现代电力 TDS

FMEG(TDS)-L

Intelligent Integrated Low Voltage Reactive Power Compensation Module

Instruction Manual

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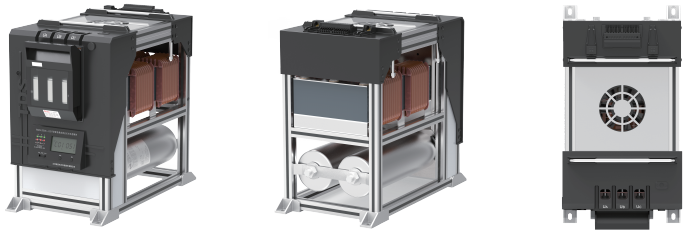
1. Introduction

FMEG(TDS)-L intelligent integrated low voltage reactive power compensation module (hereinafter referred to as the “product”) is the latest generation of “intelligent low voltage power capacitors” developed and industrialized by our company since the first intelligent low voltage power capacitor was developed domestically and internationally in 2002. This product has many merits in terms of structure, performance, maintainability and others, which is also highly cost-effective.

2. Product Shape

The shape of the FMEG(TDS)-L intelligent integrated low voltage reactive power compensation module is shown in Figure 1.



(a) (b) (c)

Figure 1 Product shape

(a) Front side view; (b) Back side view; (c) Top view

3. Product Features

3.1 Structural features

(1) The whole machine is a standard aluminum profile frame structure, and the height and depth of the modules can be adjusted according to different types and specifications.

(2) The whole module is vertically divided into three parts. The front part is a fuse protection switch and man-machine interaction, the lower side of the rear part is power capacitors, the upper part is a power reactor, and the middle part is an intelligent control component. Its ventilation and cooling are reasonable, and it is easy to observe the working conditions as well as intervene.

(3) The incoming terminal of the fuse protection switch is the module power connection terminal. Both power line inlet hole and the secondary connection terminal are both located at the top of the module, making it easy to connect and disconnect wires.

3.2 Safety feature

(1) The current fast switching protection is made through high-quality fast melting switches to effectively prevent the extension of internal faults.

(2) High quality products are used for key components such as power reactors, power capacitors, and switching switches to improve operational safety, reliability, and service life.

(3) Scientific and reasonable ventilation and cooling settings effectively reduce the temperature inside the machine, improve operational reliability and service life.

3.3 Intelligent feature

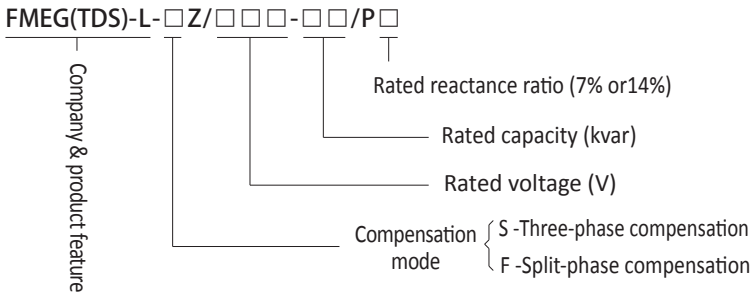
(1) Opening & closing parameters of high-quality capacitor on-off switch are stable, with accurate zero crossing and zero switching power capacitor.

(2) Online monitoring and diagnosis of operating parameters such as voltage, current, reactive power, power factor, temperature, etc., ensuring comprehensive transparency of operating conditions.

(3) There are such protections as voltage, current, and temperature limit protections as well as overcurrent segmented inverse time protection, therfore, its protections are comprehensive and accurate.

4. Product Specification & Model

Module falls into series, with various types and specifications, represented in the following form.



5. Using Conditions

5.1 Environmental condition

(1) Temperature range: -25～55℃.

(2) Altitude: ≤2000m.

(3) No explosive or corrosive gases, no conductive dust or mold, and no sources of severe vibration or shock.

5.2 Electrical condition

(1) Voltage range: Rated voltage±15%.

(2) Power frequency range: 50Hz±1.5Hz.

6. Electrical Safety

The electrical clearance, creepage distance, insulation resistance, power frequency withstand voltage, short-circuit withstand strength, short-circuit protection power and others comply with the corresponding provisions of GB/T 15576-2020 " Low voltage complete reactive power compensation devices " .

7. Main Functions

7.1 Control function

(1) Execute controller instructions to control the switch-on and switch-off of power capacitors.

(2) Automatically control the switch-on and switch-off of power capacitors.

(3) Manually control the switch-on and switch-off of power capacitors.

7.2 Measurement function

(1) Measurement of electrical quantities such as voltage, current, power, and power factor.

(2) Measurement of non electrical quantities such as temperature and time.

7.3 Protection function

(1) Overvoltage, undervoltage, and undervoltage protection.

(2) Current rapid switching and overcurrent protection.

(3) Over-temperature protection.

7.4 Signal function

(1) Signal for the switch-on and switch-off of power capacitors.

(2) Protection-type signal.

7.5 Online function

RS-485 bus online complete-set functions.

8. Main Parameters

8.1 Measurement error of electrical quantities

(1) Voltage: ≤ 0.5% (within the range of 85-115% rated voltage).

(2) Current: ≤ 0.5% (within the range of 20-120% rated current).

≤ 1.0% (≤ 20% within the rated current range).

(3) Reactive power: ≤ 1.0%.

(4) Power factor: ≤ 0.01.

8.2 Non electrical measurement error

(1) Temperature: ≤ 1.0 ℃.

8.3 Protection error

(1) Voltage: ≤ 0.5%.

(2) Current: ≤ 1%.

(3) Temperature: ≤ 1 ℃.

(4) Time: ≤ 100ms.

8.4 Mechanical Parameter

(1) The overall dimension is shown in Figure 3.

(2) The installation dimension is shown in Figure 4.

Figure 3 Overall dimension

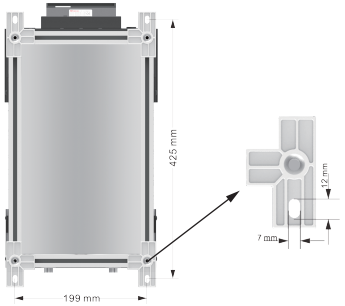


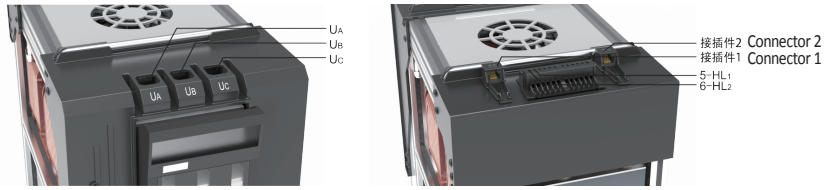
Figure 4 Installation dimension

9. Wiring Terminals and Connectors

The module wiring terminals include power wiring terminal and secondary wiring terminal. There are external indicator wiring terminals for secondary wiring terminal, besides, the connectors are used for online connection of complete set (RS-485 communication network port).

9.1 Wiring terminals and connectors of three-phase product

The wiring terminals and connectors of the three-phase compensation module are shown in Figure 5.



（a） （b）

Figure 5 Wiring terminals and connectors of three-phase compensation module

（a）Power terminal block；（b）Secondary wiring terminals and connectors

The current carrying capacity of the power connection wire shall exceed the rated current of the module. The secondary wiring terminals (5-HL1, 6-HL2) are respectively used for the on/off state outputs of two groups of capacitors (C1, C2). When connecting external indicator lights, two AC380V indicator lights are used, and the other end of the indicator light is connected to voltage UB.

9.2 Wiring terminals and connectors of single-phase product

The wiring terminals and connectors of the single-phase compensation module are shown in Figure 6.

（a） （b）

Figure 6 Wiring terminals and connectors of single-phase compensation module

（a）Power terminal block；（b）Secondary wiring terminals and connectors

The current carrying capacity of the power connection wire shall exceed the rated current of the module. The secondary wiring terminals 14-HL1, 15-HL2, and 16-HL3 are respectively used for the on/off output of single-phase capacitors A, B, and C. When connecting external indicator lights, three AC220V indicator lights are used, and the other end of the indicator light is connected to voltage UN.

10. Man-machine Interaction

10.1 Man-machine interaction component

Module debugging, operation, and maintenance require human-machine communication. The human-machine communication component is located below the module front panel and consists of a LCD display screen, indicator lights, and operation keys, as shown in Figure 7.

（a） （b）

Figure 7 Module Man-machine interaction component
（a）Three-phase type;（b）Split-phae type

There are several indicator lights on the human-machine connection components of three-phase and single-phase modules, which respectively indicate the A phase, B phase, and C phase withdrawal status of the first and second sets of capacitors.

10.2 Operational key of man-machine interaction

There are two types of operation keys on the human-machine communication components: dial keys and buttons. The status and meaning of dial keys and buttons are shown in Table 1.

Table 1 Status and meaning of operation keys

Key type	Status	Meaning
Dial key	Manual	The module enters manual control mode and you can only operate buttons to control the on-off of capacitors.
	Force switching	The module forcibly exits the capacitor and enters a locked state.
	Auto	The module switch on or switch off the capacitors according to instructions from the host or controller.
Button	Press the setting key	Page down, manually control the object selection.
	Press the Enter key	Page up, manually switch-on and switch off confirmation.

10.3 Man-machine interaction interface

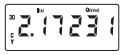
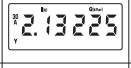
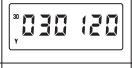
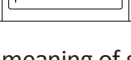
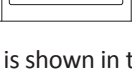
The definitions of indicators and icons are shown in the table below.

Icon	Definition
88	Displayed code number
A/B/C	Displayed phase sequence
Y	Split-phase unit mark
DEBUG	Status indication
	Fan status
	Fault prompt
	Lock prompt
	Host prompt
S.T.	Self-test
ID	Local address
No	Serial number

The data display interface of the three-phase module is shown in the table below.

No.	Interface	Notes	No.	Interface	Notes
1	C02 05 1	Product communication address 30 represents control countdown	5	39.8 39.7	A, B pahse current of reactive power compensation module
2	390 09.6	Distribution AC phase voltage, distribution power factor, the single digit “0” represents lag, and "-" represents leading.	6	39.8 000	C-phase current of the reactive power compensation module, Self checking fault.
3	0.18 15.6	Secondary current of distribution B phase, distribution reactive power	7	030 120	Control countdown, Lock time
4	025 025	Internal temperature of reactive power module	8	166 200	CT ratio

The following table shows the data display interface of the split-phase module.

No.	Interface	Notes	No.	Interface	Notes
1		Product communication address 30 represents control countdown, and "Y" signifies split-phase module mark.	7		Secondary current of distribution C phase, distribution C-phase reactive power
2		Distribution A phase voltage, distribution A-phase power factor, the single digit "0" represents lag, and "-" represents leading.	8		Internal temperature of reactive power module
3		Distribution B phase voltage, distribution B-phase power factor, the single digit "0" represents lag, and "-" represents leading.	9		A, B pahse current of reactive power compensation module
4		Distribution C phase voltage, distribution C-phase power factor, the single digit "0" represents lag, and "-" represents leading.	10		C pahse current of reactive power compensation module, self-test fault
5		Secondary current of distribution A phase, distribution A-phase reactive power	11		Control countdown, lock time
6		Secondary current of distribution B phase, distribution B-phase reactive power	12		CT ratio

The meaning of self checking fault codes (S.T.) is shown in the following table:

No.	Code	Meaning
1	10□	4. 5 and 6 respectively represent undervoltage or phase loss of power supply A, B, and C phases; 7. 8 and 9 respectively represent overvoltage in phases A, B, and C of the power supply
2	20□	1. 2, 3... respectively indicate the "closing" fault of switch 1, 2, 3
3	30□	1. 2, 3... respectively indicate the "opening" fault of switch 1, 2, 3
4	40□	1. 2 and 3 respectively represent overcurrent of capacitors A, B, and C phases; 4. 5 and 6 respectively represent the phase attenuation of capacitors A, B, and C; 7 represents three-phase (A, B an的C) imbalance of capacitors
5	50□	Reserved
6	60□	Reserved
7	70□	1. 2 respectively represent faults in the parameter libraries of Zone 1 and Zone 2
8	80□	Reserved

11. Product Inspection

11.1 Power-on inspection

Pull open the fuse switch on the module and dial the button on the human-machine interaction component to the "Manual". Then connect the power wiring terminals (three-phase UA, UB, UC, single-phase UA, UB, UC) to the power supply, close the fuse switch on the module, and the module will be powered on.

After the module is powered on, the display content and indicator light status of the human-machine contact component's LCD screen should be accurate, and the interface can be switched by operating the buttons.

Connect the RS-485 communication network port of the controller used in conjunction with the RS-485 communication network port of the module with a network cable, and the LCD screen of the controller should display relevant information about the module.

11.2 Switch-on and switch-off capacitor inspection

The power supply should be able to withstand the rated current of the module, and the current carrying capacity of the power connection wires shall exceed the rated current of the module. Perform capacitor switch-on and switch-off inspections on the "Manual Control" interface. The data, indicator light status, and external indicator light (if any) status displayed on the LCD screen of the human-machine contact components should be correct when the capacitors are put into operation and exited.

12. Product Complete Set

12.1 Electrical symbol

(1) Character symbol

According to the national standard GB/T 7159-87 the People's Republic of China, "General Rules for the Formulation of Letter Symbols in Electrotechnology", the text symbol for the FMEG intelligent low-voltage reactive power compensation module is determined as "CA (TDS)". CA represents the capacitive composite electrical apparatus, and "TDS" represents the enterprise features of the module. The three phase is CAS (TDS), and the spilt phase is CAF (TDS).

(2) Graphical symbol

According to the national standards of the People's Republic of China GB/T 4728.1-2018 "Graphical symbols for electrical diagrams-Part 1: general information" and GB/T 4728.2-2018 "Graphical symbols for electrical diagrams--Part 2: symbol elements, qualifying symbols, and other symbols having general application", the graphic symbols for the FMEG intelligent low-voltage reactive power compensation module are defined as shown in Figure 8.

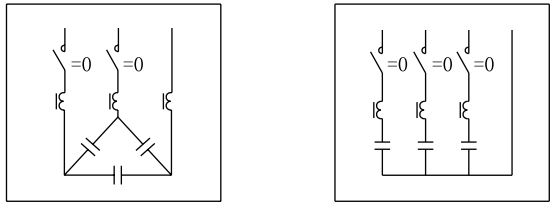


Figure 8 Graphic symbols for FMEG (TDS) - L intelligent integrated low-voltage reactive power compensation module
（a）Three-phase；（b）Split-phase type

This symbol concisely reflects the main characteristics of the module, as shown in Figure 9 below.

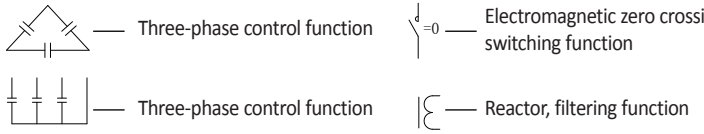


Figure 9 Meaning of module graphic symbols

(3) Electrical wiring graphic symbols

When using the FMEG (TDS)-L intelligent integrated low-voltage reactive power compensation module, it is necessary to connect it with external components. The electrical wiring diagram symbol is shown in Figure 10, indicating all its external connection lines.

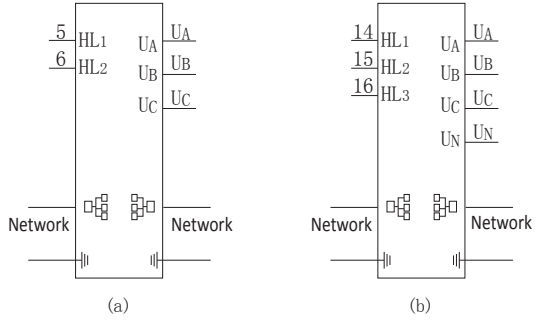


Figure 10 Module electrical wiring graphic symbols
（a）Three-phase；（b）Split-phase type

12.2 Electrical primary diagram of complete-set device

A controller and several or dozens of modules are assembled in a cabinet as an intelligent low-voltage reactive power compensation device. The primary diagram of a complete-set device is the module configuration and main wiring diagram of the device, generally in the form shown in Figure 11.

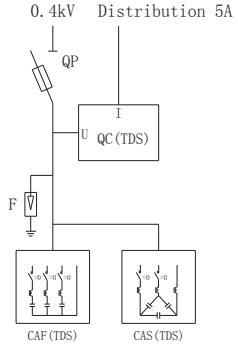


Figure 11 Electrical primary diagram of complete-set device

12.3 Electrical principle diagram of complete-set device

The electrical schematic diagram of a complete set of devices using controllers and modules is generally as shown in Figure 12, which can be used as a design basis for the complete set of electrical wiring diagrams.

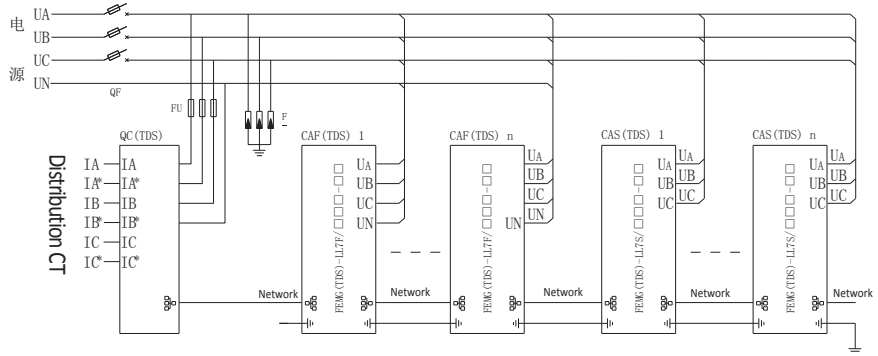


Figure 12 Electrical principle diagram of complete-set device

QF-Fuse switch；FU-Fuse；F-Arrester；QC(TDS)-TDS intelligent integrated low voltage reactive compensation controller;
CAF(TDS)1～CAF(TDS)n—TDS intelligent integrated low voltage reactive compensation moduel (split-phase)
CAS(TDS) 1～CAS(TDS)n—TDS intelligent integrated low voltage reactive compensation moduel (three-phase)

12.4 Electrical wiring diagram of complete-set device

The electrical wiring diagram design of the complete set of devices using controllers and modules can be based on more specific connection terminals, wire numbers, etc. marked on the basis shown in Figure 13.

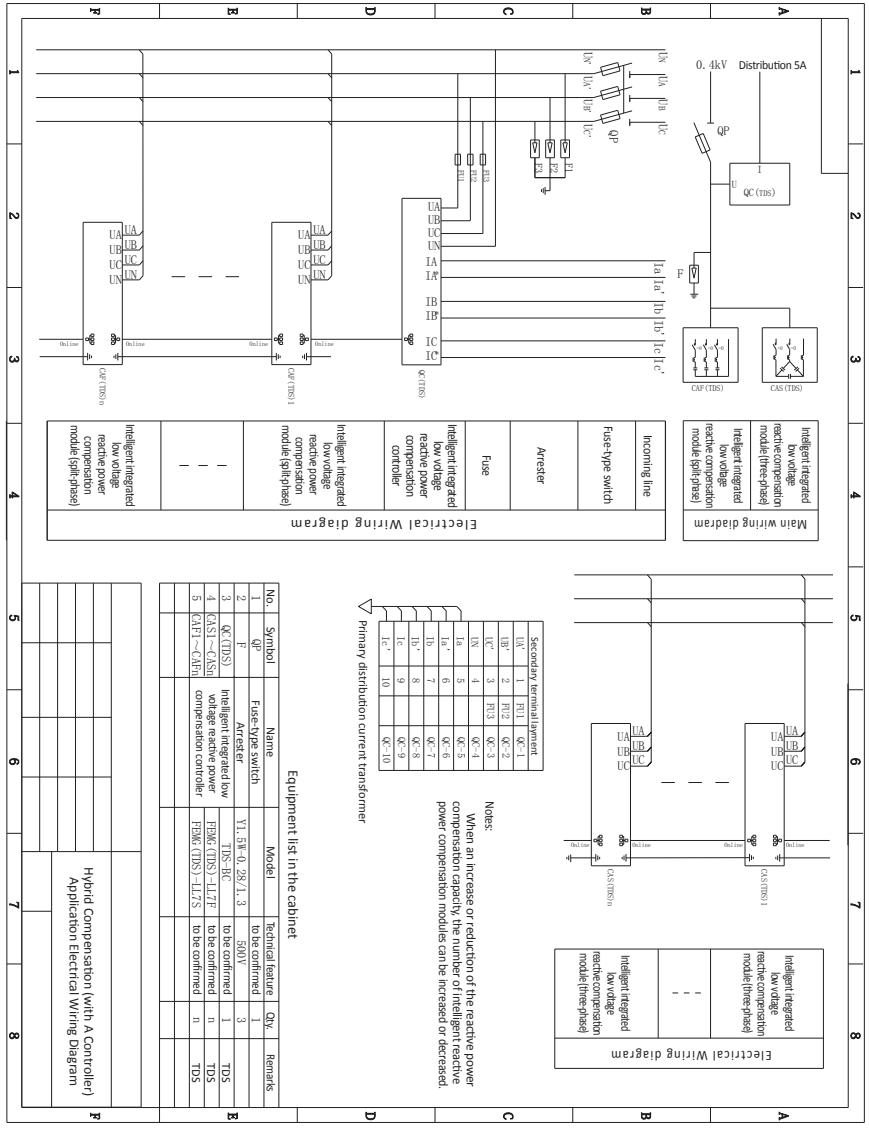


Figure 13 Electrical wiring diagram for complete-set device

12.5 Complete-set assembly

(1) Mechanical installation

The module and controller are assembled in a complete set inside the electrical cabinet or box to form an intelligent low-voltage reactive power compensation device. The power supply leading-in end generally requires the installation of a master power switch with current quick cut-off protection.

The module is vertically installed and fixed inside the cabinet or box. Place a crossbar under the module, fasten the module to the crossbar, and brace the crossbar to the inner side of the cabinet or box. The horizontal installation dimensions of the bottom of the module are shown in Figure 4, while the vertical installation dimensions and height dimensions vary depending on the model and specifications of the module. The installation layers and crossbars of modules should be designed and manufactured within the confirmed cabinet or box based on the number of modules and their bottom mounting sizes and height dimensions. The crossbar should be installed first, and then the module should be installed on the crossbar.

(2) Electrical wiring

Modules and controllers are assembled as intelligent low-voltage reactive power compensation devices in cabinets or box, and electrical wiring should be carried out according to the electrical wiring diagram. The main wiring diameter of the electrical connection should meet the current carrying capacity requirements, and the connecting screws at the connection should be tightened to avoid heating and damaging the wiring terminals. The secondary small wires of electrical connections should meet the requirements of current carrying capacity and strength, and also require stable connections at the connection points. The wiring and bundling should be reasonable and beautiful.

The intelligent low-voltage reactive power compensation device using modules and controllers is shown in Figure 14.

Figure 14 Schematic diagram of intelligent low voltage reactive power compensation

12.6 Complete-set commissioning

After the completion of the test for intelligent low voltage reactive power compensation device composed of modules and controller, the debugging of device can be made, which can be carried out according to the steps below.

(1) Disconnect the main power switch of the intelligent reactive power compensation device (cabinet);

(2) Close the fuse switch (power switch) of each module one by one;

(3) Toggle the button on the human-machine interaction components of each module to the "Force Exit" position;

(4) Close the main switch of the device (cabinet), power on the controller, and check that the controller and each module are functioning properly;

(5) Toggle the key on the human-machine interaction components of all modules to the "Auto", and each module will switch on and switch off the capacitors according to the control commands of the controller.

If the power capacity is less than the capacity of the capacitors in the module, the module can be set to a simulated debugging state. The operation steps are as follows: before powering on the module, turn the key to the "Manual", and then power on the module again. The interface will display the word "DEBUG", and the module will enter the debugging state. At this time, the module receives the command from the controller to put the capacitor into operation, and only the status light will be on. After the simulation debugging is completed, the dial key must be turned to the "Auto".

12.7 Complete-set switch-on and switch-off

(1) Complete-set switch-on

On the basis of the successful completion of the complete-set commissioning, correctly set the parameters in the parameter setting interface of the controller, meanwhile, turn the key on the human-machine contact components of each module to the "Auto"position, then the complete-set intelligent low-voltage reactive power compensation device is put into operation.

(2) Complete-set switch-off

As needed, to deactivate the complete-set device of intelligent low-voltage reactive power compensation devices, the capacitors in each module should be disconnected first, and then the main switch of the device should be disconnected, so that the intelligent low-voltage reactive power compensation device is in the exit state.

13. Product Troubleshooting

13.1 Fault component diagnosis

The product consists of main components such as a fuse-type main switch, power capacitors, reactors, on-off switch, fans, main board and display board. Any component failure means product malfunction, and different component failures of the product will produce different fault phenomena, hence the faulty components can be identified based on different fault phenomena.

The faults of the fuse-type main switch, power capacitor, power reactor, and fan are relatively intuitive and can be detected by visual observation.

Sometimes it is difficult to distinguish faults in the motherboard, display board, and on-off switch, but accurate diagnosis can be obtained through replacement.

13.2 Replacement of faulty components

The handling of product faults is solved by replacing faulty components and replacing them with intact spare parts.

The main components and parts that make up the product are shown in Figure 15. The fasteners used frequently are not indicated in the diagram.

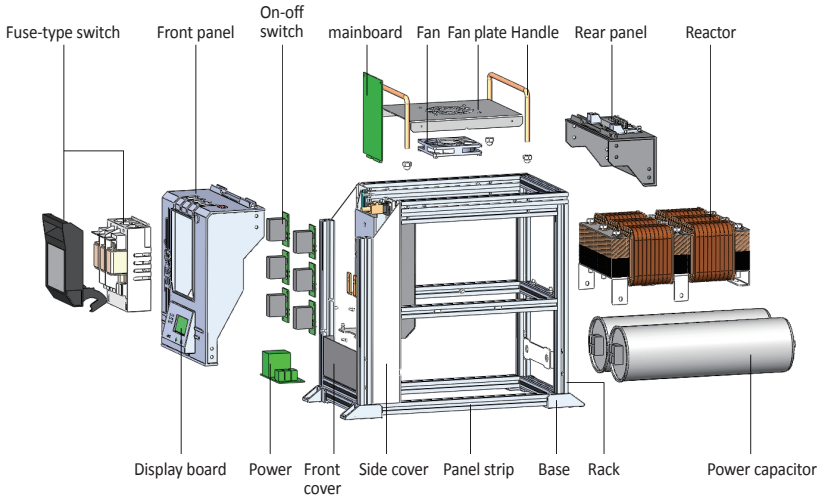
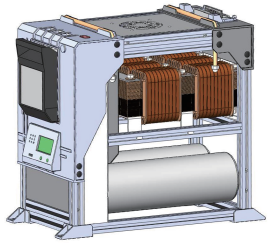


Figure 15 Product disassembly procedures

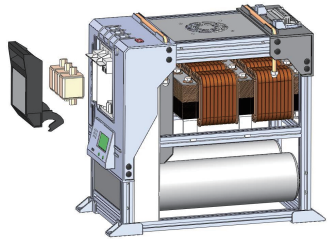
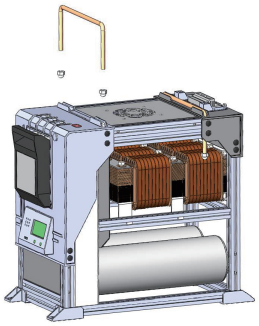
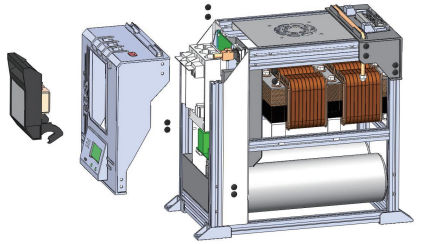
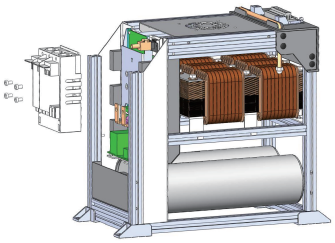
The step of disassembling the faulty component from the product and performing reverse operation is the step of assembling the spare component into the product.

The replacement of any faulty component does not necessarily require disassembling the products fully, the steps of main faulty component disassmbly from the product are shown in Table 2 below. There is a column in the table called "Front Disassembly", and the number in the column represents the disassembly done previously.

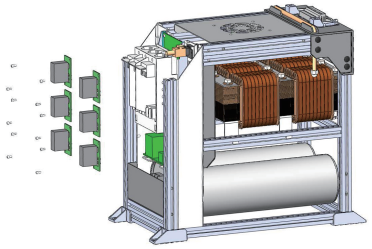
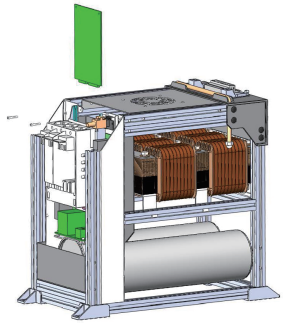
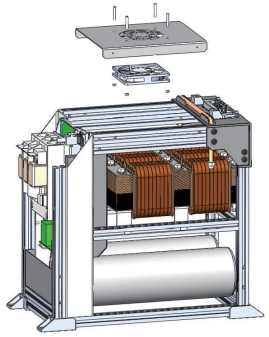
Table 2 Step diagram of replacing the components disassembled from the product

No.	disassembled component	Disassembly procedures	
		Front disassembly	Current disassembly process
1	——	——	

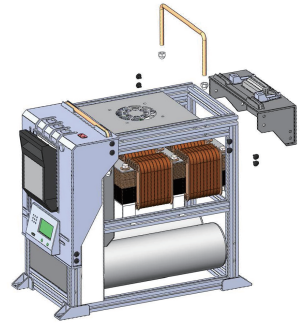
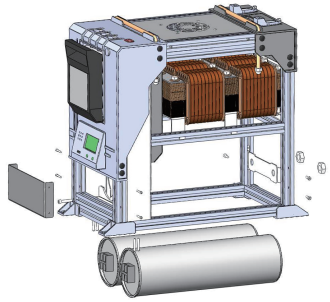
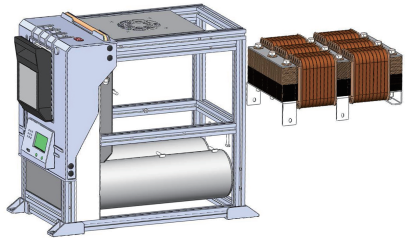
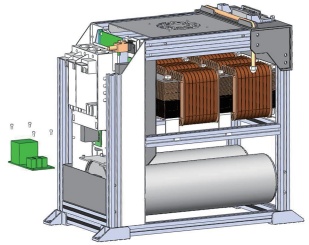
Continued table

No.	disassembled component	Disassembly procedures	
		Front disassembly	Current disassembly process
(2)	Fuse	(1) ⇩ (2)	
(3)	Handle	(1) ⇩ (3)	
(4)	Front panel	(1) ⇩ (3) ⇩ (4)	
(5)	Fuse-type switch	(1) ⇩ (3) ⇩ (4) ⇩ (5)	

Continued table

No.	disassembled component	Disassembly procedures	
		Front disassembly	Current disassembly process
(6)	Relay board	(1) ⇩ (3) ⇩ (4) ⇩ (6)	
(7)	main circuit board	(1) ⇩ (3) ⇩ (4) ⇩ (7)	
(8)	Fan	(1) ⇩ (3) ⇩ (4) ⇩ (8)	

Continued table

No.	disassembled component	Disassembly procedures	
		Front disassembly	Current disassembly process
(9)	Rear panel	(1) ⇩ (9)	
(10)	Power capacitor	(1) ⇩ (10)	
(11)	Reactor	(1) ⇩ (9) ⇩ (11)	
(12)	Power supply	(1) ⇩ (3) ⇩ (4) ⇩ (12)