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TDS[®]

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TDS (APF)

Low Voltage Active Power Filter Device

Instruction Manual



Special Note:

1) When the temporary power supply is used for factory commissioning in the APF module or the corresponding complete-set cabinets, the incoming power lines (Ua, Ub, Uc, Un) shall be connected reliably. If the current carrying capacity of the temporary power line is insufficient, you cannot “Start” the APF module, otherwise, the large current generated by the device may easily cause a rise of phase voltage, causing equipment damage or personal injury.

2) APF module will generate large impact current at the moment of power on. In the factory of complete-set cabinet, if the power of the commissioning power supply is insufficient and the connection is not reliable (especially it cannot be connected with the alligator clip), and the transient voltage surge may occur during power on, resulting in breakdown damage of the protection devices in the APF module and tripping of the commissioning power supply protection. During commissioning, mains supply can be directly used (with output power of power supply shall be no less than 20A).

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1. INTRODUCTION

1、Overview

Power electronic devices using thyristor and other power electronic devices, such as frequency converter, rectifier, UPS, electronic ballast, switching-type DC power supply, intermediate frequency furnace, etc., are nonlinear loads in the power grid. The load current is nonlinear, containing harmonic current during operation, which distorts the voltage waveform of the power grid.

Harmonic will cause additional loss to the power grid, reduce the operating efficiency of electrical equipment, affect its normal work and service life. It will also lead to misoperation of power protection and automation devices, make electrical measurement and metering instruments inaccurate, and cause interference to power carrier communication and adjacent communication systems. Serious harmonic will result in power grid accidents and electrical equipment failures.

2、Passive and Active Power Filter Device

There are two kinds of harmonic suppression devices, passive type and active type, which are used to absorb and reduce harmonics in power grid. The passive type is that the reactor and capacitor are in series to resonate at a certain harmonic frequency to produce the minimum impedance, so as to absorb the harmonic of that frequency.

In the active mode, the harmonic source current with the same amplitude but opposite phase is generated to eliminate the harmonic.

The comparison between passive and active harmonic-suppression devices is shown in Table 1.

Table 1 Comparison between passive and active power filter devices

Feature Model	Item	Harmonic -suppres sion mode	Principle	Number of harmonic suppression	Adjustability of capacity		Harmonic suppression capacity & reactive power control capacity	Structure	Capacity	Cost
					Range	Speed				
Passive type		Passive	The reactor is in series with capacitor.	Specific times	Small	Slow	Inconvertible	Simple	Large	Low
Active type		Active	IGBT controls the storage capacitors.	Any times	Large	Fast	Inconvertible	Complex	Larger	Higher

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While the active power filter device (hereinafter referred to as “device”) detects and eliminates the harmonic current, it will detect the reactive current and quickly control the residual capacity after harmonic suppression. The comparison between the active reactive power control and the existing passive reactive power compensation with shunt capacitor as reactive power source is shown in Table 2.

Table 2 Comparison between the passive-type and active-type reactive power control device

Feature Model	Item	Harmonic -suppres sion mode	Principle	Reactive power property	Continuity of regulation	Rapidity	Harmonic amplification	Structure	Capacity	Cost
Passive type		Passive	The reactor is in series with capacitor.	Leading or lagging fixation	Step jump	Slow	Large	Simple	Large	Low
Active type		Active	IGBT controls the storage capacitors.	Leading or lagging convertibility	Continuous (Stepless difference)	Fast	Small	Complex	Larger	Higher

2. DEVICE APPEARANCE

1、Device Appearance

The device appearance is shown in Figure 1, 2, and 3 below.



Figure 1 Complete-set cabinet



Figure 2 Front-end device



(50-150A)



(200-300A)

Figure 3 APF module

02

2、Layout of Device Panel

The device panel is as shown in Figure 4.

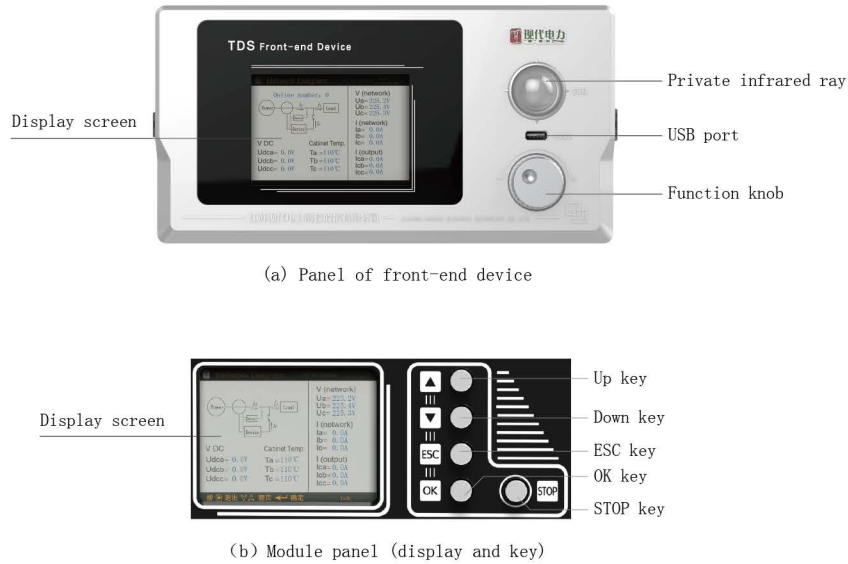


Figure 4 Layout of device panel

3. WORKING PRINCIPLE

1、Basic Principle

Basic principle of the device is shown in Figure 5 as follows.

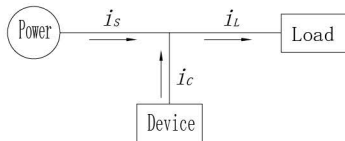


Figure 5 Schematic diagram of basic principle of the device

i_L —Harmonic current (and reactive current) generated by the Load;
 i_C —Harmonic current (and reactive current) supplied by the Device;
 i_S —Harmonic current (and reactive current) supplied by Power.

The relationship among i_S , i_L and i_C is as follows:

$i_S = i_L - i_C$

When the device is not working ($i_C = 0$, $i_S = i_L$), that is, the harmonic current (and reactive current) generated by the Load are all supplied by Power, which will seriously pollute the power supply; when $i_C = i_L$ (ideal state), $i_S = 0$, the device will eliminate all the harmonic current (and compensate all the reactive current); in general, $i_C < i_L$, $i_S < i_L$, the device will eliminate part of the harmonic current (and compensate part of the reactive current).

2、Topological structure

The topological structure of the device is shown in Figure 6 below, which is composed of filter reactor, IGBT inverter module and energy storage capacitor.

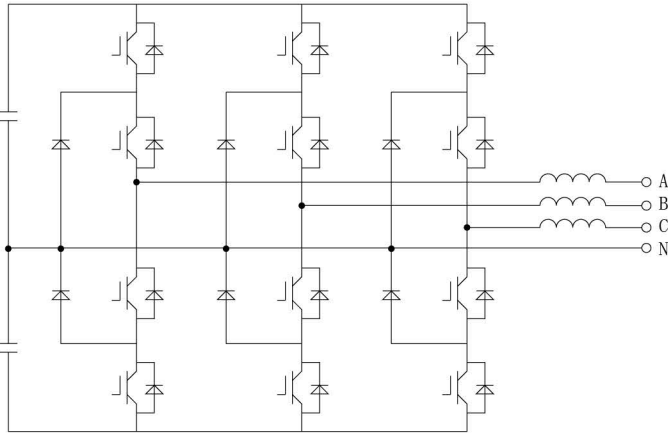
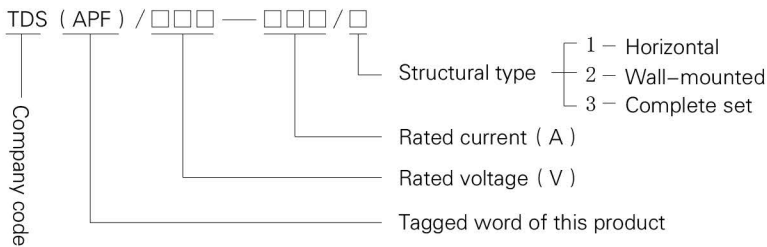


Figure 6 Topological structure diagram of main wiring of the device

4. MODEL AND CLASSIFICATION



5. MAIN FEATURES

1) The use of well-known brand IGBT, with a large module margin design, can improve the reliability of the equipment. The breaking capacity of the main power circuit breaker of the complete-set device is no less than 50KA to ensure the safety of the system.

2) There are three working modes such as harmonic suppression, reactive power control as well as an integration of harmonic suppression and reactive power control and so on, featuring strong universality and applicability.

3) The device is of modularized structure. It is recommended that the maximum rated capacity of the single cabinet is no more than 600A; in addition, the exit of a single module does not affect the normal operation of other modules, having high reliability. The module can also be replaced online, therefore, it is easy to operate and maintain.

4) The use of unique layered cooling channel design can realize efficient and rapid heat dissipation. The device has intelligent temperature protection function, that is, when the temperature exceeds the set value, the output current can be adjusted to achieve rapid cooling.

5) It can be used in combination with low voltage reactive power compensation device with low voltage shunt capacitor as the reactive power source to improve the overall compensation capacity and reduce the project cost.

6) The harmonic detecting approaches like double correction of new power frequency software phase locked loop and online adjusting of self-adaptive neuron can be adopted to realize dynamic tracking and compensation, which is highly controllable and quickly responsive. The compensation performance is not affected by the fluctuation of distribution voltage; besides, the filtering characteristics are not affected by the system impedance, and there will be no resonance with the system impedance.

6. MAIN FUNCTIONS

1、Control function

- 1) Harmonic suppression;
- 2) Reactive power control;
- 3) Integration of harmonic suppression and reactive power control.

05 2、Measurement and display function

- 1) Measurement and display of distribution each-phase voltage, current, reactive power and power factor;
- 2) Measurement and display of distribution each-phase voltage harmonic and current harmonic;
- 3) Measurement and display of distribution each-phase control current.

3、Signal function

- 1) Switch-on and switch-off signal;
- 2) Self-diagnosis fault signal;
- 3) Protection action type signal.

4、Protection function

- 1) Distribution overvoltage, under-voltage and phase loss protection;
- 2) IGBT overcurrent and over-temperature protection;
- 3) Soft-start fault protection;
- 4) Inverter DC-side overvoltage protection;
- 5) Current-limiting output protection.

5、Man-machine dialog function

- 1) Figure, text, and curves display of color LCD;
- 2) Rotary key input (regular) and touch screen input (custom touch screen);
- 3) Wireless remote dialog via GPRS.

7. MAIN TECHNICAL INDEX

1、Environmental condition

- 1) Temperature: $-25\sim+45^{\circ}\text{C}$;
- 2) Humidity: At $40^{\circ}\text{C} \leq 50\%$, At $20^{\circ}\text{C} \leq 90\%$;
- 3) Altitude: $\leq 2000\text{m}$;
- 4) Environment: There shall be no explosion hazard, no corrosive gas and conductive dust, no serious mould and no violent vibration source.

2、Power supply condition

- 1) Working voltage: Rated voltage $\pm 15\%$;
- 2) Working frequency: $50\text{Hz} \pm 5\%$;
- 3) Active Power consumption: $< 3\%$ rated apparent power.

3、Electrical safety

Electrical clearance and creepage distance, insulation strength, safety protection, short-circuit strength, sampling and control circuit protection comply with the requirements of electrical safety.

4、Measuring error

- 1) Voltage: $\leq 0.5\%$ (Within the range of 85%~115% rated voltage);
- 2) Current: $\leq 1.0\%$ (Within the range of 5%~20% rated current);
 $\leq 0.5\%$ (Within the range of 20%~120% rated current);
- 3) Voltage harmonic: $\leq 2\%$;
- 4) Current harmonic: $\leq 2\%$.

5、Protection Error

- 1) Voltage: $\leq 0.5\%$;
- 2) Current: $\leq 1.0\%$;
- 3) Temperature: $\pm 1^{\circ}\text{C}$.

6、Module capacity and maximum capacity of the complete-set cabinet

- 1) Single module: 50A, 75A, 100A, 125A, 150A, 200A, 250A, 300A.
- 2) Maximum capacity of the whole complete-set cabinet: 600A.

7、Harmonic suppression

- 1) Number of times of harmonic suppression: 2nd ~ 50th (or select times);
- 2) Harmonic suppression rate: $\geq 95\%$ (The harmonic content shall not exceed the rated range of the device).

8、Reactive power control

- 1) Reactive power property: Lagging or leading, continuous bi-directional adjustability;
- 2) Response time: $\leq 15\text{ms}$.

9、Communication

- 1) Interface: Wireless GPRS port;
- 2) Protocol: RS485, Modbus.

10、Overall size

- 1) Front-end device

Overall size of the front-end device is

270mm(W) $\times$ 125mm(D) $\times$ 140mm(H)

Hole spacing size is 258mm (W) $\times$ 128mm(H).

- 2) Module

Overall dimension of the module (50A ~ 150A) is shown in Figure 7 (a) and Table 3.

Overall dimension of the module (200A ~ 300A) is shown in Figure 7 (b).

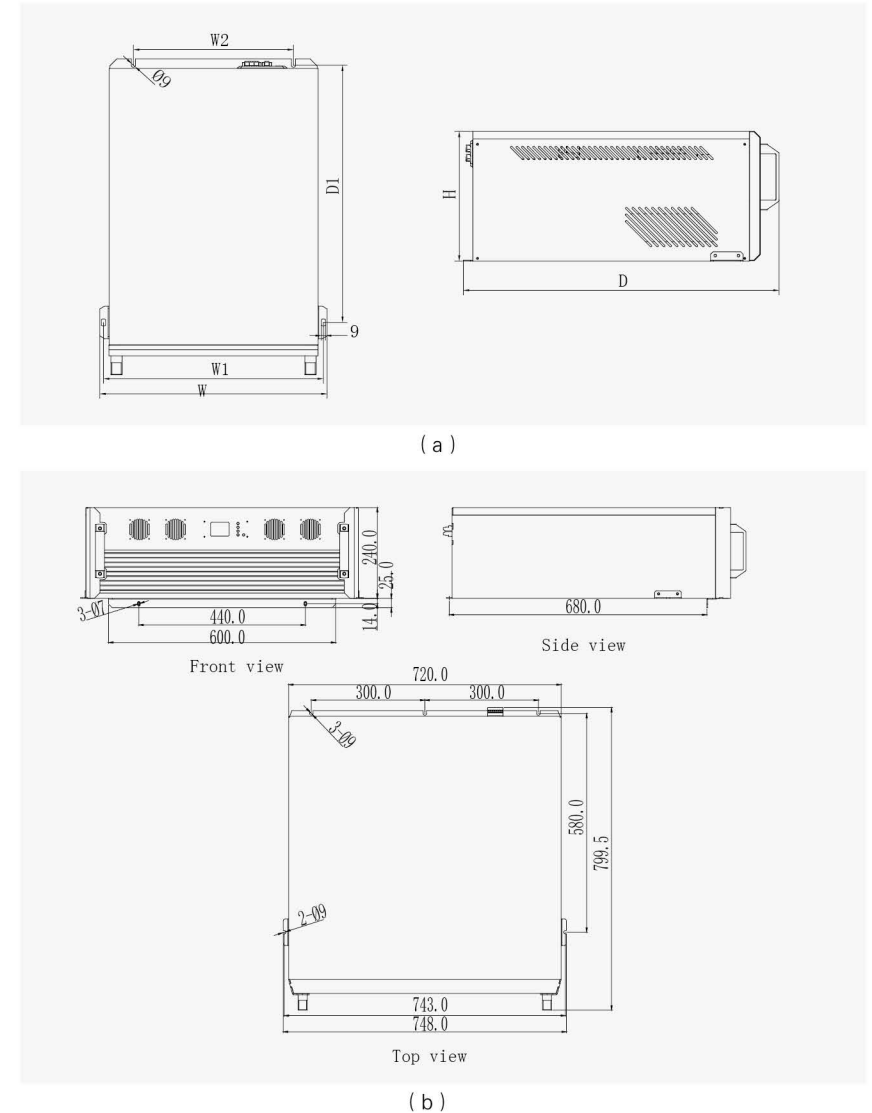


Figure 7 Overall dimension of the module
(a) Overall dimension of the module (50A ~ 150A);
(b) Overall dimension of the module (200A ~ 300A)

Table 3 Appearance and mounting dimensions of the module

No.	Module capacity	Overall dimension (W × D × H)	Mounting size (W1/W2 × D1)	Weight (kg)
1	150A	585 × 565 × 240	525/345 × 465	60
2	125A			60
3	100A	585 × 545 × 220	525/345 × 445	51
4	75A	585 × 515 × 200	525/345 × 415	43
5	50A	380 × 580 × 245	365/200 × 460	34

Note: The overall dimensions of the module include the handle and the fixed edge.

3) Complete--set cabinet

Standard electrical cabinet size: 800 (or 1000) mm (W) × 800 (or 1000) mm (D) × 2200 mm (H).

If a single 200A ~ 300A module is adopted, the cabinet at least 800 mm (W) × 1000 mm (D) is recommended.

8. INSTALLATION

1、1. Environmental requirements for installation

- 1) It is convenient to conduct wiring and install;
- 2) The front and back of the device shall be at least 0.8m away from the surrounding wall or other equipment for heat dissipation, ventilation, operation and maintenance;
- 3) Well-ventilated indoor site or the places equipped with air conditioning is suitable, which can meet the requirements of heat dissipation;
- 4) There is no corrosive gas around;
- 5) No over humidity and high temperature source;
- 6) Non dusty environment.

2、Mechanical installation

- 1) The weight of the device for the complete-set cabinet is about 600kg (including four groups of modules and the weight of the cabinet). The device can be transported together with the wooden pallet by forklift.

- 2) There is a cover plate respectively at four bottom corner of the cabinet. Loosen the fixing screw on the surface, you can see the connecting screws between the device and the bottom tray. Remove the connecting screws to separate the bottom wooden tray from the device, as shown in Fig. 8 below.



Figure 8 Schematic diagram of wooden tray removal

- 3) When lifting the device, as the device is heavy, it is necessary to fix the four rings on the top of the cabinet diagonally and lift them smoothly. As shown in Figure 9, the two diagonal ropes shall be balanced and thick enough to ensure the weight of the load-bearing device (the length of a single rope shall not be less than 3m), otherwise it may cause deformation of the cabinet.

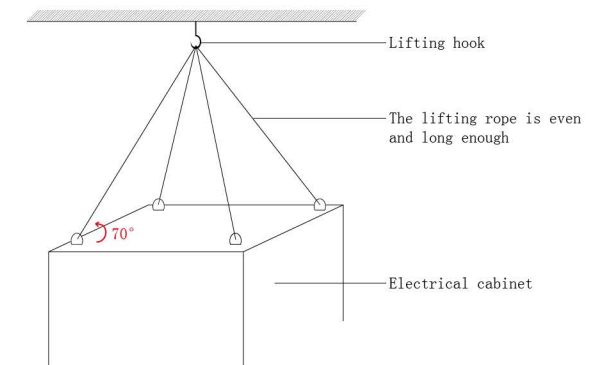


Figure 9 Schematic diagram of correct lifting mode

3、Device Wiring

1) The wiring terminals of the front-end device is displayed in Figure 10, and the definition of which is shown in Table 4.

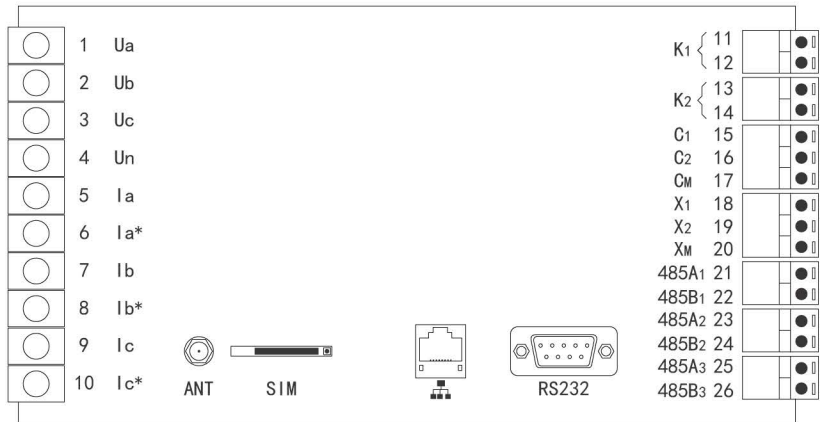


Figure 10 Wiring terminal diagram of front-end device

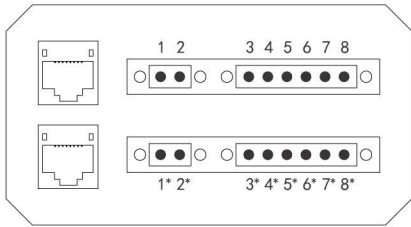
Table 4 Serial number, name and definition of wiring terminals for the front-end device

No.	Serial number	Name	Definition
1	1	Ua	Bus distribution voltage input
	2	Ub	
	3	Uc	
	4	Un	
2	5	Ia	System secondary sampling current input
	6	Ia*	
	7	Ib	
	8	Ib*	
	9	Ic	
	10	Ic*	
3	11	K1	Idle contact output, can be connected to the external running indicator
	12		
4	13	K2	Idle contact output, can be connected to the external fault indicator
	14		
5	15	C1	Temperature sensor 1 (temperature measurement in cabinet) matched indirectly is connected with Terminal CM
	16	C2	Temperature sensor 2 (temperature measurement in cabinet) matched indirectly is connected with Terminal CM
	17	CM	Common port of temperature sensor

Continue table

No.	Serial number	Name	Definition
6	18	X1	Back-up signal input 1
	19	X2	Back-up signal input 2
	20	XM	Common port of input signal
7	21	485A1	Downlink 485 communication port for communicating with the module
	22	485B1	
8	23	485A2	Uplink 485 communication port for communicating with the module
	24	485B2	
9	25	485A3	RS485 communication port (standby)
	26	485B3	
10	—	RS232	RS232 communication port (standby)
11	—	Ethernet port	Downlink 485 communication port (standby)
12	—	SIM	GPRS communication, SIM card slot
13	—	ANT	Wireless communication antenna

2) Wiring terminals of the module are shown in Figure 11 while the definition of wiring terminals is displayed in Table 5 below.



RS485A	1	1*	RS485A
RS485B	2	2*	RS485B
IA	3	3*	A phase current incoming line
IA*	4	4*	A phase current outgoing line
IB	5	5*	B phase current incoming line
IB*	6	6*	B phase current outgoing line
IC	7	7*	C phase current incoming line
IC*	8	8*	C phase current outgoing line
Network port			网络口

Note: When the current sampling is connected to the last module, 3 and 4 are short connected, 5 and 6 are short connected and 7 and 8 are short connected.

Figure 11 Wiring terminal diagram of front-end device

Table 5 Number, name and definition of wiring terminals for the module

No.	Serial number	Name	Definition
1	1	RS485A	485 communication port for connecting to the front-end device
	2	RS485B	
2	1*	RS485A	485 communication port for connecting to the next adjacent module
	2*	RS485B	
3	3	IA	System A phase secondary sampling current input
	4	IA*	
4	3*	IA	System A phase secondary sampling current output Connecting the next module A phase sampling current input
	4*	IA*	
5	5	IB	System B phase secondary sampling current input
	6	IB*	
6	5*	IB	System B phase secondary sampling current output Connecting the next module B phase sampling current input
	6*	IB*	
7	7	IC	System C phase secondary sampling current input
	8	IC*	
8	7*	IC	System C phase secondary sampling current output Connecting the next module C phase sampling current input
	8*	IC*	

3) The wiring principle of the device is shown in Figure 12. In the figure, CT is installed on the power grid side, excluding the current of the capacitor cabinet.

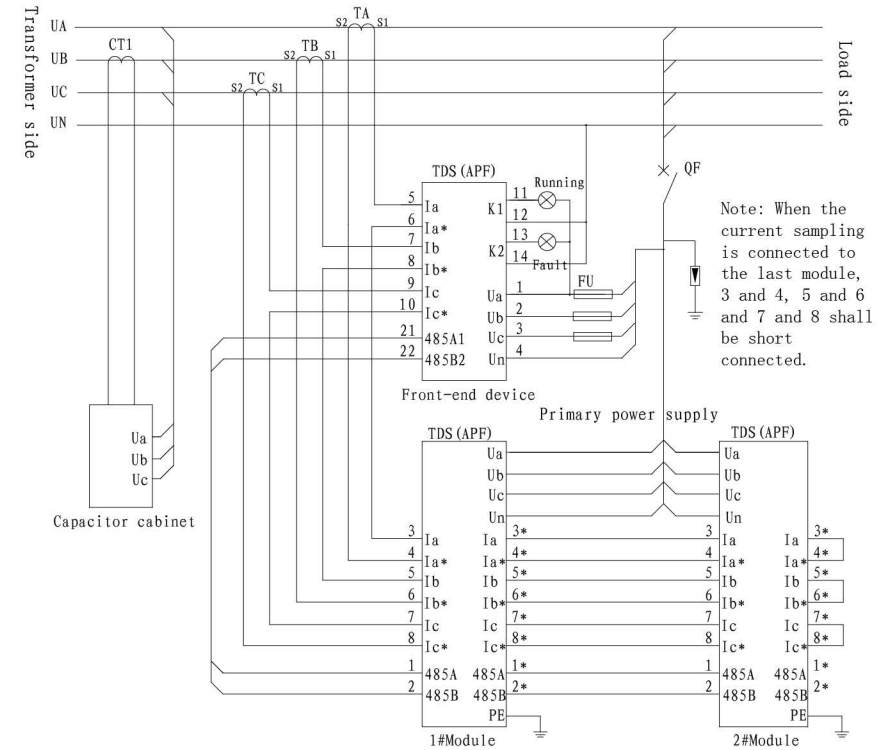


Figure 12 Wiring principle of the device

4) Wiring Instructions

(a) The incoming power supply (Ua, Ub, Uc, and Un) is connected to the main bus bar of the system. Select an appropriate copper bar or cable (for details, see Table 6) based on the capacity of the device. The ground wire PE is at least 16mm².

Table 6 Relationship between the rated current of the device and recommended connecting wire specification

Rated current of the device (A)	Power line BVR (mm ²)	Transformer wiring (mm ²)	Transformer ground wire (mm ²)	Device ground wire (mm ²)
100	50	2.5	2.5	25
150	70	2.5	2.5	35
200	95	2.5	2.5	50
250	120	2.5	2.5	70
300	150	2.5	2.5	70
350	A double70	2.5	2.5	70
400	A double95	2.5	2.5	95
450	A double120	2.5	2.5	120
500	A double150	2.5	2.5	150

(b) TA, TB and TC are used for system current sampling, including the output current and load current of the device itself (excluding the capacitor cabinet current configured separately). RVVP 2 × 2.5mm² multi-core wire can be selected. When two or more cabinets are combined for use, the current sampling is connected in series with each other.

(c) RVVP 2 × 0.5mm² wire can selected for RS485, and 485A and 485B are connected to each other and shall not be cross-connected.

9. POWER-ON OPERATION



- 1) The debugging personnel shall have necessary electrical knowledge and operation experience of electrical equipment, and take protective measures. Before power on, the debugging personnel shall carefully read this Instruction Manual of the product.
- 2) For the power outage inspection of the device, the shutdown operation shall be carried out first, after the DC side voltage in the device is lower than the safety voltage of 36V (the “DC side voltage” data of the corresponding module in the “APF Data” of the main menu of the front-end device can be checked), the inspection shall be carried out after disconnecting the incoming switch in the cabinet.

1、 Check before power on

- 1) To check whether the inside of the cabinet is clean, and no conductive debris such as copper scraps, iron scraps, spring pads and flat pads shall be left;
- 2) To check whether the copper bar or cable connection of the cabinet switch is loose to ensure that it is firm and reliable;
- 3) To check the input and output of cabinet switch and measurement with multimeter to ensure there is no short circuit between phases.
- 4) To check whether the copper bar of the module device or the power line of the cable, the system current sampling line and the communication line are loose to ensure that those are firm and reliable.
- 5) To check the system current sampling transformer (hereinafter referred to as “system CT”)

The access power supply point of APF cabinet is between the capacitor cabinet and the load. The CT can be installed in the following two ways:

(a) Power grid side

Under normal circumstances, the installation position of CT is between the power access point of the capacitor cabinet and the power access point of the APF cabinet, that is, the current of CT includes the current of the APF device and the load current, as shown in Figure 13 (a).

(b) Load side

In special cases, CT cannot be installed as described in the above “grid side” mode. The CT installation position can be between the APF cabinet power supply access point and the load, that is, the CT current includes the load current but does not include the APF device current, as shown in Figure 13 (b).

The primary current inputs from the P1 side of the CT and outputs from the P2 side while the secondary current inputs from the S1 end and outputs from the S2 end, as shown in Figure 14.

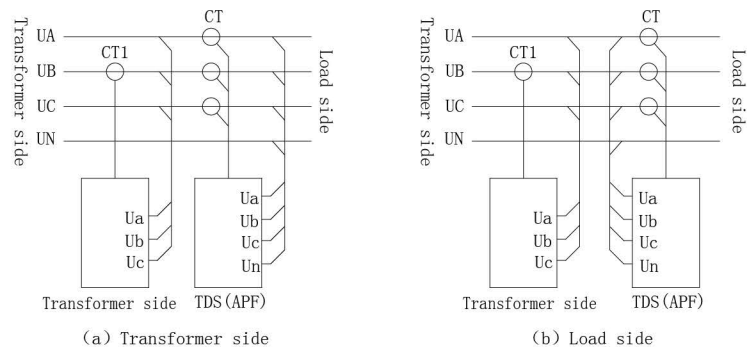


Figure 13 Installation position of system CT

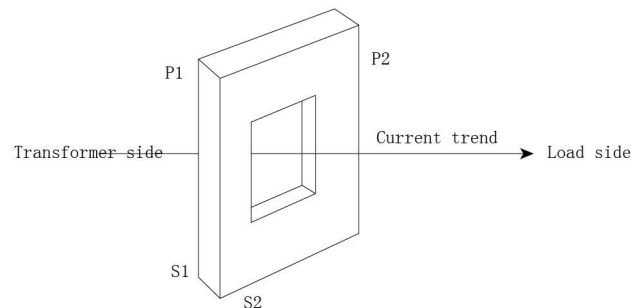


Figure 14 Current trend of system CT

After the completion of the inspection above, the cabinet of active power filters can be powered on.

2、Power-on check

1) Power-on operation

After switch-on, the power indicator of the cabinet is lit.

When the incoming switch with electric operating mechanism is installed in the cabinet, press the power switch to power on the device (Manually close the incoming switch if the incoming switch with the electric operating mechanism is not installed). After power on, the display screen of front-end device and module will light up. After the startup screen, the “Network Diagram” interface is displayed, as shown in Figure 15, then operate the rotary knob on the front panel of the front-end device (rotate left, rotate right and press), it can return to the “Home” interface, as shown in FIG. 16. You can perform related operations as prompted. The module display interface is basically the same as that of the front-end.

Note: For the MCCB with under-voltage release, if the MCCB cannot be closed, check whether the under-voltage release terminals of the MCCB is connected to 220V AC.

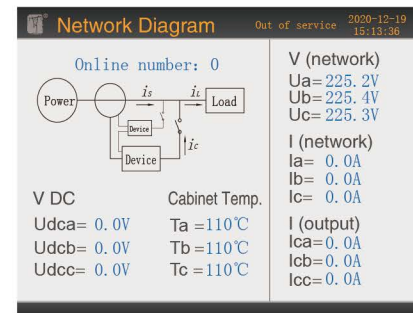


Figure 15
“Network Diagram” interface of the device

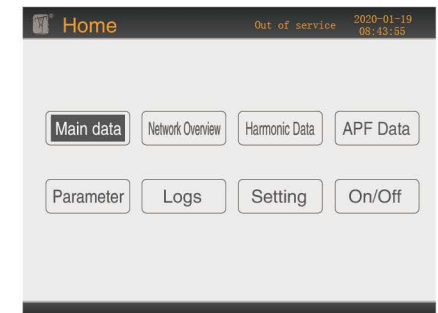


Figure 16
“Home” interface of the device

2) RS485 communication check

In the system diagram interface of the device shown in Figure 15, check whether the displayed “online number” is consistent with the number of modules in the cabinet. If so, the communication is normal.

You can also enter “Harmonic Data”, “APF Data”, “On/Off” and other interfaces in the main menu interface respectively to check whether the phase sequence diagram, module information, status information of each module are displayed. If so, the communication is normal.

If “TxOK” is displayed at the lower right corner of any interface of the module, the communication is normal. If “Terr” is displayed, the RS485 communication between the module and the front-end device is abnormal. Check whether the RS485 connecting wire is loose or crossed.

3) Phase sequence check

Operate the rotatory knob of the front-end device to enter the “Harmonic Data” interface in the main menu interface, rotate the knob to find the “Phase Sequence” screen of the front-end and each module (as shown in Figure 17), and you can also find the “Phase Sequence” diagram in the display interface of each module (as shown in Figure 18) to view the system voltage and current phase sequence of the front-end device and each module. If the indicated phase sequences of the voltage and current are correct, the external wiring is correctly connected; If the indication is incorrect, it is necessary to check and change the copper bar or cable and current sampling line of the front-end –device and each module to make the phase sequence correct.

Note: In the phase sequence detection, the normal phase sequence detection can only be carried out only when the secondary current of the system is greater than 0.1A. If the system current is too small, it maybe display the phase sequence of current is incorrect. If the current sampling line of the front-end device is not connected, but the current sampling line of each module is correctly connected, the device operation will not be affected.

When changing the current sampling line, it is necessary to short-circuit the current sampling circuit at the current terminal of the cabinet first to ensure that the CT secondary current circuit of the system is free of open circuit.

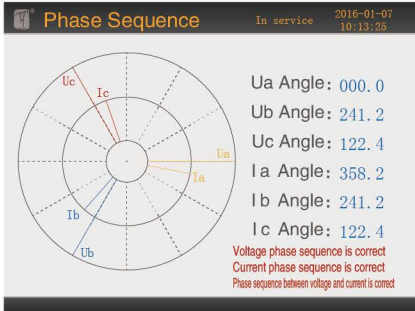


Figure 17
“Phase Sequence” of the front-end device

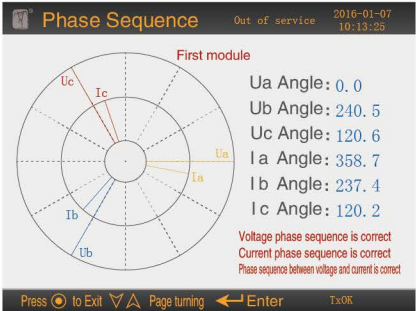


Figure 18
“Phase Sequence” of the module

3、Parameter query and setting

Select “Parameter” on the main menu interface by operating the rotatory knob of the front-end device.

When there is a need to set the parameters, enter the “Setting” in the main menu interface and enter the password (the default password is 00000000) to enter “Parameter setting” interface. After the parameter setting is completed, rotate the knob to “Modify” , and press it and ask whether to save. If you want to save the parameter, click “Yes” , otherwise click “No” to abort, in that case, the parameter will not be saved. After the parameter is saved and exited, enter the “Parameter” screen again to check whether the parameter setting is correct.

1) Operation parameter

The operating parameter setting interface of the front-end device is shown in Figure 19, and the factory settings of the operating parameters are shown in Table 7.

Table 7 Factory settings of operating parameters

No.	Parameter	Factory settings	Remarks
1	Operating Mode	0–Full harmonic	0–Full harmonic 1–Full reactive power 2–harmonic plus reactive power (It is recommended to set it to 0 after commissioning)
2	Operating Mode	1–Manual	0–Commissioning: Fixed Q Cur (Used only when debugging) 1–Manual: Manual startup is required after shutdown 2–Auto start: It can be automatically restarted after shutdown (It is recommended to set it to 1 after commissioning)
3	PF Target	0.95	Range 0.90~0.99, default value, do not have to be adjusted
4	Current limit	100A	Default value, do not have to be adjusted
5	DC voltage	400V	Default value, do not adjust
6	Harmonic limit	80%	Default value, do not have to be adjusted, and the maximum value shall not exceed 90%
7	Single/Total capacity	30/030	Default value, do not adjust
8	Phase angle	5.2°	5~6.2° , Default value, do not adjust
9	Current tracking limit	210A	Default value, do not adjust
10	Charge current limit	60A	Default value, do not adjust
11	Compen. harmonics	28,00,00,00,00,00	Harmonic 5th and 7th, default value, It can be set and adjusted according to the actual situation of on-site harmonics.

Setting method of “Compen. Harmonics” :

Select “Harmonics times” in the “Settings” interface, and press the knob to enter the interface for selecting harmonic times, as shown in Figure 20. In general industrial occasions, you can set harmonic 5th or 7th.

If there is load input on site, check the harmonic distortion rate of each current on the interface of “Network Data” — “V and I Distortion” , set the harmonic times with higher distortion rate, and give priority to the setting of the lower harmonic. The compensation times 28,00,00,00,00,00 are the transformation values, indicating that the 5th and 7th harmonics are mainly eliminated.

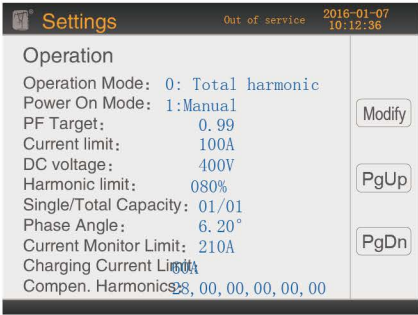


Figure 19

Operation parameter setting interface

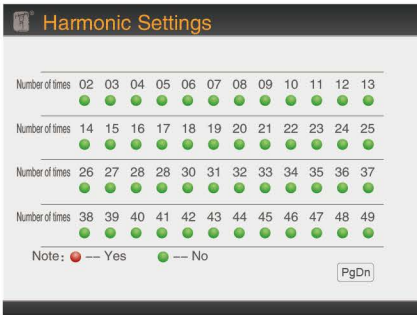


Figure 20

Harmonic setting interface

2) Limitation/Configuration setting

In the operation setting interface shown in Figure 19, select “PgDn” to enter the interface of “Limitation/Configuration” , as shown in Figure 21. The factory Settings of Limitation/Configuration are shown in Table 8.

Table 8 Limitation/Configuration parameters setting

NO.	Parameter	Factory setting	Remarks
1	Under Voltage AC/Delay	176V/200ms	Default value, do not have to be adjusted
2	Over Voltage AC/Delay	265V/80ms	Default value, do not have to be adjusted
3	Under Voltage DC/Delay	200V/400ms	Default value, do not have to be adjusted
4	DC overvoltage value/Delay	500V/40ms	Default value, do not have to be adjusted
5	Compensation overcurrent value/Delay	250A/100ms	Default value, do not have to be adjusted

Continue table

NO.	Parameter	Factory setting	Remarks
6	Module over-temperature value	70°C/40s	The temperature can be adjusted downward according to the ambient temperature and the heat dissipation of the cabinet, but it is recommended that the maximum temperature should not exceed 75°C.
7	CT Location	1:Power grid side	0:load side, 1:Power grid side Set this based on the installation position of the sampling current transformer
8	CT ratio	+500/5	Set according to the ratio of sampling current transformer
9	System Date	Actual date	Set according to actual date
10	System Time	Actual time	Set according to actual time

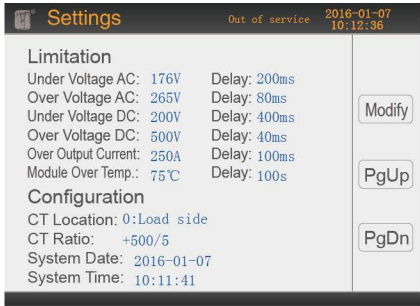


Figure 21
Interface for “Limitation
/Configuration” setting

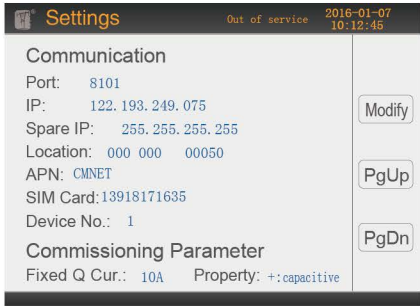


Figure 22
Setting interface of Communication
/Commissioning Parameter

3) Communication/Commissioning Parameter setting.

In the protection parameter setting interface shown in Figure 21, select “Pa Up” to enter the setting interface of “Communication” and “Commissioning Parameter” , as shown in Figure 22. The factory settings of Communication/Commissioning Parameter are shown in Table 9.

Table 9 Factory settings of communication parameters

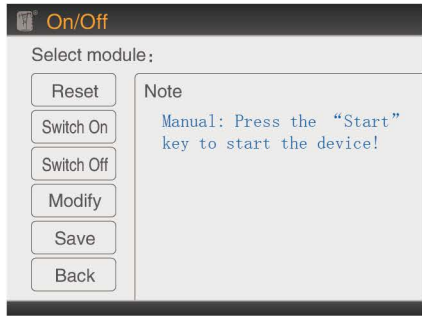
NO.	Parameter	Factory setting	Remarks
1	Port	8101	The address in the communication parameters is 000 000 00050, of which the first three digits correspond to the address of Modbus uplink communication while the last five digits refer to the address of GPRS connection to the background. The middle three digits are alternative addresses, in general, you do not have to use it.
2	IP	122.193.249.75	
3	Spare IP	255.255.255.255	
4	Location	000 000 00050	
5	APN	CMNET	
6	SIMcard	13918171635	
7	Device No.	1	Online machine number (auto detected, no need to adjust)
8	Fixed Q Cur	10A	Default value, do not have to be adjusted
9	Property	Capacitive	Default value, do not have to be adjusted

After each parameters are set, ensure that the modifications are saved, at this time, issue the parameters to each module automatically.

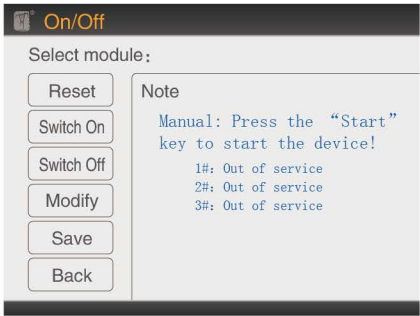
4、Switch-on and switch-off of the device

1) On/Off operation for the device

Press the key on the operation panel of the module to enter the “On/Off” interface in the menu interface, as shown in Figure 23 (a) below. Press the “Up” or “Down” key, select “Start” , and press the “OK” key to start the module. Each relay in the module is closed, and the fan starts to whirl. Wait about 20 seconds, the operation indicator on the cabinet is on, and the module generates current. View the “Main Data” interface of the front-end device to check there is the current, and examine if “On/Off” interface shows that the module is in running status; if so, the module is normal.



(a) On/Off operation interface of the Module



(b) On/Off operation interface of the front-end device

Figure 23 On/Off operation interface

Press the key on the operation module panel to enter the “On/Off” interface in the “Home” interface, select “Switch Off” , and press the “OK” key to switch off the module.

Other modules in the cabinet shall be started and stopped according to the above steps.

Note: The common error here is the abnormal indication of the indicator light of the cabinet. Please refer to the troubleshooting of common errors during on-site debugging.

2) On/Off operation for the whole complete-set cabinet

After each module can be started and stopped normally, operate the knob of the front-end device to enter the “On/Off” interface in the menu interface, as shown in Figure 23 (b). Select the “Switch On” option and press the knob to start up the complete-set cabinet, and then each module will start in turn. The “On/Off” interface will display that the status of each module is running, and the running indicator on the cabinet is on, which indicates the whole cabinet is normal.

In Figure 23 (b) “On/Off” interface, select the “Switch Off” option, press the knob once, and each module will stop running in turn.

Change the working mode of the operating parameters in Figure 19 of the “Setting” interface of the front-end device to 0 – full harmonic, change the startup mode to 1 – manual, then save it after modification, and issue the parameters again in the “On/Off” interface, at this point, the commissioning is completed. Each module can be started and stopped only through the front-end device in the future use.

Note: After starting the device again, if there is load input, you can enter the “Network Data” interface of the front-end device to check whether the distortion rate of each harmonic set is effectively reduced.

5、Troubleshooting of common errors during on-site debugging

1) System current phase sequence error

Wrong sequence means that the A/B/C three-phase sampling CT does not correspond to the A/B/C three-phase voltage. In this case, when the incoming and outgoing lines of the current sampling line are not inversely connected, a couple of system voltage and system current with an included angle within the range of 90° can be found through the phase sequence diagram, namely, the voltage and current of the same phase.

Reverse connection means that the current phase sequence is correct, but the incoming and outgoing lines of the sampling CT secondary current are connected reversely. It can be judged by observing the phase sequence diagram. If the included angle of voltage and current exceeds 100° under the system load, the current incoming and outgoing lines are connected reversely, and the lines need to be reversed.

In case of wrong sequence and reverse connection, it is necessary to eliminate an error to keep the system current in positive sequence, and then deal with other errors.

2) System voltage phase sequence error

First, check whether the sequence has been wrong at the incoming line side of the system transformer. If the sequence is incorrect, just make the system voltage correspond to the system current and the system can operate normally, that is, the system voltage of phase A corresponds to the system current of phase A, the system voltage of phase B corresponds to the system current of phase B, and the system voltage of phase C corresponds to the system current of phase C. If the system voltage is out of sequence when connecting to the active power filter cabinet, the incoming connecting cable of the cabinet needs to be changed.

3) RS485 communication exception

If “Err” is displayed at the lower right corner of the module display screen, the RS485 communication between the module and the front-end device is abnormal, and the RS485A and RS485B wiring is loose or crossed, just fasten the wiring or exchange the wiring positions of 485A and 485B.

4) Abnormal indicator display

If all modules are displayed as running, but the running indicator on the cabinet is not lit, and the fault indicator is lit instead, then the control node of the indicator is wrongly wired, just exchange the K1 and K2 terminals on the back of the front-end device, as shown in Figure 10.

10. DEVICE MAINTENANCE

The on-site technical service and maintenance work shall be carried out by the technical service personnel from the producer or the trained technical professionals of customers.

1、Routine Maintenance

- 1) To check the ambient temperature to guarantee good ventilation;
- 2) To check the heat dissipation of the equipment and clean up the dust on the inlet and outlet mesh;
- 3) During operation, check whether the panel power supply, operation and fault indicator lights are on;
- 4) To check whether the cooling fans of the module operate normally.

2、Periodic Maintenance

The device shall be cleaned and inspected regularly, and the inspection period is generally three months. For the places with bad environment, it shall be more frequent.

- 1) To shut down the device through the front-end device;
- 2) After shutdown, when the DC side voltage is lower than the safe voltage 36V (the “DC side voltage” data of the corresponding module can be viewed in the APF information menu of the front-end device), disconnect the incoming line switch;
- 3) To check whether the mechanical and electrical connections are firm;
- 4) To check whether the electrical wires are damaged;
- 5) Carefully handle the dust inside the device with small air compressor or vacuum cleaner;
- 6) After checking and cleaning, close the incoming switch and start up the device.