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On-site Service Instructions for ACx580-01 Frames R6-R9




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1. General

1.1 Warnings

WARNING!

All electrical installation and maintenance work on the ACS580 should be carried out by Authorized ABB LV AC drives service.

Do not attempt any work on a powered ACS580. After switching off the mains, always allow the intermediate circuit capacitors 5 minutes to discharge before working on the frequency converter, the motor or the motor cable. The voltage between each input terminal (U1, V1, W1) and earth must be measured with a multimeter (impedance at least 1M Ω) to ensure that the frequency converter is discharged before beginning work.

Always ensure by measuring with a multimeter (impedance at least 1 M Ω) that:

1. There is no voltage between the drive input phases U1, V1 and W1 and the ground.
2. There is no voltage between terminals UDC+ and UDC- and the ground.
3. There is no voltage between terminals R+ and R- and the ground.

Also make sure that no one can accidentally power the system up while you're working on the drive.

All insulation tests must be carried out with the ACS580 disconnected from the cabling.

Do not make any insulation or voltage withstand tests on any part of the drive.

The ACS580 motor cable terminals are at a dangerously high voltage when input power is applied, regardless of motor operation. No work on the motor cable should be attempted with mains power applied.


There can be dangerous voltage inside the ACS580 from external control circuits when the ACS580 input power is shut off. No work on the control cables should be attempted when power is applied to the frequency converter or to the external control circuits. Exercise appropriate care when working with the unit.

ESD (Electro Static Discharge): The printed circuit boards contain integrated circuits that are extremely sensitive to electrostatic discharge. Use ESD –protection and exercise appropriate care when working on the unit to avoid permanent damage to the circuits. Avoid unnecessary touching of the boards.

WARNING!

Only Authorized ABB LV AC drives service are allowed to carry out work described in this instruction. Before working with the ACS580 read carefully the Safety Instruction on the ACS580 Hardware Manual. Ignoring the safety instructions can cause injury or death.

Note that for some operations a PC with Drive Composer Entry or Drive Composer Pro software and communication tools is necessary because there isn't any easily visible led etc. to indicate the drive state.

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1.2 Content

The purpose of this document is to specify on-site maintenance and repair actions of ACS580-01 frame sizes R6 – R9. Following actions are included in this document:


- Capacitor reforming after storing
- Charging and discharging resistor replacement
- Circuit board replacement
- Cooling fan replacement
- Current transducer replacement
- DC link capacitors replacement
- Heat sink temperature check and cleaning
- R1-R5: Fault tracing
- Semiconductor replacement

1.3 Required tools

- ESD field service kit
- Cross head screwdriver
- Flathead screwdriver: 4 mm
- Torx head screwdrivers
 - T9 x 50mm
 - T20 x 125 mm
- Pointed pliers
- Torque wrenches
 - 0,5-5 Nm (for torx head)
 - 8 Nm (for M6)
 - 16 Nm (for M8)
 - 30 Nm (for M10, frames R8-R9)
- Voltage multimeter
- PC equipped with Drive Composer Entry or Drive Composer Pro
- USB cable for connecting Drives Control Panel to PC

1.4 Maintenance schedule

Maintenance schedule is available at ABB library. Contact your local ABB representative for more information.


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2. Tightening torque values

	R6			R7			R8			R9		
	Size	Torque		Size	Torque		Size	Torque		Size	Torque	
		Nm	lbf-ft		Nm	lbf-ft		Nm	lbf-ft		Nm	lbf-ft
Brake IGBT to heat sink (+D150)*	M5x20	3	2.22	M6x20	5	3.7	M5x20	3	2.22	M5x20	3	2.22
Busbars to brake IGBT (+D150)	M5x12	3	2.22	M6x16	5	3.7	M6x16	5	3.7	M6x16	5	3.7
Busbars to Input bridge module	M6x16	5	3.7	M6x16	5	3.7	M6x16	5	3.7	M8x20	12	8.88
Charging resistor to heat sink	M4x12	1,5	1.11	M4x12	2	1.48	M4x12	2	1.48	M4x12	2	1.48
Clamp capacitors	M5x12	3	2.22	M6x16	5	3.7	M6x16	5	3.7	M6x16	5	3.7
Current transducer to output busbars	M4x16	1,5	1.11	M4x20	2	1.48	M4x20	2	1.48	K50x16 pt	3	2.22
DC busbars to chokes	M6x16 M8x20	5 16	3.7 11.84	M6x20 M8x20	8 16	5.92 11.84	M8x25 M10x25	16 30	11.84 22.2	M8x25 M10x25	16 30	11.84 22.2
DC busbars to IGBT	M6x14	5	3.7	M6x16	5	3.7	M6x16	5	3.7	M6x16	5	3.7
DC capacitor pole screws	M5x12	2	1.48	M5x12	3	2.22	M5x12	3	2.22	M5x12	3	2.22
Discharging resistor to heat sink *	M4x12	1,5	1.11	M4x12	2	1.48	M4x12	2	1.48	M4x12	2	1.48
IGBT to heat sink*	M5x20	3	2.22	M5x20	3	2.22	M5x20	3	2.22	M5x20	3	2.22
Input and output terminals	M8	16	11.84	M8	16	11.84	M10	30	22.2	M10	30	22.2
Input bridge busbars to chokes	M6x20 M8x20	5 16	3.7 11.84	M6x20 M8x20	8 16	5.92 11.84	M8x20 M10x25	16 30	11.84 22.2	M8x20 M10x25	16 30	11.84 22.2
Input bridge module to heat sink* <i>MCD162-16I01**</i> <i>SKKH172/16E**</i>	M6x20 M6x20	2,5 5	1.85 3.7	M6x20	3	2.22	M6x20	5	3.7	M6x20	5	3.7
Output busbars to IGBT	M6x12	5	3.7	M6x16	5	3.7	M6x16	5	3.7	M6x16	5	3.7
ZFC2-board fixing	M4x12	2	1.48	M4x8	2	1.48	M4x8	2	1.48	M4x8	2	1.48
ZINP-board fixing	M4x8	1,5	1.11	M4x16	2	1.48	M4x12	2	1.48	M4x12	2	1.48
ZINT-board fixing	M3x6	0,5	0.37	M3x10	0,5	0.37	M3x10	0,5	0.37	M3x10	0,5	0.37
ZPOW-board fixing										M3x10	0,5	0.37

* Pre-tight: 0,5Nm / 0.37 lbf-ft

** R6 Input bridge module torque depends on the used module type

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3. Preventive maintenance actions

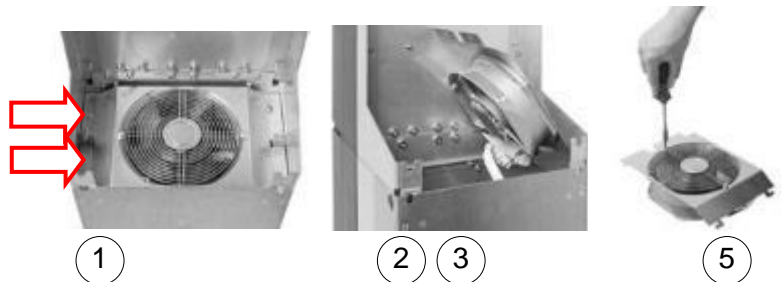
3.1 Cooling fan replacement

Switch off the main power supply for the drive before any other actions.

3.1.1 Frame R6-R8 Main cooling fan replacement

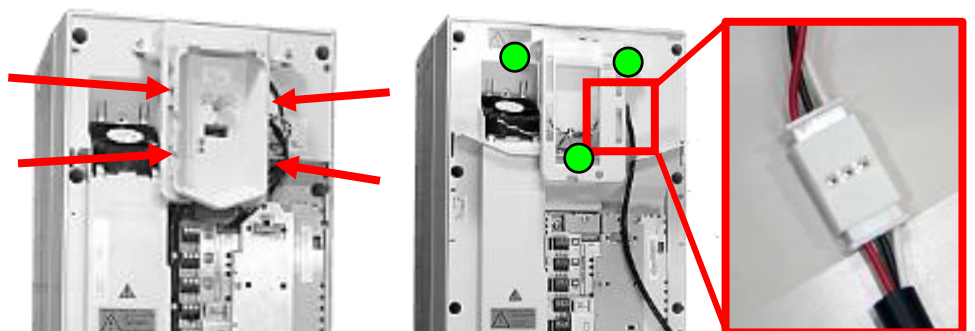
The main cooling fan is located at the bottom of the drive. Replace the fan as follows:


1. Undo the fastening screws or clips of the fan assembly plate
2. Lift the fan assembly plate up from the side edge.
3. Unplug the power supply wires.
4. Lift the fan assembly plate off.
5. Remove the fan from the assembly plate and unfasten the plug holder.
6. Clean the cooling air duct and heat sink with compressed air. See separate instructions in section 3.2.1
7. Install the new fan in reverse order to the above and ensure the fan operation when the drive is powered up.



3.1.2 Frame R6-R8 Internal cooling fan replacement

1. Lift the control panel off, remove front cover **fixing screws** (2pcs) and lift the cover off.
2. Unplug the fan power supply wires. Release the control panel support locking clips to gain access to the wire holder. If necessary, also remove support holder **fixing screws** (3pcs).
3. Release the fan from locking clips and lift it off
4. Install the new fan in reverse order to the above, see that the fan power supply wire is correctly attached and the fan outlet direction is outwards
5. Re-install control panel support, front cover and control panel.
Notice that the control panel support is attached to different position based on frame size (see page 10)
6. Ensure the fan operation when the drive is powered up.

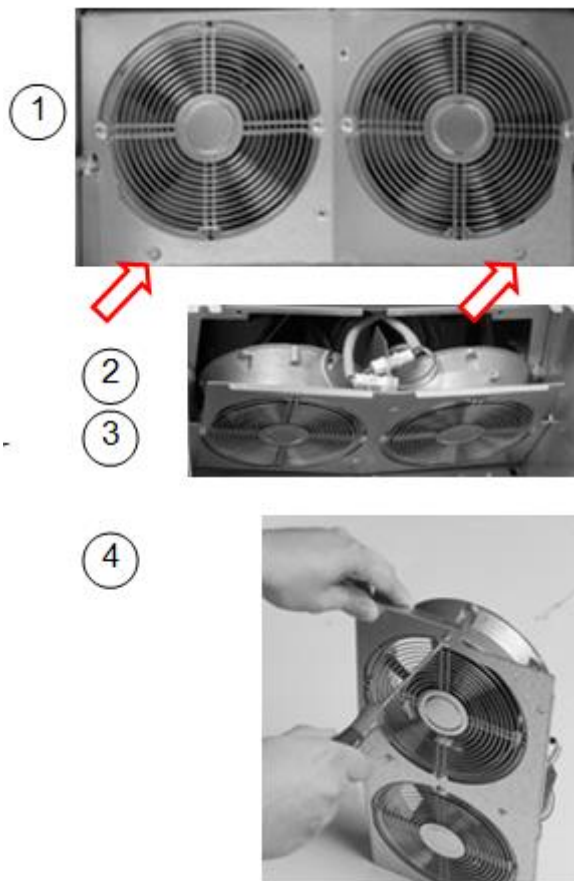



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3.1.3 Frame R9 Cooling fan replacement

The cooling fans of frame R9 are located at the bottom of the drive. Replace the fans as follows:

1. Undo the two fastening screws of the fan assembly plate.
2. Turn the assembly plate downwards.
3. Disconnect the fan power supply wires.
4. Undo the two fastening screws of the fan.
5. Clean the cooling air duct and heat sink with compressed air. See separate instructions in section 3.2.1
6. Install the new fans in reverse order to the above. After connecting the fan power supply wires, insert the fan assembly plate to the drive upper end first.
7. Ensure the fan operation when the drive is powered up.



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3.2 Heat sink temperature check and cleaning

Heat sink temperature check and cleaning depends on the dustiness of the environment. The heat sink fins pick up dust from the cooling air. The drive runs into over temperature warnings and faults if the heat sink is not clean. Too high operating temperature causes faster aging of the drive components. In a normal environment the heat sink should be checked annually and cleaned if needed, in a dusty environment more often. Heat sink must also be cleaned when replacing a cooling fan.

NOTE! Compressed air or normal vacuum cleaner must NOT be used to clean any other parts of the drive than heat sink only. Airflow causes a high risk of ESD damage to components. Fan must also be removed before cleaning with compressed air. Otherwise strong air flow will affect fan bearings.

3.2.1 Heat sink cleaning

- a. Turn off the main input power of the drive
- b. Remove the cooling fan
- c. Blow clean dry compressed air from the bottom
- d. Use a vacuum cleaner on top to trap the dust
- e. Install the cooling fan

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3.3 Replacement of circuit boards

3.3.1 Safe torque function STO

Safe operation of **the STO must be verified** after any changes and maintenance work related to the safety function (circuit boards, wiring, components, settings, etc.). The acceptance test procedure is described in section *STO Acceptance test procedure*. More information on STO can be found in the ACS580 User's Manual.

The drive supports the Safe torque off function according to standards EN 61800-5- 2:2007; EN ISO 13849-1:2008, IEC 61508, IEC 61511:2004 and EN 62061:2005. The function also corresponds to prevention of unexpected start-up of EN 1037.


The Safe torque off function disables the control voltage of the power semiconductors of the drive output stage, thus preventing the inverter from generating the voltage required to rotate the motor. By using this function, short-time operations (like cleaning) and/or maintenance work on non-electrical parts of the machinery can be performed without switching off the power supply of the drive.

WARNING! The Safe torque off function does not disconnect the voltage of the main and auxiliary circuits from the drive. Therefore maintenance work on electrical parts of the drive or the motor can only be carried out after isolating the drive from the main supply.

WARNING! (With permanent magnet motors only) In case of a multiple IGBT power semiconductor failure, the drive system can produce an alignment torque which maximally rotates the motor shaft by $180/p$ degrees regardless of the activation of the Safe torque off function. p denotes the number of pole pairs.

Notes:

- If a running drive is stopped by using the Safe torque off function, the drive will cut off the motor supply voltage and the motor will coast to a stop. If this causes danger or is not otherwise acceptable, stop the drive and machinery using the appropriate stop mode before activating the Safe torque off function.
- The Safe torque off function overrides all other functions of the drive unit.
- The Safe torque off function is ineffective against deliberate sabotage or misuse.
- The Safe torque off function has been designed to reduce the recognized hazardous conditions. In spite of this, it is not always possible to eliminate all potential hazards. The assembler of the machine must inform the final user about the residual risks.


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3.3.2 STO Acceptance test procedure

The acceptance test of the safety function must be carried out by an authorized person with expertise and knowledge of the safety function. The test must be documented and signed by the authorized person. An authorized person is an individual with authorization from the machine builder or end user to carry out, report and sign off the safety function validation / acceptance testing on behalf of the machine builder or end user.

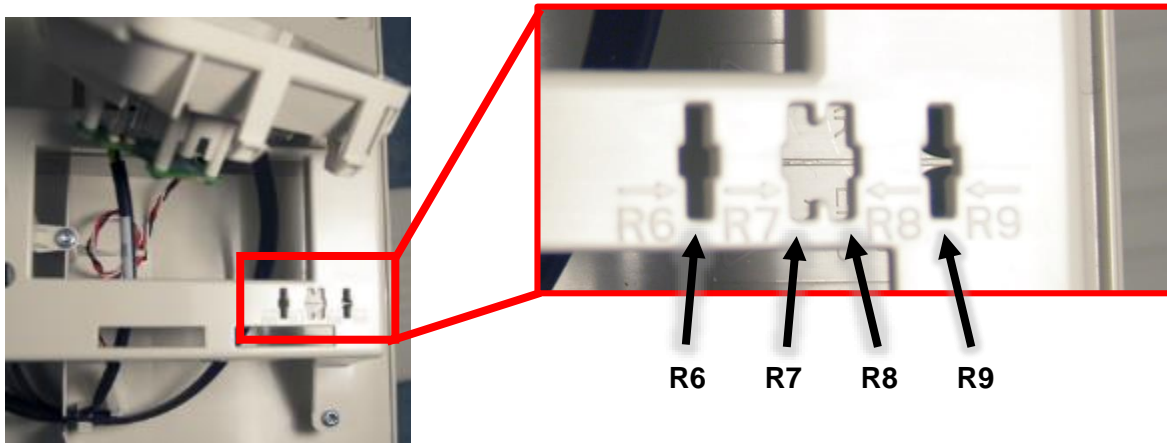
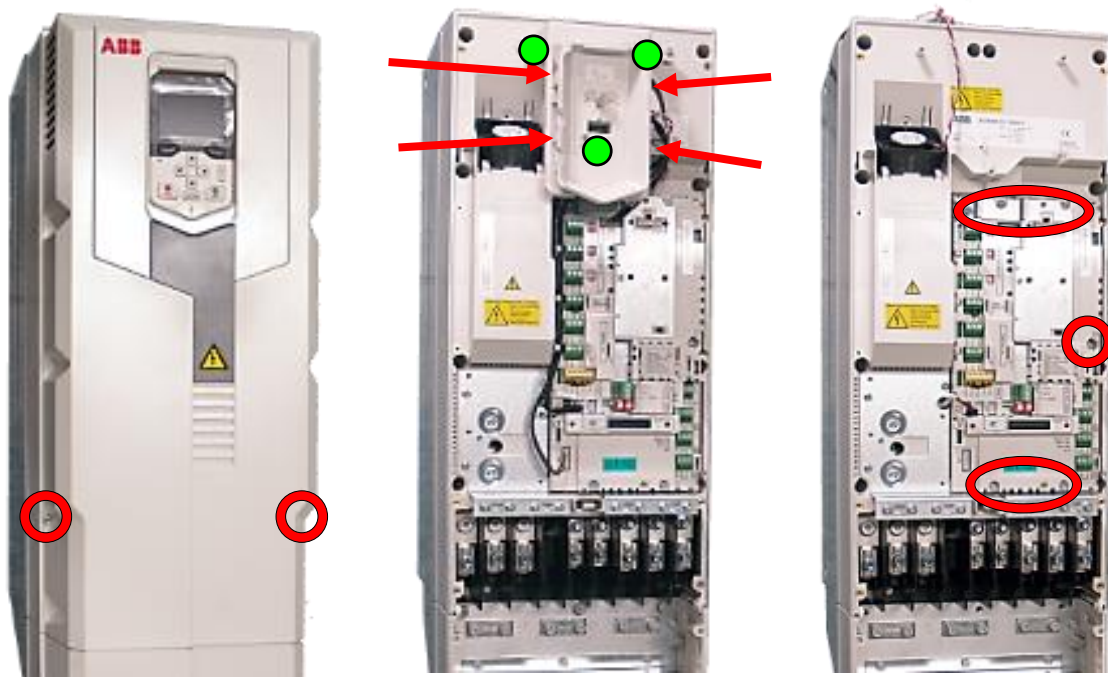
Signed acceptance test reports must be stored in the logbook of the machine. The report shall include documentation of start-up activities and test results, references to failure reports and resolution of failures. Any new acceptance tests performed due to changes or maintenance shall be logged into the logbook.


Action	<input checked="" type="checkbox"/>
Ensure that the drive can be run and stopped freely during start-up.	<input type="checkbox"/>
Stop the drive (if running), switch the input power off and isolate the drive from the power line by a disconnecter.	<input type="checkbox"/>
Check the Safe torque off circuit connections against the wiring diagram.	<input type="checkbox"/>
Close the disconnecter and switch the power on.	<input type="checkbox"/>
Test the operation of the STO function when the motor is stopped. <ul style="list-style-type: none"> • Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Ensure that the drive operates as follows: <ul style="list-style-type: none"> • Open the STO circuit. The drive generates an indication if one is defined for the 'stopped' state in parameter <i>31.22 STO indication run/stop</i>. For description of the warning, see ACS580 User's Manual. • Give a start command to verify that the STO function blocks the drive's operation. The drive displays a warning. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally. 	<input type="checkbox"/>
Test the operation of the STO function when the motor is running. <ul style="list-style-type: none"> • Start the drive and ensure the motor is running. • Open the STO circuit. The motor should stop. The drive generates an indication if one is defined for the 'running' state in parameter <i>31.22 STO indication run/stop</i>. For description of the warning, see ACS580 User's Manual. • Reset any active faults and try to start the drive. • Ensure that the motor stays at a standstill and the drive operates as described above in testing the operation when the motor is stopped. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally. 	<input type="checkbox"/>
Document and sign the acceptance test report which verifies that the safety function is safe and accepted for operation.	<input type="checkbox"/>

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3.3.3 Control unit replacement (CCU)

1. Turn off the main input power of the drive
2. Remove control panel and front cover and release control panel support
3. Unscrew control panel support holder **fixing screws** (3pcs)
4. Unplug control cables and remove all I/O connectors from CCU
5. Unplug internal fan extension cable from CCU connector X208 (FAN 1)
6. Disconnect control panel cable and temperature sensor cable from CCU
7. Remove CCU mechanics grounding **screws** (2pcs) and fixing **screws** (4pcs)
8. Transfer possible internal options to new CCU
9. Install mechanics and cablings in reverse order. Pay attention to the correct placing of the control panel support for different frame sizes
10. Turn on the main input power of the drive
11. Check the drive and option status




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3.3.4 Frame R6, ZINP replacement

1. Remove covers and cable gland box

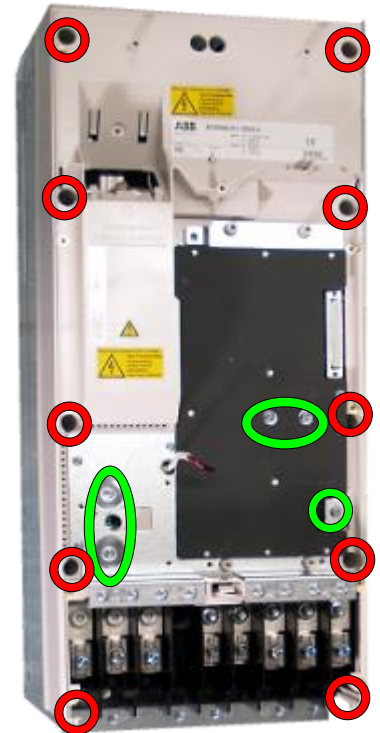
- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



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2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

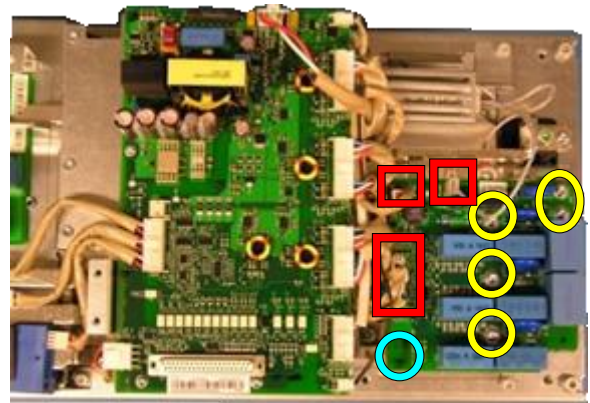


3. Remove middle frame (skeleton)

- a. Remove grounding **screws**. (5pcs) M4x8
- b. Remove skeleton mounting **screws**. (10pcs)M5x12


4. Remove ZINP board

- a. Unplug ZINP **wiring**.
- b. Remove ZINP board mounting **screws** (5pcs)M4X8 and **nut** M4
- c. Remove the board.



5. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.3.5 Frame R7, ZINP replacement


1. Remove covers and cable gland box

- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



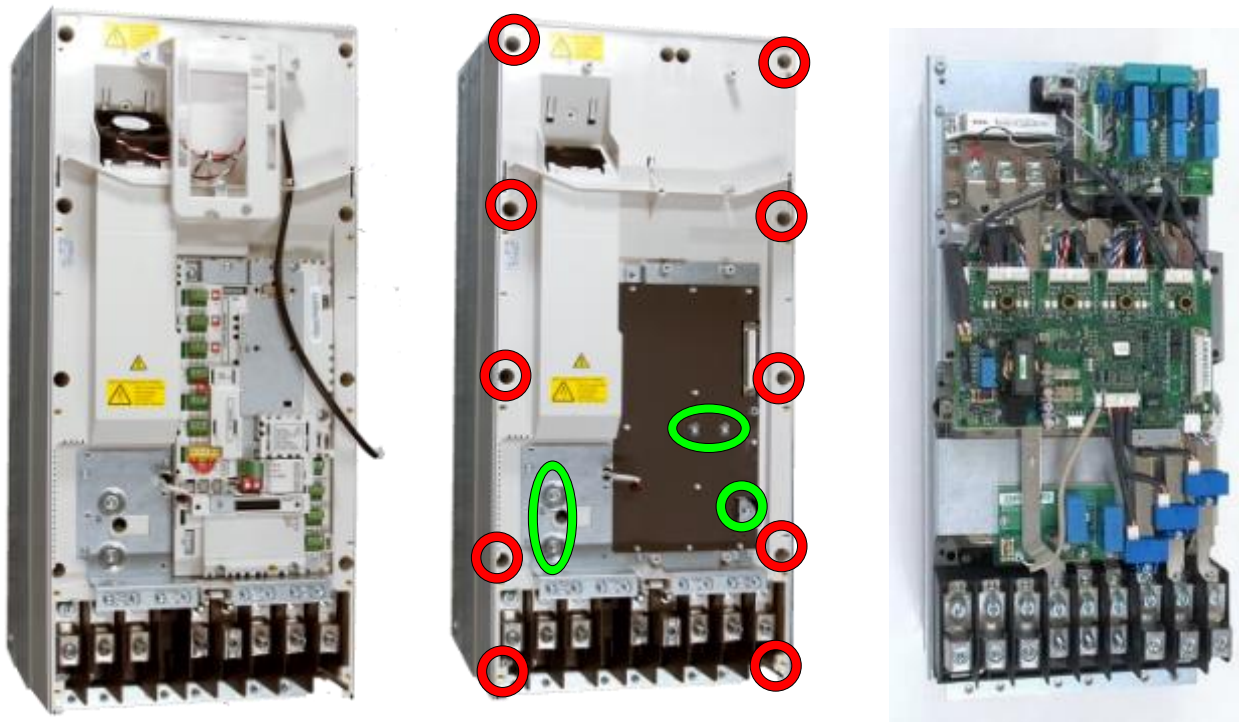
2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

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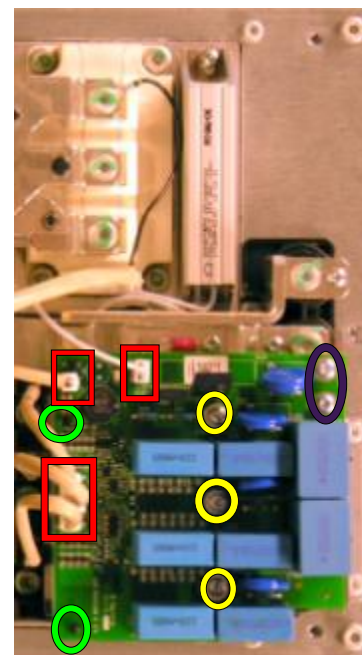
3. Remove middle frame (skeleton)

- Remove grounding **screws**. (5pcs) M4x8
- Remove skeleton mounting **screws**. (10pcs)M5x12




4. Remove ZINP board

- Unplug ZINP **wiring**
- Remove ZINP board mounting screws **(3pcs) M4X12** and **(2pcs)M4X12** (if used)
- Release ZINP board **plastic holders** and replace the board



5. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.3.6 Frame R8, ZINP replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

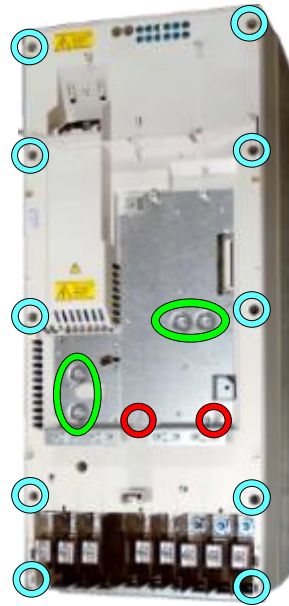
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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3. Remove middle frame (skeleton)

- a. Isolating plexiglas fixing **screws** (2pcs) K40x16 PT
- b. Grounding **screws** (2-4pcs) M4x12
- c. Skeleton fixing **screws** (8pcs) M5x12 and (2pcs) M5x20




4. Replace ZINP board

- a. Unplug ZINP wiring
- b. Remove ZINP board mounting screws, **(2pcs)M4X12** and **(3pcs) M4X12**
- c. Release ZINP board **plastic holders** and replace the board



5. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.3.7 Frame R9, ZINP replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

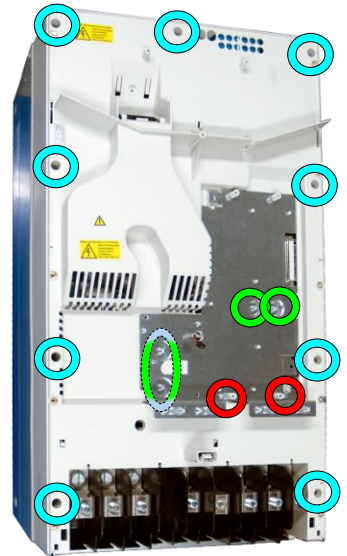
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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3. Remove middle frame (skeleton)

- a. Isolating plexiglas fixing **screws** (2pcs) M4x16 PT
- b. Grounding **screws** (2-4pcs) M4x12
- c. Skeleton fixing **screws** (9pcs) M5x12




4. Replace ZINP board

- a. Unplug ZINP wiring.
- b. Remove ZINP board mounting screws. (2pcs)M4X12 and (3pcs) **M4X12**
- c. Release ZINP board **plastic holders** and replace the board.



5. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).


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3.3.8 Frame R6, ZINT replacement

1. Remove covers and cable gland box

- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



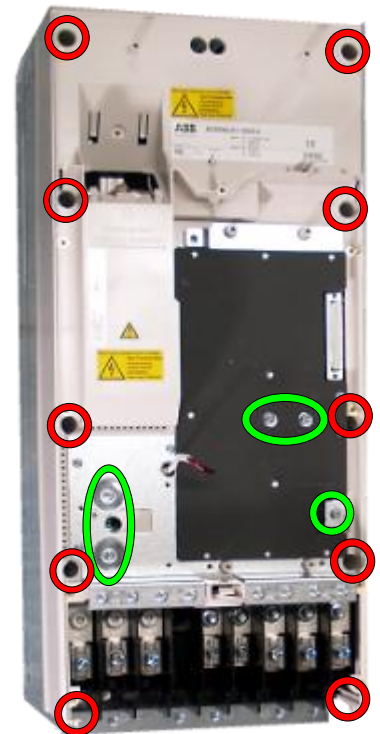
 ABB Oy, Drives Service		On-Site Service Instructions		Document nbr 3AXD10000303478
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2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

3. Remove middle frame (skeleton)

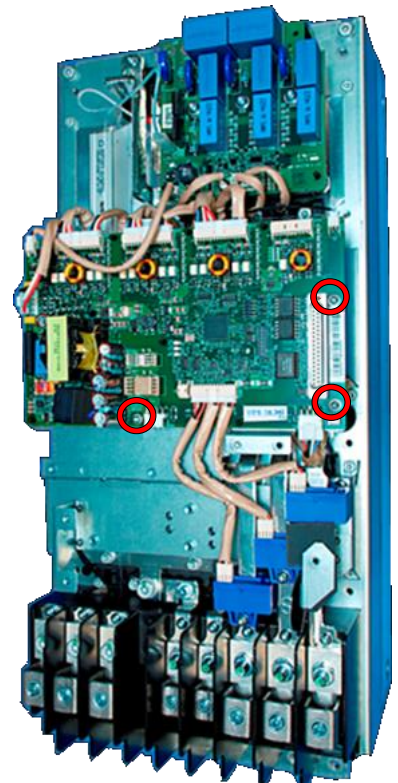
- a. Remove grounding screws. (5pcs) M4x8
- b. Remove skeleton mounting screws. (10pcs)M5x12



4. Replace ZINT board


- a. Unplug ZINT wiring
- b. Remove ZINT board fixing screws (3pcs) M3x6
- c. Release ZINT board plastic holders

Before installing the new ZINT board, check whether the correct RatingID has been uploaded to it and configure the board accordingly.



5. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.3.9 Frame R7, ZINT replacement


1. Remove covers and cable gland box

- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



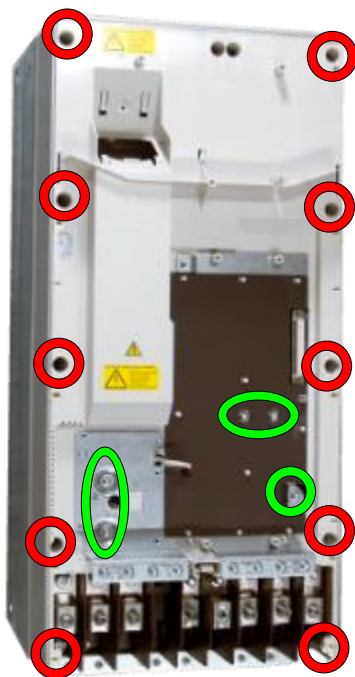
2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

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3. Remove middle frame (skeleton)

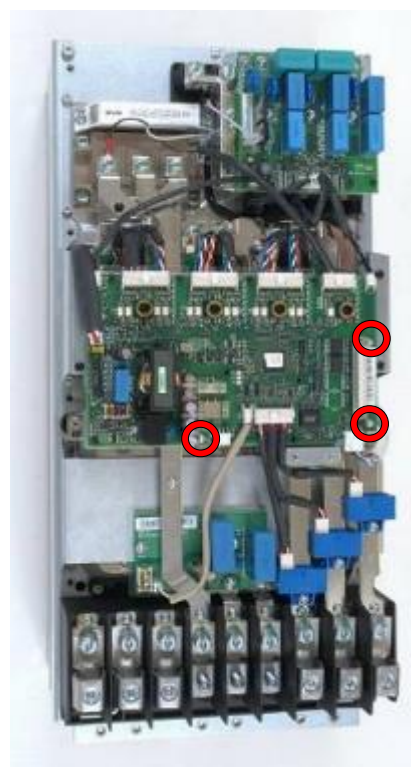
- a. Remove grounding **screws**. (5pcs) M4x8
- b. Remove skeleton mounting **screws**. (10pcs)M5x12



4. Remove ZINT board


- a. Unplug ZINT wiring
- b. Remove ZINT board fixing **screws** (3pcs) M3x10
- c. Release ZINT board plastic holders

Before installing the new ZINT board, check whether the correct RatingID has been uploaded to it and configure the board accordingly.



5. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.3.10 Frame R8, ZINT replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

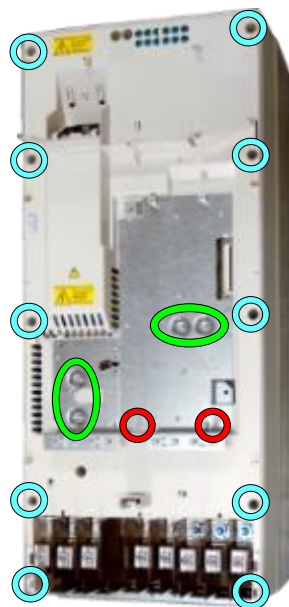
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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3. Remove middle frame (skeleton)

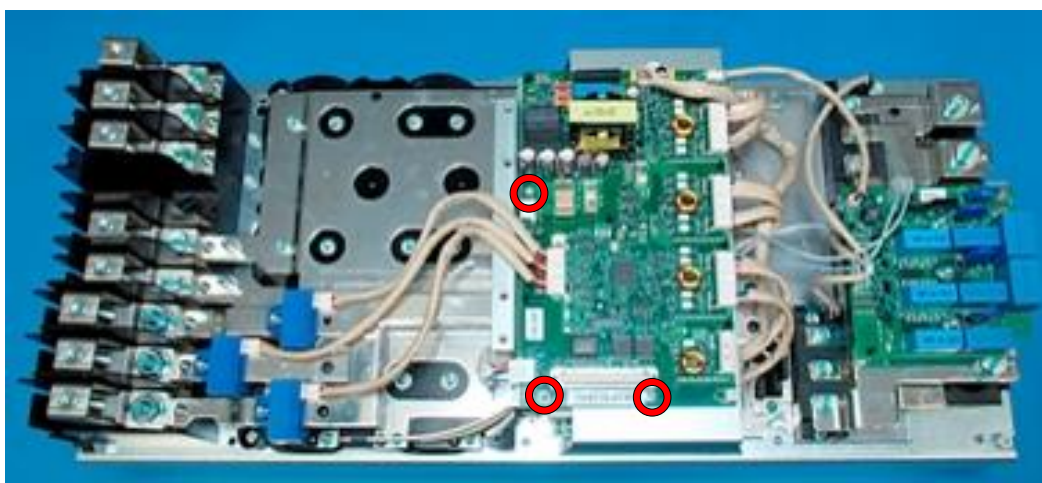
- a. Isolating plexiglas fixing **screws** (2pcs) K40x16 PT
- b. Grounding **screws** (2-4pcs) M4x12
- c. Skeleton fixing **screws** (8pcs) M5x12 and (2pcs) M5x20



4. Remove ZINT board


- a. Unplug ZINT wiring
- b. Remove ZINT board fixing **screws** (3pcs) M3x10
- c. Release ZINT board plastic holders

Before installing the new ZINT board, check whether the correct RatingID has been uploaded to it and configure the board accordingly.



5. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.3.11 Frame R9, ZINT replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

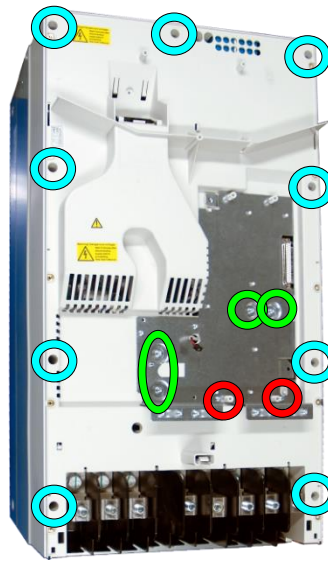
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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3. Remove middle frame (skeleton)

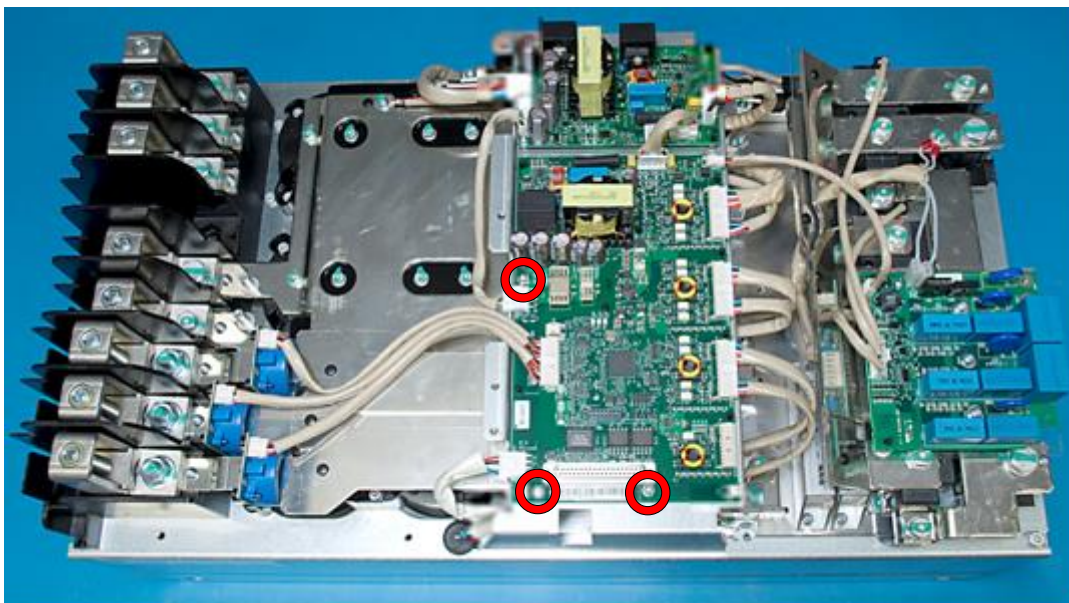
- a. Isolating plexiglas fixing **screws** (2pcs) M4x16 PT
- b. Grounding **screws** (4pcs) M4x12
- c. Skeleton fixing **screws** (9pcs) M5x12



4. Replace ZINT board


- a. Unplug ZINT
- b. Remove ZINT board fixing **screws** (3pcs) M3x10
- c. Release ZINT board plastic holders

Before installing the new ZINT board, check whether the correct RatingID has been uploaded to it and configure the board accordingly.



5. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.3.12 Frame R9, ZPOW replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

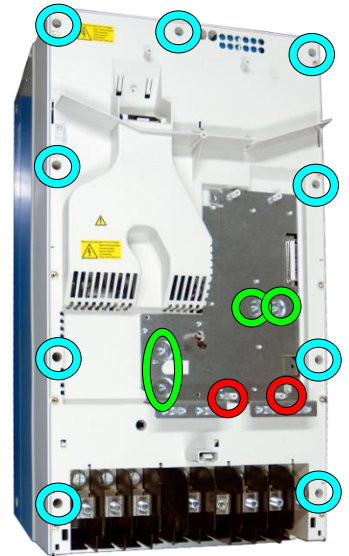
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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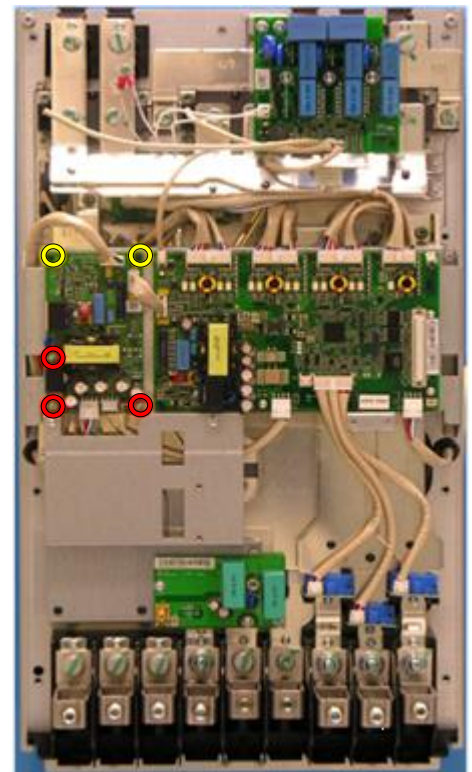
3. Remove middle frame (skeleton)

- a. Isolating plexiglas fixing **screws** (2pcs) M4x16 PT
- b. Grounding **screws** (4pcs) M4x12
- c. Skeleton fixing **screws** (9pcs) M5x12




4. Replace ZPOW board

- a. Unplug ZPOW wiring.
- b. Remove ZPOW board mounting **screws**, (3pcs) M3x10
- c. Release ZPOW board **plastic holders**



5. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.4 Replacement of DC capacitors

3.4.1 Frame R6, DC capacitor replacement

1. Remove covers and cable gland box

- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



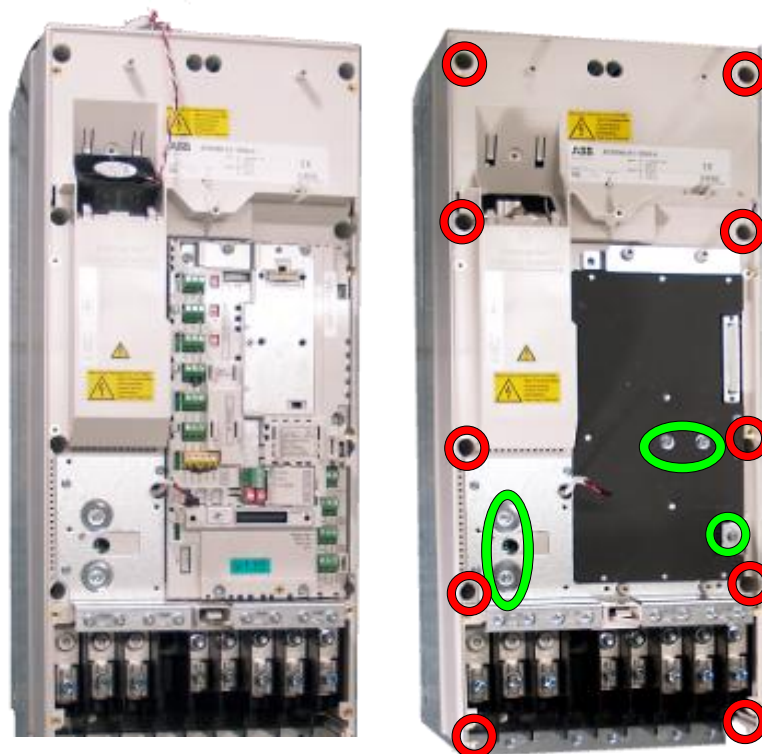
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2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

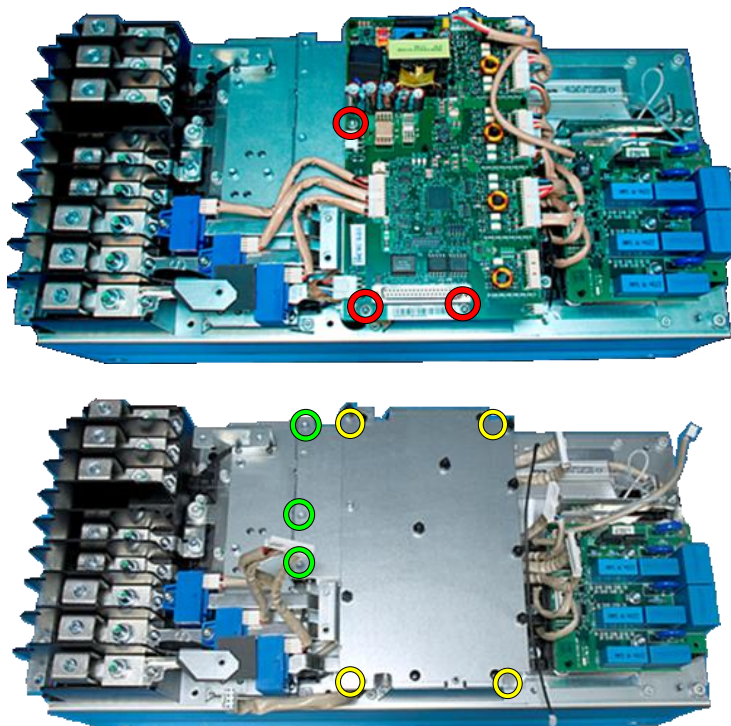
3. Remove middle frame (skeleton)


- a. Remove grounding **screws**. (5pcs) M4x8
- b. Remove skeleton mounting **screws**. (10pcs)M5x12



4. Remove ZINT board and assembly plate

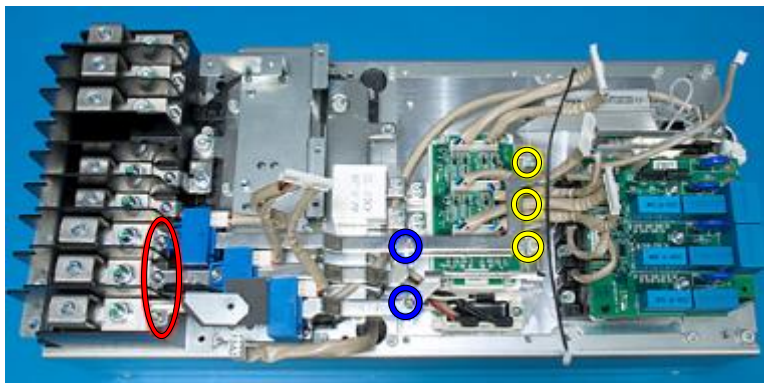
- a. Unplug ZINT wiring
- b. Remove ZINT board fixing **screws** (3pcs) M3x6
- c. Remove assembly plate fixing screws (3pcs of **M4x8** and 4pcs of **M5x12**)



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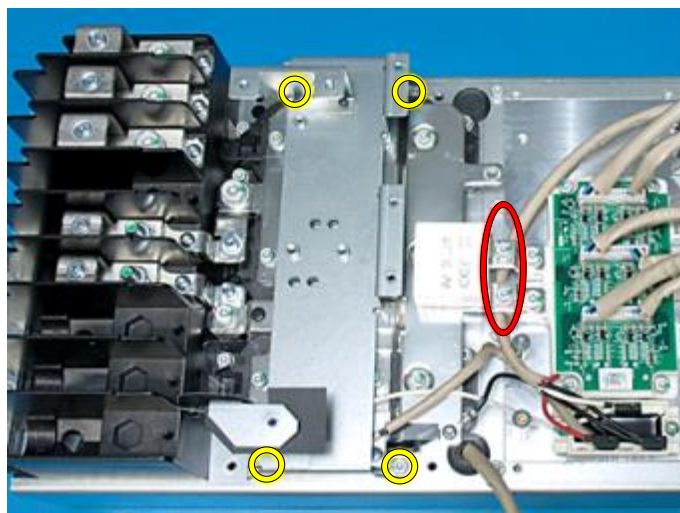
5. Remove output busbars

- a. Unscrew busbar tightening screws (3pcs) 50x14 PT and 2pcs M4x8 and one M4x12 insulating pillar
- b. Remove semiconductor output screws (3pcs) M6x12



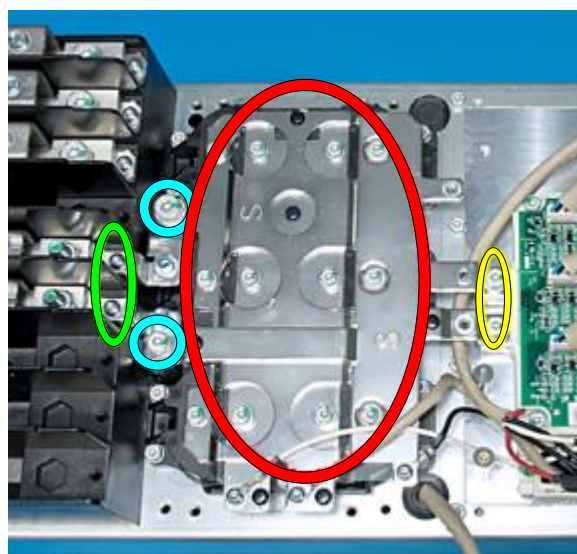
6. Remove assembly plate


- a. Remove ZFC-board if used (3pcs fixing screws, M4x12, one grounding screw M4x8)
- b. Unscrew assembly plate tightening screws (4pcs) M5x12
- c. Remove assembly plate
- d. Remove clamp capacitor screws (2pcs) M5x12



7. Remove DC busbars

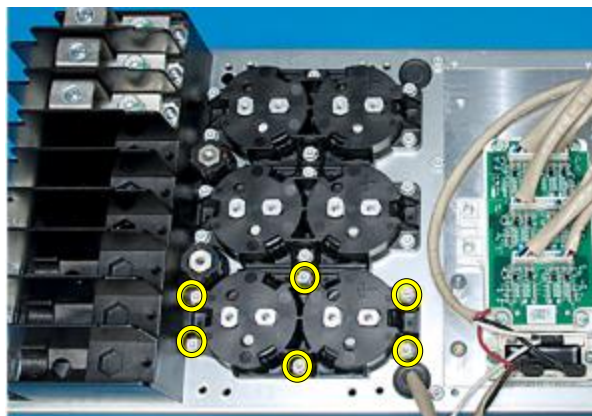
- a. Remove semiconductor DC connector screws (2pcs) M6x14
- b. Remove DC capacitor pole screws (12pcs) M5x12
- c. Remove choke connection screws M6x16 and M8x20
- d. Remove DC busbar output connector screws (2pcs) 50x14 PT



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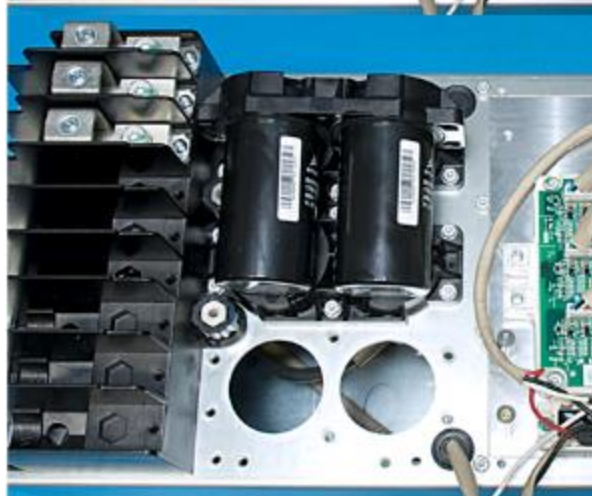
8. Replace DC capacitors


- a. Remove capacitor assembly fixing **screws** M5x20
- b. Replace capacitors. **Note: pay attention to TOP mark on capacitor assembly!**



9. Install components in reverse order

- Check the correct tightening torques from section 2 (page 6).



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3.4.2 Frame R7, DC capacitor replacement


1. Remove covers and cable gland box

- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



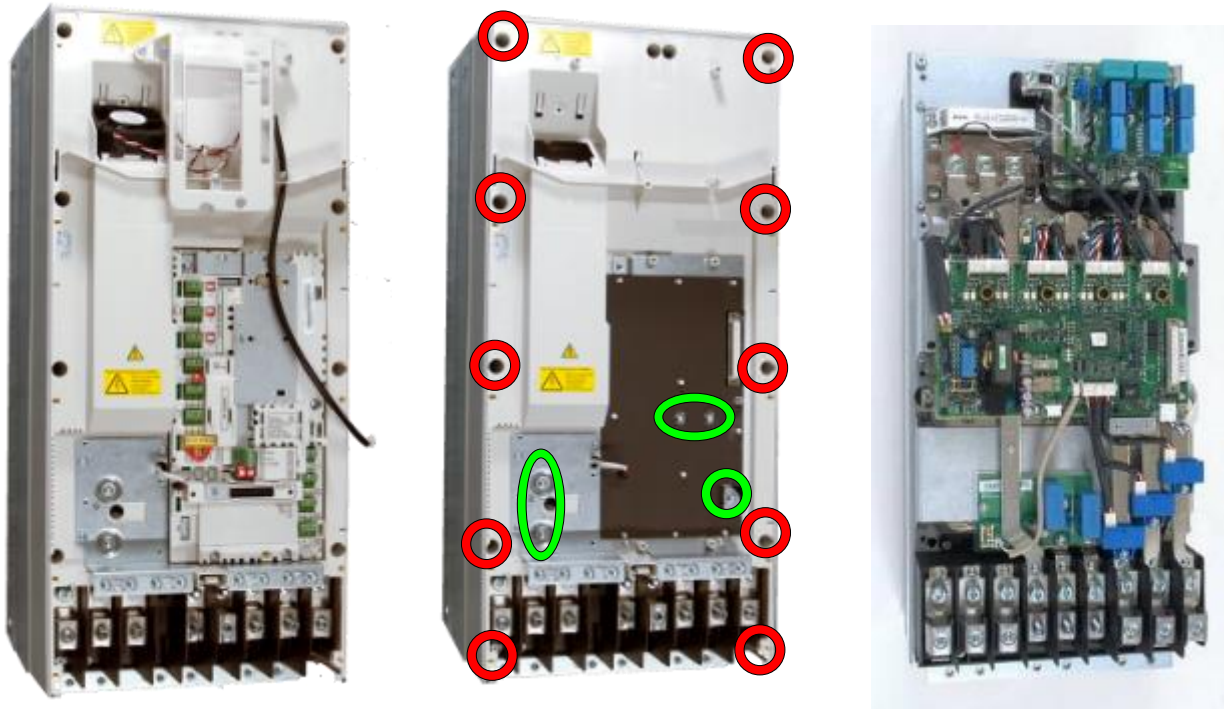
2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

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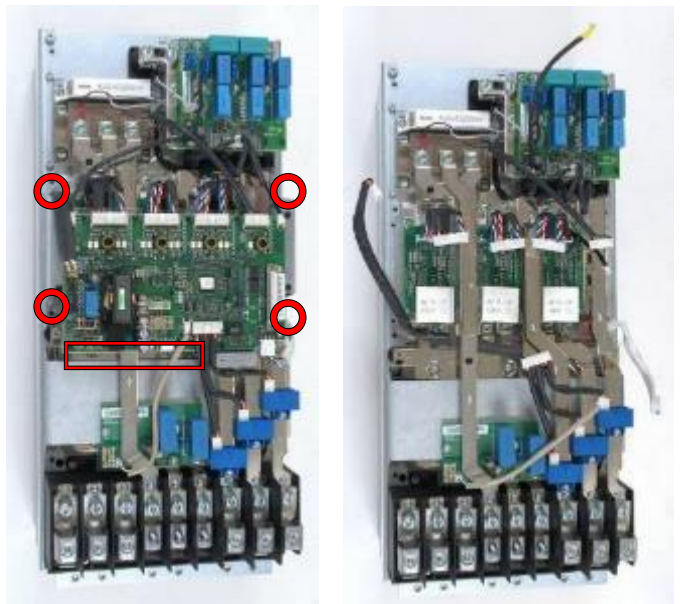
3. Remove middle frame (skeleton)


- a. Remove grounding **screws**. (5pcs) M4x8
- b. Remove skeleton mounting **screws**. (10pcs)M5x12



4. Remove ZINT board

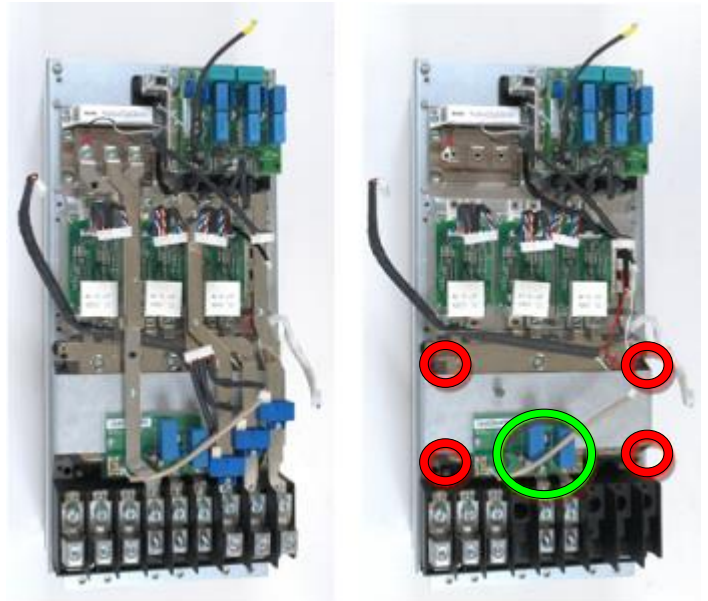
- a. Unplug ZINT wiring
- b. Remove ZINT frame fixing **screws** (4pcs) M5x12 and (4pcs) M4x12



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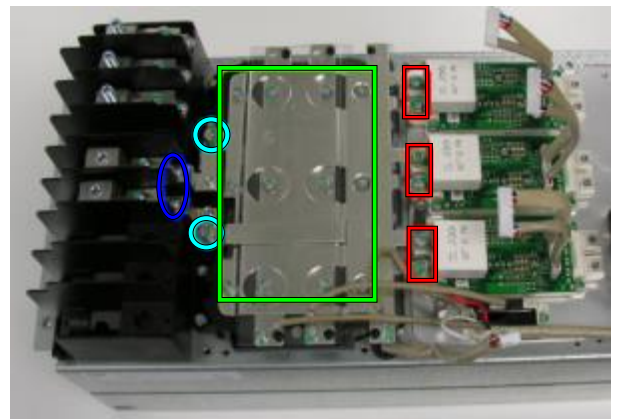
5. Remove ZFC board

- a. Remove output busbars and current transducers
- b. Remove **varistor board** (if used, 4 pcs M4x8) and frame by 4 **fixing screws** M5x12

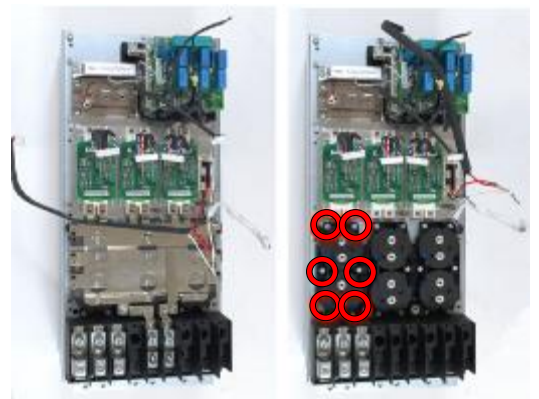


6. Remove DC capacitors

- a. Remove clamp capacitor **fixing screws**, 6pcs M6x16
- b. Remove DC capacitor **pole screws**, 12pcs M5x12
- c. Remove choke connection **screws** (M8x20 and M6x20)
- d. Remove DC busbar **fixing screws** (2pcs K50x16 PT) on the output terminals




- e. Remove DC capacitor **fixing screws** (6pcs) M5x20, lift capacitors



7. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.4.3 Frame R8, DC capacitor replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

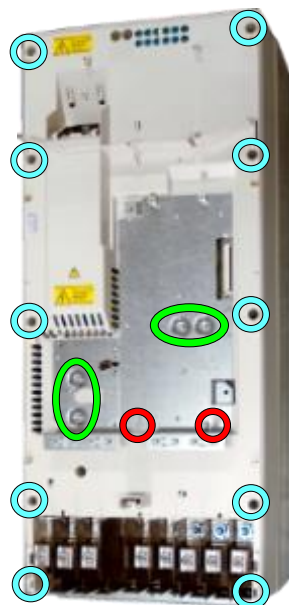
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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3. Remove middle frame (skeleton)

- a. Isolating plexiglas fixing **screws** (2pcs) K40x16 PT
- b. Grounding **screws** (2-4pcs) M4x12
- c. Skeleton fixing **screws** (8pcs) M5x12 and (2pcs) M5x20

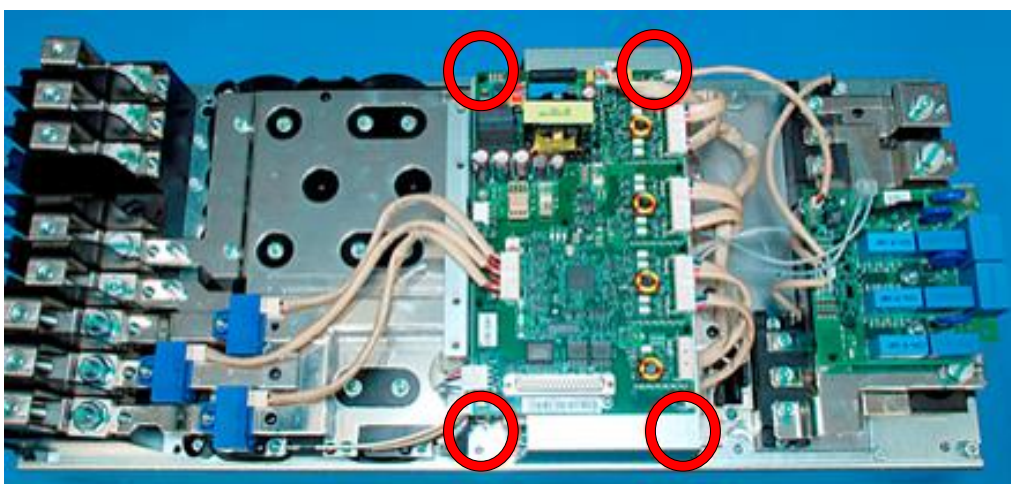



4. Remove ZFC-board (if used)

Remove two ZFC-board fixing screws (M4x8) and four assembly plate fixing screws (M4x12 and M5x12)

5. Remove ZINT board

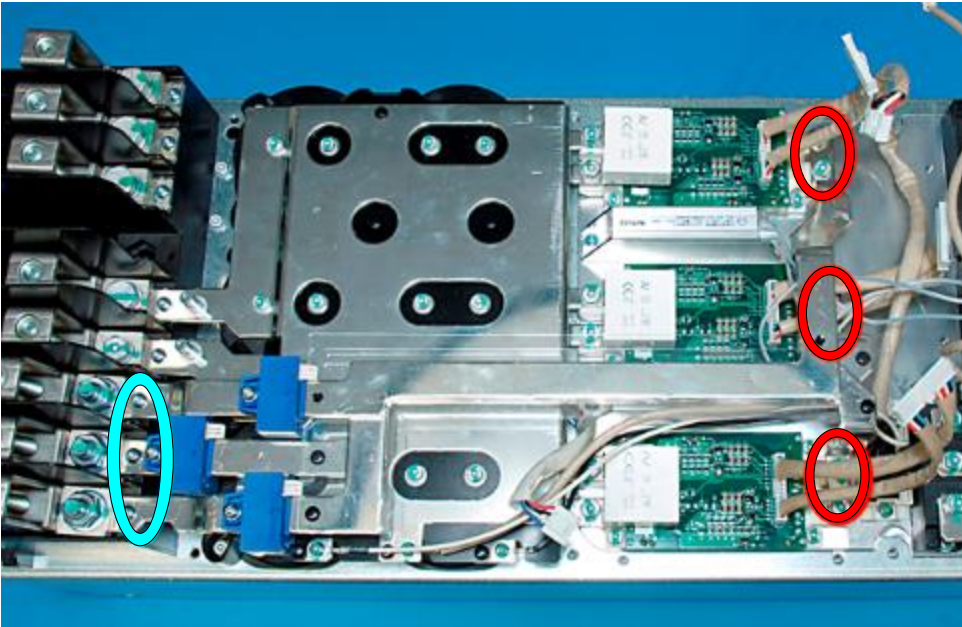
- a. Unplug ZINT wiring
- b. Remove ZINT frame fixing **screws** (4pcs) M5x12



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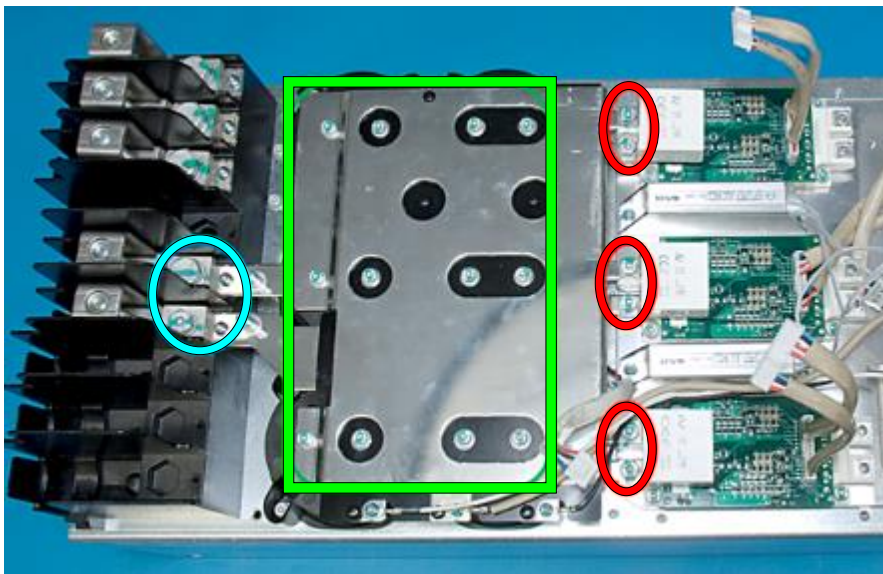
6. Remove output busbars


- Remove 3 fixing screws (K50x16 PT) on the output terminals
- Remove 6 fixing screws (M6x16) on the IGBT modules



7. Remove DC busbars

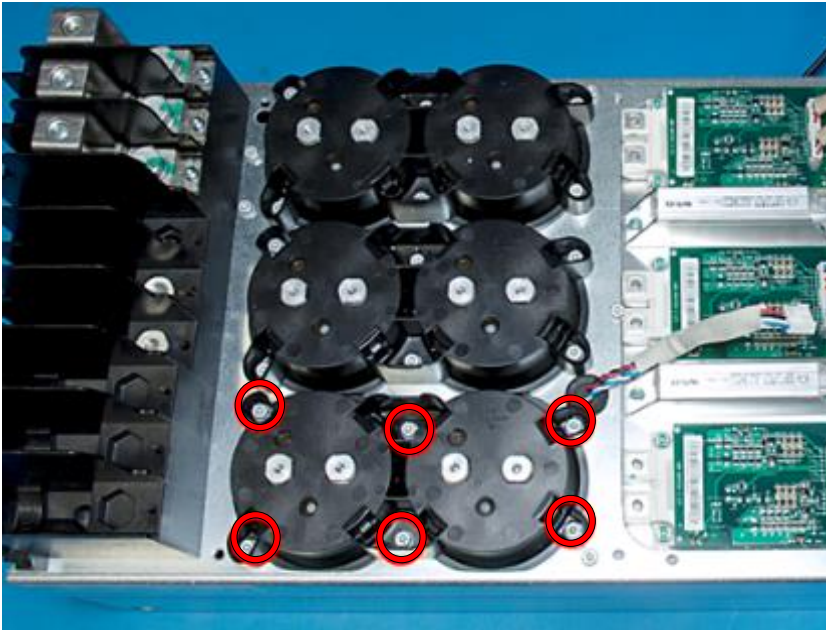
- Remove clamp capacitor fixing screws, 6pcs M6x16
- Remove DC capacitor pole screws, 12pcs M5x12
- Remove 2pcs DC busbar fixing screws (K50x16 PT) and 2pcs choke connection screws (M10x25 and M8x25) on the output terminals



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8. Replace DC capacitors

- Remove capacitor fixing **screws**, 6pcs M5x20
- Replace capacitors by lifting



9. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.4.4 Frame R9, DC capacitor replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

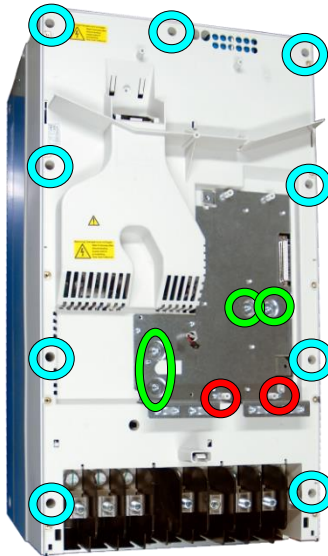
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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3. Remove middle frame (skeleton)

- a. Isolating plexiglas fixing **screws** (2pcs) M4x16 PT
- b. Grounding **screws** (4pcs) M4x12
- c. Skeleton fixing **screws** (9pcs) M5x12

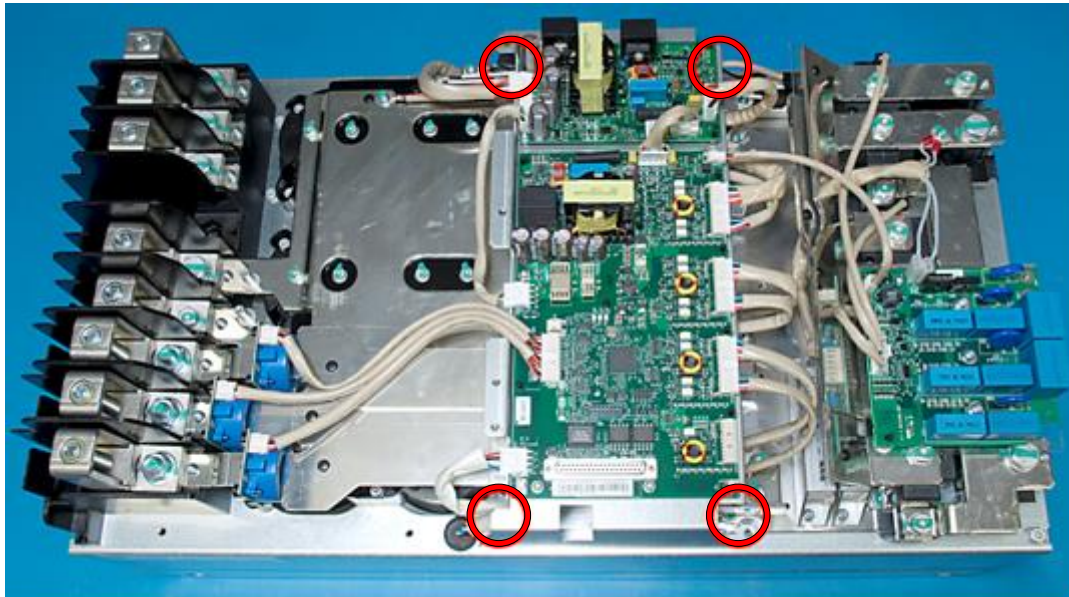



4. Remove ZFC-board (if used)

Remove two ZFC-board fixing screws (M4x8) and four assembly plate fixing screws (M4x12 and M5x12)

5. Remove ZINT and ZPOW boards

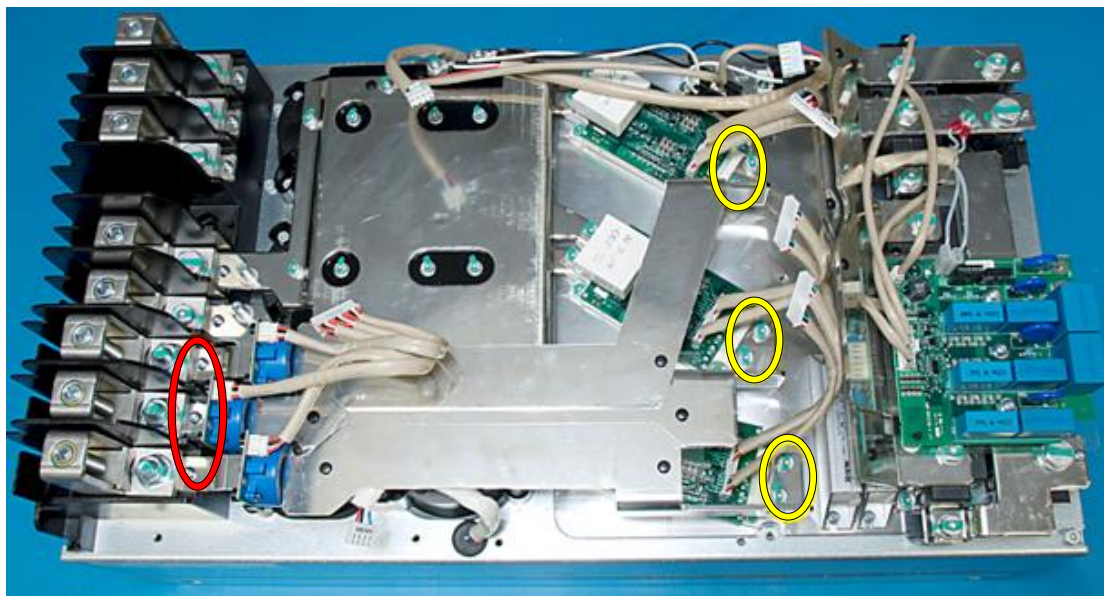
- a. Unplug ZINT and ZPOW wirings
- b. Remove ZINT frame fixing **screws** (4pcs) M5x12



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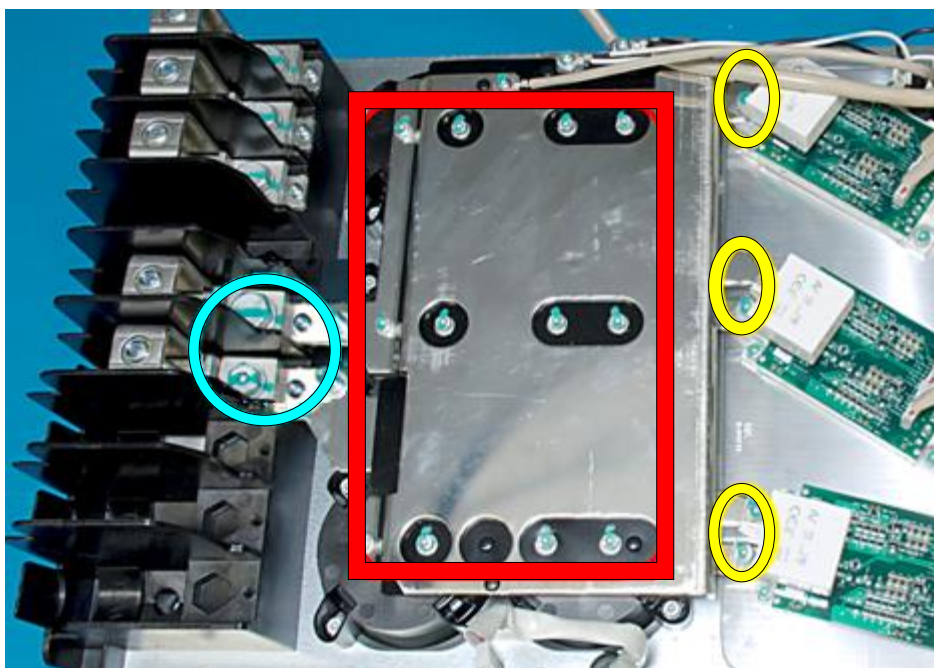
6. Remove output busbars


- a. Remove **3 fixing screws** (K50x16 PT) on the output terminals
- b. Remove **6 fixing screws** (M6x16) on the IGBT modules



7. Remove DC busbars

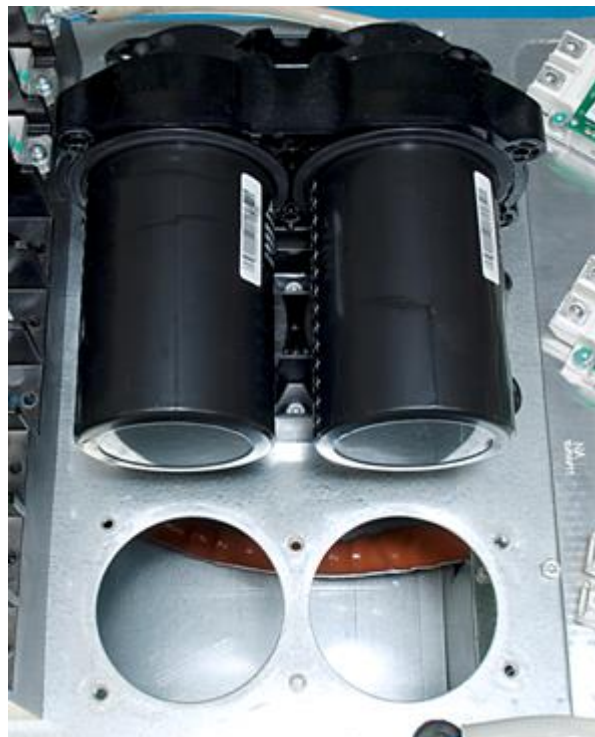
- a. Remove clamp capacitor **fixing screws**, 6pcs M6x16
- b. Remove DC capacitor **pole screws**, 12pcs M5x12
- c. Remove DC busbar **fixing screws** (2pcs K50x16 PT) and 2pcs **screws** (M8x25 and M10x25) on the output terminals



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Replace DC capacitors

- a. Remove capacitor **fixing screws**, 6pcs M5x20
- b. Replace capacitors by lifting



8. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.5 Replacement of main circuit semiconductor modules

3.5.1 Measuring semiconductor condition from main connectors


The condition of an IGBT and an input bridge can be measured with a multimeter to ensure component functionality. In this section there are given the pass criteria for values measured from main connectors. In order to measure IGBT condition directly from IGBT pins, see section 3.5.2 *Measuring IGBT condition*. In the tables below the infinite value is OL = Over limit.

Note: Always make sure there is no voltage connected to input terminals. In case a permanent magnet motor is used, the motor axel must not rotate as it would feed voltage to drive side.

STEP 1	Input bridge diode measurement		
Performance	Use a multimeter to make sure that the measurements for the input bridge diodes are OK.		
Pass criteria	By using the diode measurement setting for the multimeter, you should get the following values: Note: In case of a controlled charging circuit, the input bridge measurement is not possible for all phases.		
	+ probe	- probe	Display
	L1	+DC	~1,1 Vdc
	L2	+DC	OL
	L3	+DC	OL
	+DC	L1	OL
	+DC	L2	OL
	+DC	L3	OL
	+ probe	- probe	Display
	L1	- DC	OL
	L2	- DC	OL
	L3	- DC	OL
	- DC	L1	~0,45 Vdc
	- DC	L2	~0,45 Vdc
	- DC	L3	~0,45 Vdc
Meaning of the test	To ensure that the input bridge diodes are OK.		

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STEP 2	IGBT freewheeling diode measurement																																										
Performance	Use a multimeter to make sure that the measurements for the output bridge freewheeling diodes are OK.																																										
Pass criteria	<p>By using the diode measurement setting for the multimeter, you should get the following values:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">+ probe</th> <th style="width: 33%;">- probe</th> <th style="width: 33%;">Display</th> </tr> </thead> <tbody> <tr> <td>U</td> <td>+DC</td> <td>~0,4 Vdc</td> </tr> <tr> <td>V</td> <td>+DC</td> <td>~0,4 Vdc</td> </tr> <tr> <td>W</td> <td>+DC</td> <td>~0,4 Vdc</td> </tr> <tr> <td>+DC</td> <td>U</td> <td>OL</td> </tr> <tr> <td>+DC</td> <td>V</td> <td>OL</td> </tr> <tr> <td>+DC</td> <td>W</td> <td>OL</td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">+ probe</th> <th style="width: 33%;">- probe</th> <th style="width: 33%;">Display</th> </tr> </thead> <tbody> <tr> <td>U</td> <td>- DC</td> <td>OL</td> </tr> <tr> <td>V</td> <td>- DC</td> <td>OL</td> </tr> <tr> <td>W</td> <td>- DC</td> <td>OL</td> </tr> <tr> <td>- DC</td> <td>U</td> <td>~0,4 Vdc</td> </tr> <tr> <td>- DC</td> <td>V</td> <td>~0,4 Vdc</td> </tr> <tr> <td>- DC</td> <td>W</td> <td>~0,4 Vdc</td> </tr> </tbody> </table>	+ probe	- probe	Display	U	+DC	~0,4 Vdc	V	+DC	~0,4 Vdc	W	+DC	~0,4 Vdc	+DC	U	OL	+DC	V	OL	+DC	W	OL	+ probe	- probe	Display	U	- DC	OL	V	- DC	OL	W	- DC	OL	- DC	U	~0,4 Vdc	- DC	V	~0,4 Vdc	- DC	W	~0,4 Vdc
+ probe	- probe	Display																																									
U	+DC	~0,4 Vdc																																									
V	+DC	~0,4 Vdc																																									
W	+DC	~0,4 Vdc																																									
+DC	U	OL																																									
+DC	V	OL																																									
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+ probe	- probe	Display																																									
U	- DC	OL																																									
V	- DC	OL																																									
W	- DC	OL																																									
- DC	U	~0,4 Vdc																																									
- DC	V	~0,4 Vdc																																									
- DC	W	~0,4 Vdc																																									
Meaning of this test	To ensure that the output freewheeling diodes are OK.																																										


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3.5.2 Measuring IGBT condition


The condition of an IGBT and an input bridge can be measured with a multimeter. Pass criteria given in this section are measured directly from the IGBT pins. A broken IGBT module can also be identified by measuring between udc+/udc- and output connectors. Therefore, please conduct the measurements described in section 3.5.1 *Measuring semiconductor condition from main connectors* before performing the measurements described here.

In some cases, damage can be identified visually. Thus it is important to conduct a visual check on the IGBT modules as well. Sometimes the IGBT module might be broken or burned for example by an arc, which is caused by a short circuit inside the module.

STEP 1	Output IGBT freewheeling diode measurement		
Performance	Use a multimeter to make sure that the measurements for the output bridge freewheeling diodes are OK (see Figure 3.a-b for frame size R6 and figures 5.c-d for frame sizes R7-R9)		
Pass criteria	By using the diode measurement setting for the multimeter, you should get the following values:		
	+ probe	- probe	R6 display
	1	3	OL
	1	5	OL
	1	4	OL
	8	4	OL
	4	8	~0,4 Vdc
	4	1	~0,4 Vdc
	3	1	~0,4 Vdc
	5	1	~0,4 Vdc
	+ probe	- probe	R6 display
	2	3	~0,4 Vdc
	2	4	~0,4 Vdc
	2	5	~0,4 Vdc
	3	2	OL
	4	2	OL
	5	2	OL
	+ probe	- probe	R7-R9 display
	4	10/11	OL
	9	10/11	OL
	3	10/11	~0,4 Vdc
	10/11	4	~0,4 Vdc
	10/11	9	~0,4 Vdc
	10/11	3	OL
Meaning of the test	To ensure that the IGBT freewheeling diodes are OK.		

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STEP 2	IGBT gate measurement																														
Performance	<p>Use a multimeter to measure the condition of the IGBT gates. Please note that the ZGAD board is supposed to stay attached to the IGBT module. The condition of the IGBT gates can be measured, when the multimeter is turned to the Ohm measurement.</p> <p>NOTE! Having the correct IGBT gate - emitter resistance measurement does not automatically mean that the IGBT module is OK. If the IGBT gate - emitter has a slight leak, the measurements may show to be correct even with the faulty module in this case.</p>																														
Pass criteria	<p>The table below shows the resistance values for the IGBT gate – emitter measurement (see Figure 3.a-b for frame size R6 and figures 5.c-d for frame sizes R7-R9):</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">+ probe</th> <th style="width: 33%;">- probe</th> <th style="width: 33%;">R6 display</th> </tr> </thead> <tbody> <tr><td>17</td><td>5</td><td>10kΩ</td></tr> <tr><td>16</td><td>4</td><td>10kΩ</td></tr> <tr><td>14</td><td>3</td><td>10kΩ</td></tr> <tr><td>6</td><td>2</td><td>10kΩ</td></tr> <tr><td>10</td><td>2</td><td>10kΩ</td></tr> <tr><td>12</td><td>2</td><td>10kΩ</td></tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">+ probe</th> <th style="width: 33%;">- probe</th> <th style="width: 33%;">R7-R9 display</th> </tr> </thead> <tbody> <tr><td>7</td><td>10/11</td><td>10kΩ</td></tr> <tr><td>1</td><td>3</td><td>10kΩ</td></tr> </tbody> </table>	+ probe	- probe	R6 display	17	5	10kΩ	16	4	10kΩ	14	3	10kΩ	6	2	10kΩ	10	2	10kΩ	12	2	10kΩ	+ probe	- probe	R7-R9 display	7	10/11	10kΩ	1	3	10kΩ
+ probe	- probe	R6 display																													
17	5	10kΩ																													
16	4	10kΩ																													
14	3	10kΩ																													
6	2	10kΩ																													
10	2	10kΩ																													
12	2	10kΩ																													
+ probe	- probe	R7-R9 display																													
7	10/11	10kΩ																													
1	3	10kΩ																													
Meaning of the test	To ensure that the IGBT gates are OK																														
STEP 3	IGBT module NTC-thermistor measurement																														
Performance	<p>Use a multimeter to measure the condition of the NTC-thermistor on the IGBT module. Turn the multimeter to the Ohm measurement for this test.</p> <p>See correct IGBT pins in Figure 3.a-b for frame size R6 and figures 5.c-d for frame sizes R7-R9.</p>																														
Pass criteria	<p>The correct resistance value for the NTC-thermistor measurement. Check the correct resistance value for the NTC thermistor from the IGBT manufacturer's datasheet.</p> <p>E.g. Correct resistance values with temperatures 20°C, 25°C and 30°C: $R_{20} \rightarrow \sim 6k\Omega$ $R_{25} \rightarrow \sim 5k\Omega$ $R_{30} \rightarrow \sim 4k\Omega$</p>																														
Meaning of the test	To ensure that the NTC-thermistor is OK.																														

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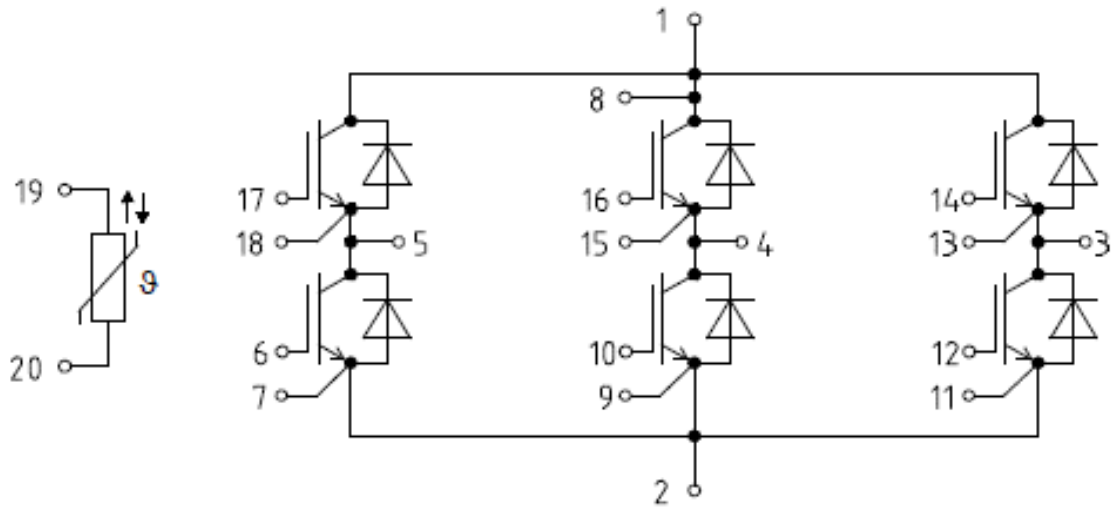


Figure 3.a: Frame R6 IGBT module: diagram of module's connectors.

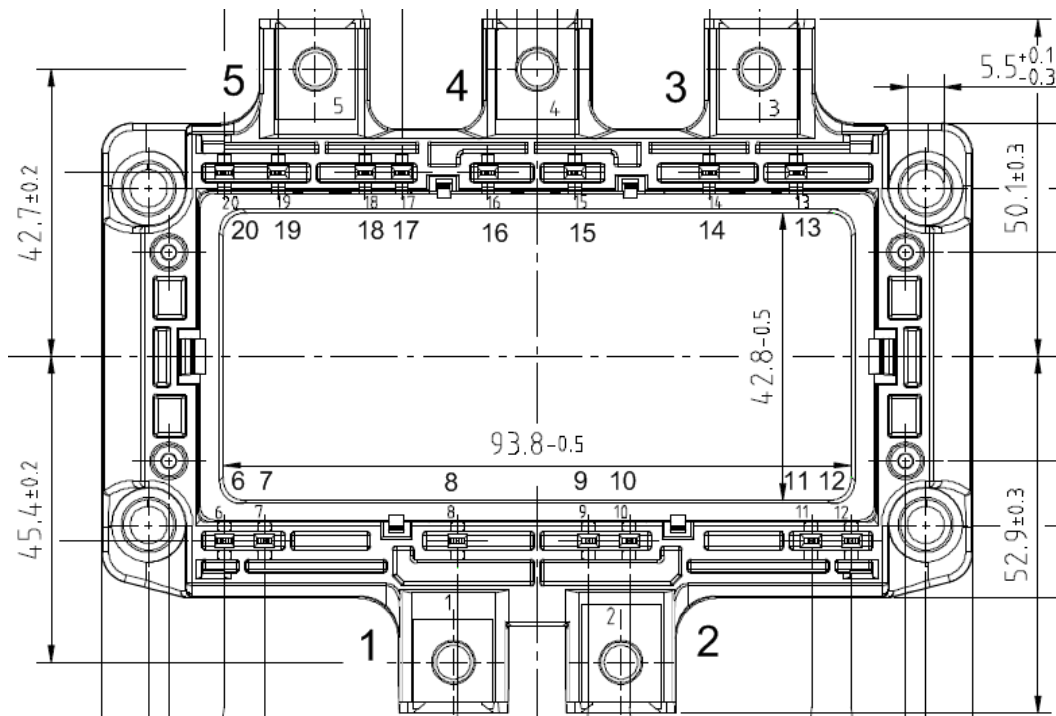



Figure 3.b: Frame R6 IGBT module: picture of module's connectors.

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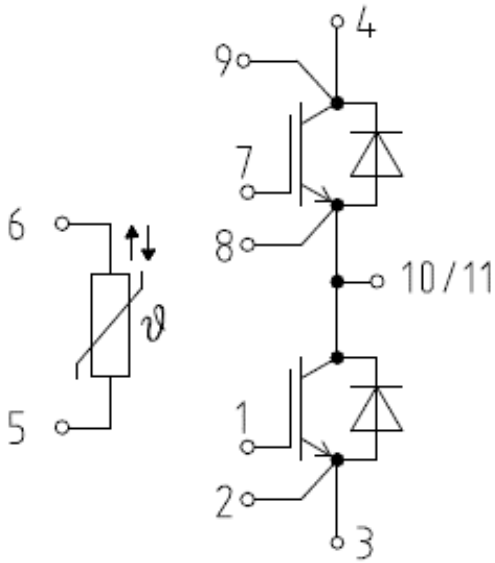


Figure 3.c: Frames R7-R9 IGBT module: diagram of modules connectors

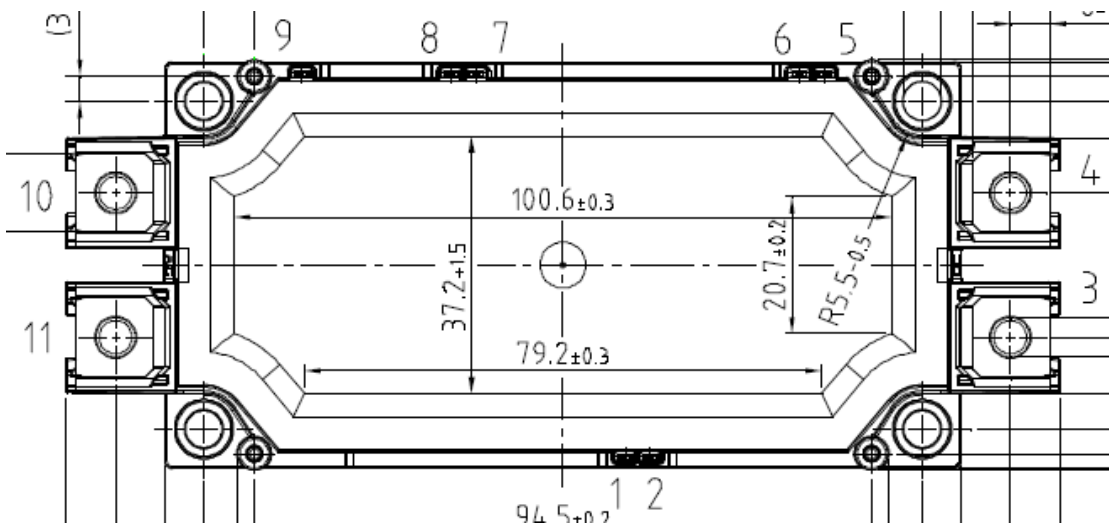



Figure 3.d: Frames R7-R9 IGBT module: picture of modules connectors.

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3.5.3 Replacing the semiconductors

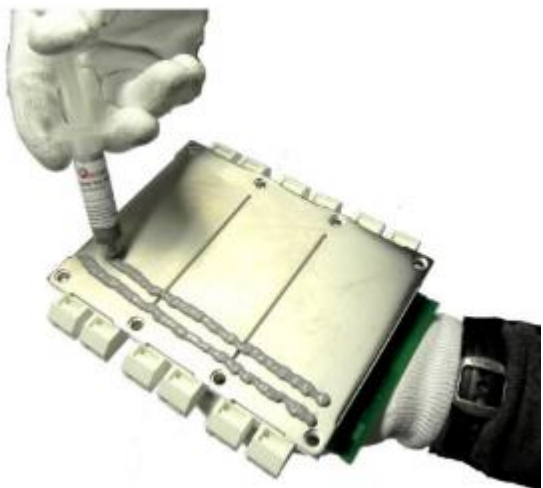
There are two different materials used between heat sink and IGBT module: thermal compound type Grey Ice 4100 and thermal graphite sheet. First remove old IGBT unit and clean the old thermal material from the heat sink with the plastic spatula and a suitable industrial solvent.


3.5.3.1 Thermal compound spreading

Always use a JIG and a Stencil if available. This provides an optimal thickness of thermal compound layer.



In most cases no JIG is available. To spread the thermal compound with a spatula, put first small amount of grease on one side of the component base plate.

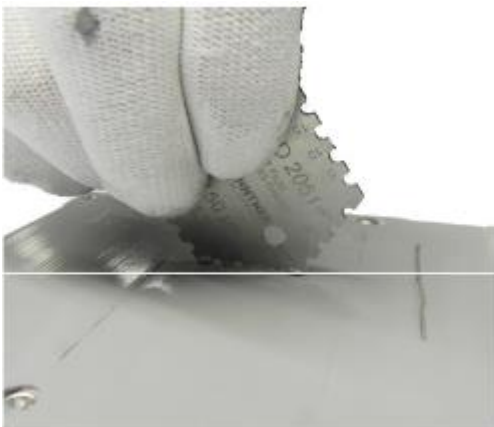



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Smoothly spread grease over the whole area with a spatula.



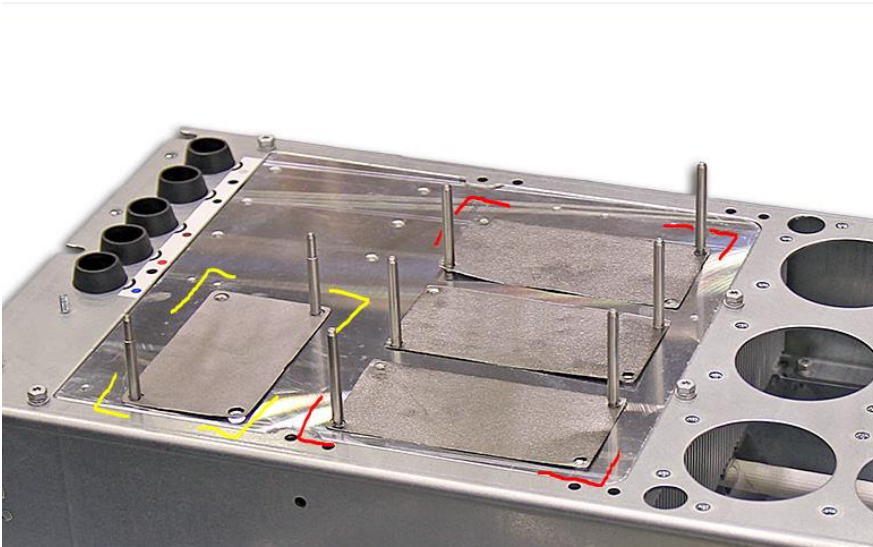
Wet film thickness meter can be used to determine thickness of grease layer. Thickness of the grease layer is supposed to be approximately 100 µm (0.1 mm).




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3.5.3.2 Thermal Graphite Sheets

Be careful not to rip or otherwise damage the graphite sheet while installing. Always handle graphite sheet extremely carefully. Install assembly pins as shown in the picture and then remove graphite sheet from the package carefully. Install the graphite sheet on the heat sink as shown in the picture. Ensure that the graphite sheet is not damaged. See detailed instructions delivered with the IGBT kit.




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3.5.4 Frame R6, IGBT replacement

1. Remove covers and cable gland box

- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



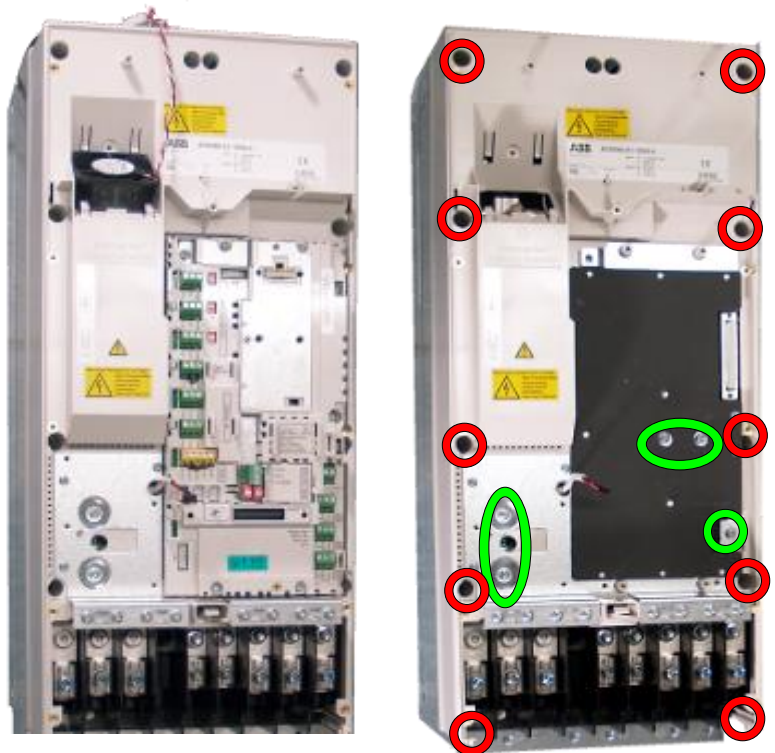
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2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

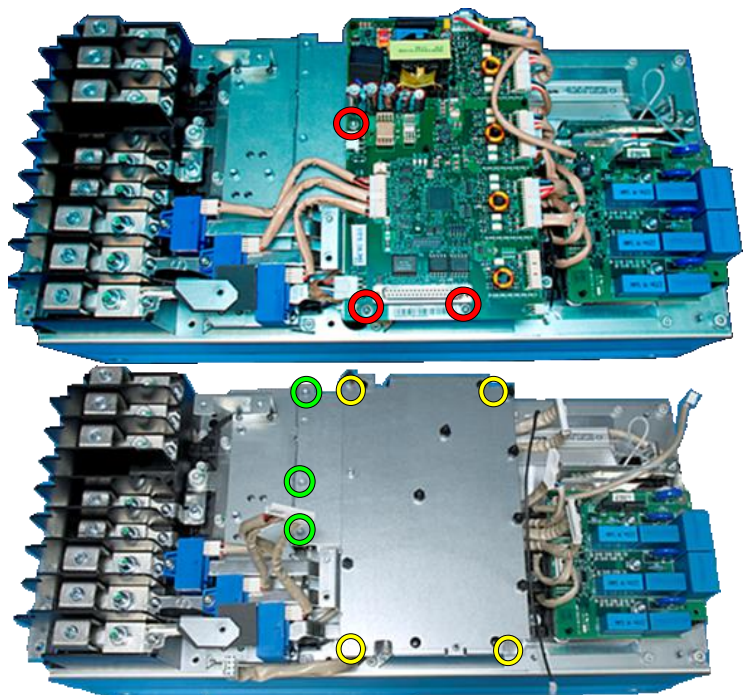
3. Remove middle frame (skeleton)


- a. Remove grounding screws. (5pcs) M4x8
- b. Remove skeleton mounting screws. (10pcs)M5x12



4. Remove ZINT board and assembly plate

- a. Unplug ZINT wiring
- b. Remove ZINT board fixing screws (3pcs) M3x6
- c. Remove assembly plate fixing screws (3pcs of M4x8 and 4pcs of M5x12)



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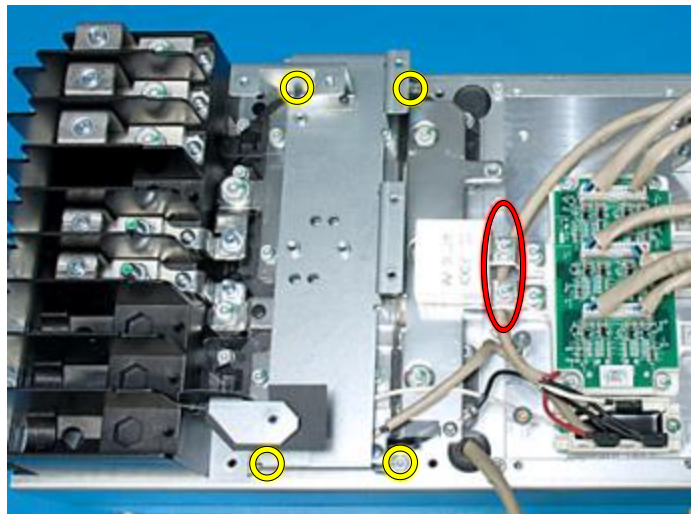
5. Remove output busbars

- a. Unscrew busbar tightening screws (3pcs) **50x14 PT** and (2pcs) **M4x8** and one **M4x12 insulating pillar**
- b. Remove semiconductor output **screws** (3pcs) M6x12



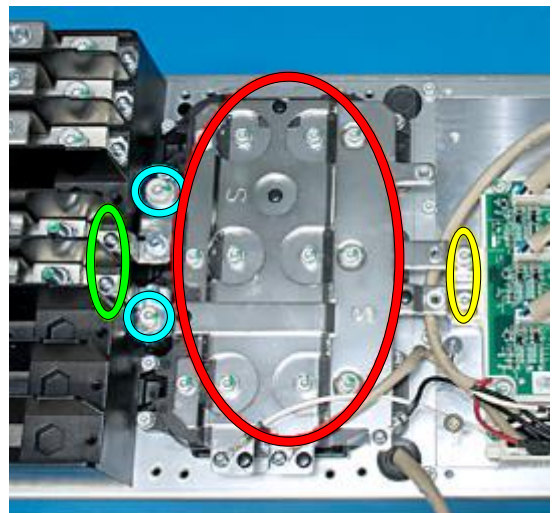
6. Remove assembly plate


- a. Remove ZFC2-board if used (3pcs fixing screws, M4x12, one grounding screw M4x8)
- b. Unscrew assembly plate tightening **screws** (4pcs) M5x12
- c. Remove assembly plate
- d. Remove clamp capacitor **screws** (2pcs) M5x12



7. Remove DC busbars

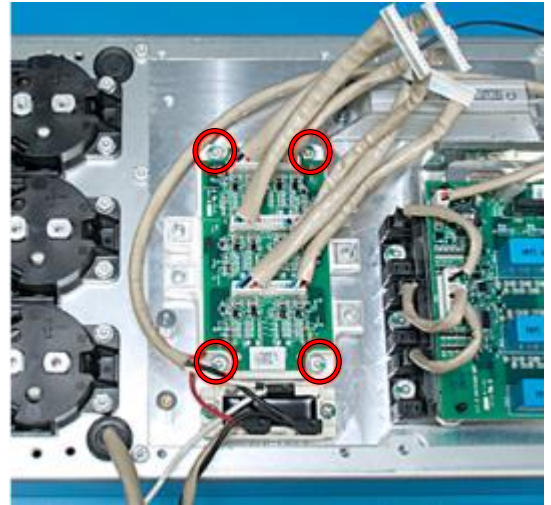
- a. Remove semiconductor DC connector **screws** (2pcs) M6x14
- b. Remove DC capacitor **pole screws** (12pcs) M5x12
- c. Remove choke connection **screws** M6x16 and M8x20
- d. Remove DC busbar output connector **screws** (2pcs) 50x14 PT



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8. Replace IGBT module


- a. Remove IGBT module fixing **screws** (4pcs) M5x20
- b. Remove IGBT module and clean heat sink with solvent.
- c. Add new heat transfer compound on surface of the IGBT module. Note: **Thermal compound type Grey Ice 4100.**
- d. Install IGBT module, check the correct tightening torques from section 4 (page 8).



9. Ensure the IGBT condition as described in section 3.5.2.

10. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.5.5 Frame R7, IGBT replacement

1. Remove covers and cable gland box

- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



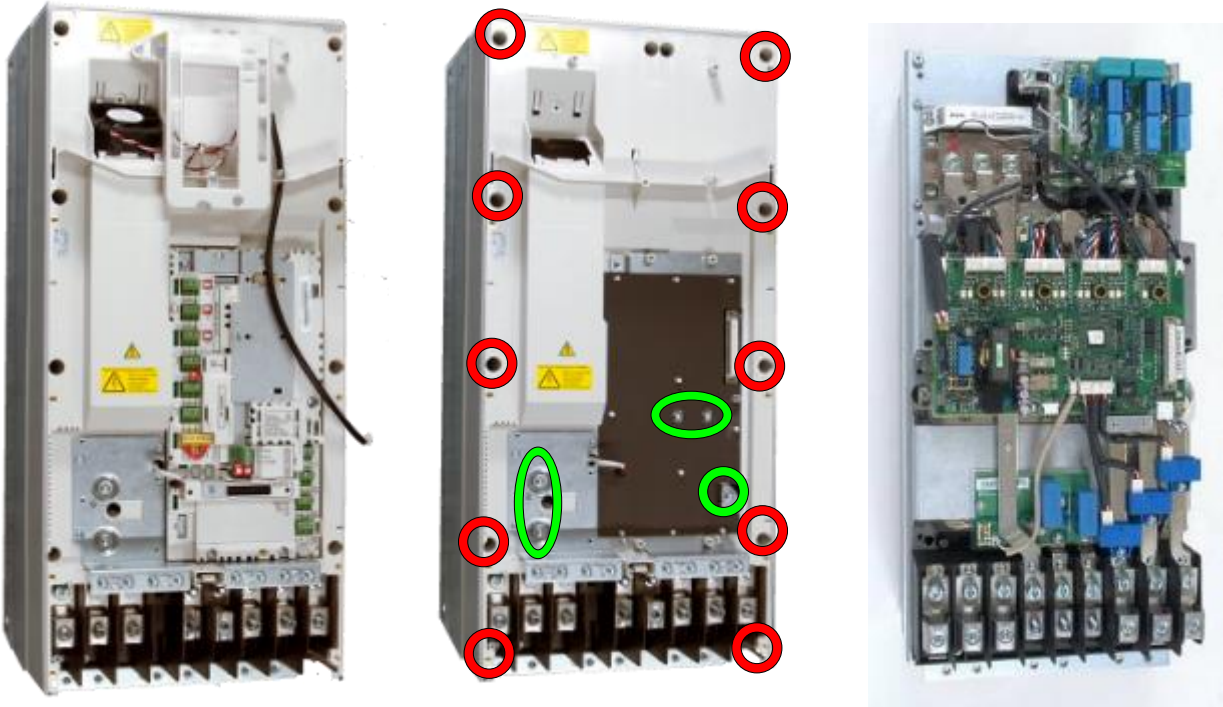
2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

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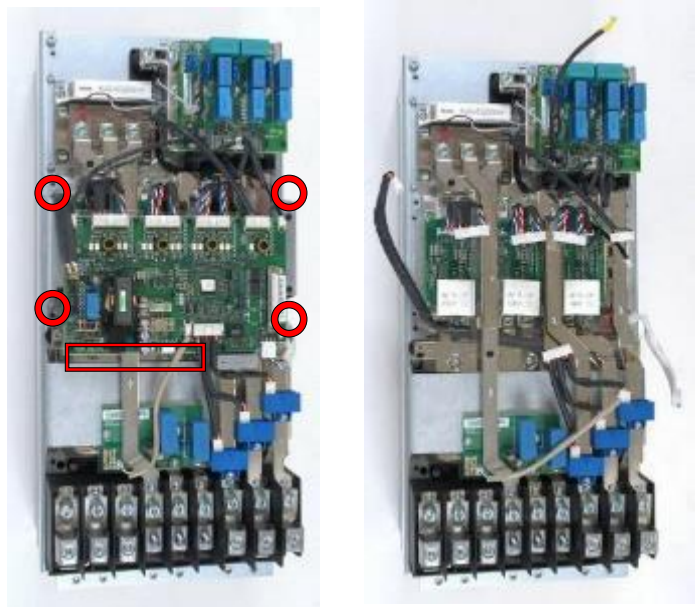
3. Remove middle frame (skeleton)


- Remove grounding **screws**. (5pcs) M4x8
- Remove skeleton mounting **screws**. (10pcs)M5x12



4. Remove ZINT board

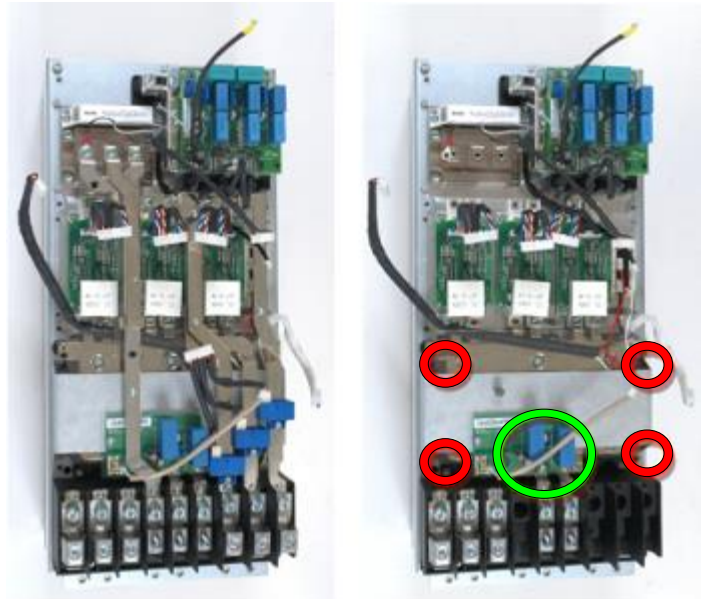
- Unplug ZINT wiring
- Remove ZINT frame fixing **screws** (4pcs) M5x12 and (4pcs) M4x12



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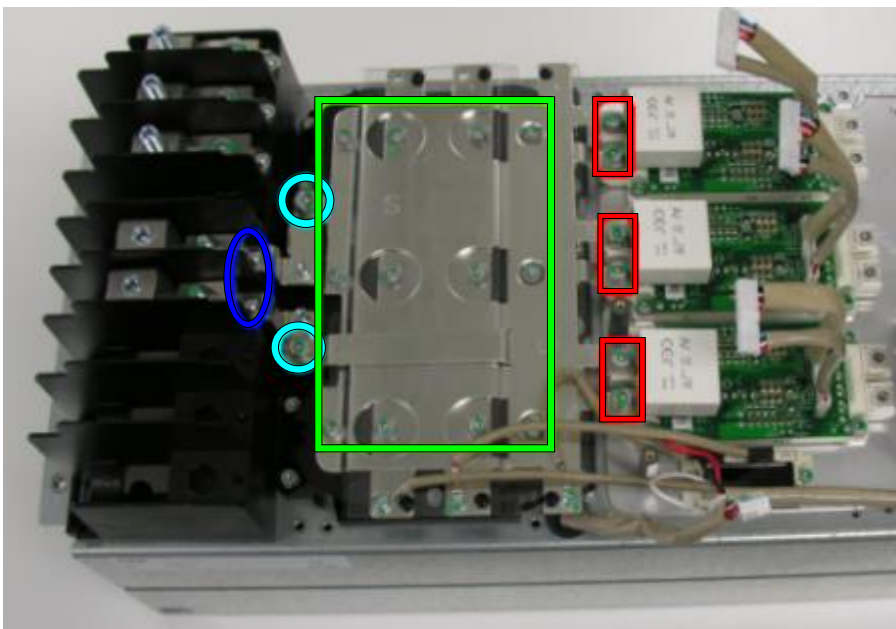
5. Remove ZFC board


- a. Remove output busbars and current transducers
- b. Remove **varistor board** (if used, 4 screws M4x8) and frame by 4 **fixing screws** M5x12



6. Remove DC busbars

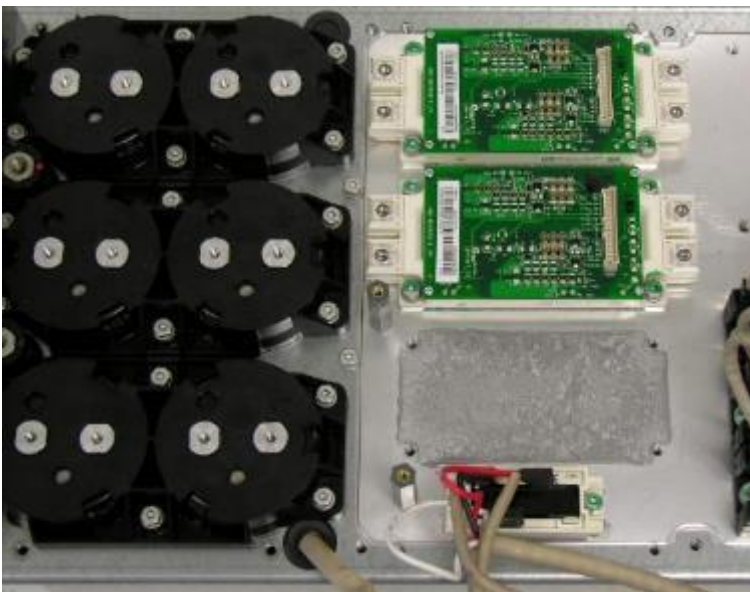
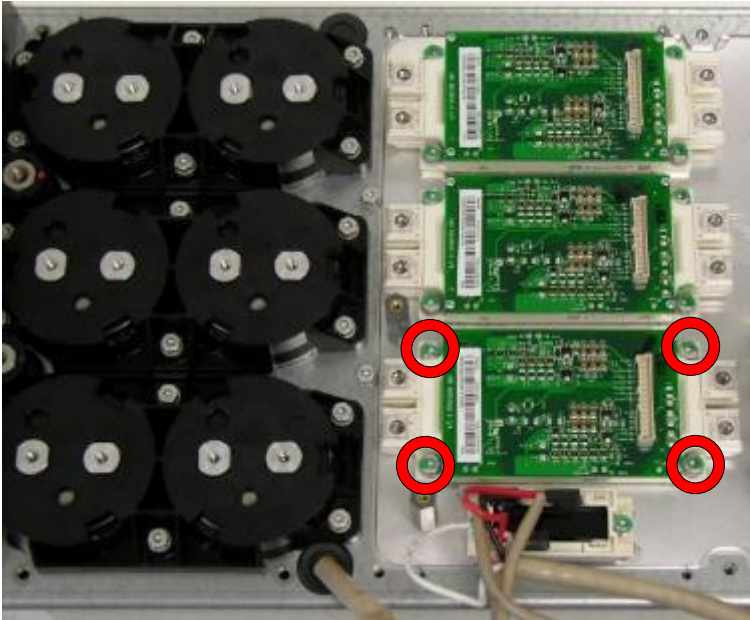
- a. Remove clamp capacitor **fixing screws**, 6pcs M6x16
- b. Remove DC capacitor **pole screws**, 12pcs M5x12
- c. Remove choke connection **screws** (M8x20 and M6x20)
- d. Remove DC busbar **fixing screws** (2pcs K50x16 PT) on the output terminals



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Replace IGBT module

- a. Remove IGBT module **fixing screws**, 4pcs M5x20
- b. Remove IGBT module and clean heat sink with solvent




- c. Depending on which IGBT kit you have in use, choose **one** of the following steps:
 1. An IGBT kit with thermal compound:
 - i. Add new heat transfer compound on surface of the IGBT module. Note: **Thermal compound type Grey Ice 4100**
 - ii. Install IGBT module, check the correct tightening torques from section 4 (page 8).
 2. An IGBT kit with thermal graphite sheets:
 - i. See separate **Graphite Installing Instructions manual** delivered with the IGBT kit.

7. Ensure the IGBT condition as described in section 3.5.2.

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8. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.5.6 Frame R8, IGBT replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

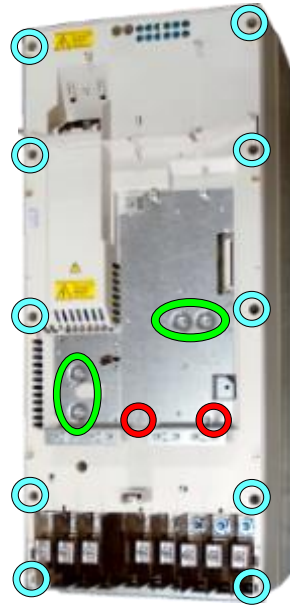
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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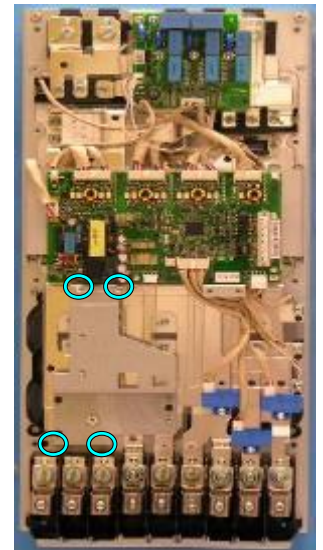
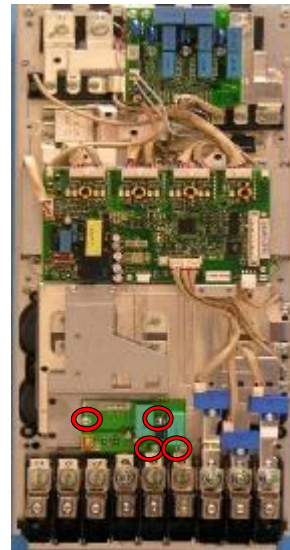
3. Remove middle frame (skeleton)

- a. Isolating plexiglas fixing **screws** (2pcs) K40x16 PT
- b. Grounding **screws** (2-4pcs) M4x12
- c. Skeleton fixing **screws** (8pcs) M5x12 and (2pcs) M5x20



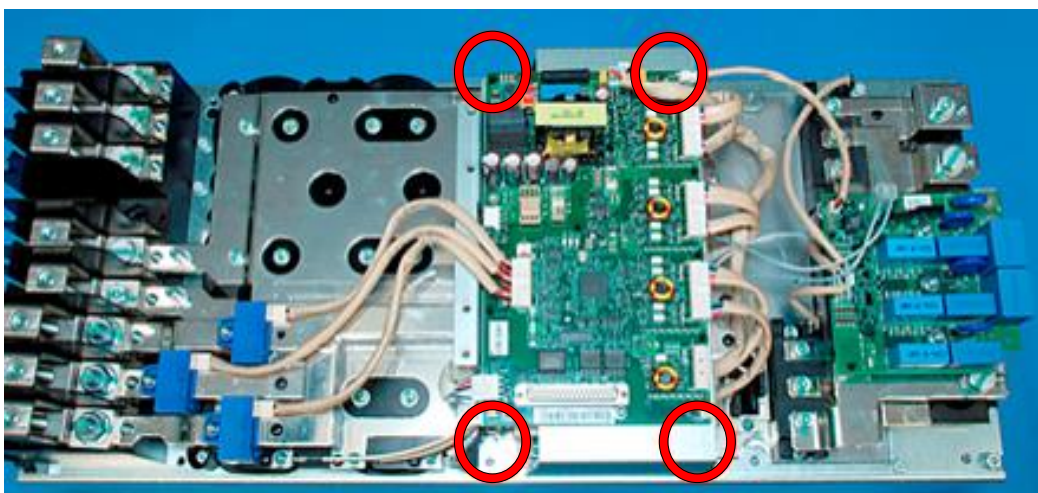
4. Remove ZFC-board (if used)


- a. Remove the ZFC2 mounting **screws** (4pcs) M4x8
- b. Remove assembly plate mounting **screws** (2pcs) M4x12 and (2pcs) M5x12



5. Remove ZINT board

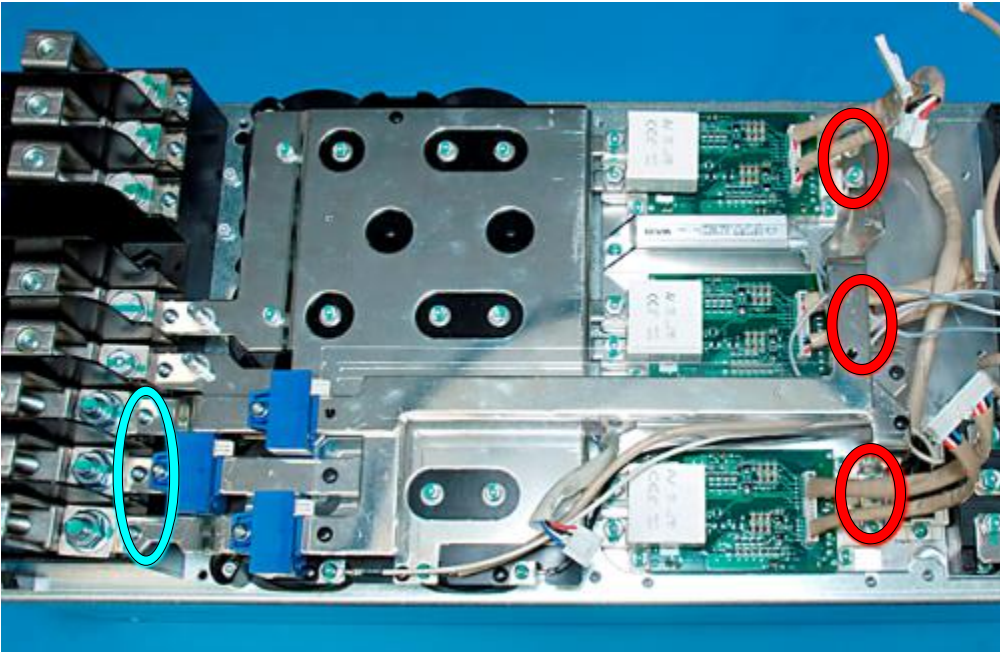
- a. Unplug ZINT wiring
- b. Remove ZINT frame fixing **screws** (4pcs) M5x12



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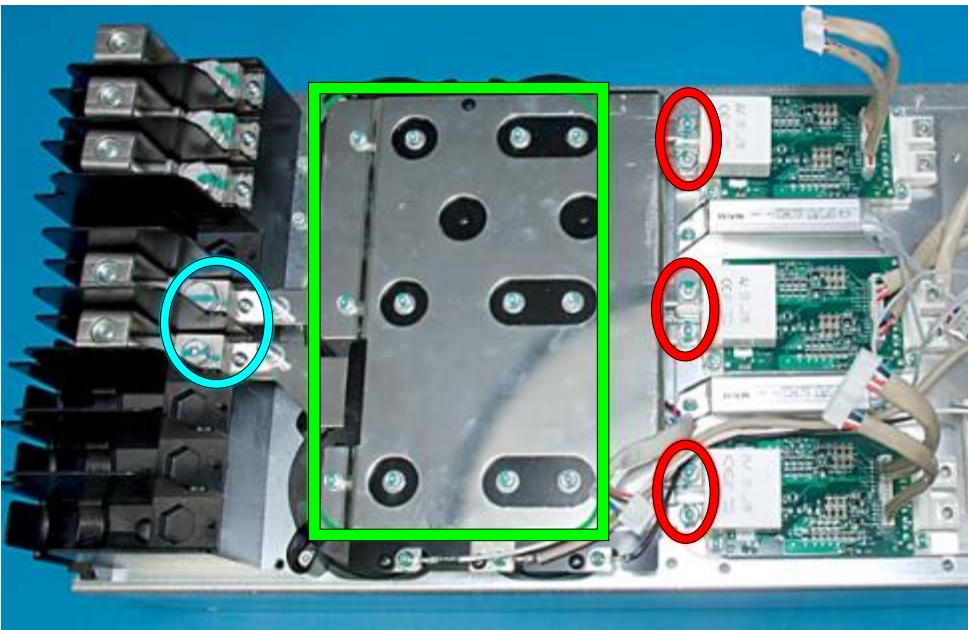
6. Remove output busbars


- a. Remove 3 fixing screws (K50x16 PT) on the output terminals
- b. Remove 6 fixing screws (M6x16) on the IGBT modules
- c.



7. Remove DC busbars

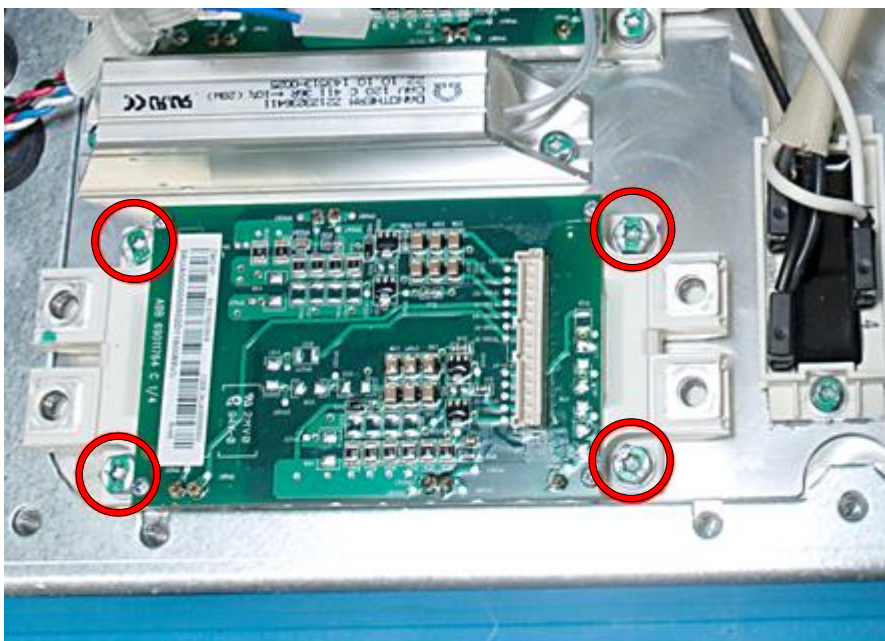
- a. Remove clamp capacitor fixing screws, 6pcs M6x16
- b. Remove DC capacitor pole screws, 12pcs M5x12
- c. Remove 2pcs DC busbar fixing screws (K50x16 PT) and 2pcs choke connection screws (M10x25 and M8x25) on the output terminals



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8. Replace IGBT module

- a. Remove IGBT module **fixing screws**, 4pcs M5x20
- b. Remove IGBT module and clean heat sink with solvent
- c. Depending on which IGBT kit you have in use, choose **one** of the following steps:
 1. An IGBT kit with thermal compound:
 - i. Add new heat transfer compound on surface of the IGBT module. Note:
Thermal compound type Grey Ice 4100
 - ii. Install IGBT module, check the correct tightening torques from section 4 (page 8).
 2. An IGBT kit with thermal graphite sheets:
 - i. See separate **Graphite Installing Instructions manual** delivered with the IGBT kit.




9. Ensure the IGBT condition as described in section 3.5.2.

10. Install components in reverse order

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Check the correct tightening torques from section 2 (page 6).

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3.5.7 Frame R9, IGBT replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

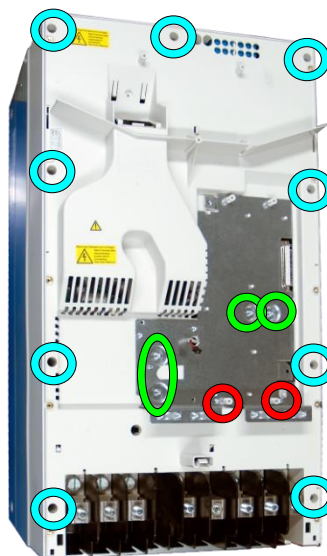
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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3. Remove middle frame (skeleton)

- a. Isolating plexiglas fixing **screws** (2pcs) M4x16 PT
- b. Grounding **screws** (4pcs) M4x12
- c. Skeleton fixing **screws** (9pcs) M5x12

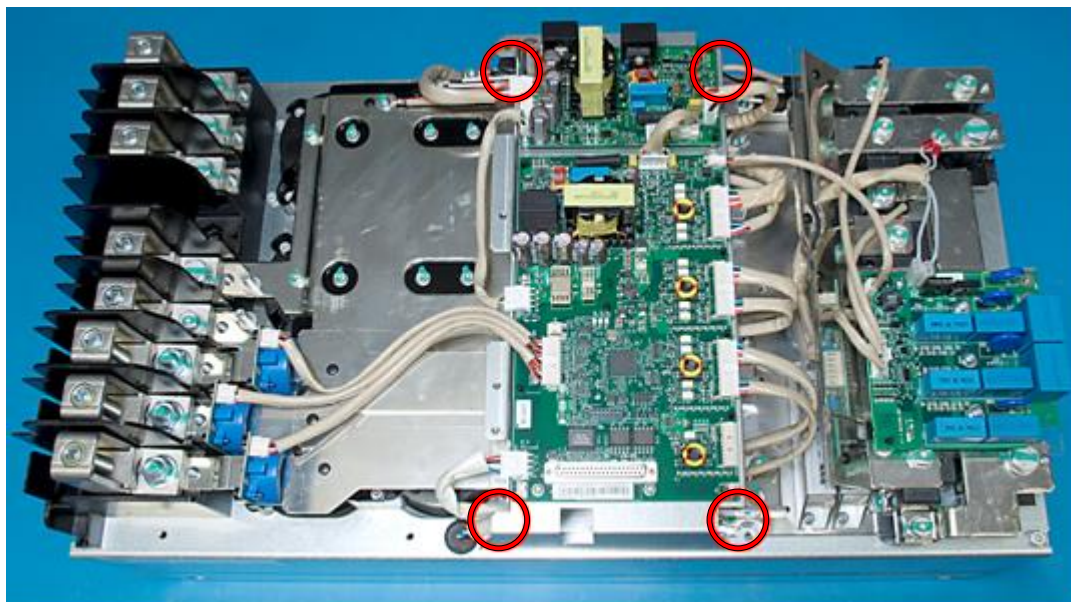



4. Remove ZFC-board (if used)

- Remove two ZFC-board fixing screws (M4x8) and four assembly plate fixing screws (M4x12 and M5x12)

5. Remove ZINT and ZPOW boards

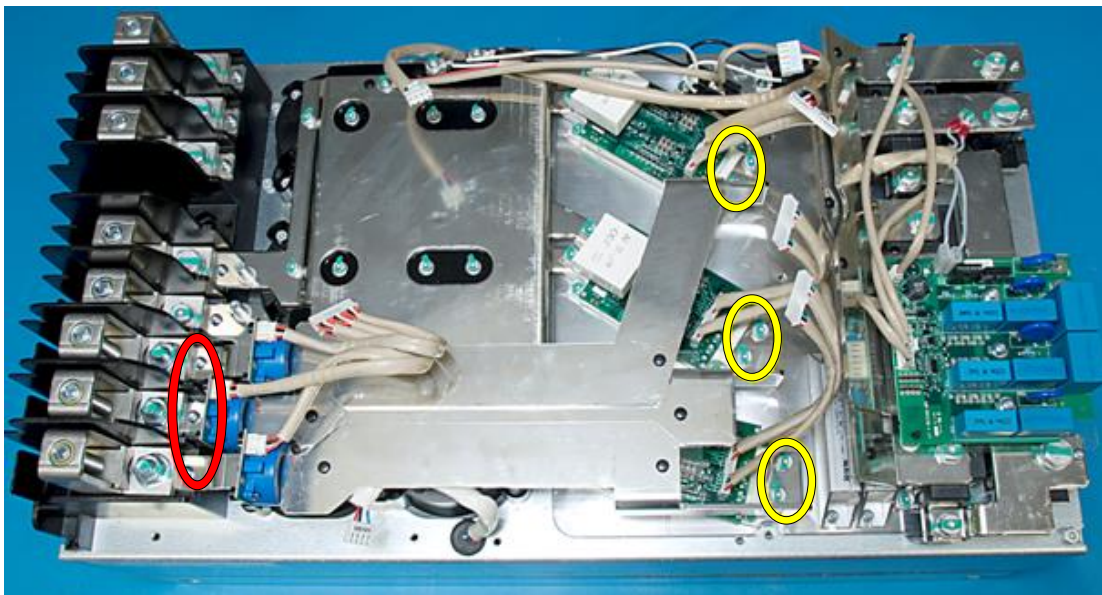
- a. Unplug ZINT and ZPOW wirings
- b. Remove ZINT frame fixing **screws** (4pcs) M5x12



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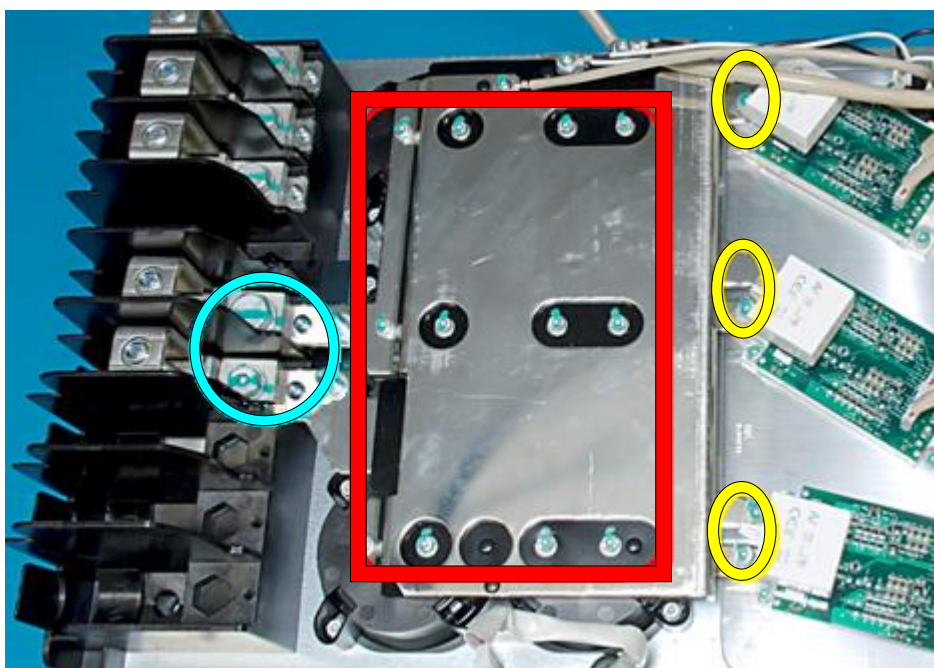
6. Remove output busbars


- Remove **3 fixing screws** (K50x16 PT) on the output terminals
- Remove **6 fixing screws** (M6x16) on the IGBT modules



7. Remove DC busbars

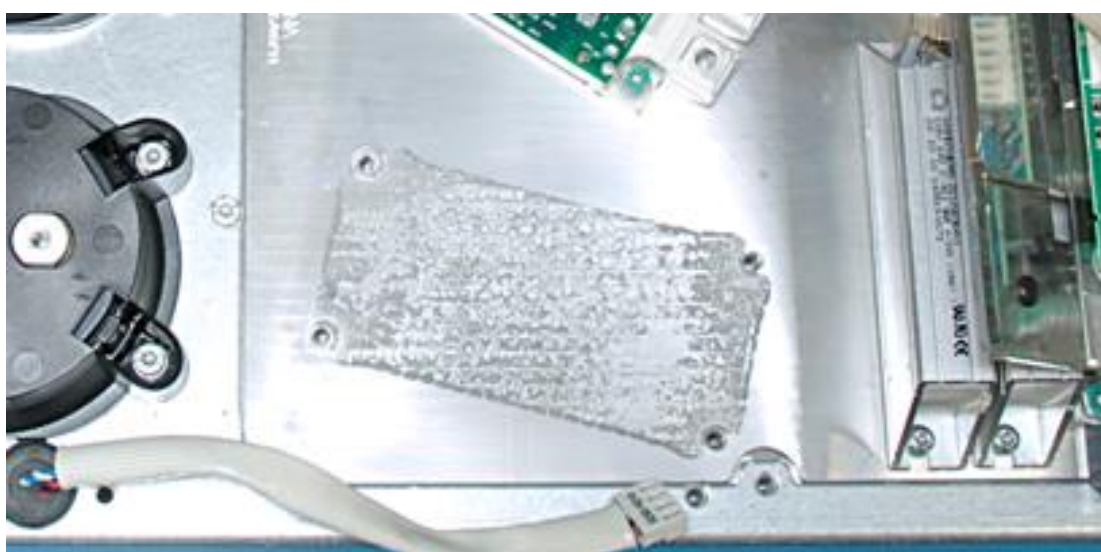
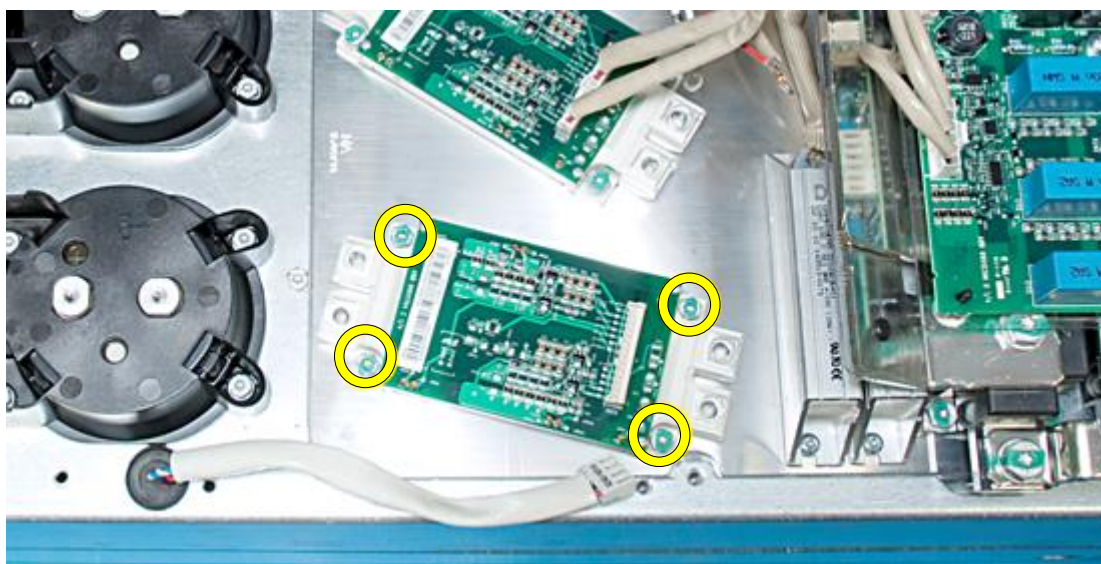
- Remove clamp capacitor **fixing screws**, 6pcs M6x16
- Remove DC capacitor **pole screws**, 12pcs M5x12
- Remove DC busbar **fixing screws** (2pcs K50x16 PT) and 2pcs **screws** (M8x25 and M10x25) on the output terminals



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8. Replace IGBT module


- a. Remove IGBT module **fixing screws**, 4pcs M5x20
- b. Remove IGBT module and clean heat sink with solvent.
- c. Depending on which IGBT kit you have in use, choose **one** of the following steps:
 1. An IGBT kit with thermal compound:
 - i. Add new heat transfer compound on surface of the IGBT module. Note: **Thermal compound type Grey Ice 4100.**
 - ii. Install IGBT module, check the correct tightening torques from section 4 (page 8).
 2. An IGBT kit with thermal graphite sheets:
 - i. See separate **Graphite Installing Instructions manual** delivered with the IGBT kit.



9. Ensure the IGBT condition as described in section 3.5.2.

10. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).


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3.5.8 Frame R6, Input bridge replacement

1. Remove covers and cable gland box

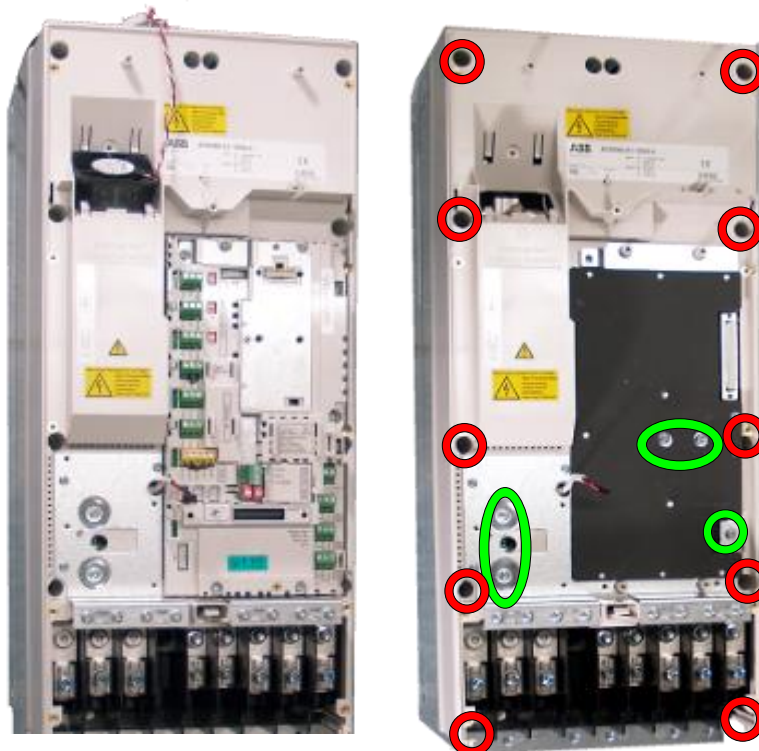
- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



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2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

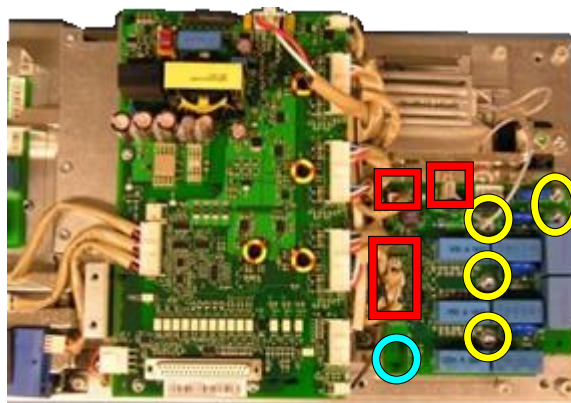


3. Remove middle frame (skeleton)

- a. Remove grounding screws. (5pcs) M4x8
- b. Remove skeleton mounting screws. (10pcs)M5x12

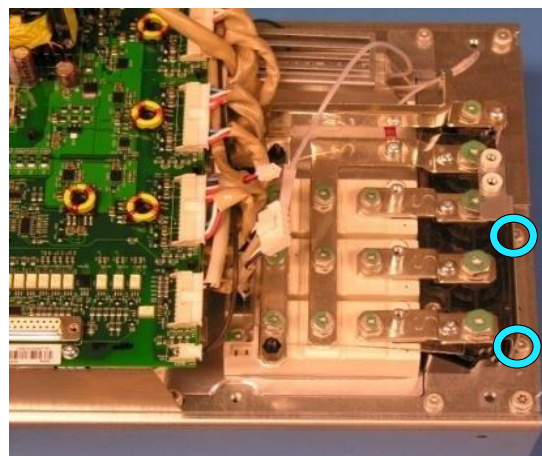
4. Remove ZINP board


- a. Unplug ZINP wiring.
- b. Remove ZINP board mounting screws (5pcs)M4X8 and nut M4
- c. Remove the board.



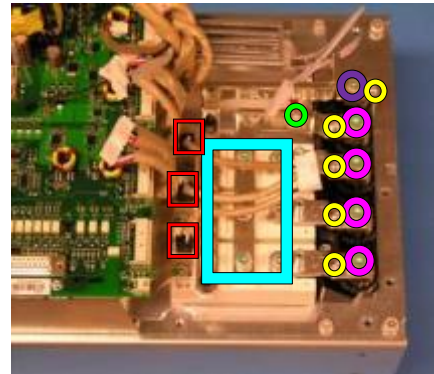
5. Replace input bridge module

- a. Remove Plexiglas mounting screws (2pcs) M5X12.

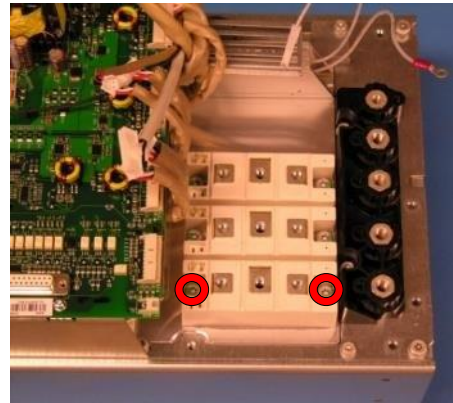


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- b. Remove the gate **wires** and the charging resistor **wire**. (1pcs) M4X12
- c. Remove the input bridge busbar screws (9pcs) **M6X16**, (1pcs) **M6X20** and (4pcs) **M8X20** and busbar mounting **screws** (5pcs) M5X14PT.




- d. Unscrew the input bridge module mounting **screws** (2pcs) M6x20.
- e. Remove input bridge module and clean heat sink with solvent.
- f. Add new heat transfer compound on surface of the input bridge module. Note: **Thermal compound type Grey Ice 4100**.
- g. Install input bridge module, check the correct tightening torques from section 2 (page 6)



6. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

7. Ensure input bridge condition as described in section 3.5.1

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3.5.9 Frame R7, Input bridge replacement


1. Remove covers and cable gland box

- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



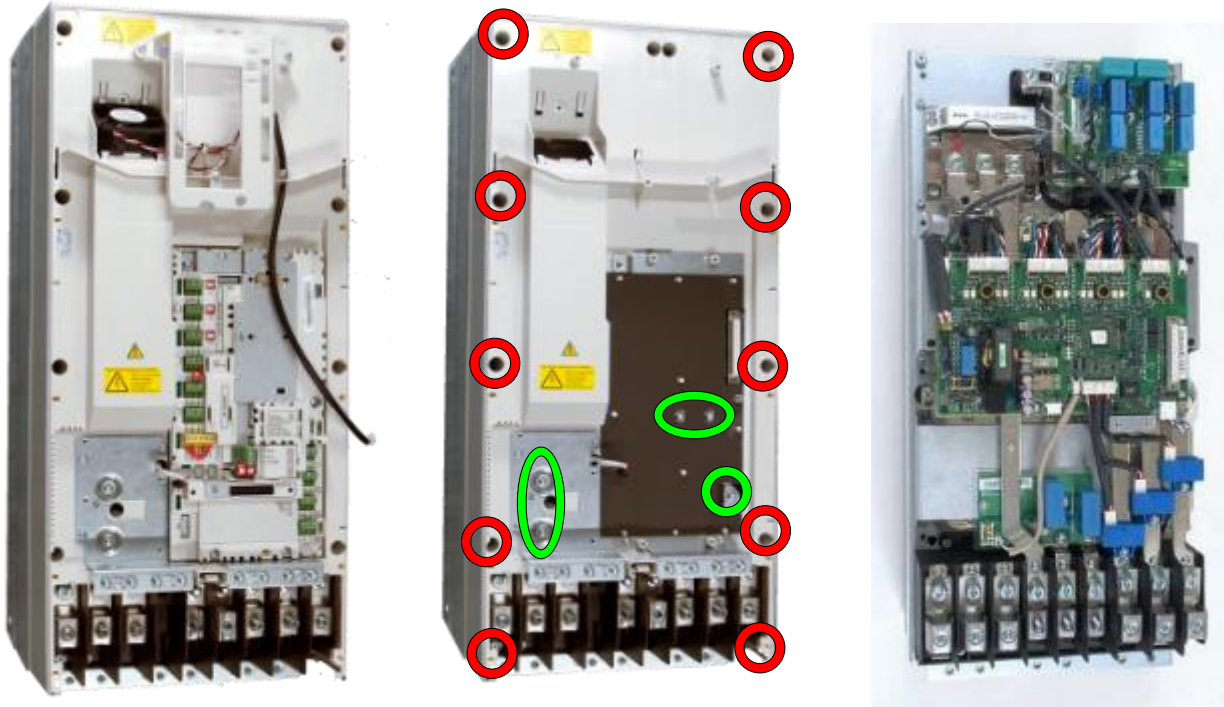
2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

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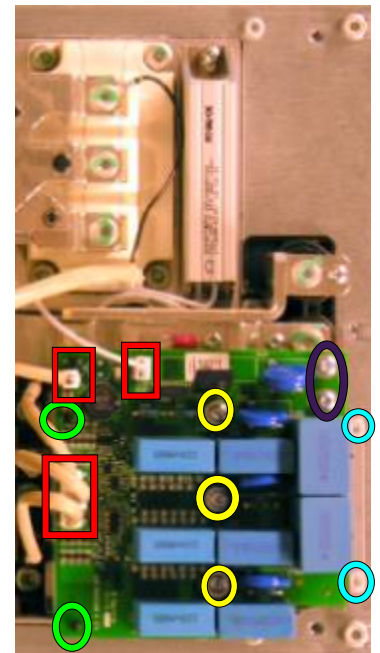
3. Remove middle frame (skeleton)


- a. Remove grounding **screws**. (5pcs) M4x8
- b. Remove skeleton mounting **screws**. (10pcs)M5x12



4. Remove ZINP board

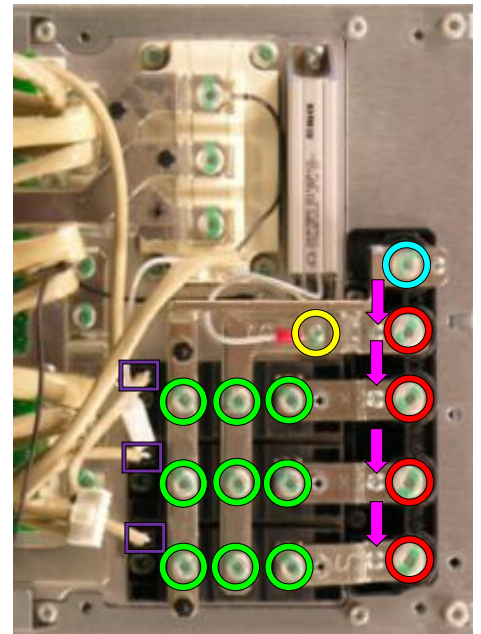
- a. Unplug ZINP **wiring**
- b. Remove ZINP board mounting screws (2pcs)M4x12(if used) and (3pcs) M4X12
- c. Release ZINP board plastic **holders** and replace the board
- d. Remove Plexiglas mounting **screws**, (2pcs)M5x12



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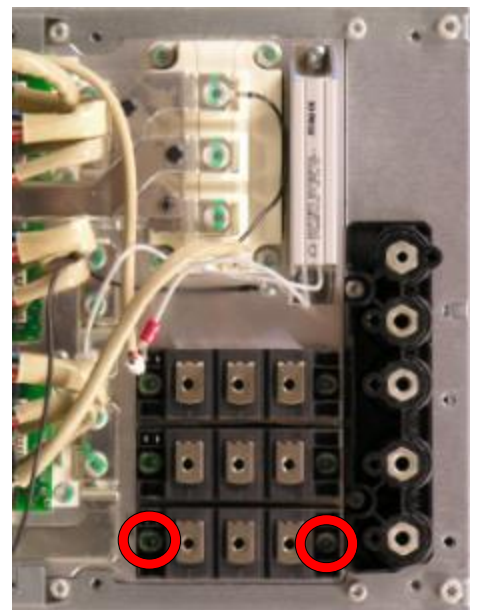
5. Remove input bridge busbars

- a. Remove the input bridge busbar screws (4pcs M8x20), (1pc M6x20)
- b. Unscrew busbar mounting screws (4pcs) 50x14 PT
- c. Remove the charging resistor wire (1pc) M4X12
- d. Remove the semiconductor gate wires.
- e. Unscrew DC busbar screws (9pcs M6x16)



6. Replace input bridge module


- a. Unscrew the input bridge module mounting screws (2pcs) M6x20.
- b. Remove input bridge module and clean heat sink with solvent.
- c. Add new heat transfer compound on surface of the input bridge module. Note: **Thermal compound type Grey Ice 4100.**



7. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

8. Ensure input bridge condition as described in section 3.5.1

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3.5.10 Frame R8, Input bridge replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

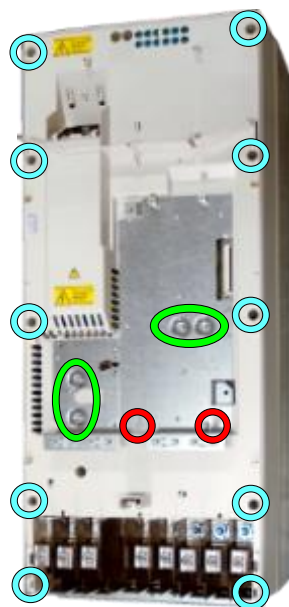
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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Remove middle frame (skeleton)


- a. Isolating plexiglas fixing **screws** (2pcs) K40x16 PT
- b. Grounding **screws** (2-4pcs) M4x12
- c. Skeleton fixing **screws** (8pcs) M5x12 and (2pcs) M5x20



3. Remove ZINP board

- a. Unplug ZINP wiring.
- b. Remove ZINP board mounting screws (2pcs) M4X12 and (3pcs) M4X12
- c. Release ZINP board **plastic holders** and remove the board.



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4. Remove input bridge busbars

- a. Remove the input bridge busbar screws (3pcs) **M6X16**, (3pcs) **M10X25**
- b. Unscrew busbar mounting **screws** (3pcs) K50x16 PT
- c. Remove the charging resistor **wire** (1pc) M4X12
- d. Remove the semiconductor gate **wires**.
- e. Remove the input bridge DC busbar screws (6pcs) **M6X16**, (1pcs) **M10X25**, (1pcs) **M8X20**.
- f. Unscrew busbar mounting **screws** (2pcs) K50x16 PT



5. Replace input bridge module


- a. Unscrew the input bridge module mounting **screws** (2pcs) M6x20.
- b. Remove input bridge module and clean heat sink with solvent.
- c. Add new heat transfer compound on surface of the input bridge module. Note: **Thermal compound type Grey Ice 4100**.



6. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

7. Ensure input bridge condition as described in section 3.5.1

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3.5.11 Frame R9, Input bridge replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

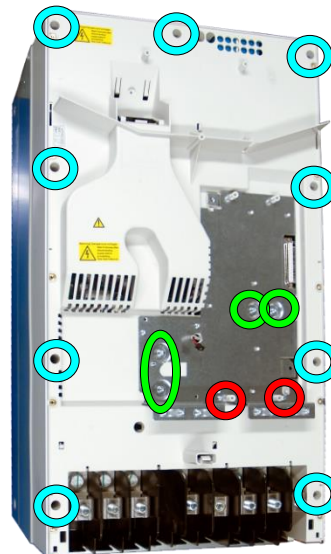
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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3. Remove middle frame (skeleton)

- a. Isolating plexiglas fixing **screws** (2pcs) M4x16 PT
- b. Grounding **screws** (4pcs) M4x12
- c. Skeleton fixing **screws** (9pcs) M5x12



4. Remove ZINP board


- a. Unplug ZINP wiring.
- b. Remove ZINP board mounting screws. (2pcs) M4x12 and (3pcs) M4x12
- c. Release ZINP board **plastic holders** and remove the board.



5. Remove input bridge busbars

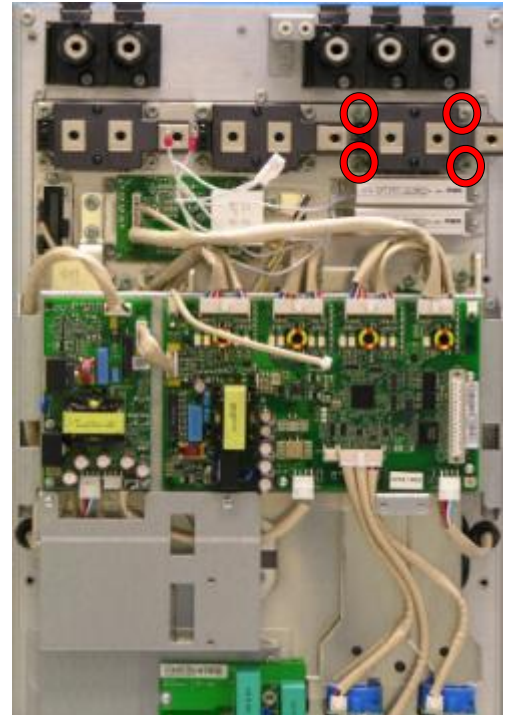
- a. Remove the charging resistor **wires** (1pc) M4X12
- b. Remove the semiconductor gate **wires**.
- c. Remove the input bridge DC busbar screws (10pcs) M8X20, (4pcs) M10X25
- d. Unscrew busbar mounting **screws** (5pcs) K50x16 PT



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6. Replace input bridge module


- a. Unscrew the input bridge module mounting **screws** (4pcs) M6x20.
- b. Remove input bridge module and clean heat sink with solvent.
- c. Add new heat transfer compound on surface of the input bridge module. Note: **Thermal compound type Grey Ice 4100.**



7. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

8. Ensure input bridge condition as described in section 3.5.1

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3.6 Replacement of charging and discharging resistors

3.6.1 Frame R6, Charging resistor replacement

1. Remove covers and cable gland box

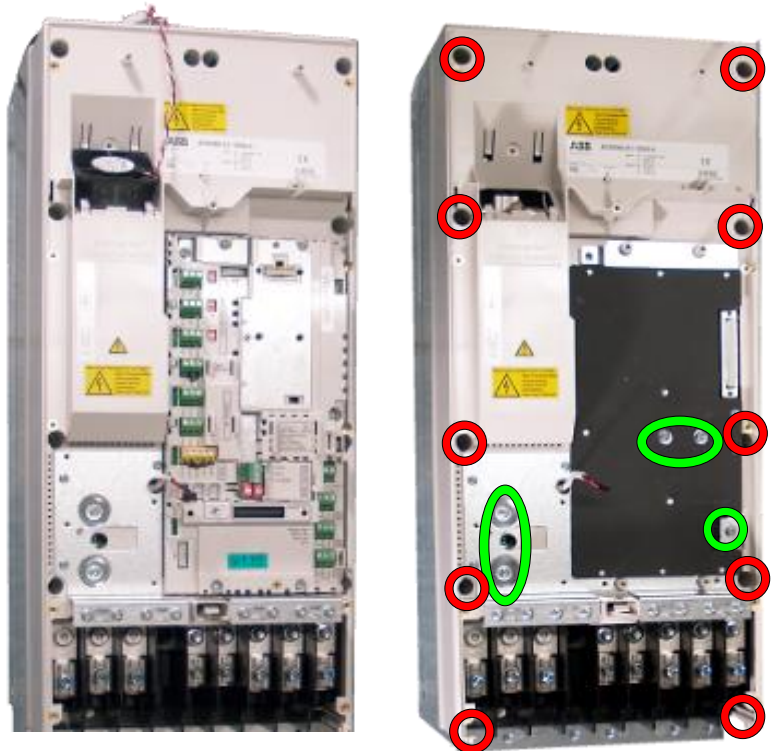
- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



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2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

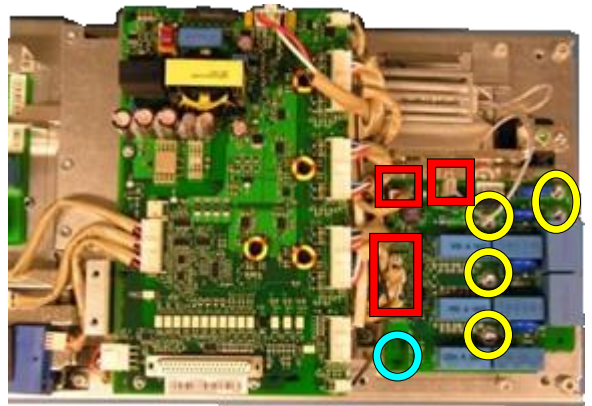


3. Remove middle frame (skeleton)

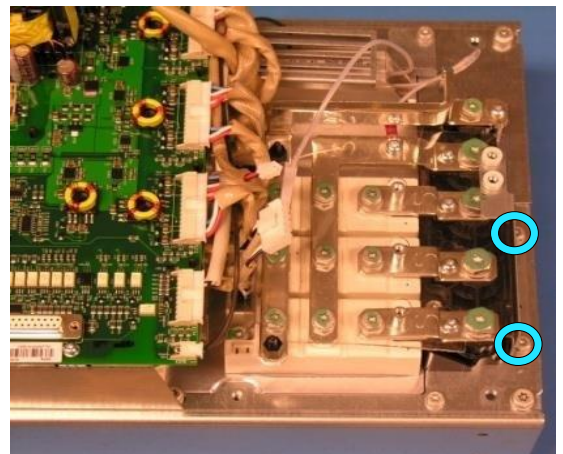
- a. Remove grounding **screws**. (5pcs) M4x8
- b. Remove skeleton mounting **screws**. (10pcs)M5x12


4. Remove ZINP board

- a. Unplug ZINP **wiring**.
- b. Remove ZINP board mounting **screws** (5pcs)M4X8 and **nut** M4
- c. Remove the board.



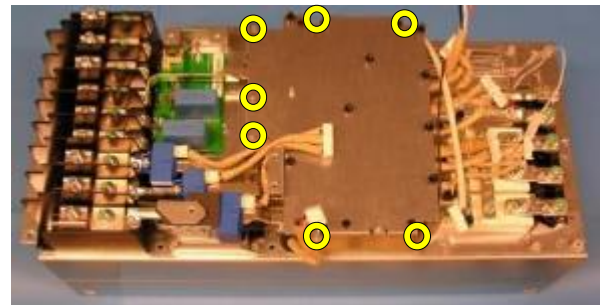
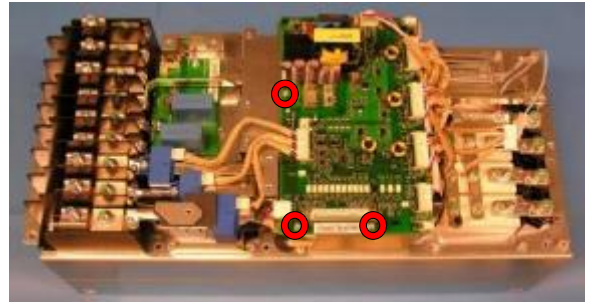
- d. Remove Plexiglas mounting **screws**.(2pcs)M5X12



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5. Remove ZINT board and assembly plate

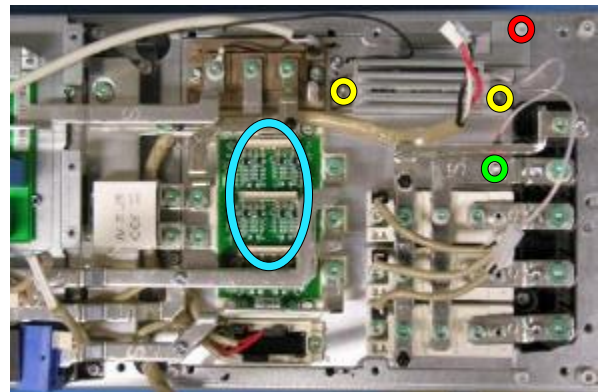
- a. Unplug ZINT wiring.
- b. Remove ZINT board mounting **screws**. (3pcs) M3x6
- c. Release ZINT board plastic holders.
- d. Remove assembly plate mounting **screws**. (3pcs of M4x8 and 4pcs of M5x12)



6. Replace charging resistor


- a. Remove charging resistor cover plate **screw** (1pcs) M5x12
- b. Remove the charging resistor **wire** (1pcs) M4X12
- c. Remove charging resistor mounting **screws** (2pcs) M4X12
Charging resistor value is 36Ω,28W

Note! **ZGAD Gate adapter** wires have been removed for better illustration.



7. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.6.2 Frame R7, Charging resistor replacement


1. Remove covers and cable gland box

- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



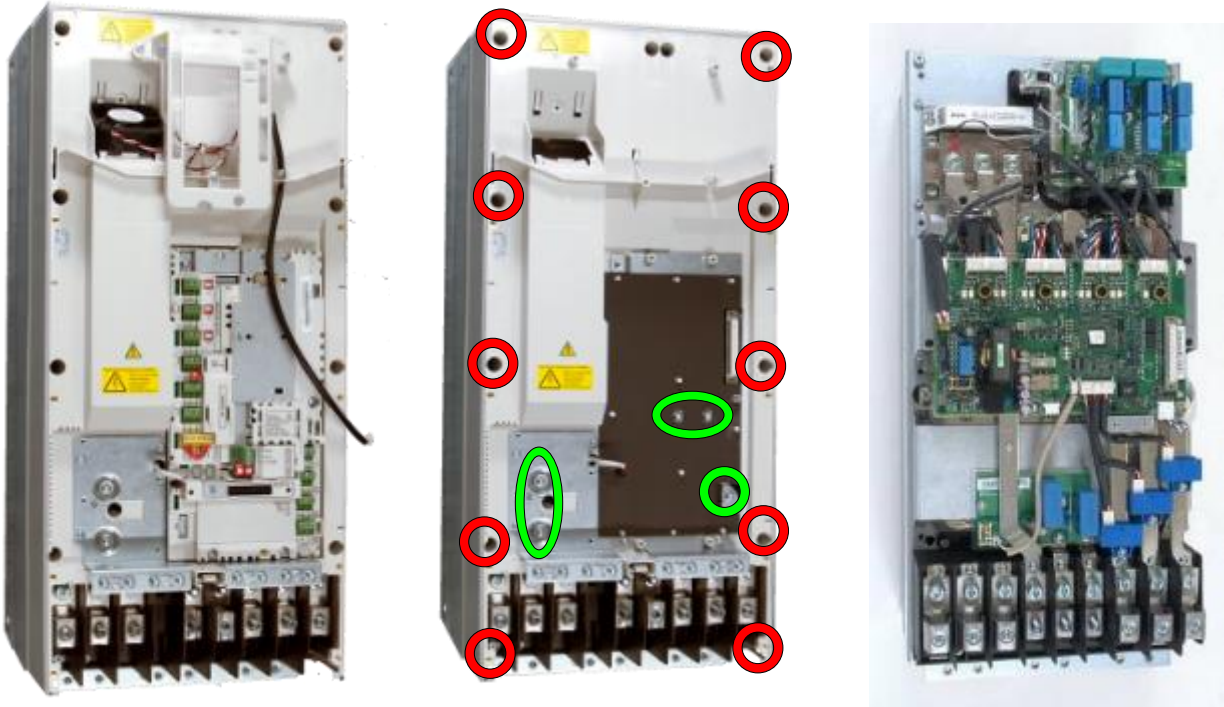
2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

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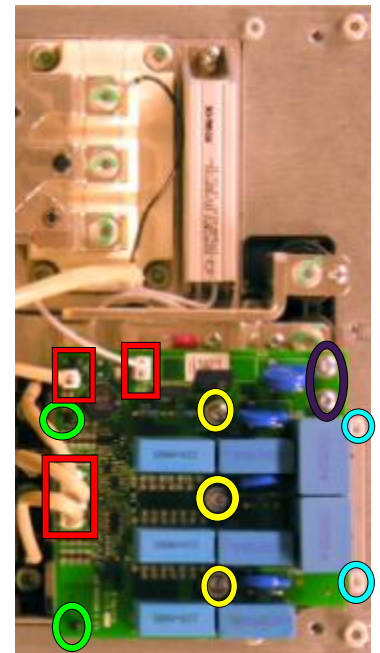
3. Remove middle frame (skeleton)


- a. Remove grounding **screws**. (5pcs) M4x8
- b. Remove skeleton mounting **screws**. (10pcs)M5x12



6. Remove ZINP board

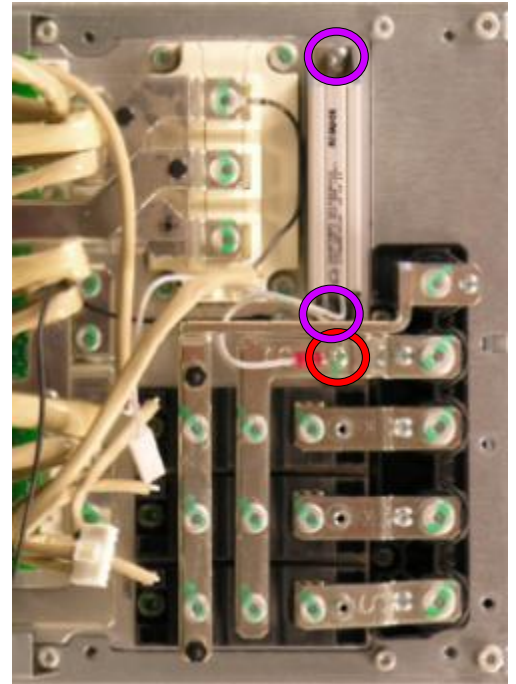
- a. Unplug ZINP **wiring**
- b. Remove ZINP board mounting screws (3pcs) **M4X12** and (2pcs)**M4x12**(if used)
- c. Release ZINP board plastic **holders** and replace the board
- d. Remove Plexiglas mounting screws, (2pcs)**M5x12**



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7. Replace Charging Resistor

- Remove the charging resistor wire (1pcs) **M4X12**
- Remove charging resistor mounting **screws** (2pcs) M4X12



8. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.6.3 Frame R8, Charging resistor replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

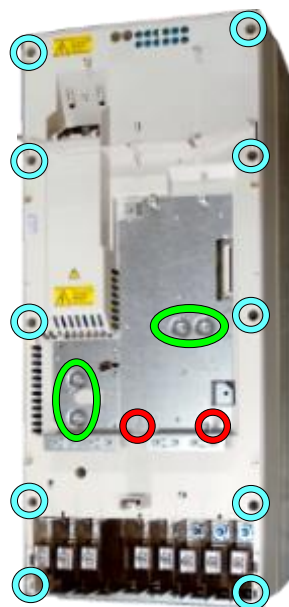
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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3. Remove middle frame (skeleton)

- a. Isolating plexiglas fixing **screws** (2pcs) K40x16 PT
- b. Grounding **screws** (2-4pcs) M4x12
- c. Skeleton fixing **screws** (8pcs) M5x12 and (2pcs) M5x20



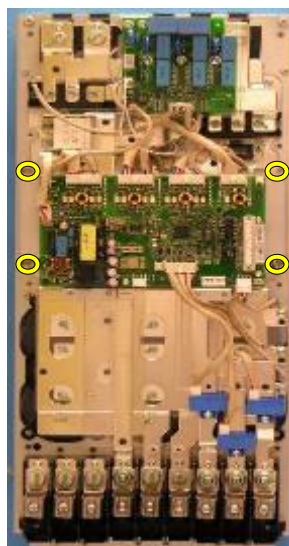
4. Remove ZFC-board and assembly plate (if used)

- a. Remove the ZFC2 mounting **screws** (4pcs) M4x8
- b. Remove assembly plate mounting **screws** (2pcs) M4x12 and (2pcs) M5x12



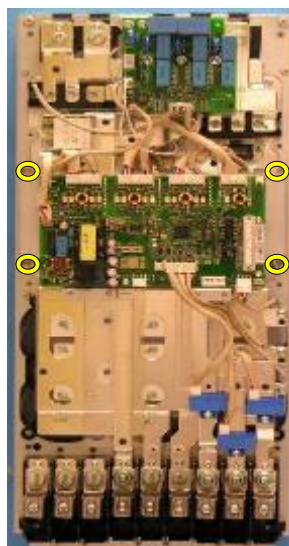
5. Remove ZINT assembly plate


- a. Unplug ZINT wirings.
- b. Remove ZINT assembly plate fixing **screws** (4pcs) M5x12



6. Remove ZINP board

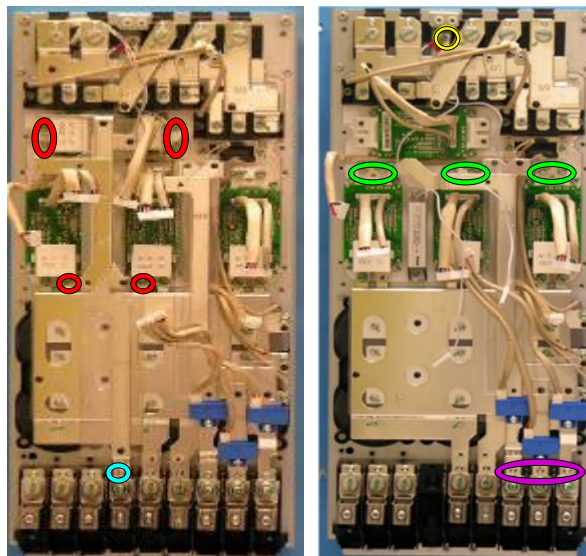
- a. Unplug ZINP wiring.
- b. Remove ZINP board mounting screws. (2pcs) M4x12 and (3pcs) M4x12
- c. Release ZINP board **plastic holders** and remove the board.



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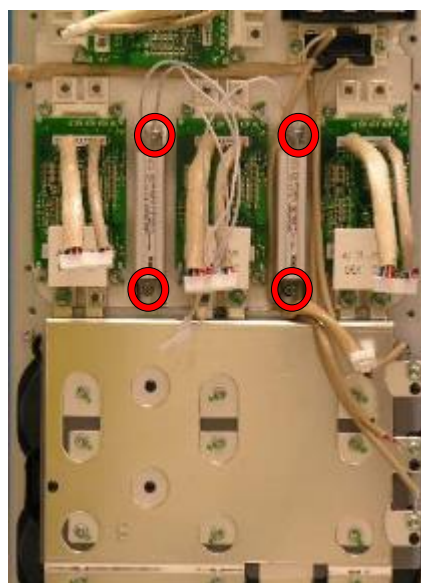
7. Remove output busbars

- a. Remove the DC link and DC output **screws**. (6pcs) M6x16
- b. Remove the brake IGBT output busbar mounting **screw**. (1pc) K50X16 PT
- c. Remove the charging resistor **wire** (1pc) M5X12
- d. Remove the output busbars **screws**. (6pcs) M6x16
- e. Remove the output busbar mounting **screws**. (3pcs) K50X16 PT




8. Replace charging resistor

- Unscrew the charging resistor mounting **screws** (4pcs)M4X12



9. Install components in reverse order

- Check the correct tightening torques from section 2 (page 6).

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3.6.4 Frame R9, Charging resistor replacement

1. Remove covers and cable gland box


- a. Remove control panel
- b. Open two mounting **screws**
- c. First lift off top cover and then release four clips to remove bottom cover
- d. Remove the cable gland box by opening the mounting **screws** (3pcs)M6x12



2. Remove CCU

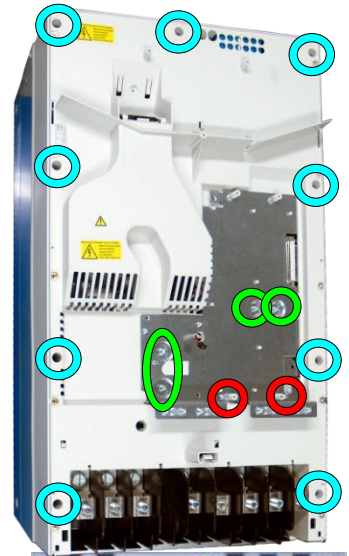
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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3. Remove middle frame (skeleton)

- Isolating plexiglas fixing **screws** (2pcs) M4x16 PT
- Grounding **screws** (4pcs) M4x12
- Skeleton fixing **screws** (9pcs) M5x12



4. Remove ZINP board


- Unplug ZINP wiring.
- Remove ZINP board mounting screws. (2pcs) M4X12 and (3pcs) M4X12
- Release ZINP board **plastic holders** and remove the board.



5. Remove input bridge busbars

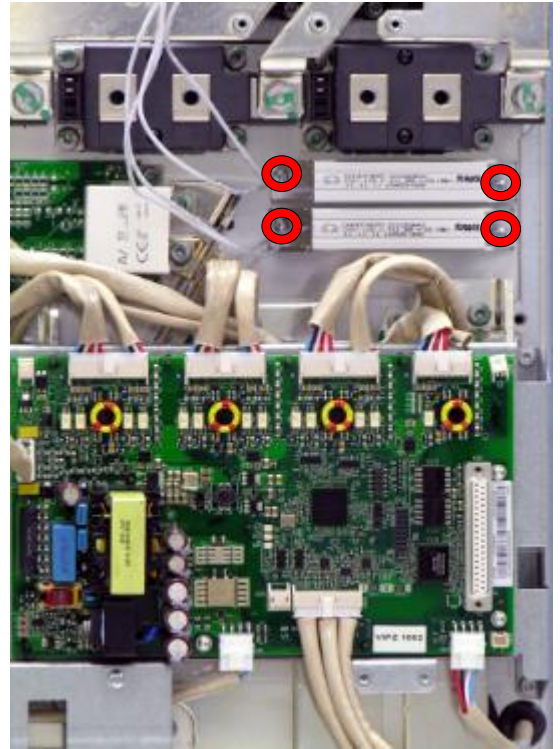
- Remove the charging resistor **wires** (1pc) M4X12
- Remove the semiconductor gate **wires**.
- Remove the input bridge DC busbar screws (10pcs) M8X20, (4pcs) M10X25
- Unscrew busbar mounting **screws** (5pcs) K50x16 PT



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6. Replace charging resistor

Unscrew the charging resistor mounting screws (4pcs)M4X12



7. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).


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3.6.5 Frame R6, Discharging resistor replacement

1. Remove covers and cable gland box

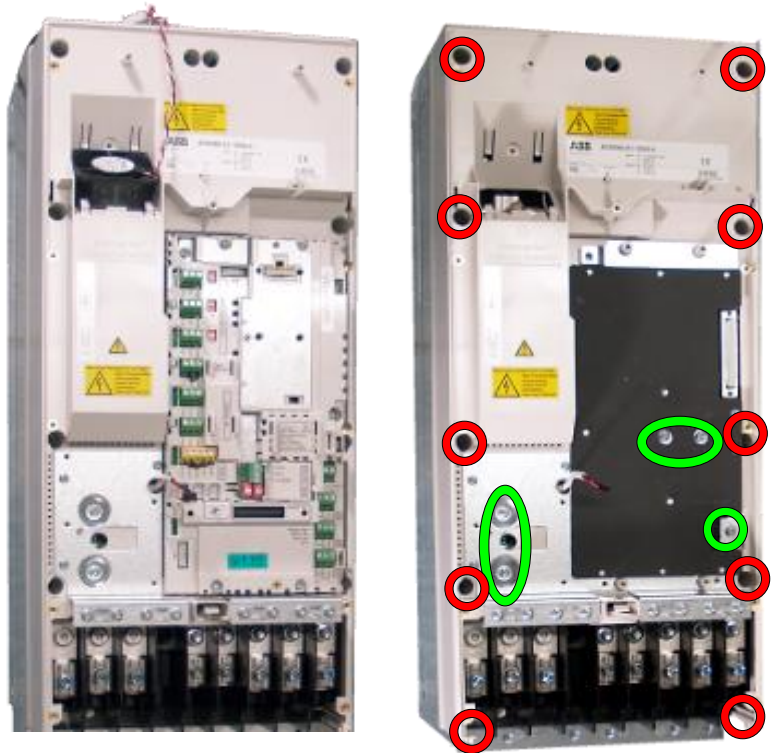
- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



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2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

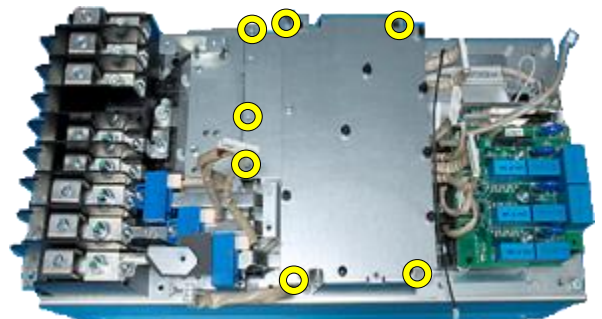
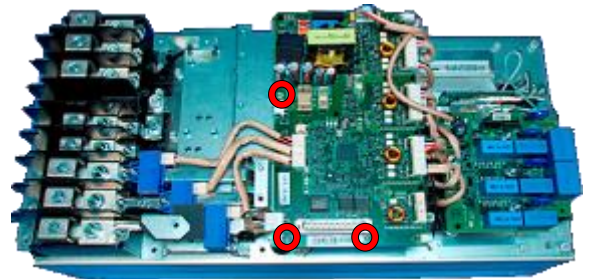



3. Remove middle frame (skeleton)

- a. Remove grounding **screws**. (5pcs) M4x8
- b. Remove skeleton mounting **screws**. (10pcs)M5x12

4. Remove ZINT board and assembly plate

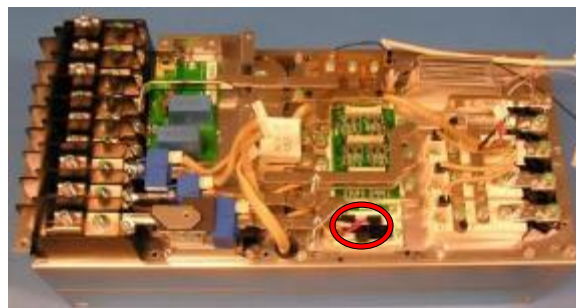
- a. Unplug ZINT wiring.
- b. Remove ZINT board mounting **screws**. (3pcs) M3x6
- c. Release ZINT board plastic holders.
- d. Remove assembly plate mounting **screws** (3pcs of M4x8 and 4pcs of M5x12)



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5. Replace discharging resistor

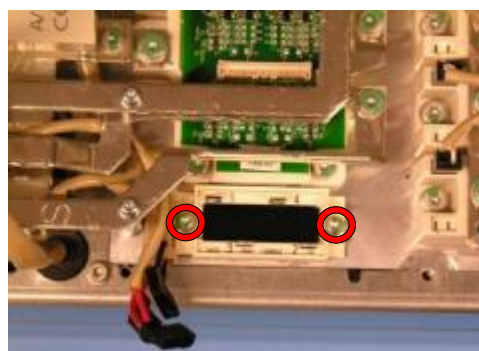
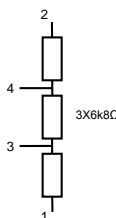
- a. Disconnect the discharging resistor **wires**.



- b. Remove the discharging resistor mounting **screws** (2pcs) M4X12 and clean heat sink with solvent.

Discharging resistor consists of 3 times 6K8Ω resistors in series.


- c. Add new heat transfer compound on surface of a discharging resistor. Note: **Thermal compound type Grey Ice 4100**.



- d. Install discharging resistor, check the correct tightening torques from section 2 (page 6).
- e. Connect discharging resistor wires:
 Red → 4
 White → 3
 Black → 1

6. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.6.6 Frame R7, Discharging resistor replacement


1. Remove covers and cable gland box

- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



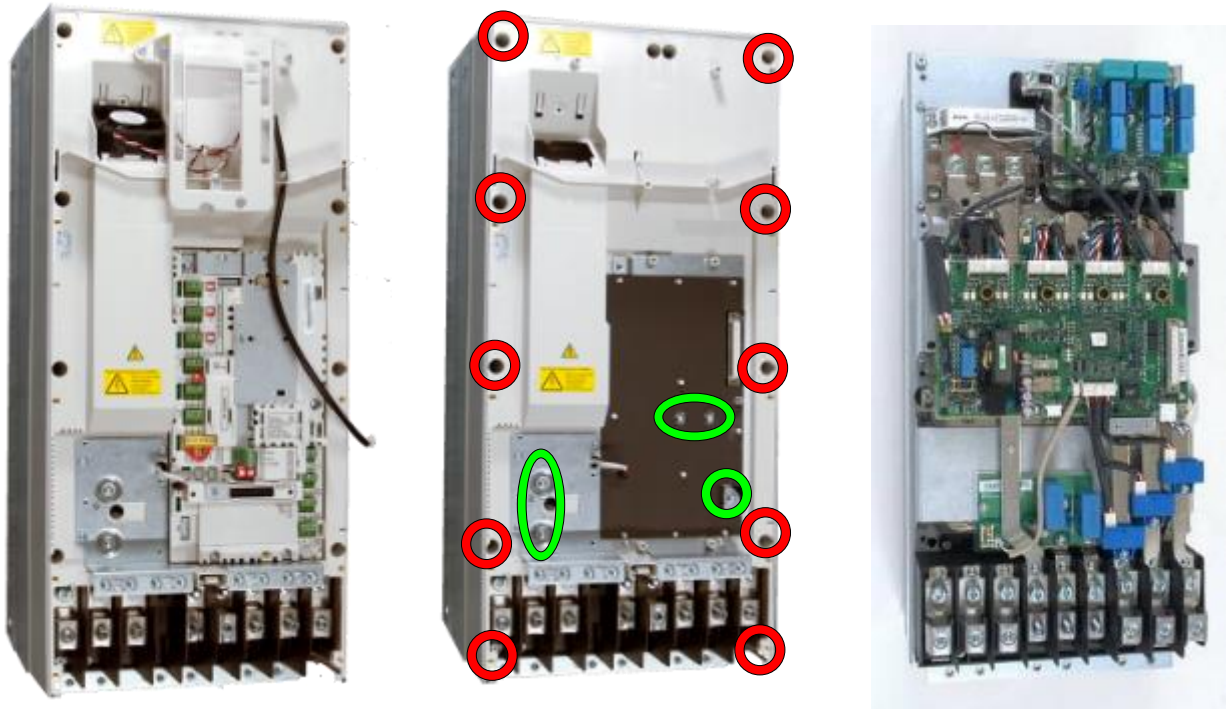
2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

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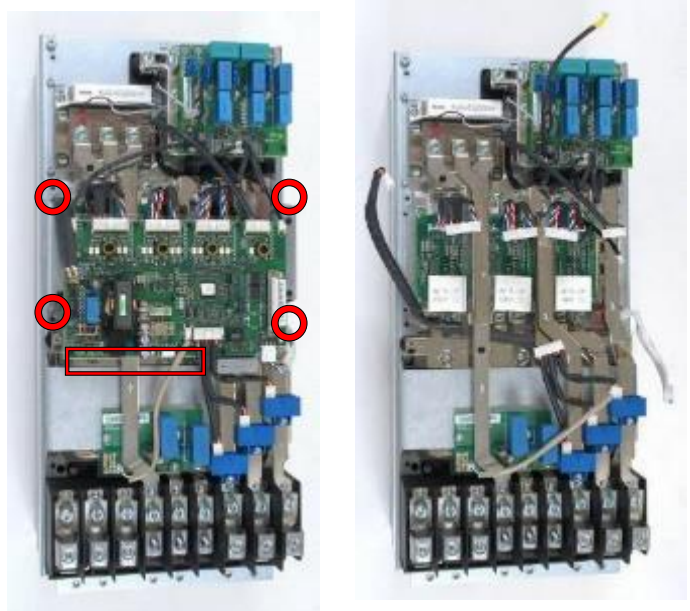
3. Remove middle frame (skeleton)


- a. Remove grounding **screws**. (5pcs) M4x8
- b. Remove skeleton mounting **screws**. (10pcs)M5x12



4. Remove ZINT board

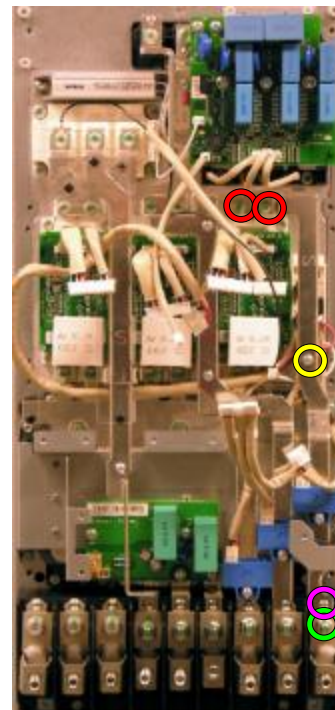
- a. Unplug ZINT wiring
- b. Remove ZINT frame fixing **screws** (4pcs) M5x12 and (4pcs) M4x12



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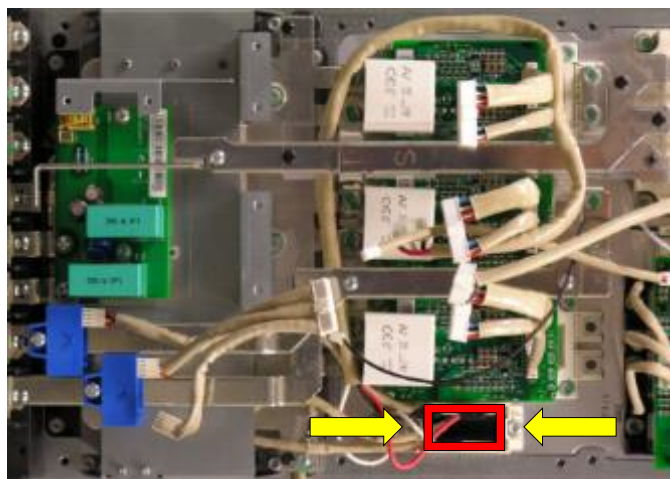
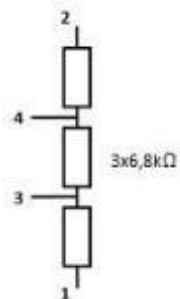
5. Remove output busbar

- Loosen output busbars nuts (1pc) M8
- Remove the output busbars screws. (2pcs) M6x16
- Remove the output busbar mounting screws. (1pc k50X16 PT, 1pc M4x8)



6. Replace the Discharging resistor

- Disconnect the discharging resistor wires
- Remove the discharging resistor mounting screws (2pcs) M4X12 and clean the heat sink with solvent.




Discharging resistor consists of three 6,8 kΩ resistors in series

- Add new heat transfer compound on surface of a discharging resistor. Note: Thermal compound type Grey Ice 4100.
- Install discharging resistor, check the correct tightening torques from section 2 (page 6)
- Connect discharging resistor wires:
 - Red → 3
 - White → 4
 - Black → 2

7. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.6.7 Frame R8, Discharging resistor replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

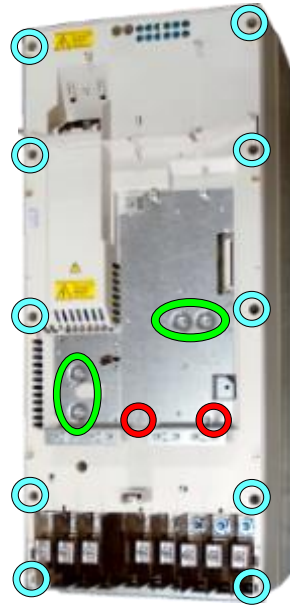
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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3. Remove middle frame (skeleton)

- a. Isolating plexiglas fixing **screws** (2pcs) K40x16 PT
- b. Grounding **screws** (2-4pcs) M4x12
- c. Skeleton fixing **screws** (8pcs) M5x12 and (2pcs) M5x20

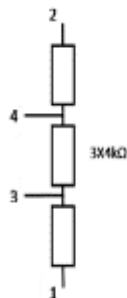


4. Remove the discharging resistor

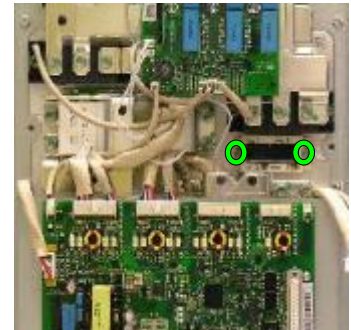
- a. Unplug ZINT **wirings**.




- b. Disconnect the discharging resistor **wires**.
- c. Remove the discharging resistor mounting **screws** (2pcs) M4x12 and clean the heat sink with solvent.



Discharging resistor consists of 3 times 4kΩ resistors in series.




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- d. Add new heat transfer compound on surface of a discharging resistor. **Note: Thermal compound type Grey Ice 4100.**
- e. Install discharging resistor check the correct tightening torques from section 2 (page 6).
- f. Connect discharging resistor wires:
 - Red → 3
 - White → 4
 - Black → 2

5. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.6.8 Frame R9, Discharging resistor replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

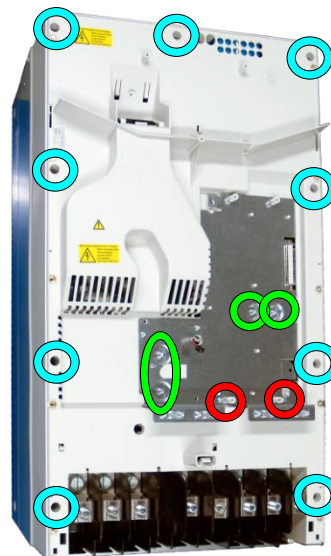
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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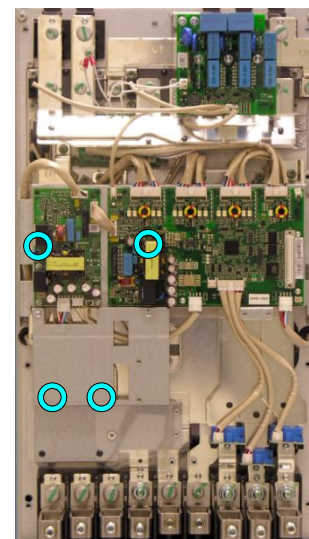
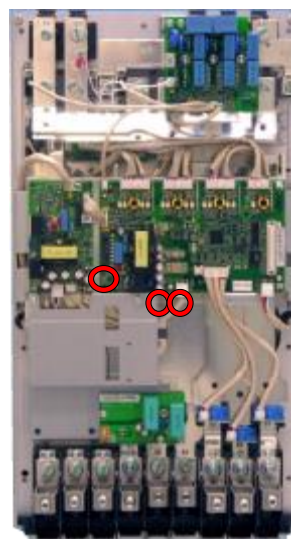
3. Remove middle frame (skeleton)

- a. Isolating plexiglas fixing **screws** (2pcs) M4x16 PT
- b. Grounding **screws** (4pcs) M4x12
- c. Skeleton fixing **screws** (9pcs) M5x12



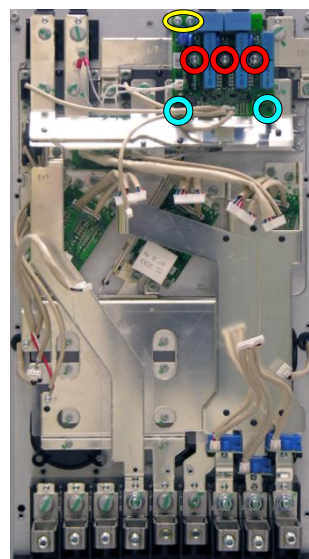
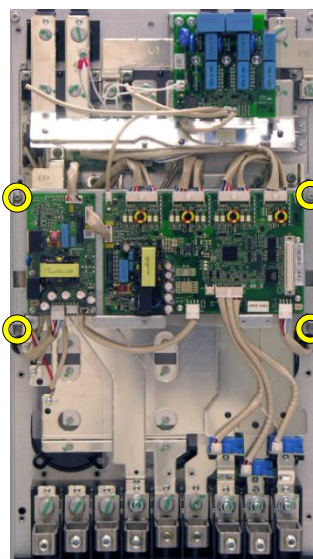
4. Remove ZFC-board and assembly plate (if used)

- a. Remove the ZFC2 mounting **screws** (3pcs) M4x12
- b. Remove assembly plate mounting **screws** (2pcs) M4x12 and (2pcs) M5x12




5. Remove ZINT and ZPOW assembly plate

- a. Unplug ZINT and ZPOW wirings
- b. Remove ZINT assembly plate fixing **screws** (4pcs) M5x12



6. Remove ZINP board

- a. Unplug ZINP wiring.
- b. Remove ZINP board mounting screws (2pcs) M4x12 and (3pcs) M4x12
- c. Release ZINP board **plastic holders** and remove the board.

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7. Remove input bridge DC busbars


- a. Remove the charging resistor **wire** (1pc) M4X12
- b. Remove the semiconductor gate **wires**.
- c. Remove the input bridge DC busbar screws **(7pcs) M8X20, (1pcs) M10X25**
- d. Unscrew busbar mounting screws (2pcs) 5x16 PT



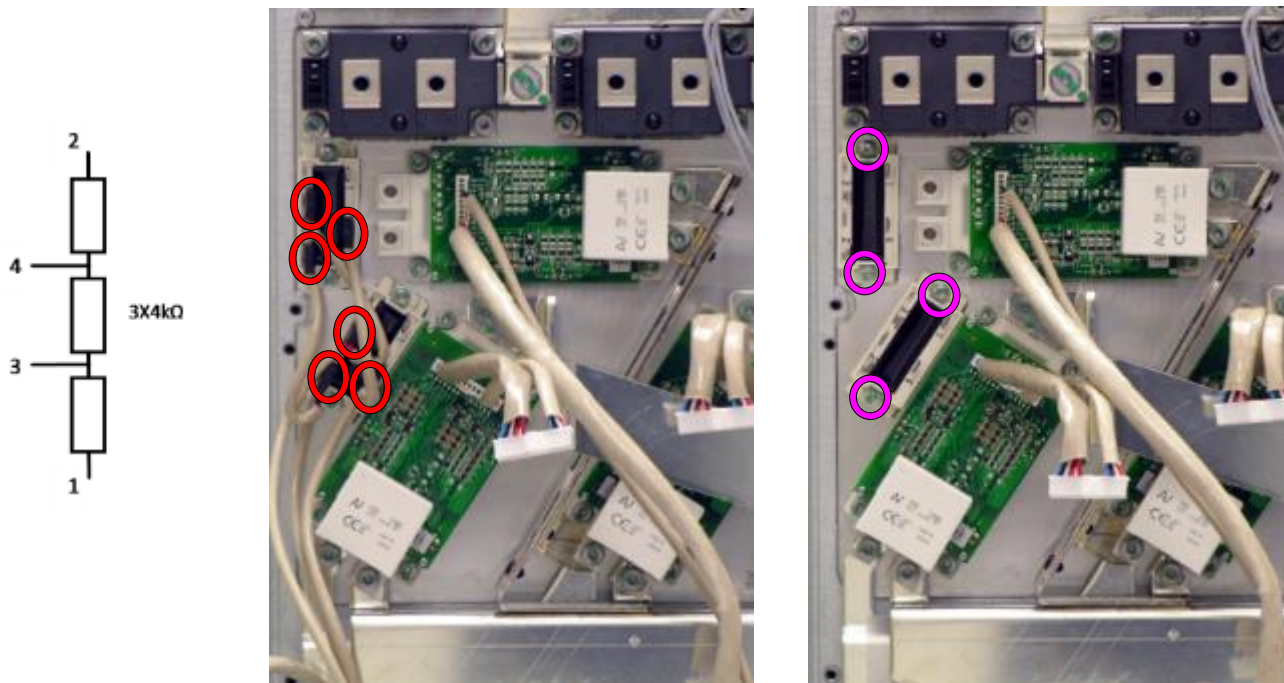
8. Replace discharging resistors

- a. Remove the brake IGBT output busbar **screws**. (2pcs) M6x16
- b. Remove the brake IGBT output busbar mounting **screw**. (1pcs)M5X16PT



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- c. Disconnect the discharging resistor **wires**.
- d. Remove the discharging resistor mounting **screws** (2pcs) M4X12 and clean the heat sink with solvent.




Discharging resistor consists of 3 times 4KΩ resistors in series.

- e. Add new heat transfer compound on surface of a discharging resistor. **Note: Thermal compound type Grey Ice 4100.**
- f. Install discharging resistor, check the correct tightening torques from section 2 (page 6).
- g. Connect discharging resistor wires:
 - Red → 3
 - White → 4
 - Black → 2

9. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.7 Replacement of current transducers

3.7.1 Frame R6, Current transducer replacement

1. Remove covers and cable gland box

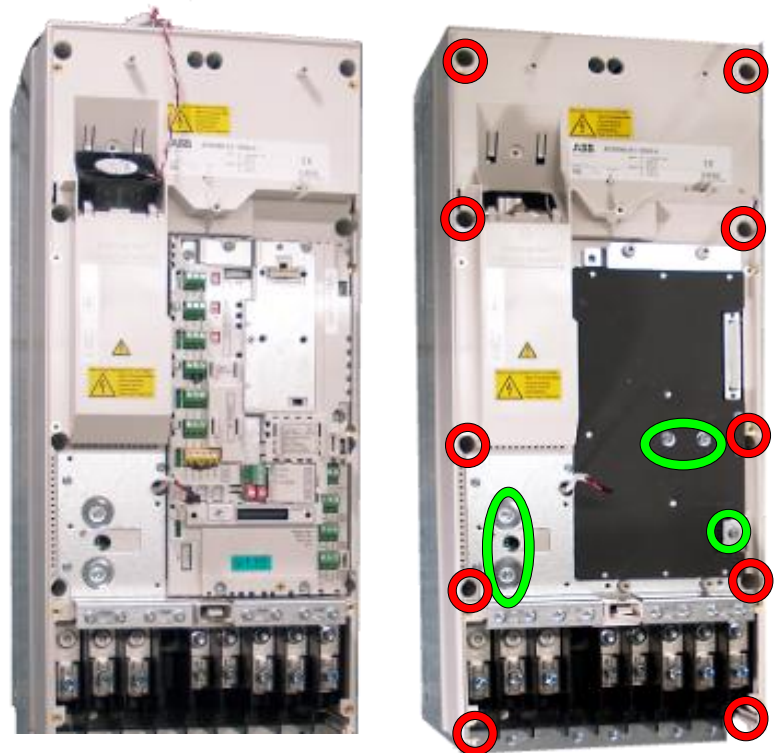
- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



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2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

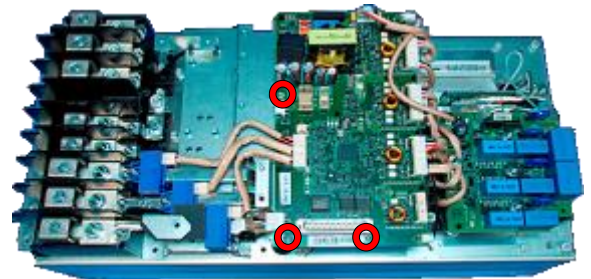


3. Remove middle frame (skeleton)

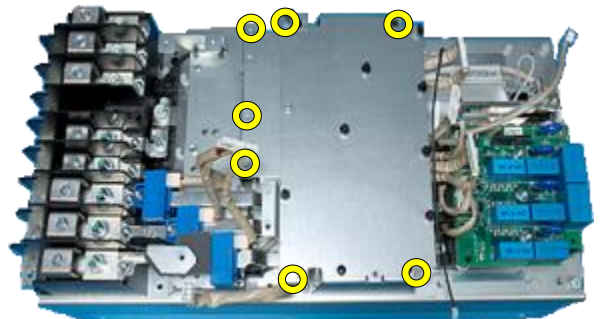
- a. Remove grounding **screws**. (5pcs) M4x8
- b. Remove skeleton mounting **screws**. (10pcs)M5x12


4. Remove ZINT board and assembly plate

- a. Unplug ZINT wiring.
- b. Remove ZINT board mounting **screws**. (3pcs) M3x6
- c. Release ZINT board plastic holders.



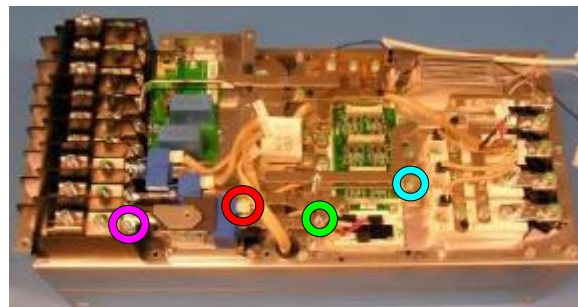
- d. Remove assembly plate mounting **screws** (3pcs of M4x8 and 4pcs of M5x12).



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Remove output busbars and replace current transducers

- a. Unplug the current transducer **wires**.
- b. Unscrew output busbar screws and remove the busbar (1pcs) **M6X12**, (1pcs) **M4X8**, (1pcs) **50X14** PT



- c. Undo the output busbar nut and remove the output cable terminal (1pcs) **M8X25**




- d. Unscrew the transducer mounting **screw** and remove the transducer (1pcs) M4x16



5. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.7.2 Frame R7, Current transducer replacement


1. Remove covers and cable gland box

- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



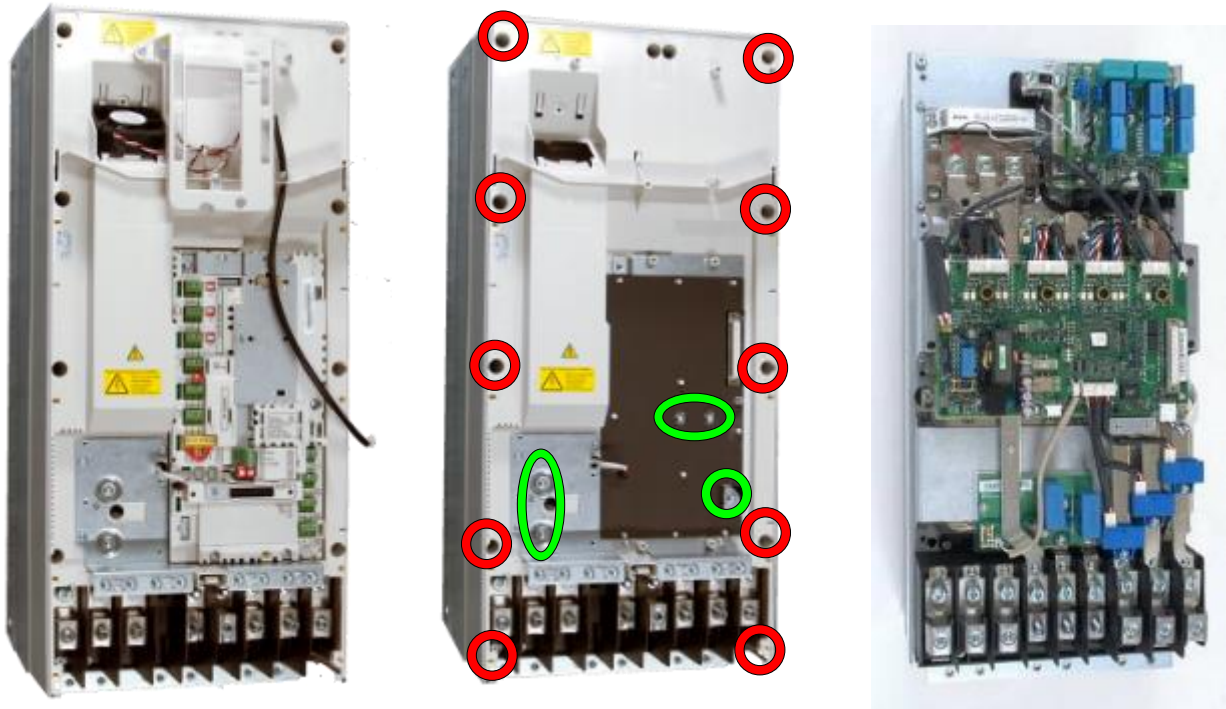
2. Remove CCU

- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).

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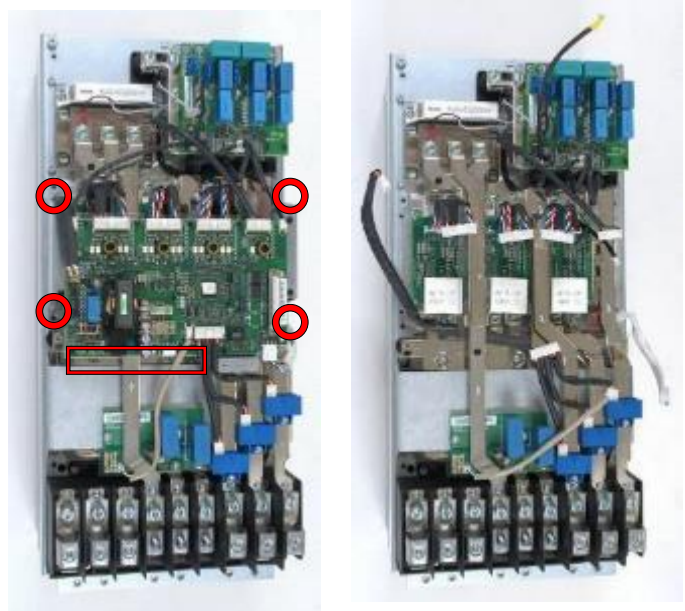
3. Remove middle frame (skeleton)


- a. Remove grounding **screws**. (5pcs) M4x8
- b. Remove skeleton mounting **screws**. (10pcs)M5x12



4. Remove ZINT board

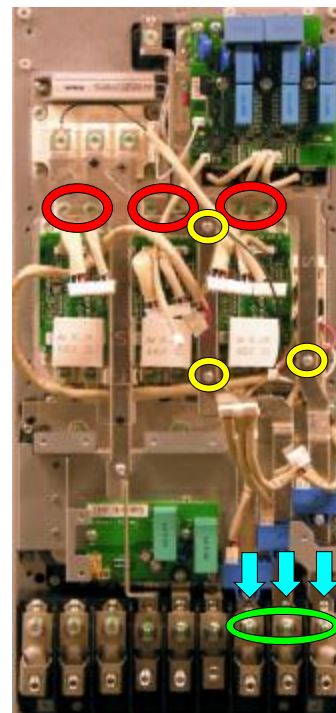
- a. Unplug ZINT wiring
- b. Remove ZINT frame fixing **screws** (4pcs) M5x12 and (4pcs) M4x12



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5. Remove output busbars

- a. Loosen output busbars **nuts**. (3pcs) M8
- b. Remove the output busbar mounting **screws**. (3pcs) M4x8
- c. Remove the output busbar mounting **screws**. (3pcs) k50X16 PT
- d. Remove the DC link and DC output **screws**. (6pcs) M6x16




6. Replace Current transducers

- a. Undo the output busbar nut and remove the output cable terminal (1pc) **M8X25**
- b. Unscrew the current transducer mounting screw(1pc) **M4x20**
- c. Replace the Current transducer

7. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).



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3.7.3 Frame R8, Current transducer replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

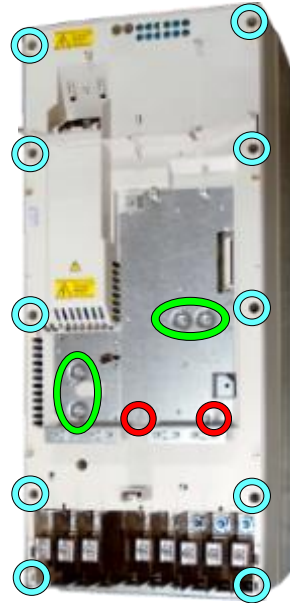
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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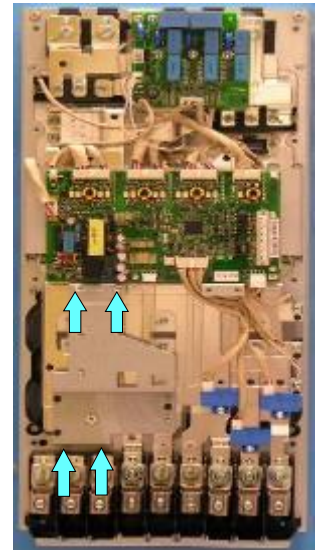
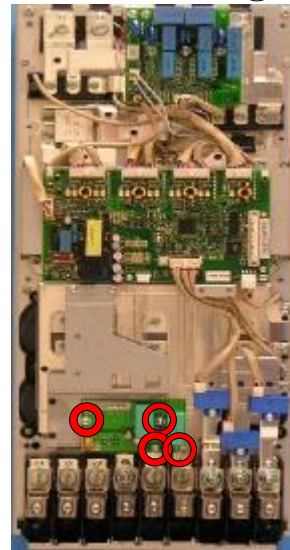
3. Remove middle frame (skeleton)

- a. Isolating plexiglas fixing **screws** (2pcs) K40x16 PT
- b. Grounding **screws** (2-4pcs) M4x12
- c. Skeleton fixing **screws** (8pcs) M5x12 and (2pcs) M5x20



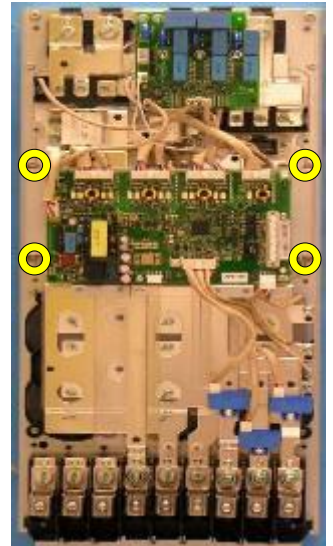
4. Remove ZFC-board and assembly plate (if used)


- a. Remove the ZFC2 mounting **screws** (4pcs) M4X8
- b. Remove assembly plate mounting **screws** (2pcs) M4x12 and (2pcs) M5X12



5. Remove ZINT assembly plate

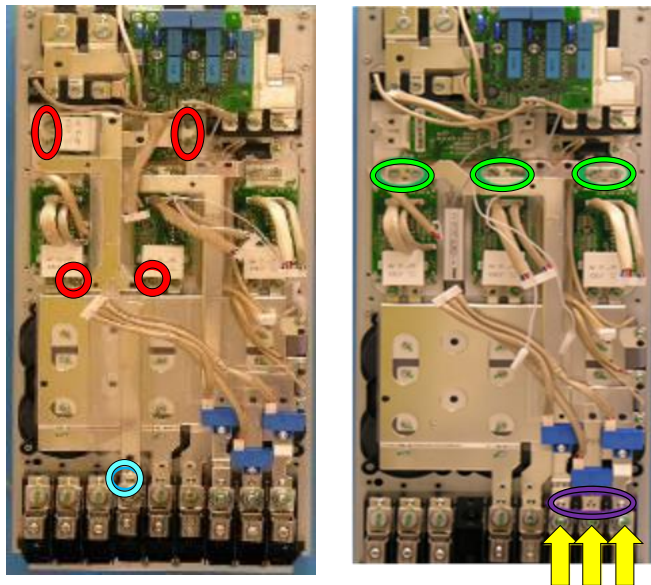
- a. Unplug ZINT wirings.
- b. Remove ZINT assembly plate fixing **screws** (4pcs) M5x12



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6. Remove output busbars

- a. Remove the DC link and DC output **screws**. (6pcs) M6x16
- b. Remove the brake IGBT output busbar mounting **screw**. (1pc) K50X16 PT




7. Remove output busbars and replace current transducers

- a. Loosen output busbars **nuts** (3pcs) M10
- b. Remove the output busbars **screws**. (6pcs) M6x16
- c. Remove the output busbar mounting **screws**. (3pcs) K50X16 PT
- d. Unbolt the output busbar cable **terminals**. (3pcs) M10
- e. Unscrew the CT's mounting **screws**. (3pcs) M4x20



8. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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3.7.4 Frame R9, Current transducer replacement

1. Remove covers and cable gland box


- a. Remove the control panel
- b. Open two mounting **screws**.
- c. First lift off top cover and then release four clips to remove bottom cover.
- d. Remove the cable gland box by opening the mounting **screws**. (3pcs)M6x12



2. Remove CCU

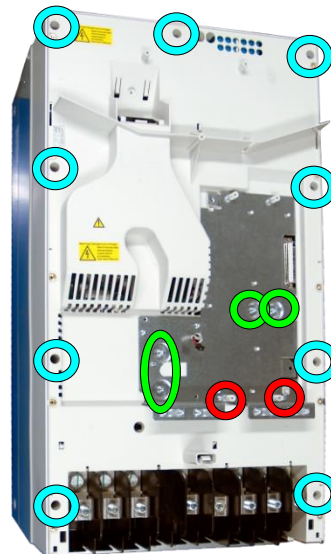
- a. Remove CCU (see instructions in section 3.3.3 *Control unit replacement (CCU)*, page 12).



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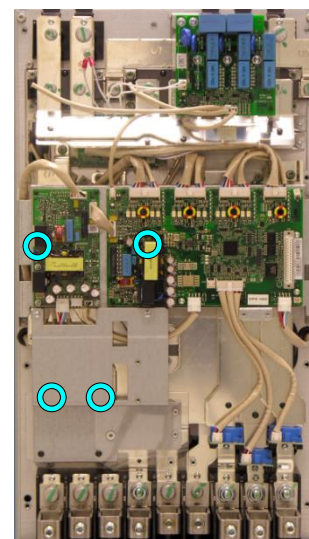
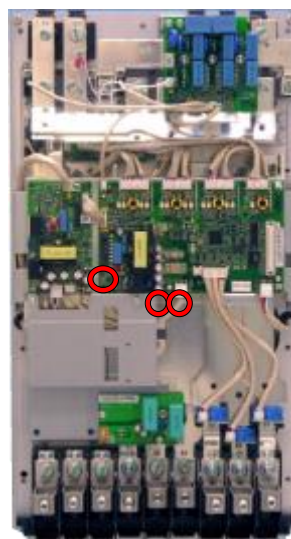
3. Remove middle frame (skeleton)

- a. Isolating plexiglas fixing **screws** (2pcs) M4x16 PT
- b. Grounding **screws** (4pcs) M4x12
- c. Skeleton fixing **screws** (9pcs) M5x12



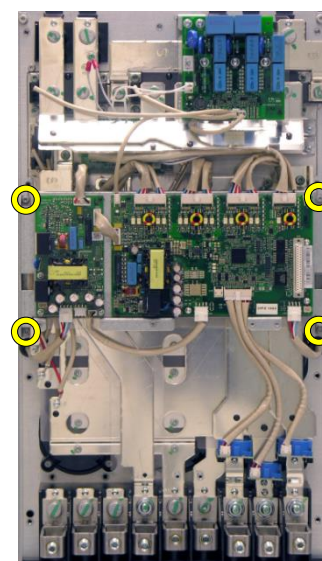
4. Remove ZFC-board and assembly plate (if used)


- a. Remove the ZFC2 mounting **screws** (3pcs) M4x12
- b. Remove assembly plate mounting **screws** (2pcs) M4x12 and (2pcs) M5x12



5. Remove ZINT and ZPOW assembly plate

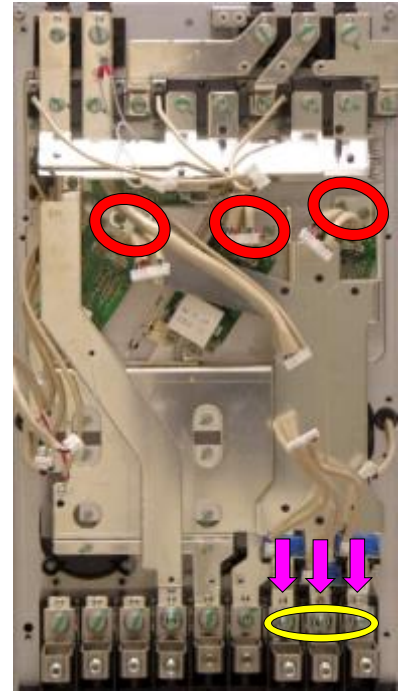
- a. Unplug ZINT and ZPOW wirings
- b. Remove ZINT assembly plate fixing **screws** (4pcs) M5x12



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6. Remove output busbars and replace current transducers

- a. Loosen output busbars **nuts** (3pcs) M10
- b. Unscrew the output busbar **screws** (6pcs) M6X16
- c. Unscrew the output busbar mounting **screws** and remove the output busbars.(3pcs)M5X16PT




- d. **Unbolt** the output busbar cable terminals.(3pcs)M10
- e. Unscrew the CT's mounting **screws**.(3pcs)K50x16 PT



7. Install components in reverse order

Check the correct tightening torques from section 2 (page 6).

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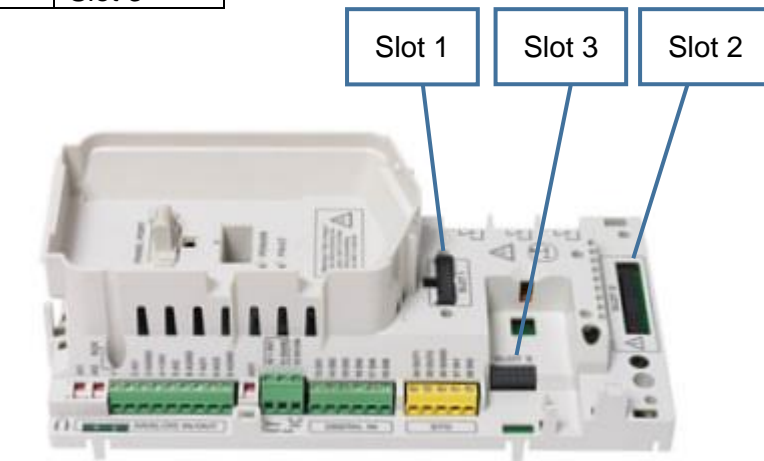
4. Other maintenance actions

4.1 Replacement of interface options

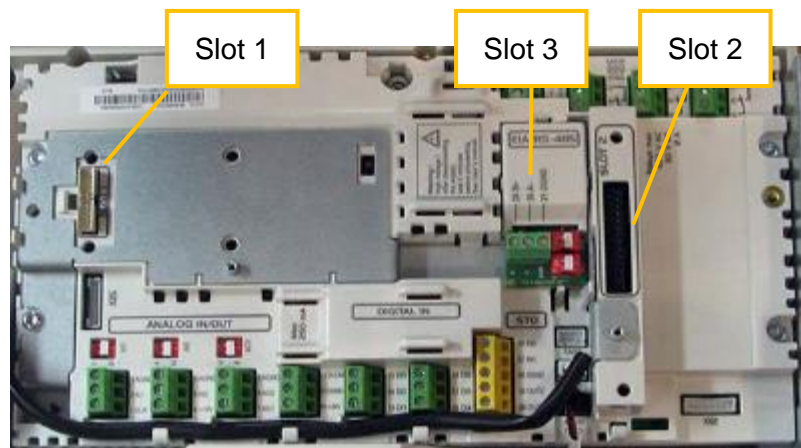
Optional modules such as fieldbus adapters and I/O extensions are inserted in the optional module slot on the control unit.

ACS580 CCU control unit contains three option slots. In the table below there is described which interface options can be used in which slot

Option modules	Install to
Fieldbus adapters (FENA, FPBA)	Slot 1
I/O extensions (CMOD)	Slot 2
Embedded fieldbus (CEIA)	Slot 3




CCU-11 option slots



CCU-12 option slots

Install the optional modules as follows:

1. Insert the module carefully into its position on the control board.
2. Fasten the **fastening screws**. **Note:** Proper tightening of the screws is essential for fulfilling the EMC requirements and for proper operation of the module.

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4.2 Reforming the DC link capacitors

Even though the insulation resistance test will initially indicate a possible fault in the circuits, it is recommended to power up the unit by gradually increasing the voltage, before placing the unit in a test cabin.

If the module has been in storage for over a year, or if there is any reason to suspect fault in the circuits (e.g. DC-capacitor short-circuit), the DC link capacitors need to be reformed (re-aged) by increasing the DC link voltage step by step. Without reforming, the capacitors may get damaged when the converter starts to operate. It is recommended to reform the capacitors once a year.

Note: Ensure that the converter is clean and dry (no condensation) before conducting capacitor reforming.

Capacitor reforming is based on DC power supply, which is connected to the converters DC link. The power supply current charges the converter capacitors. If the power supply cannot limit the current, increase the voltage gradually (with e.g. 100 V steps). The maximum allowed reforming current is 500 mA. An appropriate reforming voltage is $(1.35 \times U_s)$ (U_s = Nominal supply voltage of the converter (VAC)).

1. Check manufacturing date (serial number 1st digit = manufacturing country, 2nd and 3rd digits = manufacture year, 4th and 5th digits = manufacture week)
2. Connect DC power supply to DC connectors. Increase the voltage gradually (with e.g. 100 V steps).
3. Correct reforming voltage is $1,35 \times U_N$
4. Reforming time is 1 hour per 1 storage year

Or contact your local ABB representative

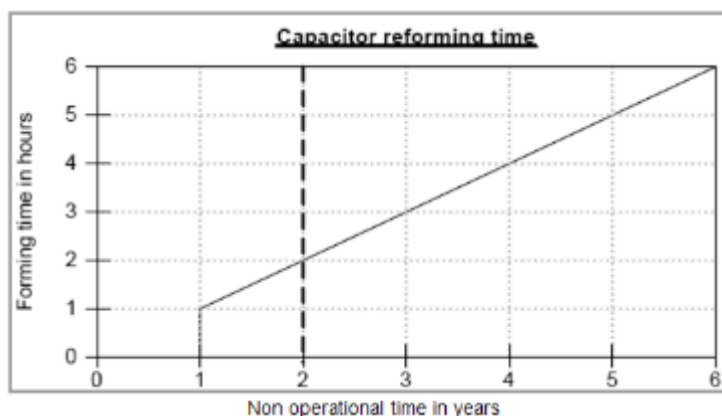



Figure 4.1 Capacitor reforming time

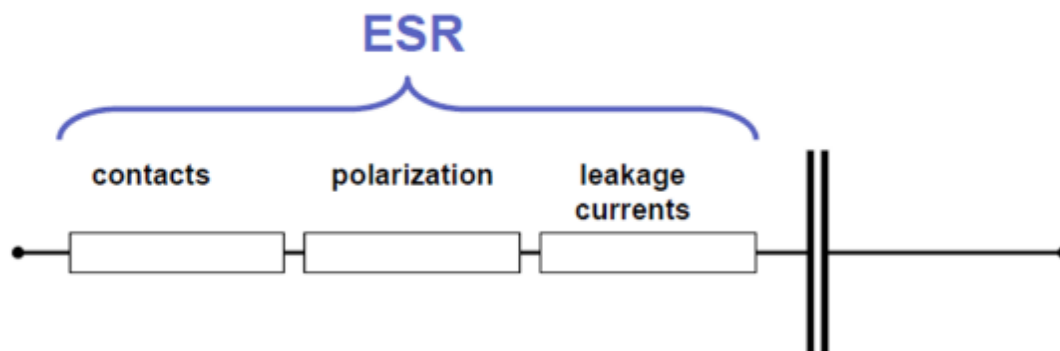
For more information regarding the reforming time and procedures for capacitor reforming, please refer to the Capacitor reforming guide (3BFE64059629 REV C EN).

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4.3 ESR

4.3.1 ESR presentation

Equivalent Serial Resistance



ESR is the ohmic part of the equivalent series circuit of a capacitor. It represents the losses associated with a capacitor due to metallic contacts, polarization, leakage currents, etc.; expressed in milliohms (mΩ).

4.3.2 ESR measurement of the DC capacitors

Safety precaution!

- ESR measurement is always performed on discharged capacitors.
- Check that the DC-link voltage is at a safe level before working on mechanical parts.

Calibration

- When measuring ESR, the meter has to be at the same ambient temperature as the capacitor
- Calibration is done with both open and closed circuit (short circuit plug in meter accessories)


Test frequency

- In general the following test signals are used:
 - 1kHz test signal for 0.01 μF or smaller capacitors
 - 100Hz test signal for 10 μF or larger capacitors

Pass criteria for each capacitor type:

Frame	Supplier	Type	Capacitance μF	Capacitance tolerance	ESR(mΩ) 100Hz	ESR(mΩ) 100Hz max
R6	EPCOS	3AUA0000077643	1750	-10 / +15%	21,9	38,3
R7	EPCOS	3AUA0000077644	2550	-10 / +15%	14,4	25,2
R8	EPCOS	3AUA0000077654	3750	-10 / +15%	10,4	18,2
R9	EPCOS	3AUA0000077655	5850	-10 / +15%	8	14

If measured value exceeds maximum ESR value, the capacitor is at the end of its life cycle and needs to be replaced.

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4.4 R1-R5 fault tracing

A possible fault in an output or an input bridge can be traced without opening the module. In this section there are given pass criteria for following measurements conducted with a multimeter for frame sizes R1-R5:


- Input bridge diode measurement from input connectors
- IGBT freewheeling diode measurement from output connectors

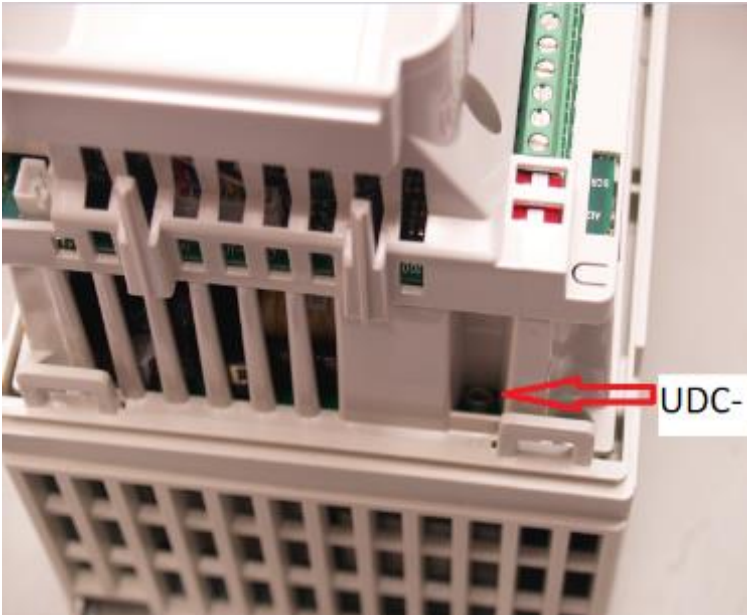
If a broken semiconductor module is detected, the whole drive must be replaced.

Corresponding measurements and pass criteria for frame sizes R6-R9 are given in section 3.5.1 *Measuring semiconductor condition from main connectors.*

Note: Always make sure there is no voltage connected to input terminals. In case a permanent magnet motor is used, the motor axel must not rotate as it would feed voltage to drive side.

STEP 1	Input bridge diode measurement				
Performance	Use a multimeter to make sure that the measurements for the input bridge diodes are OK.				
Pass criteria	By using the diode measurement setting for the multimeter, you should get following values: Note: In case of a controlled charging circuit, the input bridge measurement is not possible for all phases.				
	+ probe	- probe	R1-R3 display	R4 display	R5 display
	L1	+DC	~0,5 Vdc	~0,45 Vdc	~1,1 Vdc
	L2	+DC	~0,5 Vdc	~0,45 Vdc	OL
	L3	+DC	~0,5 Vdc	~0,45 Vdc	OL
	+DC	L1	OL	OL	OL
	+DC	L2	OL	OL	OL
	+DC	L3	OL	OL	OL
	+ probe	- probe	R1-R3 display	R4-R5 display	
	L1	-DC	OL	OL	
	L2	-DC	OL	OL	
	L3	-DC	OL	OL	
	-DC	L1	~0,5 Vdc	~0,45 Vdc	
	-DC	L2	~0,5 Vdc	~0,45 Vdc	
	-DC	L3	~0,5 Vdc	~0,45 Vdc	
Meaning of the test	To ensure that the input bridge diodes are OK.				

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UDC- test point.

STEP 2	Freewheeling diode measurement																																										
Performance	Use a multimeter to make sure that the measurements for the output freewheeling diodes are OK.																																										
Pass criteria	<p>By using the diode measurement setting for the multimeter, you should get following values:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">+ probe</th> <th style="width: 33%;">- probe</th> <th style="width: 33%;">R1-R5 display</th> </tr> </thead> <tbody> <tr> <td>U</td> <td>+DC</td> <td>~0,4 Vdc</td> </tr> <tr> <td>V</td> <td>+DC</td> <td>~0,4 Vdc</td> </tr> <tr> <td>W</td> <td>+DC</td> <td>~0,4 Vdc</td> </tr> <tr> <td>+DC</td> <td>U</td> <td>OL</td> </tr> <tr> <td>+DC</td> <td>V</td> <td>OL</td> </tr> <tr> <td>+DC</td> <td>W</td> <td>OL</td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">+ probe</th> <th style="width: 33%;">- probe</th> <th style="width: 33%;">R1-R5 display</th> </tr> </thead> <tbody> <tr> <td>U</td> <td>-DC</td> <td>OL</td> </tr> <tr> <td>V</td> <td>-DC</td> <td>OL</td> </tr> <tr> <td>W</td> <td>-DC</td> <td>OL</td> </tr> <tr> <td>-DC</td> <td>U</td> <td>~0,4 Vdc</td> </tr> <tr> <td>-DC</td> <td>V</td> <td>~0,4 Vdc</td> </tr> <tr> <td>-DC</td> <td>W</td> <td>~0,4 Vdc</td> </tr> </tbody> </table>	+ probe	- probe	R1-R5 display	U	+DC	~0,4 Vdc	V	+DC	~0,4 Vdc	W	+DC	~0,4 Vdc	+DC	U	OL	+DC	V	OL	+DC	W	OL	+ probe	- probe	R1-R5 display	U	-DC	OL	V	-DC	OL	W	-DC	OL	-DC	U	~0,4 Vdc	-DC	V	~0,4 Vdc	-DC	W	~0,4 Vdc
+ probe	- probe	R1-R5 display																																									
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-DC	V	~0,4 Vdc																																									
-DC	W	~0,4 Vdc																																									
Meaning of this test	To ensure that the output freewheeling diodes are OK.																																										