Security Classification: 绝 密

Goldwind 1.5MW Wind Turbine Generator System Manuals

Manual Of Goldwind Type Ⅰ Converter

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FOREWORD

The standard is drafted in accordance with the rules given in the ISO/IEC Directives, Part2.

This Standard upgrade is for A2 edition. Compared with the A1 edition, the main changes have been made as following:

--the “Goldwind Air-cooled Converter” is replaced by “Type Ⅰ Converter”.

--the page 10:three notes on safety use of converter equipment are added.

--the page 38:” Semikron - IPM Skiip3 2403GB172 for Goldwind 70/77/82, or IPM Skiip4 2414GB17E4 for boost units of Goldwind 87,the boost units are IGBT1,IGBT2 and IGBT3 in Figure 5-1” is added.

This Standard upgrade is for A1 edition. Compared with the A0 edition, the main changes have been made as following:

--the page 6: Rated power factor is changed to 1 instead of 0.98. Also, 600 Vac grid rated voltage has been added.

--the page 6: Rated input frequency: 12.7Hz (Goldwind 77/82), 13.9Hz（Goldwind 70）, 12.17Hz (Goldwind 87).” is added.

--the page 43:Line voltage of transformer’s low voltage is changed to 600±10% instead of 600 ±5%.

--the page55 : Normally the temperature raise of IGBT L1a,L1b, L2a, L2b, L3a, L3b is changed to 55° instead of 50 ° .

--the Chapter 7: Fault tracking content has been updated, with the failure code added.

--the Appendix A: The introduction of the AC fuses installation.

--the Appendix B: The wiring instruction of dehumidifier heaters.

This Standard is provided by Goldwind Science & Technology Co., Ltd.

This Standand is drafted by Goldwind Science and Technology Co., Ltd.

This Standard is mainly drafted by Gu Weifeng.

Issue condition of historical edition of this Standard:

Drafted by	Approval date	Edition	Using state	The explain of version used situation
Li Tianyu	2010-12	A0	Invalid	
Jingshuang	2011-09	A1	Invalid	

INTRODUCTION

The Goldwind Type I Converter is one of the most important electric parts of the Goldwind 1.5MW wind turbine generator (WTG) system. The Goldwind Type I Converter is a full power converter for Direct-drive type WTGs. The converter uses advanced IGBT units and PWM control technology, which can efficiently achieve power conversion from generator to grid.

The manual is written for better understanding and use of Goldwind Type I Converter . Anyone who will operate the converter shall read the manual first and abide by all requirements. If there are any additional questions which are not mentioned in the manual, please consult with the services and engineers of Electric Control Department of Research & Development Centre, Goldwind Science & Technology Co.

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Manual Of Goldwind Type I Converter

1 Safety

1.1 Fundamental requirements

Goldwind Science & Technology always takes "Safety First" as its main principle. Safety is the foundation of throughout process of product design, manufacture and operation.

All maintenance personnel must read the safety manual carefully and abide by the safety specifications in the manual. Any faulty operation or behavior will cause serious injuries to the personnel and sever damage to equipment.

The Goldwind Type I Converter is a part of the whole electric system in the wind turbine generator system. It is very important to reemphasize the safety requirement of the whole system installation, maintenance and operation.

1.2 Personnel requirements

The related working personnel of wind turbine generator system shall follow the basic rules in the "Safety Code of Wind Farm" of the power field. Related staff shall receive practical and flexible protection according to the code.

The professional personnel who have studied and understood the requirements in the Instructions and been trained and specifically assigned by Goldwind Science & Technology Co., Ltd. are allowed to install, operate and maintain the converter equipment. The professional personnel are those who can complete the assigned tasks and be aware of the possible hazards, successfully complete the technical training, and have a good understanding of related regulations.

It is forbidden to climb the wind turbine without permission. The assignment at high heights shall be carried out by the personnel who have been trained in climbing the tower.

The personnel who are currently undergoing training could be allowed to operate the wind turbine generator system and its converter under the continuous supervision of at least one experienced working person.

At least two persons are required to carry out the converter-related work at any time!

The working personnel not only shall understand the system equipment, but also have the following knowledge:

Understand the possible hazards and corresponding protective measures;
Know what safety measures shall be taken to the converter and the entire system under the fault conditions;
Be able to use the safety equipment correctly;

Be able to use the protection equipment correctly;

Be familiar with the operation procedures and requirements of the wind turbine generator system and converter;

Be familiar with the related faults and their solutions;

Know the correct mechanism of the tools being used;

Know and be willing to employ first-aid skills when needed;

Anyone who does not have the knowledge above is forbidden to operate the converter.

Before entering the wind turbine generator system for maintenance operation, it is required to get the administrator of the wind farm personnel's permission. The operators should know the contact number of the local leader for further use. During the maintenance, the wind turbine shall be under maintenance state!

1.3 Protection equipments

Wear a safety helmet with locking belt when working inside the wind turbine generator system;

Wear protective clothing or suitable uniform;

Wear cotton gloves (Proper insulating gloves are necessary when touching the equipment with high voltage cables);

Wear rubber-sole protective shoes;

Work at high heights is inevitable in some maintenance work. In such situations, the safety belt must be worn;

Use a flashlight in dark places;

The operators shall use the safety protection equipment correctly and check them prior use. The protection equipment shall have the expected functions and be in line with the existing laws and standards.

1.4 Notes on safety use of converter equipment

Employing caution is necessary to avoid unnecessary injuries, especially when they have the possibilities to be fatal. The following caution signs are shown to illustrate what the operators should be cautious of:

High voltage: This caution sign warns about the high voltage of electricity which may cause personal injury or equipment damage.

High leakage current, earthing terminal must be connected before powered on.

General caution: It is a caution on that the personal injury or equipment damage is possible to happen due to the non-electric factor.


Static sensitive equipment: This caution sign warns about electrostatic discharge which may cause equipment damage. The operator(s) should wear appropriate gloves to avoid the situation.


Safety grounding: It is a mark on safe grounding of earth wires or electronics device shells. (These parts are ultimately connected with tower foundation of WTG.)

 
Caution risk of hearing damage, wear hearing protection. The maximum noise produced by the equipment may exceeds 80 dBA, which could cause a hazard to hearing. Please wear a hearing protection device when sitting near the machine during the operation.

Installation and maintenance

Caution! Only an electrical engineer with the required qualifications is allowed to install and maintain the converter!

•Before maintaining or installing the converter, make sure that the input voltage to the generator and power grid of the converter is turned off and the voltage from the DC bus is completely discharged.

•When the converter is connected with the grid and the generator, no maintenance or installation on the converter are permitted. When the connections of both sides are cut off, allow the converter 5 minutes to completely discharge the capacitor on the middle DC bus. Before performing any installation or maintenance work, it's required to use the multimeter to measure the voltage of the incoming lines to the ground reference (the multimeter is under AC position) and the voltage of the positive and negative (+/-) copper bars (the multimeter is under DC position). Installation or maintenance will be permitted, only if the voltage is confirmed to have a value of 0.

• During maintenance or installation, the metal connection parts of the cable, exposed copper bar, reactor, capacitor, and circuit breaker will be subject to voltage measurement by use of the multimeter. The corresponding operation is permitted after confirming that there is no dangerous AC or DC voltage.

• The equipment should be temporarily grounded before installation and maintenance.

• Even though some electrical parts inside the converter have anti-direct-contact protection, it's still required that one exercises caution when touching the protection covers (such as a metal baffle).

• No insulation or withstanding voltage test is allowed to the driver equipment, circuit board, module and other parts of the converter.

• If the insulation resistance or withstanding voltage of the converter needs to be measured, it's required to disconnect the related low-voltage equipment, modules etc..

• When changing the cables of the generator side or grid side, it is required to check that whether the phase sequence is correct.

Caution!

• Be careful of the glowing surfaces of heated parts. Even though when the power supply of the converter is cut off, some parts may still maintain a very high temperature. This includes the chokes, the aluminum radiators of the IGBT module and the diode module, discharging and charging resistances, break resistance, etc.

• Be extra cautious when transporting large, overweight parts such as IGBT module, capacitor bank, and inductor.

• It's better not to carry out operations such as drilling and welding that might cause conductive dust inside the converter cabinet. This would help prevent any potential damage or fault which might be caused by dust falling upon some control circuits or modules.

• Ensure that there is no water spraying or splashing around the converter, and ensure that there is no missing tools within the converter. One should also ensure that the converter is safe to recover the power-on work.

Caution! When carrying out replacement operation on the control circuits or modules, extra caution is needed to prevent discharge to static sensitive parts on the printed circuit board. When working on the printed circuit board, it's required to wear grounded wrist strips or discharge grounded parts like the metal shell. Do not touch other printed circuit boards without any reason.

2 Technical data

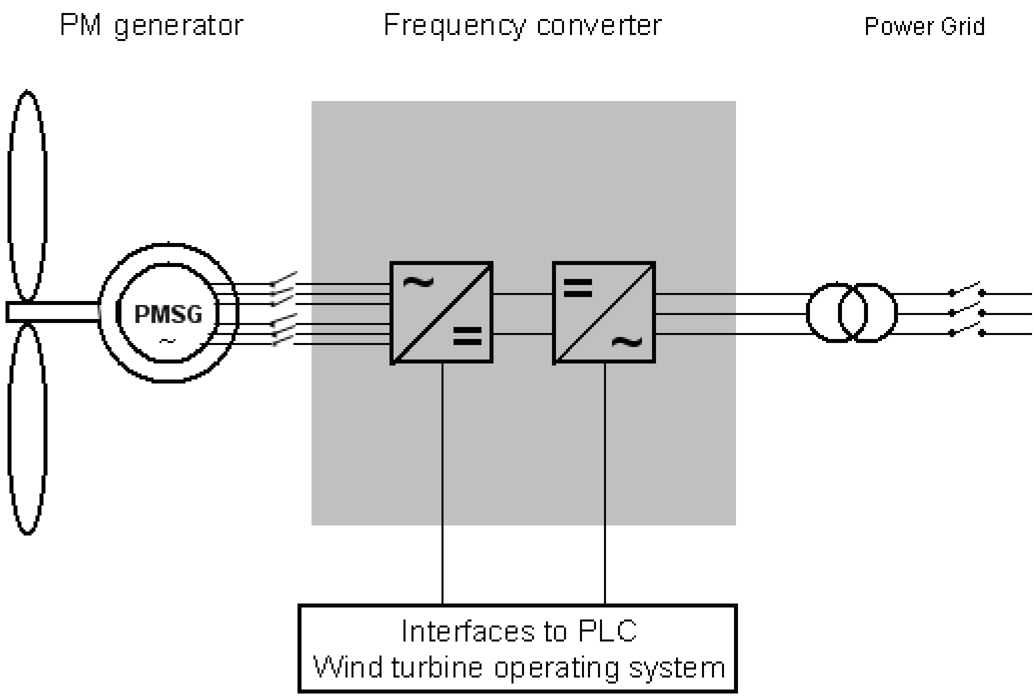


Figure 1 overview of the converter system

The Goldwind Type I Converter is a full-power type converter suit for PMSG (permanent magnetic synchronous generator) in wind power industry, as shown in Figure 1; the converter connects the generator and the grid. The converter use AC-DC-AC transformer to achieve the energy transportation from the generator to the grid.

The Goldwind Type I Converter is adapted to 6-phase PMSG and compatible with different types of grids. This enables the converter to be used well in a wide range of voltages, reactive powers and frequency grids. The Goldwind Type I Converter has advanced control and protection design. It has the superior LVRT capability (low voltage ride through capability) for grid short time fault. The control system has independent signal measuring, interfaces and communication to high performance PLC controller, with which the converter has high self control and EMC performance.

The Goldwind Type I Converter and related components comply with accepted international standards and respective national regulations such as the latest IEC regulations, GL wind turbine certification guideline etc and it also complies with related UL/ETL/CSA /CE safety standards.

2.1 fundamental parameters of the converter

Total size of the converter system：3300 × 6680 × 1640 mm

Total weight：5.7t

Detail structure (see Chapter 3.1)

Grid side parameter

Rated output power: 1500kW

Rated grid voltage: 620VAC/600VAC

Rated grid frequency: 50/60Hz

Rated power factor:0.98

Power factor range: ±0.95
Generator side parameter
Rated input power: 1580kW
Rated input voltage: 690VAC
Rated input frequency: 12.7Hz (Goldwind 77/82), 13.9Hz（Goldwind 70）, 12.17Hz (Goldwind 87)
Note: the Goldwind 70/77/82/87 are the listed name of Goldwind 1.5MW WTG which is named by the diameter of the rotor.
Rated DC link voltage: 1090~1170V
IGBT switching frequency: 2.5 kHz
Overvoltage protection: chopper IGBT with braking resistor
Cooling style: air cooling
Power loss: 40kW
Operation temperature: -30℃ ～ +40℃
Relative humidity: less than 90%
Altitude: ≤2000m
Pollution degree: Ⅲ
OVC（Overvoltage category）: Ⅲ

3 Mechanical installations

3.1 Mechanical structure

The Goldwind Type I Converter is an important part of electric system; the main parts of the converter are installed at the bottom of the tower. There are 4 parts of the converter as shown in Figure 2

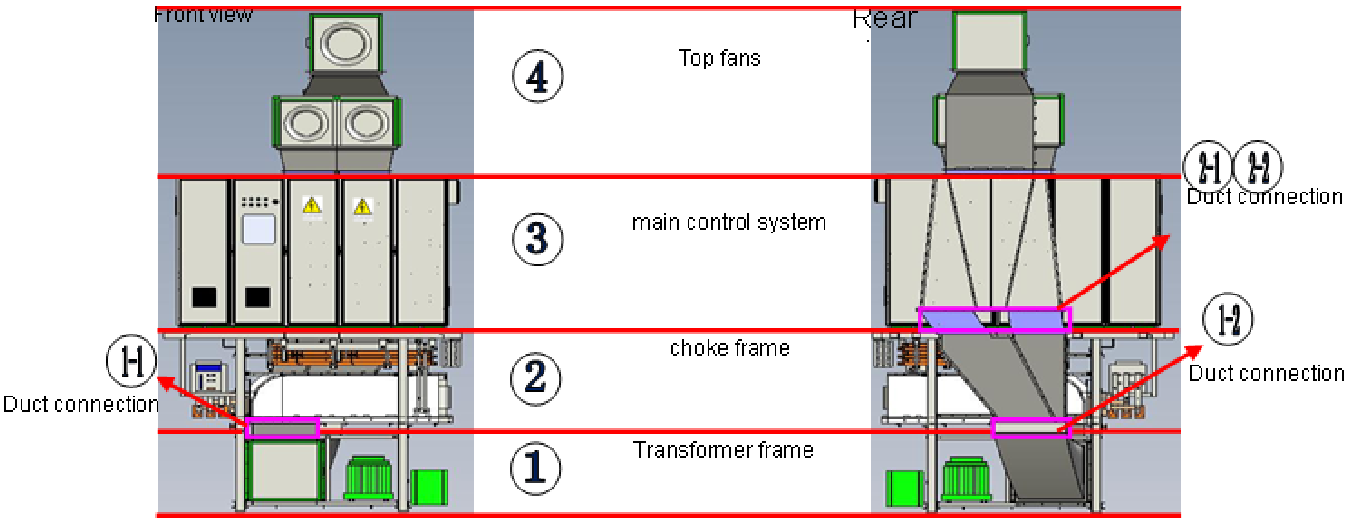


Figure 2 structure of Goldwind Type I Converter

From bottom to top is described as follows,

1）Transformer frame (including control transformer, IGBT cooling fan, chopper resistor box)

size：1990 × 1084 × 1357mm; weight：590kg

2）Choke (inductor) frame (including chokes, copper bars and main breaker)

size：3300 × 1386 × 1357mm; weight：2300kg

3）Main cabinets (5 sub-cabinets, from left to right: low-voltage distribution cabinet, control cabinet, IGBT cabinet 1 and 2, capacitors cabinet)

size：3308 × 2082 × 1183mm; weight：2300kg

4）Cooling fans (3 cooling fans on the top and the air channel at the backside)

size：1424 × 2173 × 1281mm; weight：480kg

5）generator switch box (2 boxes in the nacelle)

size：424 × 600 × 750mm; weight： 98kg

3.2 Assembly steps

3.2.1 Step 1 Installation of transformer frame

The necessary accessories are listed in the Table 1.

Table 1-accessories needed for Installation of transformer frame

Category	Name	Specification	Quantity

Accessories	adjusting bolt	M20×180	4
	Nut	M20	8

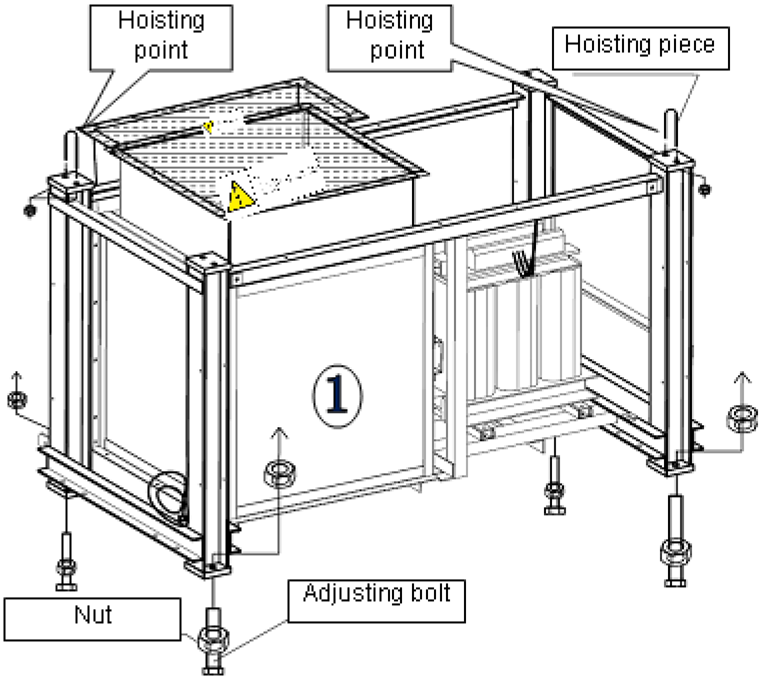


Figure 3 fixing point of transformer frame

Installation tools: sleeve (M20), sling: 10t 12m

Hoisting position: during hosting, it is required to stay away from the backside of the bending air channel. It is important to check to see if the air channel interface is well protected. In case of damage, it is required to be repaired immediately to avoid the air leakage upon assembly of the whole air channel.

Installation: The transformer frame shall be positioned strictly according to the mechanical design requirements. Tightly insert the hoisting piece into the angle plate at the top of the frame to the hoist transformer frame. Screw the adjusting bolts into the nuts, and insert them into the four angle plate holes at the bottom of the frame, and then install the nuts. Place the transformer frame into the foundation ring, with its front face being consistent with the direction of the tower door, install the four adjusting bolts at the marked position, and level them according to the mechanical design. Upon completion of installation, remove the hoisting piece.

3.2.2 Step 2: Installation of inductor frame

Table 2 -accessories needed for Installation of inductor frame

Category	Name	Specification	Quantity
Accessories	outer hexagonal bolt	M16×70	8
	Nut	M16	8
	Spacer	Φ16	16

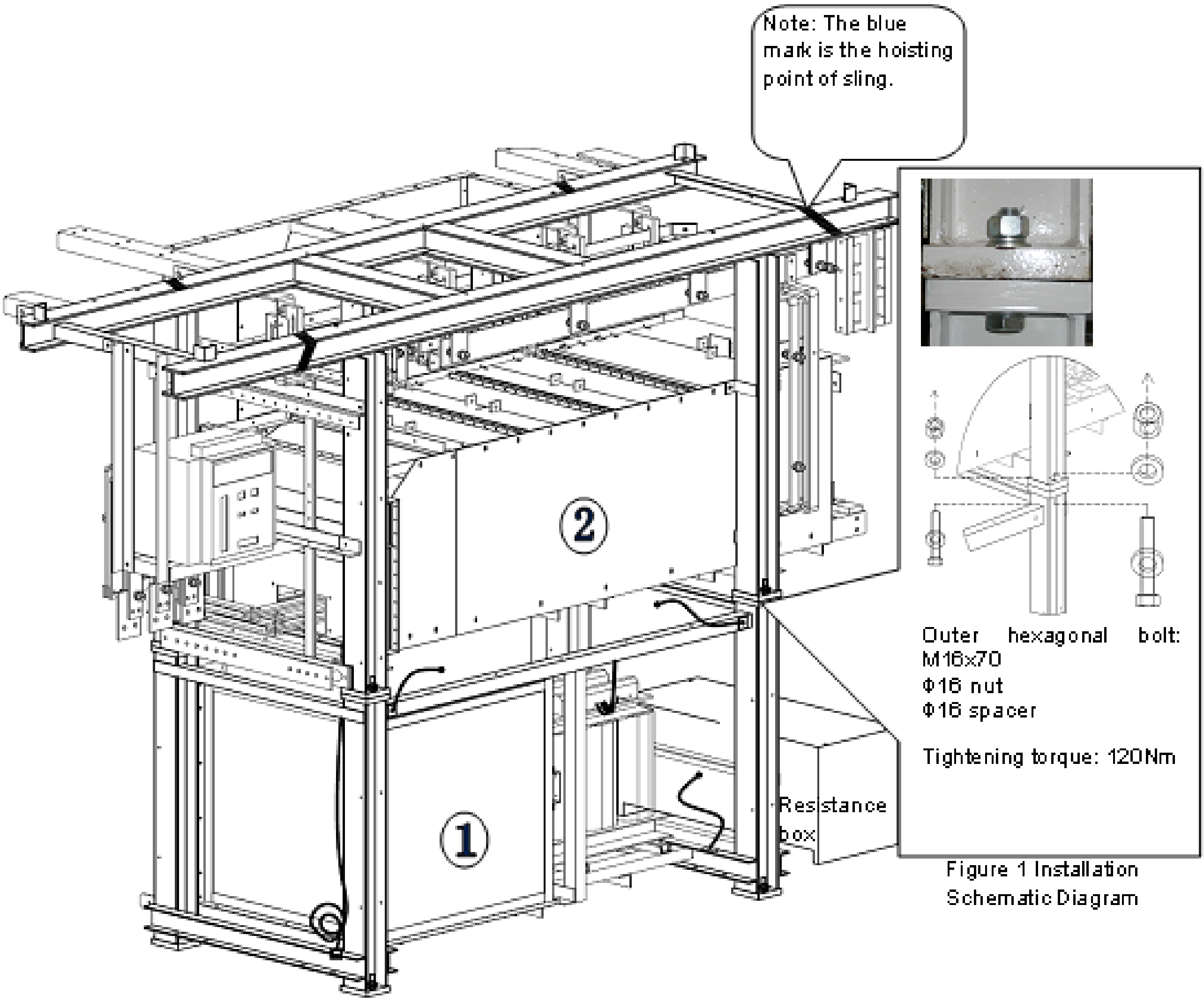


Figure 4 installation of inductor frame

Installation tools: sleeve (M16), sling: 10t 12m

Hoisting: During hosting, collision should be avoided. The hoisting position should be kept away from the connecting copper bar and electric elements. Attention should be paid to prevent cables from falling off or any other damages.

Installation: Remove the wood package and the wooden support at the bottom of the inductor frame, place the inductor frame on the transformer frame and install the screws. During installation, don't remove other electrical elements. Review whether the screws have been completely installed on the fixed positions and if the torque conforms to the requirements. Place the braking resistor box at the right side of the transformer frame.

3.2.3 Step 3: Installation of main cabinets

Table 3-accessories needed for Installation of main cabinets

Category	Name	Specification	Quantity
Accessories	outer hexagonal bolt	M10×40	8
	Nut	M10	8
	enlarged flat washer	Φ10	16

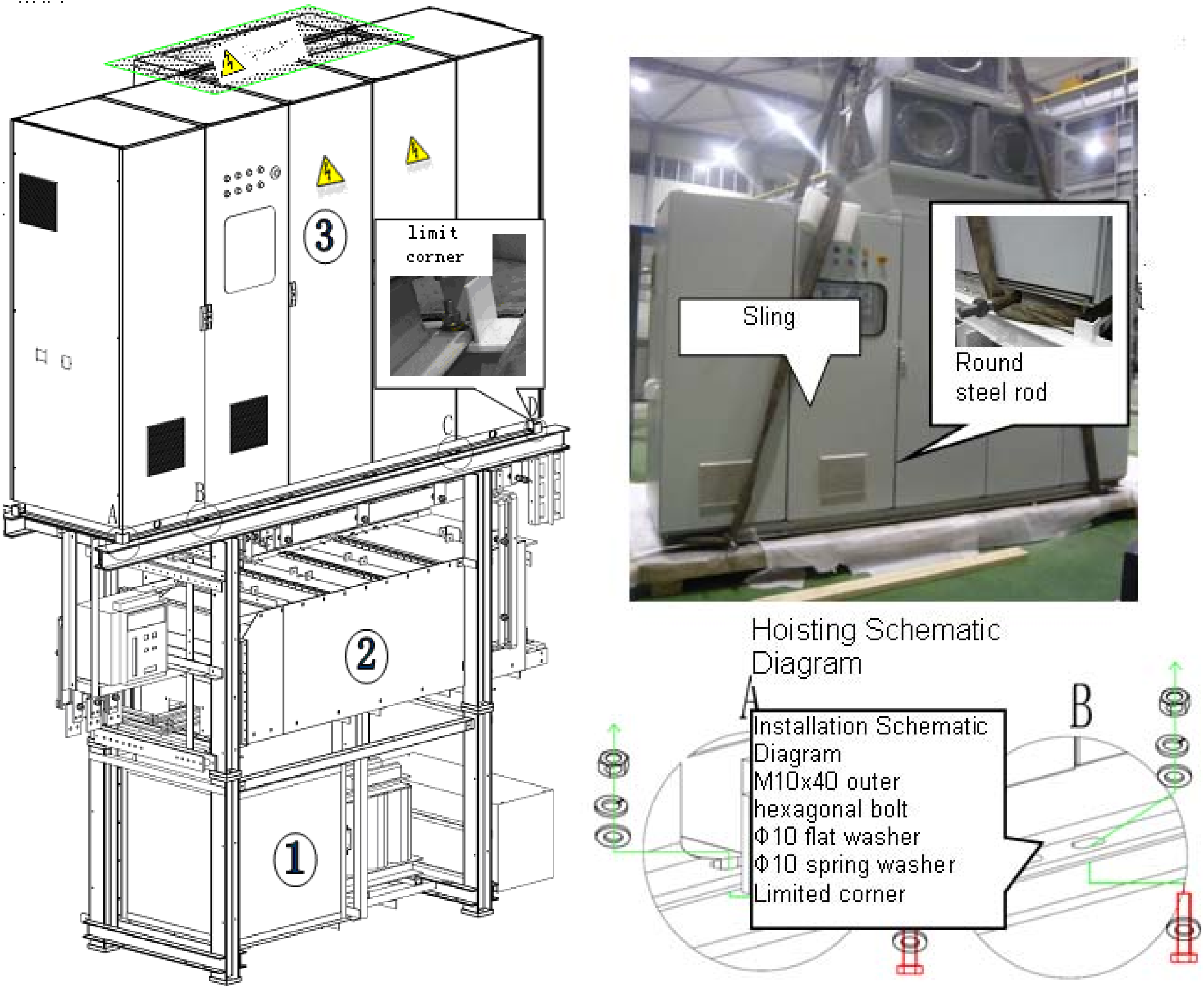


Figure 5 installation of main cabinets

Installation tools: sleeve (M10), sling: 10t 12m

Hoisting: Collision should be avoided during hoisting. Note: the cabinet body shouldn't be collided, the sling shall be kept away from the elements on the main control cabinet door and the lamp/button on the main control cabinet door shall be protected.

Installation: Remove all fixed screws on the cabinet body and wooden support. Make sure that the cabinet doors are closed and locked. Protect the indicator lamps and button elements of main control cabinet door to avoid damage during hoisting. Insert two round steel rods into the hoisting holes at the bottom of the cabinet and hang the sling. Place the four corners of the cabinet into the four limited corners of the inductor frame and tighten them with bolts. The bolts are shown in structural connection accessories box. Four sets of bolts are respectively arranged at the front and back of the cabinet (8 sets in total) and the installation positions of the front bolts are shown at Points A and B in the Figure 5. The rear bolts of the cabinet are installed symmetrically with the front bolts.

3.2.4 Step 4: Installation of top fans

Table 4-accessories needed for Installation of top fans

Category	Name	Specification	Quantity
Accessories	outer hexagonal bolt	M12×35	6
	Flat washer	Φ12	6
	Spring washer	Φ12	6

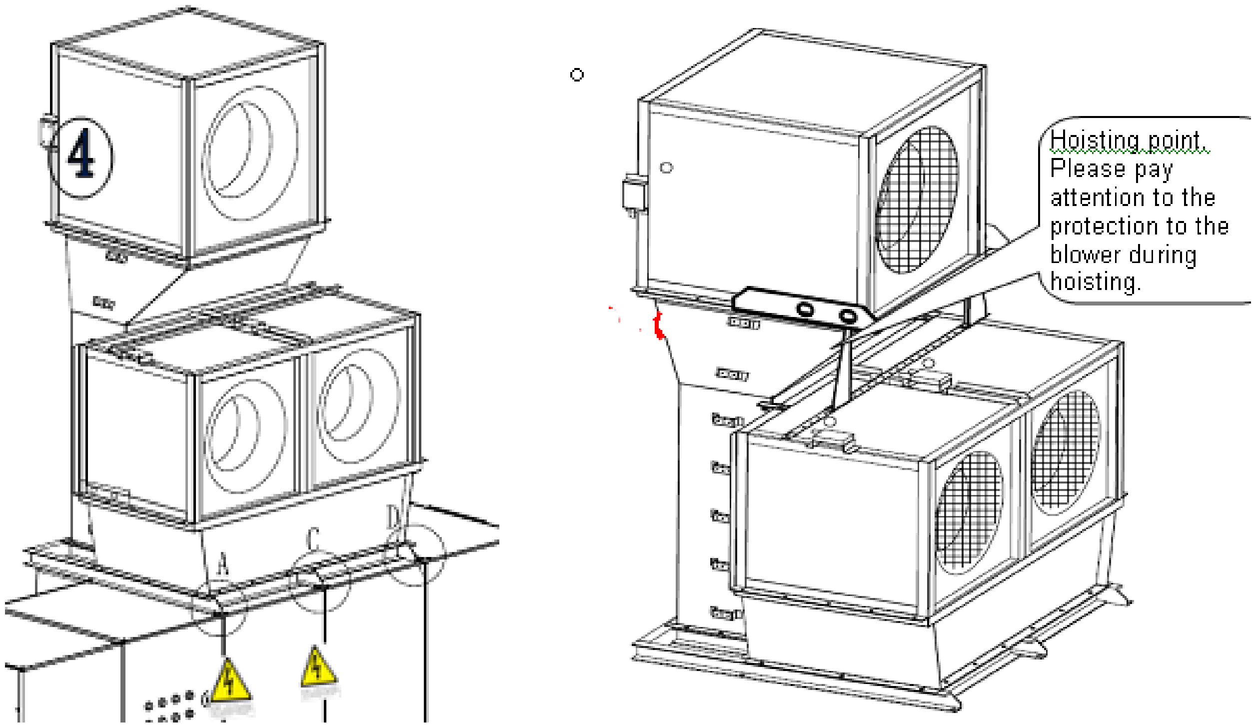


Figure 6 installation of top fans

Installation tools: 10t 12m. : sleeve (M12), sling:

Hoisting: During hoisting, the fans should not collide and no foreign materials should fall into the fans and air channel.

Installation: Remove the protective film of the top air channel prior to installation of top fans. No foreign materials should fall into the air channel. Remove the 8 fixed screws at the top cover plate, i.e.: each front and rear bolt at the right side of the main control cabinet, one rear bolt at the left side of IGBT1 cabinet, each front and rear bolt at the right side of IGBT1 cabinet, one rear bolt at the left side of IGBT2 cabinet, and each front and rear bolt at the right side of IGBT2 cabinet. Fix the top fans with these screws. The positions of the top fans and the cabinet fixed holes are shown in Figure 3-5, of which, the rear parts on the left and right sides of IGBT1 and the rear part on the left side of IGBT2 do not need to be fixed. The hoisting position of the fans is shown in Figure 6.

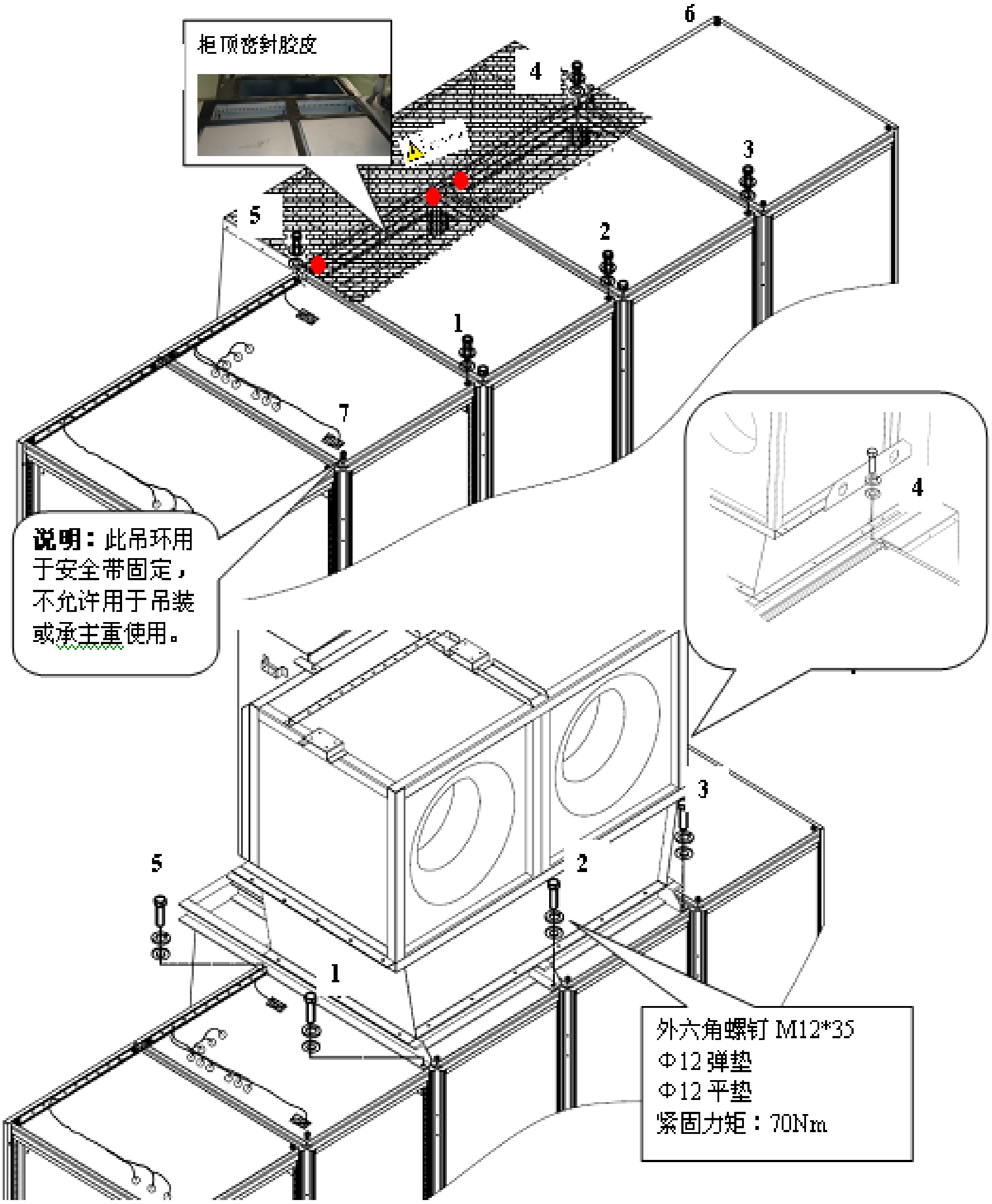


Figure 7 fixing of top fans

Exam if the stripper rubber between the fans and the cabinet are flat and well joint. First remove the five bolts (1, 2, 3, 4 and 5) and properly preserve them. The red paint coating and hoisting rings should not to be removed. Then remove the protective film on top of the cabinet. No foreign materials should fall into the air channel. The two rings (6 and 7) are used for hanging safety belts instead of hoisting.

3.2.5 Step 5: Installation of air channel connection

Table 5-accessories needed for Installation of air channel connection

Type	Name	Specification	Quantity
Accessory	Hexagon flange bolt	M8×25	52
	Hexagon flange nut	M8	36

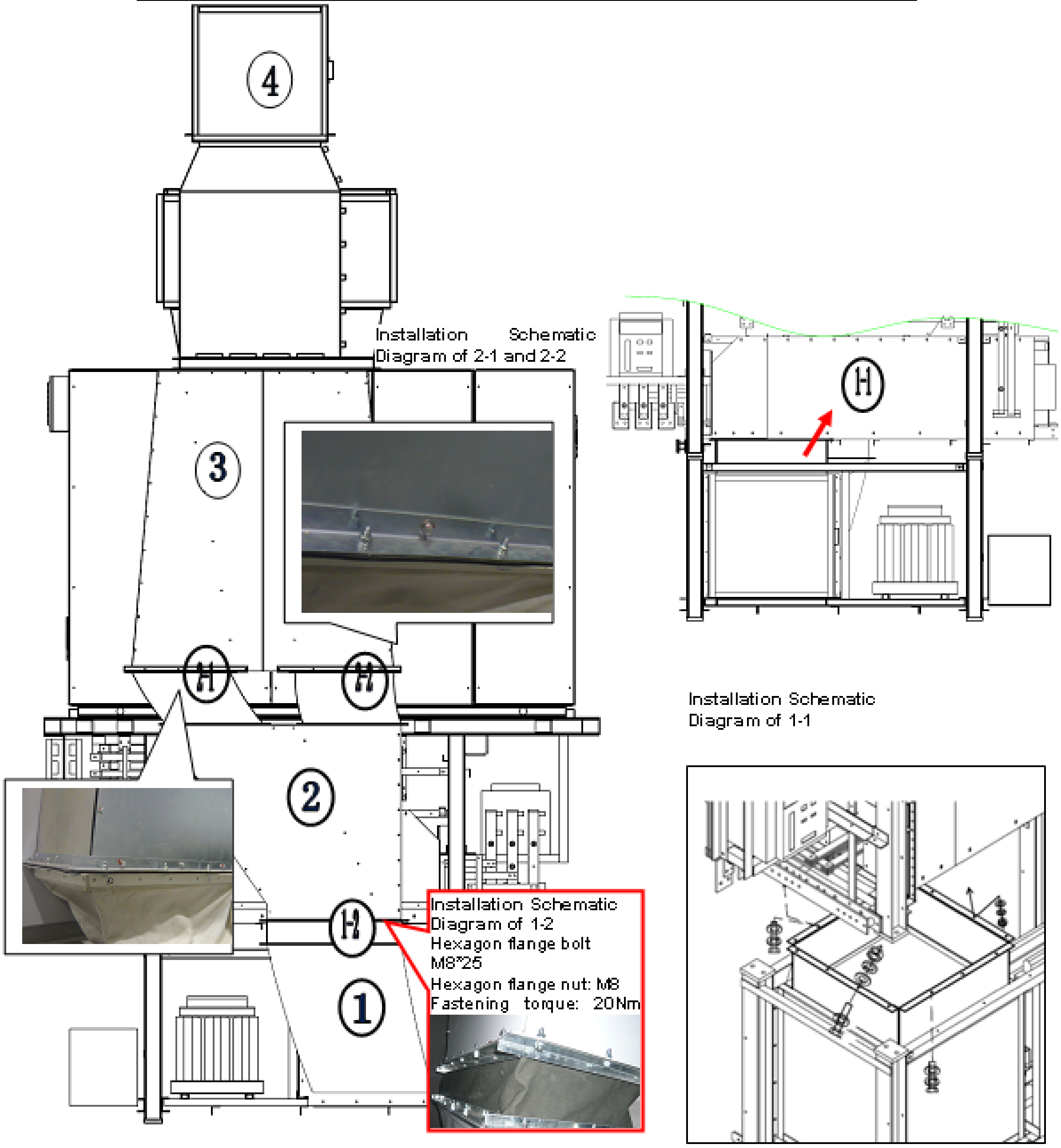


Figure 8 connection of air channel backside

Installation tool: sleeve (M8)

Installation: Mount air channel flexible connections 2—1 and 2—2 and check to see if the stripper rubber is leveled and joint closely during installation. Strip the protective film of the air channel before mounting the air channel flexible connection 1—1. No foreign materials should fall into the air channel. See installation of the air channel connector for the mounting method. Repeat this process for air channel flexible connection 1—2. After finishing installation, check all the air channel connections to see if they are properly sealed.

4 Electrical wiring harnesses

4.1 Main circuit of the converter

4.1.1 Cable connection of the main cabinets and the inductor frame

See external package of accompanied accessories for the mounting position of each kind of cable. All the external connected bolts are conFigured at contact holes.

All the cables and copper bars have contact marks with marked cables and soft bus bars which correspond to that.

Quantity of connecting cables between IGBT cabinet 1 and inductor frame:

Left side copper bar - 40*10 mm soft bus bar. Quantity: 5;

Copper bar at AC side of diode - 40*10 mm soft bus bar Quantity: 3;

Cable at positive pole of diode 150mm^2 Quantity: 3.

Quantity of connecting cables between IGBT cabinet 2 and inductor frame:

Left side copper bar - 40*10 mm soft bus bar. Quantity: 5;

Copper bar at AC side of diode - 40*10 mm soft bus bar Quantity: 3;

Cable at positive pole of diode 150mm^2 Quantity: 3.

Quantity of connecting cables between capacitor cabinet and inductor frame:

150mm^2 cable Quantity: 6

Quantity of connecting cables among IGBT cabinet 1, inductor frame and brake resistor: 70mm^2 cable Quantity: 2

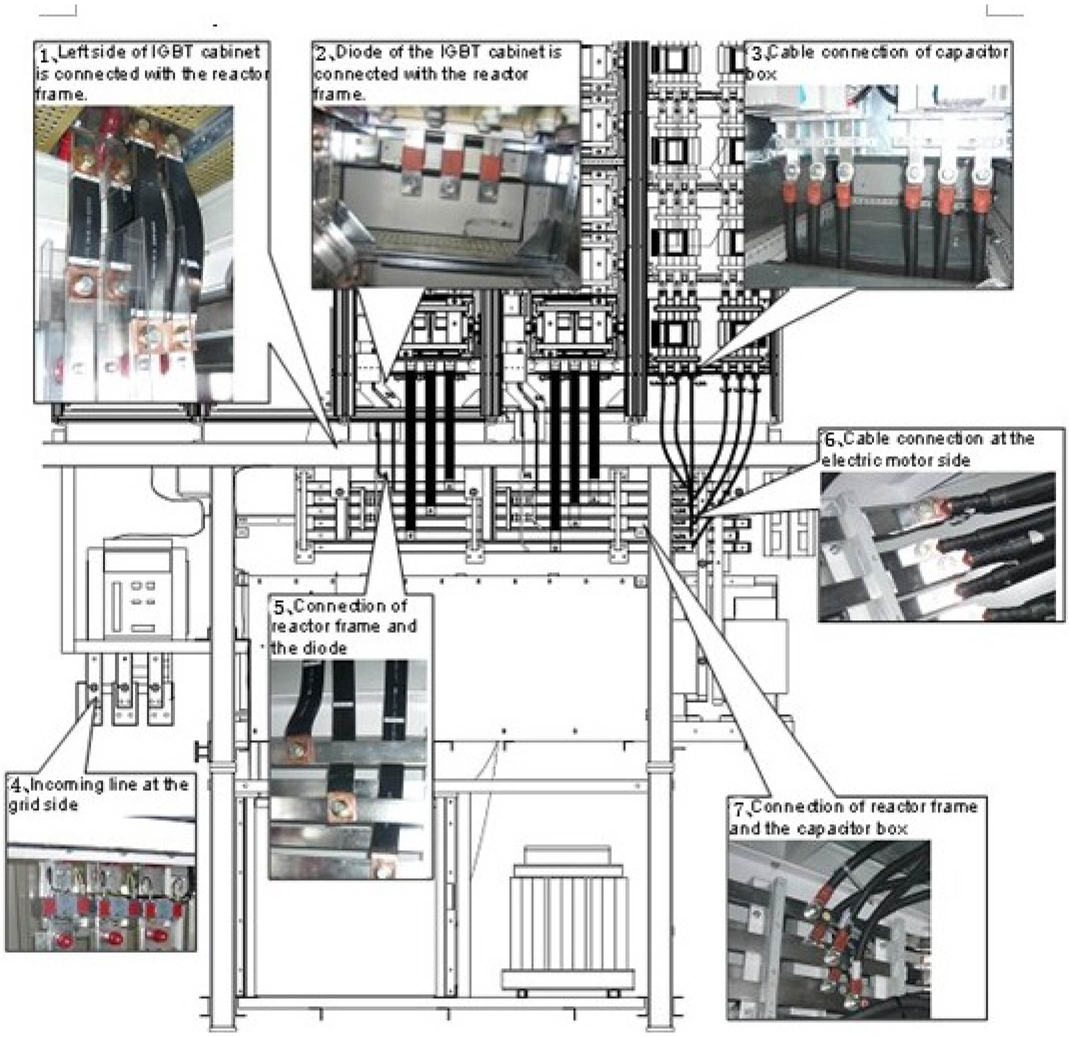


Figure 9 diagram of electric wiring of converter

Installation tool: sleeve (M12)

Table 6-accessories needed for cable connection of main cabinets and the inductor frame

Type	Name	Specification	Type
Accessories	Outer hexagonal bolts	M12*40	Accessories
	Tile gasket	Φ12	

Note: the way of 6X1 is similar to that of 5X1. During connection, the soft bus bar shall not be collided and scratched, and the overlapped faces shall be flat and fitted. During installation, it is not allowed to damage other elements, such as air damper, PC protector and soft bus bar insulation.

Step 1 the left terminal of IGBT connects with the terminal of the inductor frame

Note: After the optimization of the converter, 6 AC fuses will be installed between the two IGBT cabinets and the inductor frame. The connection is introduced in APPENDIX A.

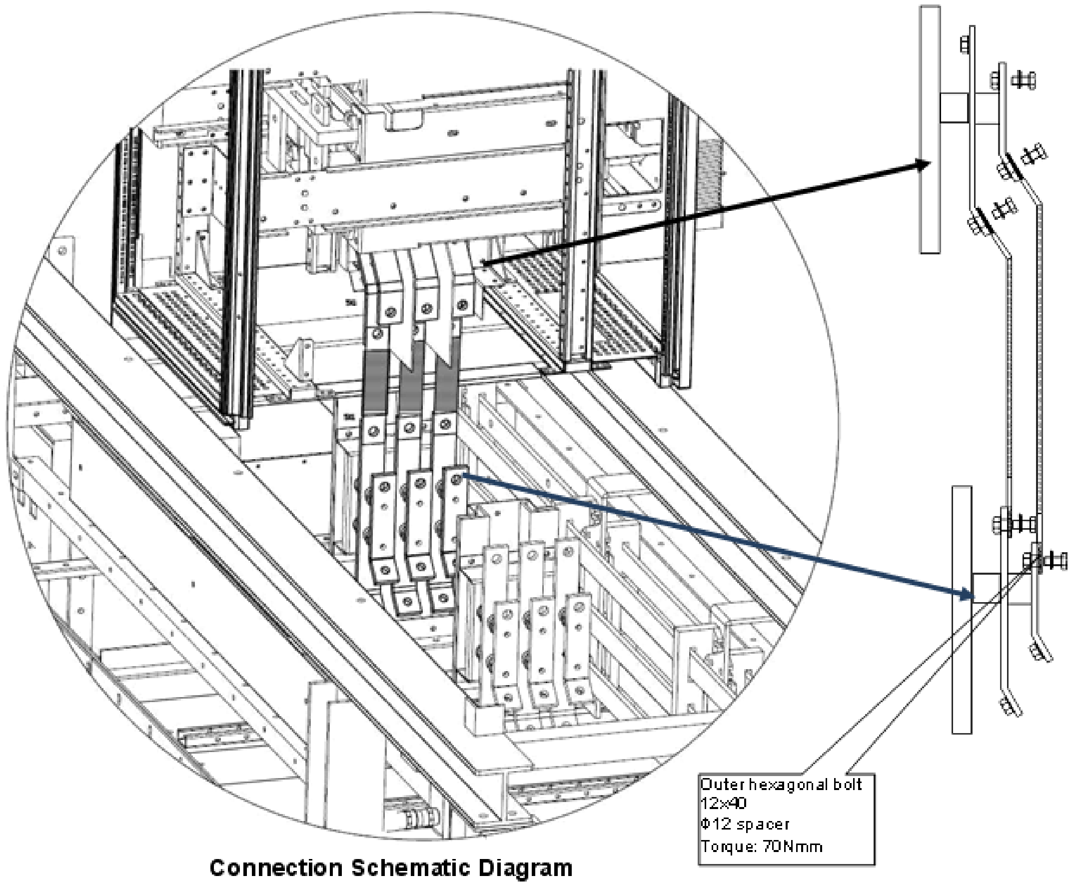


Figure 10 diagram of IGBT connections

Table7-IGBT cabinet 1、2 installation wiring

	Position 1	Position 2	Specification	Length
Name	IGBT cabinet 1, 2	Inductor frame	Flexible (soft) bus bar	
Mark	Front of IGBT cabinet 1 -5X1.1	Front of inductor frame -5X1.1	40*10	185mm
Mark	Front of IGBT cabinet 1 -5X1.2	Front of inductor frame -5X1.2	40*10	185mm
Mark	Front of IGBT cabinet 1 -5X1.3	Front of inductor frame -5X1.3	40*10	185mm
Mark	Front of IGBT cabinet 1 -5X1.4	Front of inductor frame -5X1.4	40*10	305mm
Mark	Front of IGBT cabinet 1 -5X1.5	Front of inductor frame -5X1.5	40*10	305mm
Mark	Front of IGBT cabinet 2 -6X1.1	Front of inductor frame -6X1.1	40*10	185mm
Mark	Front of IGBT cabinet 2 -6X1.2	Front of inductor frame -6X1.2	40*10	185mm

Mark	Front of IGBT cabinet 2 -6X1.3	Front of inductor frame -6X1.3	40*10	185mm
Mark	Front of IGBT cabinet 2 -6X1.4	Front of inductor frame -6X1.4	40*10	305mm
Mark	Front of IGBT cabinet 2 -6X1.5	Front of inductor frame -6X1.5	40*10	305mm

Step 2 Connection between diode of IGBT cabinet and inductor frame

Table 8-accessories needed for connection between diode of IGBT cabinet and inductor frame

Type	Name	Specification	No.
Accessories	Outer hexagonal bolts	M12*40	12
	Tile gasket	Φ12	48

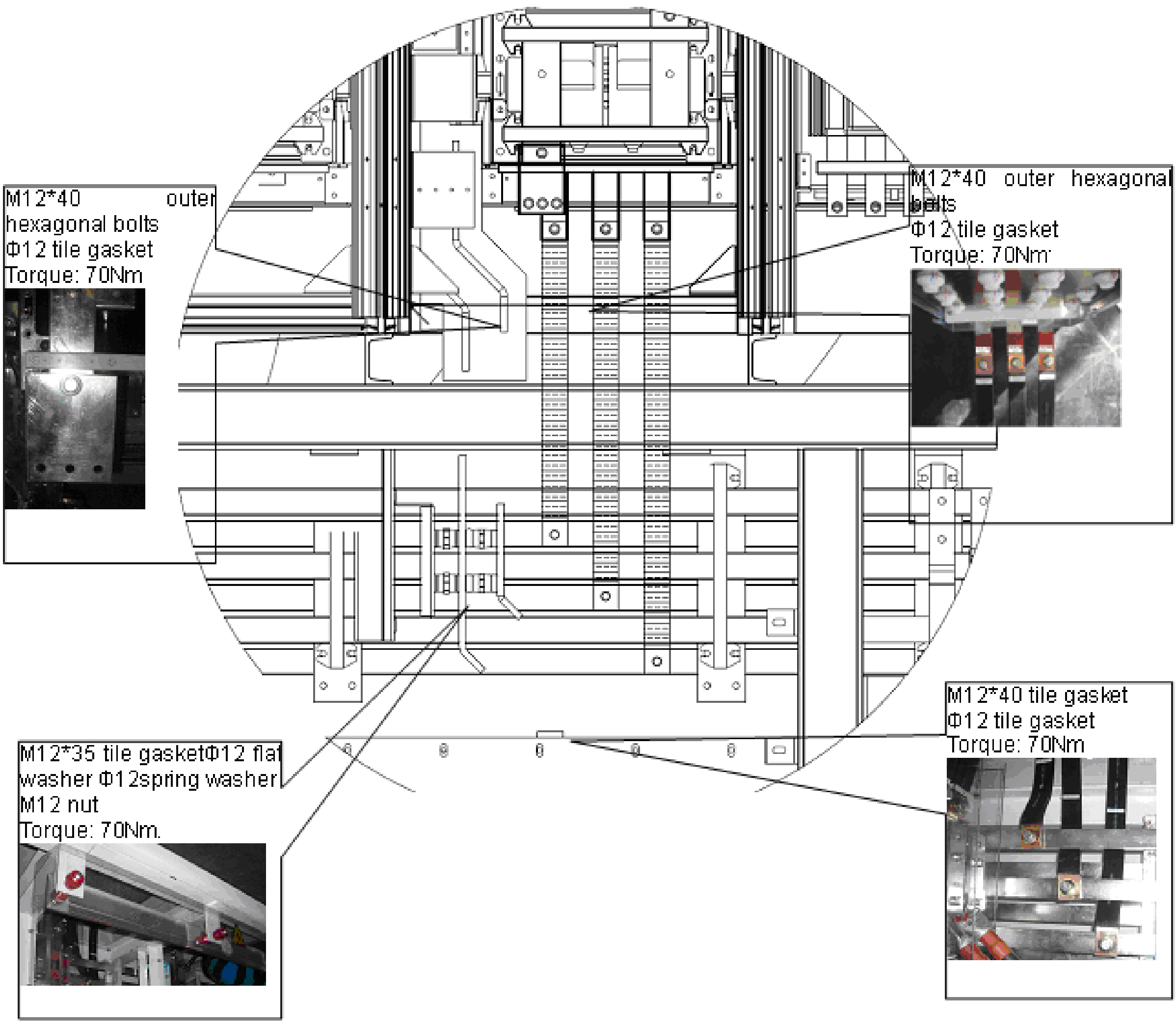


Figure 11 diagram of diode connections

Table 9-cabinet 1、2 installation wiring

	Position 1	Position 2	Specification	Length
Name	IGBT cabinet 1, 2	Inductor frame	Flexible bus bar, cable	
Mark	Front of IGBT cabinet 1 G-L1.1	G-L1.1	40*10	435mm
Mark	Front of IGBT cabinet 1 G-L2.1	G-L2.1	40*10	535mm
Mark	Front of IGBT cabinet 1 G-L3.1	G-L3.1	40*10	635mm
Mark	Front of IGBT cabinet 2 G-L1.2	G-L1.2	40*10	485mm
Mark	Front of IGBT cabinet 2 G-L2.2	G-L2.2	40*10	585mm
Mark	Front of IGBT cabinet 2 G-L3.2	G-L3.2	40*10	685mm
Mark	IGBT cabinet 1 “+”	“+”	150mm^2	610mm

Step 3 Connection between generator/grid side and inductor frame

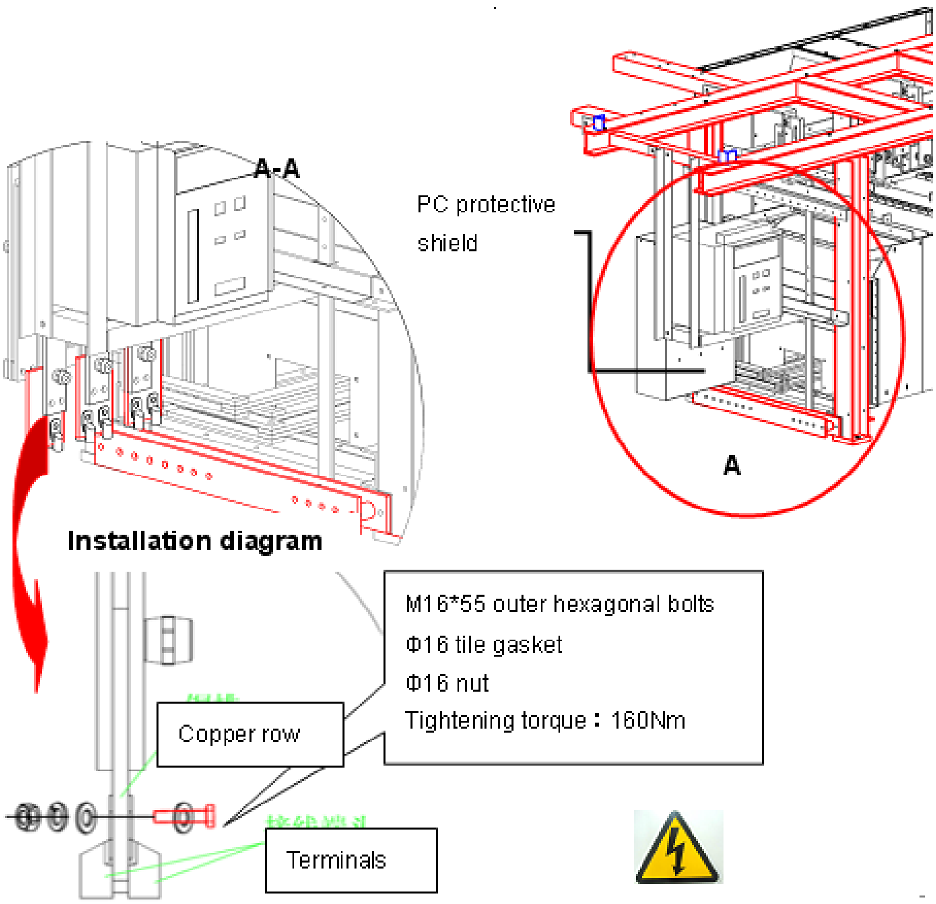


Figure 12 grid side cable connection

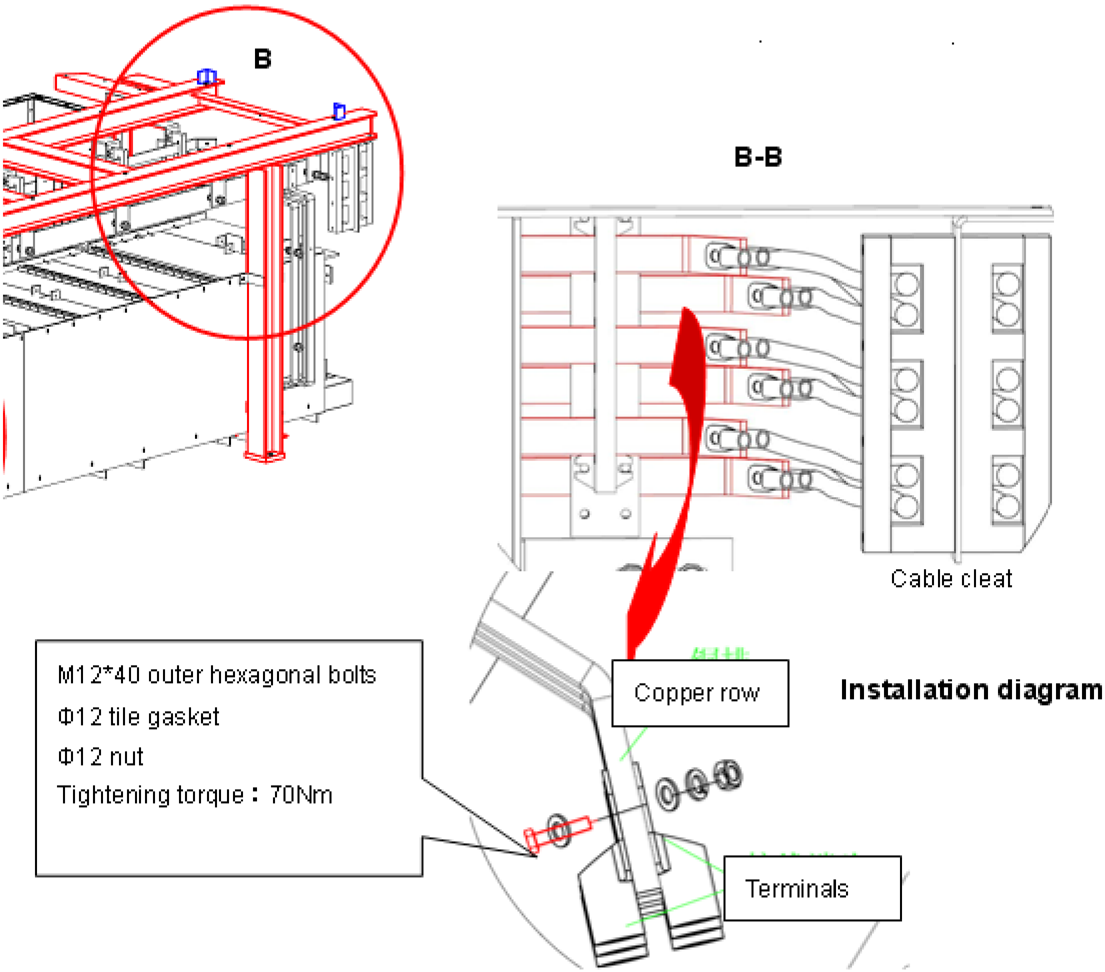


Figure 13 generator side cable connection

Note: in the compression direction of the Flexible bus bar, the terminal end shall be compacted flat and matched.

All high voltage insulation heat shrinks tubing must measure longer than 100 mm.

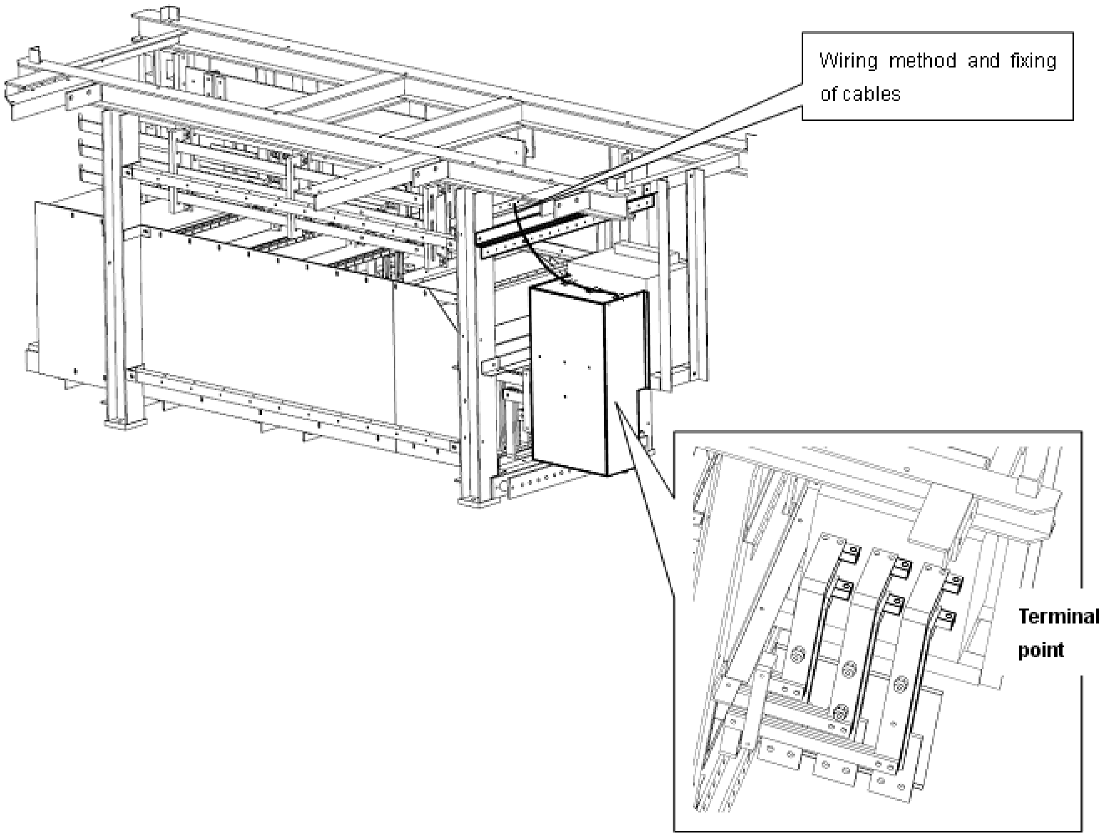


Figure 14 terminal points of grid side

Installation tool: Sleeve (M12)

Table 10- accessorie for connection between generator/grid side and inductor frame

Type	Name	Specification	No.
Generator side accessories	Outer hexagonal bolts	M12*55	12
	Nut	M12	12
	Flat washer	Φ12	24
Grid side accessories	Outer hexagonal bolts	M16*55	6
	Nut	M12	6
	Flat washer	Φ12	12

Table 11- Inductor frame motor side connection

	Position 1	Position 2	Specification
Name	Inductor frame	Switch box 1, 2	Flexible bus bar
Mark	G-L1.1	L1—7TA1.1	185mm^2
Mark	G-L2.1	L2—7TA2.1	185mm^2
Mark	G-L3.1	L3—7TA3.1	185mm^2
Mark	G-L1.2	L1—7TA1.2	185mm^2

Mark	G-L2.2	L2—7TA2.2	185mm^2
Mark	G-L3.2	L3—7TA3.2	185mm^2

Step 4 Connection between capacitor cabinet and inductor frame

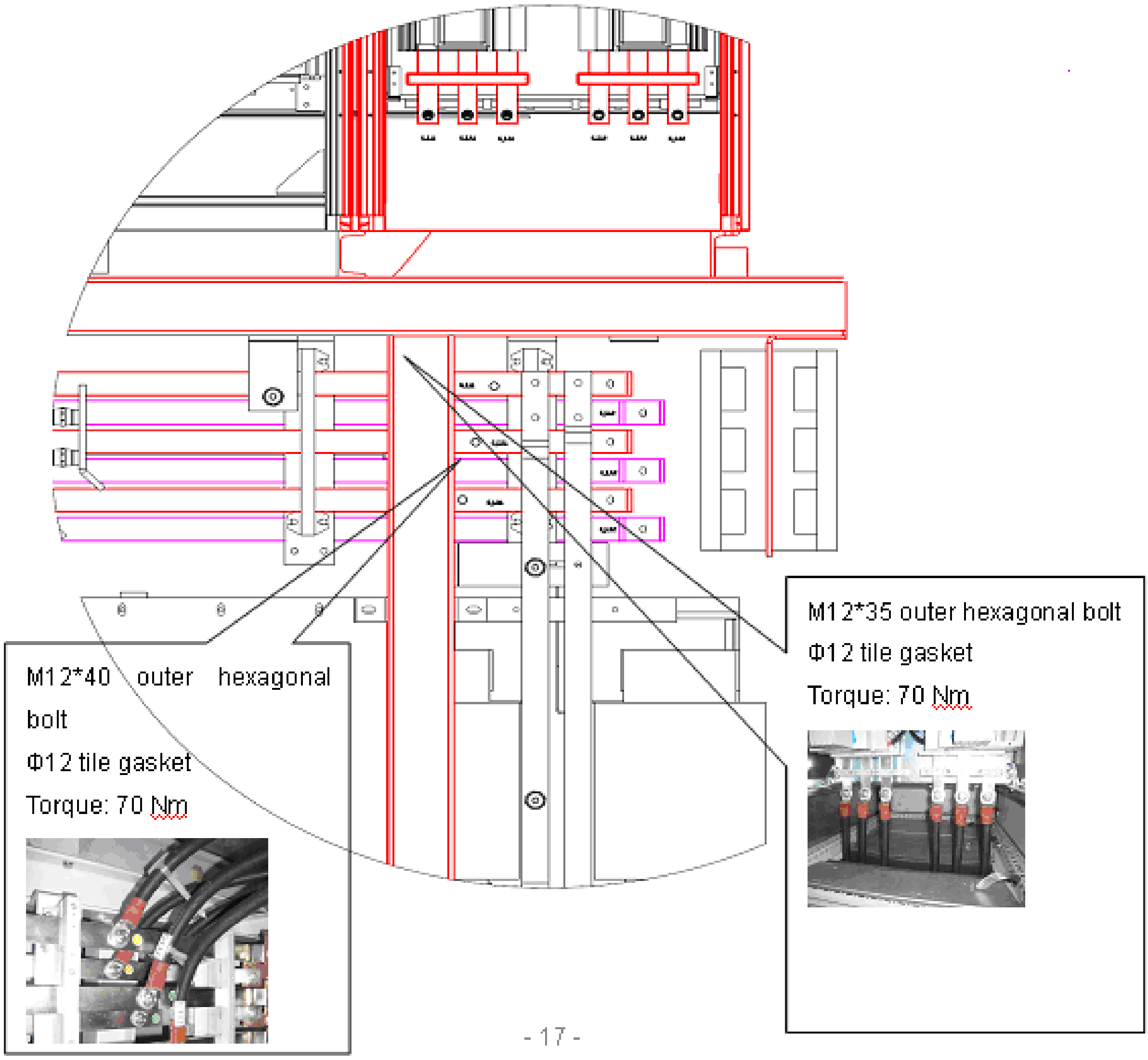


Figure 15 connection between capacitor cabinet and inductor frame

Installation tool: sleeve（M12）

Table 12- accessories for connection between capacitor cabinet and inductor frame

Type	Name	Specification	Quantity
Accessory	Outer hexagonal bolt	M12*35	12
	Tile gasket	Φ12	12

Table 13- Capacitor cabinet wiring connection

	Position 1	Position 2	Specification	Length
Name	Capacitor box	Inductor frame	Cable	
Mark	Q1/1	G-L1.1	150mm^2	800mm
Mark	Q1/3	G-L2.1	150mm^2	900mm
Mark	Q1/5	G-L3.1	150mm^2	1000mm
Mark	Q2/1	G-L1.2	150mm^2	940mm
Mark	Q2/3	G-L2.2	150mm^2	1000mm
Mark	Q2/5	G-L3.2	150mm^2	1100mm

4.1.2 Cable connections of the main control cabinets, inductor frame, transformer frame& fans

Special wire clips used for cables are fastened on the cable beam.

Note: For the converter system with dehumidifier, the cable connection is introduced in the APPENDIX B.

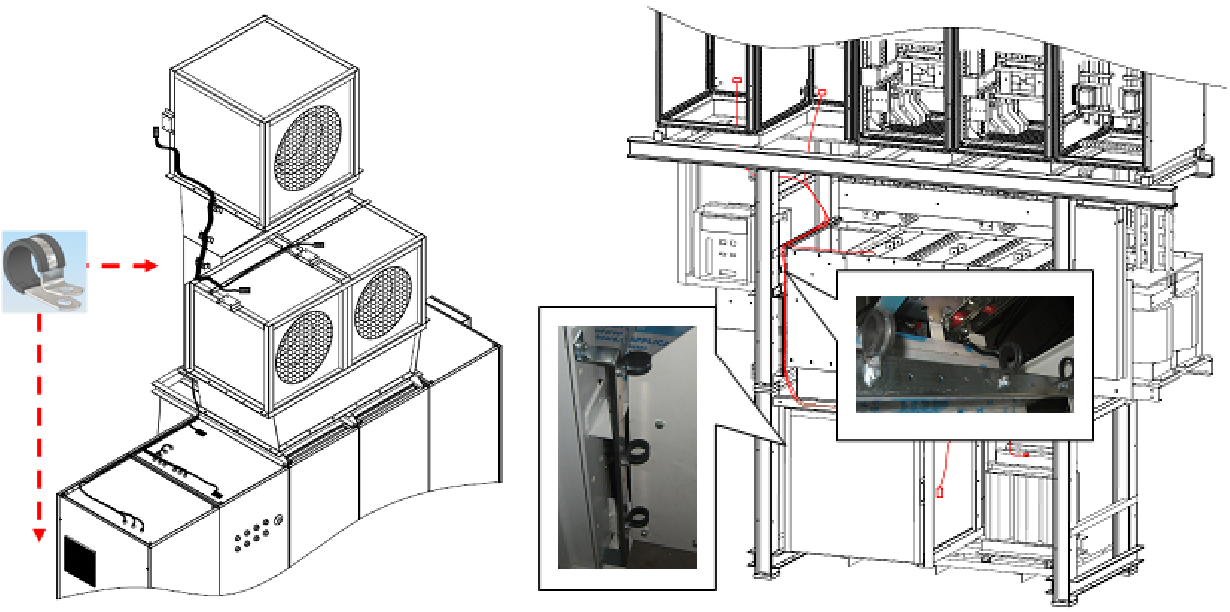


Figure 16 fixing of fans cables

Installation tool: sleeve (M12), sleeve (M6)

Table 14- accessories for fixing of fans cables

	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6
Name	Low voltage distribution cabinet	Master control cabinet	Fans	Inductor frame	Transformer frame	Nacelle box
Mark	2Q1/1			1Q2/2		
Mark	2Q1/3	-13XS2	-13XS2（cabinet top）	1Q2/4		
Mark	2Q1/5	-13XS3	-13XS3（cabinet top）	1Q2/6		
Mark	-2XS4 base	-12XS6	-12XS6（transformer frame）		-2XS4 plug	
Mark	1Q7/1			1Q2/1		
Mark	1Q7/3			1Q2/3		
Mark	1Q7/5			1Q2/5		
Mark		-1X4/1		-1T2.1/S1		
Mark		-1X4/2		-1T2.1/S2		
Mark		-1X4/3		-1T2.2/s1		
Mark		-1X4/4		-1T2.2/s2		
Mark		-1X4/5		-1T2.3/s1		
Mark		-1X4/6		-1T2.3/s2		
Mark		-20XS6 terminal		-20XS6 plug		
Mark		-4XS2 terminal		-4XS2 plug		
Mark		-2XS6 base			-2XS6 plug	
Mark		-2X7/1			2T4/3U1	
Mark		-2X7/2			2T4/3V1	
Mark		-2X7/3			2T4/3W1	
Mark		-2X7/4			2T4/3N	
Mark		-13XS6 terminal				
Mark		-3XS4				-XS101
Mark		-9X3 tower lighting				
Mark		-9X5 booster				
Mark		-15XS1				-XS122

4.1.3 Earth/ground connection

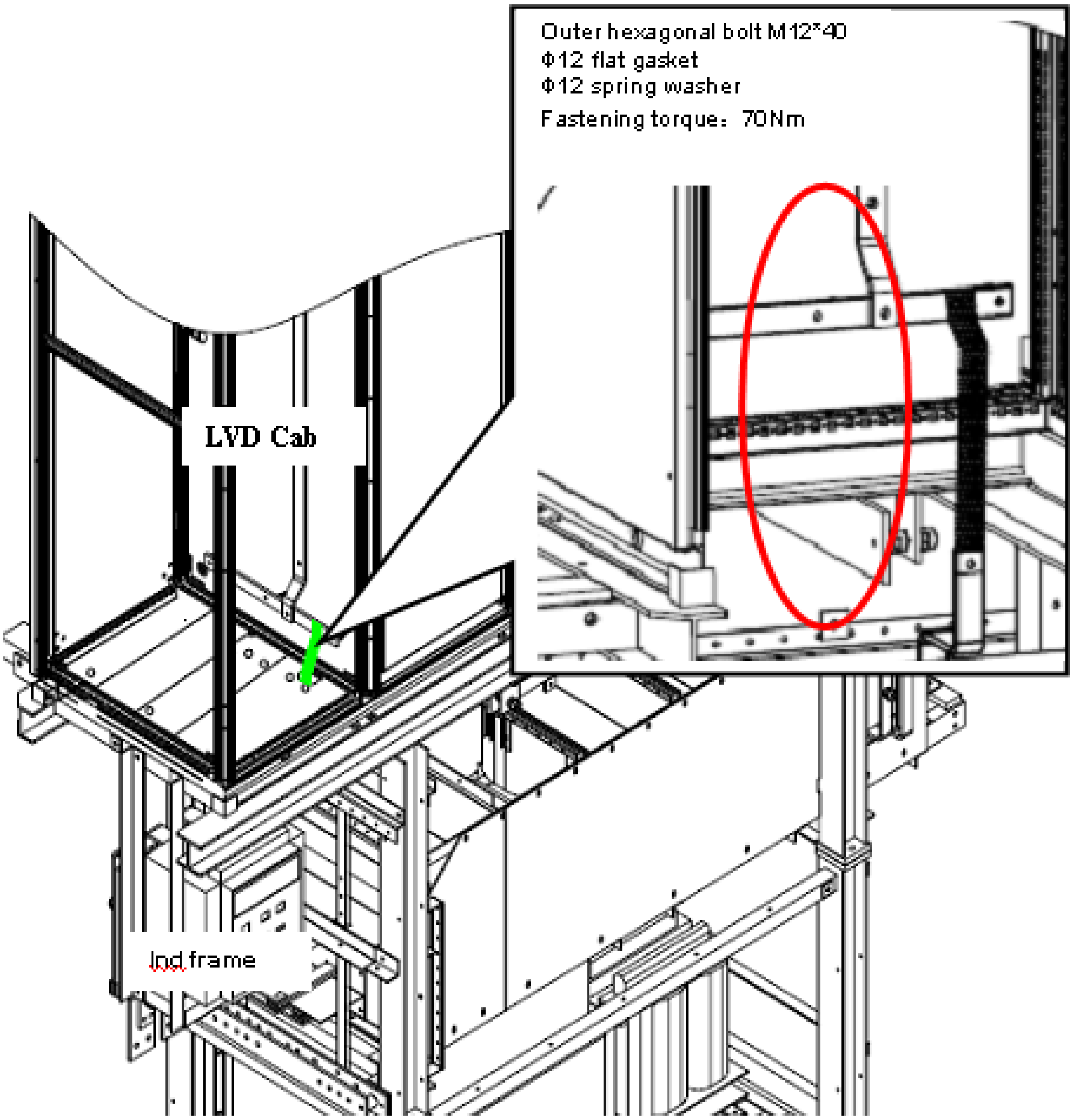


Figure 17 earth bar connection and fixing

Earth connection of the low voltage distribution cabinet and inductor frame uses the accompanied accessory soft bus bar in the specification of 40×10×315 mm. Please refer the installation instructions.

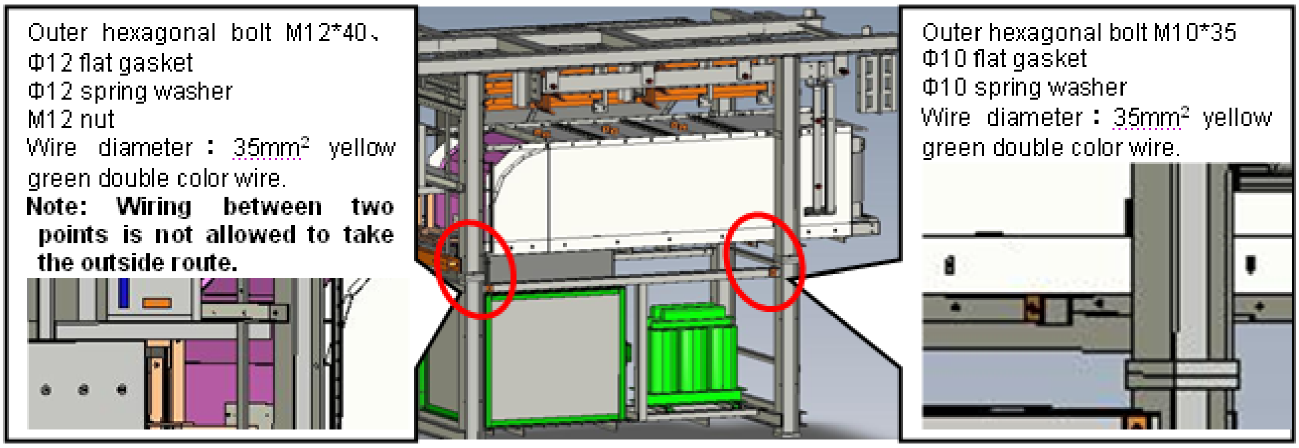


Figure 18 earth cable fixing of two frames

Wiring of resistor box: remove side panel of the resistance box and install cables. Wiring and fastening method are shown in Figure 19 and Figure 20.

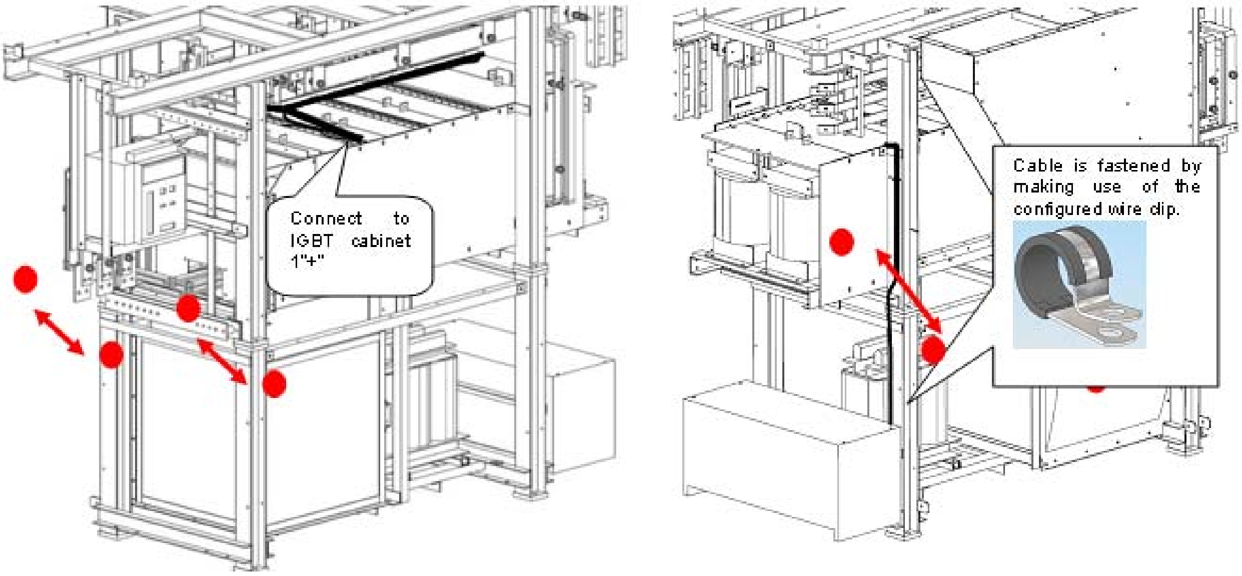


Figure 19 chopper resistor cables connection

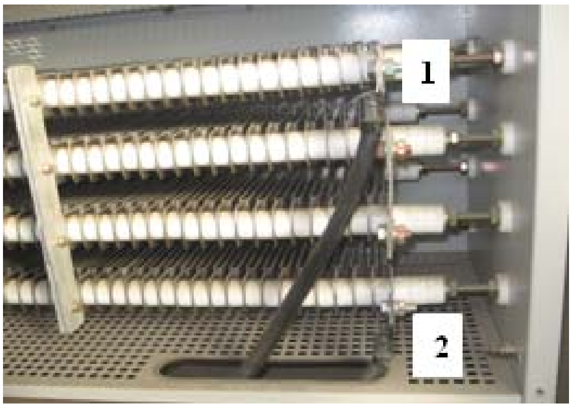


Figure 20 terminal connection of chopper resistor

Table 15- chopper resistor wiring connections

	Position 1	Position 2	Position 3	Specification
Name	IGBT cabinet 1	Inductor frame	Resistance box	Cable
Mark	"+"		1	70mm^2
Mark		-5X1.4	2	70mm^2

4.2 Schematics of the cable connection for the nacelle system

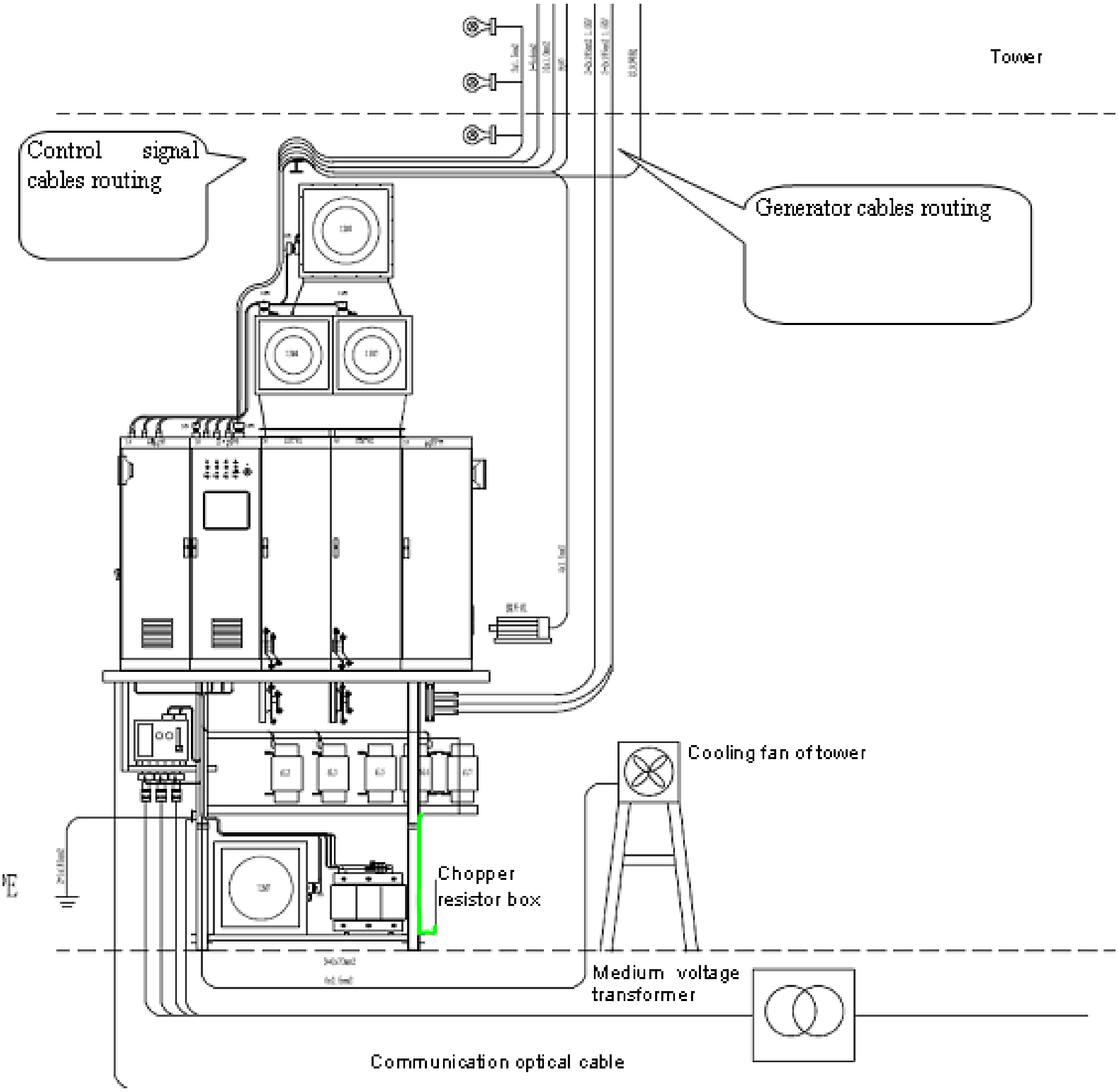


Figure 21 cables between converter and main system

For detailed cable wiring between the converter system and the whole turbine system, see the document "*GW 1500kW wind turbine field electrical wiring for Freqcon system*".

4.3 Testing after the installation

Recheck the fastened torque of bolts, especially for cables.

Table 16- torque value for different bolt

bolt size	torque	note
Φ6	8Nm	the torque value suits to bolts from Goldwind (carbon 8.8)
Φ8	20Nm	
Φ10	40Nm	
Φ12	70Nm	
Φ14	90Nm	
Φ16	120Nm	

5 Hardware

5.1 Topology of the converter

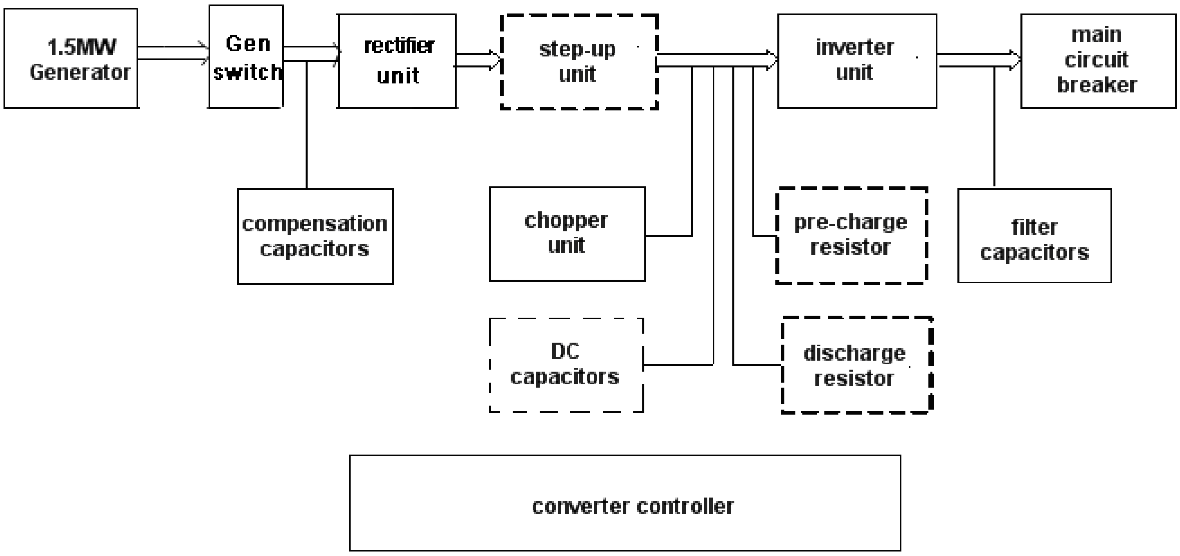


Figure 22 structure diagram of converter system

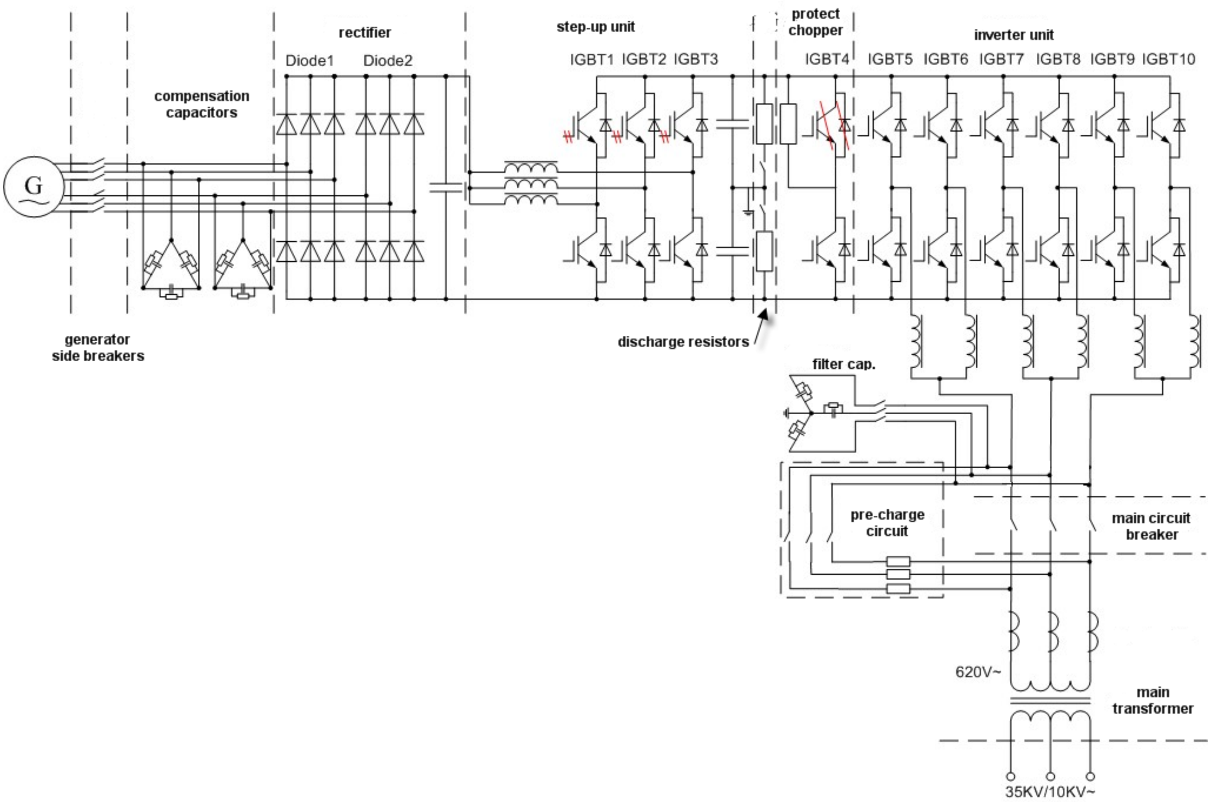


Figure 23 main circuit topology of converter

The topology of the converter shows the system structure from the generator to the grid side. This includes the generator-side breaker, compensation capacitors for the generator, diodes rectifier, step-up circuit, chopper for protection, inverter circuit, grid filters, main circuit breaker, pre-charge and discharge circuit.

The generator-side breakers are in two cabinets in the nacelle. The main circuit breaker is located on the left side of the inductor frame. Compensation capacitors and filter capacitors are in the No.5 cabinet (on the right side) of converter.

The step-up circuit and inverter circuit consist of IGBT modules and chokes (inductors). Chopper circuit consists of IGBT module and the resistor. Both IGBT modules and diode modules are installed in the converter cabinet 3 and 4. The chokes are installed in the frame under the cabinets.

Pre-charge and discharge circuits and all auxiliary circuits are in converter cabinet 1.

Function of topology

The voltage, current and frequency of AC power from the generator are changing with its rotating speed. This AC power is rectified by diode bridge to DC power, and then stepped up by step-up (boost) circuit to ± 560~600VDC range (depends on power magnitude). Finally, the DC power is transformed to AC power again by inverter circuit, which is match with the grid voltage and frequency.

The pre-charging of the DC-link must be done before the main circuit closing, otherwise the DC link capacitors are short-circuited to the grid by the IGBTs' paralleling diodes in several seconds, which means the DC link will be damaged!

The chopper circuit is used for DC link overvoltage protection and the discharge circuit is used for the DC link capacitors discharging for safety reason.

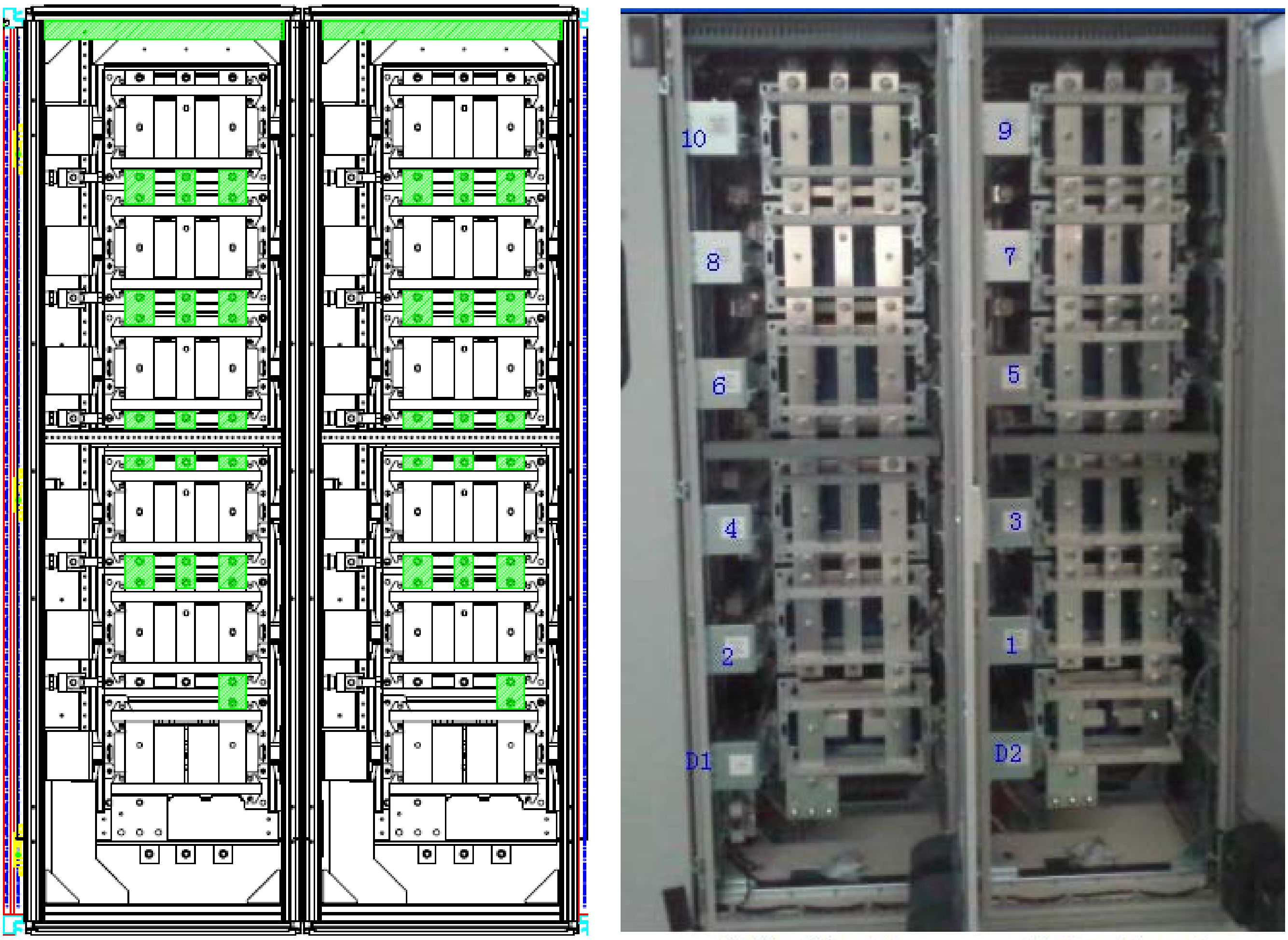
5.2 Power modules and compensation capacitors

Power modules including IGBT modules and power diode modules are the most important parts of energy transformation.

There are 10 IGBT modules in the converter. IGBT 1~3 are used in the step-up circuit, IGBT4 is used in chopper circuit, IGBT5~10 are used in inverter circuit.

There are 2 diode modules for 2 set of 3-phase generator windings output cables.

There are 4 banks of compensation capacitors for the generator. The PMSG with diode rectifier will create inductive current in its windings so proper compensation capacitors are used to provide suitable capacitive reactive power and make the power factor of generator to 1.0 and then the efficiency and capacity of generator will be raised.



IGBT cabinets

IGBT cabinet 1 IGBT cabinet 2

Figure 24 arrangement of power modules in cabinets

IGBT module and diode module have similar structure. IGBT module is shown in Figure25.

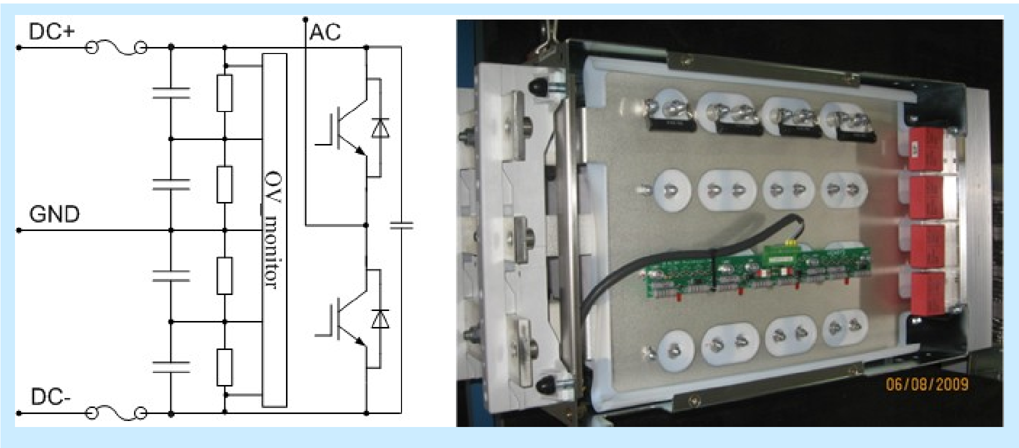


Figure 25 structure of IGBT module

The module consists of IGBT the unit (Semikron - IPM Skiip3 2403GB172 for Goldwind 70/77/82, or IPM Skiip4 2414GB17E4 for boost units of Goldwind 87,the boost units are IGBT1,IGBT2 and IGBT3 in Figure 23), the electrolytic capacitors, the snubber capacitors, the resistors for voltage averaging,

the over-voltage protection board and the DC fuses as shown in Figure 25.
There are Infineon diodes unit inside the diode module but there is no snubber capacitors, so are the other components.

Figure 26 compensation capacitor banks

The compensation capacitor banks are in the right capacitor cabinets, the capacitor bank is shown in Figure 26. The capacitors are linked parallel to the copper bars by fuse switch (or ABB T-max breaker). The copper bars are connected to the generator cable under the cabinet as mentioned in Chapter 3.

5.3 Converter controller

The control system mainly includes the converter controller module (box) and the PLC system, which are installed in converter cabinet 2.
The converter controller module (CCM) connects a High voltage I/O board to measure the voltage and current signal of the main circuit. CCM also connects the PLC modules to exchange the analogue and digital signals. CCM also connects and controls all IGBT modules to achieve the converter's function.

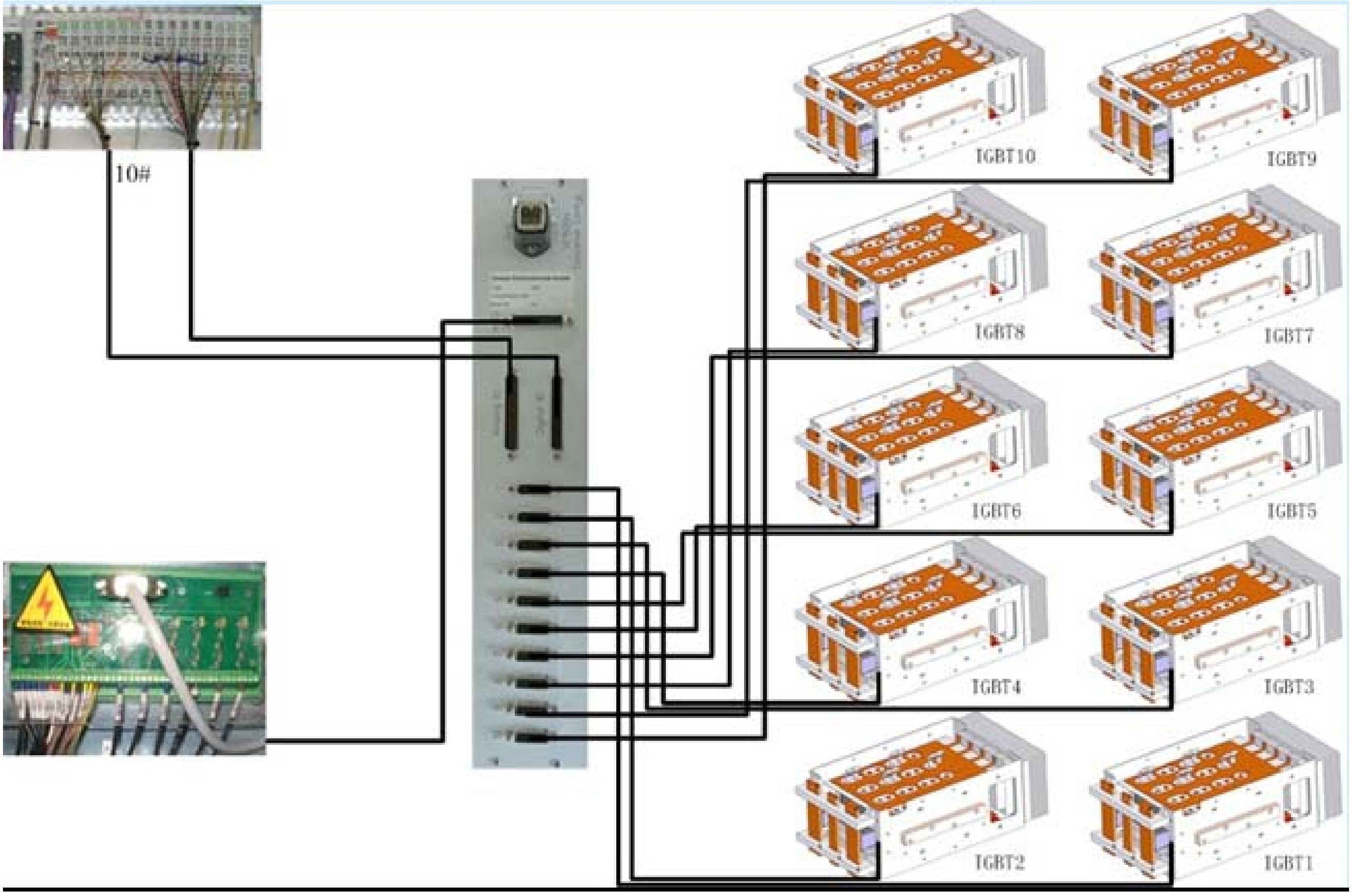


Figure 27 connection for converter controller module

5.3.1 Converter controller module

The converter controller module (box) or called CCM is the most important part of Goldwind Type I Converter .

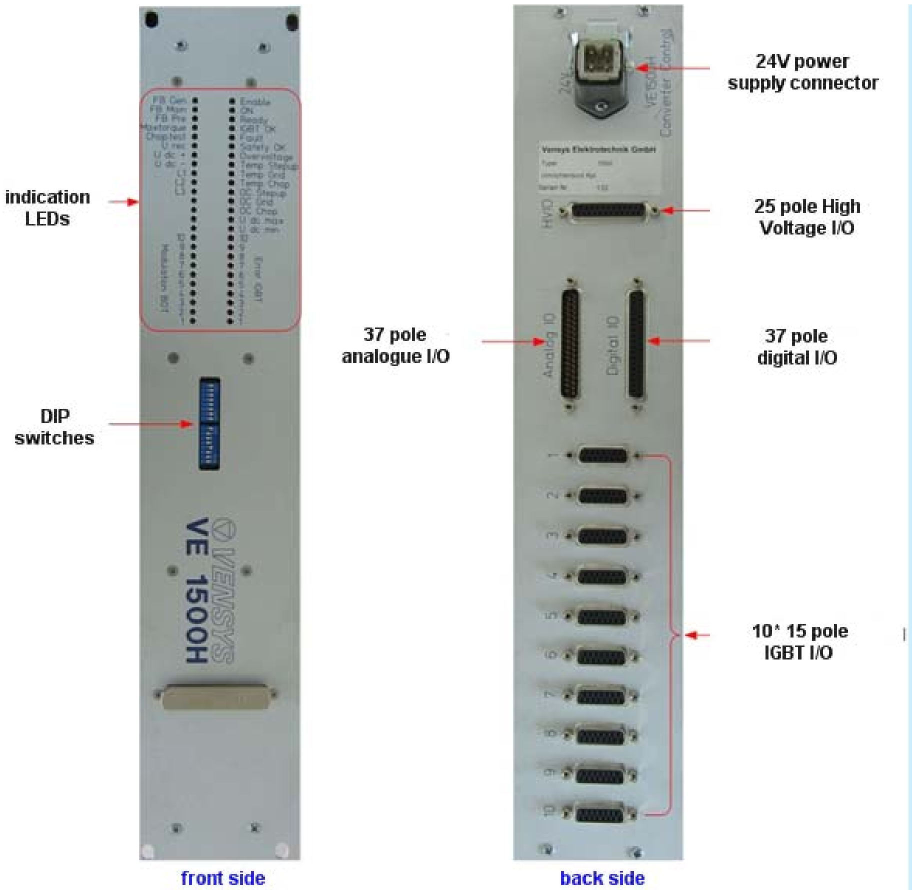


Figure 28 front/back view of CCM

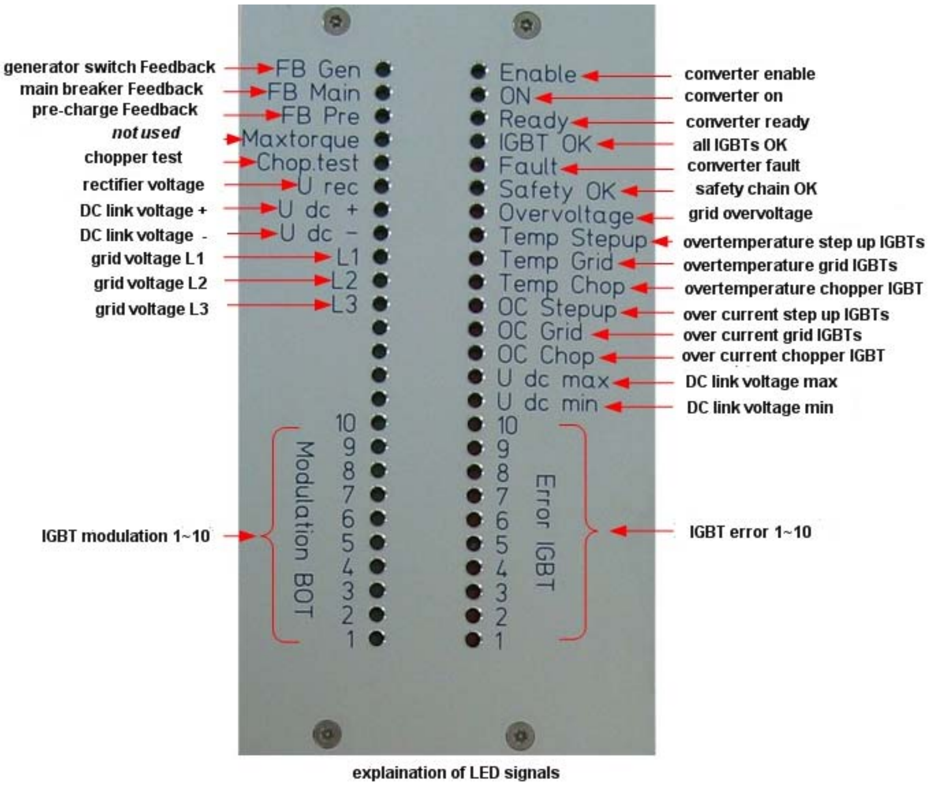


Figure 29 front LED explanation

Explanation of DIP switches

Table 17- explanation of switch

Switch1 , left side

Switch Nr.	Function
1on	IGBT 1 disabled Step up 1
1off	IGBT 1 enabled
2on	IGBT 2 disabled Step up 2
2off	IGBT 2 enabled
3on	IGBT 3disabled Step up 3
3off	IGBT 3enabled
4on	IGBT 5disabled L1b
4off	IGBT 5 enabled
5on	IGBT 6 disabled L1a
5off	IGBT 6 enabled
6on	IGBT 7 disabled L2b
6off	IGBT 7 enabled
7on	IGBT 8 disabled L2a
7off	IGBT 8 enabled
8on	IGBT 9 disabled L3b
8off	IGBT 9 enabled

Switch1 , right side

Switch Nr.	Function
1on	IGBT 10disabled L3a
1off	IGBT 10enabled
2on	Enable Step up converter test analogue signal
2off	Disable Step up converter test
3on	
3off	
4on	Enable chopper test
4off	Disable chopper test
5on	Disable top IGBT 1 for step up converter test
5off	Enable top IGBT1 for step up converter test

5.3.2 I/O connectors of CCM Definitions

There are 10 ×15-pole D_sub female connectors. These connect to 10 IGBT modules via shield cables. Each signal of pole is defined as following table.

Table 18- IGBT connection signal description

Flat cable number	DSUB number	colour	description
1	1		Nc
2	9		IGBT bot in
3	2		Error current volt.
4	10		IGBT top in
5	3		Overtemp
6	11		+24V
7	4		+24V
8	12		+15V
9	5		+15V
10	13		Gnd
11	6		Gnd
12	14		Analog temp
13	7		Analog gnd
14	15		Analog current
15	8		nc

37-pin Dsub male connector is for the analogue signals. It connects PLC module via shield cable. Each signal pin is defined in the following table.

Table 19- analogue connection signal description

Flat cable number	DSUB number	colour	description
1	1		Analogue gnd Profi Bus
2	20		profi_in_converter_UL1 1Vdc = 50Vrms
3	2		profi_in_converter_UL2
4	21		profi_in_converter_UL3
5	3		profi_in_converter_I1 1Vdc = 187,5Arms
6	22		profi_in_converter_I2
7	4		profi_in_converter_I3
8	23		profi_in_converter_active_power 1Vdc = 175kW
9	5		profi_in_converter_reactive_ power 1Vdc = 175kVA
10	24		Analogue gnd Profi Bus
11	6		profi_in_converter_rectifier_U 1Vdc = 70Vdc, range from –650 to +650V , calculate Urec – Udc- for power control
12	25		profi_in_converter_U_DC + 1Vdc = 70 Vdc
13	7		profi_in_converter_U_ DC - 1Vdc = 70 Vdc
14	26		profi_in_converter_grid_frequenzy 1V = 10Hz
15	8		Do not connect
16	27		profi_in_converter_chopper_I 1V = 166,6Adc
17	9		profi_in_converter_I_DC DC of step up converter 1V = 125Adc
18	28		Do not connect
19	10		Do not connect
20	29		Do not connect
21	11		profi_in_converter_step_up_igbt_temperature1 0…10V = 20..120°C,
22	30		profi_in_converter_step_up_igbt_temperature2
23	12		profi_in_converter_step_up_igbt_temperature3
24	31		profi_in_converter_chopper_igbt_temperature
25	13		profi_in_converter_grid_L1a_igbt_temperature
26	32		profi_in_converter_grid_L1b_igbt_temperature
27	14		profi_in_converter_grid_L2a_igbt_temperature
28	33		Analogue gnd Profibus
29	15		profi_in_converter_grid_L2b_igbt_temperature
30	34		profi_in_converter_grid_L3a_igbt_temperature
31	16		profi_in_converter_grid_L3b_igbt_temperature
32	35		profi_out_converter_DC_ current_setpoint 1V = 75VDC
33	17		profi_out_converter_reactive_power_setpoint 1V = 59Aac
34	36		profi_out_converter_test_circle_ AC_current_setpoint 1V = 176Aac
35	18		profi_out_converter_test_circle_ DC_ current_setpoint 1V = 75A
36	37		Do not connect
37	19		Do not connect

37-pole Dsub female connector is for digital signals. It connects PLC module via shield cable. Each signal pole is defined in the following table.

Table 20- analogue connection signal description

Flat cable number	DSUB number	colour	description
1	1		Connect +24V supply field bus
2	20		Connect to gnd supply field bus
3	2		Do not connect
4	21		Do not connect
5	3		profi_out_converter_test_circle_AC low = no test
6	22		profi_out_converter_test_circle_ DC low = no test
7	4		profi_out_converter_on low : converter is off
8	23		profi_out_converter_enable low: converter not enabled
9	5		profi_out_converter_test_chopper low: no test
10	24		safety_clamp_out_converter_safety_sys_fault low: fault condition
11	6		safety_clamp_out_converter_safety_sys_torque_max low : no torque required
12	25		Do not connect
13	7		Do not connect
14	26		Do not connect
15	8		Do not connect
16	27		Do not connect
17	9		safety_clamp_in_converter_generator_contactor_switch_on low: contactor is off
18	28		Do not connect
19	10		Do not connect
20	29		Do not connect
21	11		Do not connect
22	30		profi_in_converter_grid_ IGBT_fault low: no fault
23	12		profi_in_converter_chopper_ IGBT_ fault "
24	31		profi_in_converter_step_ up_ IGBT_fault "
25	13		profi_in_converter_DC_ link_max "
26	32		profi_in_converter_DC_link_min "
27	14		profi_in_converter_phase_ voltage_ peak "
28	33		Do not connect
29	15		profi_in_converter_grid_ IGBT_overcurrent_peak "
30	34		profi_in_converter_chopper_overcurrent "
31	16		profi_in_converter_DC_current_overcurrent "
32	35		profi_in_converter_pulsino low : no pulsino, Info
33	17		profi_in_converter_ready low: not ready
34	36		profi_in_converter_ IGBT_ ok low : IGBT not ok
35	18		profi_in_converter_generator_ contactor_feedback low: not closed
36	37		profi_in_converter_main_contactor_feedback low: not closed
37	19		profi_in_converter_precharge_contactor_feedback low: not closed

25-pole Dsub female connector is for High Voltage I/O signal. It connects PLC module via shield cable. Each signal pole is defined in the following table.

Table 21- HVI/O connection signal description

Flat cable number	DSUB number	colour	description
1	1		Analogue gnd
2	14		Current L1b
3	2		Analogue gnd
4	15		Phase L3
5	3		Analogue gnd
6	16		Phase L2
7	4		Analogue gnd
8	17		Phase L1
9	5		Nc
10	18		Dclink +
11	6		Nc
12	19		Dclink -
13	7		Current L3b
14	20		Rec+
15	8		Current L2b
16	21		
17	9		
18	22		
19	10		
20	23		Switch on net contactor
21	11		Switch on precharge contactor
22	24		Feedback precharge
23	12		Feedback net contactor
24	25		+24V ext. supply
25	13		Gnd ext. supply

37-pole Dsub male connector is in front. Most analogue signals can be detected by this connector. Each signal pin is defined in the following table.

Table 22- analogue test and measure-used signal description

Flat cable number	DSUB number	colour	description
1	1		Current phase L2
2	20		
3	2		Voltage Phase L2
4	21		
5	3		Current Phase L3
6	22		
7	4		Voltage Phase L3
8	23		
9	5		UDC+
10	24		
11	6		UDC-
12	25		
13	7		Rectifier DCvoltage
14	26		
15	8		Current IGBT 1
16	27		
17	9		Current IGBT 2
18	28		
19	10		Current IGBT 3
20	29		
21	11		Current IGBT 4
22	30		
23	12		Current IGBT 5
24	31		
25	13		Current IGBT 6
26	32		
27	14		power
28	33		
29	15		Current IGBT7
30	34		
31	16		Current IGBT8
32	35		gnd
33	17		Current IGBT9
34	36		Current phase L1
35	18		Current IGBT10
36	37		Voltage Phase L1
37	19		

6 Commissioning

6.1 Preparation

6.1.1 Commissioning conditions

• The earth connection system should comply with the requirements in file “GW1.5MW wind turbine generator anti-lightning and grounding system installation standard”.

• Check all installation and cable connections according to file “GW 1.5MW wind turbine generator installation check list”.

• When the transformer from medium voltage gets power, check the low voltage side, make sure the phase sequence is right. Pay attention to short circuit of phase-phase or phase-ground by measuring the voltage. (Correct range 600V± 10%).

6.1.2 Notes on commissioning

- Be aware of the safety requirements during operation.
- Maintenance personnel must leave the tower when the transformer gets power initially, they can go back to the tower if nothing happens.
- Maintenance personnel must wear rubber gloves when measuring grid voltage and operating switches manually.
- There is no person allowed near the tower fan when it starts.
- All test instruments must be operated according to the manuals.
- All cable connection and parameter settings must be checked before the turbine turned on.

6.2 Commissioning steps

List of commissioning steps can be found in Table 22.

Note: Before the converter commissioning, the PLC programs should be downloaded to the machine and be debugged first. For the details see appendix A, B of “GW 1.5MW wind turbine generator commissioning manual”.

Table 23- commissioning steps

No.	Item	Item 1	Item 2	description
1	main control system	voltage check		measure the voltage of L1/L2/L3 from main breaker 1Q2, normal value is 600V±5% measure the voltage of terminal 1Q3, 1Q3:1-1Q3:3 、1Q3:1-1Q3:5 、1Q3:3-1Q3：5, the normal value is 600V±5%
		power on of voltage distribution cabinet		Close the switches in sequence: 1Q3、2Q1、2Q2、1Q7、3Q8.1、3Q8.2、5Q8、5Q9、9F3.1、9F3.2、9F6、9F9、10Q2、10F9、10F10、12Q2、12Q6、13Q2、13Q6、14F2、14F4、14F5.(the feedback indicator of switch should be in on position) 15S8 should be turned to service mode, and 15S2 emergency button should be pulling out. All other switches are in off state.
		voltage check		measure voltage of switch 3F2, 3F2:1-3F2:3、3F2:1-3F2:5、3F2:3-3F2:5, the normal voltage is 400V±5%VAC.

				Close 3F2, measure the voltage of 3F2：2-3F2：4 、3F2：2 -3F2：6、 3F2：4 -3F2：6, the normal voltage is 400V±5%VAC. Measure output of 10T4, the normal voltage is +24V±5%. Close 10F7/10F8, measure voltage X24V1-X0V1、X24V2-X0V2, the normal voltage is +24V±5%.
		software download	PLC software download	See detail in appendix A of *GW 1.5MW wind turbine generator commissioning manual*
			display panel software download	See detail in appendix B of *GW 1.5MW wind turbine generator commissioning manual*
2	converter system	converter test		Operating according the detailed requirement

6.3 Commissioning manual for converter

6.3.1 Notes on the converter tests

- Display panel can be used.
- Emergency button is pulled up.
- No IGBT error is in converter CCM.
- The machine is in service mode.
- The communication of LVD and converter sub-station is normal.
- The chopper resistor is connected well.
- The blade should be locked if the nacelle is powered on.

6.3.2 Commissioning steps

6.3.2.1 Settings and test of cooling fan driver converter

All fans are controlled by the ABB frequency converters which are in cabinet 1, Enter LOC REM in the panel, then enter MENU/ENTER to control the fan in local control mode, use or to choose setting mode “rEF” as in Figure 30.

Figure 30 “reF”（setting mode）

Figure 31 enter into frequency setting menu

Enter MENU/ENTER to go down in the menu, as in Figure 31 key to adjust the frequency to 10.0Hz, and then enter START to start the converter as in Figure 32. Look if the fan is running normally and the rotating direction is right.

All 4 ABB converters from left to right is IGBT cooling fan 1, IGBT cooling fan 2, DC capacitor cooling fan and tower base fan.

Figure 32 Setting to 10.0Hz **Figure 33 enter into REM mode**

IGBT cooling fan 1, DC capacitor fans should rotate clockwise. IGBT cooling fan 2 should draw out air from cabinet to tower. Tower base fan should draw air outside. Enter STOP to stop converter running after the test, key to decrease the frequency to 0Hz, then enter EXIT/RESET to go back to main menu, then enter to set the converter to REM (remote mode), as in Figure 33.

6.3.2.2 Pre-charge and main breaker closing test

Push “start” button for 8 seconds. Release when you can hear the closing sound of 11K2. The value of DC link± in the display panel will rise to ±420VDC symmetrically and then the main breaker 1Q2 will close in 1 second with a clear sound. The LED of CCM “FB Main” and “Ready” will light up and all LEDs in HVI/O will light up, the grid filter contact will close and open for 3 seconds.

Note：

i） IGBT cabinets gates should be locked before testing.

ii） To watch pre-charge resistor 3R8, the emergency button must be on if there is any smoke or problem of 3R8 or other components.

iii） If the “Fault” or “Overvoltage” LED light before the first test, all the tests can be done in this situation since the state of these 2 LED indicators is uncertain.

iv） The following tests must be done with the DC link voltage being charged. No one should open the IGBT cabinet when DC link is charged.

6.3.2.3 Parameter setting mode in display panel.

Click “local commissioning and control” in display panel, enter password 1234567 into commissioning mode as shown in Figure 34.

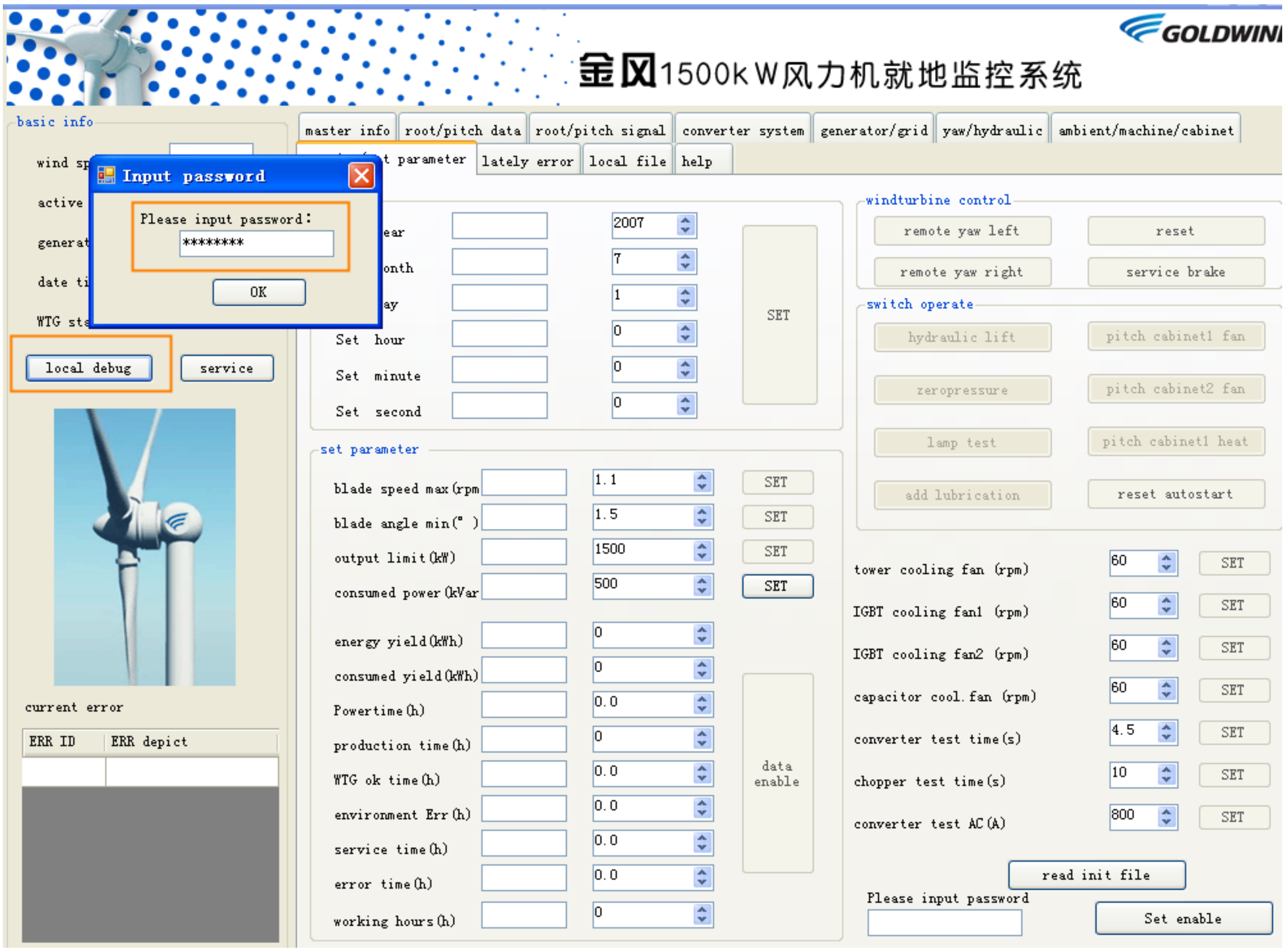


Figure 34 Enter into commissioning mode

Input the password "1234567" and click "parameter setting enable", then click confirm enter. Enter into the parameter setting and commissioning mode.

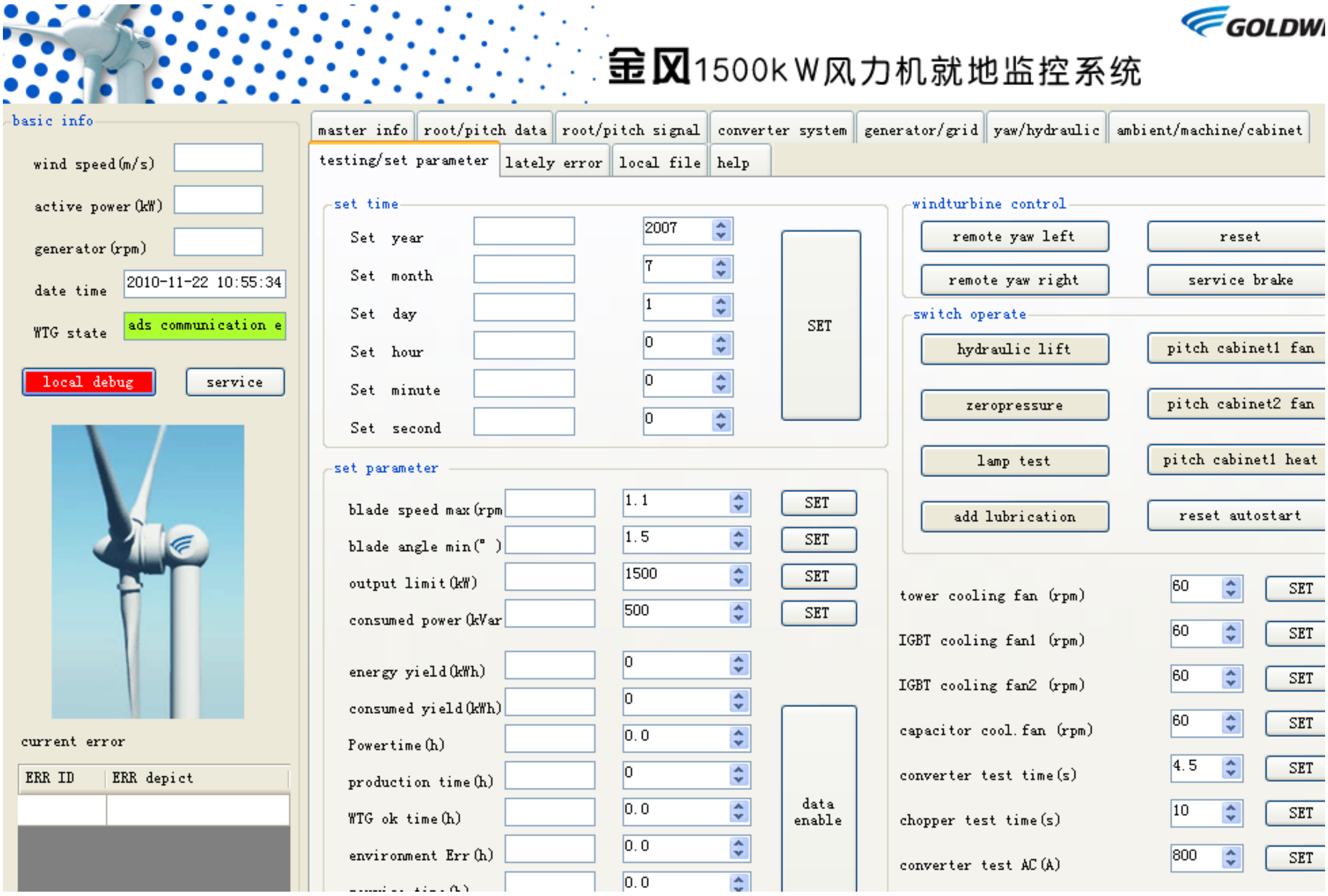


Figure 35 Enter into the state of commissioning parameter setting

6.3.2.4 REM test of cooling fans

Set “IGBT cooling fan 1, 2, DC capacitor fan, tower base fan set” to 10, click “setting” and watch the fan running.

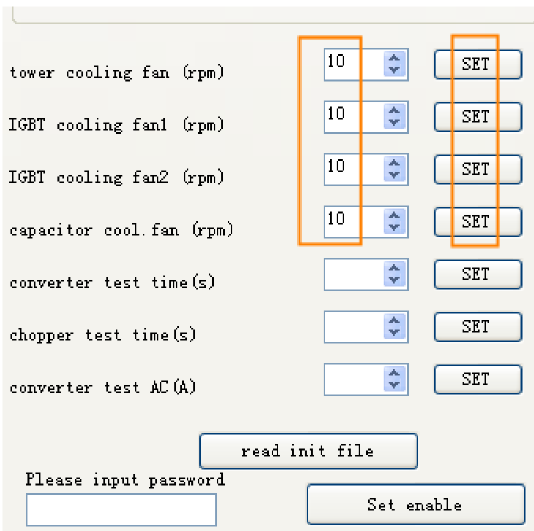


Figure 36 cooling fan tests

6.3.2.5 IGBT chopper test

Set the DIP switches in front CCM as Figure 37 (DIP 2-4, on is test enable, off is disable).

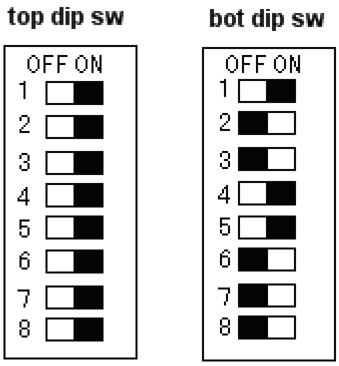


Figure 37 position of DIP switches for chopper test

Set “chopper test time (s)” to 0.02/0.2, click “test chopper enable”, the LED “Chop. test” of CCM should flash one time with short current sound and no error should happen. If this occurs, the chopper IGBT and its circuit are OK.

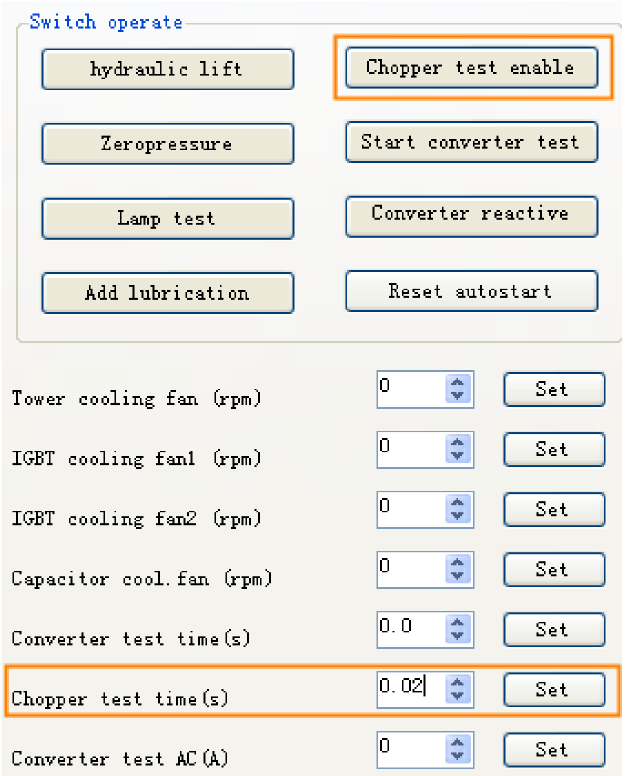


Figure 38 20ms chopper test

Click “chopper test off” and change the value “chopper test time (s)”to 0. Exit the chopper test.

6.3.2.6 Inverter IGBTs test

IGBT 5 test

i) Set DIP switches as in Figure 39

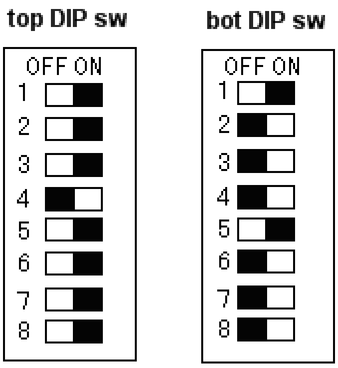


Figure 39 position of DIP switches for IGBT 5 test

ii) Change “converter test time (s)”to 0.02, click “converter test enable” as in Figure 40, then LED “Modulation Bot 5” of CCM will flash a short time with current sound of IGBT, also the grid filter contact will also close after enable and open again 3 seconds after modulation finish. There is no error LED or problem if it works normally.

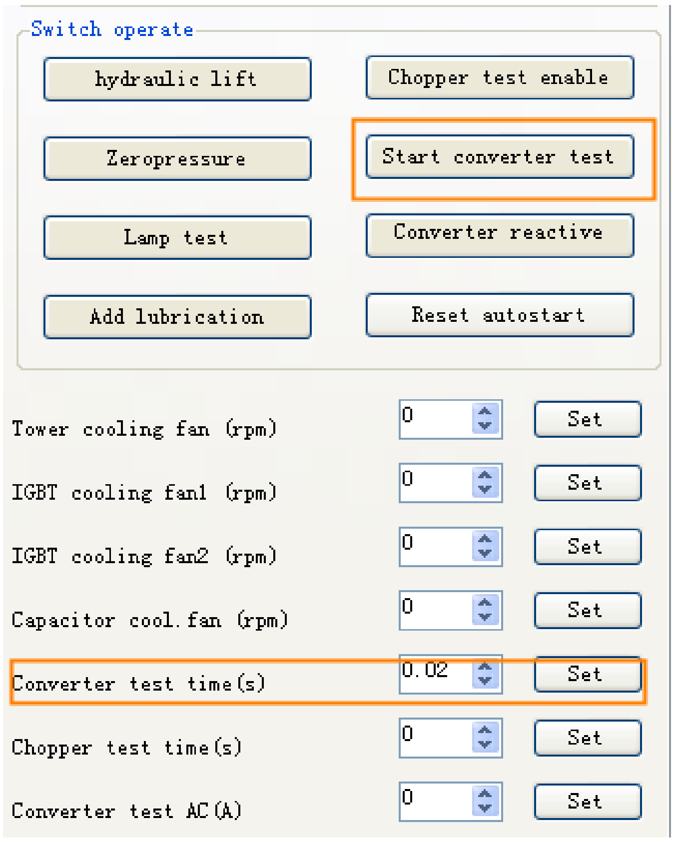


Figure 40 20 ms IGBT 5 test

For long time modulation test, we should also set the “converter test time (s)” to 3 seconds, and then enable it again, as in Figure 41. If there is no problem, please set the “converter test time (s)” to 0 to quit IGBT 5 test.

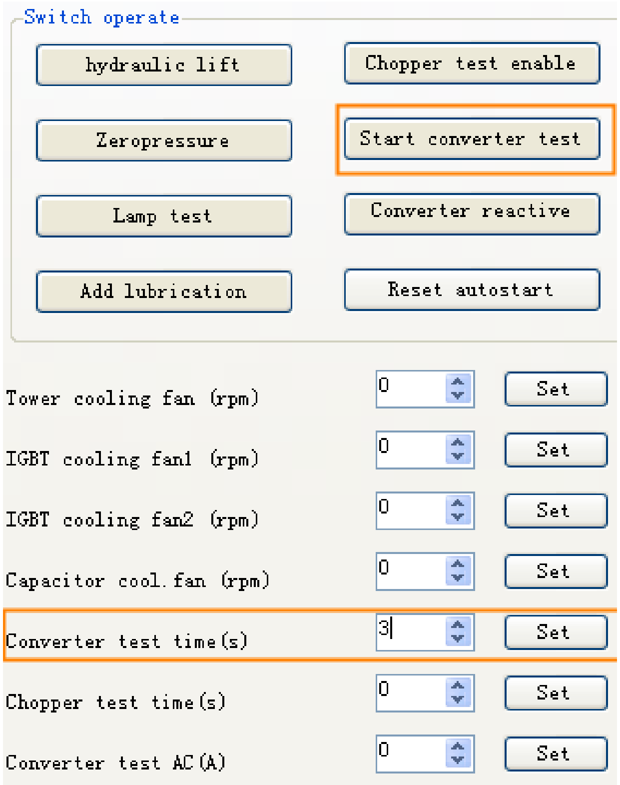


Figure 41 3s IGBT 5 test

IGBT 6 test

i) Set DIP switches as in Figure 42

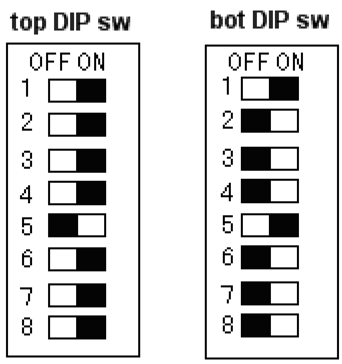


Figure 42 Position of DIP switches for IGBT 6 test

ii) It is similar to the IGBT 5 test, change the “converter test time (s)”to 0.02 and later to 3 s, and watch the LED “Modulation Bot 6” flash and the current sound should be heard, no problem means the IGBT is OK. Change the test time back to 0.

IGBT 7 test

i) Set DIP switches as in Figure 43

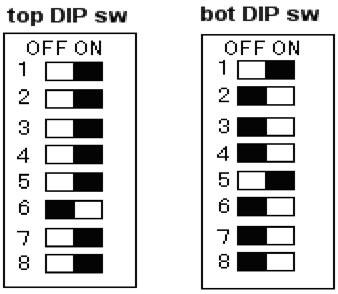


Figure 43 position of DIP switches for IGBT 7 test

ii) It is similar to the IGBT 5 test, change the “converter test time (s)”to 0.02 and later to 3 s, and watch the LED “Modulation Bot 7” flash and the current sound should be heard, no problem means the IGBT is OK. Change the test time back to 0.

IGBT 8 test

i) Set DIP switches as in Figure 44

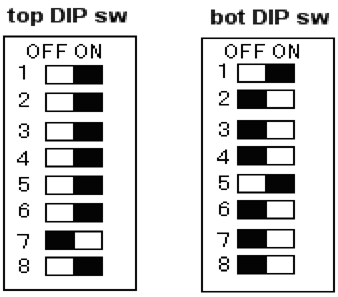


Figure 44 position of DIP switches for IGBT 8 test

ii) It is similar to the IGBT 5 test, change the “converter test time (s)”to 0.02 and later to 3 s, and watch the LED “Modulation Bot 8” flash and the current sound should be heard, no problem means the IGBT is OK. Change the test time back to 0.

IGBT 9 test

i) Set DIP switches as in Figure 45

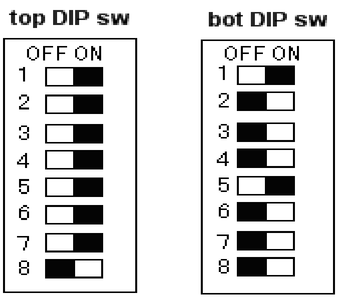


Figure 45 position of DIP switches for IGBT 9 test

ii) It is similar as IGBT 5 test, to change the “converter test time (s)”to 0.02 and later to 3 s, and watch the LED “Modulation Bot 9” flash and hear the current sound, no problems means IGBT OK. Change the test time to 0 back.

IGBT 10 test

i) Set DIP switches as in Figure 46

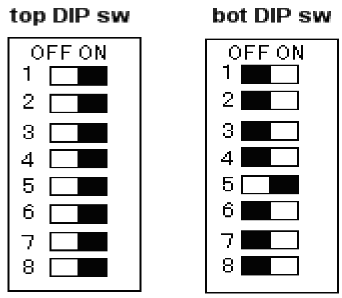


Figure 46 position of DIP switches for IGBT 10 test

ii) It is similar to the IGBT 5 test, change the “converter test time (s)”to 0.02 and later to 3 s, and watch the LED “Modulation Bot 10” flash and the current sound should be heard, no problem means the IGBT is OK. Change the test time back to 0.

All inverter IGBTs tests now have been completed.

6.3.2.7 Inverter IGBT AC current running test

i) Set DIP switches of CCM as in Figure 47

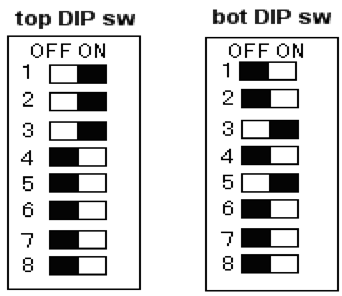


Figure 47 state of inverter AC current test

ii) Inverter AC current test

Set “IGBT cooling fan 1/2 speed setting”, “DC capacitor fan speed setting” to 60 and set “tower base fan speed setting” to 70 then change the “converter test time (s)” to 7200 as in Figure 48. Click “converter test enable” to get into test state. All the cooling fans will run and LED “Modulation Bot 5~10” will flash with a clear current sound, the DC link voltage will raise about 20VDC to ±550V. If there are no errors, all inverter IGBT are in the AC current running state.

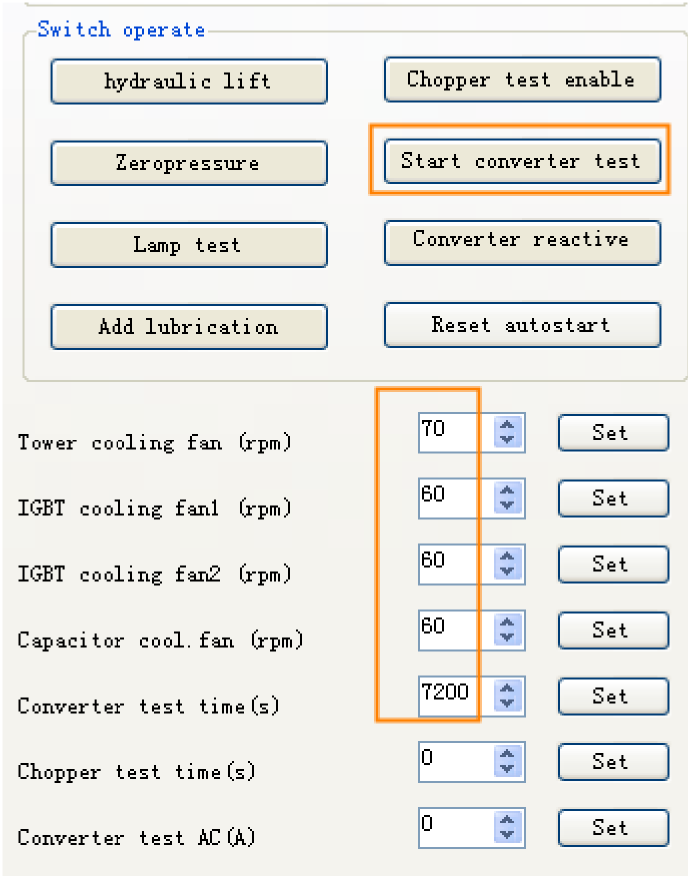


Figure 48 enter into parameter setting for AC current test

iii) Reactive power setting

Find and set the "converter reactive power setting" to 90 and click "converter reactive power setting enable" as in Figure 49. After the reactive power is set, the grid current I1, I2, I3 will be reduced to about 30A and the grid voltage, DC link voltage is still normal which can be watched in column "generator/grid system" as in Figure 50.

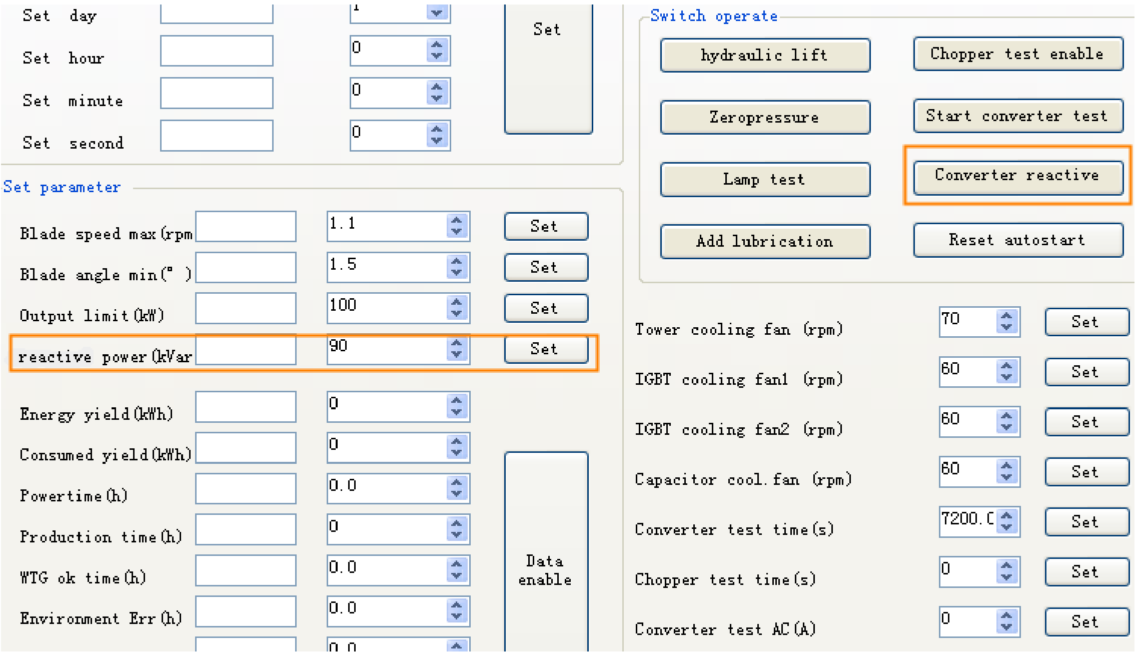


Figure 49 Reactive power setting

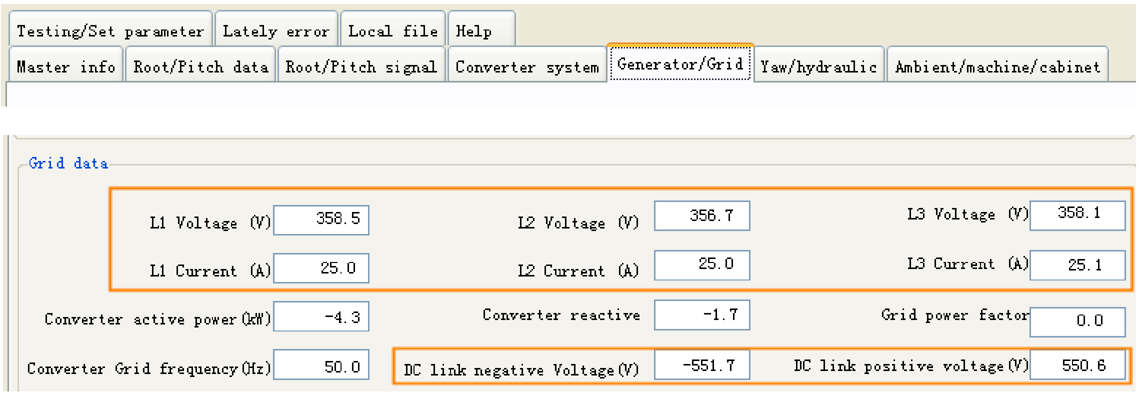


Figure 50 watching for grid current, voltage and DC link voltage

iv) AC current setting

Set the “converter test AC current setting” to 100 as in Figure 51.

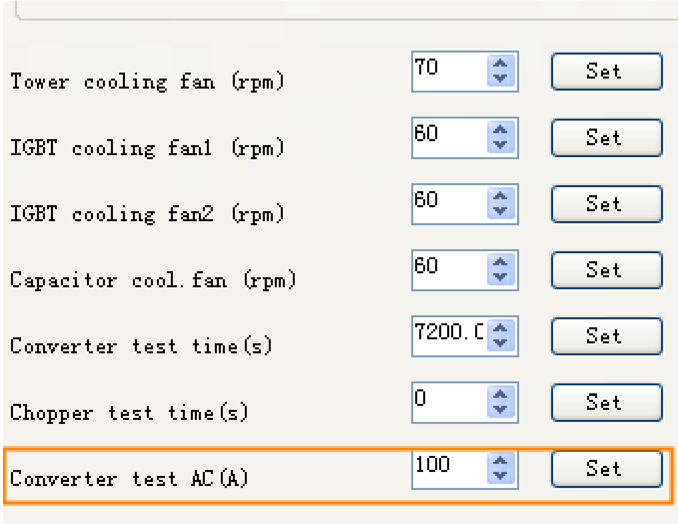


Figure 51 set AC current value to 100

Wait for 60 seconds then add 100 to the value of "converter test AC current setting" every 60 seconds. When the current value is 500, set all cooling fans speed to 90 and then set all speeds to 100 when the current value is 1000. The maximum current value is 1400 as shown in Figure 52.

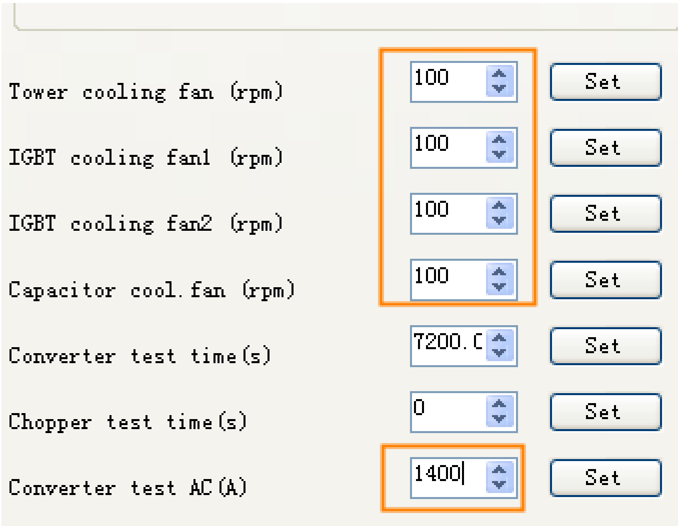


Figure 52 start all fans after 1400A setting

Keep the AC current running state for 30 minutes; watch the temperature of IGBTs in column "converter system"

Normally the temperature raise of IGBT L1a,L1b, L2a, L2b, L3a, L3b will not exceed 5℃ as in Figure 53.

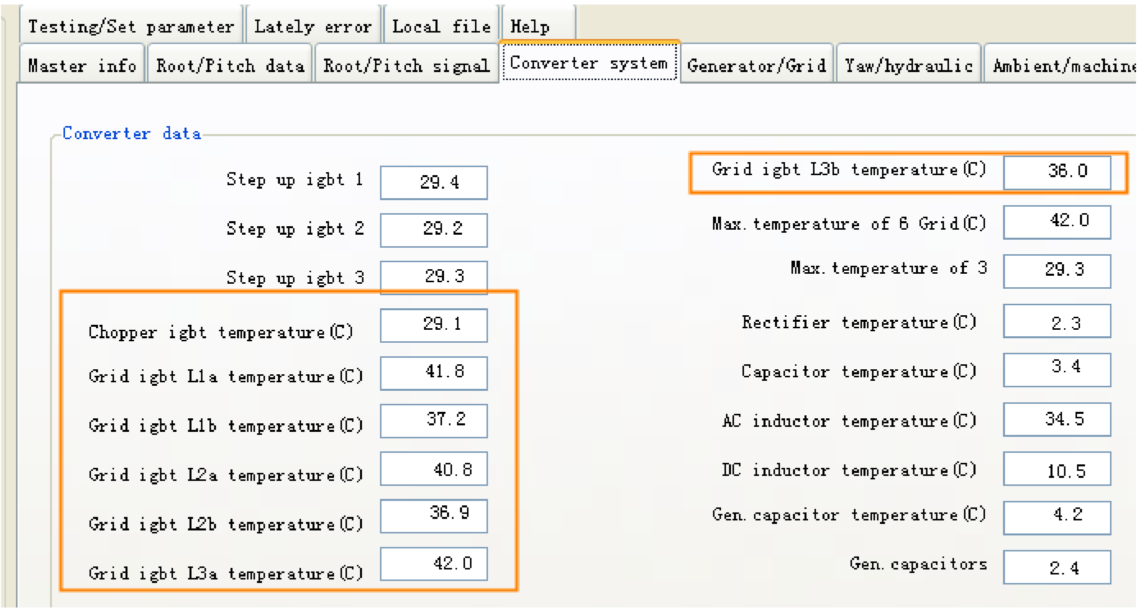


Figure 53 temperature of inverter IGBTs

Also watch grid voltage L1, L2, L3 and current I1, I2, I3; and DC link voltage. As in Figure 54, it is normal that the voltage is in 358V±5% with imbalance less than 50V, the current is no higher than 50A, the DC link voltage is within 585 ± 5V.

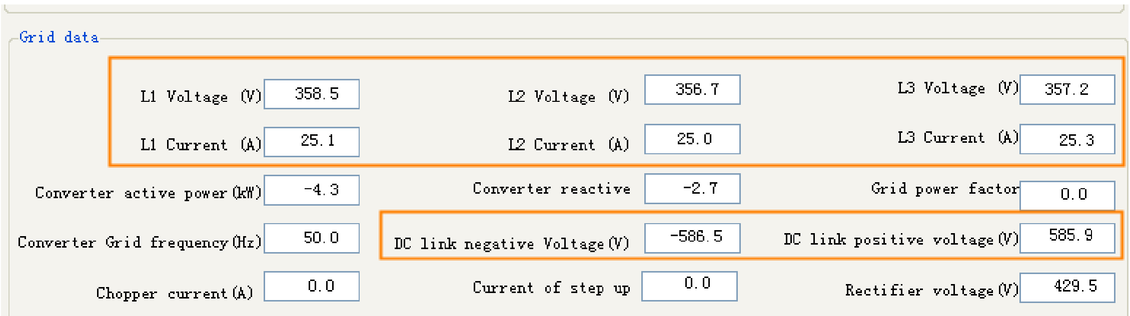


Figure 54 grid voltage, current and DC link voltage

If there is any problem that occurs during the test, push the emergency button immediately and troubleshoot after the temperature decreases.

When finished, decrease 100 of the current value of “converter test AC current setting” every 60 seconds then also reduce the fan speed’s given value. Eventually all values are set to 0, then click “converter test enable” and “converter reactive power setting enable” off to quit the test as shown in Figure 55.

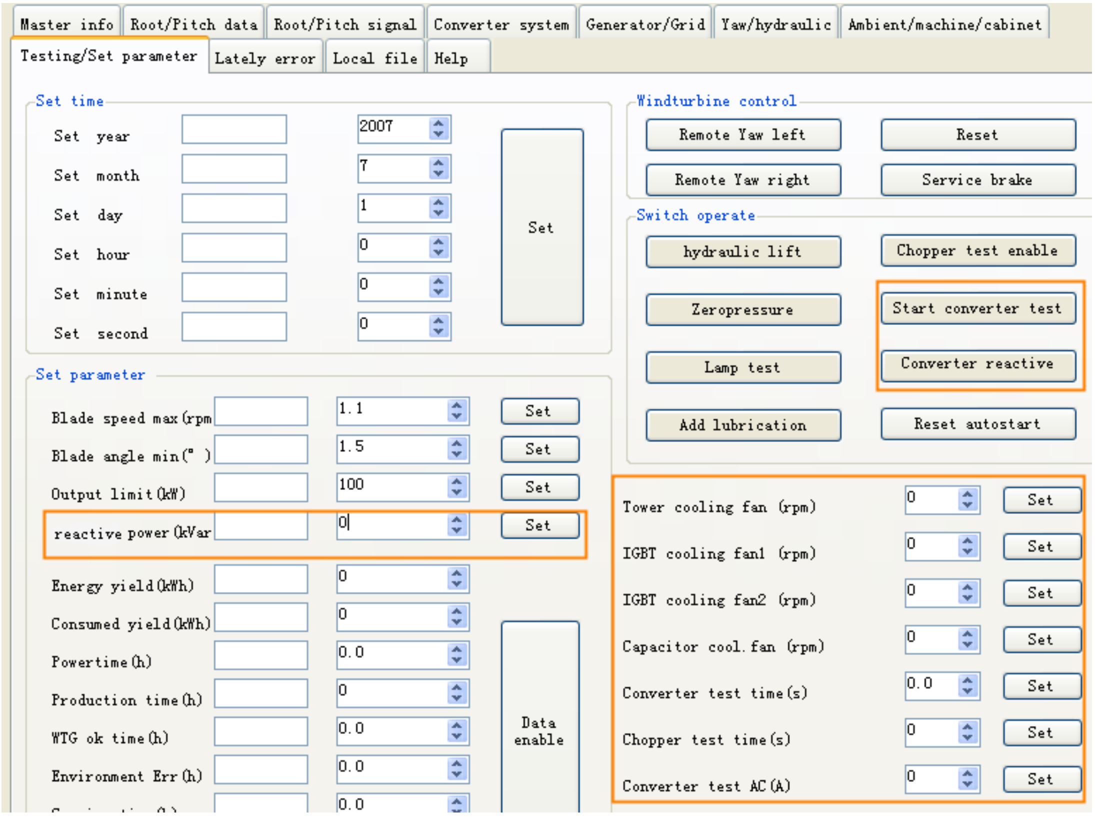


Figure 55 quit the AC current test

Click red button "local commissioning and control" to quit the local test then push the "stop" button of the converter cabinet, the converter main breaker will open immediately and the DC link voltage will drop down through discharge resistors. After the DC link voltage falls down to near 0V, change the DIP switches as shown in Figure 56.

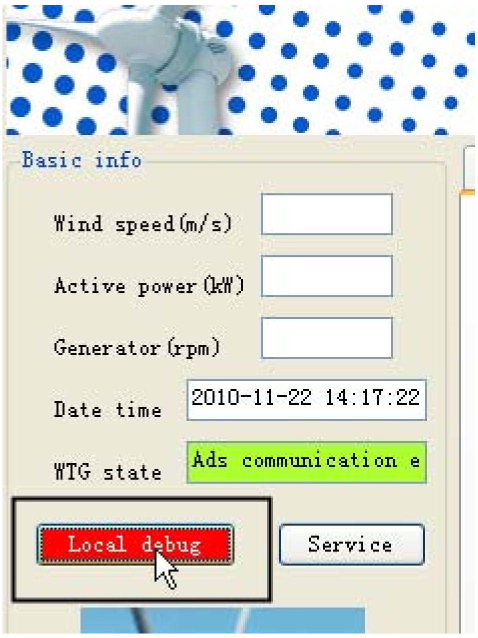


Figure 56 quit local commissioning and control mode

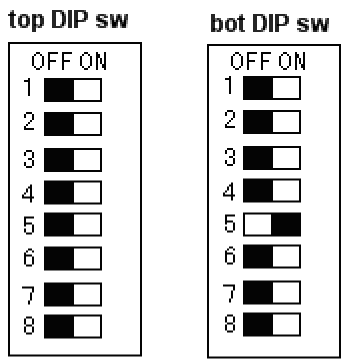


Figure 57 position for normal operation

If the nacelle is powered on and DP communication is OK, the generator switches will close at the same time of the main breaker.

The generator compensation capacitors are 4 groups, the real group number which should be used depends on the blade type: 2 groups should be used for 70 type machine and 4 groups should be used for 77/82/87 type machine.

Note:

- When the test is finished, do not cut off the 24VDC power supply until the DC link voltage drops to about 0V DC.
- Step-up circuit test does not need to be done in site tests due to the special tool requirement.

The converter tests now have been completed.

7 Error tracking

7.1 Error indications of CCM

When a converter fault happens, the whole machine will shut down immediately; the PLC system will record and display majority of the error information in the buffer. The errors of the converter are also shown by the LEDs of CCM, maintenance personnel can find the exact error information from LEDs. (note: when the system resets again, the “converter on” signal will be reset and all error LEDs of CCM will disappear). When maintenance personnel finds that the machine shuts down, do not reset the power system or power off 24VDC supply. Record the error LEDs information for error tracking and error analysis.

Instructions on LEDs

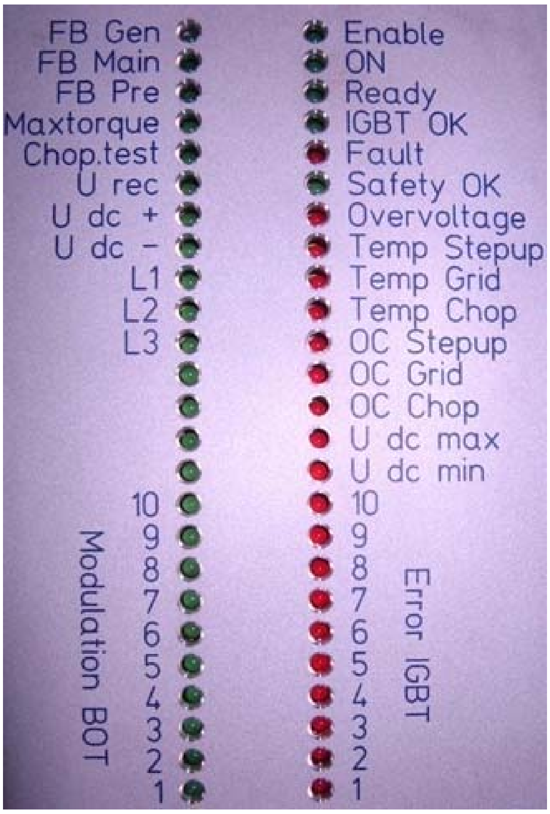


Figure 58 front panel of CCM

Table 24- explanation of LEDs

signal	explaination	signal	explaination
FB Gen	Feedback of generator switch closing	Enable	converter enable (IGBT start modulation and grid filter cut in)
FB Main	Feedback of main breaker closing	ON	converter on (start for precharge, main breaker and generator switch closing)
FB Pre	Feedback of pre-charge contactor closing	Ready	converter ready (ready for converter modulation)
Maxtorque	max torque given by PLC to shut down converter fast (not use)	IGBT OK	no error of IGBTs
Chop. test	chopper test	Fault	Fault by all converter errors
U rec	rectifier voltage	Safety OK	safety chain OK
U dc +	DC link voltage +	Overvoltage	over voltage of grid
U dc -	DC link voltage -	Temp Stepup	over temperature of step up circuit IGBTs
L1, L2, L3	grid side voltage L1, L2, L3	Temp Grid	over temperature of grid inverter circuit IGBTs
Modulation BOT	modulation of IGBT1~10	Temp Chop	over temperature of chopper IGBT
		OC Stepup	over current of step up circuit IGBT
		OC Grid	over current of grid inverter circuit IGBTs
		OC Chop	over current of chopper IGBT
		U dc max	DC link voltage too high
		U dc min	DC link voltage too low
		Error IGBT	IGBT error

7.2 Converter error information in PLC and its solutions

Details see the table in next page

Table 25- Converter error information in PLC and solutions

Note: CCM in the table below means converter controller module

The solutions for error will be upgraded with the converter' upgrading!

ERROR CODE	ERROR NAME	EXPLANATION	POSSIBLE CAUSES OF ERROR	SOLUTIONS
3000	Error_converter_global	converter error global		
30100	Error_converter_monitoring	converter error of monitoring		
30101	Error_converter_not_ready	The error appears if there is no "converter ready" signal back to PLC in 15 seconds after the PLC sending "converter on" signal to CCM	a) converter on signal not received b) didn't receive ready signal feedback c) fault on converter controller d) pre-charge contact fault e) main breaker feedback fault f) safety chain fault g) DC link voltage too high h) DC link voltage too low i) high grid voltage j) step up IGBT over current k) chopper IGBT over current l) grid IGBT over current m) step up IGBT fault n) chopper IGBT fault o) grid IGBT fault	a) Check the "converter on" LED, or check the circuit of converter substation (including the Bechhoff DO module and the 37 pole D sub cable) b) If "converter Ready" LED light is on, then check the 37 pole digital D sub cable. c) Check converter controller d) See code 30104 e) See code 30103 f) Check the safety chain LED and its circuit g) See code 30306 h) See code 30305 i) See code 30303 j) See code 30301 and code 30903 k) See code 30304 l) See code 30302 m) See code 30202

				n) See code 30203 o) See code 30203
30102	Error_converter_shutdown_after_enable	"converter ready" signal missing for the last 40ms after converter enable	a) converter ready signal missing	a) See code 30101 for "not ready" error
30103	Error_converter_main_contactor	converter ready but no feedback from main breaker	a) loss of main breaker closing signal b) no feedback signal to PLC from CCM c) no feedback signal to HVI/O from main breaker d) main breaker fault	a) Check control signal to main circuit breaker b) Check the LED FB main, check associated feedback signal circuit c) Check associated feedback signal circuit d) Check the main breaker and its wiring
30104	Error_converter_precharge_contactor	converter ready but no feedback from converter precharge contactor	a) converter precharge closing signal lost b) no feedback signal to PLC from CCM c) no feedback to CCM from precharge circuit d) precharge contactor fault	a) Check the control signal circuit to the converter precharge contactor b) Check CCM LED FB Pre, or check associated feedback signal circuit c) Check the contactor d) Check converter precharge contactor and its wiring
30105	Error_converter_generator_contactor	Converter is ready but no feedback from generator contactor	a) loss of generator switch closing signal b) no feedback signal to PLC from generator switch c) generator switch fault	a) Check generator switch closing control signal circuit b) Check feedback signal circuit from generator switch to the "Topbox" in nacelle c) Check the generator switch
30106	Error_converter_enable_pulsing	The converter is enabled but no IGBT modulation	a) no enable signal to CCM b) CCM error c) no feedback signal to PLC from CCM	a) Check associated signal circuit b) Check CCM c) Check the feedback signal circuit
30107	Error_converter_contactor_	No feedback from filter	a) no closing signal to grid filter	a) Check associated signal circuit

	filter_capacitor	contactor when it closes	contactor b) fault on grid filter contactor c) no feedback signal to PLC from grid filter contactor	b) Check contactor and its wiring c) Check the feedback signal circuit
30300	Error_converter_signal_ monitoring	some signal monitoring of converter		
30301	Error_converter_signal_DC_ current_overcurrent	step up IGBT overcurrent	a) DC current set given from PLC is wrong b) CCM error c) problem on IGBT driving cable d) fault on IGBT module e) step up inductor fault	a) Check associated signal circuit b) Check CCM c) Check IGBT driving cable and its connection d) Check IGBT module e) Check the step up inductor
30302	Error_converter_signal_IGBT_o vercurrent_peak	grid IGBT over current	a) WTC receives "false" converter grid side IGBT over-current fault signal b) CCM error c) IGBT driving cable problem d) Fault on IGBT module e) Inverter main circuit problem	a) Check if the converter front panel of OC Grid light is red, check signal loop from the converter board to the converter sub-station b) Check CCM c) Check if the IGBT driving cable is loose or damaged (the IGBT driving cable can be exchanged in same phase for fault IGBT chasing.) d) Check head module DSUB, adapter, flat cable, over-voltage protection board, SKIIP IPM module, etc. e) Check inverter main circuit
30303	Error_converter_signal_ phase_voltage_peak	grid phase voltage too high	a) WTC receives a "false" converter grid side IGBT over-voltage fault	a) Check the converter front panel and find out if Over voltage light is red, check signal

			signal b) Error in CCM c) Error from voltage measuring circuit d) Fault inverter unit	loop from the converter board to the converter sub-station b) Check CCM c) Check voltage detection loop d) Check inverter unit
30304	Error_converter_signal_chopper_overcurrent	chopper IGBT overcurrent	a) Error in CCM b) problem with IGBT driving cable c) Fault in IGBT module d) Fault with the chopper resistor	a) Check CCM b) Check IGBT driving cable c) Check IGBT module d) Check chopper resistor
30305	Error_converter_signal_DC_link_min	DC link voltage too low	a) Error in CCM b) voltage measuring circuit error c) WTC receives "false" converter DC bus low voltage fault signal d) Fault in step up IGBT e) Fault in inverter unit f) problems in the main circuit	a) Check CCM b) Check voltage detection loop c) Check if the converter front panel of U dc min light is red, check signal loop from the converter board to the converter sub-station d) Check step up IGBT module e) Check inverter unit f) Check the main circuit
30306	Error_converter_signal_DC_link_max	DC link voltage too high	a) CCM error b) Error in voltage measuring circuit c) WTC receives "false" converter DC bus high voltage fault signal d) Fault in inverter unit	a) Check CCM b) Check voltage detection loop c) Check if the converter front panel of U dc max light is red, check signal loop from the converter board to the converter sub-station d) Check inverter unit
30700	Error_converter_igbt_temperature	IGBT overheating error （100℃）		

30710	Error_converter_grid_igbt_temperature	grid IGBT overheating	a) temperature fault on grid side IGBT L1a(IGBT5) b) temperature fault on grid side IGBT L1b(IGBT6) c) temperature fault on grid side IGBT L2a(IGBT7) d) temperature fault on grid side IGBT L2b(IGBT8) e) temperature fault on grid side IGBT L3a(IGBT9) f) temperature fault on grid side IGBT L3b(IGBT10)	a) see code 30711 b) see code 30712 c) see code 30713 d) see code 30714 e) see code 30715 f) see code 30716
30711	Error_converter_grid_L1a_igbt_temperature	grid IGBT L1a overheating	a) Converter sub-station analog acquisition AI module, 37pin digital signal cable problem b) Error in CCM c) problem with IGBT driving cable d) fault in cooling system	a) Check temperature signal transmission loop from the converter board to the converter sub-station b) Check CCM c) Check IGBT driving cable d) Check Module DSUB head, adapter, Flat cable, over-voltage protection board, SKiiP IPM module, etc. e) Check IGBT heat sink, duct, fan, inverter, etc.
30712	Error_converter_grid_L1b_igbt_temperature	grid IGBT L1b overheating	a) Converter sub-station analog acquisition AI module, 37pin digital signal cable problem b) CCM error c) IGBT driving cable problem	a) Check temperature signal transmission loop from the converter board to the converter sub-station b) Check CCM c) Check IGBT driving cable

			d) fault with grid IGBT e) fault in cooling system	d) Check Module DSUB head, adapter, Flat cable, over-voltage protection board, SKiiP IPM module, etc. e) Check IGBT heat sink, duct, fan, inverter, etc.
30713	Error_converter_grid_L2a_igbt_temperature	IGBT L2a overheating	a) Converter sub-station analog acquisition AI module, 37pin digital signal cable problem b) CCM error c) problem IGBT driving cable d) grid IGBT fault e) fault in cooling system	a) Check temperature signal transmission loop from the converter board to the converter sub-station b) Check CCM c) Check IGBT driving cable d) Check Module DSUB head, adapter, Flat cable, over-voltage protection board, SKIIP IPM module, etc. e) Check IGBT heat sink, duct, fan, inverter, etc.
30714	Error_converter_grid_L2b_igbt_temperature	IGBT L2b overheating	a) Converter sub-station analog acquisition AI module, 37pin digital signal cable problem b) CCM error c) problem with IGBT driving cable d) grid IGBT fault e) fault in cooling system	a) Check temperature signal transmission loop from the converter board to the converter sub-station b) Check CCM c) Check IGBT driving cable d) Check Module DSUB head, adapter, Flat cable, over-voltage protection board, SKIIP IPM module, etc. e) Check IGBT heat sink, duct, fan, inverter, etc.
30715	Error_converter_grid_L3a_igbt_temperature	IGBT L3a overheating	a) Converter sub-station analog acquisition AI module, 37pin	a) Check temperature signal transmission loop from the converter board to the converter

			digital signal cable problem b) CCM error f) problem with IGBT driving cable c) grid IGBT fault d) fault in cooling system	sub-station b) Check CCM c) Check IGBT driving cable d) Check Module DSUB head, adapter, Flat cable, over-voltage protection board, SKiiP IPM module, etc. e) Check IGBT heat sink, duct, fan, inverter, etc.
30716	Error_converter_grid_L3b_ igbt_temperature	IGBT L3b overheating	a) Converter sub-station analog acquisition AI module, 37pin digital signal cable problem b) CCM error c) IGBT driving cable problem d) grid IGBT fault e) fault in cooling system	a) Check temperature signal transmission loop from the converter board to the converter sub-station b) Check CCM c) Check IGBT driving cable d) Check Module DSUB head, adapter, Flat cable, over-voltage protection board, SKiiP IPM module, etc. e) Check IGBT heat sink, duct, fan, inverter, etc.
30717	Error_converter_grid_igbt_ temperature_difference	The maximum temperature difference of grid side IGBT exceeds 15 ℃	a) Converter sub-station analog acquisition AI module, 37pin digital signal cable problem b) CCM error c) problem with IGBT driving cable d) grid IGBT fault e) fault in cooling system	a) Check temperature signal transmission loop from the converter board to the converter sub-station b) Check CCM c) Check IGBT driving cable d) Check Module DSUB head, adapter, Flat cable, over-voltage protection board, SKiiP IPM module, etc. e) check IGBT heat sink, duct, fan, inverter,

				etc.
30720	Error_converter_step_up_igbt_temperature	step up IGBT overheating	a) temperature fault in chopper boost IGBT1 b) temperature fault in chopper boost IGBT2 c) temperature fault in chopper boost IGBT3	a) See code 30721 b) See code 30722 c) See code 30723
30721	Error_converter_step_up_igbt_temperature_1	step up IGBT1 overheating	a) 37pin digital signal cable problem b) CCM error c) IGBT driving cable problem d) chopper IGBT fault e) cooling system fault	a) Check associated signal circuit b) Check CCM c) Check IGBT driving cable d) Check step up IGBT module e) Check the air channel and fan of cooling system
30722	Error_converter_step_up_igbt_temperature_2	step up IGBT2 overheating	a) 37pin digital signal cable problem b) CCM error c) IGBT driving cable problem d) chopper IGBT fault e) cooling system fault	a) Check associated signal circuit b) Check CCM c) Check IGBT driving cable d) Check step up IGBT module e) Check the air channel and fan of cooling system
30723	Error_converter_step_up_igbt_temperature_3	step up IGBT3 overheating	a) 37pin digital signal cable problem b) CCM error c) IGBT driving cable problem d) chopper IGBT fault e) cooling system fault	a) Check associated signal circuit b) Check CCM c) Check IGBT driving cable d) Check step up IGBT module e) Check the air channel and fan of cooling system
30724	Error_converter_step_up_igbt_temperature_difference	The maximum temperature difference of step up IGBT	a) 37pin digital signal cable problem	a) Check associated signal circuit b) Check CCM

		exceeds 15 ℃	b) Error in CCM c) problem with IGBT driving cable d) chopper IGBT fault e) fault in cooling system	c) Check IGBT driving cable d) Check step up IGBT module e) Check the air channel and fan of cooling system
030730	Error_converter_chopper_ igbt_temperature	chopper IGBT overheating	a) 37pin digital signal cable problem b) CCM error f) problem with IGBT driving cable c) chopper IGBT fault d) fault in cooling system	a) Check associated signal circuit b) Check CCM c) Check IGBT driving cable d) Check the chopper IGBT module e) Check the air channel and fan of cooling system
030900	Error_converter_grid_ monitoring	converter monitoring error		
030901	Error_converter_grid_ monitoring_U_DC_positive	(400V～650V) DC link + voltage exceed	a) DC link + too high b) DC link + too low	a) See code 30306 b) See code 30305
030902	Error_converter_grid_ monitoring_U_DC_negative	(—650V～-400V) DC link – voltage exceed	a) DC link - too high b) DC link - too low	a) See code 30306 b) See code 30305
030903	Error_converter_grid_ monitoring_I_DC	(830A) step up circuit over current	a) The value of DC current set high b) CCM error c) IGBT driving cable problem d) fault in IGBT module e) chopper boost IGBT over-current	a) Check the DC setting circuit (converter sub-station AO module, 37-pin analog cable, etc.) b) Check CCM c) Check IGBT driving cable d) Check module DSUB head, adapter, flat cable, over-voltage protection board, SKiiP IPM module, etc. e) See code 30301
030904	Error_converter_grid_ monitoring_chopper_I	chopper IGBT converter current	a) error in CCM b) problem with 15 pin IGBT driving	a) Check CCM b) Check IGBT driving cable and its connection

			cable c) Fault in IGBT module d) chopper resistor fault	c) Check IGBT module d) Check chopper resistor
030905	Error_converter_grid_ monitoring_step_up_U_DC_limits	overvoltage of rectifier output (1200V)	a) voltage detection circuit error b) step up IGBT fault c) generator over speed	a) Check HVI/O board and its wiring b) Check IGBT driving cable and its connector c) Check generator control system
30200	Error_converter_monitoring_IGBT	IGBT monitoring signal (error from SKiiP3 unit inside IGBT)		
30201	Error_converter_IGBT_ok	IGBT error	a) no IGBT “ok” signal to PLC from CCM b) error in CCM c) step up IGBT fault d) chopper IGBT fault e) grid IGBT fault	a) Check CCM LED IGBT OK and associated signal circuit b) Check code CCM c) See code 30202 d) See code 30203 e) See code 30204
30202	Error_converter_step_up_ IGBT	step up IGBT error	a) CCM error b) 15 pin IGBT driving cable problem c) step up IGBT fault d) WTC receives ” false” chopper boost IGBT fault signal	a) Check CCM b) Check IGBT driving cable and its connector c) Check IGBT module d) Check if the converter front panel of Error IGBT1, 2,3 lights are red, check signal loop from the converter board to the converter sub-station
30203	Error_converter_chopper_ IGBT	chopper IGBT error	a) error in CCM b) problem with the 15 pin IGBT driving cable c) fault with chopper IGBT d) WTC receives a “false” chopper	a) Check CCM b) Check IGBT driving cable and its connector c) Check IGBT module d) Check if the converter front panel of Error IGBT4 light is red, check signal loop from

			brake IGBT fault signal	the converter board to the converter sub-station
30204	Error_converter_grid_IGBT	grid IGBT error	a) error in CCM b) problem with the 15 pin IGBT driving cable c) grid IGBT fault d) WTC receives "false" grid side inverter IGBT fault signal	a) Check CCM b) Check 15 pin driving cable and its connector c) Check grid IGBT(5~10) d) Check if the converter front panel of Error IGBT5, 6, 7, 8, 9, 10 lights are red, check signal loop from the converter board to the converter sub-station
04000	Error_converter_temperature_periphery_global	temperature error global		
040001	Error_converter_temperature_generator_capcitors	compensation capacitor over temperature (80℃)	fault in compensation capacitor cooling fan	Check compensation capacitor cooling fan
040002	Error_converter_temperature_DC_link_capacitor	DC link capacitor over temperature (80℃)	fault in DC capacitor cooling fan	Check DC capacitor cooling fan
040003	Error_converter_temperature_DC_inductor	step up circuit inductor overheating (150℃)	a) IGBT cooling fan 2 fault b) tower base fan fault	a) Check IGBT cooling fan 2 b) Check tower base fan
040004	Error_converter_temperature_AC_inductor	inverter AC inductor overheating (150℃)	a) fault IGBT cooling fan 2 b) tower base fan fault	a) Check IGBT cooling fan 2 b) Check tower base fan
040005	Error_converter_temperature_rectifier	rectifier diode overheating (90℃)	PT 100 sensor to PLC connection problem	Check the PT 100 sensor connectors and wiring
100100	Error_grid_voltage	(325V ～ 385V)grid voltage exceeds normal range (100101, 100102, 100103)	a) grid voltage too high or too low b) error in CCM c) detection circuit of grid voltage d) grid IGBT error e) grid filter capacitor not be connected when modulation	a) Check grid voltage b) Check CCM c) Check HVI/O board and its connection d) Check grid IGBT module e) Check the grid filter capacitor's connection
100101	Error_grid_voltage_limit_max	voltage high_ WTC fault(any of three-phase voltages value is greater than		

		378VAC, and it lasts 100ms)		
100102	Error_grid_voltage_limit_min	voltage low _ WTC fault(any of three-phase voltages value is less than 325VAC, and it lasts 100ms)		
100103	Error_grid_voltage_unsymmetrical	voltage unsymmetrical _ WTC fault(the maximum absolute value of grid side voltage difference is greater than 50VAC, and it lasts 3s)		
100200	Error_grid_current	grid current exceeds the normal range	a) grid current exceeds normal range b) error with active power calculator c) problem with grid current transducer or wrong connection sequence	a) Check real grid current exceeding the grid, check the IGBT current reference and IGBT modules b) Check the calculation program c) Check the current transducers and their connection sequence
100201	Error_grid_current_limit	current high_ WTC fault(any of three-phase current value is greater than current calculated value, and it lasts 100ms (the Current calculated value: the smaller value between active power and 1600A))		
100202	Error_grid_current_Unsymmetrical	current unsymmetrical _ WTC fault (the maximum absolute value of grid side three-phase current difference is greater than the value (active power(0.05+150), and lasts		

100300	Error_grid_frequency	grid frequency exceeds the normal range (58.5Hz ～ 61.5Hz)	a) fault in CCM b) frequency exceeds normal range c) frequency signal interface (corresponding to voltage)	a) Check and change CCM b) Check real frequency exceeding
100301	Error_grid_frequency_max	grid frequency high fault (grid frequency is greater than 51.5Hz, and it lasts 2000ms)		
100302	Error_grid_frequency_min	grid frequency high fault(grid frequency is less than 47.5Hz, and it lasts 2000ms)		
100400	Error_grid_active_power	active power exceeds the normal range	a) active power exceeds the normal range b) a high DC current given by CCM when self-restart which causes an active power output c) fault in CCM d) high generator rotating speed cause higher power	a) Check real active power exceeding b) power off the CCM before restart the machine c) Check and change CCM d) Check the generator running information.
100401	Error_grid_active_power_limit_max	fault due to high active power (the active power of converter output is greater than the smaller value between which the sum(power value output which the inverter requires +200 and 1600A), and lasts 1s)		
100402	Error_grid_active_power_limit_min	active power low fault(the active power of converter output is less than -50kw, and it lasts 5s)		

100403	Error_grid_active_power_ Relation	active power relation (1: the absolute value of the difference between the actual output of active power and active power output which WTC required is greater than 250KW, and it lasts 2min. 2: the absolute value of difference between the actual output of active power and active power output which WTC required is greater than the sum(active power output which inverter required (0.1+130KW), and it lasts 2.5s)		
100501	Error_grid_reactive_power _limit	reactive power fault(the reactive power of converter output is greater than 180kvar or less than -180kvar ,and it lasts 100ms)	a) reactive power exceeds the normal range b) fault in CCM c) Short circuit of grid phases	a) Check for real reactive power exceeding or any software limit b) Check and change CCM c) Check the grid circuit
110002	Error_fuse_capacitors_ feedback	fault in fuse capacitors feedback	a) fault in grid side of the filter feedback contact b) Filter does not work normally	a) Capacitance knife molten insurance b) Check insurance feedback loop and insurance feedback switches

130000	Error_tower_cooling_global	tower cooling error global		
130001	Error_tower_cooling_control_tower_cooling_fan_disable	tower cooling fan error feedback	a) fault in tower fan b) fan driving converter problem	a) Check tower fan b) Check driving converter
130002	Error_tower_cooling_control_tower_cooling_fan_ feedback	tower cooling fan running feedback	a) tower fan fault b) fan driving converter problem	a) Check tower fan b) Check driving converter
20100	Error_cabinet_cooling_ temperature	problem with main cabinet temperature （ codes 20100,20101 、 20102 、 and 20103）		
20101	Error_cabinet_cooling_ control_cabinet_temperature	Exceed the cabinet normal temperature range of -20 ～ 55 （ when the temperature of cabinet is above 55℃ or below -20 ℃, and it lasts 5s）	a) real temperature problem in cabinet b) sensor circuit problem c) (the detected temperature will be too high)	a) Check if temperature is normal b) Check if PT 100 sensor and its wiring is OK
20102	Error_cabinet_cooling_LVD_cabinet_temperature	exceed LVD cabinet normal temperature range of -20～55℃(when the temperature of LVD cabinet is above 55℃or below -20 ℃, and it lasts 5s）		
20103	Error_cabinet_cooling_tower_base_air_input_temperatue	exceeds the tower base normal temperature range of -20 ～ 55 ℃ （ when the	a) real temperature problem in tower base area b) problem in sensor circuit (the	a) Check if temperature is normal b) Check if PT 100 sensor and its wiring is OK

		temperature of tower base is above 55℃ or below -20 ℃, and it lasts 5s)	detected temperature will be too big)	
20104	Error_cabinet_cooling_ topbox_cabinet_temperatur	Exceeds the Topbox cabinet normal temperature range of -20 ～ 55 ℃ (when the temperature of Topbox cabinet is above 55℃ or below -20 ℃, and it lasts 5s)	a) real temperature problem in Topbox cabinet area b) problem in sensor circuit (the detected temperature will be too big)	a) Check if temperature is normal b) Check if PT 100 sensor and its wiring is OK
20200	error_cabinet_cooling_control _cooling_fan	Fault on Cabinet cooling fan (20201、20202、20203)		
20201	Error_cabinet_cooling_control _IGBT_cooling_fan1_feedback	IGBT fan 1 running feedback	a) IGBT cooling fan 1 fault b) problem in fan driving converter	a) Check IGBT fan 1 b) Check driving converter
20202	Error_cabinet_cooling_control _IGBT_cooling_fan1_disable	IGBT fan 1 error feedback	a) IGBT cooling fan 1 fault b) problem in fan driving converter	a) Check IGBT fan 1 b) Check driving converter
20203	Error_cabinet_cooling_control _capaciter_cooling_fan_feedba ck	DC capacitor fans running feedback	a) fault in DC link capacitor fans b) problem in fan driving converter	a) Check DC link capacitor fans b) Check driving converter
20204	Error_cabinet_cooling_control _capacitor_cooling_fan_disabl e	Feedback error in DC capacitor fans	a) DC link capacitor fans fault b) problem in fan driving converter	a) Check DC link capacitor fans b) Check driving converter
20205	Error_cabinet_cooling_control _IGBT_cooling_fan2_feedback	IGBT fan 2 running feedback error	a) IGBT cooling fan 2 fault b) problem in fan driving converter	a) Check IGBT fan 2 b) Check driving converter
20206	Error_cabinet_cooling_control _IGBT_cooling_fan2_disable	IGBT fan 2 error feedback	a) IGBT cooling fan 2 fault b) problem in fan driving converter	a) Check IGBT fan 2 b) Check driving converter
900001	Error_ambient_temperature_max	high environmental	a) Actual ambient temperature is	a) Wait for the temperature to meet the

		temperature fault (when the temperature of environment is above 43℃, and it lasts 10m. The wind turbine executes a normal shutdown process when temperature is below 41℃ and automatically resets.)	high b) Temperature sensor circuit malfunctioning	requirements of the kai machine b) Test the temperature sensor and check the damaged cable measurements while testing the temperature acquisition module Beckhoff too
900002	Error_ambient_temperature_min	environmental low temperature fault (when the temperature of environment is below -28℃, and it lasts 10m. wind turbine executive a normal shutdown process, when temperature is above -26℃, it be automatically reset.)	a) Actual ambient temperature b) Temperature sensor malfunctioning	a) Wait for the temperature to meet the requirements of the kai machine b) Test the temperature sensor and check the damaged cable measurements while testing the temperature acquisition module Beckhoff too

8 Maintenance

8.1 Periodic maintenance

According to the enterprise standard of Goldwind, the maintenance work has 4 classes:

Class A: One time maintenance in 1 to 3 months after the first operation, all fixed bolts in converter should be tightened again. The adjustable time is ± 1 month.

Class B: One time maintenance every 6 months, the adjustable time is ± 1 month.

Class C: One time maintenance every year, all fixed bolts in converter should be tightened again. The adjustable time is ± 1 month.

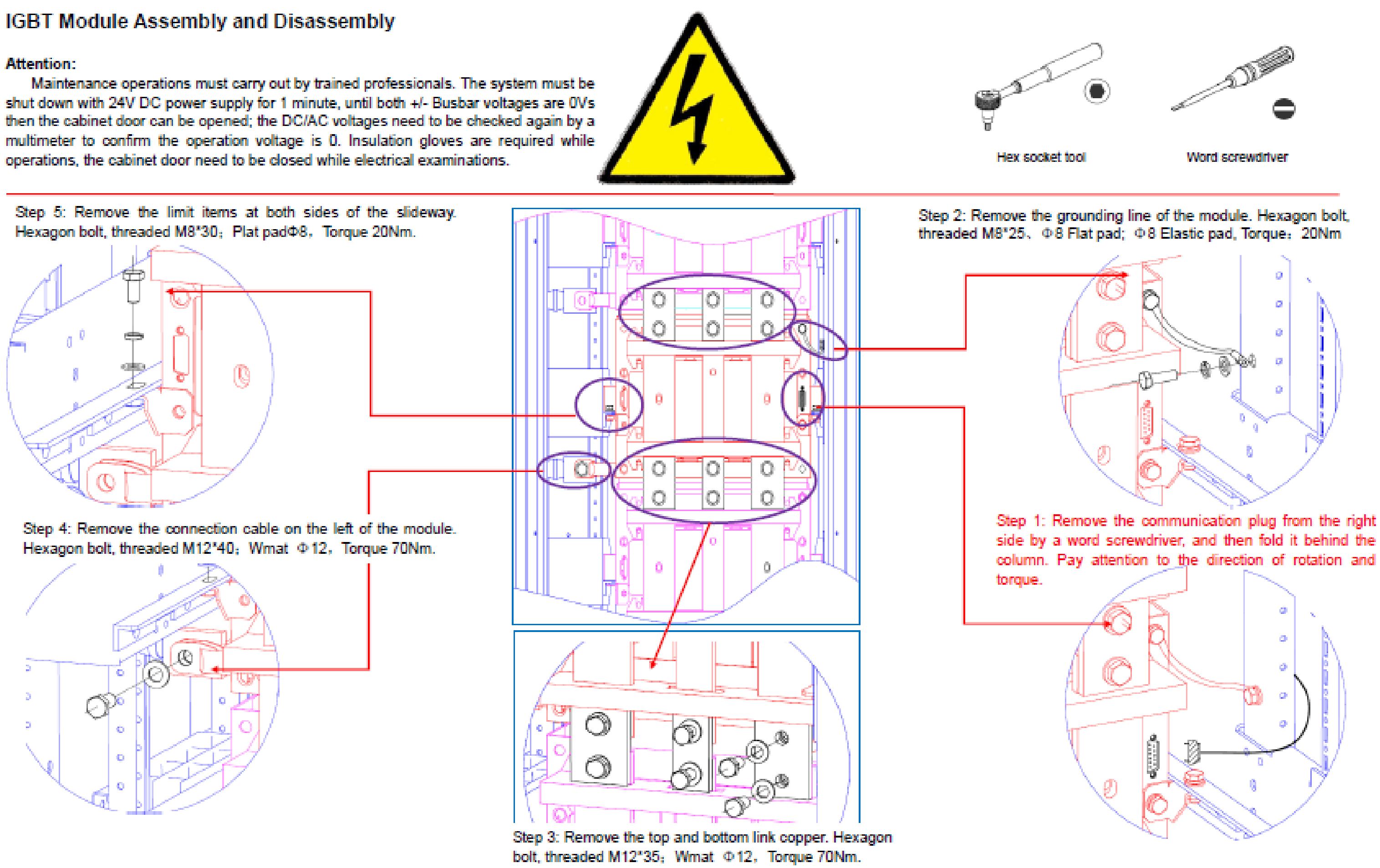
Table 26- periodic maintenance

checking of converter and correlative electric part					
1	tighten all fixing and connection bolts in cabinets	A		C	
2	tighten all cable connections (especially earth cable!)	A		C	
3	check cables for cracks, damage or insulation aging problem	A	B	C	
4	check lighting system, check all indicators of fuses	A	B	C	
5	clean fans and air filters	A	B	C	
6	check and tighten cable clamp bolts	A	B	C	

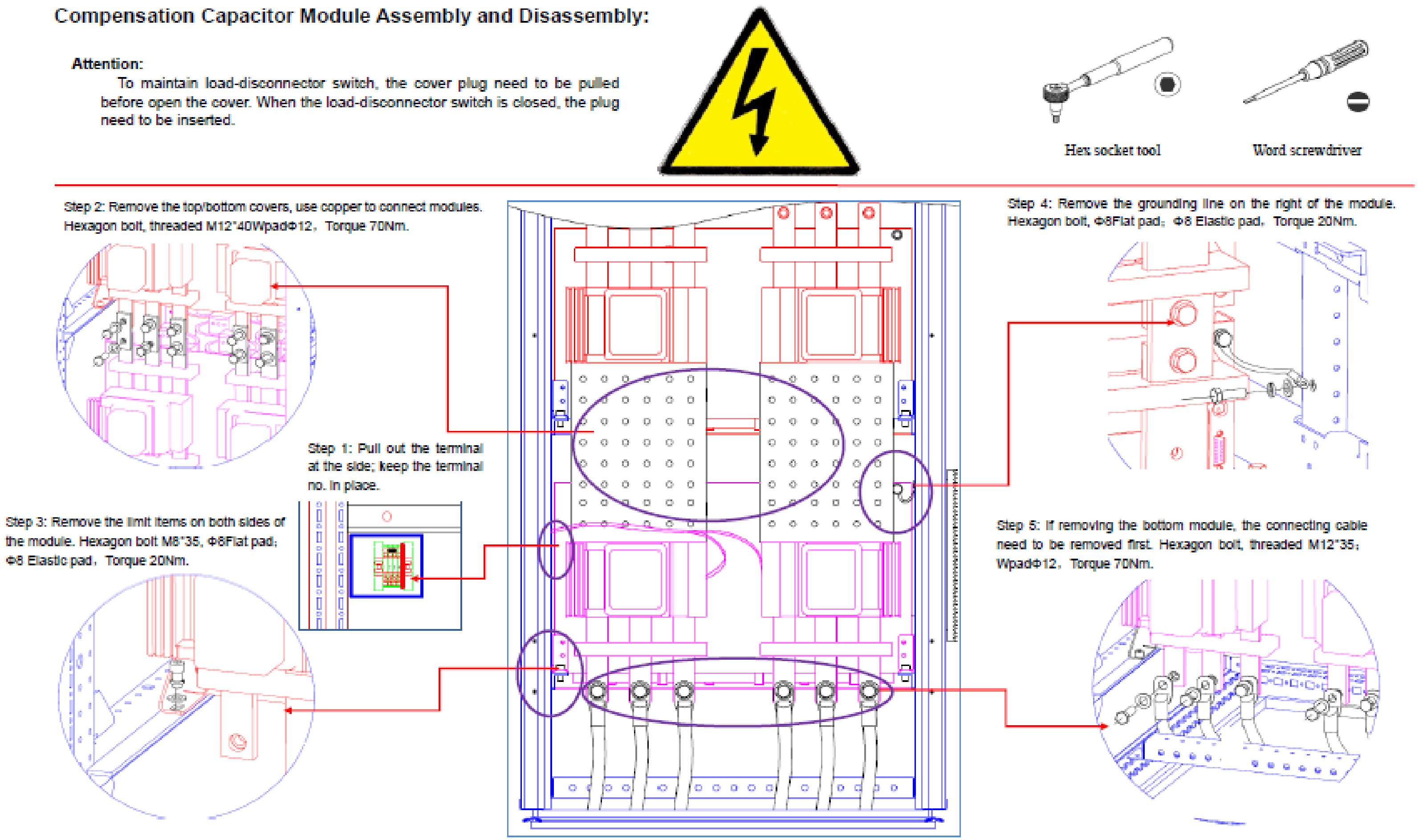
Regular inspection

- Clean all garbage and insects inside the cabinet
- Check if there is water, oil, and other drops on or in the cabinet
- Check the lock, inlet, outlet for sealing
- Check if the converter’s warning sign is spoiled.

8.2 IGBT module assembly and disassembly



8.3 Capacitor module assembly and disassembly



Annex A

A.1 Harnesses of the Main Circuit

A.1.1 The Connection Cable and Flexible Insulated Busbar from Reactor Bracket to IGBT Cabinet

The locations of all cables can be found on the outer packaging, and all the bolts are equipped on the contact holes. There are contact marks on cable and copper busbar contacts, and the marks of cable and flexible insulated busbar should correspond with the relevant copper busbar (see Table A.1).

Table A. 1- The Connection Table of IGBT Unit

	Position 1	Position 2	Specification	Length	Quantity(piece)
Name	IGBT Unit 1	Reactor Bracket	Flexible insulated busbar (cable)		
Mark	Front of IGBT Unit 1 -5X1.1	Front of Reactor Bracket -5X1.1	Flexible insulated busbar 40*10	185mm	1
Mark	Front of IGBT Unit 1 -5X1.2	Front of Reactor Bracket -5X1.2	Cable 150 ㎜²	800mm	2
Mark	Front of IGBT Unit 1 -5X1.3	Front of Reactor Bracket -5X1.3	Cable 150 ㎜²	340mm	2
Mark	Front of IGBT Unit 1 -5X1.4	Front of Reactor Bracket -5X1.4	Flexible insulated busbar 40*10	345mm	1
Mark	Front of IGBT Unit 1 -5X1.5	Front of Reactor Bracket -5X1.5	Cable 150 ㎜²	630mm	2
Mark	Front of IGBT Unit 2 -6X1.1	Front of Reactor Bracket -6X1.1	Flexible insulated busbar 40*10	185mm	1
Mark	Front of IGBT Unit 2 -6X1.2	Front of Reactor	Cable 150 ㎜²	800mm	2

		Bracket -6X1.2			
Mark	Front of IGBT Unit 2 -6X1.3	Front of Reactor Bracket -6X1.3	Cable 150 ㎜²	340mm	2
Mark	Front of IGBT Unit 2 -6X1.4	Front of Reactor Bracket -6X1.4	Flexible insulated busbar 40*10	345mm	1
Mark	Front of IGBT Unit 2 -6X1.5	Front of Reactor Bracket -6X1.5	Cable 150 ㎜²	630mm	2

A.1.2 The Operation Method of the Connecting Busbar Between the Cabinets

The connected busbars of reactor bracket 6X1 and IGBT unit 2:

First of all, install 6X1.1 flexible insulated busbar, and then install 6X1.4 flexible insulated busbar, at last, install the cables of 6X1.2、6X1.3、6X1.5 in order, and make sure the back end of the cable contacts are connected together (see Figure A.1).

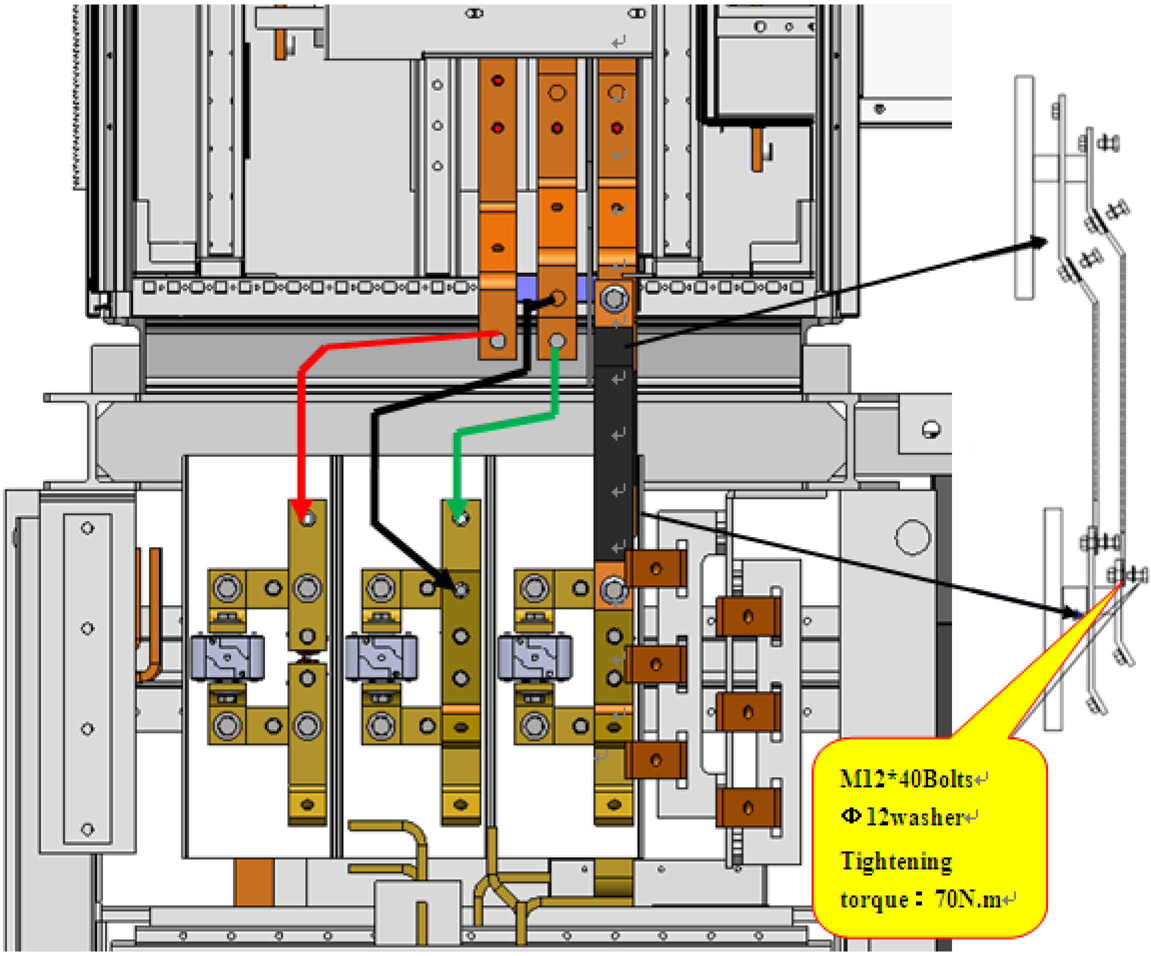


Figure A.1 The diagram of connected busbar between the cabinets（6X1）

6X1.2 connected cable
6X1.3 connected cable
6X1.5 connected cable
Tool：socket wrench（M12）

Table A.2- Standardized Parts and Components

Category	Name	Specification	quantity
standardized parts and components	Hex bolt	M12*40	20
	Washer	Φ12	8
	Spring Washer	Φ12	12
	Spring washer	Φ12	12

Notice: The connection method of 6X1 and 5X1 are the same. The flexible insulated busbar shall not be collided or scarified. The connection interface shall be smooth and fit. And other electric components like wind baffle, PC protection and insulation protection of the busbar should not be damaged during the assemblying procedure.

A.2 Harnesses of the Secondary Circuit

Secondary signal feedback circuit is connected between one 2×1.5sheilded wire from main control cabinet terminal 19X3,and install new terminal 19X5 on reactor bracket (see Figure A-2).

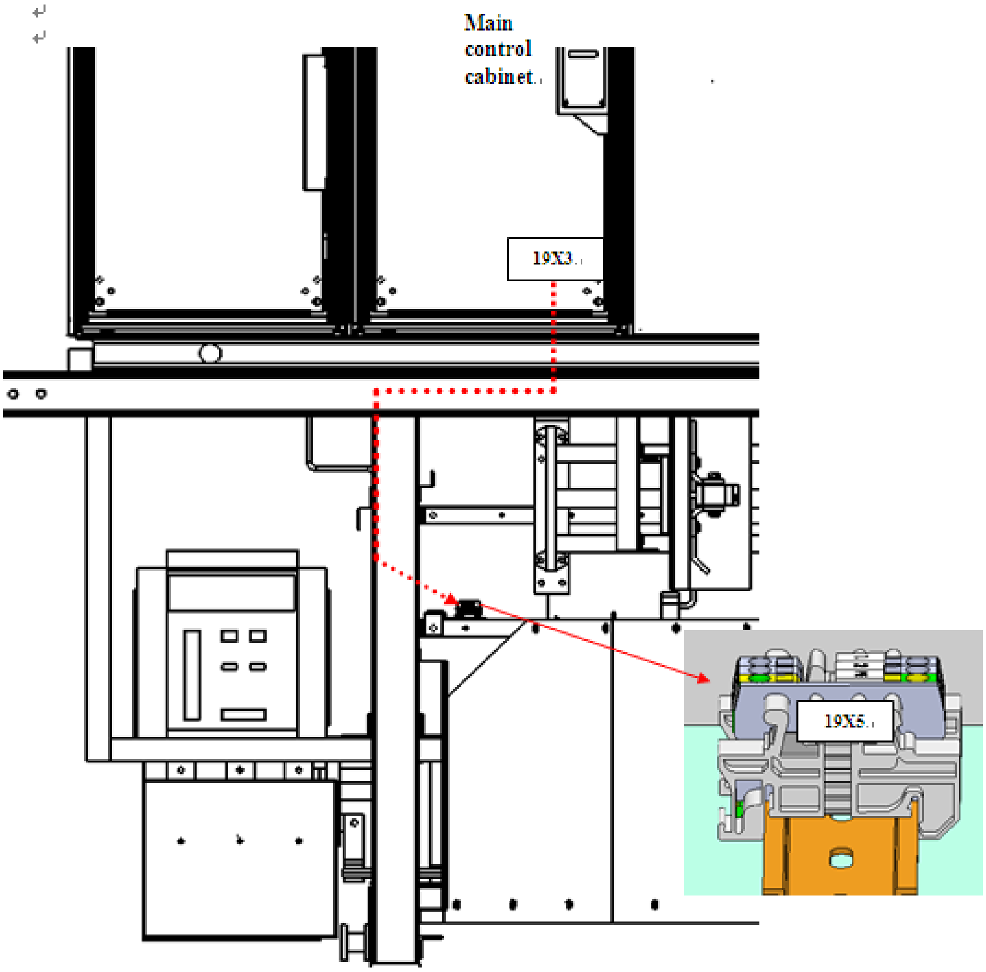


Figure A.2 Secondary Circuit Connection Diagram

TableA.3- Cables of Terminal Block 19X5 to Terminal Block 19X3

Category	Name	Specification	Length	Quantity	Tool
standardized parts and components	Conducting wire	Shield wire 2*1.5	1550mm	1	Phoenix contact in screw driver

Annex B

B.1 The main control cabinet top marks,　38 R4,38 R5 cable laying lines to slot.

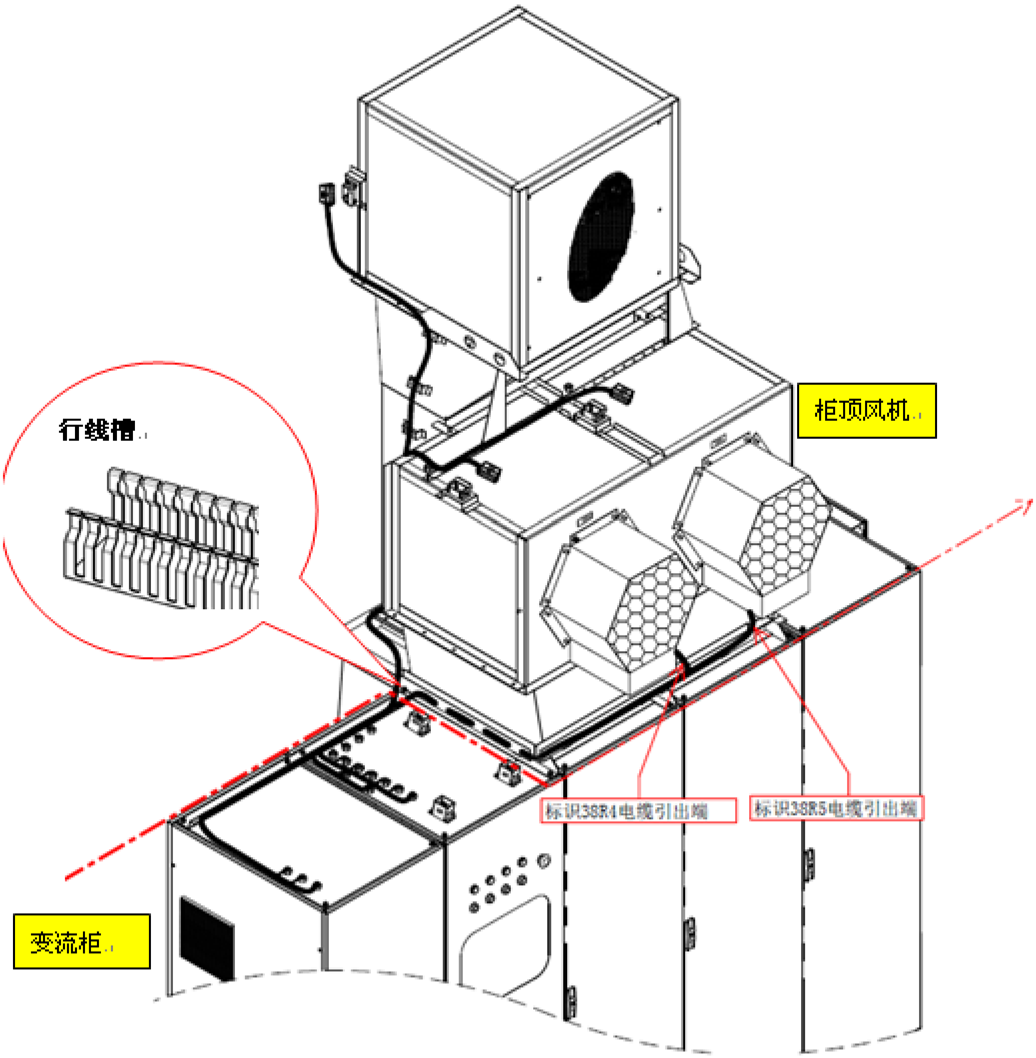


Figure B. 1 The main control cabinet top marks

B.2 Disassemble the sealing plate at the bottom of Anti condensation heater

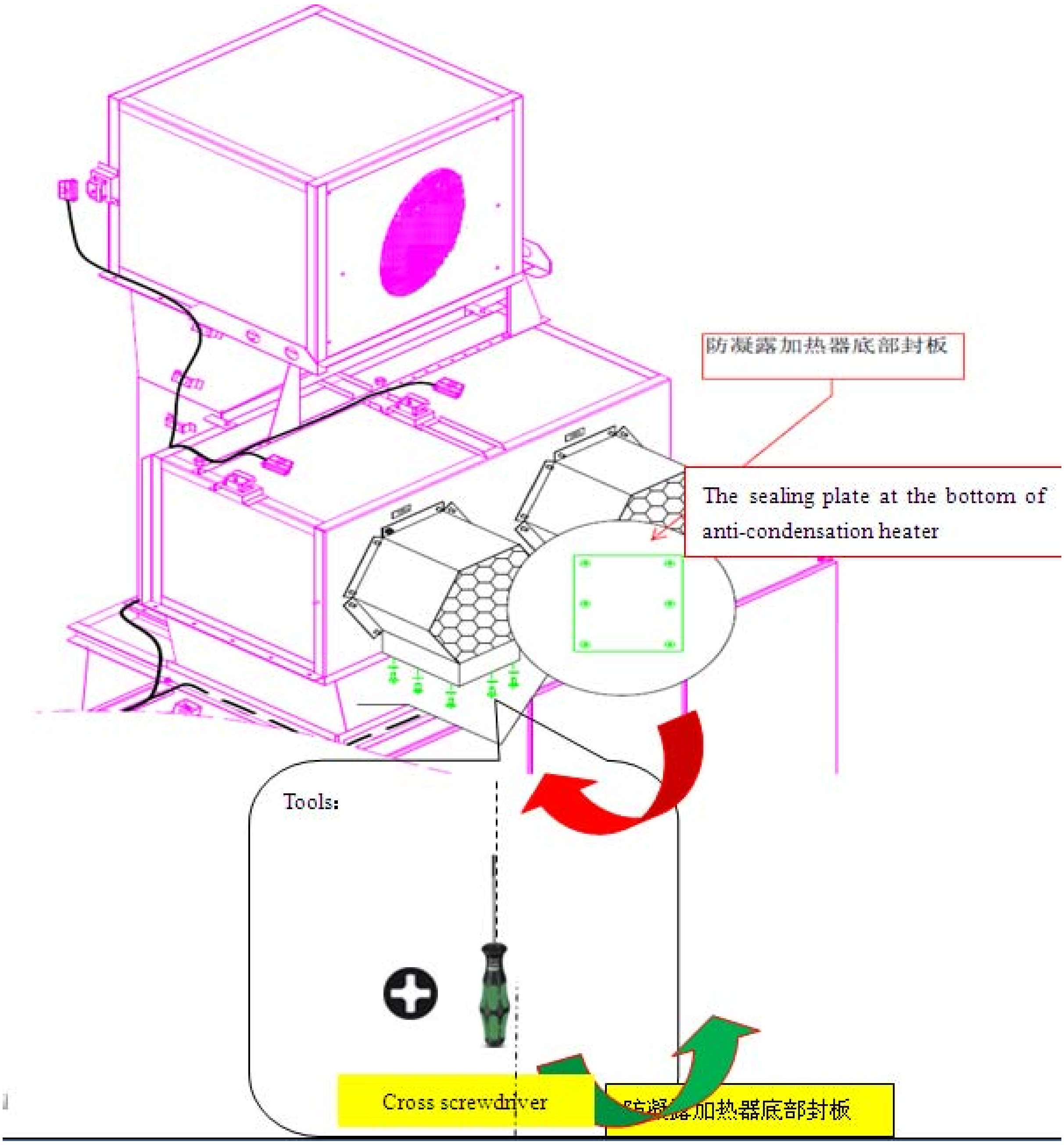


Figure B. 2 Disassemble the sealing plate at the bottom of Anti condensation heater

B.3 Installation of the cable

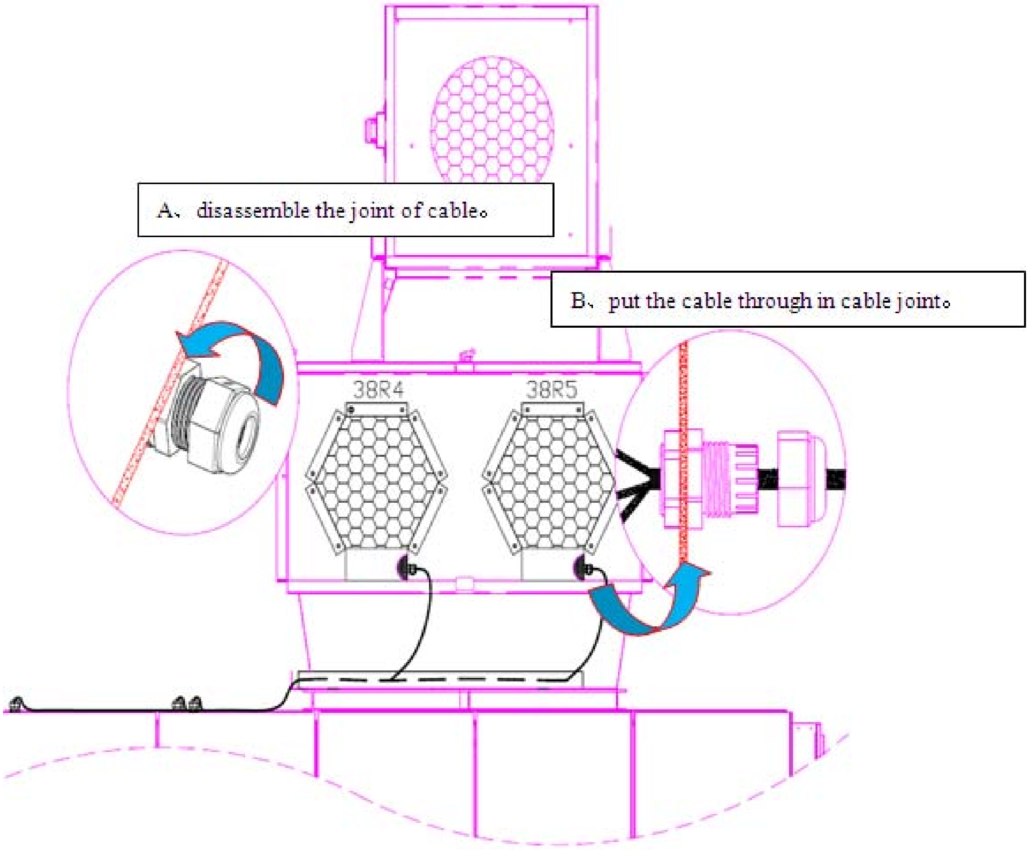


Figure B. 3 Installation of the cable

B.4 Corresponding wiring

a、Cable connector with the corresponding cable types

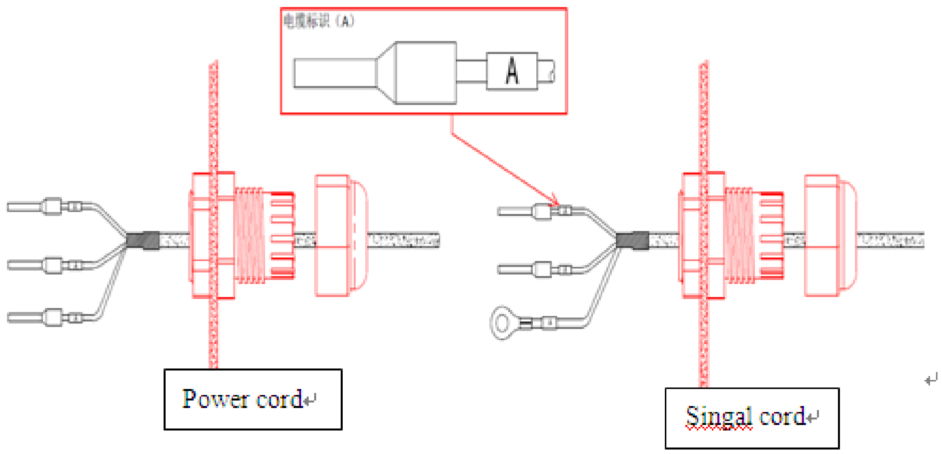


Figure B. 4 Cable connector with the corresponding cable types

b、Wiring table（table B.1）

Table B.1- Wiring table

Equipment for identification	Serial number	Identification for cables	Equipment contact identification
38R4	1	38R4/U	U
	2	38R4/V	V
	3	38R4/W	W
	4	38R4/101	101
	5	38R4/102	102
	6	PE	
38R5	1	38R5/U	U
	2	38R5/V	V
	3	38R5/W	W
	4	38R5/101	101
	5	38R5/102	102
	6	PE	

B.5Testing

a、Check the connection of the wiring .

b、Check the contact screws.

B.6 Cable joint test

After checking the fastening cable joint, make sure that they are both fixed completely.

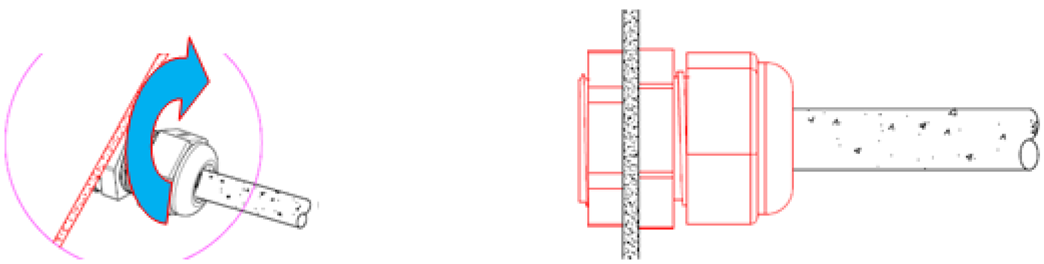


Figure B.5 check the fastening cable joint

B.7 Install the sealing plate at the bottom of the anti-condensation heater