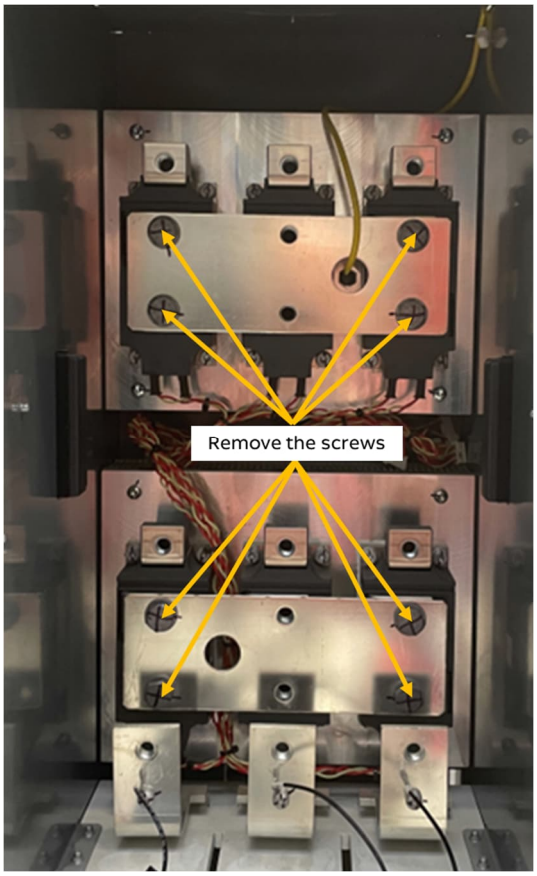
15. To remove the fuses, loosen the screws using a spanner (nut size 17)



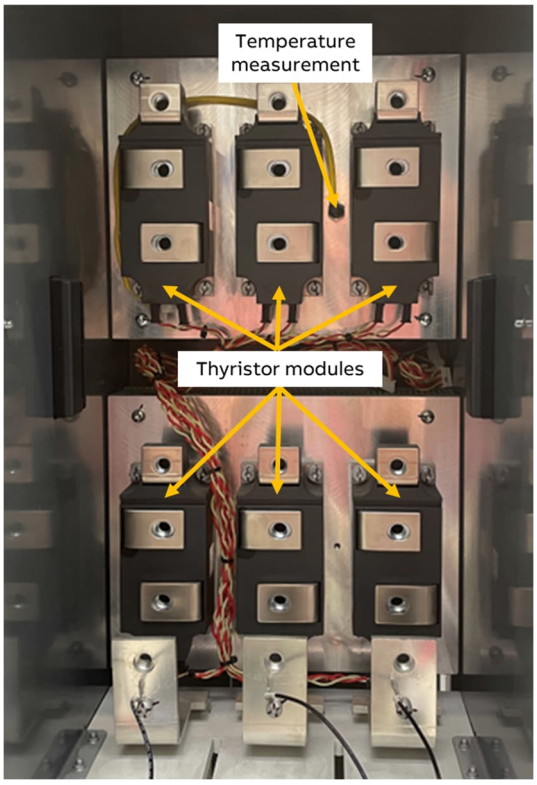
16. To remove the C1 and D1 busbars loosen the screws using a spanner (nut size 17).



17. To remove the busbars, loosen the screws using a spanner (nut size 17).



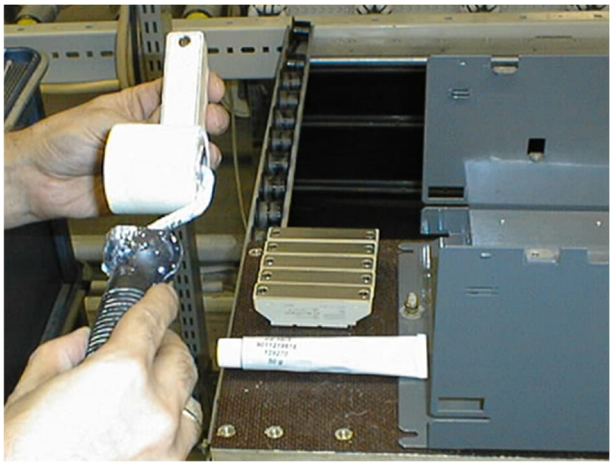
18. Check the thyristors.



19. Remove the gate leads from the faulty thyristor module and mark the connectors clearly.
20. Remove only as many parts as needed around the faulty thyristor module.
21. Remove the faulty thyristor module and mark it clearly as defective.

Install new thyristor modules

1. Ensure that the new thyristor module is of the correct type.
2. Remove old heat-conducting compound (grease) from the heat sink. Clean the mounting surfaces (heat sink and thyristor module) with an appropriate solvent (e.g., ethanol) by means of tissue paper. When the heat sink is clean, spread out the heat-conducting compound with a rubber spatula or by hand.
3. Apply a **thin** layer of heat conducting compound to the new thyristor module.



4. Spread the heat-conducting compound evenly by moving the thyristor module forward and backward on the heat sink.
5. Tighten all clamping screws by hand until the screw heads touch the bottom of the thyristor module. Then pre-torque the screws to 2.0 Nm.
   Note: If the thyristor module is mounted by means of four screws, tighten the screws crosswise.
6. Tighten the screws to nominal torque according to table Nominal mounting torque for H5 thyristor modules.

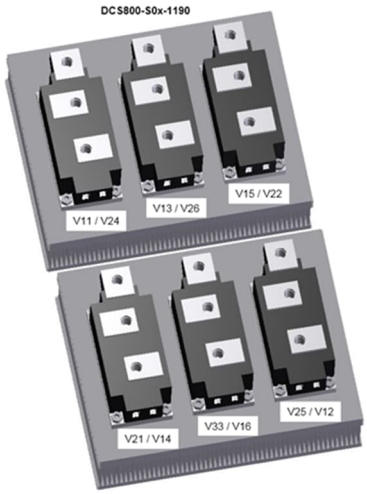
Nominal mounting torque for H5 thyristor modules

Thyristor modules		Nominal mounting torque	
Size (width)	**Type**	**Electrical connections**	**Thyristor module to heat sink**
60 mm block	MT3-595	12 Nm	6 Nm

7. Reconnect all gate leads to the thyristor module.
8. Perform an OHM test to make sure the thyristor is ok.
9. Reinstall the busbars. Make sure the correct torque is applied according to table Nominal mounting torque for H5 thyristor modules.
10. Reinstall the C1 and D1 busbars. Make sure the correct torque is applied according to table Nominal mounting torque for H5 thyristor modules.
11. Reinstall the fuses. Make sure the correct torque is applied according to table Required tools.
12. Reinstall the U1, V1 and W1 busbars. Make sure, the correct torque is applied according to table Required tools.
13. Re-hinge the electronic tray of the SDCS-PIN-H01 board.
14. Reconnect all cables and plugs at the SDCS-PIN-H01:
    - X30, X31 snubber resistor.
    - X22 temperature sensor.
    - X3, X5 current transformers.
    - First X15, X17 then X16, X18 gate leads.
    - X24, X21, X25, X23, X20 voltage measurement.
    - XC12, XS13, X38 flat cables/cable from SDCS-CON-H01 to SDCS-PIN-H01. Use the lock connectors at the SDCS-PIN-H01.

15. Reinstall the electronic tray including the SDCS-PIN-H01 using the two holding screws at the electronic tray.
16. Reinstall the plastic cover.
17. Reconnect the flat cables at the SDCS-CON-H01 (XS13, XC12, X38), then X99 at the SDCS-PIN-H01 and re-hinge the electronic tray.
18. Reconnect the grounding/holding screws at the electronic tray including the SDCS-CON-H01.
19. Reconnect all I/O plugs with the electronic tray and all connections with the present plug-in options.
20. Reinstall the design cover and the control panel.

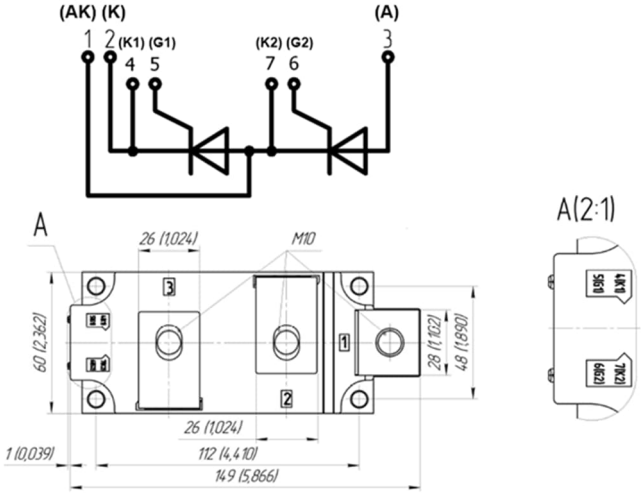
Thyristor module location in DCS880-S0x (2-Q and 4-Q) converters



Notes:
- Both 2-Q and 4-Q converters feature 6 thyristor modules.
- This drawing is only showing the location of the thyristor modules, the actual size in the converter is different!

Thyristor module terminals

The next figures show the terminals of the used thyristor modules. The terminal description is also stamped or marked by a sticker on the thyristor modules.
For all firing pulse cables is valid:
- **Yellow** is gate lead.
- **Red** is cathode lead.



MT3-595

Exchange thyristors size H6

Installation of thyristors in converters size H6 (900 ... 2000 A)

All DCS880 converters size H6 are equipped with disk type thyristors. The structure of the disc type semiconductor component is such that it requires a certain compression force to operate. The prevention of overheating of the component depends on good heat dissipation between the semiconductor and the conducted heat sink. It is thus important that all joints have good thermal and electrical conduction.

Required tools

Special tools or material needed in addition to standard tools for the exchange of thyristors:

– Torx screwdrivers:	TX10, TX20, TX25.
– Torque spanner for electrical connections:	13Nm (M8). 25 Nm (M10). 50 Nm (M12).
– Screws are metric type; use appropriate nuts.	
– 17 mm ring spanner for fuse and busbar connections.	
– 17 mm ring spanner for press clamp.	
– Tissue paper.	
– Solvent (e.g., ethanol).	
– Thermal joint compound (conducting) for thyristor modules and disk type thyristors:	GHSN390001P0001 Type Berulub FK-SU 2
– Disassembly tool:	3ADT621023P0001.

Note: For more detailed information about the wiring of the power part, see DCS880 Hardware Manual (3ADW000462).

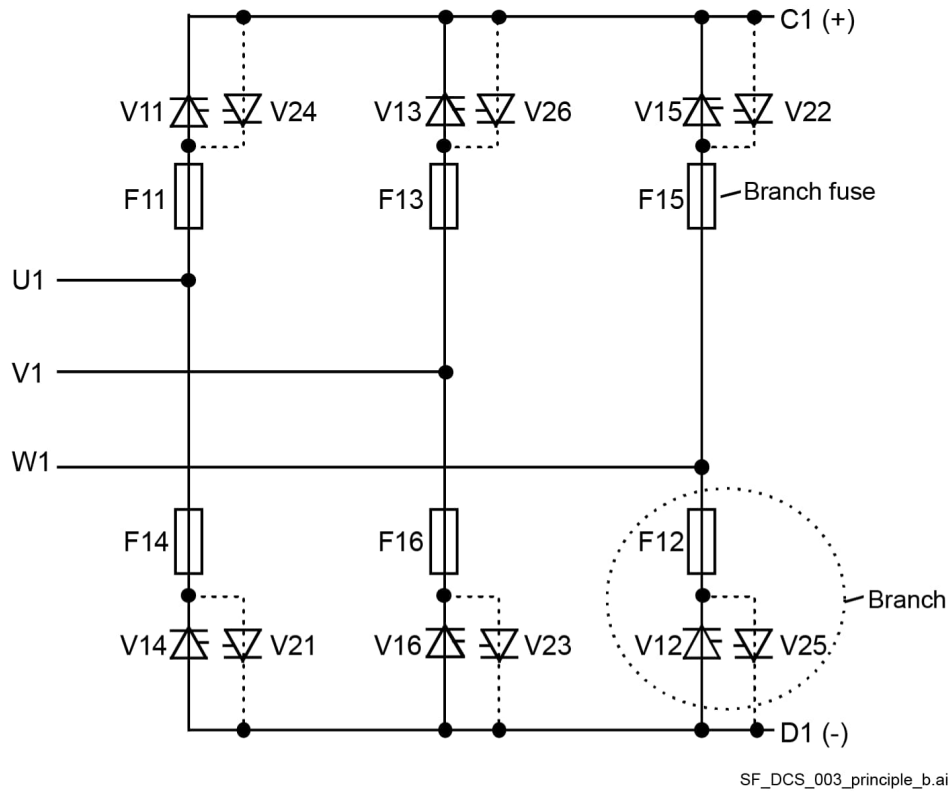
Therefore, strict observance of the building instructions given below is of utmost importance. Make sure that the new component can replace the old one.
Semiconductors and heat sinks are to be handled carefully to avoid scratches and other damage. Avoid touching the contact surfaces. Do not lift the semiconductor with the gate wire. Do not lift the semiconductor by touching the current contact surfaces. Do not damage the welding flange or the contact surface.

Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

Find faulty thyristors

Recommendation:
Use safety equipment to protect your hands.

1. Check the branch fuses by performing an OHM test.
2. Find the defective branches by performing an OHM test (both polarities) between U1, V1, W1 and C1, D1.



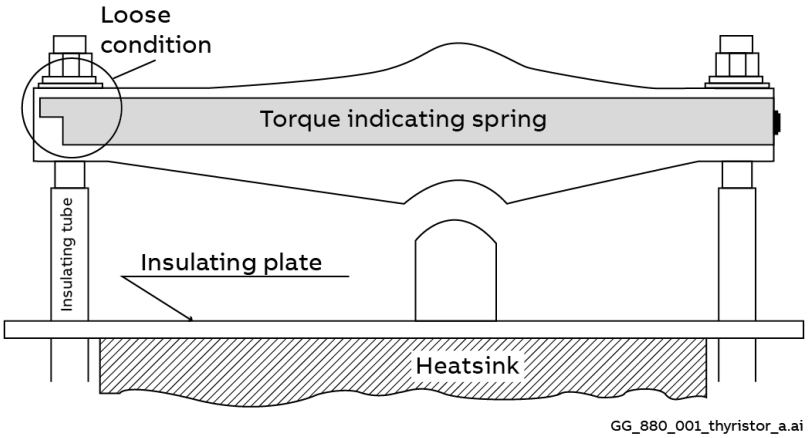
Bridge configuration H5 … H8

3. Disconnect the branching fuses of the defective branches.
4. Find the defective thyristors by performing an OHM test (both polarities) over their heat sinks.
5. In a 4-quadrant converter exchange **both** thyristors clamped between the same heatsinks.

Note: Because “Disc Type” semiconductors need a certain compression force to operate properly, a measurement outside the clamped heat sinks might be wrong.

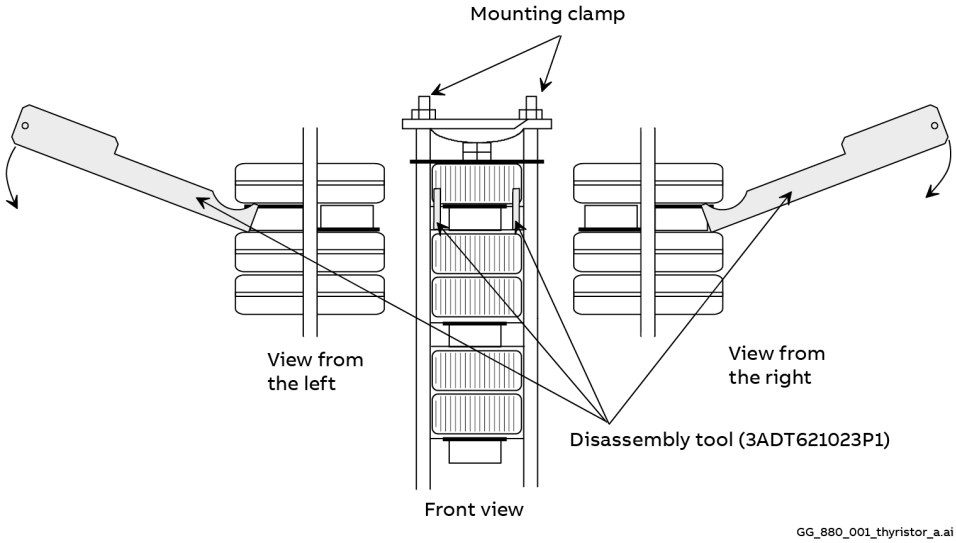
Remove faulty thyristors

1. Remove the screws of the DC-busbars and branch fuses preventing the stack to be prized open.
   Note: It depends on the location of the defective thyristor which DC-busbar and fuses have to be disconnected.
2. Write down the direction and location of the thyristors to be removed and mark their gate leads.
3. Remove the gate leads if possible.
4. Loosen the mounting clamp at the top of the thyristor stack.



Attention: While loosening the mounting clamp the indicating spring must be pulled out a little, otherwise the spring will be damaged!
Do not remove the nuts totally, otherwise the treaded rods will fall down!

5. Attach the disassembly tool (3ADT621023P1) at the faulty thyristor and prize open the upper and lower heat sinks.

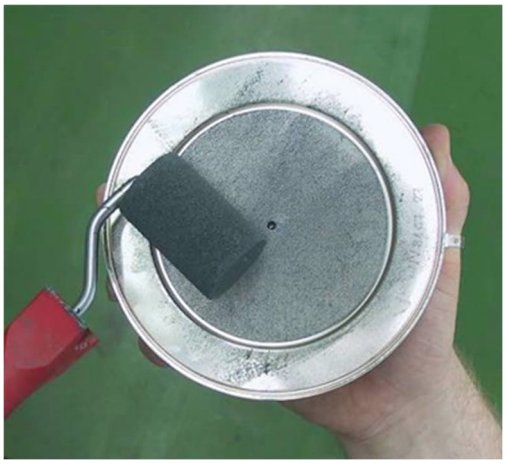


6. Remove the thyristors.

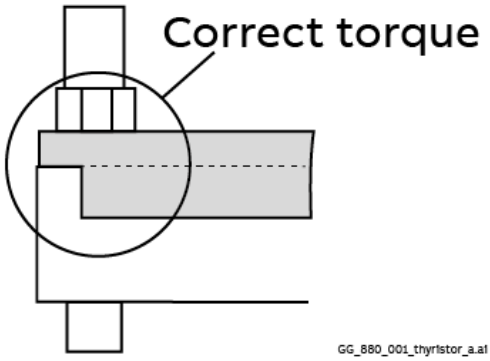
Attention: To center the thyristors spring pins are used. The pins are inlayed into all lower heat sinks. Open the gap wide enough so that the thyristor and the pins are not damaged while removing the thyristor!

Install new thyristors

1. Ensure that the new thyristor is of the correct type. Keep the semiconductor and its surroundings clean.
   Note: Do not touch the polished surfaces of the thyristor.
2. Clean all parts with tissue paper moistened with solvent, which have had or will have contact with the thyristor or each other (lower/upper heat sink). Do not clean the surfaces of grease too thoroughly, because the aluminum surfaces will oxidize in a few seconds. Dry all surfaces.
3. Clean the polished surfaces of the semiconductor with a piece of tissue paper moistened with solvent. Dry all surfaces. Spread a **thin** layer of conducting paste on both sides of the thyristor, if necessary, use a rubber spatula.



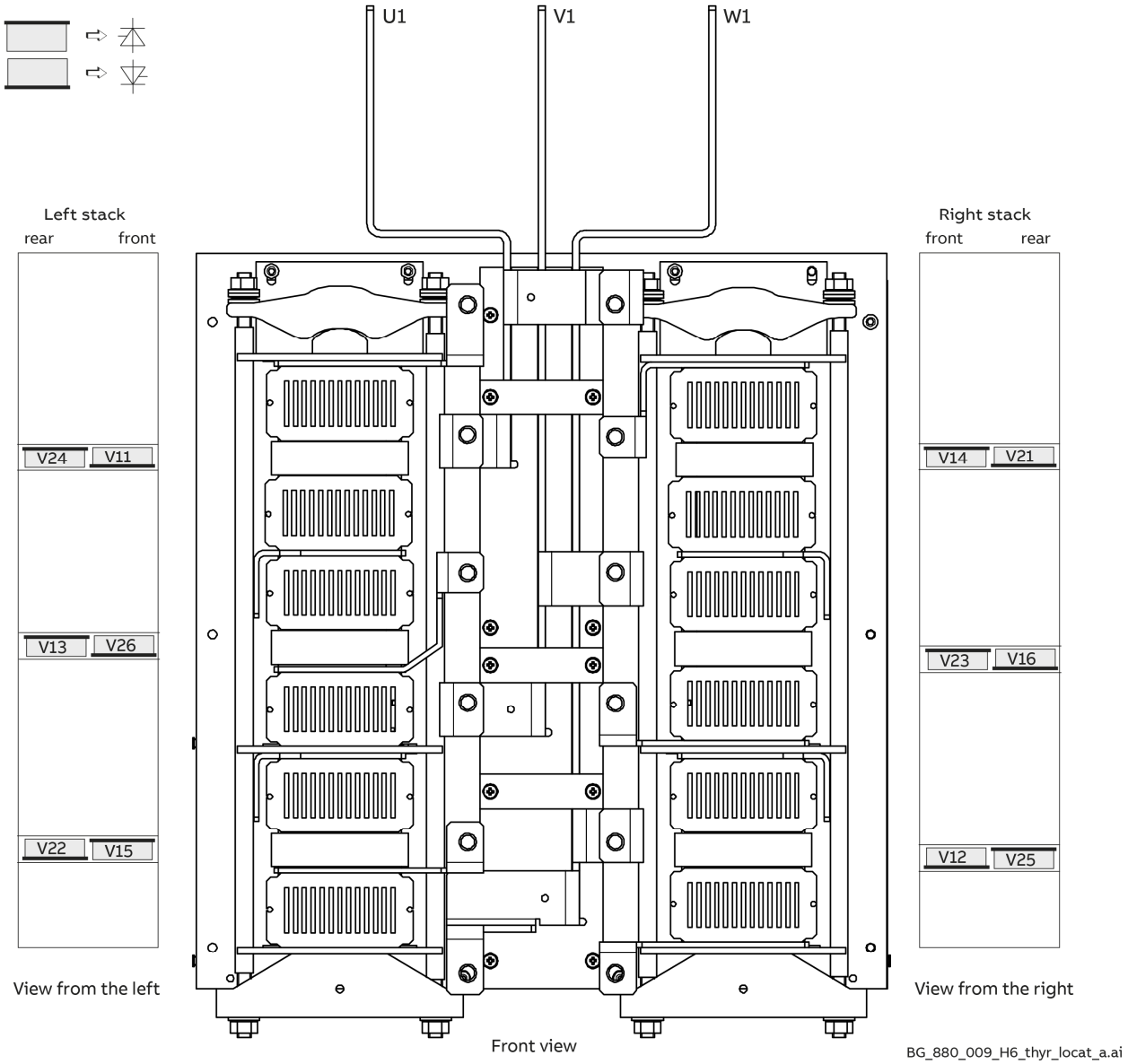
4. Connect the gate leads if possible.
5. Centre the thyristors by means of the spring pins.
   Note: Be sure that the thyristor is installed in the right direction. Do not pinch or cut the gate leads or any other cable.
6. Turn the thyristor so that the gate leads point in the right direction.
7. Tighten the nuts of the mounting clamp by hand so that the clamp is parallel with the contact surface of the heat sinks.
   Note: The indicating spring is an extremely sensitive instrument and must be handled with care.
8. Tighten each nut in turn, half a turn at a time with the help of a ring spanner until the indicating spring clicks into position “correct torque”. Do not tighten the screws any further.



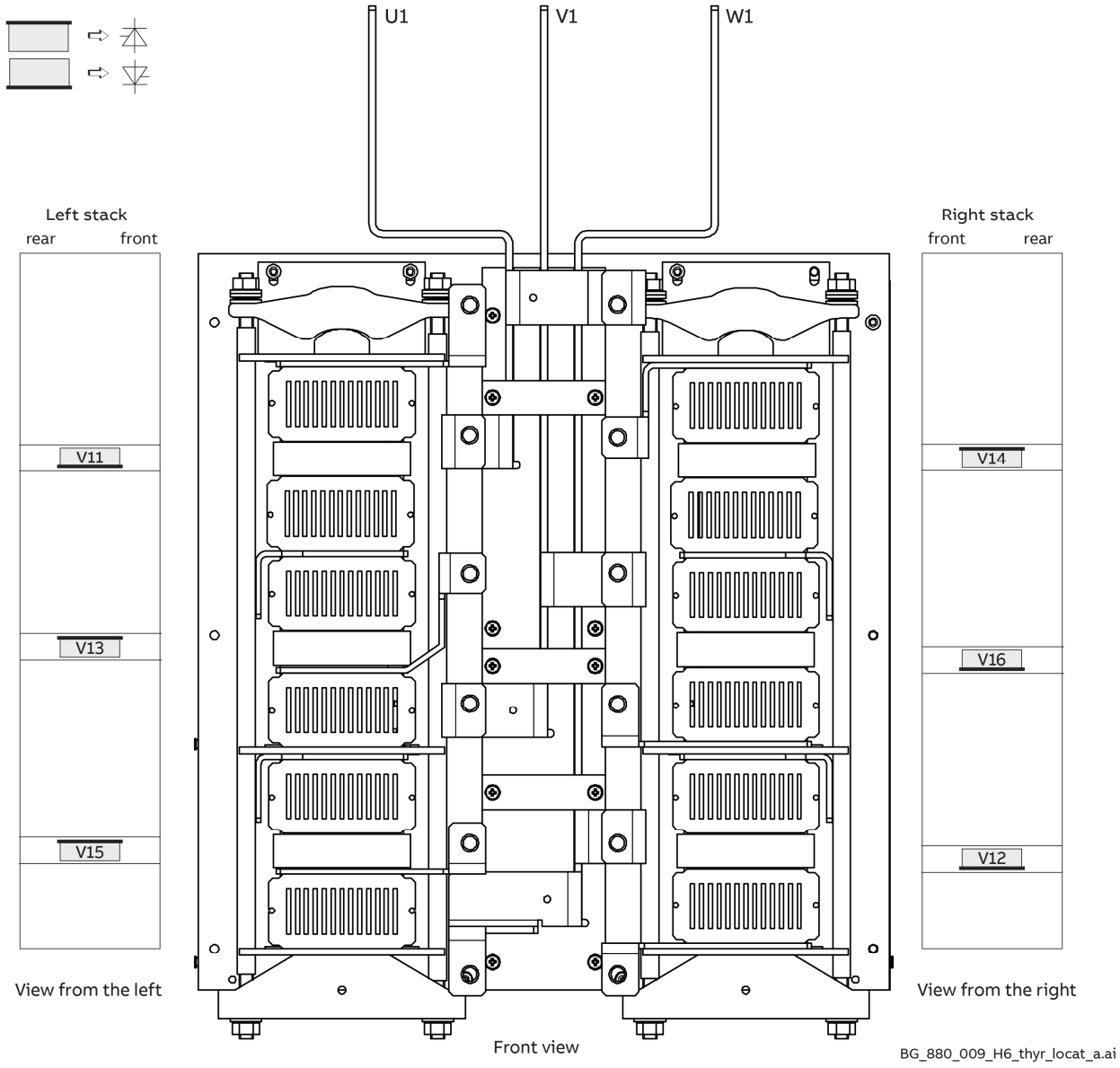
   Note: The correct torque is indicated by means of the welded indicating spring.
9. Perform an OHM test to make sure the thyristor is ok.
10. Reconnect the DC-busbars, branch fuses and all other dismantled parts.
11. Perform an OHM test between U1, V1, W1 and C1, D1 to make sure the power part is ok.

Location of thyristors in converters size H6 (4-Q bridge)

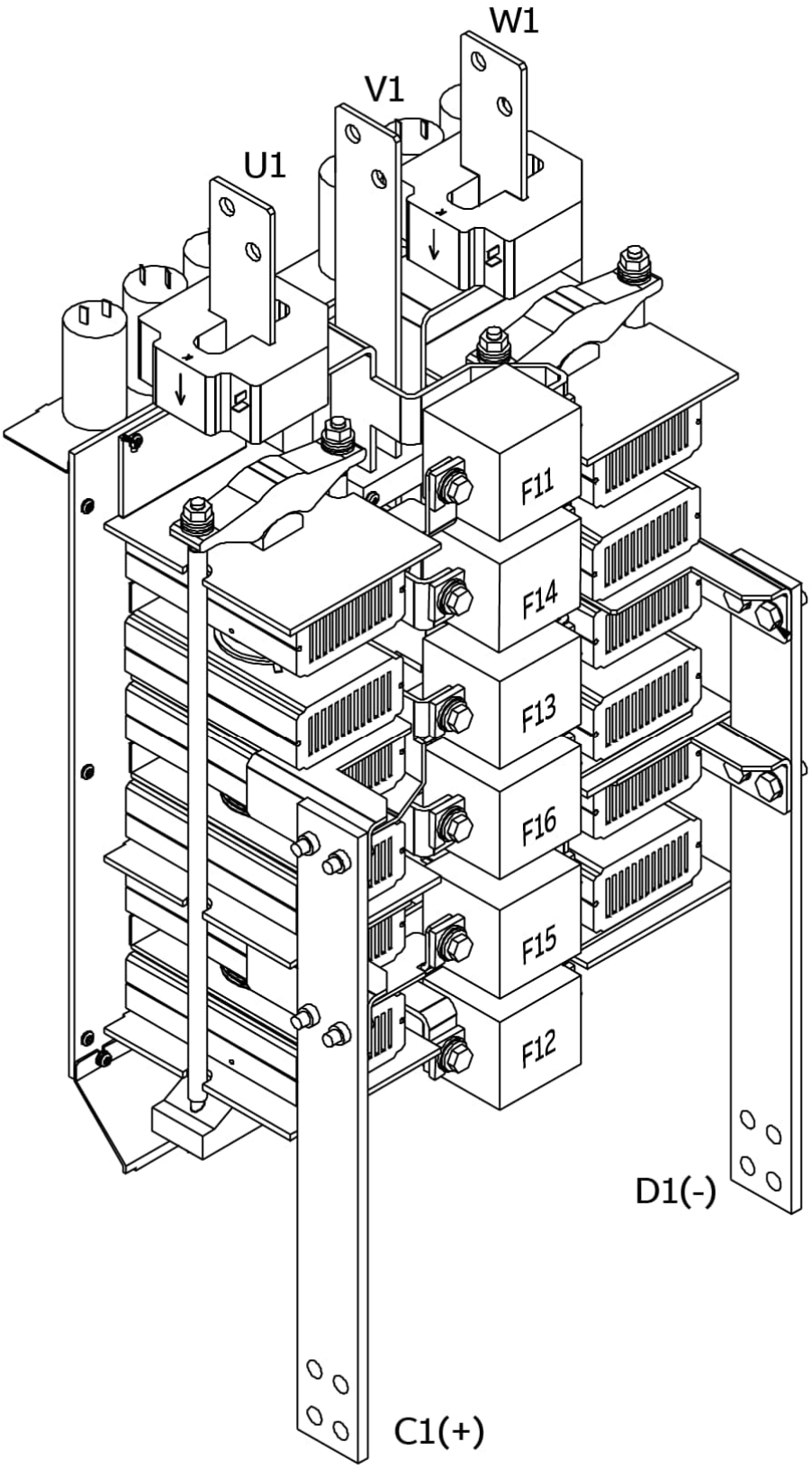
Attention: Exchange **both** thyristors clamped between the same heatsinks.



Location of thyristors in converters size H6 (2-Q bridge)



Location of branch fuses in converters size H6



BG_880_008_H6_fuse_locat_a.ai

Exchange thyristors size H7

Installation of thyristors in converters size H7 (1900 ... 3000 A)

All DCS880 converters size H7 are equipped with disk type thyristors. The structure of the disc type semiconductor component is such that it requires a certain compression force to operate. The prevention of overheating of the component depends on good heat dissipation between the semiconductor and the conducted heat sink. It is thus important that all joints have good thermal and electrical conduction.

Required tools

Special tools or material needed in addition to standard tools for the exchange of thyristors:

- Torx screwdrivers: TX10, TX20, TX25.
- Torque spanner for electrical connections: 13Nm (M8). 25 Nm (M10). 50 Nm (M12).
- Screws are metric type; use appropriate nuts.
- 17 mm ring spanner for fuse and busbar connections.
- 24 mm ring spanner for press clamp.
- Tissue paper.
- Solvent (e.g., ethanol).
- Thermal joint compound (conducting) for thyristor modules and disk type thyristors: GHSN390001P0001 Type Berulub FK-SU 2
- Disassembly tool: DCF1066721P0001.

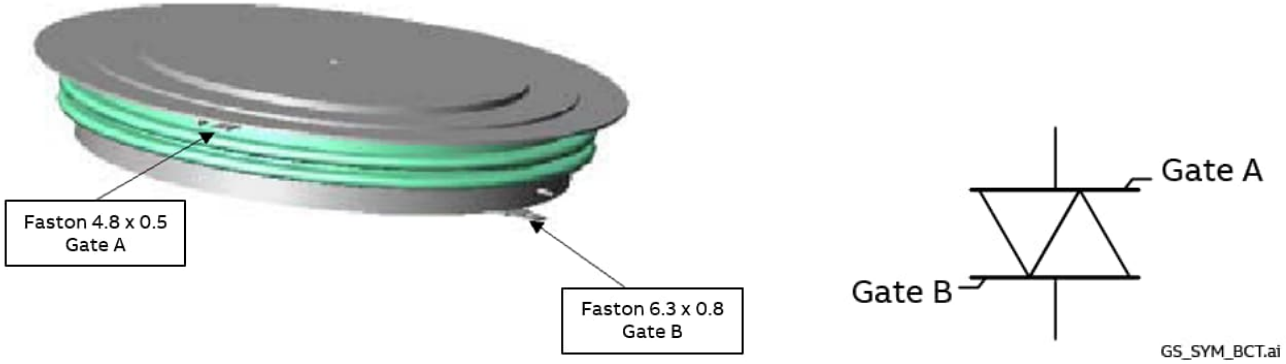
Note: For more detailed information about the wiring of the power part, see DCS880 Hardware Manual (3ADW000462).

Therefore, strict observance of the building instructions given below is of utmost importance. Make sure that the new component can replace the old one.
Semiconductors and heat sinks are to be handled carefully to avoid scratches and other damage. Avoid touching the contact surfaces. Do not lift the semiconductor with the gate wire. Do not lift the semiconductor by touching the current contact surfaces. Do not damage the welding flange or the contact surface.

Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

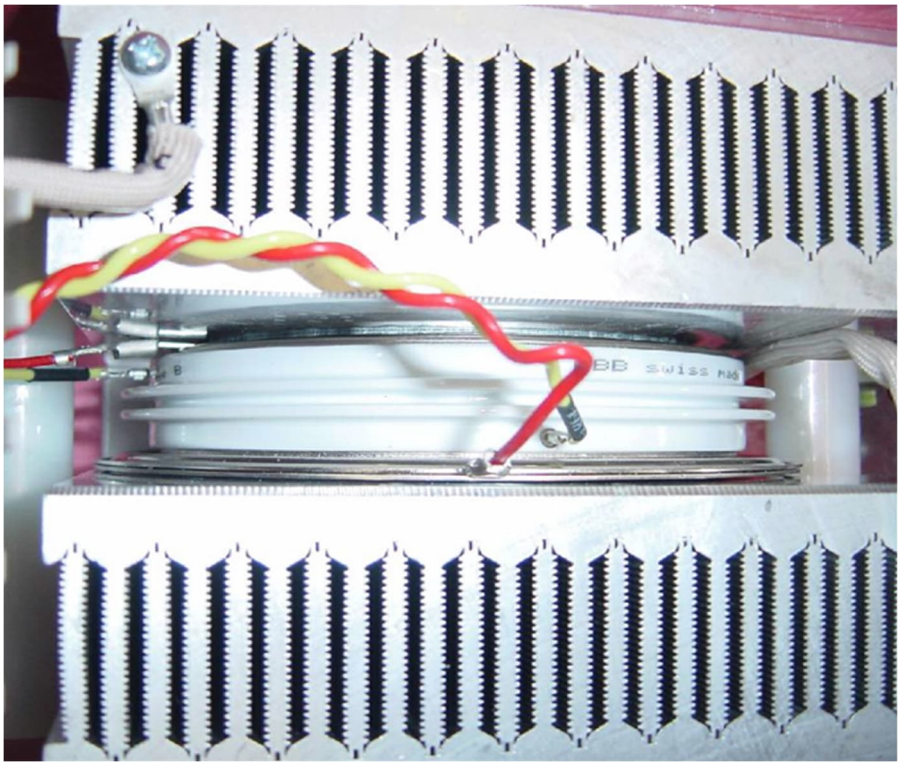
Bidirectional-Controlled-Thyristors (BCTs)

In some converters size H7 so called BCTs (**B**idirectional-**C**ontrolled-**T**hyristors) are used. BCTs are a pair of anti-parallel thyristors in one disk type housing. They can easily be identified by the second pair of gate leads. The second gate is marked with **Gate B** on the thyristor:



Note: The Faston connectors of the gates are of different sizes.

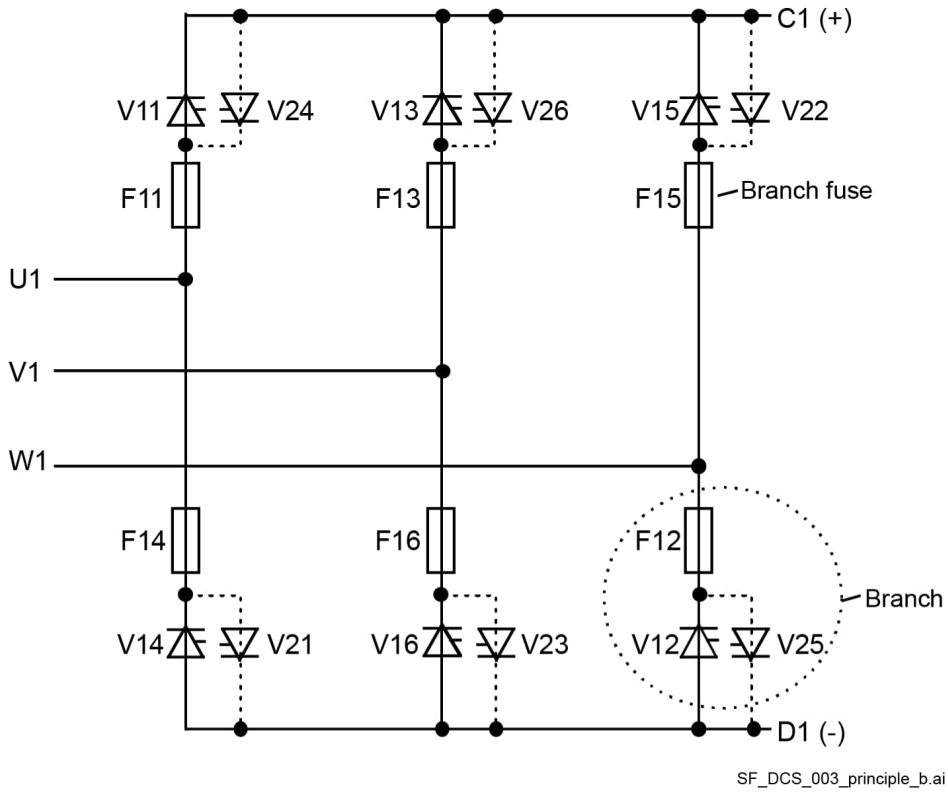
Gate A should always be in front of the clamped heat sinks due to cooling reasons. Location of BCTs gate A when built in:



Find faulty thyristors

Recommendation:
Use safety equipment to protect your hands.

1. Check the branch fuses by performing an OHM test.
2. Find the defective branches by performing an OHM test (both polarities) between U1, V1, W1 and C1, D1.



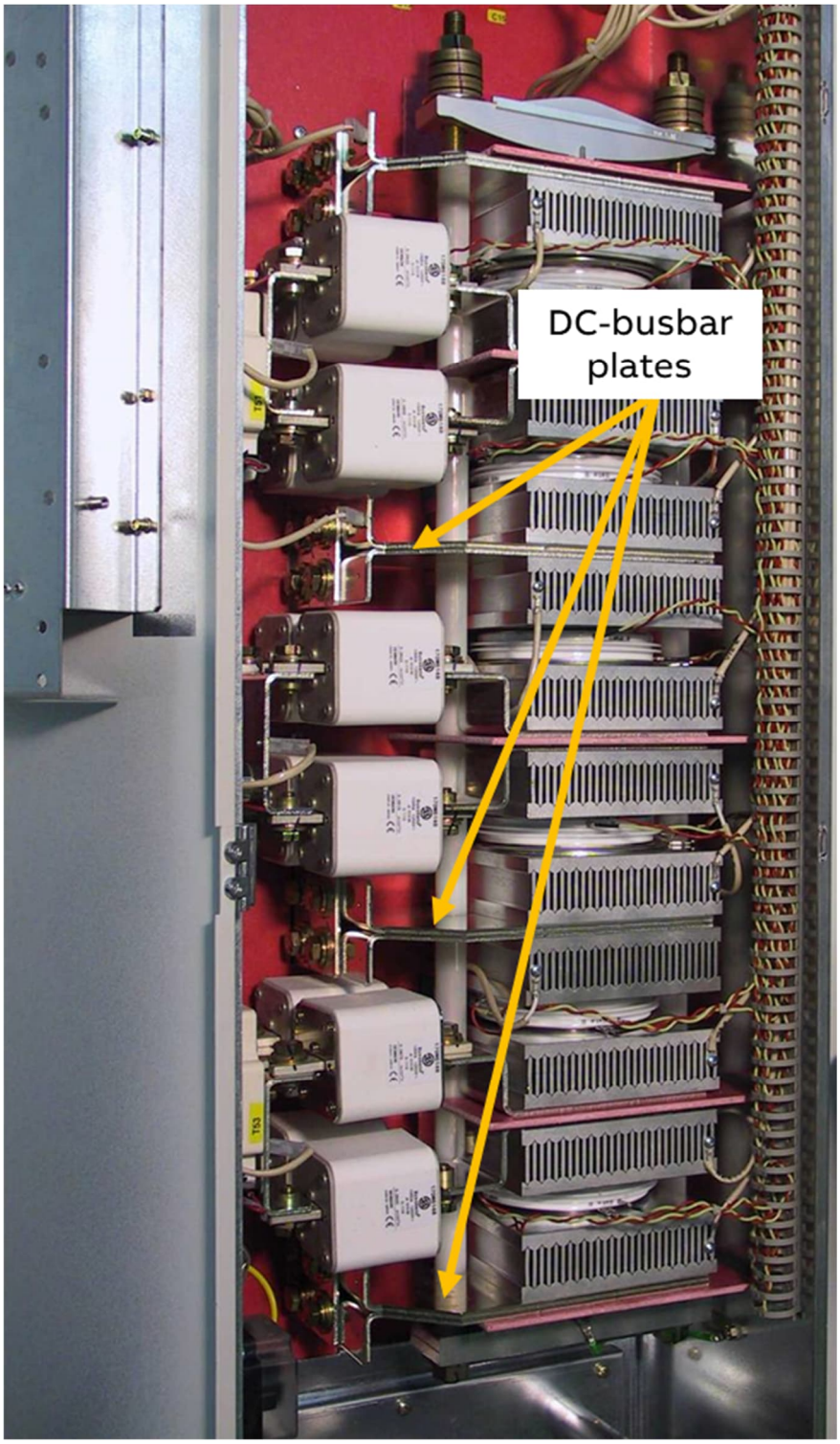
Bridge configuration H5 … H8

3. Disconnect the branching fuses of the defective branches.
4. Find the defective thyristors by performing an OHM test (both polarities) over their heat sinks.
5. In a 4-quadrant converter with BCTs change the BCT.
6. In a 4-quadrant converter with 2 single thyristors exchange **both** thyristors clamped between the same heatsinks.

Note: Because “Disc Type” semiconductors need a certain compression force to operate properly, a measurement outside the clamped heat sinks might be wrong.

Remove faulty thyristors

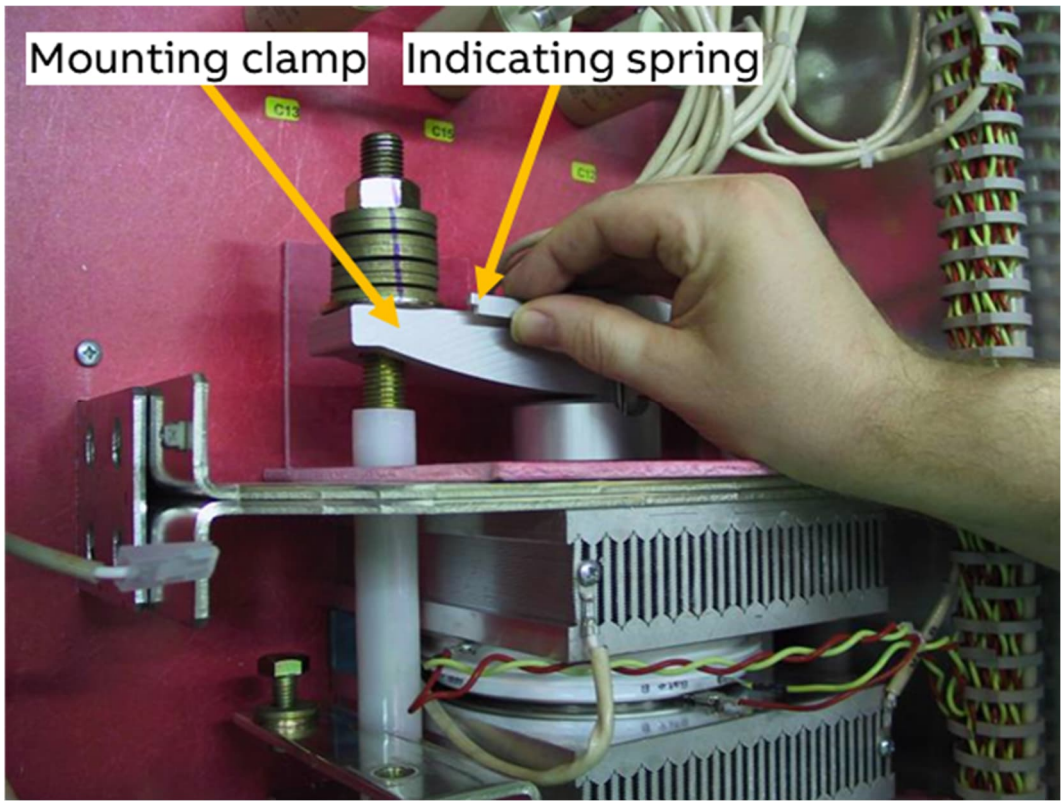
1. Replace all blown fuses and reconnect all fuses taken out during search for the faulty thyristor.
2. Remove the screws of the DC-busbar plates adjacent to the defective thyristors.



Note: It depends on the location of the defective thyristor which DC-busbar plates have to be disconnected.

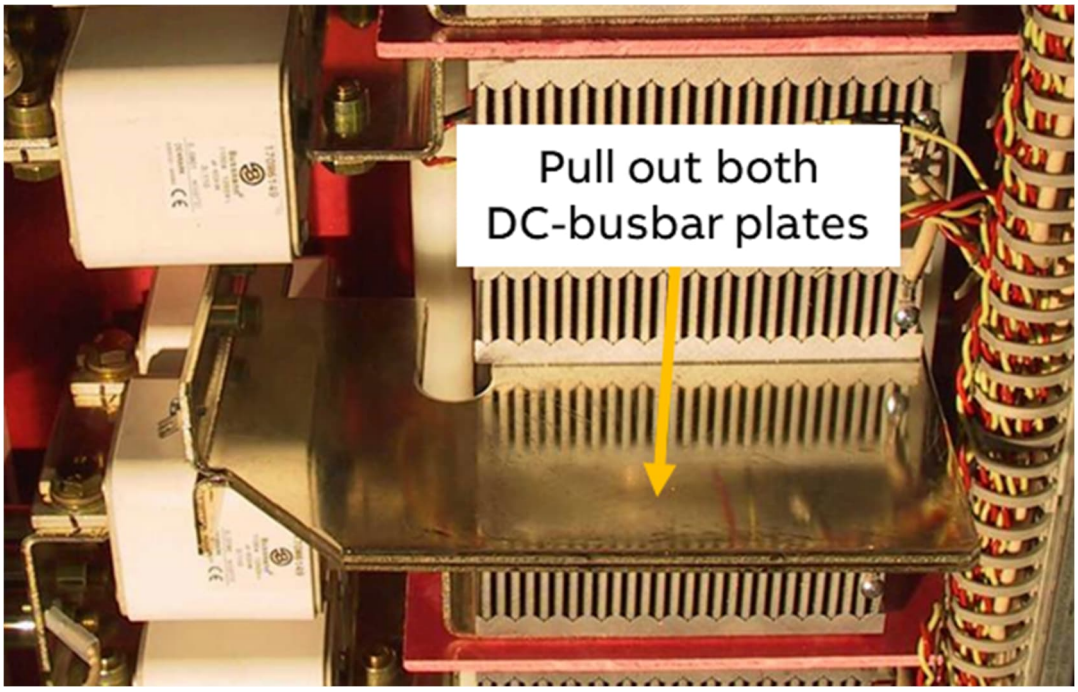
3. Write down the direction and location of the thyristors to be removed and mark their gate leads. In case of BCTs add the position of the gates.
4. Remove the gate leads if possible.

5. Loosen the mounting clamp at the top of the thyristor stack.

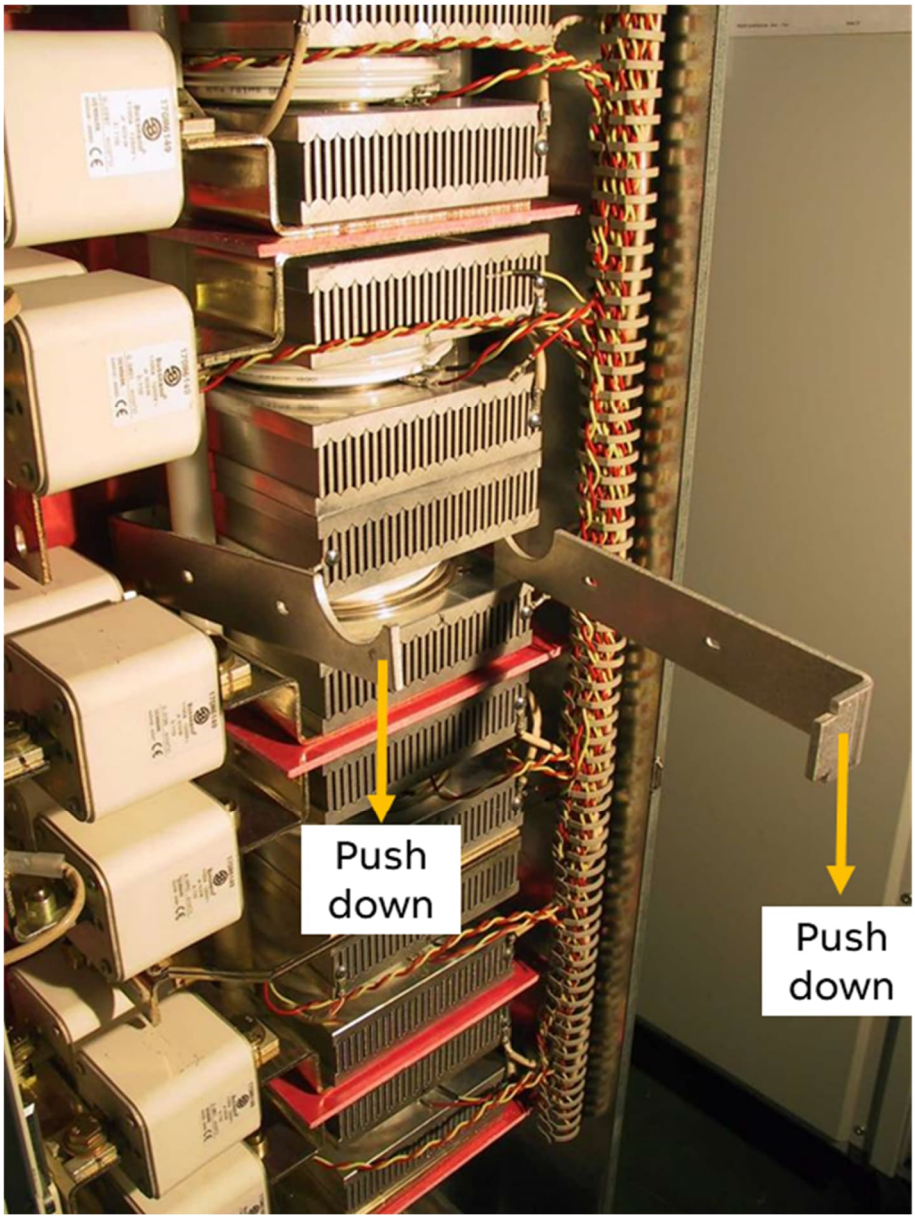


Attention: While loosening the mounting clamp the indicating spring must be pulled out a little, otherwise the spring will be damaged!
Do not remove the nuts totally, otherwise the treaded rods will fall down!

6. Pull out both DC-busbar plates.



7. Attach the disassembly tool (DCF 1066721 P1) at the faulty thyristor and prize open the upper and lower heat sinks.

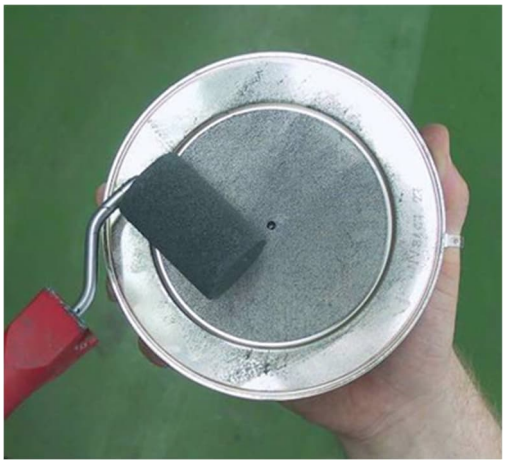


8. Remove the thyristors with e.g., a pair of pliers.

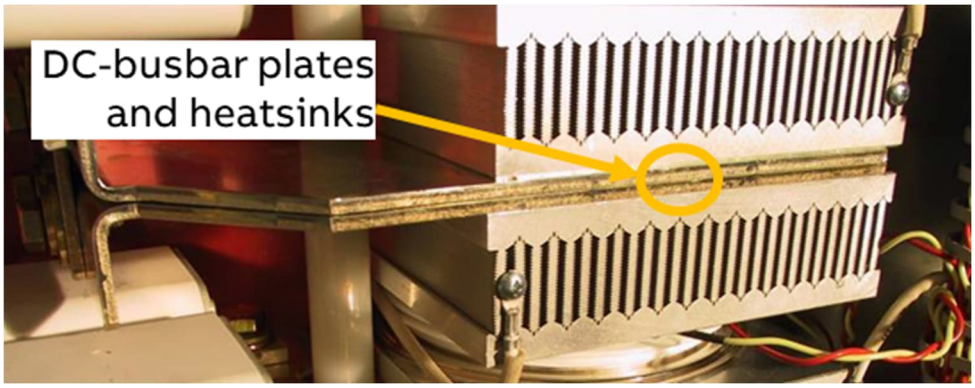
Attention: To center the thyristors spring pins are used. The pins are inlayed into all lower heat sinks. Open the gap wide enough so that the thyristor and the pins are not damaged while removing the thyristor!

Install new thyristors

1. Ensure that the new thyristor is of the correct type. Keep the semiconductor and its surroundings clean.
   Note: Do not touch the polished surfaces of the thyristor.
2. Clean all parts with tissue paper moistened with solvent, which have had or will have contact with the thyristor or each other (lower/upper heat sink). Do not clean the surfaces of grease too thoroughly, because the aluminum surfaces will oxidize in a few seconds. Dry all surfaces.
3. Clean the polished surfaces of the semiconductor with a piece of tissue paper moistened with solvent. Dry all surfaces. Spread a **thin** layer of conducting paste on both sides of the thyristor, if necessary, use a rubber spatula.

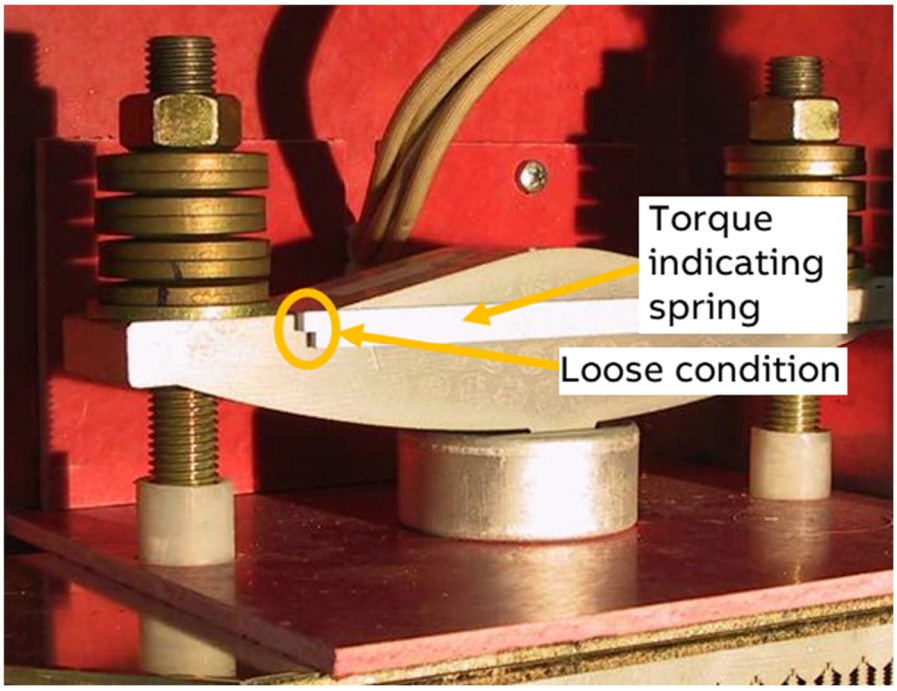


4. Centre the thyristors by means of the spring pins.
   Note: Be sure that the thyristor is installed in the right direction. Do not pinch or cut the gate leads or any other cable.
5. Turn the thyristor so that the gate leads point in the right direction. When changing BCTs make sure, that gate A is in front (see Bidirectional-Controlled-Thyristors).
6. Connect the gate leads if possible.
7. Insert first the top DC-busbar plate and then the bottom one.



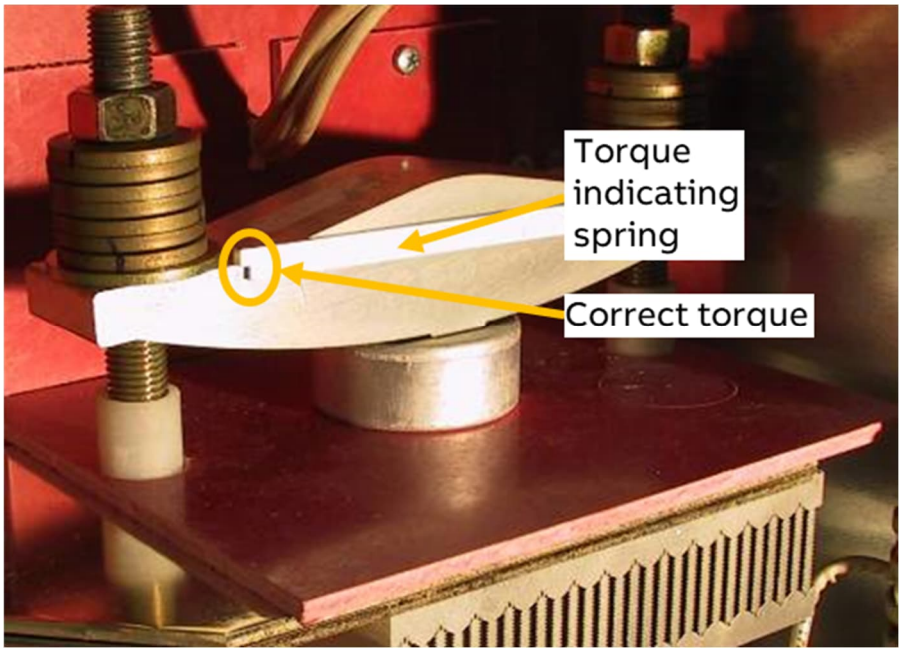
   Note: The DC-busbar plates should line up with the adjacent heat sinks.
8. Reconnect the DC-busbars.

9. Tighten the nuts of the mounting clamp by hand so that the clamp is parallel with the contact surface of the heat sinks.



Note: The indicating spring is an extremely sensitive instrument and must be handled with care.

10. Tighten each nut in turn, half a turn at a time with the help of a ring spanner until the indicating spring clicks into position “correct torque”. Do not tighten the screws any further.

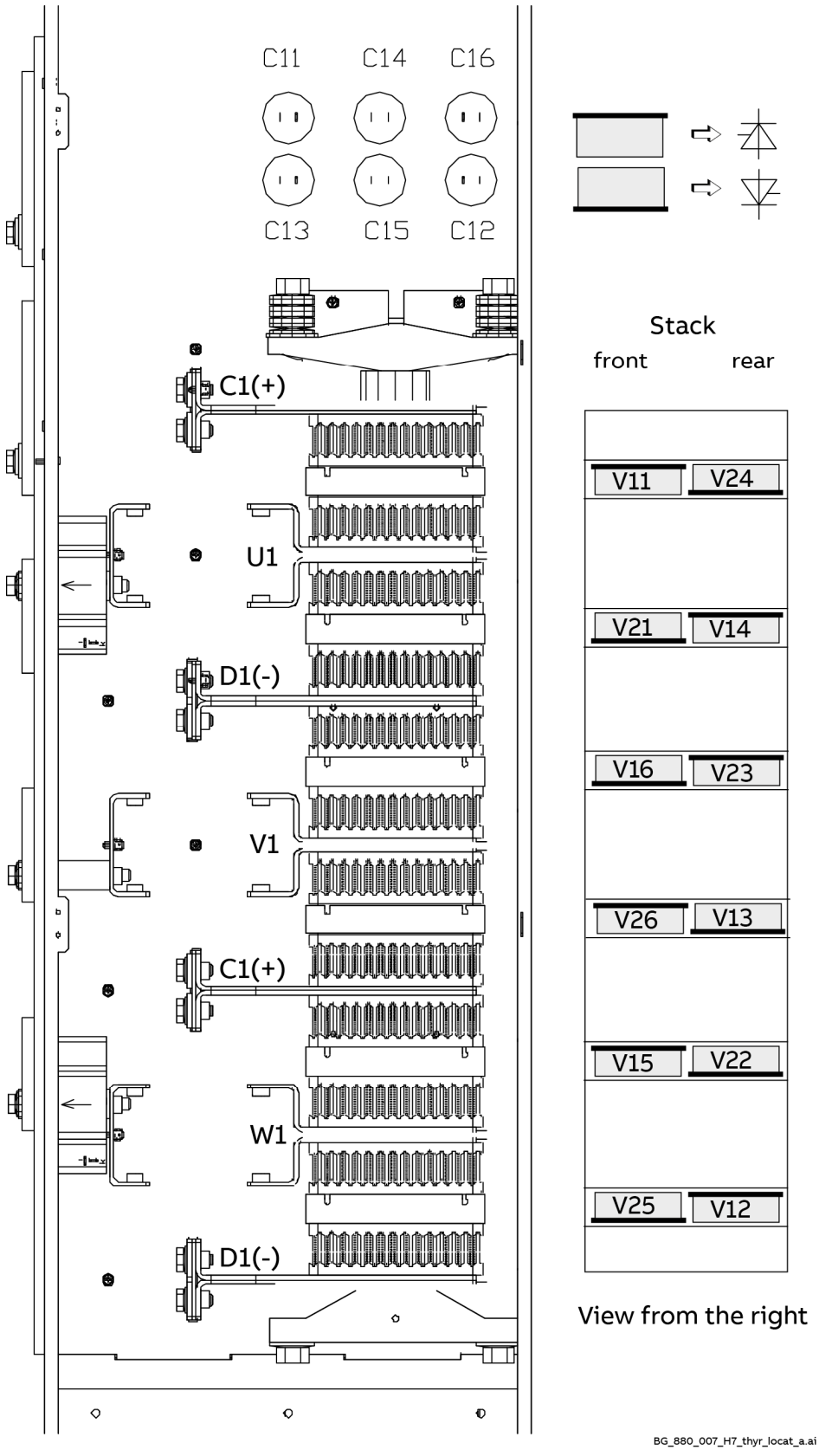


Note: The correct torque is indicated by means of the welded indicating spring.

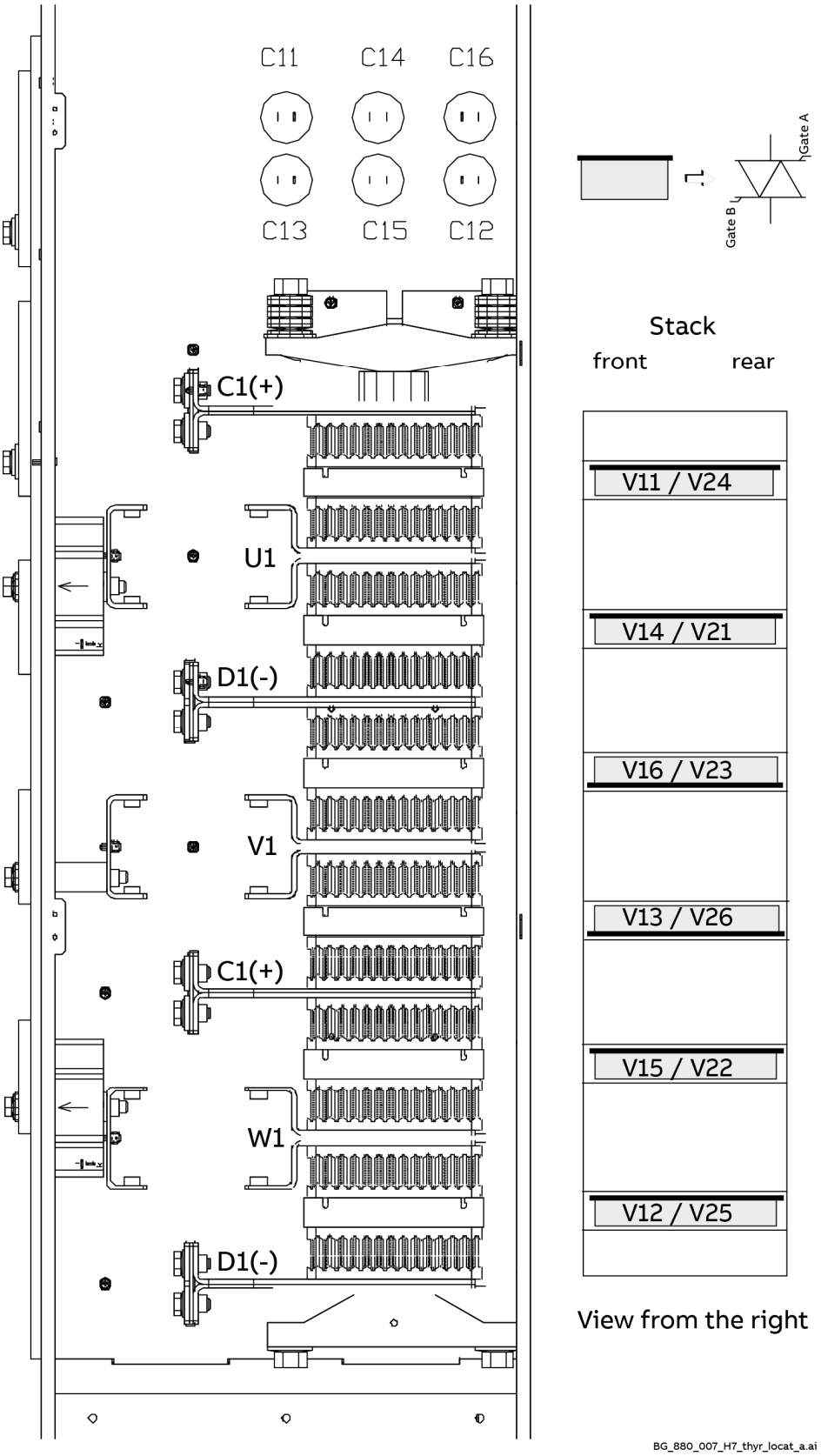
11. Perform an OHM test to make sure the thyristor is ok.
12. Reconnect all other dismantled parts.
13. Perform an OHM test between U1, V1, W1 and C1, D1 to make sure the power part is ok.

Location of thyristors in converters size H7 (4-Q bridge with single thyristors)

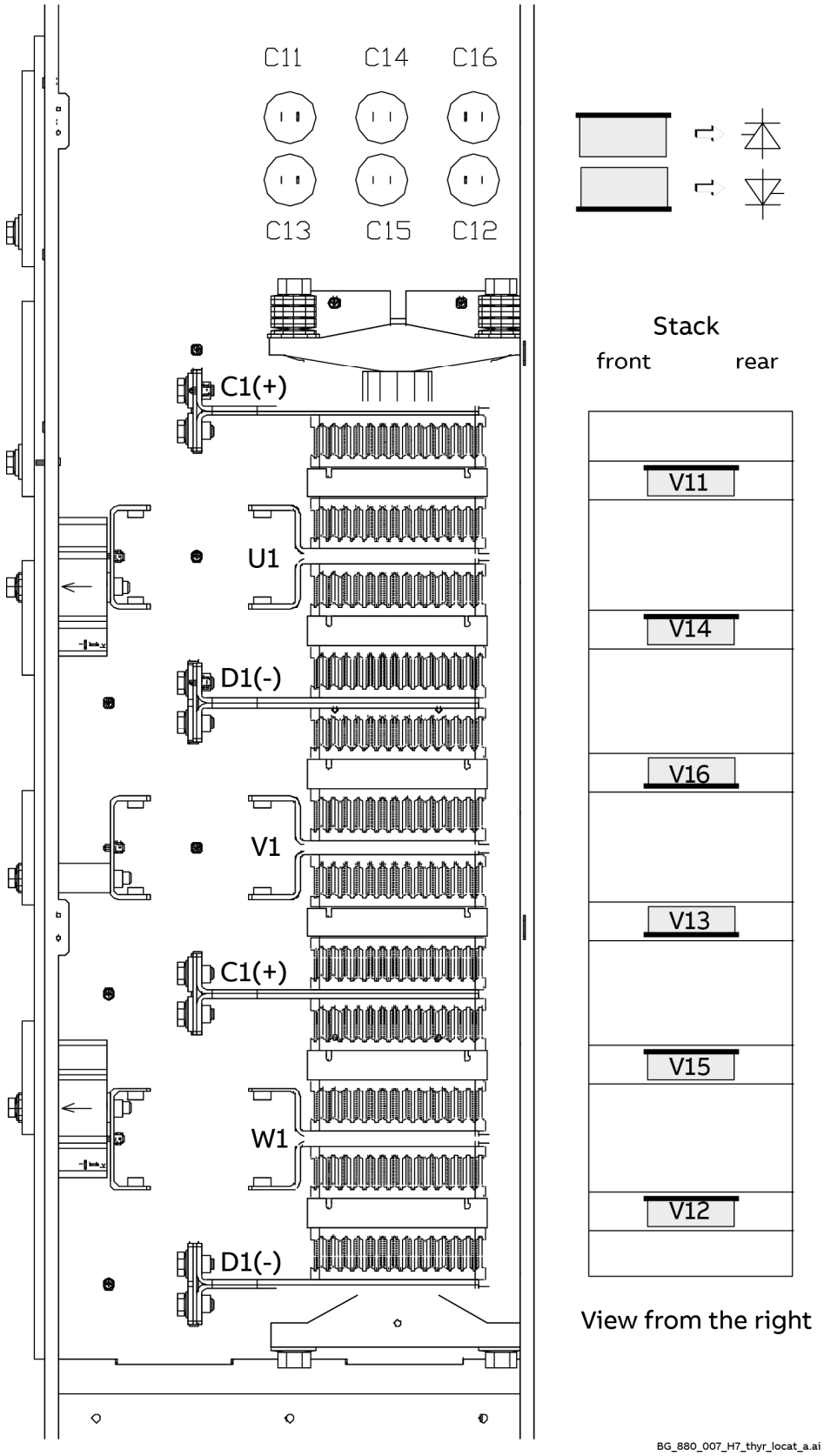
Attention: Exchange **both** thyristors clamped between the same heatsinks.



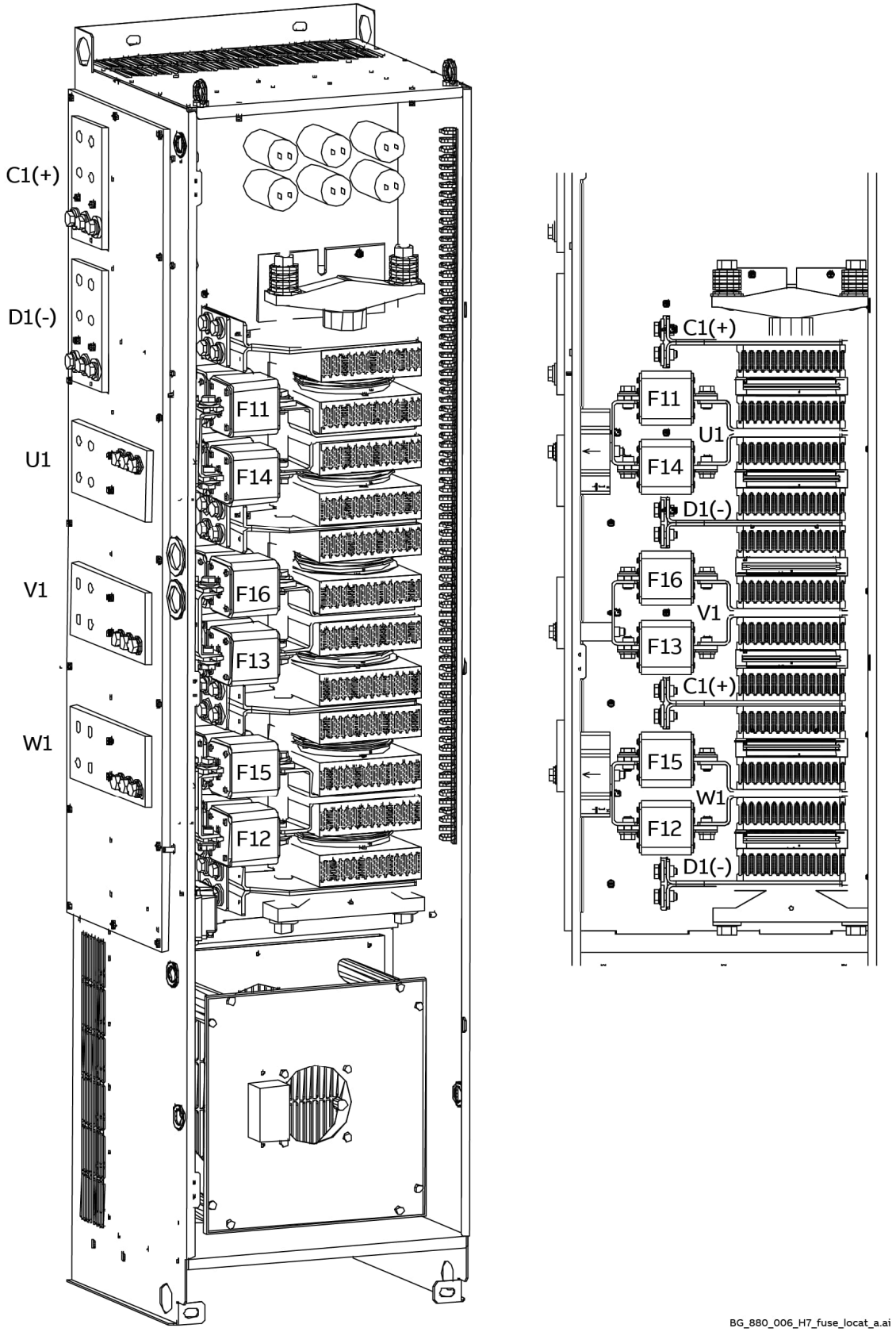
Location of thyristors in converters size H7 (4-Q bridge with BCTs)



Location of thyristors in converters size H7 (2-Q bridge with single thyristors)



Location of branch fuses in converters size H7



Exchange thyristors size H8

Installation of thyristors in converters size H8 (2500 ... 5200 A)

All DCS880 converters size H8 are equipped with disk type thyristors. The structure of the disc type semiconductor component is such that it requires a certain compression force to operate. The prevention of overheating of the component depends on good heat dissipation between the semiconductor and the conducted heat sink. It is thus important that all joints have good thermal and electrical conduction.

Required tools

Special tools or material needed in addition to standard tools for the exchange of thyristors:

– Torx screwdrivers:	TX10, TX20, TX25.
– Torque spanner for electrical connections:	13Nm (M8). 25 Nm (M10). 50 Nm (M12).
– Screws are metric type; use appropriate nuts.	
– 17 mm ring spanner for fuse and busbar connections.	
– 24 mm ring spanner for press clamp.	
– Tissue paper.	
– Solvent (e.g., ethanol).	
– Thermal joint compound (conducting) for thyristor modules and disk type thyristors:	GHSN390001P0001 Type Berulub FK-SU 2
– Disassembly tool:	DCF1066721P1.

Note: For more detailed information about the wiring of the power part, see DCS880 Hardware Manual (3ADW000462).

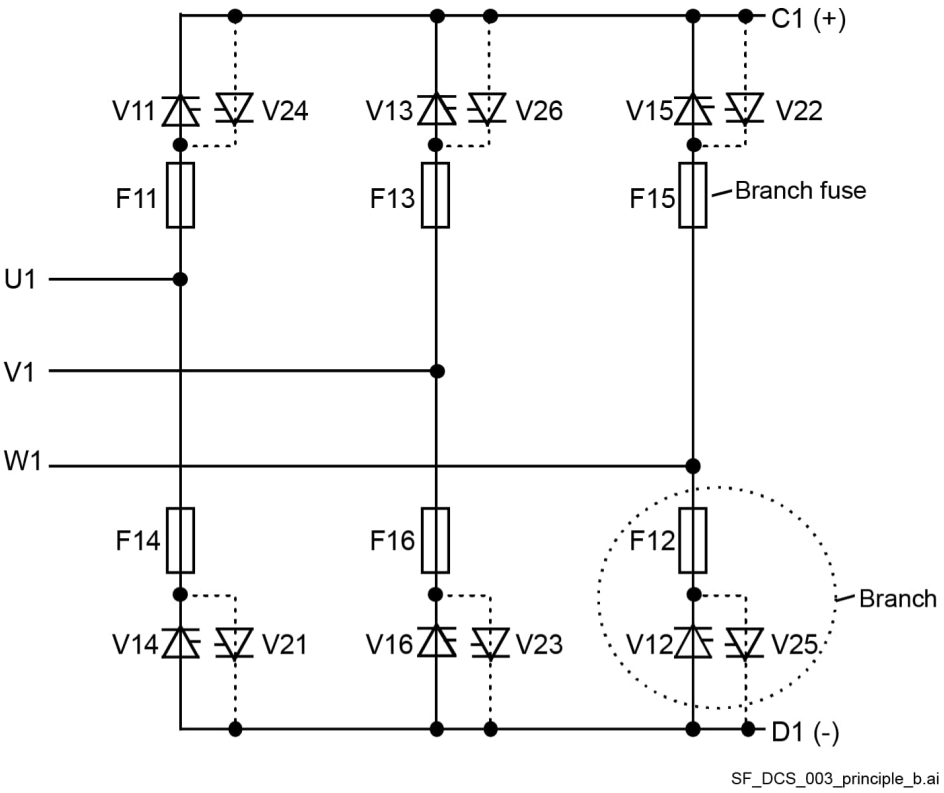
Therefore, strict observance of the building instructions given below is of utmost importance. Make sure that the new component can replace the old one.
All thyristors are always mounted in the same direction, independent of current, voltage, number of quadrants (2-Q or 4-Q), left or right-side connection.
Semiconductors and heat sinks are to be handled carefully to avoid scratches and other damage. Avoid touching the contact surfaces. Do not lift the semiconductor with the gate wire. Do not lift the semiconductor by touching the current contact surfaces. Do not damage the welding flange or the contact surface.

Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

Find faulty thyristors

Recommendation:
Use safety equipment to protect your hands.

1. Check the branch fuses by performing an OHM test.
2. Find the defective branches by performing an OHM test (both polarities) between U1, V1, W1 and C1, D1.

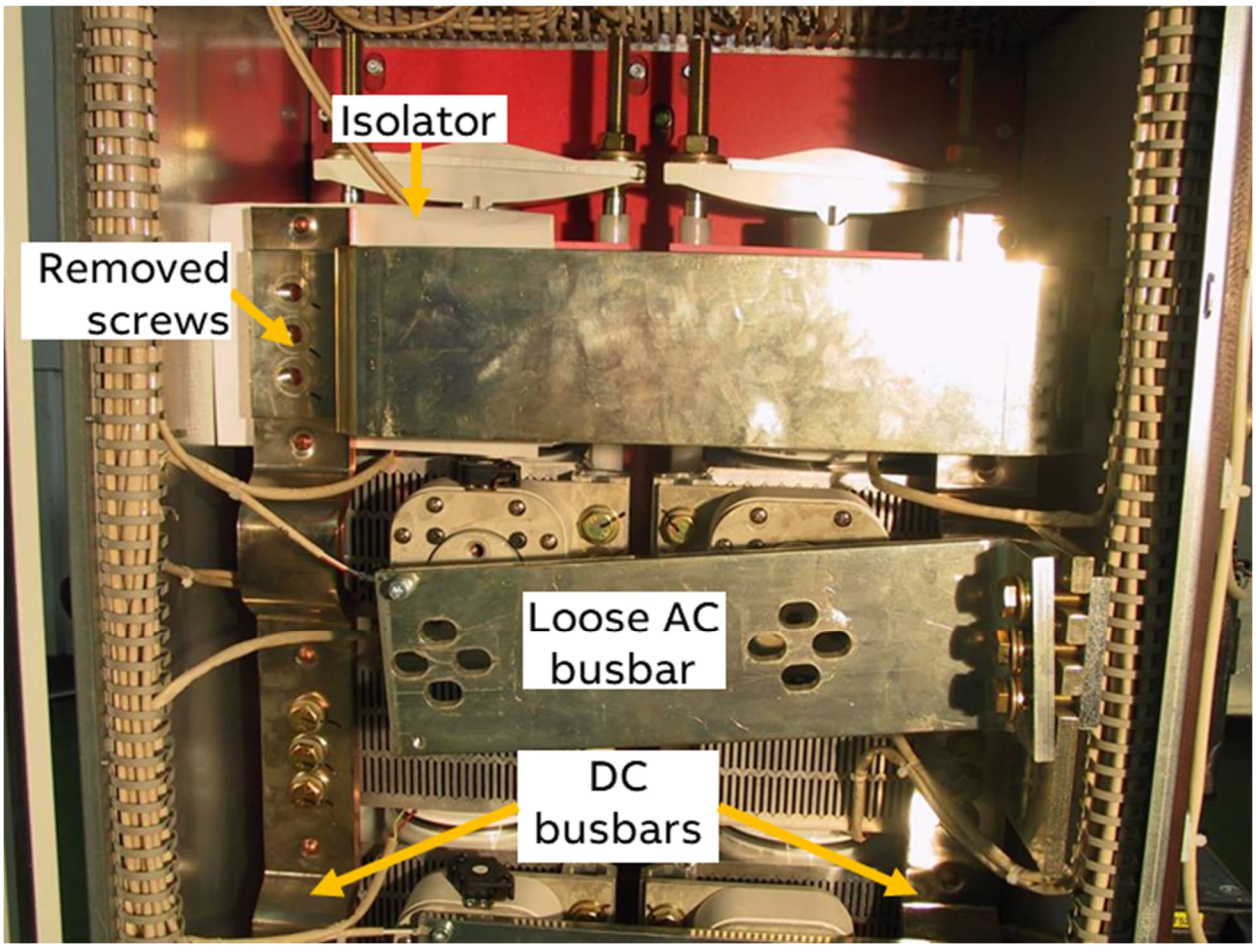


Bridge configuration H5 ... H8

3. Remove the AC busbars, of the defective branches.

4-quadrant (4-Q) converter:

4. Remove all screws of the DC-busbars either above or below the fuses of the defective branches.
   Note: The connection is made with a screw socket, which may fall down, when all screws are removed.



5. Put a small piece of isolator (e.g., paper) between the DC-busbar and the heat sink to insulate the anti-parallel thyristors from each other.
6. Find the defective thyristors by performing an OHM test (both polarities) over their heat sinks.

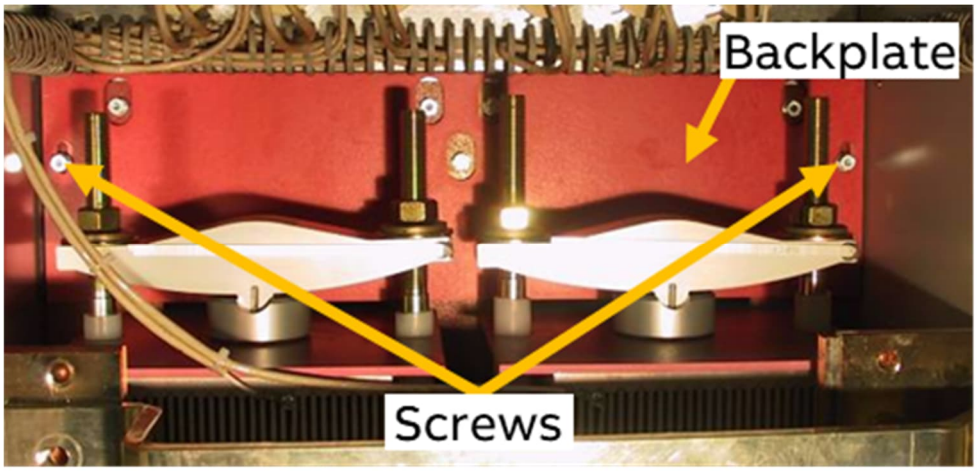
2-quadrant (2-Q) converter:

4. Find the defective thyristors by performing an OHM test (both polarities) over their heat sinks.

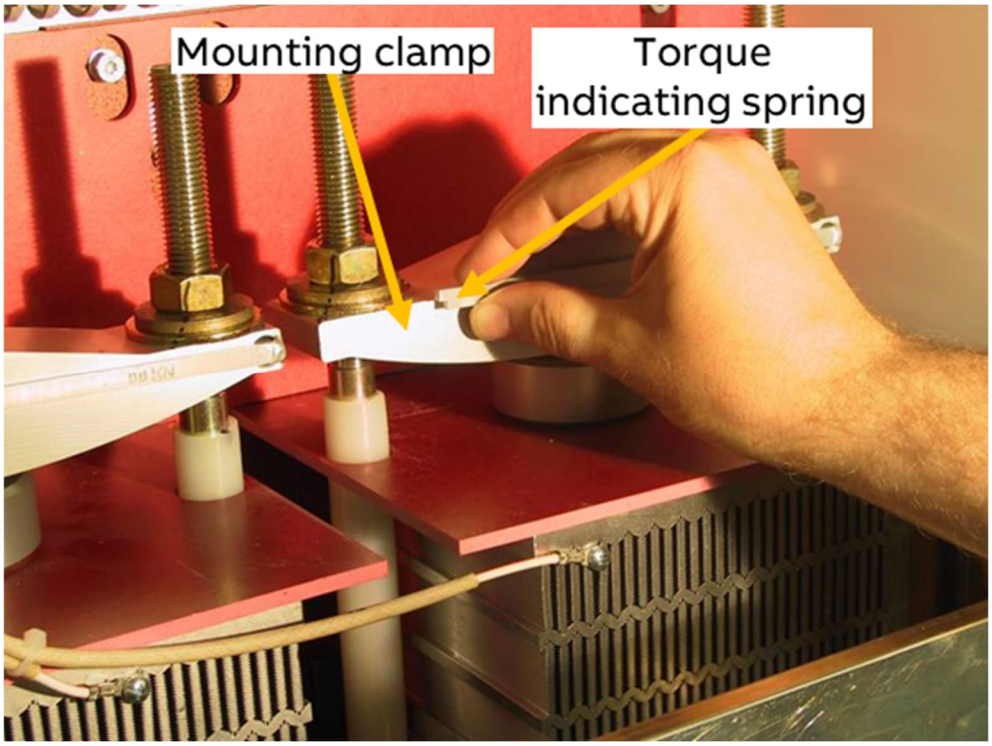
Note: Because “Disc Type” semiconductors need a certain compression force to operate properly, a measurement outside the clamped heat sinks might be wrong. To be sure which thyristor is broken change only one thyristor, clamp the heat sinks again and repeat step three.

Remove faulty thyristors

1. Remove the screws of all DC/AC-busbars preventing the stack to be prized open. Remove the branch fuses if they cover the defective thyristors.
   Note: It depends on the location of the defective thyristors, which DC/AC-busbars have to be disconnected.
2. Loosen the screws holding the backplate and make sure the backplate can move up.

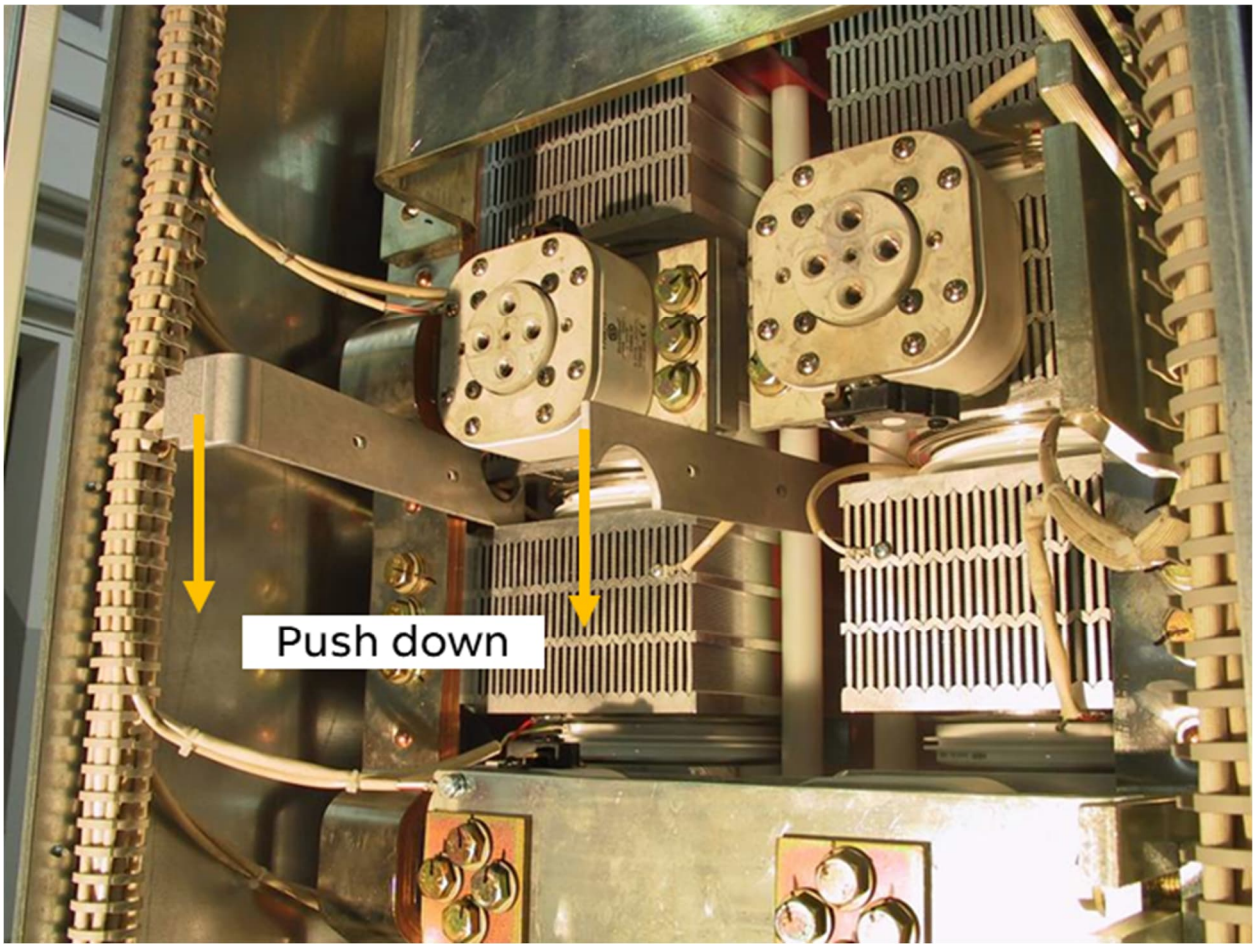


3. Write down the direction and location of the defective thyristors to be removed and mark their gate leads.
4. Remove the gate leads if possible.
5. Loosen the mounting clamp at the top of the thyristor stack.



Attention: While loosening the mounting clamp the indicating spring must be pulled out a little, otherwise the spring will be damaged!
Do not remove the nuts totally, otherwise the treaded rods will fall down!

6. Attach the disassembly tool (DCF1066721P1) next to the faulty thyristor and prize open the upper and lower heat sinks.

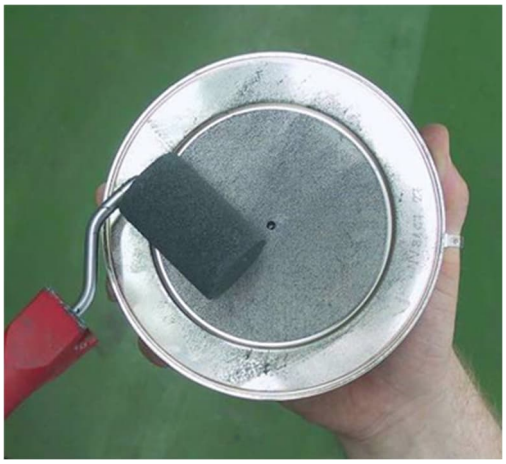


7. Remove the thyristors with e.g., a pair of pliers.

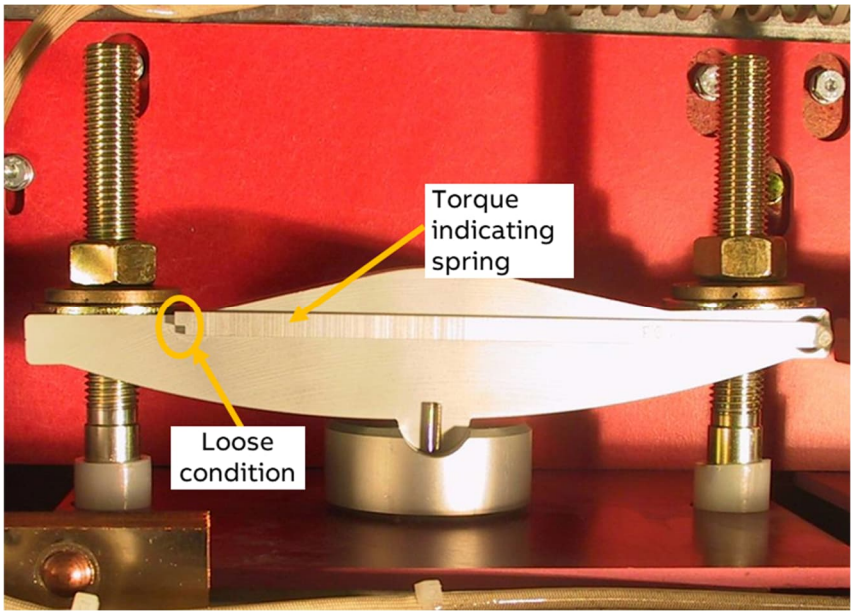
Attention: To center the thyristors spring pins are used. The pins are inlayed into all lower heat sinks. Open the gap wide enough so that the thyristor and the pins are not damaged while removing the thyristor!

Install new thyristors

1. Ensure that the new thyristor is of the correct type. Keep the semiconductor and its surroundings clean.
   Note: Do not touch the polished surfaces of the thyristor.
2. Clean all parts with tissue paper moistened with solvent, which have had or will have contact with the thyristor or each other (lower/upper heat sink). Do not clean the surfaces of grease too thoroughly, because the aluminum surfaces will oxidize in a few seconds. Dry all surfaces.
3. Clean the polished surfaces of the semiconductor with a piece of tissue paper moistened with solvent. Dry all surfaces. Spread a **thin** layer of conducting paste on both sides of the thyristor, if necessary, use a rubber spatula.

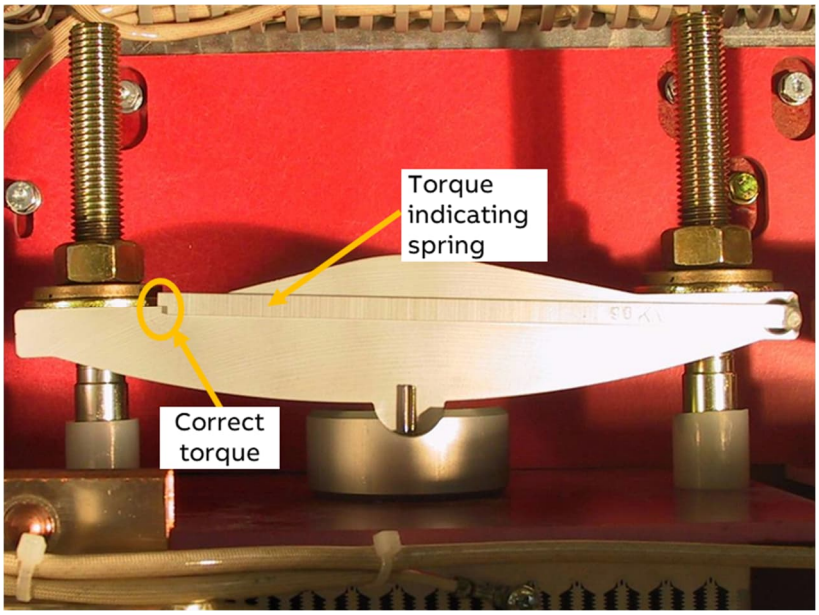


4. Centre the thyristors by means of the spring pins.
   Note: Be sure that the thyristor is installed in the right direction. Do not pinch or cut the gate leads or any other cable.
5. Turn the thyristor so that the gate leads point in the right direction.
6. Connect the gate leads if possible.
7. Tighten the nuts of the mounting clamp by hand so that the clamp is parallel with the contact surface of the heat sinks.



Note: The indicating spring is an extremely sensitive instrument and must be handled with care.

8. Tighten each nut in turn, half a turn at a time with the help of a ring spanner until the indicating spring clicks into position “correct torque”. Do not tighten the screws any further.

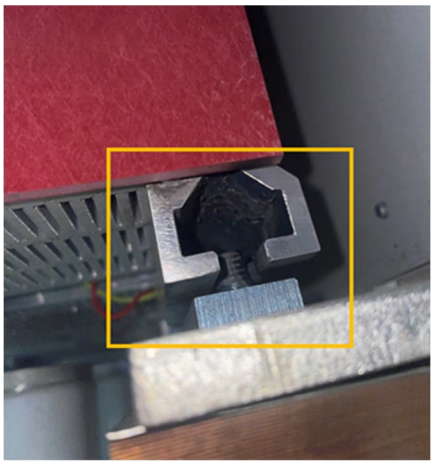


Note: The correct torque is indicated by means of the welded indicating spring.

9. Perform an OHM test to make sure the thyristor is ok.
10. Reconnect the backplate, branch fuses, DC/AC-busbars, and all other dismantled parts.
Attention: Make sure the screw sockets are in the right place.

Correct placement:

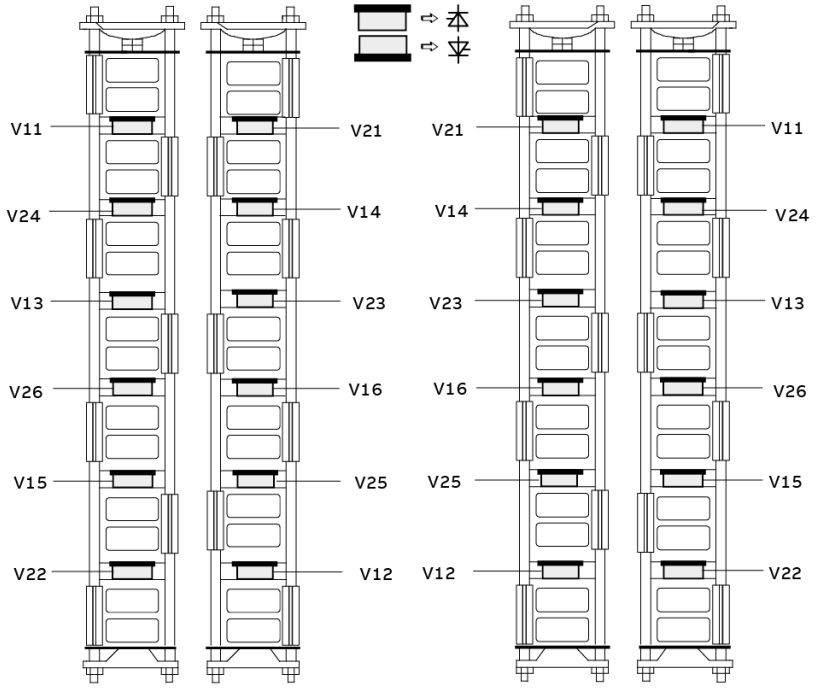
Wrong placement:



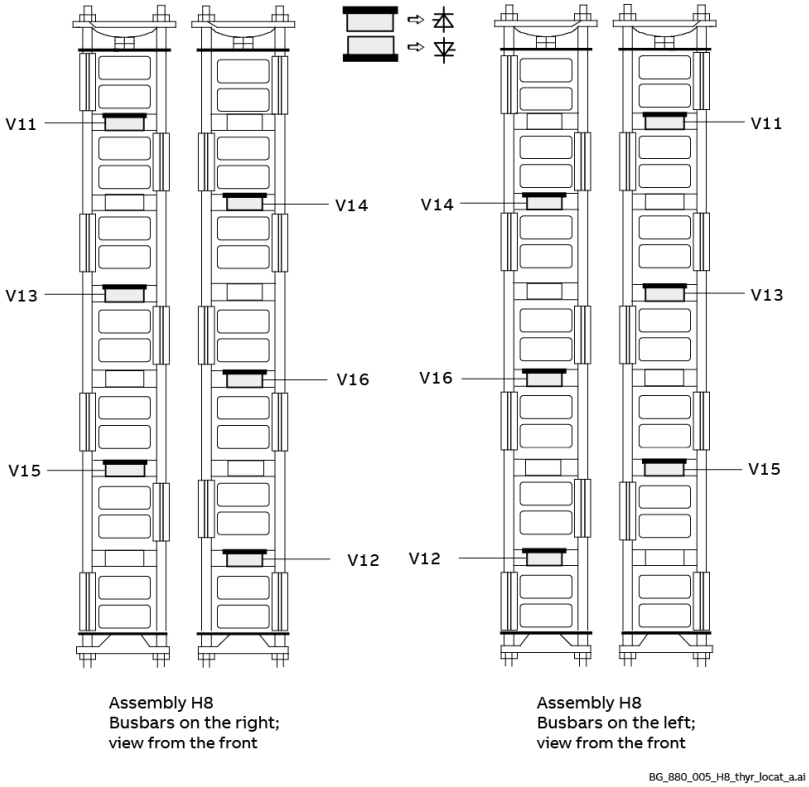
Result of wrong placement:

11. Perform an OHM test between U1, V1, W1 and C1, D1 to make sure the power part is ok.

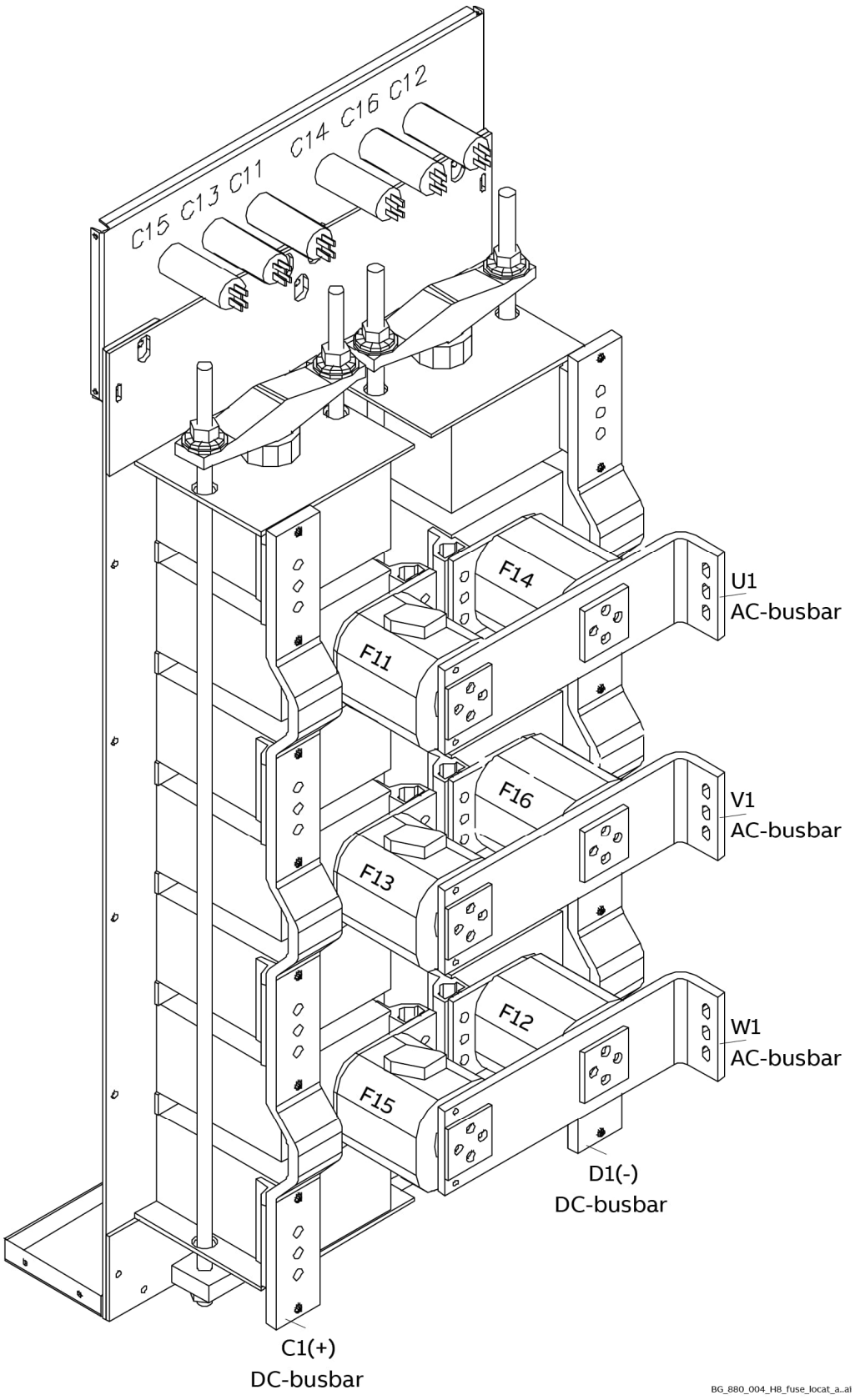
Location of thyristors in converters size H8 (4-Q bridge)



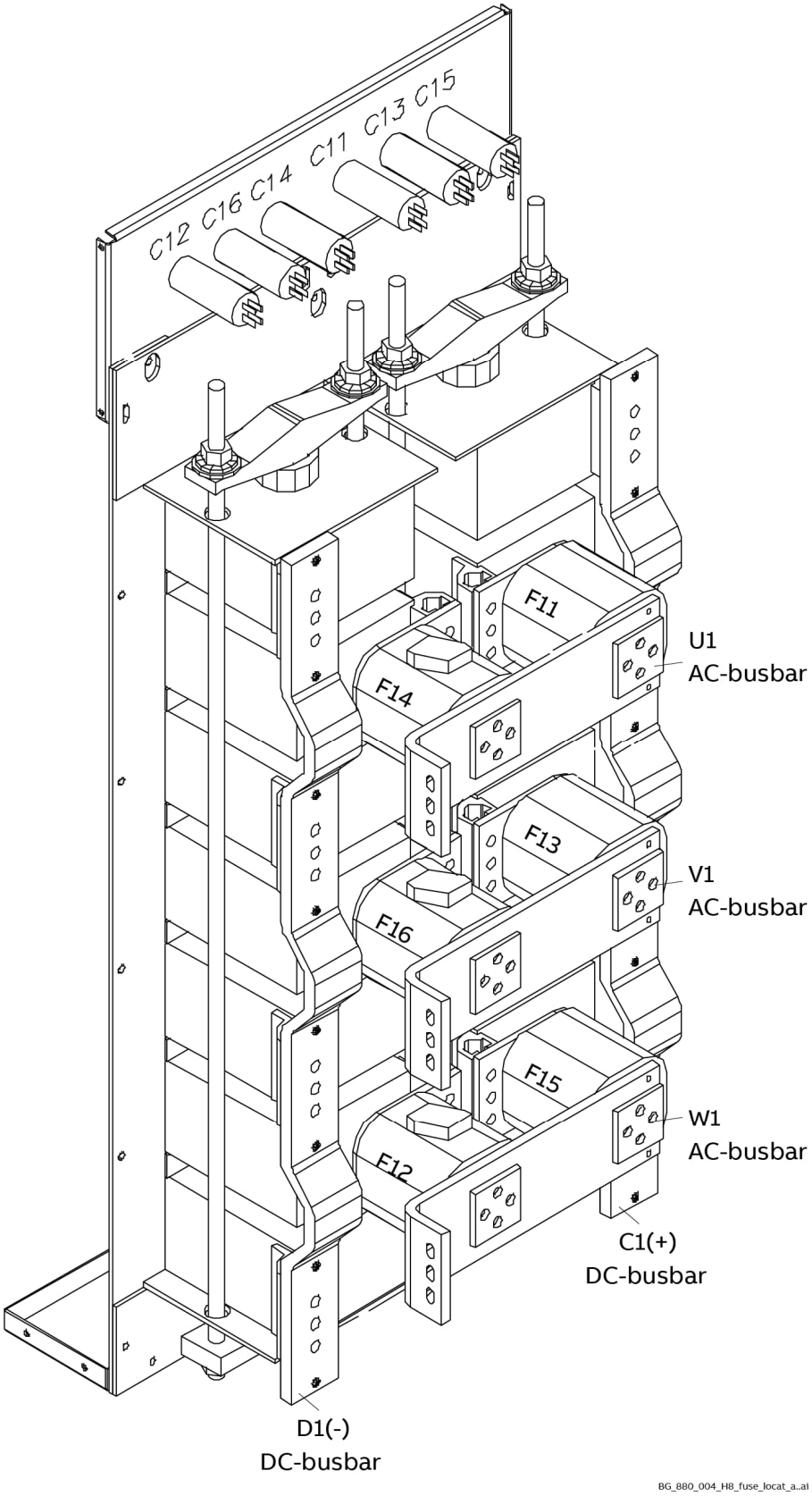
Location of thyristors in converters size H8 (2-Q bridge)



Location of branch fuses in converters size H8 (busbars on the right)



Location of branch fuses in converters size H8 (busbars on the left)



Exchange the electronic tray (SDCS-CON-H01)

General

All DCS880 size H1 … H8 are equipped with either:

– Electronic tray DCS880/DCT880 3ADT220166R0002 (includes SDCS-CON-H01).
– Electronic tray DCS880/DCT880 3ADT220166R0012 (includes SDCS-CON-H01L).

Thus, the exchange is similar for all converter sizes.

Note: Both electronic trays are interchangeable.

Required Tools

Special tools or material needed in addition to standard tools for the exchange of the electronic tray:

– Torx screwdrivers: TX10, TX20, TX25.

Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

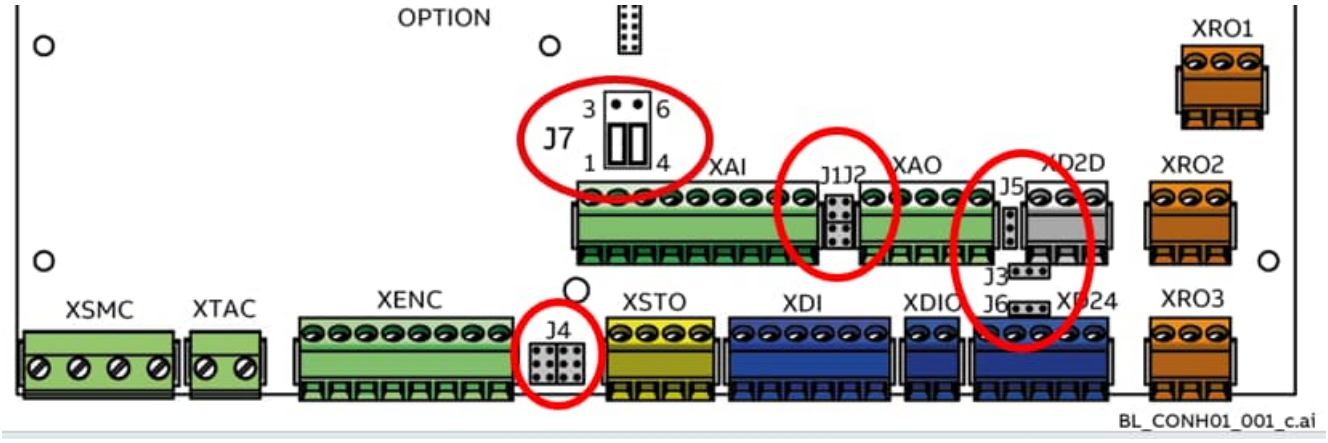
Overview of electronic tray exchange

1. Write down type code of the converter.
2. Set the jumpers on the new electronic tray according to the old electronic tray.
3. Exchange the electronic tray.
4. Set type code of the converter.

1. Write down type code of the converter

Write down the contents of 95.25 Set: Type code. This information must be set manually in the new electronic tray.

2. Set the jumpers on the new electronic tray according to the old electronic tray



Copy the jumper settings (J1 … J7) of the old electronic tray onto the new electronic tray accordingly.

3. Exchange the electronic tray

Remove the old electronic tray

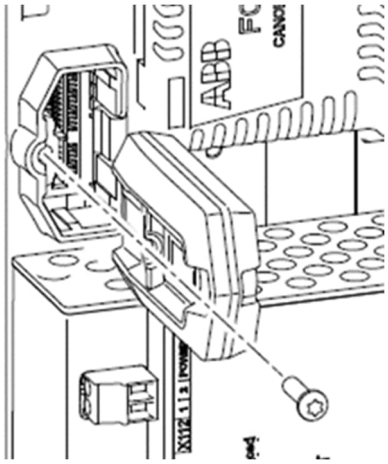
1. Remove control panel and design cover.

2. Remove the memory unit from X205.
   The converter is equipped with a memory unit that is plugged into X205 on the electronic tray. The memory unit contains the firmware, the parameters, and the application program (as option). When an electronic tray is replaced, the parameter settings can be retained by transferring the memory unit from the defective electronic tray to the new electronic tray.

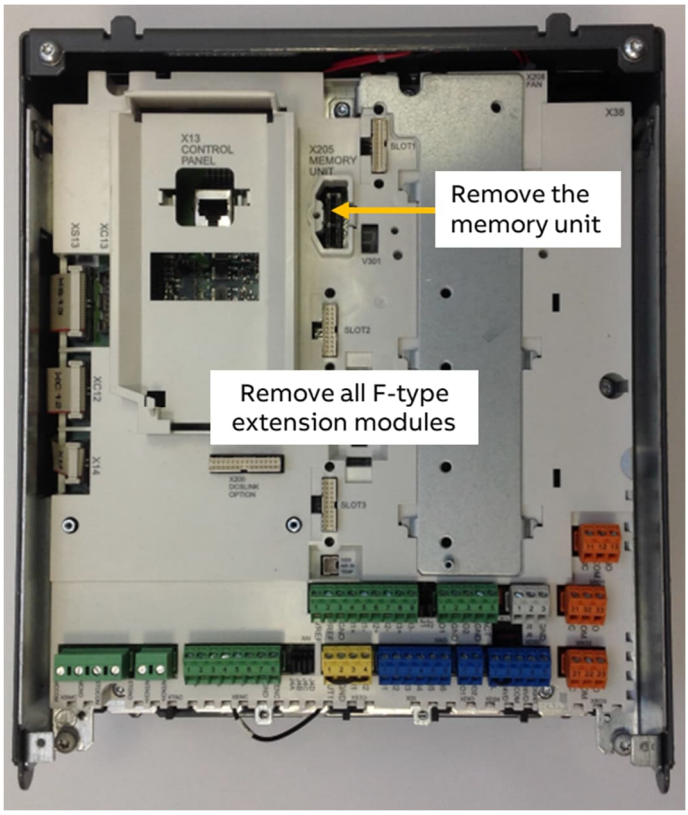
WARNING
Do not remove or insert a memory unit when the converter is powered.

Replacing the memory unit

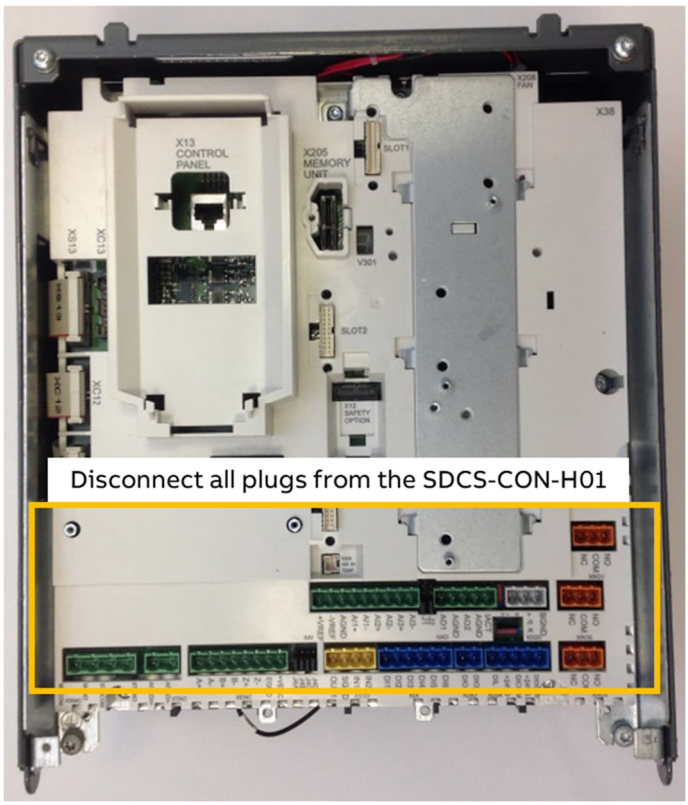
Unscrew the memory unit and pull it out. Replace the memory unit in reverse order.



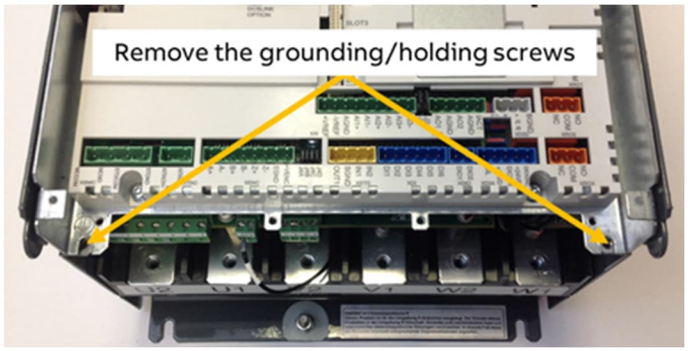
3. Remove all F-type extension modules.



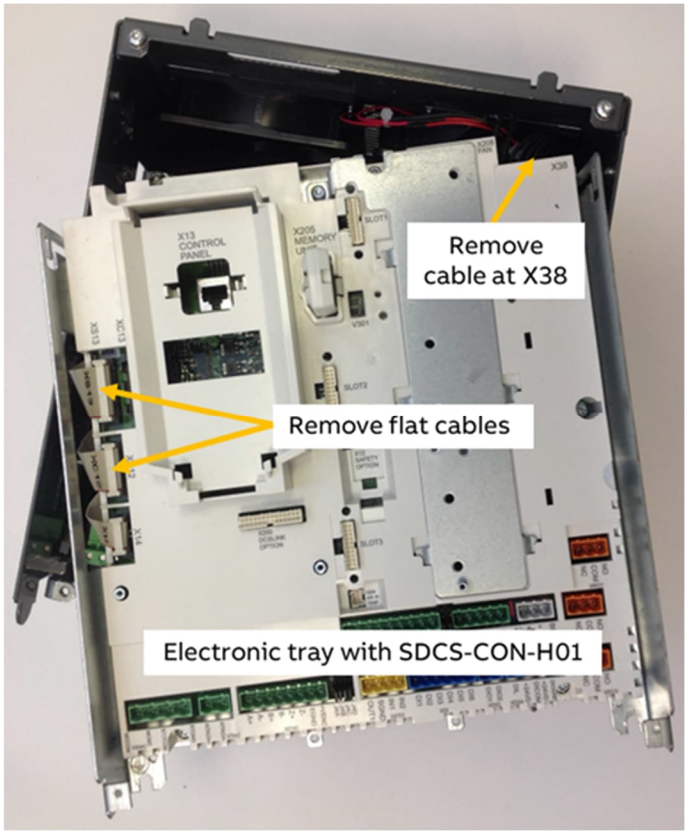
4. Disconnect all I/O plugs from the electronic tray.



5. Remove the grounding/holding screws from the electronic tray.



6. To unhinge the electronic tray pull it up and then out.
7. Before removing the electronic tray completely unplug the flat cables (XC12, XS13) and the cable connected to X38.



Install the new electronic tray

1. Reconnect the flat cables to the electronic tray (XC12, XS13), the cable at X38 and re-hinge the electronic tray.
2. Reconnect the grounding/holding screws at the electronic tray.
3. Reconnect all I/O plugs to the electronic tray.
4. Reinstall all plug-in options (do not forget the screws), the memory unit, the design cover, and the control panel.

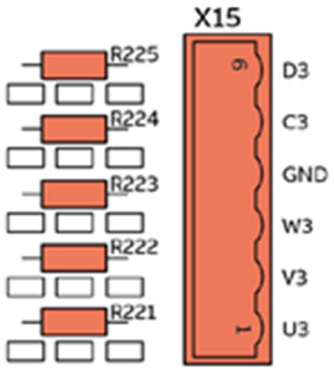
4. Set type code of the converter

Follow the instructions in chapter Set type code.

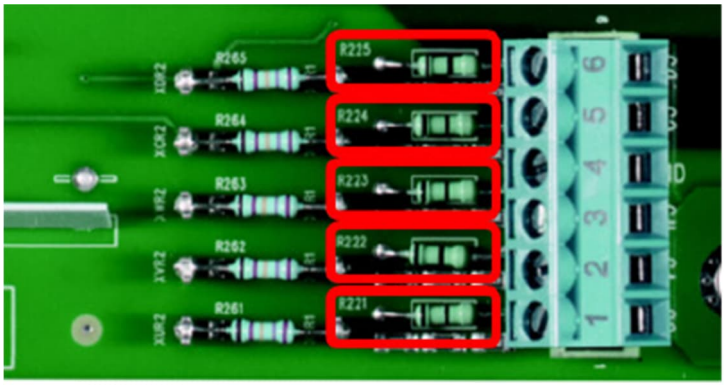
Exchange the SDCS-PIN-H51 (+S185)

Adapting the DCS880 to mains voltages from 20 V_{AC} to 100 V_{AC} requires plus code +S185. For this:

– The voltage measurement is connected to plug X15.



– The zero-ohm resistors R221 ... R225 are removed (cut out).



When exchanging the SDCS-PIN-H51 make sure that the adaptations for plus code +S185 are fulfilled.

Safe Torque Off (STO)

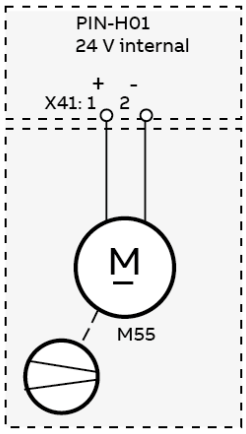
For information about STO functions and acceptance test instructions, refer to the Supplement for functional safety (3ADW000452).
For the STO revalidation test and the repetitive function test, refer to the Service instruction DCS880 - STO revalidation test and DCS880 - Repetitive function test (3ADW000835).

Service

Exchange cooling fan size H1 (one fan)

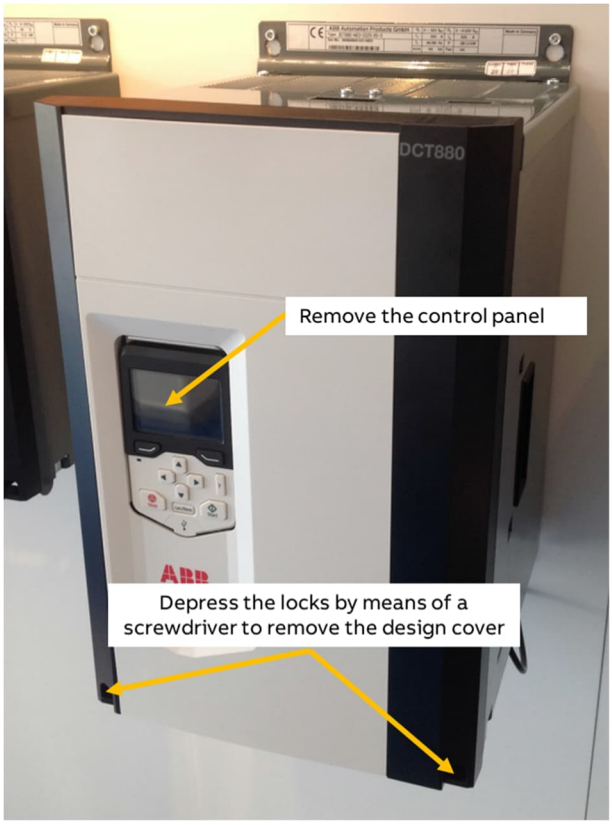
Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

Converters size DCS880-S01-0020-dd and DCS880-S02-0050-dd have no cooling fans. They are convection cooled.
Converters size DCS880-S0b-0045-dd ... DCS880-S0b-0100-dd using one 24 V_{DC} fan.

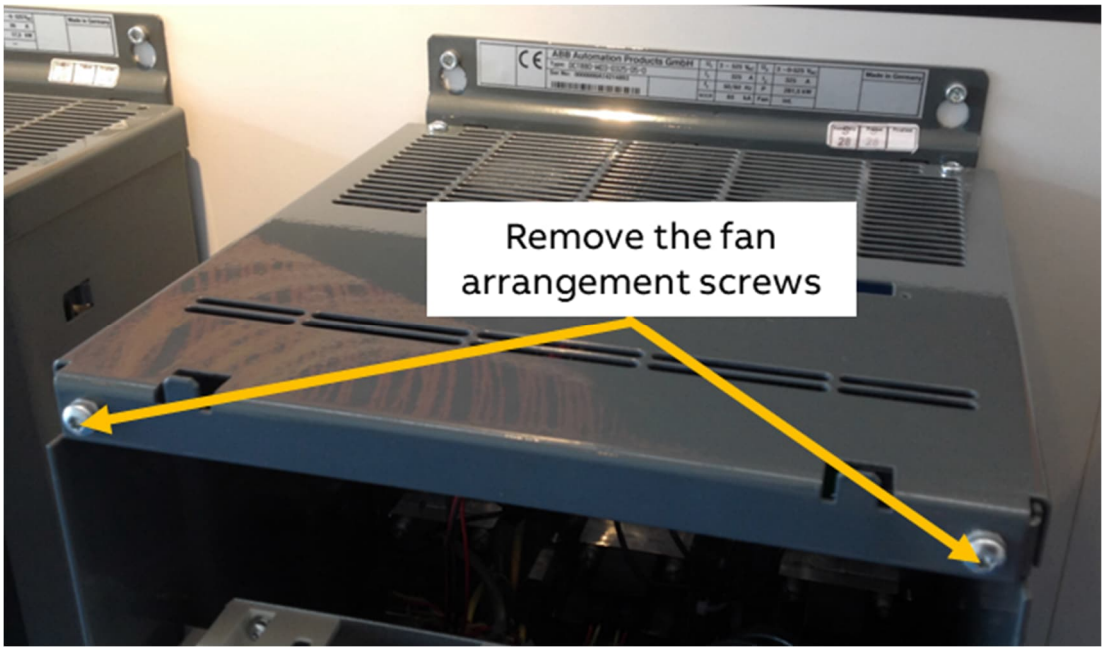


Removing the cooling fan

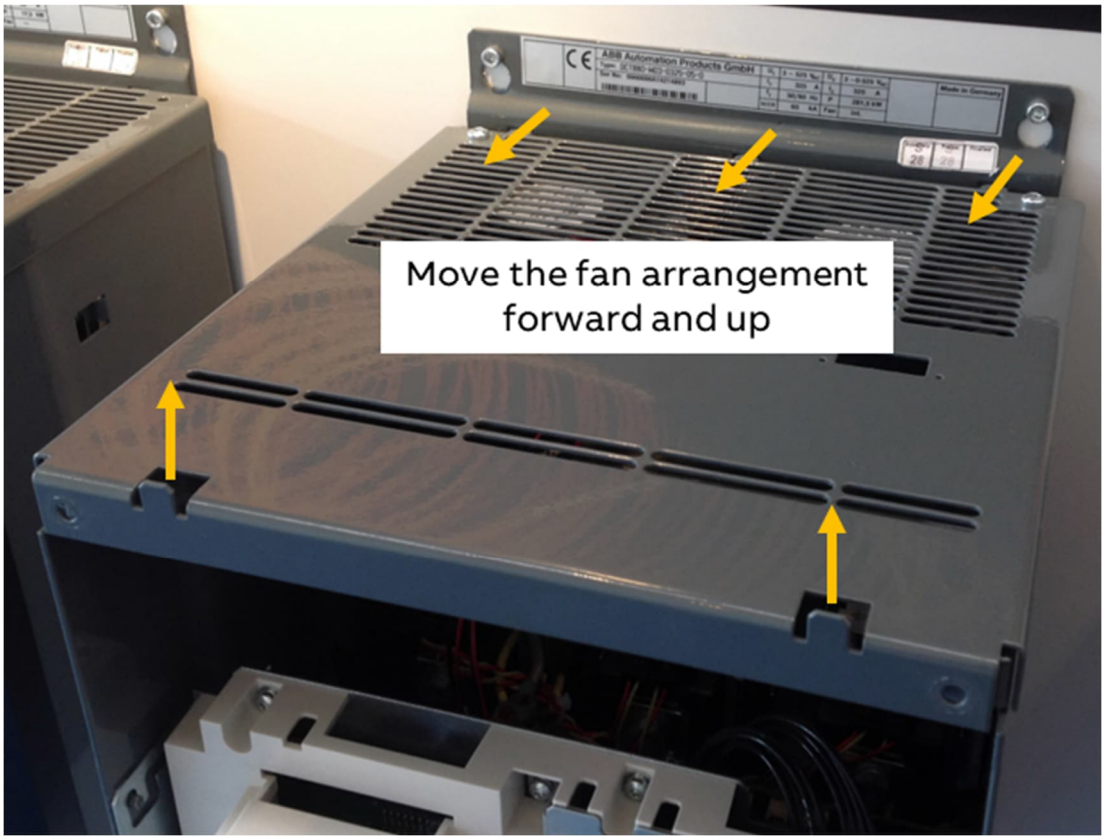
1. Remove the control panel and the design cover.



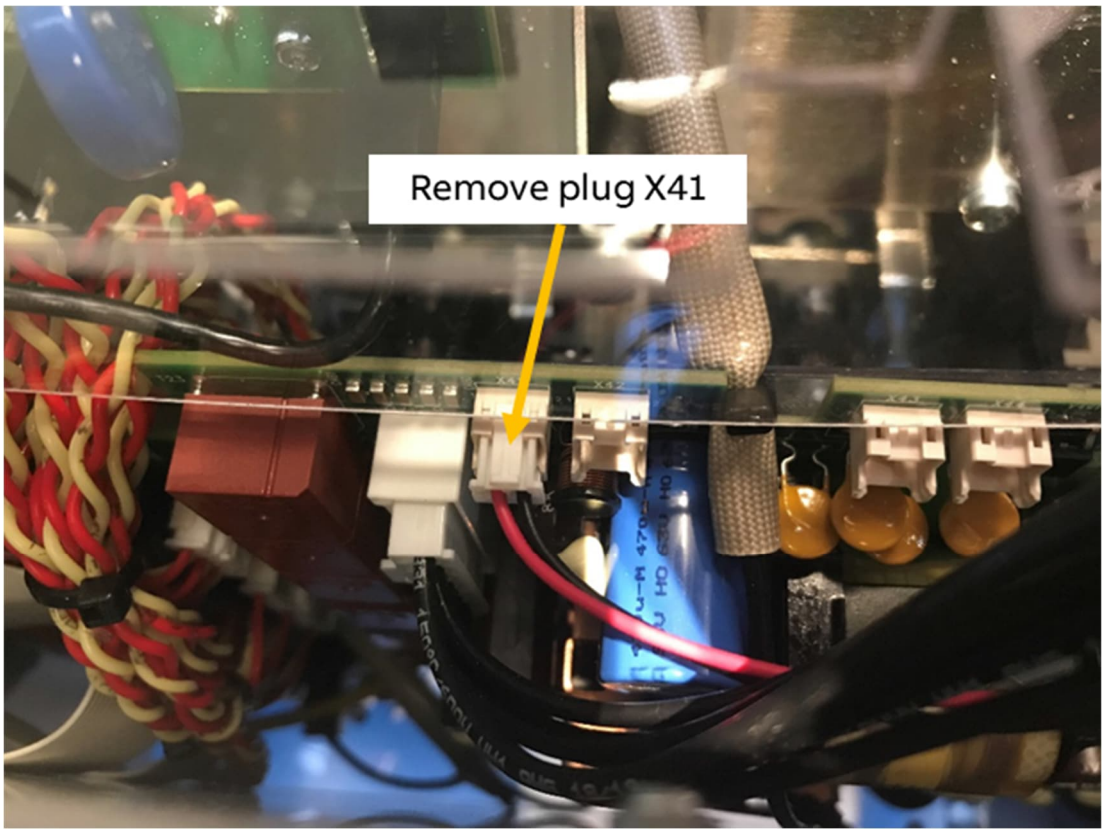
2. Remove the two fan arrangement screws.



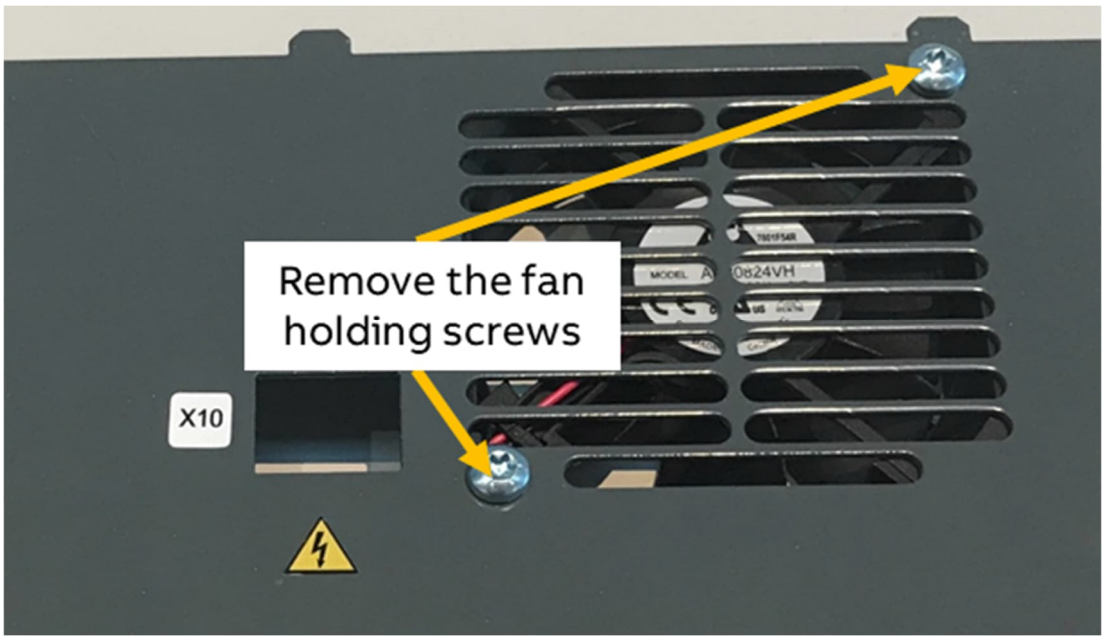
3. Move the fan arrangement forward and up.



4. Remove plug X41 on the SDCS-PIN-H01.



5. Remove the fan holding screws of the broken fan.

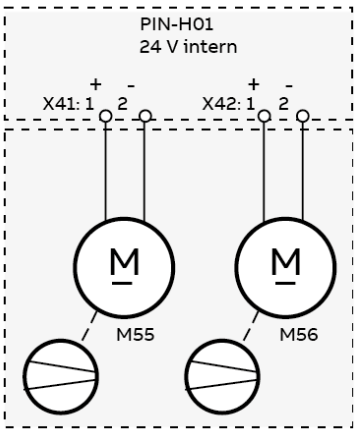


6. Attach the new fan, reassemble all parts, and check for correct blow direction of the fan. The air should be sucked out of the module.

Exchange cooling fans sizes H2 … H3 (two fans)

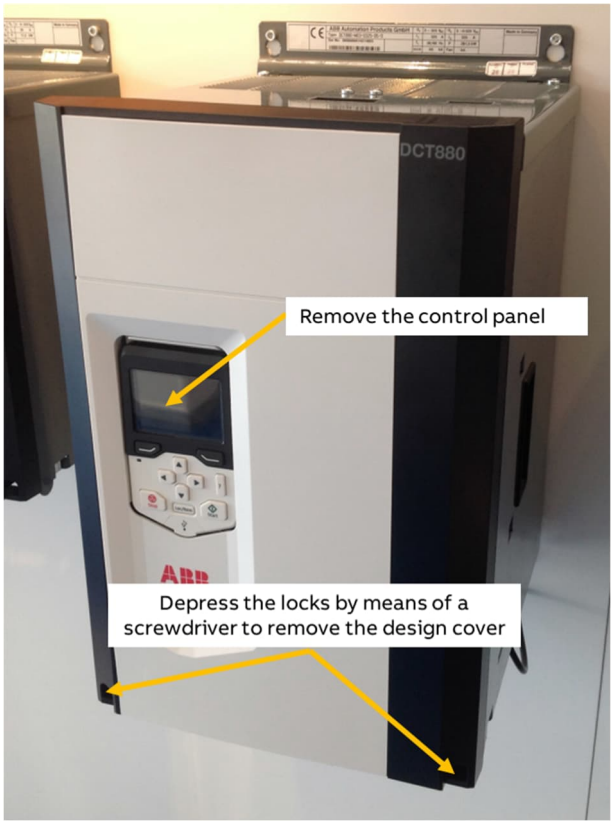
Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

Converters size DCS880-S0b-0135-dd … DCS880-S0b-0450-dd and using two 24 V_{DC} fans.

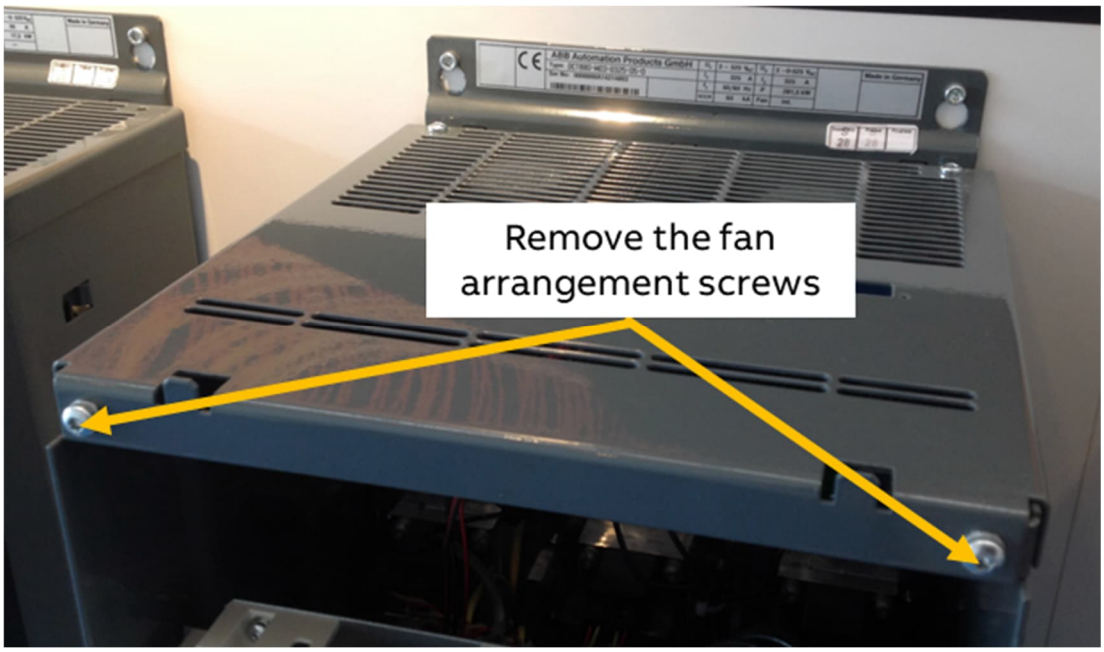


Removing the cooling fan

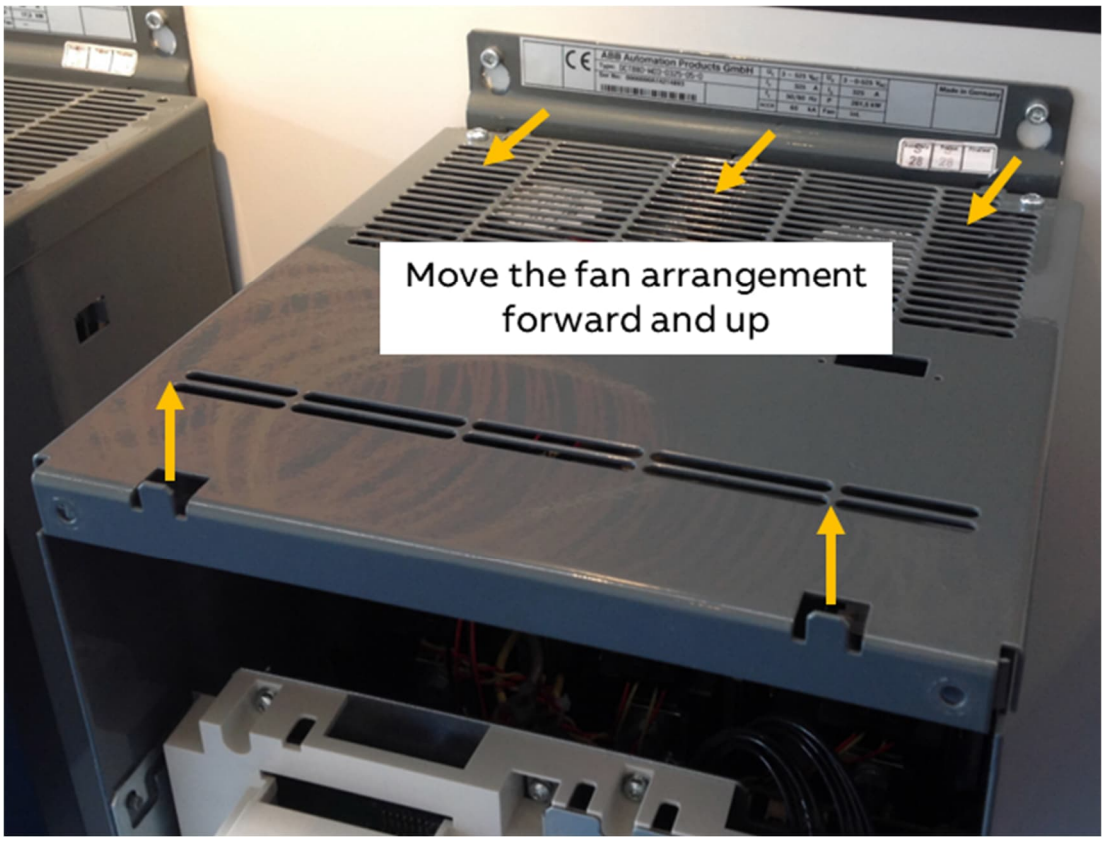
1. Remove the control panel and the design cover.



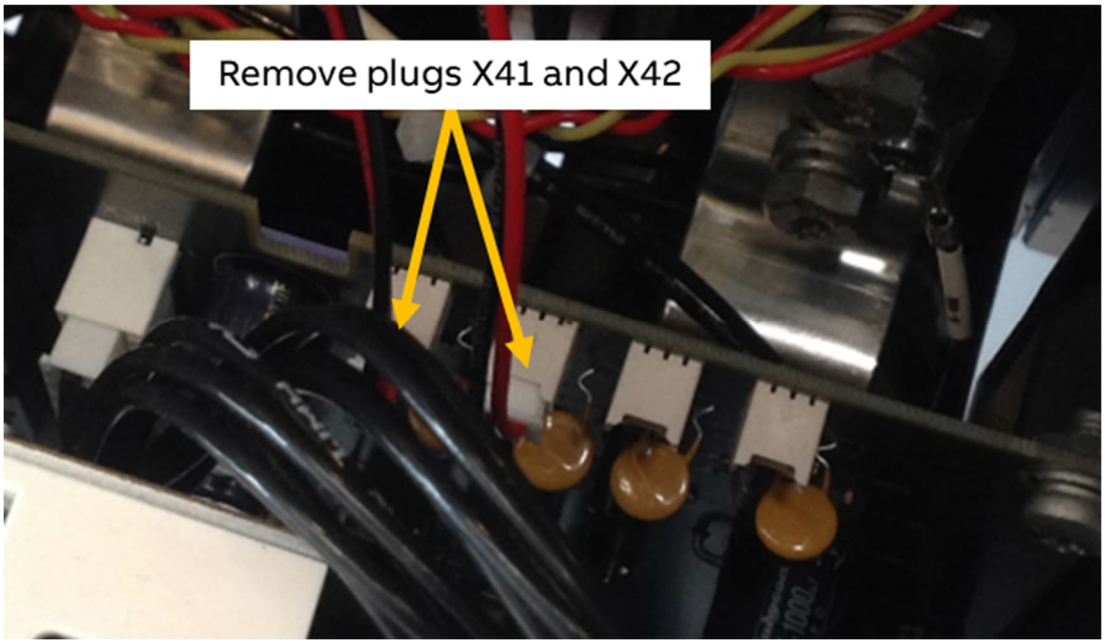
2. Remove the two fan arrangement screws.



3. Move the fan arrangement forward and up.



4. Remove plugs X41 and X42 on the SDCS-PIN-H01.



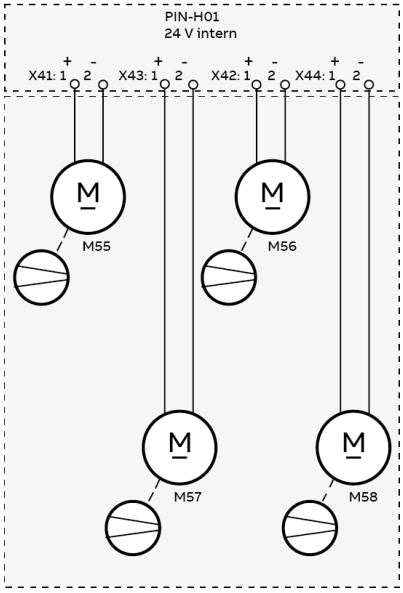
5. Remove the fan holding screws of the broken fan.

6. Attach the new fan, reassemble all parts, and check for correct blow direction of each fan. The air should be sucked out of the module.

Exchange cooling fans size H3 (four fans)

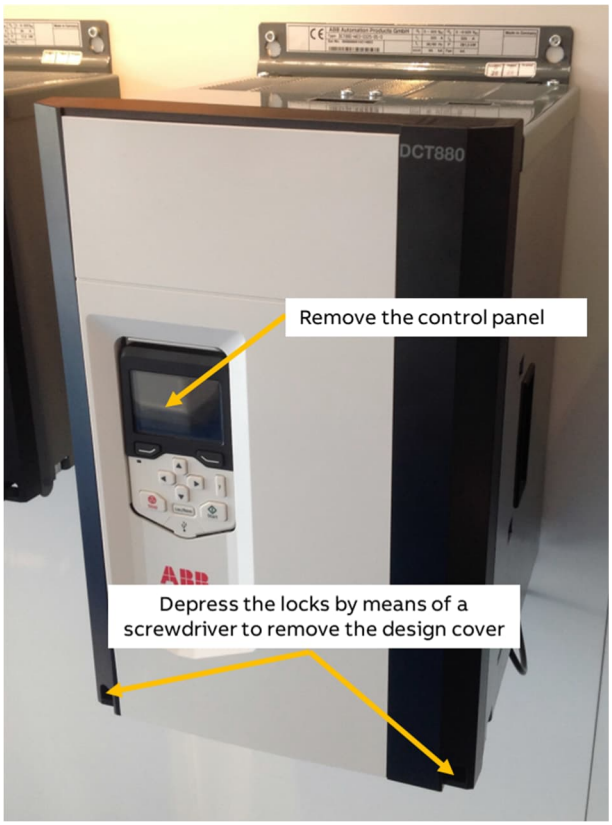
Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

Converters size DCS880-S0b-0470-dd ... DCS880-S0b-0520-dd and using four 24 V_{DC} fans.



Removing the cooling fan

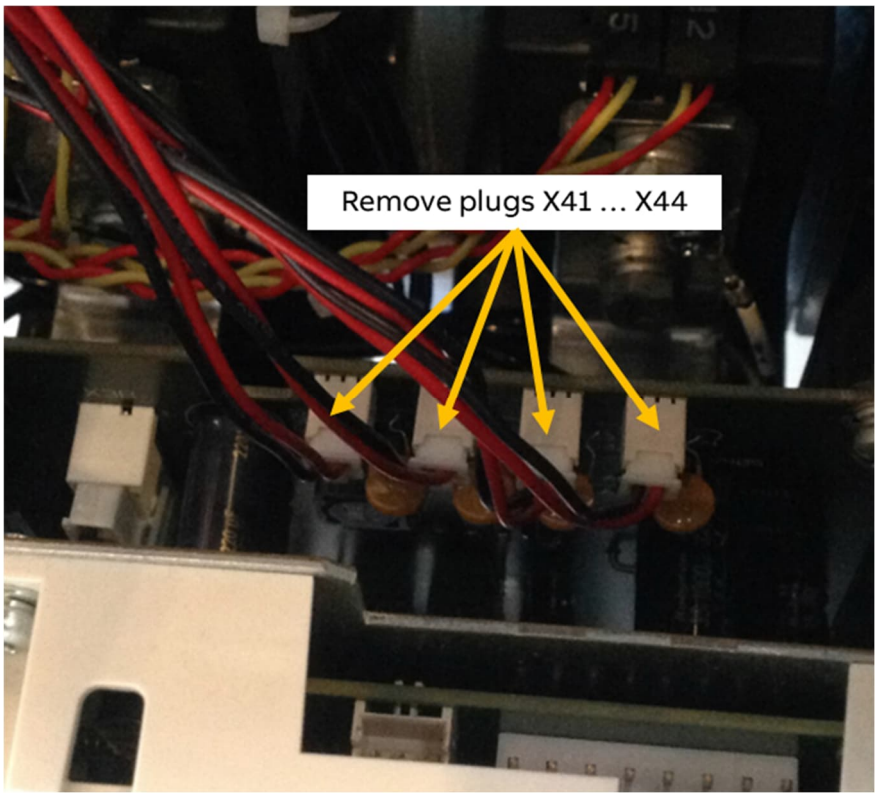
1. Remove the control panel and the design cover.



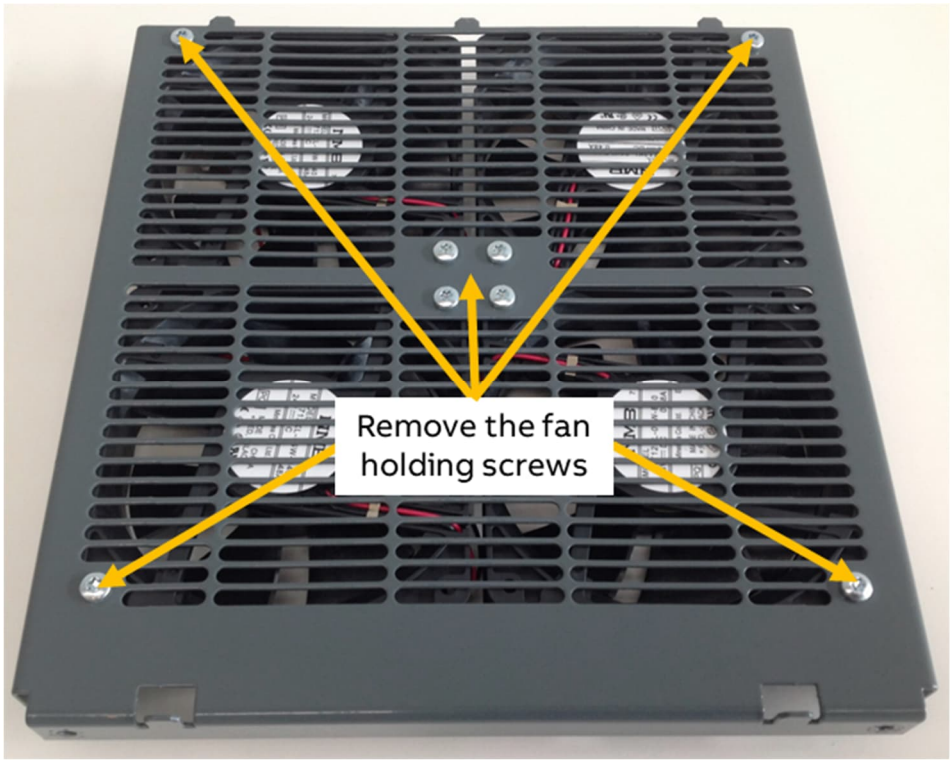
2. Remove the two fan arrangement screws.

3. Move the fan arrangement forward and up.

4. Remove plugs X41 … X44 on the SDCS-PIN-H01.



5. Remove the fan holding screws of the broken fan.

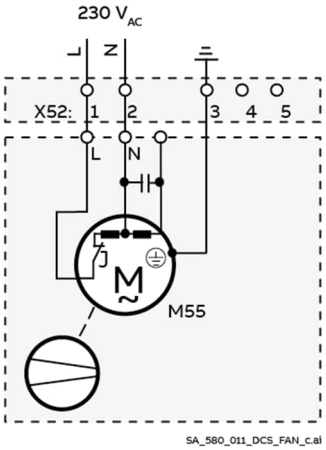


6. Attach the new fan, reassemble all parts, and check for correct blow direction of each fan. The air should be sucked out of the module.

Exchange cooling fan size H4

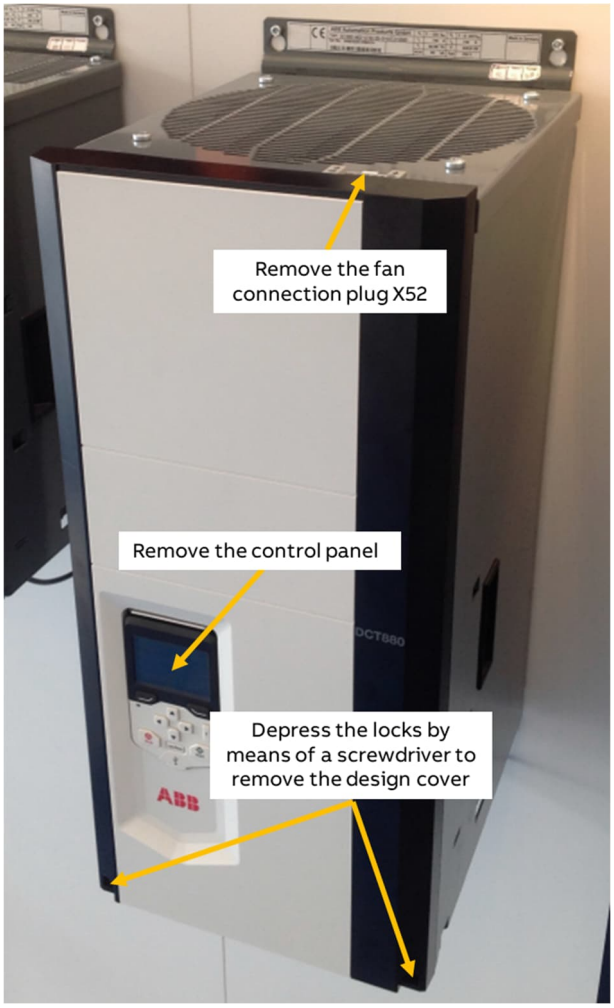
Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

Converters size DCS880-S0b-0610-dd ... DCS880-S0b-1000-dd using either one 230 V_{AC} or one 115 V_{AC} fan.

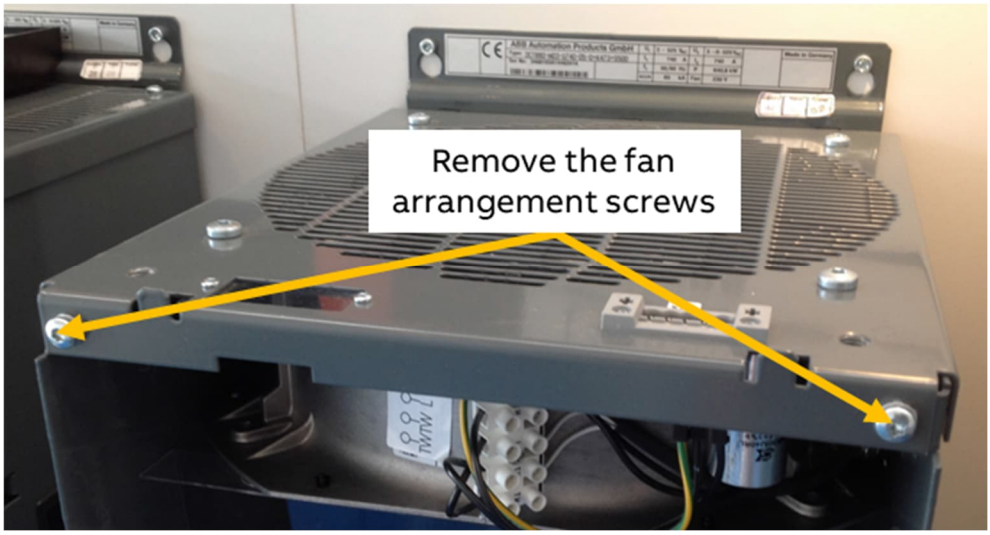


Removing the cooling fan

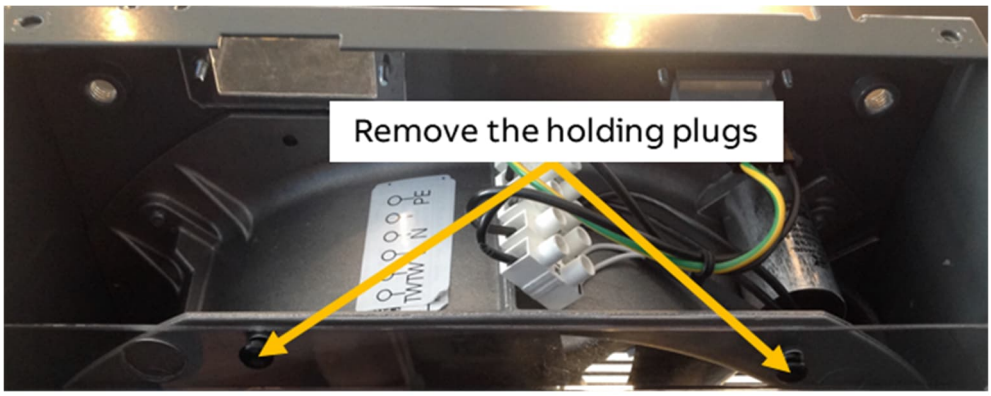
1. Remove the control panel, the design cover, and the fan connection plug X52 on the top of the converter housing.



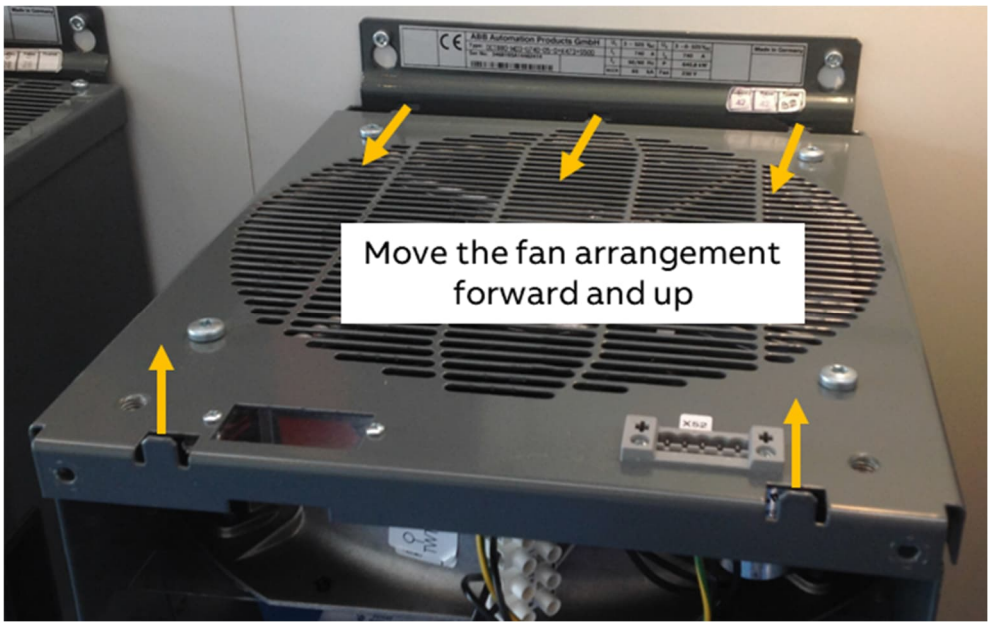
2. Remove the two fan arrangement screws.



3. Remove the holding plugs by pulling out the head (use a flat screwdriver).

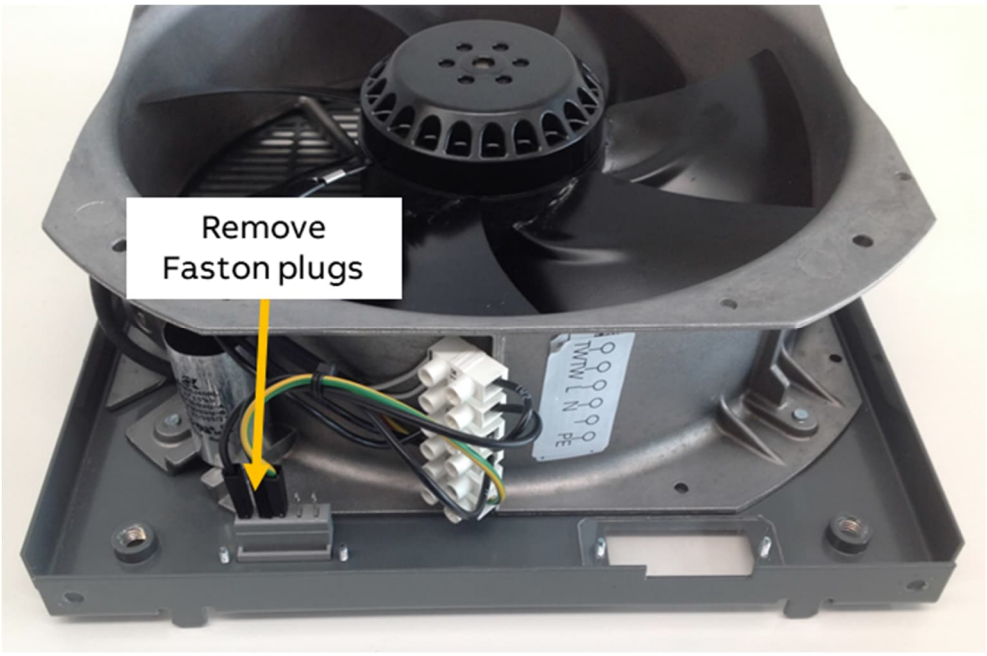


4. Move the fan arrangement forward and up.



5. Remove the fan holding screws.

6. Remove the Faston plugs from X52 and the broken fan.

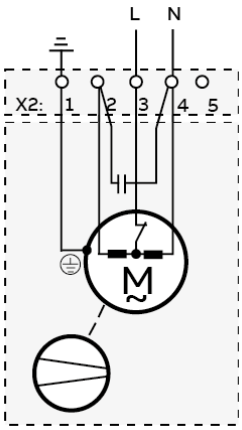


7. Attach the new fan, reassemble all parts, and check for correct blow direction of each fan. The air should be sucked out of the module.

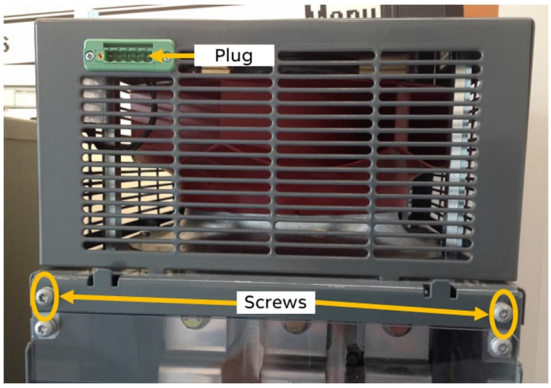
Exchange cooling fan size H5

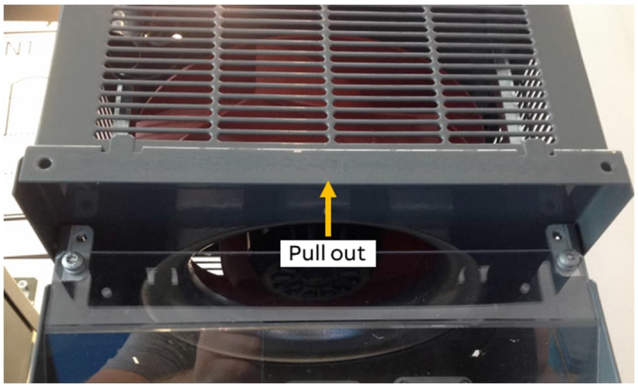
Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

Converters size DCS880-S0b-1190-dd using one 230 V_{AC} fan.



1. Remove both screws at the bottom of the fan arrangement.
2. Disconnect the plug.
3. Now the fan arrangement can be pulled out.





4. Attach the new fan, reassemble all parts, and check for correct blow direction of the fan. The air should be sucked out of the module.

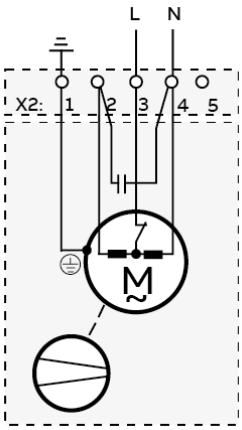
Exchange cooling fan size H6

Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

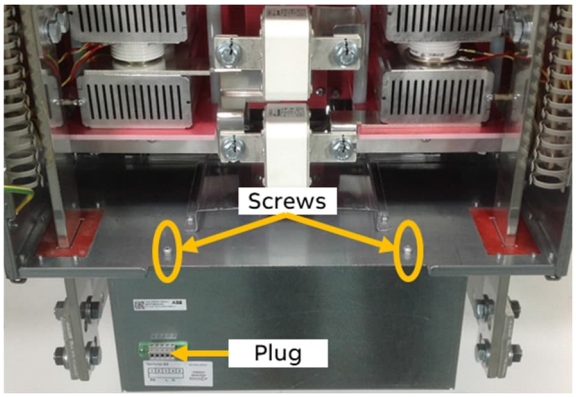
Converters size DCS880-S0b-0900-dd ... DCS880-S0b-2000-dd using one 230 V_{AC} fan.

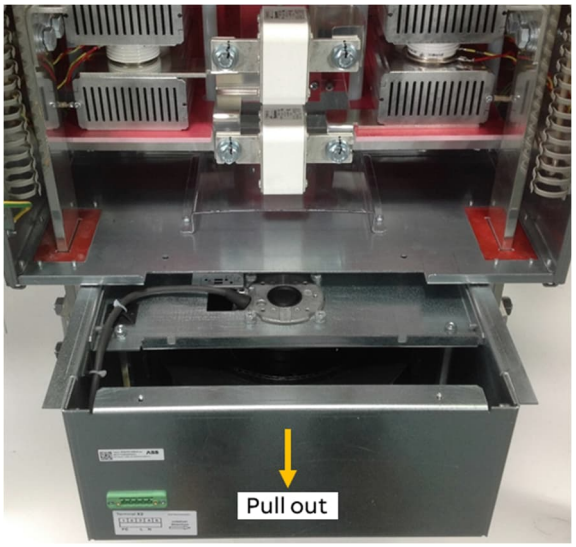
Notes:

- This instruction is valid for both classic and ErP fan boxes.
- The ErP fan box is a suitable spare part for converters with a classic fan box. Classic and ErP compliant fan boxes are electrically and mechanically compatible. Except for their heights.



1. Remove both screws at the top of the pull-out box.
2. Disconnect the plug.
3. Now the fan box can be pulled out.

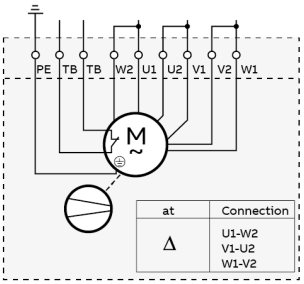




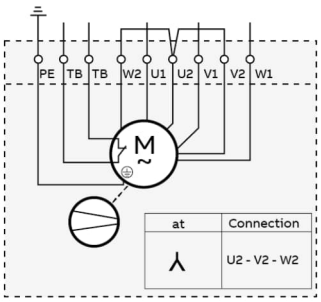
Exchange cooling fan size H7

Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

Converters size DCS880-S0b-1900-dd ... DCS880-S0b-3000-dd using one fan in delta connection:
- 400 V_{AC}, 50 Hz.
- 460 V_{AC}, 60 Hz.



Converters size DCS880-S0b-1900-dd ... DCS880-S0b-3000-dd using one fan in star connection:
- 500 V_{AC}, 50 Hz.

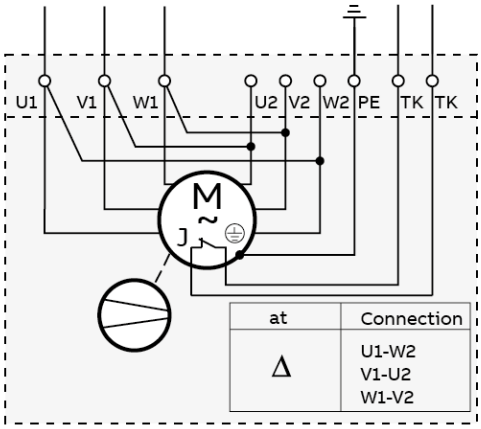


1. Disconnect the cables.
2. Remove the three screws at the top of the fan.
3. Lift the fan up and pull it out.

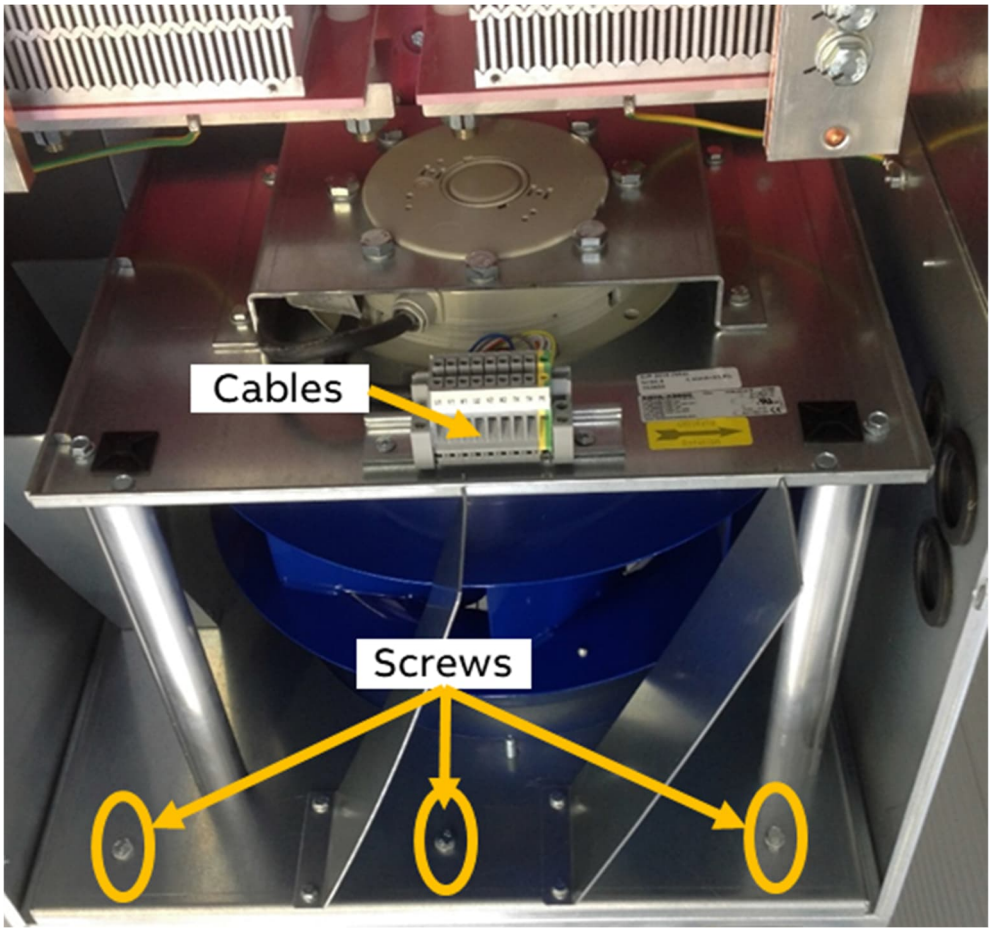
Exchange cooling fan size H8

Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

Converters size DCS880-S0b-2050-dd ... DCS880-S0b-5200-dd using one fan.



1. Disconnect the cables.
2. Remove the three screws at the bottom of the fan.
3. Lift the fan up and pull it out.



Exchange internal semiconductor fuses size H5 (1190 A)

All DCS880 size H5 are equipped with internal semiconductor fuses.

Required tools

Special tools or material needed in addition to standard tools for the exchange of thyristor modules:

- Torx screwdrivers: TX10, TX20, TX25
- Torque spanner for electrical connections: 13Nm (M8)
  25 Nm (M10)
  50 Nm (M12)
- Screws are metric type; use appropriate nuts.

Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

Find blown semiconductor fuses

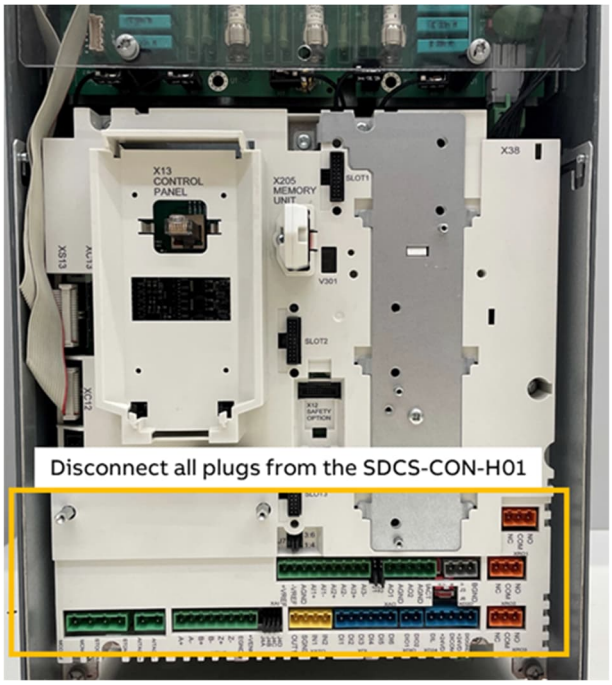
Using the OHM function of a normal multimeter, measurements must be made from both sides of the semiconductor fuses.

Remove blown semiconductor fuses

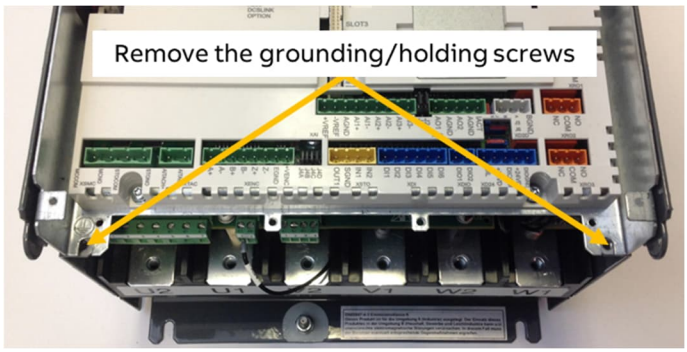
Recommendation:
Use safety equipment to protect your hands.

1. Remove control panel and design cover.

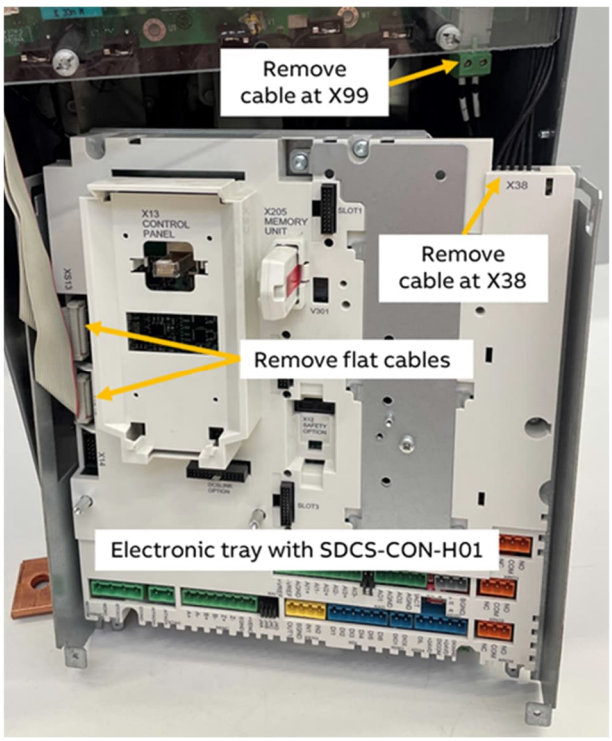
2. Disconnect all I/O plugs from the electronic tray.
3. Disconnect all connections from present plug-in options.



4. Remove the grounding/holding screws from the electronic tray.

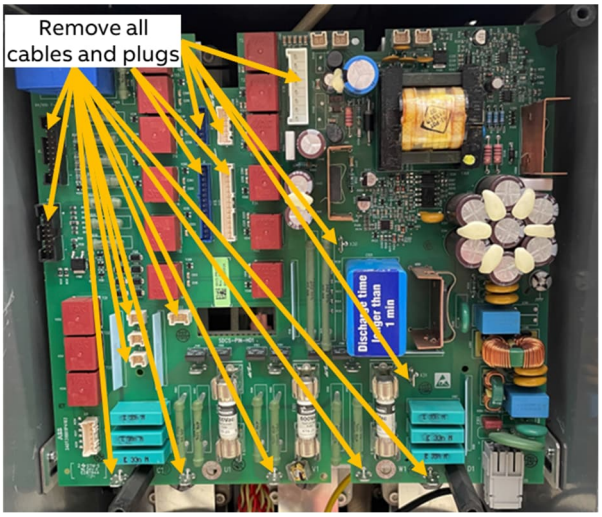


5. To unhinge the electronic tray pull it up and then out.
6. On the electronic tray unplug the flat cables (XC12, XS13) and the cable connected at X38.
7. On the SDCS-PIN-H01 unplug the cable at X99.
8. Remove the electronic tray completely.

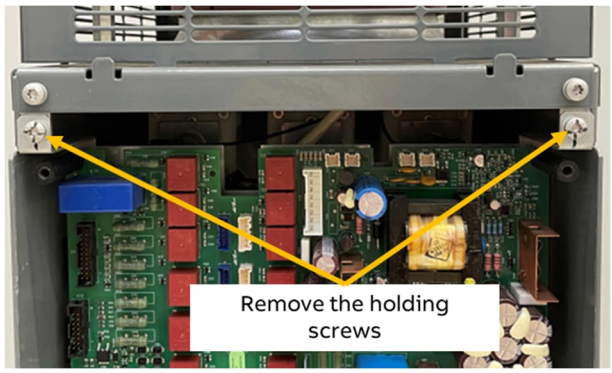


9. Remove the plastic cover.

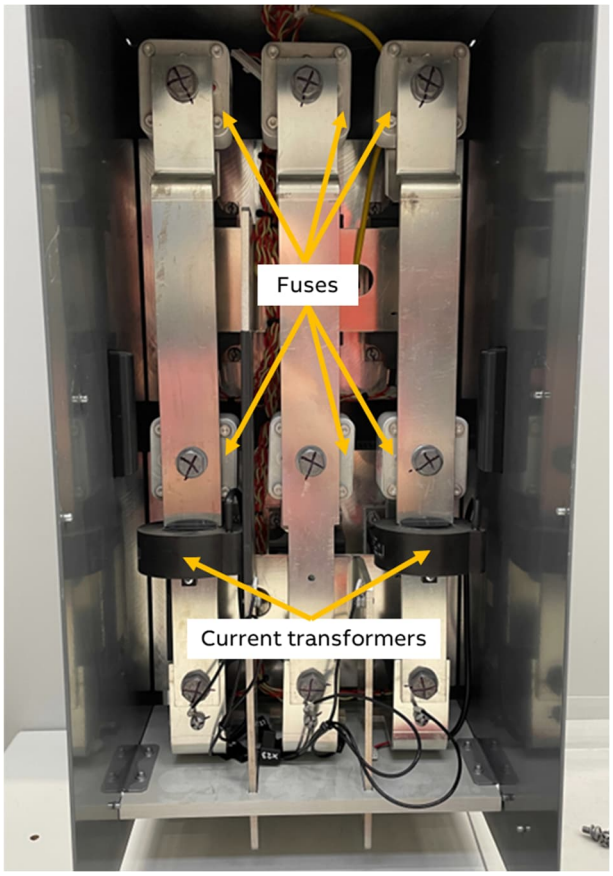
10. Remove all cables and plugs at the SDCS-PIN-H01.



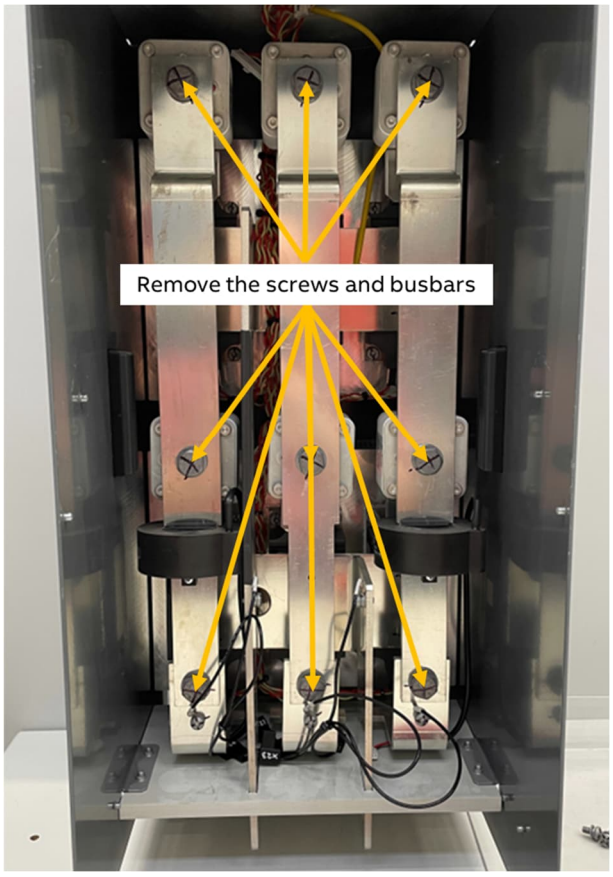
11. Remove the holding screws.
12. To unhinge the electronic tray including the SDCS-PIN-H01 pull it up and then out.



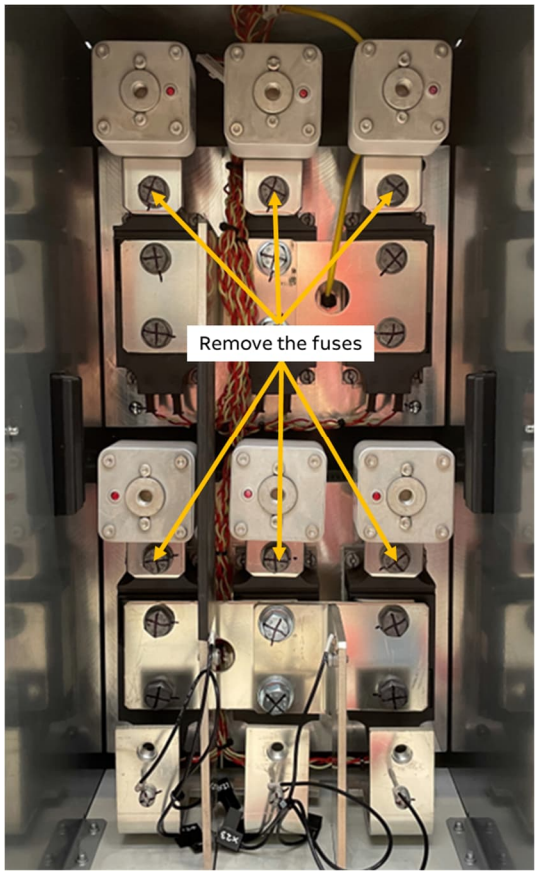
13. After the electronic tray including the SDCS-PIN-H01 is removed.
14. Check for blown fuses.



15. To remove the U1, V1 or W1 busbar of the blown fuse(s), loosen the screws using a spanner (nut size 17).



16. To remove the blown fuses, loosen the screws using a spanner (nut size 17)



17. The busbar of the blown fuse must be re-used. Remove the busbar from the blown fuse.

18. Remove only as many parts as needed around the blown fuse.
19. Remove the blown fuse and mark it clearly as defective.

Install new semiconductor fuse(s)

1. Ensure that the new semiconductor fuse(s) are of the correct type.
2. Reinstall the new semiconductor fuse(s). Make sure, the correct torque is applied according to table Required tools.
3. Perform an OHM test to make sure the semiconductor fuse(s) are ok.
4. Reinstall the U1, V1 and W1 busbars. Make sure, the correct torque is applied according to table Required tools.
5. Re-hinge the electronic tray of the SDCS-PIN-H01 board.
6. Reconnect all cables and plugs at the SDCS-PIN-H01:
   - X30, X31 snubber resistor.
   - X22 temperature sensor.
   - X3, X5 current transformers.
   - First X15, X17 then X16, X18 gate leads.
   - X24, X21, X25, X23, X20 voltage measurement.
   - XC12, XS13, X38 flat cables/cable from SDCS-CON-H01 to SDCS-PIN-H01. Use the lock connectors at the SDCS-PIN-H01.
7. Reinstall the electronic tray including the SDCS-PIN-H01 using the two holding screws at the electronic tray.
8. Reinstall the plastic cover.
9. Reconnect the flat cables at the SDCS-CON-H01 (XS13, XC12, X38), then X99 at the SDCS-PIN-H01 and re-hinge the electronic tray.
10. Reconnect the grounding/holding screws at the electronic tray including the SDCS-CON-H01.
11. Reconnect all I/O plugs with the electronic tray and all connections with the present plug-in options.
12. Reinstall the design cover and the control panel.

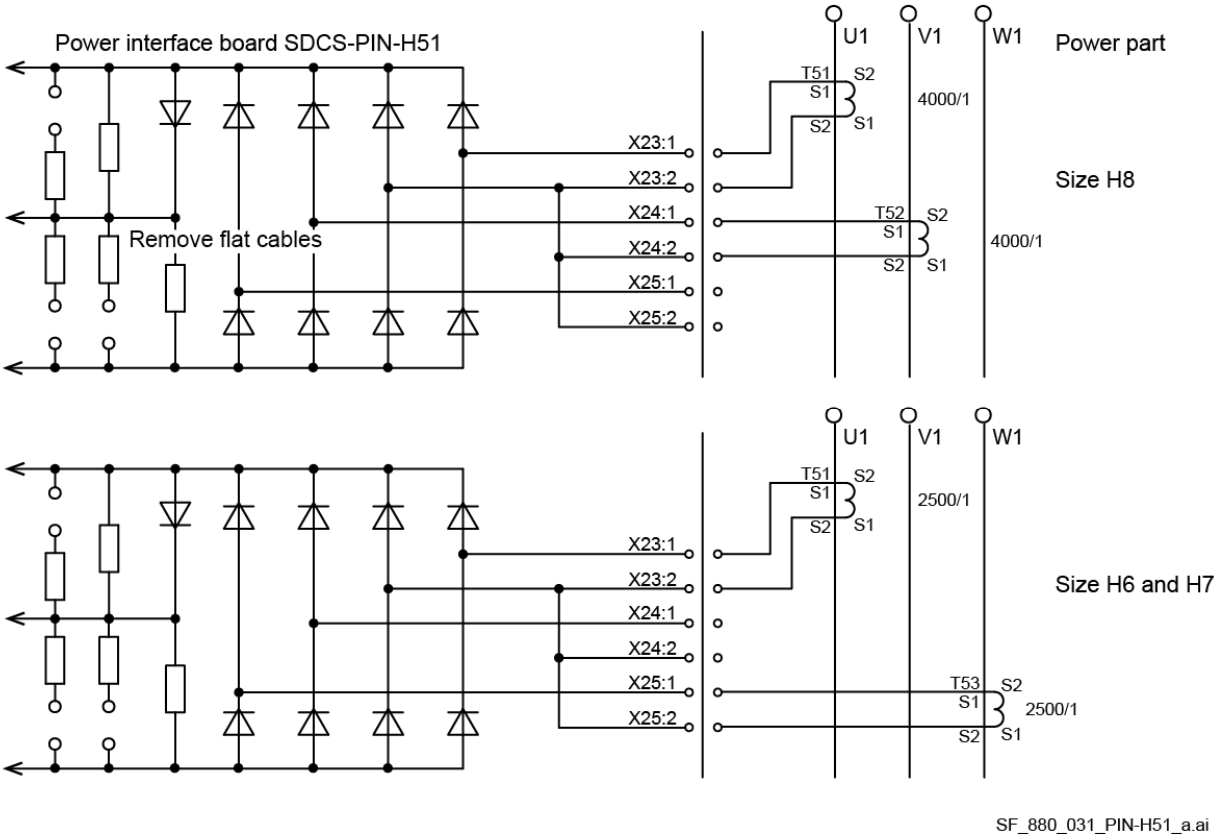
Exchange current transformers sizes H6 ... H8

Measuring the actual current

The control electronic of the converters is designed to use either 2 or 3 standard current transformers. They are located on the AC side of the bridge to measure the DC current.

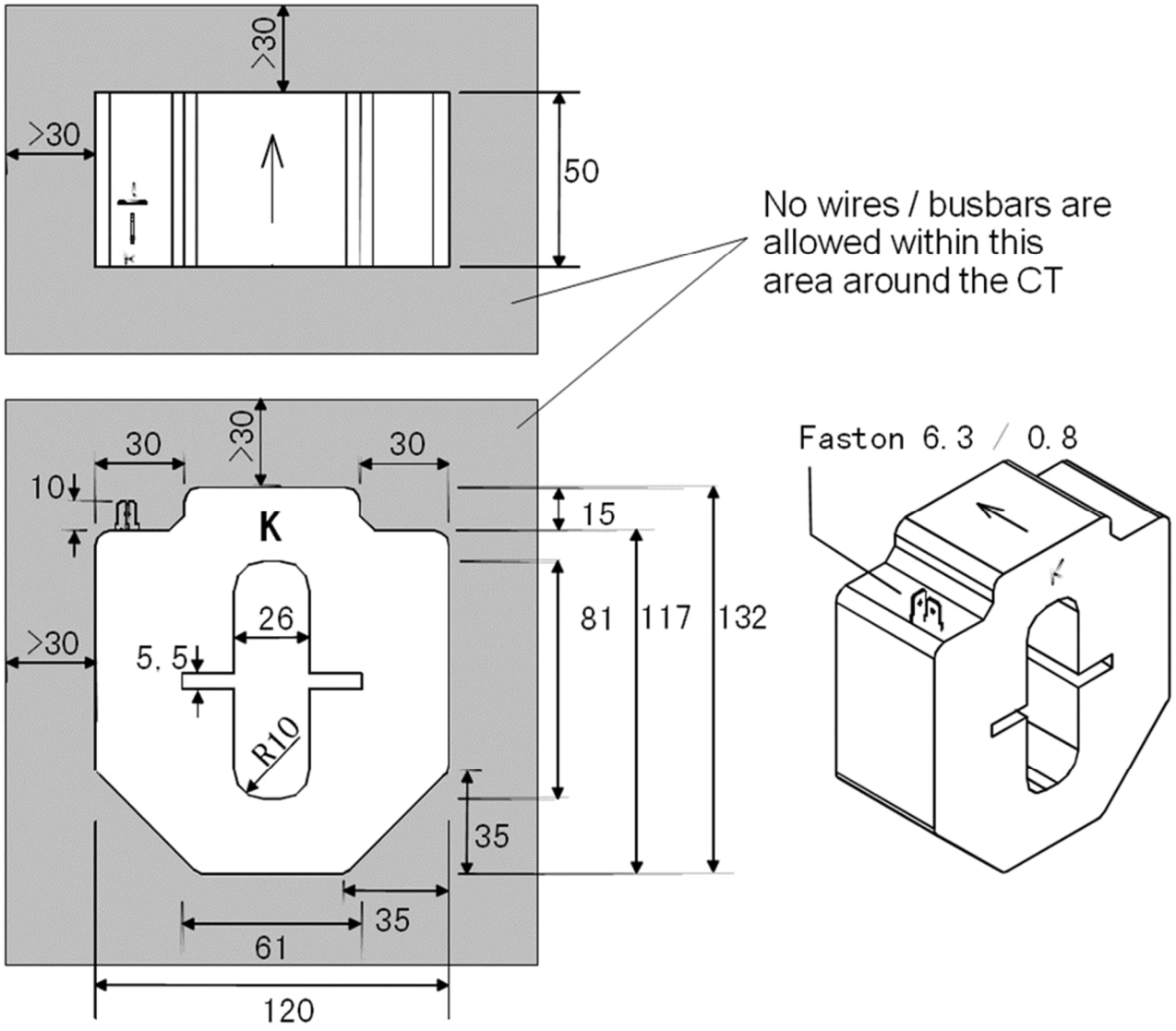
Wiring

The wiring of the current transformers are basically identical for all converters. The figure below shows the most common configurations.



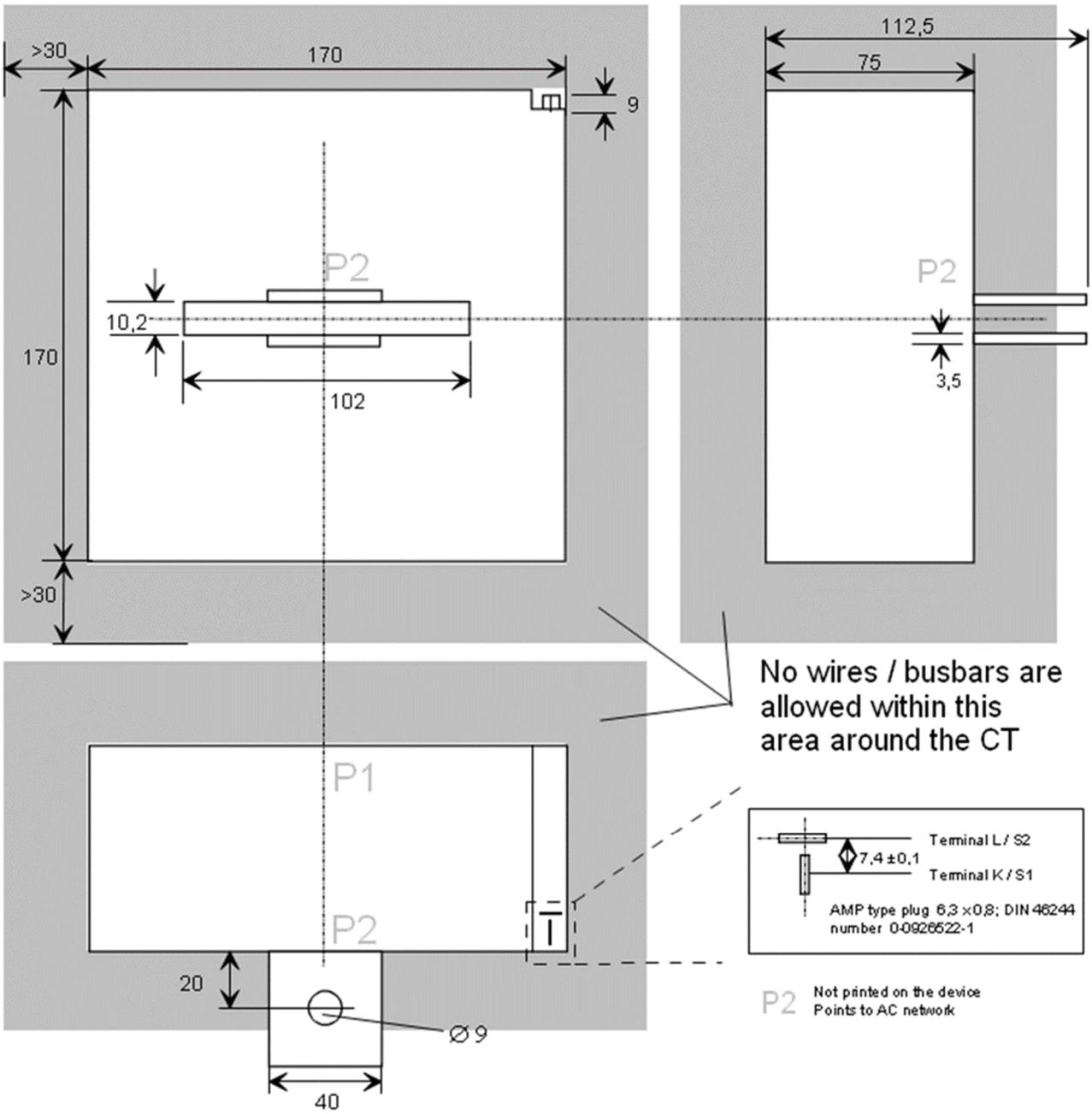
Current transformers for sizes H6 and H7

Type:	LT 2032.
Ordering number:	3ADT 751 010 P0001.
Rated primary current:	3000 A_{AC}.
Rated secondary current:	1.2 A_{AC}.
Ratio:	2500 : 1.
Magnetic overload capacity for a short time:	3 times rated primary current.
Maximum rated voltage:	1500 V_{AC}.
Maximum test voltage:	5000 V_{AC} for less than 3 seconds.
Dimensions:	In mm, see figure below.
Weight:	1.7 kg.
Maximum ambient (e.g., cooling air) temperature at rated current:	55°C.
Maximum conductor (wire/busbar) temperature at rated current:	90°C.



Current transformers for size H8

Ordering number:	3ADT 751 007 P0001.
Rated primary current:	5000 A_{AC}.
Rated secondary current:	1.25 A_{AC}.
Ratio:	4000 : 1.
Magnetic overload capacity for a short time:	3 times rated primary current.
Maximum rated voltage:	1200 V_{AC}.
Maximum test voltage:	4000 V_{AC} for less than 60 seconds.
Dimensions:	In mm, see figure below.
Weight:	1.7 kg.
Maximum ambient (e.g., cooling air) temperature at rated current:	55°C.
Maximum conductor (wire/busbar) temperature at rated current:	90°C.



Exchange current transformers size H6

Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

If current transformers fail or need to be repaired, the following has to be considered:

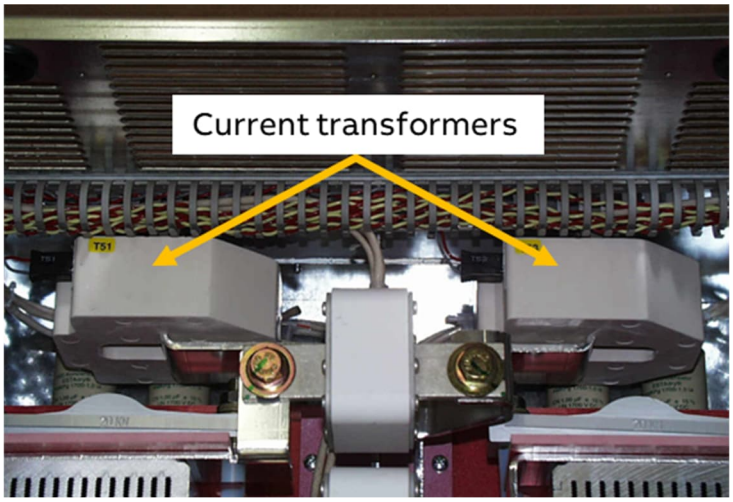
- It is important that all current transformers are orientated and mounted in the same way on the busbars.
- Check the wiring of the old current transformers according the figure in chapter Wiring. It is important that all current transformers are wired in the same way. Take additional care in case the connection is not done by coded twisted pair cables.

Current transformer type

- The current transformers are located in the H6 module.
- AC busbars are routed through the current transformers. The current transformers are kept in place by design and need no further mounting.
- The connection to the electronics is done via twisted pair cables with coded faston plugs on both ends.

Exchange

- Disconnect the AC wires/busbars at the top of the converter.
- To get access to the current transformers remove the top panel of the converter's body.
- Now the old current transformers can be removed.
- Install the new current transformers with proper orientation. No extra mechanical mounting is necessary.
- Take care of proper electrical connections.
- Remount the top panel.
- Reconnect the AC wires/bus bars.



Exchange current transformers size H7

Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

If current transformers fail or need to be repaired, the following has to be considered:

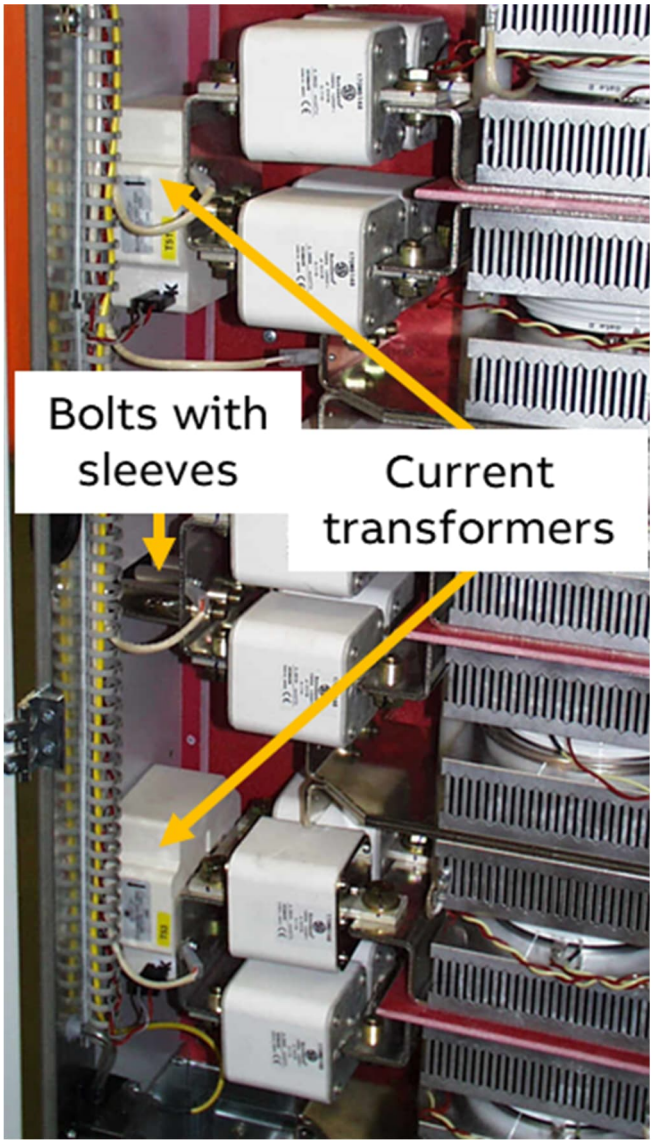
- It is important that all current transformers are orientated and mounted in the same way on the busbars.
- Check the wiring of the old current transformers according the figure in chapter Wiring. It is important that all current transformers are wired in the same way. Take additional care in case the connection is not done by coded twisted pair cables.

Current transformer type

- The current transformers are located in the H7 module.
- AC busbars are routed through the current transformers. The current transformers are kept in place by design and need no further mounting.
- The connection to the electronics is done via twisted pair cables with coded faston plugs on both ends.

Exchange

- Remove the fuses connected to the busbars leading to the current transformers.
- To get access to the current transformers remove the bolts with sleeves from the AC busbars outside the converter.
- Make sure the current transformers are not falling down when removing the bolts and sleeves.
- Install the new current transformers with proper orientation. No extra mechanical mounting is necessary.
- Fasten the bolts including sleeves.
- Take care of proper electrical connections.
- Remount the fuses.



Exchange current transformers size H8

Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

If current transformers fail or need to be repaired, the following has to be considered:

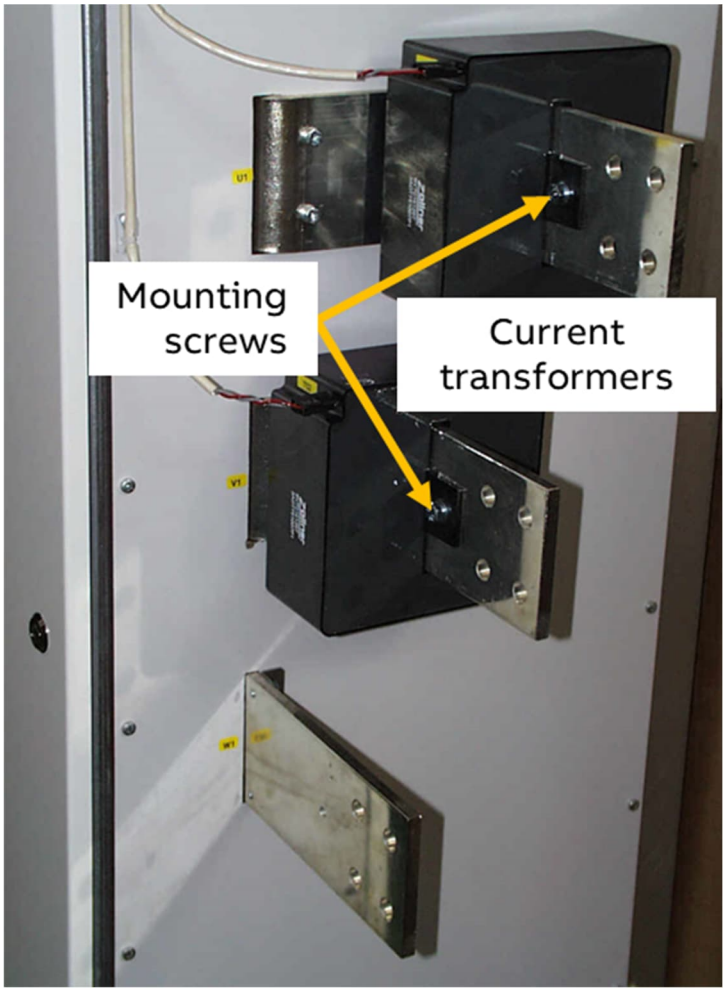
- It is important that all current transformers are orientated and mounted in the same way on the busbars.
- Check the wiring of the old current transformers according the figure in chapter Wiring. It is important that all current transformers are wired in the same way. Take additional care in case the connection is not done by coded twisted pair cables.

Current transformer type

- The current transformers are located outside the H8 module.
- AC busbars are routed through the current transformers. The current transformers are mounted on the busbars by means of screws.
- The connection to the electronics is done via twisted pair cables with coded faston plugs on both ends.

Exchange

- Disconnect the AC wires / busbars at the side of the converter.
- Remove the mounting screws.
- Remove the old current transformers.
- Install the new current transformers with proper orientation.
- Fix the current transformers by means of the mounting screws.
- Take care of proper electrical connections.



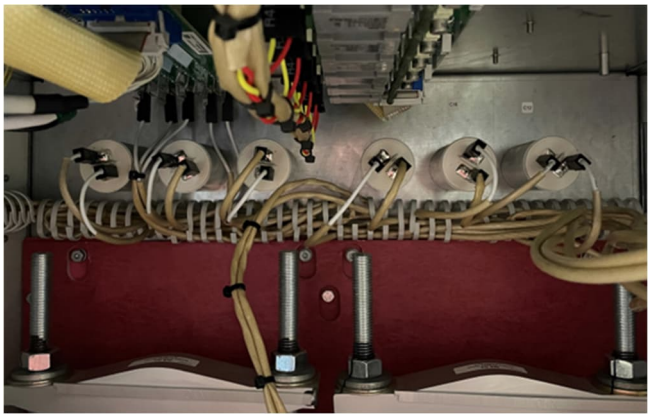
Exchange snubber capacitors size H8

Note: For 990 V_{AC} and 1190 V_{AC} converters only.

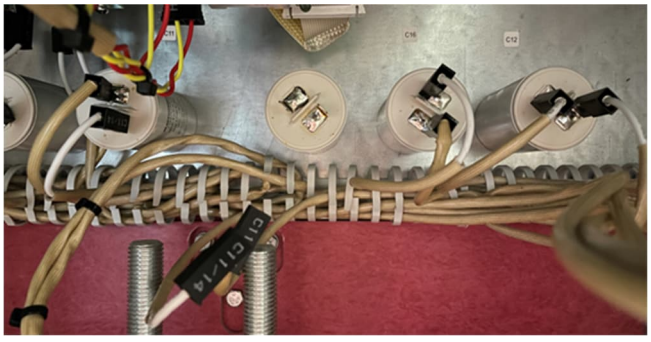
Before work starts, disconnect the converter completely from the power supply, then check the voltage free condition and make sure everything is located in an electrical and mechanical safe condition!

1. Snubber capacitor.

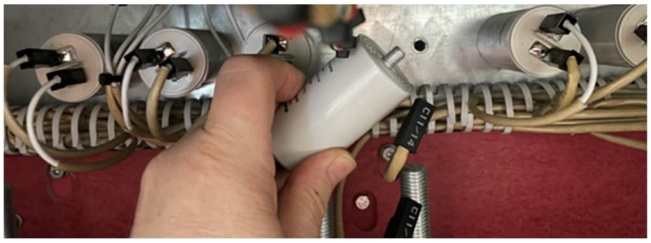
2. The snubber capacitors are located at the back of the module.



3. Disconnect the fastons.



4. Unscrew the snubber capacitors.
5. Mount the new snubber capacitors and reassemble the fastons.



DCS880 firmware download

General

This chapter describes how to download firmware using Drive Composer pro 2.6 or higher.
All DCS880 size H1 … H8 are equipped with either:

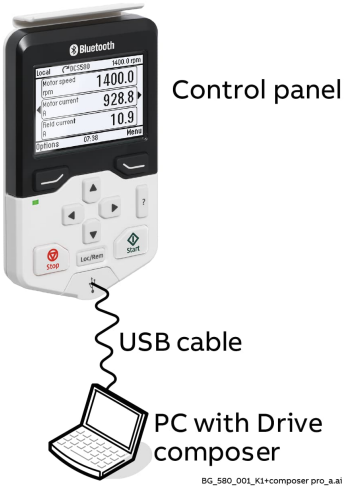
- Electronic tray DCS880/DCT880 3ADT220166R0002 (includes SDCS-CON-H01) compatible with all firmware versions.
- Electronic tray DCS880/DCT880 3ADT220166R0012 (includes SDCS-CON-H01L) compatible with firmware versions 3.00.0.0 and higher.

Note: Both electronic trays are interchangeable.

Download SDCS-CON-H01 firmware using Drive Composer pro 2.6 or higher

Prepare firmware download

- Firmware loading package:
  - The firmware loading package can be found in section Firmware of the DCS880 sales toolbox.
- Parameters:
  - The firmware download is setting all parameters back to default. Make a parameter backup beforehand using either the control panel or Drive Composer pro. This is for safety reasons only.
  - Nevertheless, Drive Composer pro will save the parameters (if activated) and write them back after the firmware download.
- Adaptive Program:
  - The firmware download deletes the Adaptive Program. In case an Adaptive Program is included, make a backup beforehand using Drive Composer pro. This is for safety reasons only.
  - Nevertheless, Drive Composer pro will save the Adaptive Program (automatically) and write it back after the firmware download.
- Application program:
  - The firmware download deletes the application program.
  - Make sure that a loading package of the application program is available.
  - The loading package of the application program can be downloaded the same way as a firmware loading package.
- The firmware download is done via a USB port and the control panel.

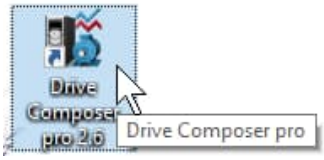


Firmware download

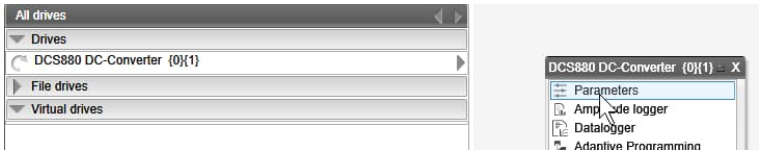
Make sure:

- The DCS880 is done with booting (energized, auxiliary voltage is on).
- The control panel is only connected to **one** DCS880.

– Open Drive Composer pro 2.6 or higher double click.

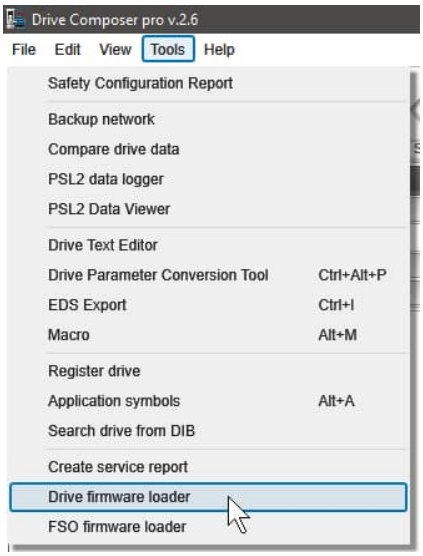


– Open the parameters.

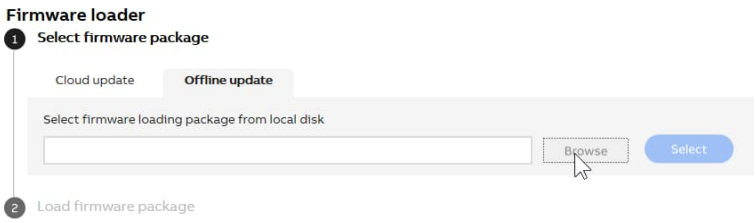


– Make sure that 28.36 M1 field heating source and 42.53 M2 field heating source = Disable field heating.
Note: Do not forget to set the values back after the procedure.

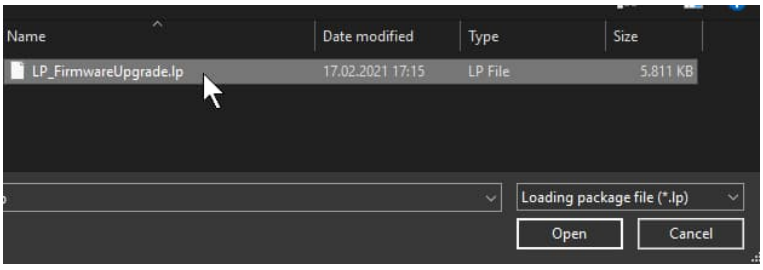
– Click *Tools* - *Drive firmware loader*.



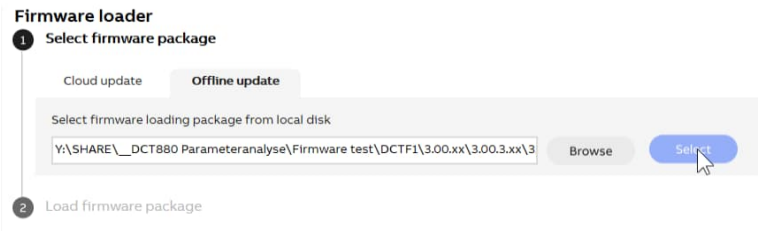
– Click *Browse* and go to the folder containing the desired firmware loading package.



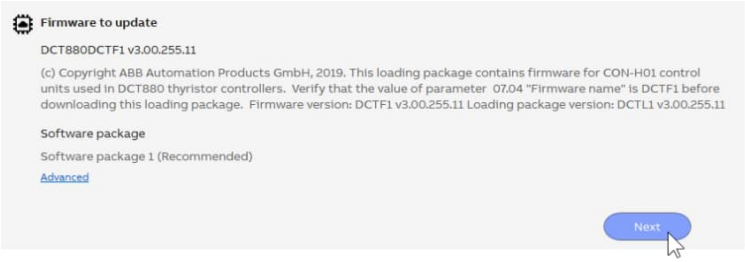
– Mark the desired firmware loading package and click *Open*.



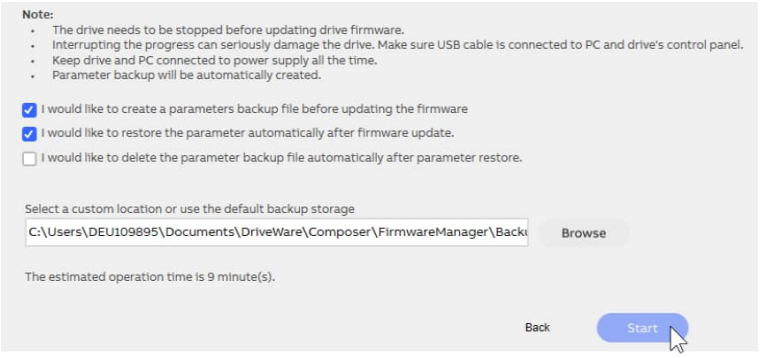
– Click *Select*.



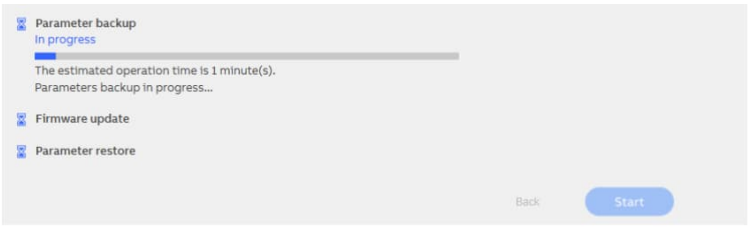
– Scroll down and click *Next*.



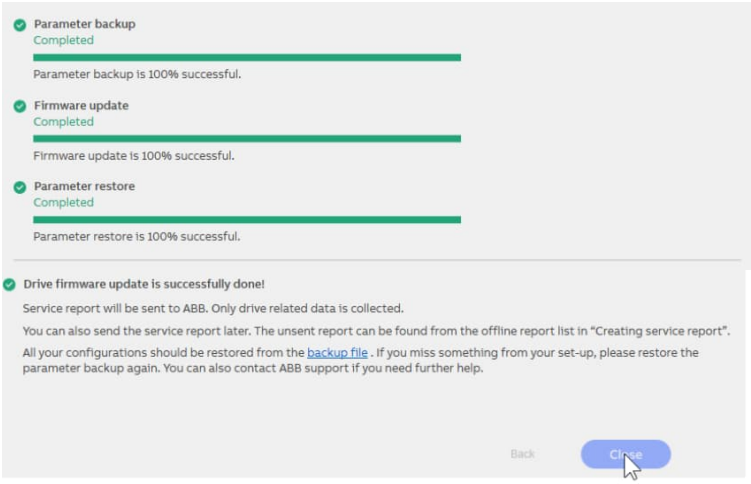
– Follow the hints under ***Note:*** at all times.
– Make sure to tick *I would like to ...* This will save the parameters of the converter.
– Click *Start*.



– Status information.
  – *Parameter backup.*
  – *Firmware update.*
  – *Parameter restore.*



– Click *Close*.



Set type code

The type code, see 95.25 Set: Type code, is preset in the factory and is write protected. It identifies the converters current-, voltage-, temperature measurement and its quadrant type. The type code can only be changed as whole or individually.

To change the type code as whole use the control panel and follow the instructions below:

- Un-protect the type code by means of 95.24 Service mode = Set: Type code.
- 95.25 Set: Type code = S01-0020-04 … S02-5200-05 (details, see table below).

The converter's basic type code: **DCS880-aab-cccc-ddef + plus code**			
Product family:	DCS880		
Product type:	aa	= S0	Standard converter module
		= S9	Standard converter module (fuseless)
		= R0	Rebuild kit
		= U1	Upgrade kit
		= A	Cabinets
Bridge type:	b	= 1	Single bridge (2-Q)
		= 2	2 anti-parallel bridges (4-Q)
Module type:	cccc	=	Rated DC current (IP00)
Rated AC voltage:	dd	= 04	100 V_{AC} … 415 V_{AC}
		= 05	100 V_{AC} … 500 V_{AC} (IEC)/525 V_{AC} (UL)
		= 06	270 V_{AC} … 600 V_{AC}
		= 07	315 V_{AC} … 690 V_{AC}
		= 08	360 V_{AC} … 800 V_{AC}
		= 10	450 V_{AC} … 990 V_{AC}
		= 12	540 V_{AC} … 1190 V_{AC}
Power connection:	e	= X	Standard H1 … H7
		= L	Busbars on the left H8, H7F
		= R	Busbars on the right H8, H7F
Revision code:	f	= 0	1st generation
		= A	H7: Double fuse
		= B	H5/H6: New cooling fan R2E250-RE04-10

The technical data and specifications are valid as of going to press. ABB reserves the right to make subsequent alterations.

Attention: When using H1 … H5 modules the current and voltage range of the type code setting is limited to max 1190 A_{DC} and max 600 V_{AC}.

- The change of the type code is immediately taken over and 95.24 Service mode must be set back to Normal mode by the user.
- The new values can be seen in group 7:
  - 07.60 Drive size.
  - 07.61 Drive block bridge 2 set.
  - 07.62 Drive DC current scaling set.
  - 07.64 Drive AC voltage scaling set.
  - 07.65 Drive max bridge temperature set.

To change the type code individually use the control panel and follow the instructions below:

- Un-protect the type code by means of 95.24 Service mode = Set: Type code.
- Set the type code individually by means of:
  - 95.26 Set: Drive block bridge 2.
  - 95.27 Set: Drive DC current scaling.
  - 95.28 Set: Drive AC voltage scaling.
  - 95.29 Set: Drive max bridge temperature.

The change of the type code is immediately taken over and 95.24 Service mode must be set back to Normal mode by the user.

- The new values can be seen in group 7:
  - 07.61 Drive block bridge 2 set.
  - 07.62 Drive DC current scaling set.
  - 07.64 Drive AC voltage scaling set.
  - 07.65 Drive max bridge temperature set.

DC-Motor neutral zone adjustment

Types concerned

DC-Motors.

Summary

Procedure to adjust the neutral zone of a DC-motor.

General

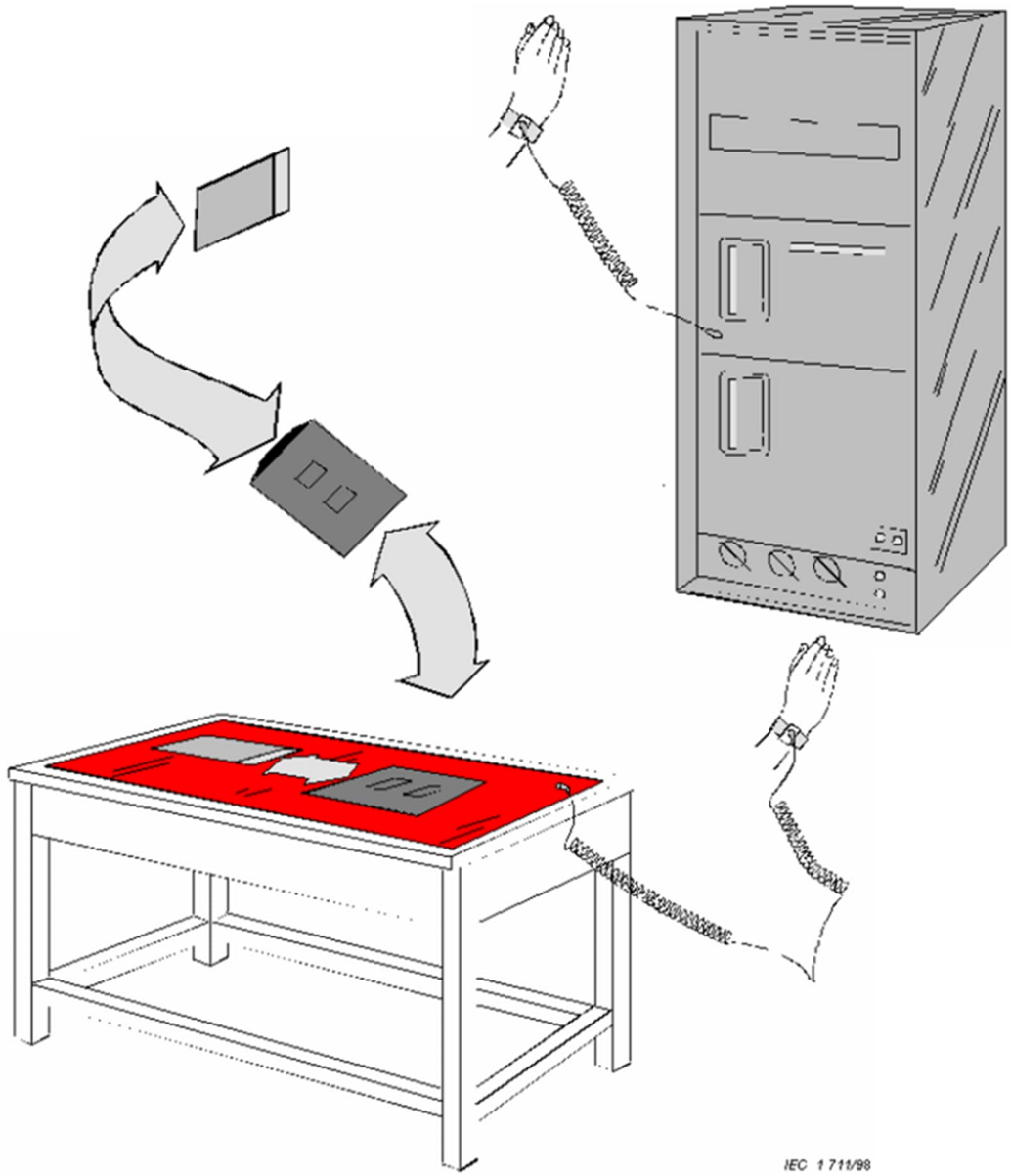
- Loosen the bolts holding the brush bridge.
- Connect a scope or a voltmeter between two adjacent brush-holder assemblies (holders with different polarity).
- Set the scaling on the scope or voltmeter to mV AC.
- Disconnect the excitation cables and connect 110 … 240 V_{AC} between F+ and F- (a normal extension cord is sufficient).
- Start moving the brush bridge slowly in one direction and watch the scope or voltmeter. If the voltage increases move the brush bridge in the other direction.
- Try to get the voltage down to less than 50 mV AC. The smaller the better.
- When this is achieved, start tightening the brush bridge bolts and watch the voltage. Sometimes you have to do a little offset to compensate for movements during tightening.
- Finally, mark the correct neutral zone position in case the motor will be taken apart in the future.

Preventive Maintenance

WARNING
Before performing any maintenance, the chapter Safety Instructions at the beginning of this manual must be followed. Negligence of these instructions can cause injury or death.

WARNING
The printed circuit boards contain components sensitive to electrostatic discharge. Use an ESD-field service kit when handling the boards. Do not touch the boards unnecessarily.

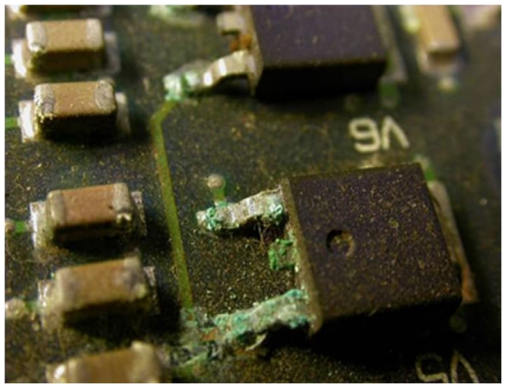
Handling the boards:



When ESD sensitive boards are removed from the converter and transferred to a temporary work surface, they should be placed in a protective packaging.
Handle unprotected ESD sensitive boards only when connected to the system and always place them in a protective package that is sealed.
It is easiest to use the spare parts ESD package. Place the protective package on the ESD mat before opening.

Recommended regular maintenance

The DCS880 requires little maintenance if installed in an appropriate environment. Regular inspection according to the maintenance schedule is strongly recommended. Preventive maintenance prevents unexpected production stops and production loss. It also increases availability of the converter.
The environmental and operating conditions of the converter are also to be considered.



A harsh environment, such as high ambient temperature, humidity, dust, and cyclic heavy load, not only shortens the components lifetime but also the preventive maintenance and replacement intervals.

Maintenance schedule

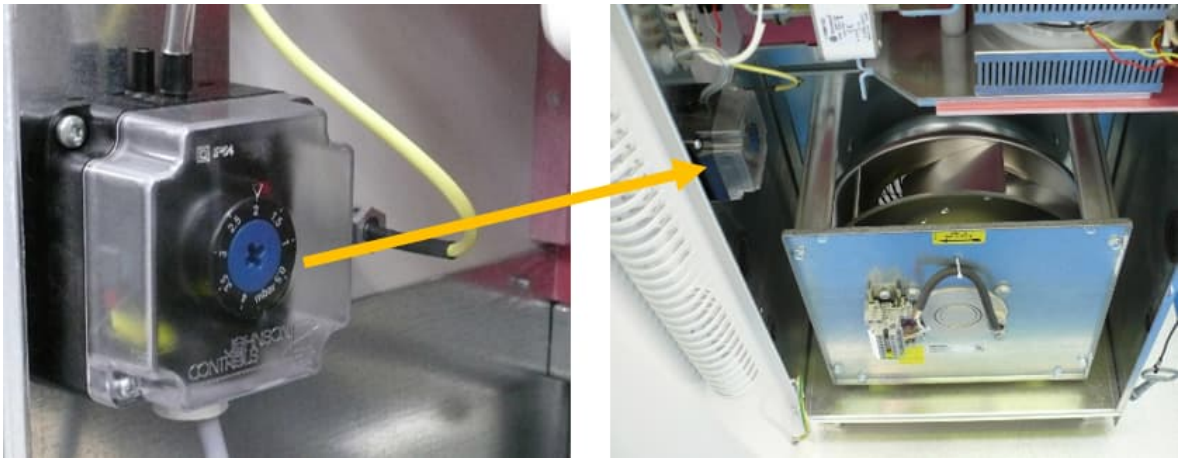
	Years from start-up																					
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Start-up	P																					
Cooling																						
Air cooled unit:																						
Cooling fan DCS880 H7, H8		I	I	R	I	I	R	I	I	R	I	I	R	I	I	R	I	I	R	I	I	R
Cooling fan DCS880 H1 (> 25 A) ... H6		I	I	I	I	I	R	I	I	I	I	I	R	I	I	I	I	I	R	I	I	I
Aging																						
DCS880 power interface board SDCS-PIN-H01							(R)			R			(R)						R			
DCS880 power supply board SDCS-POW-H01							(R)			R			(R)						R			
Snubber capacitor H8										R									R			
Connections and surroundings																						
Flat cables							(R)			R			(R)						R			
Tightness of terminals				I			I			I			I			I			I			I
Tightness of terminals, heatsink H8		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Door filters		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Condition of contactors				I			I			I			I			I			I			I
Fiber optic cables (connections)				I			I			I			I			I			I			I
Dustiness, corrosion, and temperature		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Quality of the mains voltage		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Improvements																						
Based on product notes		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Measurements																						
Basic measurements with mains voltage		P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Spare parts																						
Spare parts		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I

The service intervals and component replacements are based on the operational environment specified by ABB.
Legend:
R = **R**eplacement of components.
I = **I**nspection (visual inspection, correction and replacement if needed).
P = **P**erformance of on-site work (commissioning, tests, measurements, etc.).
(R) = **R**eplacement if high ambient temperature or cyclic heavy duty.

Annual preventive maintenance

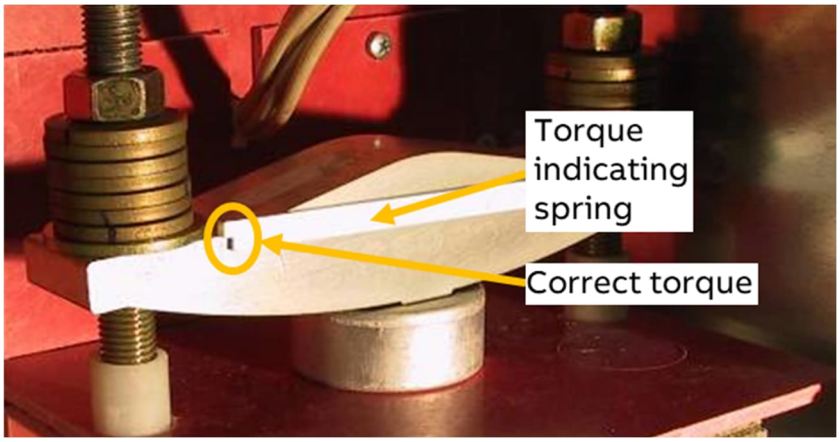
The following actions have to take place:

- Check the cooling fans of converters size H1 … H8.
  The lifetime of the cooling fan is about 30,000 … 100,000 hours depending on the converter type, the usage of the DCS880 and the environmental conditions (e.g., temperature). Fan failure can be predicted by means of increasing noise from its bearings and a gradual rise in heatsink temperature. If the DCS880 operates in a critical part of the process it is recommended to replace the fan once the above-mentioned symptoms appear.
- Check the cooling air pressure switch of converters size H7 and H8.



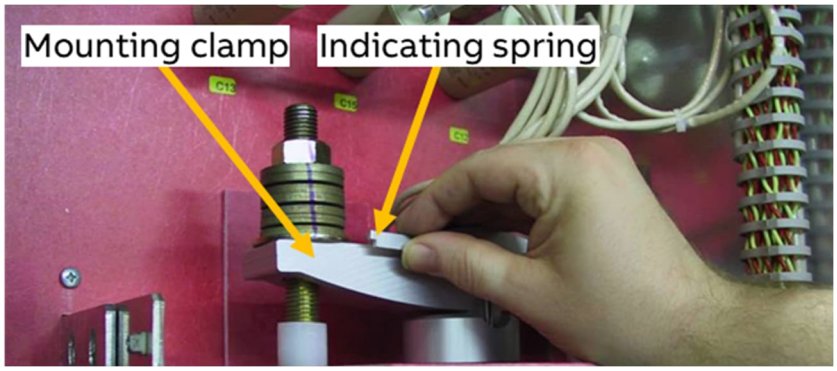
  Actions:
  - Make sure electrical safety is performed.
  - Open the cabinet's door and hold it in position to prevent any movement.
  - Repeat it with the module's door.
  - Start the converter.
  - The air pressure switch is ok when the converter is either switched off by 5080 Drive fan acknowledge or shows warning A518 Drive fan acknowledge, see 20.38 Drive fan acknowledge source. Crosscheck this result with the module's door closed.

  Attention: Do not reach into the fan. Negligence to this warning can cause injury.
- Check for tightness of converters stacks H6 … H8.
  The thyristors together with the heatsinks are stacked. The proper stack torque is shown by the torque indication spring:

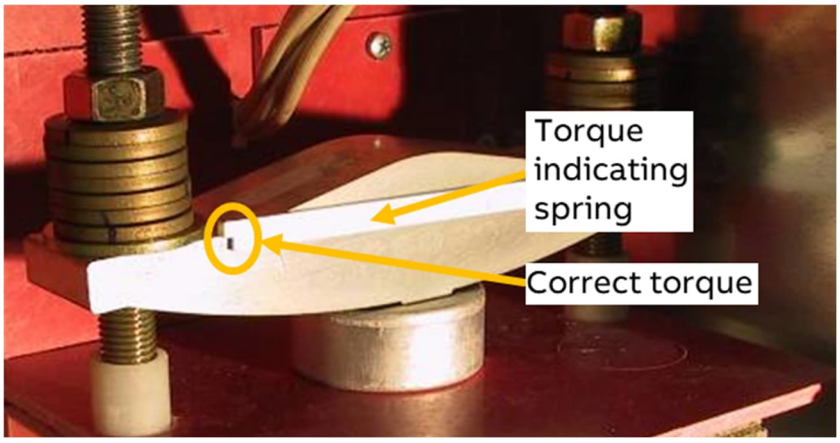


- The correct torque has to be checked the following way:
  - Make sure all supply voltages are switched off, most important the voltages for the power part, for the converter electronics (SDCS-POW-H01), for the cooling fan and for other auxiliaries!

- Open the cabinet's and module's door; if needed secure them.
- Pull the torque indication spring a little bit out:

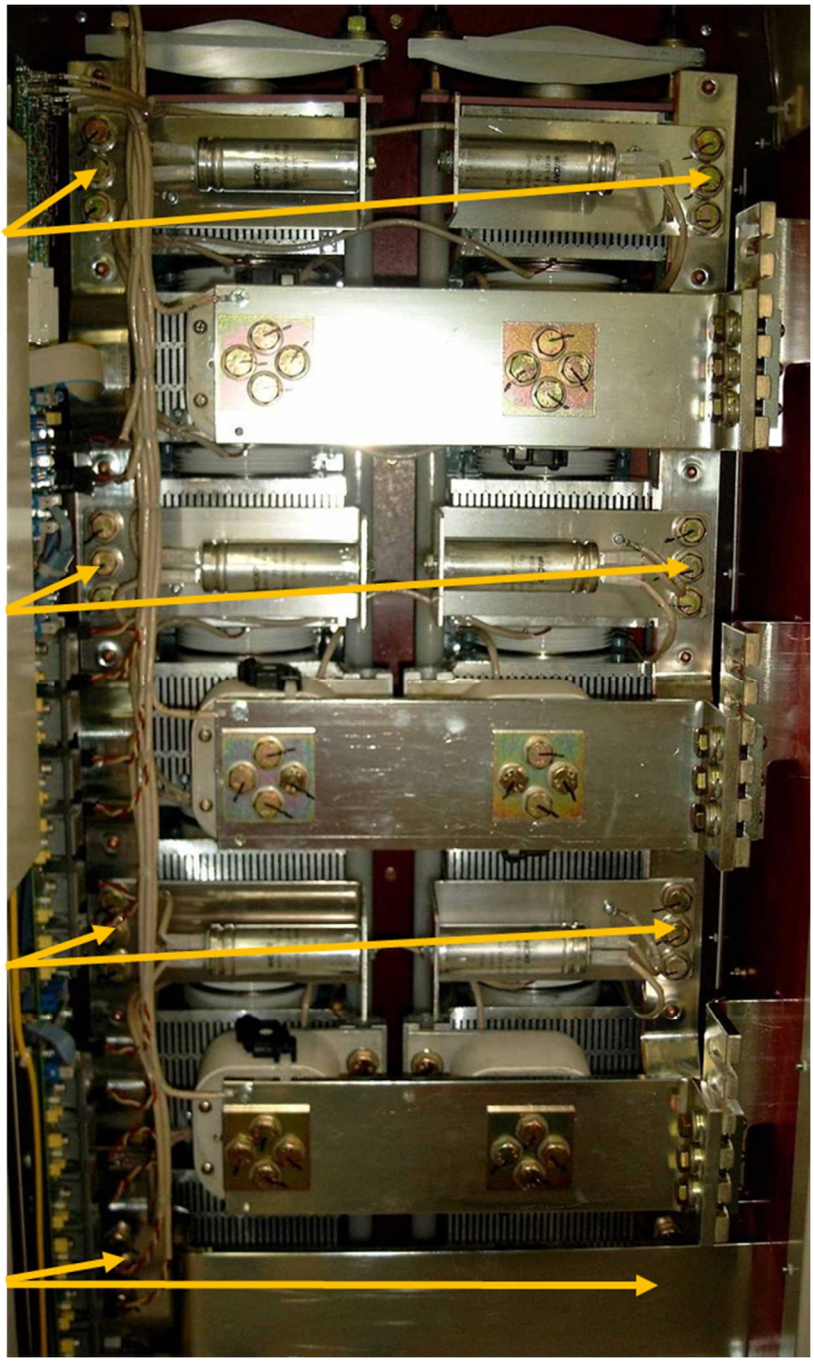


- Release the torque indication spring. It has to snap back into position "correct torque":



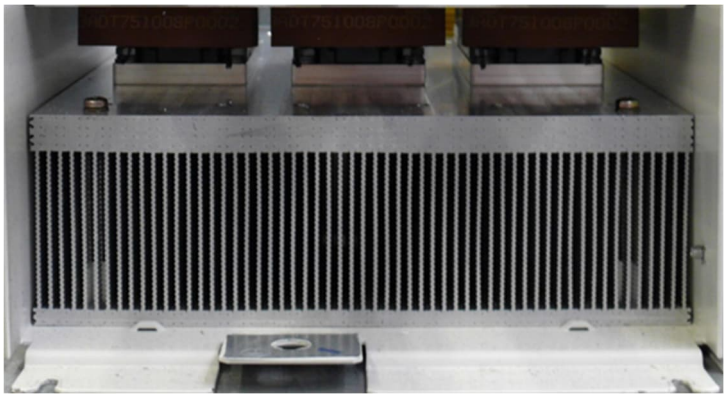
- If the torque indicating spring does not snap back into position "correct torque" the stack has to be retorqued otherwise everything is fine.
- Tighten each nut in turn, half a turn at a time with the help of a ring spanner until the indicating spring clicks into position "correct torque". Do not tighten the screws any further.

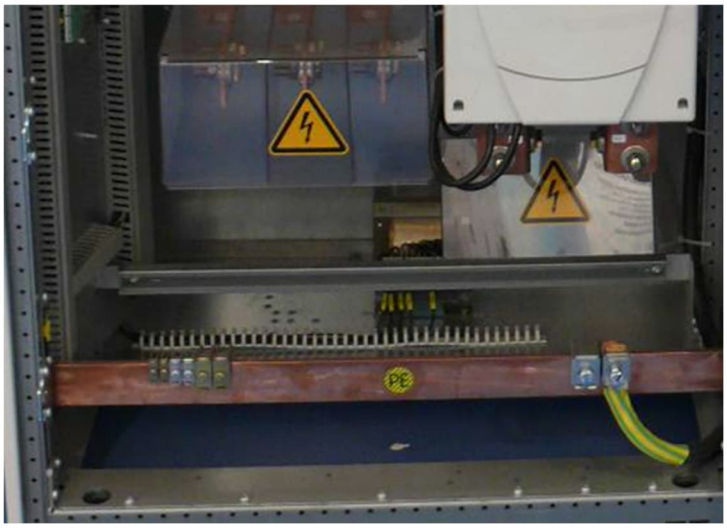
– Check for tightness of heatsink terminals of converters size H8.
The thyristors together with the heatsinks are stacked. Every single thyristor is connected to the DC+ and DC- busbars via flexible copper busbars. These busbars consist of 10 layers of pre-shaped sheet copper. This construction is able to compensate for small changes in length caused by temperature rise when current is flowing. The screw fixings between heatsink and flexible copper busbar have to withstand different types of mechanical stress.
Therefore, each fixing needs to be checked for correct torque.
Actions:
  - Make sure all supply voltages are switched off, most important the voltages for the power part, for the converter electronics (SDCS-POW-H01), for the cooling fan and for other auxiliaries!
  - Open the cabinet's and module's door; if needed secure them.
  - Set a latching torque spanner to 25 Nm (18 lb-ft). A 17 mm nut is needed too.
  - Check the torque of the screws marked within the next figure.
  - Apply the torque spanner to the screw and turn right until the right torque is indicated.
  - Do **not** loosen the screws with a left-hand turn!
  - Put on a new marking, if appropriate.



- Check the door air filters.
- Clocked up filters prevent proper cooling of the converter. Wash dirty filters with water (60°C) and detergent.

- Check for dust, corrosion, and temperature inside the module/cabinet. The converter will run into overtemperature faults if the heatsinks are not clean.
- Pre-clean the heatsinks using an ESD vacuum cleaner then use compressed air to remove the dust from the heatsinks (the airflow must be from bottom to top). Fan rotation caused by the compressed air must be stopped in order to prevent damage.
- Use an ESD vacuum cleaner to clean the dust from the air inlet, air outlet, the interior of the cabinet and the electronic boards.
- Any signs of corrosion, especially at ground components, must be removed.





- Check the quality of the mains voltage (e.g., deviation from nominal voltage value, …).

3 years preventive maintenance

Following additional actions have to take place:

- Replace the cooling fans of converters size H7 and H8:
  - Exchange cooling fan size H7.
  - Exchange cooling fan size H8.

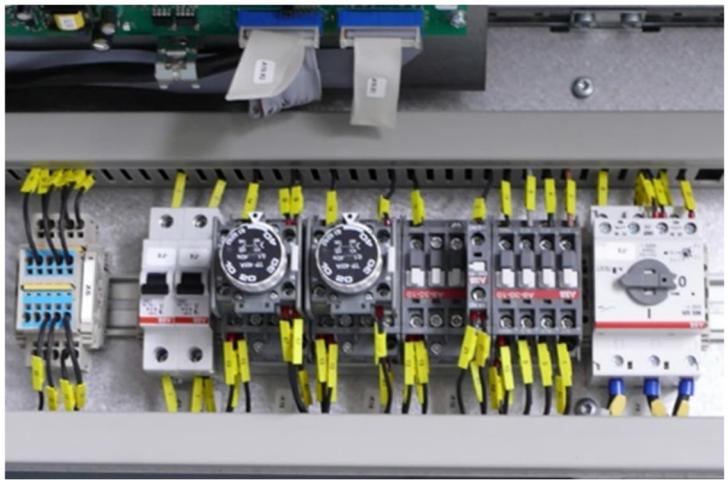
  The manufacturer's estimation for the operational time of the cooling fans is:
  - GR28C-2DK 30,000 hours at 40°C.
  - GR35C-2DD 30,000 hours at 40°C.

  The mayor problem is the failure of the bearings. The cooling fans are used in:

DCS880-S0b-1900-dd … DCS880-S0b-3000-dd	H7	GR28C-2DK 400 V/500 V
DCS880-S0b-2050-dd … DCS880-S0b-5200-dd	H8	GR35C-2DD 400 V

  Aging of the components result in:
  - Increased vibration due to the imbalance of the cooling fan (can last for several months).
  - Increased temperature due to the stopped cooling fan (converter trips with overtemperature).

- Check the tightness of all terminals.
- All connections should be inspected and checked for tightness.
- Check the condition of the contactors and relays.
- Contactors and relays should be checked for proper function.
- Check the fiber optic cables and their connections.



6 years preventive maintenance

Following additional actions have to take place:

- Replace the cooling fans of converters size H5 and H6:
  - Exchange cooling fan size H5.
  - Exchange cooling fan size H6.

  The manufacturer's estimation for the operational time of the cooling fans is:
  - R2E250-RB 40,000 hours at 40°C.

  The mayor problem is the failure of the bearings. The cooling fans are used in:

DCS880-S0b-1190-dd	H5	R2E250-RB
DCS880-S0b-0900-dd ... DCS880-S0b-2000-dd	H6	230 V

  Aging of the components result in:
  - Increased vibration due to the imbalance of the cooling fan (can last for several months).
  - Increased temperature due to the stopped cooling fan (converter trips with overtemperature).
- Replace the cooling fans of converters size H1 … H4.
  - Exchange the cooling fan size H1 (one fan).
  - Exchange the cooling fan sizes H2 … H3 (two fans).
  - Exchange the cooling fan size H3 (four fans).
  - Exchange the cooling fan size H4.

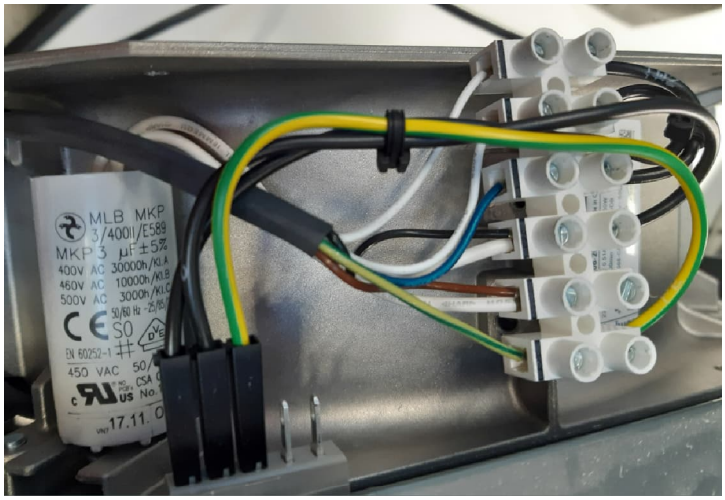
  The manufacturer's estimation for the operational time of the classic cooling fans is:
  - 3110UL: 70,000 hours at 25°.
  - AFB122: 100,000 hours at 25°.
  - W2E200: 45,000 hours at 60°C.
  - W2E250: 40,000 hours.

  The mayor problem is the failure of the bearings. The cooling fans are used in:

DCS880-S0b-0045-dd ... DCS880-S0b-0100-dd	H1	1 x 3110UL 24 V internal
DCS880-S0b-0135-dd ... DCS880-S0b-0300-dd	H2	2 x AFB122 24 V internal
DCS880-S0b-0315-dd ... DCS880-S0b-0450-dd	H3	2 x 3110UL 2 x AFB122 24 V internal
DCS880-S0b-0610-dd ... DCS880-S0b-0820-dd	H4	1 x W2E200 230 V
		1 x W2E200 115 V (plus code E171)
DCS880-S0b-0900-dd ... DCS880-S0b-1000-dd		1 x W2E250 230 V
		1 x W2E250 115 V (plus code E171)

  Aging of the components result in:
  - Increased vibration due to the imbalance of the cooling fan (can last for several months).
  - Increased temperature due to the stopped/too slow cooling fan (converter trips with overtemperature).
- Check the flat cables and their connections.

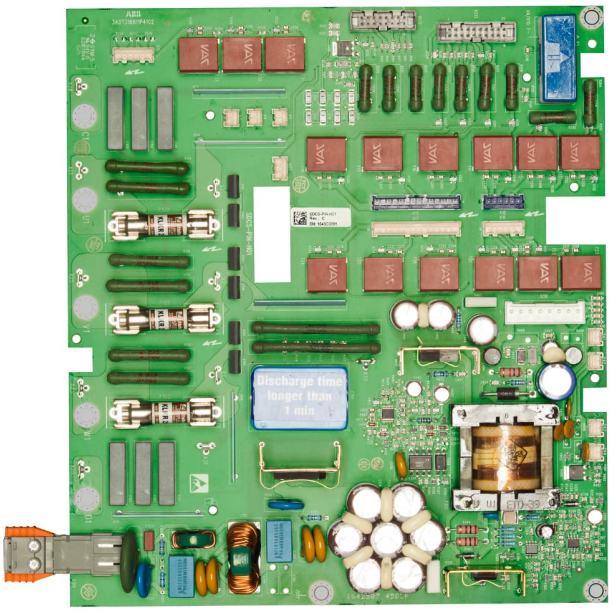
– Another problem is the loss of capacitor capacitance in the H4 modules:



9 years preventive maintenance

Following additional actions have to take place:

- Replace the power interface board SDCS-PIN-H01 of converters size H1 … H5 (DCS880-S0b-0020-dd … DCS880-S0b-1190-dd).
- The SDCS-PIN-H01 is located between the heat sink and the electronic tray. It operates continuously because it supplies the converter electronics even when the DC current is switched off. Therefore, all its components are exposed to hot conditions.
- Additionally, the electrolytic capacitors on the SDCS-PIN-H01 are aging. The SDCS-PIN-H01 is also equipped with capacitors, which are sensitive to high ambient temperatures.
- Aging of the components result in:
  - Damage other devices.
  - Trip the converter and cause breakdown time.



- Replace the power supply board SDCS-POW-H01 of converters size H6 … H8 (DCS880-S0b-0900-dd … DCS880-S0b-5200-dd) and DCS880-R (Rebuild- and Upgrade Kits).
- The SDCS-POW-H01 is located between the module door on the electronic tray. It operates continuously because it supplies the converter electronics even when the DC current is switched off. Therefore, all its components are exposed to hot conditions.
- Additionally, the electrolytic capacitors on the SDCS-POW-H01 are aging. The SDCS-POW-H01 is also equipped with capacitors which are sensitive to high ambient temperature.
- Aging of the electronic card result in:
  - Damage other devices.
  - Trip the converter and cause unexpected shutdown.

- Replace the flat cables of all converters size H1 … H8.
- Environmental conditions, especially temperature and humidity could cause corrosion on the contact surfaces and embitterment of the insulation.
- Aging of the flat cables result in:
  - Contact problems.
  - Flat cable insulation breaks.

– Exchange the snubber capacitors of converters size H8, see chapter Exchange snubber capacitors size H8.
Note: For 990 V_{AC} and 1190 V_{AC} converters only.

Preventive maintenance checklist for DCS880

Type of converter:	
Serial number:	
Last inspection:	

Converter size:	
Year of initial startup:	
Converter name:	

	Inspection cycle	H1 ... H5	H6	H7	H8
1. Environment					
1.1 Checking the environment.	yearly				
1.2 Documentation checked and available.	yearly				
1.3 Checking the spare parts.	yearly				
2. Maintenance with no voltage applied					
2.1 Cleaning with ESD vacuum cleaner and/or soft brushes:					
Converter and cabinet.	yearly				
Air inlet and outlet filters (replace/clean if IP54 or if needed).	yearly				
Fins of fan.	yearly				
Heat sinks.	yearly				
2.2 Relays & connections:					
Inspect relays/contacts for proper functionality.	3 years				
Inspect electrical connections for tightness.	3 years				
Inspect for proper grounding.	yearly				
Inspect for corrosion.	yearly				
Inspect tightness of stacks (torque indicating spring).	yearly				
Inspect tightness of heatsink terminals (25 Nm required).	yearly				
Inspect connection of fiber optical cables.	3 yearly				
Inspect connection of flat cables.	6 years				
3. Maintenance with mains voltage applied					
Create parameter backup.	yearly				
Test the cooling air pressure switch.	yearly				
Check level of all connected voltages.	yearly				
Inspect condition of fans (check that all fans are operational).	yearly				

	Inspection cycle	H1 … H5	H6	H7	H8
4. Preventive Replacements					
4.1 Flat cables:					
SDCS-CON-H01 … SDCS-PIN-H01 (XC12, XS13, X38).	9 years				
SDCS-CON-H01 … SDCS-PIN-H51 (XC12).	9 years				
SDCS-CON-H01 … SDCS-PIN-H41 (XS13).	9 years				
SDCS-PIN-H41 … SDCS-PIN-H41 (XS23 … XS13).	9 years				
SDCS-CON-H01 … SDCS-POW-H01 (X38).	9 years				
SDCS-OPL-H01 … SDCS-PIN-H51 (XC12).	9 years				
SDCS-OPL-H01 … SDCS-PIN-H41 (XS13).	9 years				
SDCS-PIN-H41 … SDCS-PIN-H41 (XS23 … XS13).	9 years				
SDCS-OPL-H01 … SDCS-POW-H01 (X38).	9 years				
4.2 Boards:					
SDCS-PIN-H01.	9 years				
SDCS-POW-H01.	9 years				
Snubber capacitors converters size H8. 990 V_{AC} and 1190 V_{AC} only.	9 years				
4.3 Fan					
Cooling fan converters size H1 … H6.	6 years				
Cooling fan converters size H7, H8.	3 years				

Inspect = visual inspection, correction and replacement if needed.

Remarks:

Date of inspection:	
Name of field service engineer:	
Sign of field service engineer:	

Appendix: Spare parts

For spare parts information please contact:

sales.productsupport@fi.abb.com.

Revision

Revision	Date	Comments
A	11.2017	First edition.
B	08.2024	Bug fixes. Added chapters: – Checking current bubbles using 30.44 Minimum firing angle. – Exchange thyristors size H5. – Exchange the SDCS-PIN-H51 (+S185). – Exchange internal semiconductor fuses size H5 (1190 A). – Exchange snubber capacitors size H8. – Download SDCS-CON-H01 firmware using Drive Composer pro 2.6 or higher.
C	10.2025	Bug fixes. E.g.: – Correct thermal joint compound type information. – Changed drive to converter. Added: – Table for maintenance schedule.
D		–
E		

DCS Family

DCS580 modules
The compact drive for machinery application

20 ... 1,000 A_{DC}
0 ... 610 V_{DC}
230 ... 525 V_{AC}
IP00

- Compact
- Robust design
- Adaptive Programming
- High field exciter current
- Extruder macro

DCS880 modules
For safe productivity

20 ... 5,200 A_{DC}
0 ... 1,500 V_{DC}
230 ... 1,200 V_{AC}
IP00

- Safe torque off (STO) built in as standard
- Compact and robust
- Single drives, 20 A_{DC} to 5,200 A_{DC}, up to 1,500 V_{DC}
- IEC 61131 programmable
- Intuitive control panel and PC tool with USB connection and start up assistant
- Wide range of options to serve any DC motor application

DCS880-A cabinets
Complete drive solutions

20 ... 20,000 A_{DC}
0 ... 1,500 V_{DC}
230 ... 1,200 V_{AC}
IP21 ... IP54

- Suitable for motoric and non motoric applications (e.g. electrolysis & hydrogen production)
- Individually adaptable to customer requirements
- User-defined accessories like external PLC or automation systems can be included
- High power solutions in 6- and 12-pulse up to 20,000 A_{DC}, 1,500 V_{DC}
- In accordance to usual standards
- Individually factory load tested
- Detailed documentation

DCT880 modules
Thyristor power controller

20 ... 4,200 A_{AC}
110 ... 990 V_{AC}
IP00

- Precise power control in industrial heating applications
- Two or three phase devices
- Power optimizer for peak load reduction
- Built on ABB's all-compatible drives architecture
- Intuitive control panel and PC tool with USB connection and start up assistant
- Application control programs and drive application programming with IEC 61131 programming

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