Integrated DC power System Technical Manual

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Contents

Chapter 1 System overview

1.1 Brief

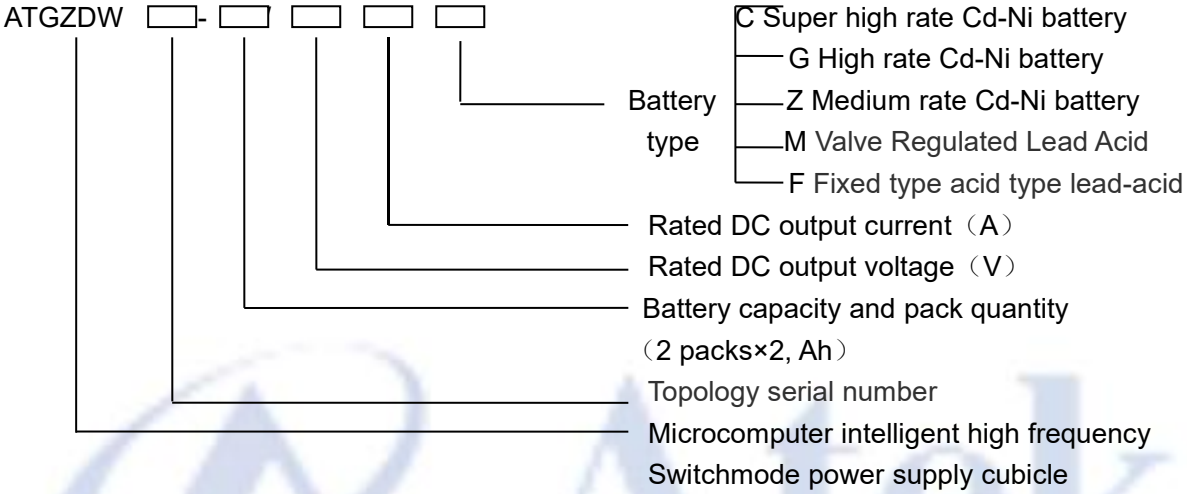
ATGZDW series is DC system we designed and developed independently with our years' technology experience and management, which is the essential DC power supply of transformer substation system. It serves in power plants (15MW-60MW) and substations (500KV-10KV), thermal power plant, hydropower station, transformer stations as DC power supply for controlling, signal transmission, protection, telecommunications and lighting. It is widely applied in electric power industry, petroleum industry, chemical industry, metallurgy, machinery, papermaking, coal industry, building materials, textile, brewing industry and etc.

1.2 Features

- **High intelligence**
  The AT series intelligent high frequency charging modules, using our own patent technology "resonant voltage dual loop control type power transformation", are designed especially for DC system with "four remotes" functions. They feature high efficiency, high power density, high reliability, intelligent control, small size and light weight. Three series 220V, 110V, 48V and a variety of options, which are all with standard RS485 interface. Suitable for 500KV-10KV substations, switching station, 15MW~60MW power plants and other DC power supply applications such as national projects in subway, oil&gas, chemical metallurgy and etc. The charging process meets requirements of lead acid battery and NiCd battery with intelligent battery management. The monitors are with standard RS-232/485 interface and several communication protocols. Through flexible configuration, the monitor can connect with automatic system and realize "four remote" and unattended.
- **High reliability**
  The charging modules can be connected in parallel, N+1 hot backup, high current share capability, flexible configuration, hot swapping (try to avoid hot swapping with load to prevent from damage). Integration interface design, which improves reliability and stability of the system.
- **Easy operation**
  The monitor is well designed and the data acquisition modules are plug and play (need set in monitor), hot swapping, convenient and quick installation and service.
- **Perfect display and alarm function**
  Intelligent monitoring function, LCD screen, Audible and Visual Alarm. Perfect records function, does not lose in case power failure.
- **Two AC inputs, automatic switch**
  With phase lack protection, delay protection when AC input switch and ensure soft start of charging module.
- **Perfect battery management**
  Intelligent battery management and service. Monitor terminal voltage, charging/discharging current, test and record discharge capacity (AH); automatic equalizing and float charge and start equalizing charge regularly.

- **Automatic battery temperature compensation**
  With temperature compensation function, the compensation factor can be set according different battery type and brand to maximize the battery life.
- **High efficiency and power factor**
  Efficiency under full load> 95%; use passive power factor correction technology and power factor under full load> 0.92.
- **High voltage and current stability**
  Current stability ≤±1%；voltage stability≤±0.5%；Ripple factor≤±0.5%
- **Various solutions and easy to configurate**

1.3 Model name



1.4 Technical specification

- AC input voltage: 380V±15%
- Frequency：50Hz±10%
- Output current：10A～320A
- Battery capacity:10AH～3000AH
- Rated output voltage：220V/110V
- Output voltage range: 198V～286V /99V～143V adjustable continuously
- Output current limiting：rated current×（10%～105% ）
- Dynamic response：the recovery time from 20％ load to 80％ load≤200μS, overshoot≤±5％
- Efficiency: ≥95%（mono module）
- Insulation resistance: ≥20MΩ
- Insulation strength： output to grounding, input to grounding, input to output no flashover within 1 min under 2.5KVAC
- Relative humidity: ≤90%
- Altitude： ≤2000m
- Earthquake intensity: ≤7
- Ambient temperature: -10℃～40℃
- Audible noise: natural cooling≤40dB fan cooling≤55dB（away from the cubicle）
- IP lever： ≥IP30

1.5 Regular service conditions

- Altitude ≤2000m
- Ambient temperature: -10℃～40℃
- Average daily relative humidity≤95%, average monthly relative humidity≤90%
- No strong vibration and impact at installation and working site, no strong electromagnetic interference, and external filed magnetic induction should be less 0.5mT
- Installation degree of vertical inclination should be no more than 5%
- Should not be used under conditions of fire, explosion, earthquake and chemical corrosion environments.
- AC input: three-phase five-wires, voltage dissymmetry≤ 5%
- AC input voltage should be sine wave, non-sine content be no more than 10%
- The equipment is for indoor use only, please pay attention to the working ambient temperature.

1.6 Reference standards

- DL/T459-2000 Electric DC power cubicle technical specifications
- DL/T637-1997 VRLA battery technical specifications
- DL/T5044-95 Technical specifications of thermal power plant, substations DC power supply system
- LS（W）30-40-JT Technical specifications of electric system microprocessor control DC power supply cubicle

Chapter 2 DC system configuration

2.1 DC system configuration

ATGZDW DC system consists of AC distribution unit, DC distribution unit, rectifier unit, monitoring unit, data acquisition unit, Lightning protection unit, battery pack unit and etc. whose transferred to host monitor via RS485 interface. Shown as fig. 2-1

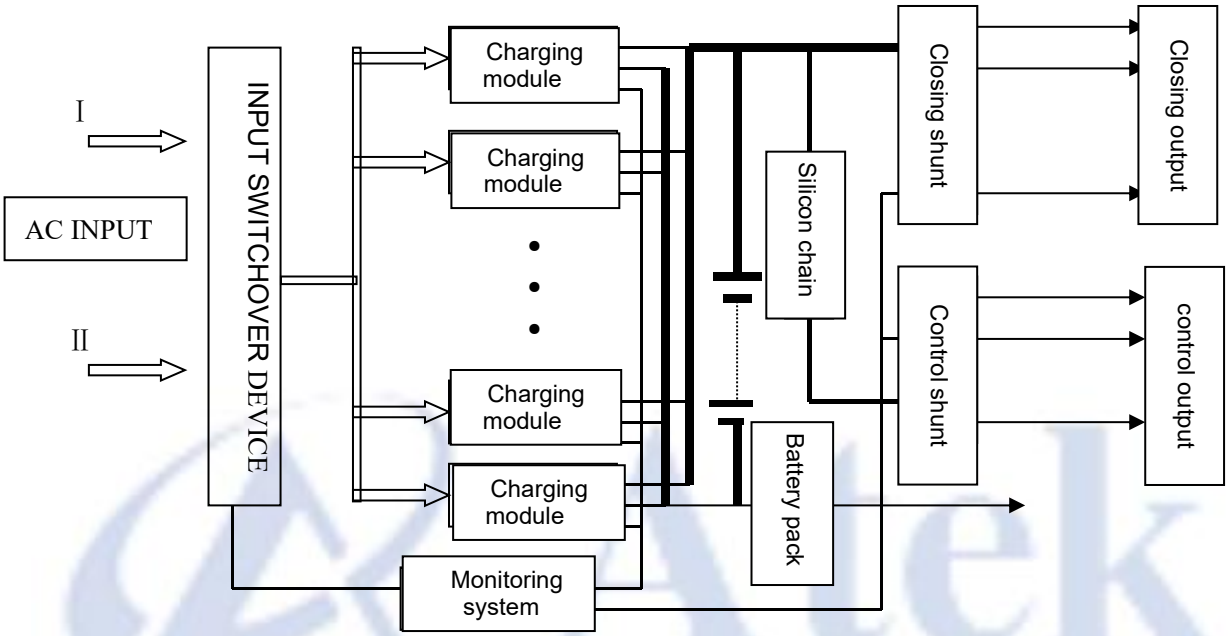


Fig 2-1 System configuration

2.2 Units configuration

- **AC distribution unit**

  2 AC input (380VAC, 3 phases), one main supply, one standby supply. Once the main power supply failures, switch to the other standby power supply within 5S

- **Lighting protection unit**

  Prevent from damage the equipments under over voltage and lightning.

- **Monitor and control unit**

  The intelligent monitors are ATM001-1, ATM070-1 and other new products under development, which feature flexible configuration, compact structure and high intelligence.

  ATM001-1, suitable for small system, the bus unsegmented.

  ATM070-1, meets all requirements of DC systems.

Table 2-1 Monitor function

Model	JK001	JK070
Picture		
Screen	Blue 128*64 lattice LCD	**7″ Full-graphic color LCD**
Operation	Button	**Touch screen**
Working voltage	24VDC	24VDC
Current fault	30 records	**Depends on Memory**
History fault	200 records	**Depends on Memory**
Log	48 records	**Depends on Memory**
Interface	RS485 / RS232	**RS485 / RJ45**
Protocol	CDT / MODBUS	**MODBUS/IEC61850**
Battery management	Yes	**Yes**

- **Data acquisition module unit**

The key equipments for data acquisition and monitoring. The host monitor and data acquisition modules are modular designed, easy for configuration to fit different systems. The data acquisition modules range integrated data acquisition module (ZHCL-2、ZHCL-3), battery detector module (DCXJ-19、DCXJ-55), insulation detector module (JYJC-32、JYJC-64), and switching value module(KGL-64). All the data modules are of same dimension, which is easy to installation.

The main functions of each module are as shown below Table 2-2, for details, refer to the Instruction Manual.

Table 2-2

Model		**Main function**	**pic**
Integrated data acquisition module	ZHCL-2	Detect one circuit AC voltage; Detect three-circuit DC voltage, two-circuit current, one circuit temperature; Detect 24 input, 8 output switching value Bus isolation	
	ZHCL-3	Detect two-circuit AC voltage; Detect six-circuit DC voltage, four-circuit current, two-circuit temperature; Detect 32 input, 8 output switching value Bus insulation	

Battery detector module	DCXJ-19	Detect 19 12V battery voltage, one circuit temperature;	
	DCXJ-55	Detect 55 12V battery voltage, 2 circuit temperature	
Insulation detector module	JYJC-32	Detect one bus isolation; 32 branch isolation	
	JYJC-64	Detect two period bus isolation, 64 branch isolation	
Switching module	KGL-64	Detect 64 input, 8 output switching value	

- **Battery pack unit**

  Capacity allocation principle:

  - Continuous discharge under main power failure, failure time designated 1 hour
  - The capacity left discharge ends should not be less 25% of rated capacity.
  - The bus voltage drops less 10% once impact load.

- **Voltage regulation unit**

  Two series DC110V with a regulation range 0-18V (could be 0-41V for special system) and DC220V with a range 0-35V. they divide into two types 5-steps and 7-steps. The components capacity should be 1.5-2 times of the bus continuous current. The regulation unit could be manual and automatic mode.

- **Rectifier module unit**

  The charging rectifier modules work in parallel, N+1hot backup. The algorithm of rectifier module quantity configuration is as follows

  - without control bus module

quantity≥（0.1×C10 +regular load current）/rated current+1

- with control bus module

  module quantity on closing bus≥（0.1×C10）/rated current+1

  module quantity on control bus≥ regular load current/rated current

Refer to Chapter 3 for detailed technical instruction

- **DC distribution unit**

Use air switch or breaker as DC distribution and protection; consist of indication lights, air switches, alarm contacts, auxiliary contacts and etc.

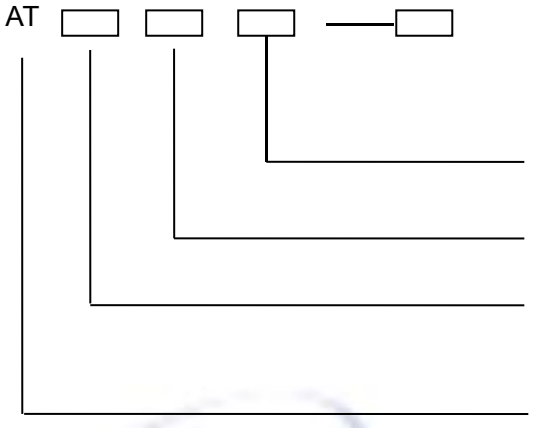
The monitor can detect the switching status of each loop and fault trip, grounding faults via current sensor. Refer to the Monitor Instruction Manual for details.

Chapter 3 Rectifier module instructions

Rectifier module is designed with patent technology “resonant voltage type dual loop control power transformation” which features high efficiency, high reliability, low consumption, small size and light weight. Three series 220V、110V、48V, dozens of varieties. With standard RS485 interface, easy to connect with automatic equipments. Designed with automatic current-sharing control and N+1 redundancy, the system can be easily expanded.

3.1 Model name

- **3 phases input**



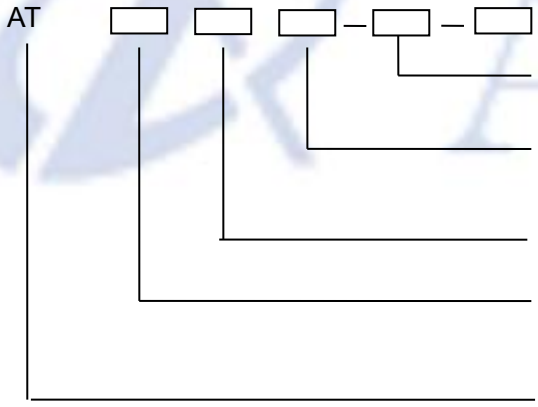
1: digital display, iron plate;

N：Natural cooling intelligent；
F：Fan cooling intelligent

Rated current：5A、10A、20A、30A、40A

Rated DC output voltage
220: 220V;
110: 110V
AT: abbr. of manufacturer name “Atek”

- **Single phase input**



220AC: input voltage 220VAC

1: digital display, iron plate;

N：Natural cooling intelligent；
F：Fan cooling intelligent

Rated output current:5A、10A、20A

Rated DC output voltage
220: 220V;
110: 110V
AT: abbr. of manufacturer name “Atek”

3.2 Products list

Table 3-1 3 phases input rectifier module lists

module	output voltage （V）	output current （A）	cooling method	External dimensions （W×H×D mm）
AT22005N-1	220	5	natural cooling	109×179×260
AT22010N-1	220	10	natural cooling	130×230×325
AT22020N-1	220	20	natural cooling	146×323×400
AT22030F-1	220	30	fan cooling	136×303×410
AT22040F-1	220	40	fan cooling	136×303×410
AT11010N-1	110	10	natural cooling	109×179×260
AT11020N-1	110	20	natural cooling	130×230×325
AT11040N-1	110	40	natural cooling	146×323×400

Table 3-2 single phase rectifier list

Model name	Rate voltage	Rate current	Cooling type	Dimension (mm) （width ×height×depth）
AT22005N-1-220AC	220 V	5 A	Natural cooling	109×179×260
AT22010N-1-220AC	220 V	10 A	Natural cooling	130×230×325
AT11010N-1-220AC	110 V	10 A	Natural cooling	109×179×260
AT11020N-1-220AC	110 V	20 A	Natural cooling	130×230×325

3.3 Main features

- Designed with soft switch technology, high efficiency, low consumption, small size and light weight;
- Built in diode;
- DC output diode, hot swappable. ;
- 3 phases passive power factor correction circuit with P F0.94, no neutral line;
- Isolated current share, sharing imbalance in parallel ＜±3%, 20 modules can work well in parallel;
- RS-485 interface, easy to connect with automatic system
- Output over voltage protection: the rectifier stop output and light alarm once over voltage. Resume to work after troubleshooting;
- Output current limiting protection: the max output current of each rectifier is restrained 105% of rating output current. Once over load, the output voltage drops to protect itself;
- Short circuit protection: output characteristic is as follows fig.2-1, the output voltage drops to 0 once short circuit and current is kept 15% of rating current. The rectifier can keep undamaged under short circuit and resume to work after troubleshooting;

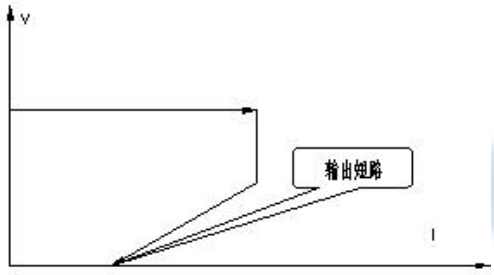


Fig. 3-1 Output characteristics

- Parallel connection protection: internal protection circuit, the fault rectifier quit without any influence to other rectifiers;
- Over temperature protection: Auto power off once the radiator temperature exceeds 85℃ resume after temperature decreases;
- Communication rectifier have fault node output function: low resistance between fault node once output over voltage, over current and over temperature.

3.4 Technical specification

Table 3-4 3 phases input , 220VDC output rectifiers

Items \ Model		AT2205N-1	AT2210N-1	AT2220N-1	AT22030F-1	AT22040F-1
Output current （A）		5	10	20	30	40
Power （KW）		1.5	3	6	9	12
Weight (kg)		5.2	9	16	19	19
Cooling type		Natural cooling			Fan cooling	
Radiator temperature rise		≤30℃			≤20℃	
Input voltage （VAC）	Min	323				
	Typical	380				
	Max	437				
Output range （VDC）	Min	190				
	Max	286				
Voltage Stabilizing accuracy		±0.5%				
Current Stabilizing accuracy		±1%				
PFC		≥0.94				
Efficiency		≥94%				
Noise（dB）		<50				
Storage temperature （℃）	min	-40				
	Typical	25				
	max	60				
working temperature （℃）	min	-10				
	Typical	25				
	max	40				
Current loading share Imbalance		≤±3%				
Soft start time（s）		3~8				
Ripple coefficient		≤0.2%				
Load grade		Continuous working with Grade I(100%) rating output current				
Automatic current limiting		The output current does not increase infinitely. When output current is over threshold, there will be limited constant current output.				
Output overvoltage protection		After output voltage is over threshold (320±5VDC), the module stop output automatically				
output short circuit protection		When short circuit, the module will protect itself from broken. Resume after troubleshooting				

Table 3-5 3 phases input 110VAC rectifiers

Item \ Model		AT11010N-1	AT11020N-1	AT11040N-1
rated output current(A)		10	20	40
power（KW）		1.5	3	6
weight(kg)		5.2	9	16
cooling type		Natural cooling		
Internal radiator temperature rise		≤30℃		
Input voltage（VAC）	min	323		
	Typical	380		
	max	437		
Output voltage（VDC）	min	95		
	Typical	110		
	max	143		
Voltage Stabilizing accuracy		≤±0.5%		
Current Stabilizing accuracy		≤±1%		
PFC		≥0.94		
Efficiency		≥94%		
Noise（dB）		Natural cooling 50，fan cooling 55		
Storage temperature（℃）	min	-40		
	Typical	25		
	max	60		
working temperature（℃）	min	-10		
	Typical	25		
	max	40		
Current loading share Imbalance		≤±3%		
Soft start time（s）		3~8		
Ripple coefficient		≤0.2%		
Load grade		Continuous working with Grade I(100%) rating output current		
Automatic current limiting		The output current does not increase infinitely. When output current is over threshold, there will be limited constant current output.		
Output overvoltage protection		After output voltage is over threshold (160±3VDC), the module stop output automatically. Self recoverable		
output short circuit protection		When short circuit, the module will protect itself from broken. Self recoverable		

Table 3-6 single input rectifiers

Item \ Model		AT22005N-1-220AC	AT22010N-1-220AC	AT11020N-1-220AC	AT11010N-1-220AC
Output current （A）		5	10	20	10
Power （KW）		1.5	3.0	3.0	1.5
Weight （kg）		5.2	9	9	5.2
Input Voltage (VAC)	min	187			
	Typical	220			
	max	253			
Output voltage (VDC)	min	190		95	
	Typical	220		110	
	max	286		143	
Voltage stabilizing accuracy		<±0.5%			
Efficiency		≥93%			
Noise （dB）		<50			
Storage temperature （℃）	min	-40			
	Typical	25			
	max	60			
working temperature （℃）	min	-10			
	Typical	25			
	max	40			
Current loading share Imbalance		<±3%			
Soft start time（s）		3S-8S			
Ripple coefficient		≤0.2%			
Load grade		Continuous working with Grade I(100%) rating output current			
Automatic current limiting		The output current does not increase infinitely. When output current is over threshold, there will be limited constant current output.			
Output overvoltage protection		After output voltage is over threshold (320(160)±5VDC), the module stop output automatically. Self recoverable			
output short circuit protection		When short circuit, the module will protect itself from broken. Self recoverable			
Note: the input voltage is 165VAC-264VAC for rectifier AT11020N-220AC					

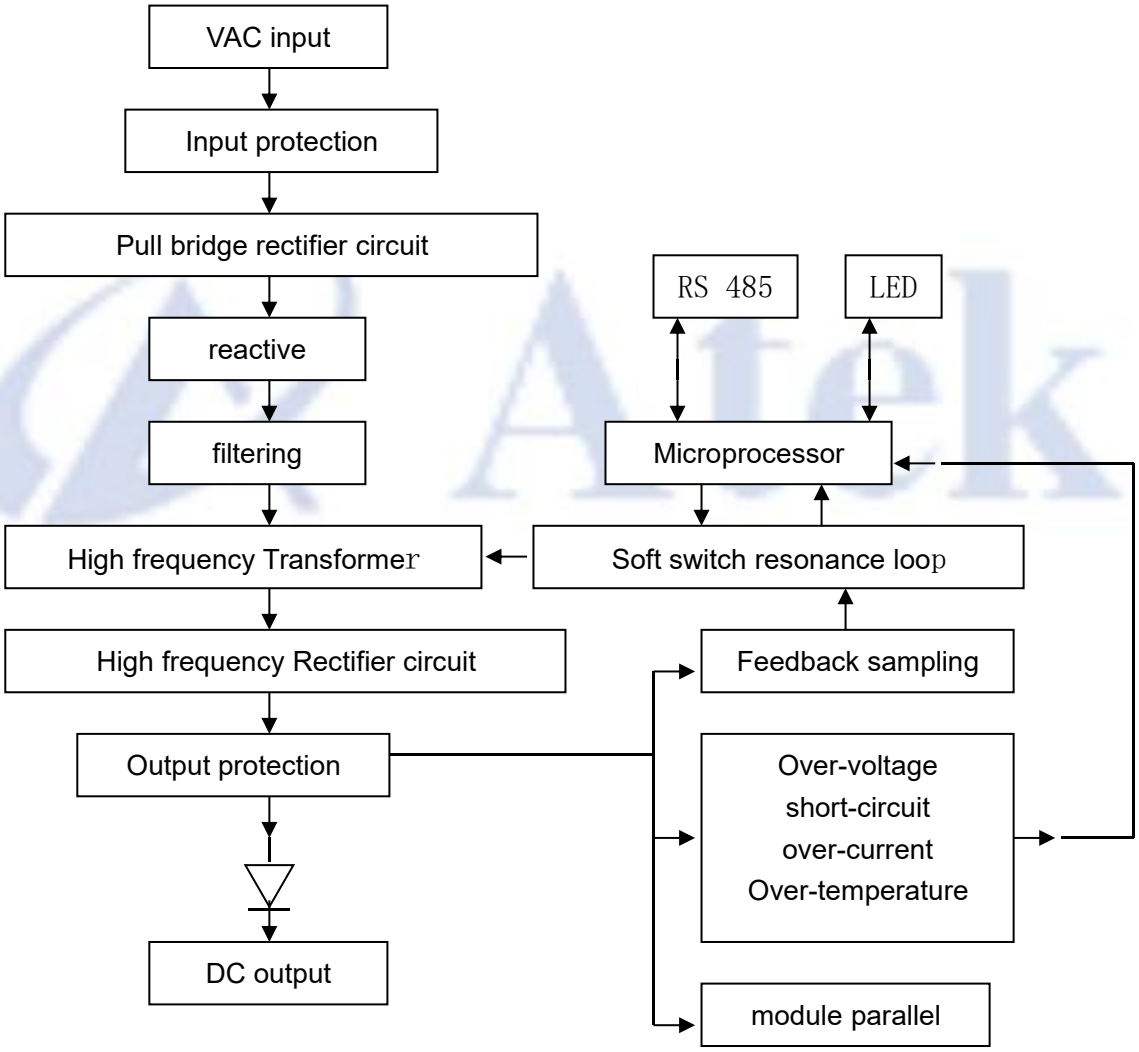
3.5 Ambient conditions

- Altitude ≤ 2000m;
- Storage temperature: -40℃~+60℃; ambient temperature: －10°C ~ 40°C;
- Relative humidity: ≤ 96%（operating temperature 25°C）;
- No conductive and explosive dust, no caustic gas;
- Indoor only;

3.6 Module structure

- **Working princple**

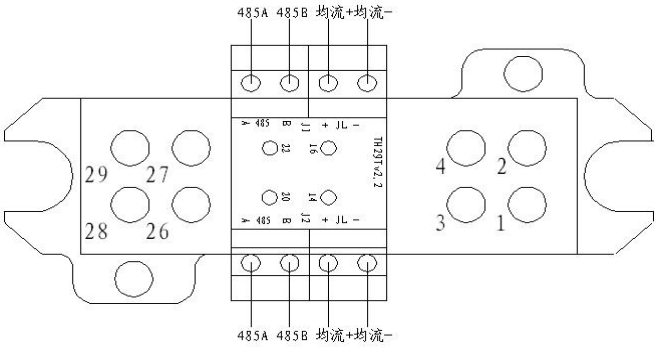
Fig.3-2



Functional diagram

Fig 3-2 working principle

● Connector definition



Fig。3-3 JMD-29T connector

- Connector JMD29T of models AT22005N-1, AT22010N-1, AT22020N-1, AT11010N-1, AT11020N-1 is as Fig. 3 and table 3-8

Table 3-8 JMD-29T connector

terminal	Access	Spec	Define	Function
1	Weld	12#	DC+	DC output +
2	Weld	12#	DC-	DC output -
26	Weld	12#	G	Grounding PE
27	Weld	12#	A	Input 380V
28	Weld	12#	B	Input 380V
29	Weld	12#	C	Input 380V

- Connector （JMD29T）of models AT22040F-1, AT11040N-1, AT22030F-1 is shown as Fig. 3 and table 3-9

Table 3-9 JMD-29T connector

Terminal	Access	Spec	Define	Function
1、3	Weld	12#	DC+	DC output +
2、4	Weld	12#	DC-	DC output -
26	Weld	12#	G	Grounding PE
27	Weld	12#	A	Input 380V
28	Weld	12#	B	Input 380V
29	Weld	12#	C	Input 380V

- Connector（JMD-29T）of single phase input rectifiers is shown as as Fig. 3 and table 3-10

Table 3-10 JMD-29T connector

Terminal	Access	Spec	Define	Function
1	Weld	12#	DC+	DC output +
2	Weld	12#	DC-	DC output -
26	Weld	12#	GND	Grounding PE
28	Weld	12#	L	AC input L
29	Weld	12#	N	AC input N

Remarks：

① Undefined terminal is empty, no wiring

② Keep a good natural ventilation around the charger module.

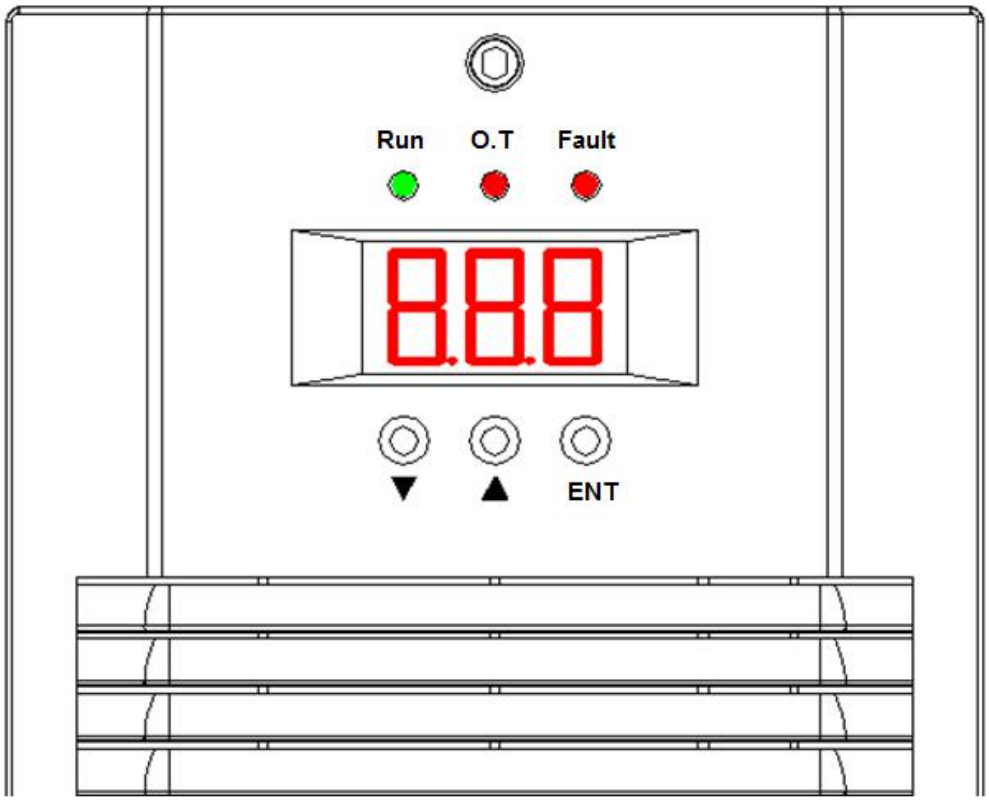
③ Keep a good ventilation around the fan cooling modules

④ Connect according to the indication “current share +”, “current share -” to achieve the automatic current share.

⑤ Wire terminal A and terminal B separately and connect with the host monitor through terminal A & terminal B of RS485 A, which achieve communication between the module and monitor

3.7 Operating instructions

3.4 Operation Introduction



3.4.1 Indication light

There are three indication lights on the module panel，table 4-1 shows the function of them.

table 4-1

Operation instructions	Normal State	Fault State	Fault Reasons
RUN Power indicator light (green)	on	off	No input voltage
O.T. Over temperature light (red)	off	on	Module internal overheating
Fault Fault light (red)	off	on	Module internal fault

3.4.2 Buttons for displaying panel switch

The up and down button is used to switch the display of current and voltage. If the screen is displaying the output voltage, after you push the button, it will display the output current. if you push the button again, then it will display the output voltage.

3.4.3 Introduction of operation:

(1) When power on，the display will show the existing output DC voltage.

(2) Touch"▲"or"▼"button，it will show the existing voltage（voltage accuracy is 1V）", or existing current（current accuracy is 0.1A）, or the "existing failure code"

(3) Long press (hold down) the button "ENT"， it will be the "Setting mode". The default setting mode is "F01"，touch"▲"or"▼"button to show the options from "F01" to"F15". If short time press the button "ENT", it will choose this option, If long press "ENT", it will not choose, and will return to the display mode.

(4) when it show the options from "F01" to "F15", then short press "ENT" button to enter parameter setting mode, all parameters will flicker, touch"▲"or"▼"button to change the parameter, then short press "ENT" button, it will save this parameter. If long press "ENT" button, it will return to display mode without saving the parameter.

(5) In the Setting mode, if no button operation within 15 seconds, it will return to the display mode without saving the parameter.

Re：Instruction and function for button code

Item	Code	function	specs	default	Step size
1	F01	Working mode set	0: indenpent;1: manual; 2: auto	2	
2	F02	Module communication protocol	0: Modbus；1: TH	0	
3	F03	Over voltage alarm set	under voltage alarm ~ max value	260V/130V	1V
4	F04	Under voltage alarm set	Min value ~ over voltage value	190V/95V	1V
5	F05	charging status when module power on	0: float charge; 1: boost charge	0	
6	F06	Float charge voltage set	Min value ~ boost charge voltage	242V/121V	1V
7	F07	Boost charge voltage set	Float charge voltage ~ max	253V/126V	1V

			value		
8	F08	Charging current limit set	10% ~ max value	105% of the rated value	0.1A
9	F09	Current set from float charge to boost charge	The current of switching to float charge ~ max value	80% of the current limitation value	0.1A
10	F10	Current set from boost charge to boost charge	0.5 ~ the current of switching to boost charge	20% of the current limitation value	0.1A
11	F11	end current charging time	0 ~ 10hours	3h	1hour
12	F12	Max boost charging time set	0 ~ 99hours	10h	1 hour
13	F13	timing boost charging time set	0 ~ 999days	180days	1day
14	F14	dry contact output of module fault	0: normally open； 1: normally close	reserve	
15	F15	Module's address set	0—31	0	

3.4.4 Fault Display

Alarm information are displayed in the LED display with fault code. Fault code as shown in Table below.

Table 4-2

Item	Code	Fault instruction	Red light display
1	E01	Output under voltage（alarm）	flicker
2	E02	Output over voltage（alarm）	flicker
3	E04	Output over voltage（power off）	Keep on always
4	E05	Over temperature（power off）	Keep on always
5	E06	Input under/over voltage（power off）	Keep on always
6	E07	Input phase failure（alarm, output power limitation）	flicker

3.4.5 Communication Function

The module can communicate with the host PC via RS485 modbus. It can send the output voltage and current, the module protection and alarm information to the host PC, accepting and implementing the command from the host PC.

Note：When the module is in automatic mode, and no communication with monitor and controllers in 4 minutes .The module output voltage would become 234VDC automatically.

3.7.5 Assembling and package

NOTE

Strictly prohibit open the charging module without permission. Otherwise, we ATOS Electronics assume no liability or responsibility for any damage of equipments and personal injury. Meantime we reserve the right to the legal responsibility if any technology leak cause by.

The charging module is fixed only by the two screws on front panel. Must take out the modules, pack and delivery separately.

Prohibit keep the modules on the cubicle during transportation. Otherwise it may

Damage the system and modules.

3.7.5 Current sharing

The modules on same bus can share the load current and rigorous sharing test before delivery. There is no need to do any sharing regulation when the modules work in automatic mode.

If there is control bus module, connect the communication wire only between control bus module and charging module. Connect only communication wire between modules and monitor in any case.

If current share fault, trouble shooting and replace failure module according to the following ways.

First, check each sharing bus and sharing wire well connected. Whether the modules work in automatic mode. If all are ok, find out the failure module as follows:

1．Disconnect fully the sharing and communication wire. Power on one module
2．Load the module to 50% of rated output current.
3．Measure whether there is a 2V about voltage between +-sharing bus. Short out JL+/JL- with load, the output voltage will drop a few volts.
4．Check sharing bus voltage of each module with load. It is normal if there is voltage. It means the sharing circuit damaged if no voltage.

Next, if the control bus module sharing failure, and all previous checks are of no problem. It may be something wrong with the manual voltage regulation. Check and trouble shooting as follows:

1. Disconnect fully the sharing and communication wire. Power on one charging module.；
2. Load the module to 10-15% of rated output current
3. Measure the voltage between +-output bus of control bus module.
4. Check output bus voltage of each module with load same or not. If different, regulate the output voltage and make them same.

NOTE

When the modules connected onto different bus, prohibit connect sharing wire between control module and charging module.

The same time prohibit connect the sharing wire to monitor

Chapter 4 Installation and Commissioning

4.1 Appearance view

Take 65AHsystem for example, shown as fig. 4-1, which is subject to the final drawing

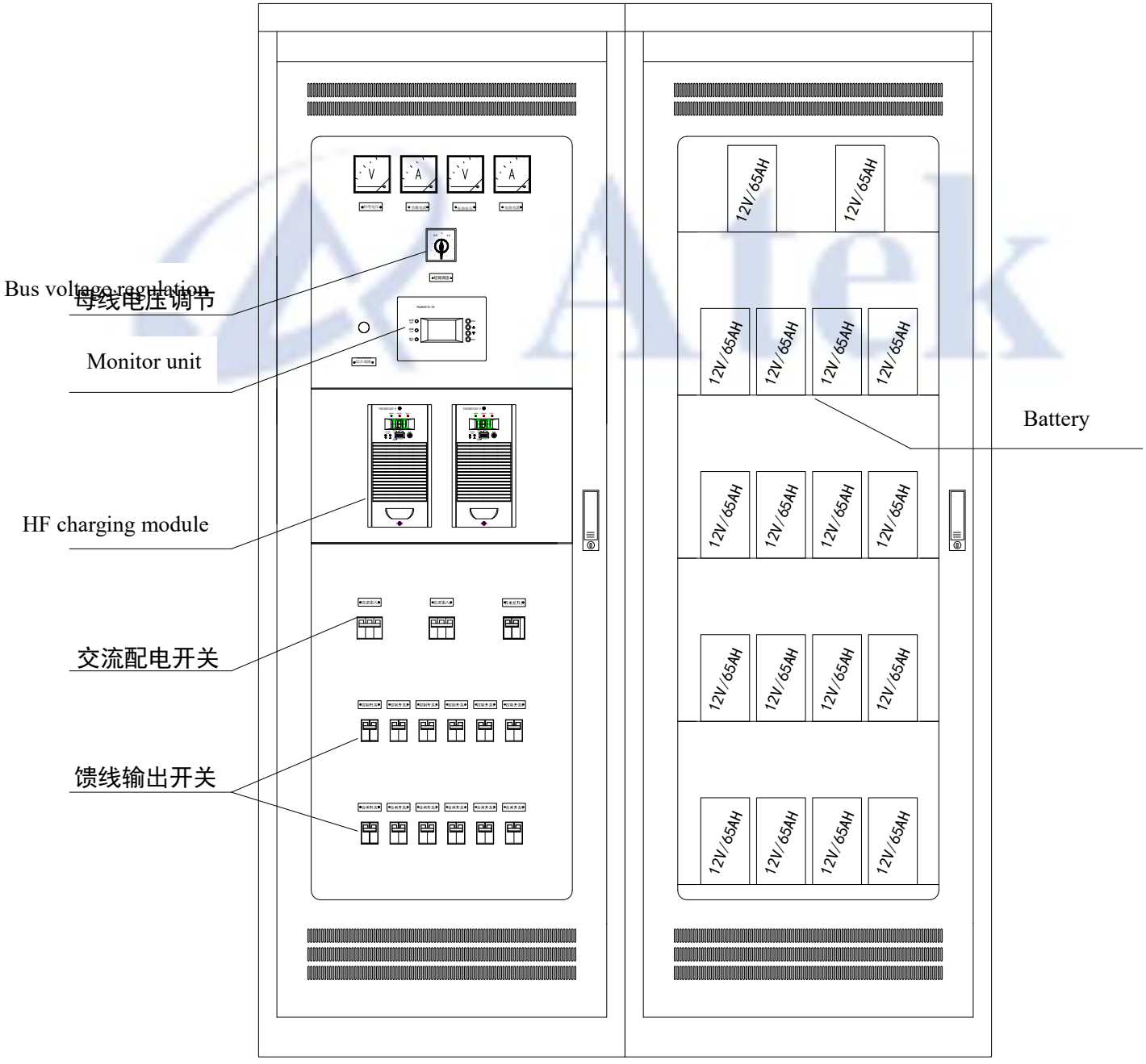


Fig. 4-1 65AH DC system Appearance view

4.2 Preparation before use

- Check all the fasteners are loose and electric components are in good condition.
- The system should be reliably grounded after installation, remove all fastening of relay moving contact, and keep all switches open.
- According to the drawing, check the AC input voltage meets the required voltage, check the AC supply lead, control circuit, tie lines between equipments whether are in good condition to avoid possible damage to the equipment. See Part III for detailed AC power input requirements.
- After long distance transportation or long time storage, measure first the resistance DC/AC busbar insulation resistance to earth with 500V megger. It is qualified if the resistance is greater than 10MΩ. Remove the charging module, monitor before test, disconnect their input/output, communication circuit, remove the cables connecting battery bank and external circuit, and disconnect the lightning arrester and etc..

AC distribution switch

4.3 Power-up Sequence

- **Preparation before power-up**

Output switch

attention to the following issues before power-on:

revent from getting an electric shock. Because the DC system is a power conversion and generation device.

- Check the AC input and DC output grade meet the requirements or not.
- Chose right cross-section of cable according to rated current. Choose breaker according to max current. The working condition of max current is not considered as long term working conditions.
- The cable connecting DC system and battery cubicle goes through the bottom of the DC charging cubicle. Pay attention to the + - terminals and their labels consistent or not. ***Prohibit reverse connection; otherwise, it will cause damage to the system.***
- Wiring people must attend training and be qualified and work under supervision of experienced worker.
- Wiring people and supervisor must read the Instruction and Wiring diagram carefully.
- Wiring people and supervisor identify all the terminals correct, including input terminals, output and battery pack.
- Wiring people and supervisor check and confirm the phase wire, natural wire and grounding wire correct.
- Wiring people and supervisor check and confirm the +- outlet of battery pack.
- Wiring people and supervisor check and confirm the output breakers and output terminals correspond.
- Wiring people and supervisor check and confirm the positive and negative of closing bus output and control bus output.

- **Power up commissioning**

Power up after all previous checks and insulation test. Please be careful and follow the commissioning procedure “measure—operate--measure” for equipments and personal safety.

Commissioning and observe, shut down in case any abnormal. Continue after trouble shooting.

Step 1: AC distribution power up commissioning

Cut off the three phases AC air switches of main power, take out all charging rectifier,

unplug the monitor, and disconnect all feeder switches.

Close external AC distribution switch, switch on the lead in main power and measure there is normal 380V AC voltage (line voltage) and small difference between phases at the corresponding AC input air switch end. If normal then close the corresponding AC input air switch.

If system with automatic AC input switch over, check according to Table 4-1（if with ZHCL-3,check after normal monitor power up）

Step 2: Charging rectifier power up commissioning

Start this step after step 1 is ok

1. Plug one rectifier module
2. Check output voltage and current
3. Plug other modules in sequence, repeat 2
4. Check whether the output voltage of each module consistent or not. The deviation should not exceed 1V. If normal, cut power and check modules.

Table 4-1 Automatic AC switchover checklist

Test item	Standards	Results
Switch on mains 1, switch off	The corresponding AC contactor should close	
Switch off mains 1, switch on	The corresponding AC contactor should close	
Switch on two mains	Should be one AC input, measure the AC voltage at input and output ends normal or not	

Note

The floating and equalizing voltages are controlled by only monitor in automatic mode. The user can set and adjust according to battery data and requirements. Refer to the Monitor Instruction Manual for detailed setting method. If there is control bus module, it should be in “manual” mode. Adjust the potentiometer on front panel to get the output voltage required.

Step 3: Monitor unit power up commissioning

Start this step after step 2 is ok:

- Check the power supply of monitor normal or not. Pay attention to the polarity.
- Check and confirm the DC power supply for charging modules correct. Plug all the monitor and all data acquisition modules well, then start monitor.
- Set the monitor according to actual system conditions. (Normally all are already set up

correctly in factory, please do not change the parameters at will if no special reasons) the monitor becomes effective after restart if any change. Refer to the Instruction Manual for details.

- If any fault, indentify according to the monitor display and trouble shooting

Step 4：DC distribution unit power up commissioning

Come to this step after Step 3:

- Close each output control switch of control loop in sequence, check corresponding output terminal voltage and indicate light
- Close each output control switch of closing loop in sequence, check corresponding output terminal voltage and indicate light.
- If there is silicon chain unit, then check according to Table 4-2. 5 steps parameter: 7V per step for 220V module (5V per step for 110V modules). 7 steps: 5V per step (3V per step). It may be a little different according to the current.

Step 5: Connect load and current share regulation

- Make the system work under ＞50% load and regulate current share.
- The output voltage could be only regulated when the charging rectifiers are in manual mode. All the managements including current share are controlled by monitor when the charging rectifiers are in automatic mode. So normally do not need to make such regulation.
- If the current of rectifiers connected to same bus exceeds threshold, check the current share communication line and the components.

Table 4-2 Voltage dropping unit checklist

Switch position	Items	Standards	Results
Auto	The closing bus voltage varies in certain range	The control bus voltage is （220V±2.5% or 110V±2.5%）	
Stop	Fix closing bus voltage, measure control bus voltage	Do not adjust	
Manual 1		The control bus voltage drops 1 level	
Manual 2		The control bus voltage drops 2 levels	
Manual 3		The control bus voltage drops 3 levels	
Manual 4		The control bus voltage drops 4 levels	
Manual 5		The control bus voltage drops 5 levels	

Step 6: Connect battery

Do this step after the previous checks are OK

- Before connection, check the battery installation and make sure the polarities are correct and the monocell voltage is basically same. Measure the total voltage of battery pack and record.
- Before connection, take out all the charging rectifiers. Close the battery fuse or battery charging switch.

Note

Prohibit connect the battery polarity reversely, otherwise it will damage the system at the user's risk.

- Check each bus voltage polarity right with multimeter, and the monitor works well
- Break battery fuse or battery charging switch, plug in one charging module.
- Keep the system under floating charging, and set the floating charging voltage in monitor about 2V different with the battery voltage. (parameter set-module set)
- Check and confirm the difference between output voltage and battery voltage is within 2V, then close battery fuse or battery charging switch.
- Set in the monitor according to battery data and work conditions. Especially the battery capacity set, current limiting threshold, and equalizing / float charge convert. (If the system manufacturer provides battery pack, all settings are done before delivery. Do not change if no special circumstances) Refer to Monitor Manual for details
- Finish all steps without faults, and then break AC input switch and switch on again after plug all charging modules. This completes the system commissioning.

4.4 Notes

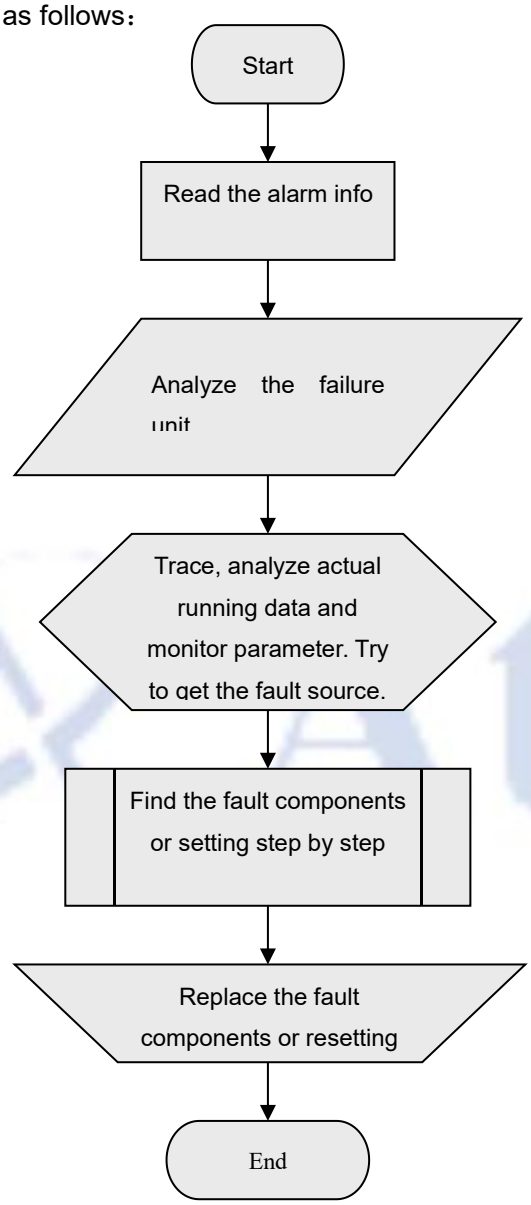
- Indoor use only and pay attention to the ambient temperature.
- The monitor has been set done before delivery. Please do not change at will, otherwise it will affect the normal operation.
- If equipped with one group battery, keep the voltage 60%～80% of battery capacity after discharge. Otherwise it may cause serious consequences.
- It is strictly prohibited to short circuit, reverse polarity connection. Non professional personnel does not connect battery.
- The voltage regulation buttons, dial up switches are all set done before delivery. Please do not change at will, otherwise it will affect the normal operation.

Chapter 5 Common faults & Troubleshooting

5.1 Common faults troubleshooting procedure

It is normal if the rectifiers alarm during the installation and commissioning and the user can trace the fault, analyze and troubleshooting with this procedures guide.

The procedure is as follows：



The unit types are AC distribution unit, DC feeder unit, charging rectifier, monitor unit, integrated data acquisition unit, switch on/off unit, battery detector unit, insulation unit and etc.

5.2 Fault analysis and trouble shooting of charging modules

- **Self protection**
  - Caused by AC input over voltage, under voltage, phase lack, over temperature. Check according to the fault code.
  - Over temperature protection caused by poor ventilation in the system cubicle.
  - Ambient temperature is high in the room
- **Charging module fault**
  - Over voltage or over current may cause fault. Cut off the AC input and restart, the module is self recoverable.
  - The over voltage threshold is 242V in manual mode. The module will alarm if the regulation is beyond the rated range. Regulate the voltage in the normal range, the alarm stops.
  - In automatic mode, the output voltage is controlled by host monitor. It is normal if the output voltage and actual setting differs, which caused by temperature compensation.
- **Current share imbalance**
  - Make sure the current load is over 50% rated load.
  - Non connection of the current share wiring or wrong connection.
  - Cannot share current between controlling bus module and closing module.
  - Disconnect the current share wiring and communication wiring, load the module and test the signal of current share terminal. The signal should be i/1.05I×4.2V, among “i” is the actual output current, “I” is the rated output current. And then connect current share terminal reversely, the output voltage will drop about 10V.
- **Communication fault**
  - Wrong broadcast address setting and same setting in two modules may all cause communication fault.
  - Communication fault in non-work state.
  - The quantity setting in the monitor is more than the actual quantity.
  - The address of charging module starts from 1 and continuous setting in one group of modules.
- **The output voltage fails to reach the set voltage**
  - There is current limiting protection if over load, may cause the output voltage fails to reach the setting value.
  - Under float charging, the temperature compensation may cause the output voltage and setting value differs.

5.3 Common fault analysis and trouble shooting of monitor

- **LCD flash or no indicate**
  - Check the power input voltage（24V）, polarity, wiring.

- **Fuzzy display**
  - Adjust the brightness in the monitor “system set”/”other set”
- **Black screen**
  - Check whether there is power supply of monitor 90-300V and loose wiring. Replace monitor if all previous check is ok.
- **Host monitor report all or partial units communication faults**
  - Check the setting of the monitor and the actual configuration is consistent.
  - Check all the wiring of RS485 interfaces, whether they are correctly and well wired.
  - Disconnect all RS 485 interfaces and check whether there is a voltage 3V at each interface. Replace fault unit if any.
  - Communication test between host monitor and each unit. Replace the fault unit if only some unit can not communicate with the host monitor. Replace the host monitor if it can not communicate with none of units.
- **Communication fault between host monitor and PC end**
  - Check whether the communication protocol, address and baud rate of the host monitor are consistent with the PC end. Correct if any error.
  - Check whether RS485/RS232 mode option is consistent with the PC end. Manufacture setting is RS485 mode.
  - Check the communication interface wiring, whether reverse connection, short circuit.
  - Contact the PC end software supplier if only individual data is not correct.
  - Replace the host monitor if the previous checks do not work.

5.4 Fault analysis and processing of integrated data acquisition module

- **The monitor alarm over voltage or under voltage of control bus, closing bus, battery**
  - Check the monitor “system set”/”module set”, whether the float and equalizing charging set is correct. Normally the float charge voltage is 235～243V for 220V rectifier modules, half of rated output voltage for 110V rectifier modules.
  - Check the monitor, whether each alarm threshold set is correct.
  - Measure the actual DC bus voltage, whether is consistent with what displayed in the monitor. If a large deviation, it means something wrong with the rectifier module.
- **No or abnormal current display in host monitor**
  - Check the sensor range set in monitor and whether is consistent with the actual range of Hall sensor. Reset if not.
  - Check whether the bus pass through the Hall sensor in the right direction.
  - Check whether the Hall sensor is well connected with the monitor.
  - Check whether the ±12V power supply at current sampling terminals is normal：
    A. If abnormal, check the wiring right, fast or not.
    B. If the voltage normal, replace Hall sensor.
    C.

- Something wrong with the rectifier module and replace if all previous check normal.

- **Integrated data acquisition module communication fault**
  - Check whether the working voltage is normal (90～300V):
    A. If normal, take out current sampling terminal and check the communication normal or not. If normal, it means something wrong with the sensor wiring and check.
    B. If normal, check the ±12V power supply normal or not. Replace monitor if abnormal.
    C. If normal, check the DC unit ±12V normal or not. If normal, check the connection with RS485 right, fast or not.

- **First AC input closing fault**
  - Check the wiring right or not. If normal, check the following
  - Short out the first control terminal of monitor and power up test. Measure the first AC contractor coil.
    A. If normal but the contractor does not work either, replace AC contractor.
    B. If no or abnormal voltage, check circuit.
    C. If the contractor can close after power up, replace data acquisition unit （ZHCL-3）

- **First AC input breakout, the other closing fault**
  - Check wiring correct, fast or not. If correct, check following
  - Power off first AC input, short out the other input control terminal. Power up the other AC, check the AC contactor coil:
    A. If coil voltage normal but the contact does not work either, replace AC contactor
    B. If no or abnormal voltage, check the circuit.
    C. If the contactor can close, replace data acquisition unit (ZHCL-3)

- **Host monitor alarm AC over voltage or under voltage**
  - Check each alarm threshold correct or not
  - Check actual AC voltage, whether consistent with the monitor display. Replace monitor if large deviation.

5.5 Common fault analysis and trouble shooting of switches unit

- **The host monitor does not alarm once failure**
  - Check the switch type set correct or not, whether is set “state”
  - Check the signal acquisition of switches unit abnormal or not. If open, check the circuit; if closing, replace switch value unit.

- **Host monitor switch unit communication fault**
  - Check monitor unit working voltage (90-300V) normal or not：
    A. If normal, power up again, measure there is 3V voltage between communication interface AB. If no, replace switch unit monitor.

B. If normal, measure there is 3V voltage between communication interface AB. If there is but the monitor alarms, check the wiring between host monitor and RS485 correct, fast or not. If all normal, replace the switch unit monitor.

5.6 Common fault and trouble shooting of battery detector unit

- **Host monitor alarm single cell battery over/under voltage**
  - Check cells set in host monitor consistent with actual numbers
  - Measure the actual voltage and compare with monitor display. And check the alarm threshold is beyond the rated range. If wrong threshold set, rest the over/under voltage threshold. If host monitor alarm 20V of some battery cell, check carefully the sampling circuit correct or not.
- **Battery detector communication fault**
  - Check the working voltage (90-300V) normal or not.
    A. If abnormal, check power supply circuit. If normal, power up again and check whether there is 3V around between communication terminal AB.
    B. If there is but the host monitor alarms still, check the connection with host monitor RS485 correct, fast or not.

5.7 Common faults and trouble shooting of insulation detector unit

- **The host monitor does not display each branch resistance to ground**
  - Check the wiring right, fast or not
  - Check the insulation threshold setting too low or not.
  - Check the ±12V power supply of insulation unit abnormal or not. If normal, check whether is a 0-5V output between branch sensor output end and Hall power ground. If no voltage or output over 5V, it means branch sensor broken.
- **The actual branches and display do not agree**
  - Check wiring right, fast or not
  - If several insulation detector, check whether the dial switch setting and wiring correct or not
- **Abnormal actual insulation but monitor show normal**
  - Check there is and normal bus voltage or not
- **Host monitor alarm insulation detector communication fault**
  - Check the dial switch position and wiring correct or not. If correct, check the following
  - Check the working voltage (90-300V) normal or not
    A. If normal, check there is 3V around voltage between RS485A/B
    B. If there is such a voltage, the monitor alarms, check the wiring with monitor 485 interface right or not.

5.8 Common fault and trouble shooting of DC distribution unit

- **The silicon chain cannot adjust voltage normally**
  - Regulate manually the output voltage setting knob and check whether could adjust voltage normally.
  - If control the silicon chain by monitor, check the monitor setting and wiring right or not.
- **Feeder output trip**
  - Feeder output branch short circuit or over load may cause trip
  - Air switch auxiliary contact broke, may cause trip alarm
  - Wrong auxiliary contact type may cause alarm mentioned above
- **Over voltage or under voltage cause by abnormal bus voltage**
  - Integrated data acquisition module fault may cause bus voltage abnormal, over voltage or under voltage alarm
  - Improper bus sampling point, may cause bus voltage abnormal alarm when bus tie
  - Improper over/under voltage threshold may cause such alarm

5.9 Common faults and trouble shooting of other equipments

- **Lightning arrestor trouble shooting**
  - The green window of C level arrestor piezoresistor turn red , replace piezoresistor
- **Backstage communication protocol trouble shooting**
  - Test with corresponding test program, check the data source and measured value consistent or not.

Chapter 6 Common system solutions

The customer may use different system solution according different conditions. Some standard wiring schemes are as follows:

6.1 ATGZDW-30 wiring schemes

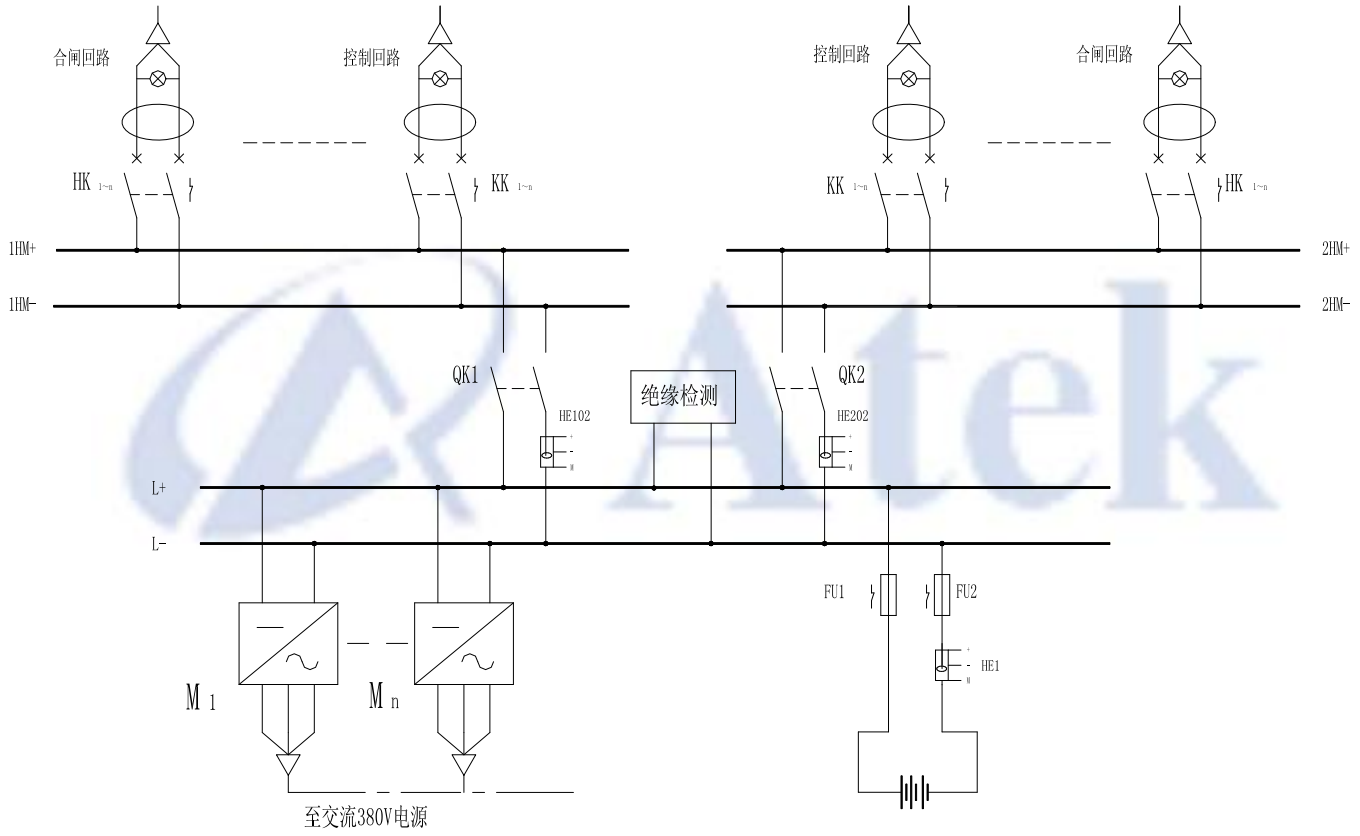


Fig 6-1 ATGZDW30 wiring schemes

Single battery group, single bus with section, without silicon diode chain

6.2 ATGZDW-31 wiring schemes

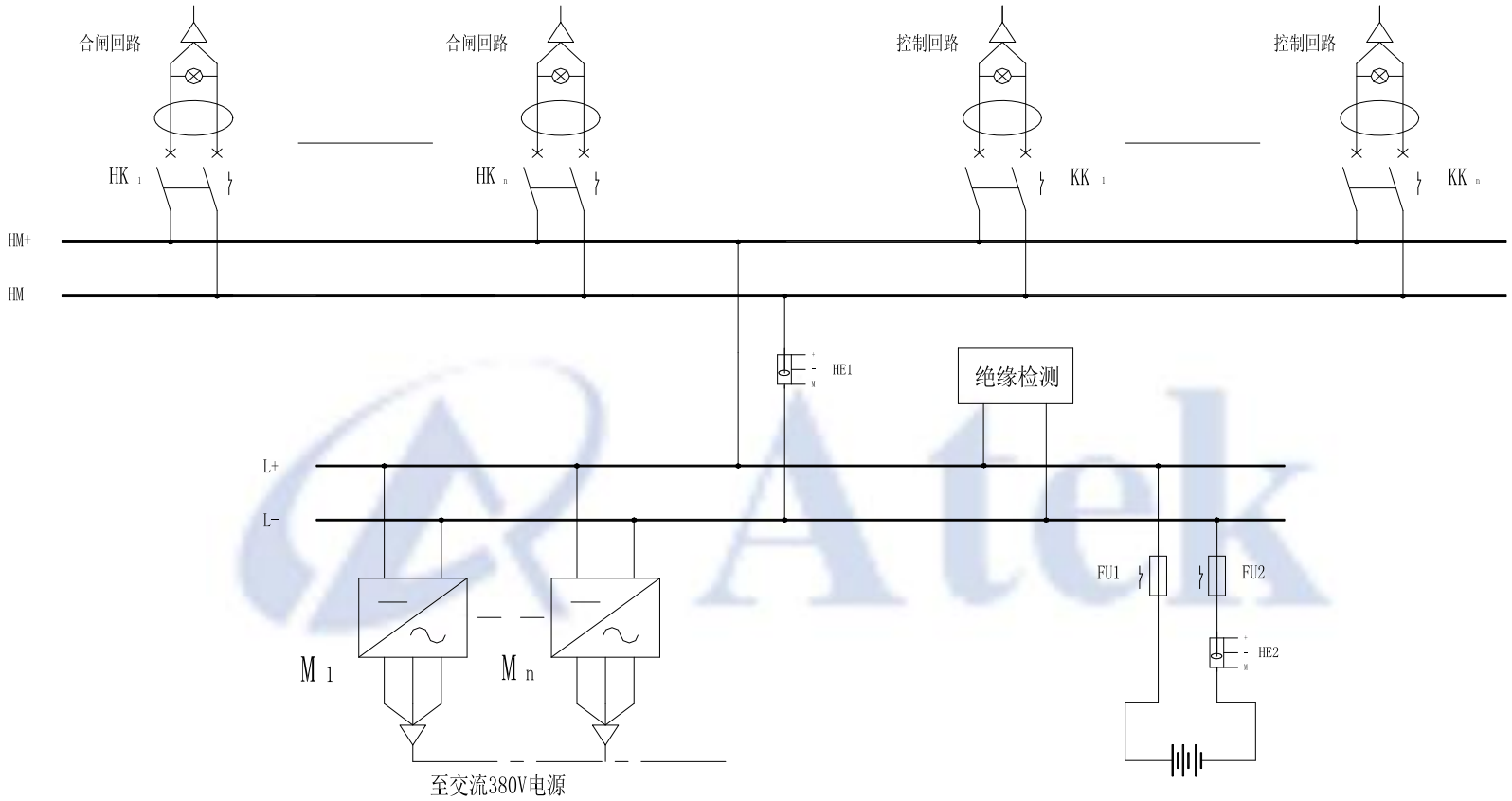


Fig 6-2 ATGZDW31 wiring schemes

Single battery group, single bus without section, without silicon diode chain

6.3 ATGZDW-32 wiring schemes

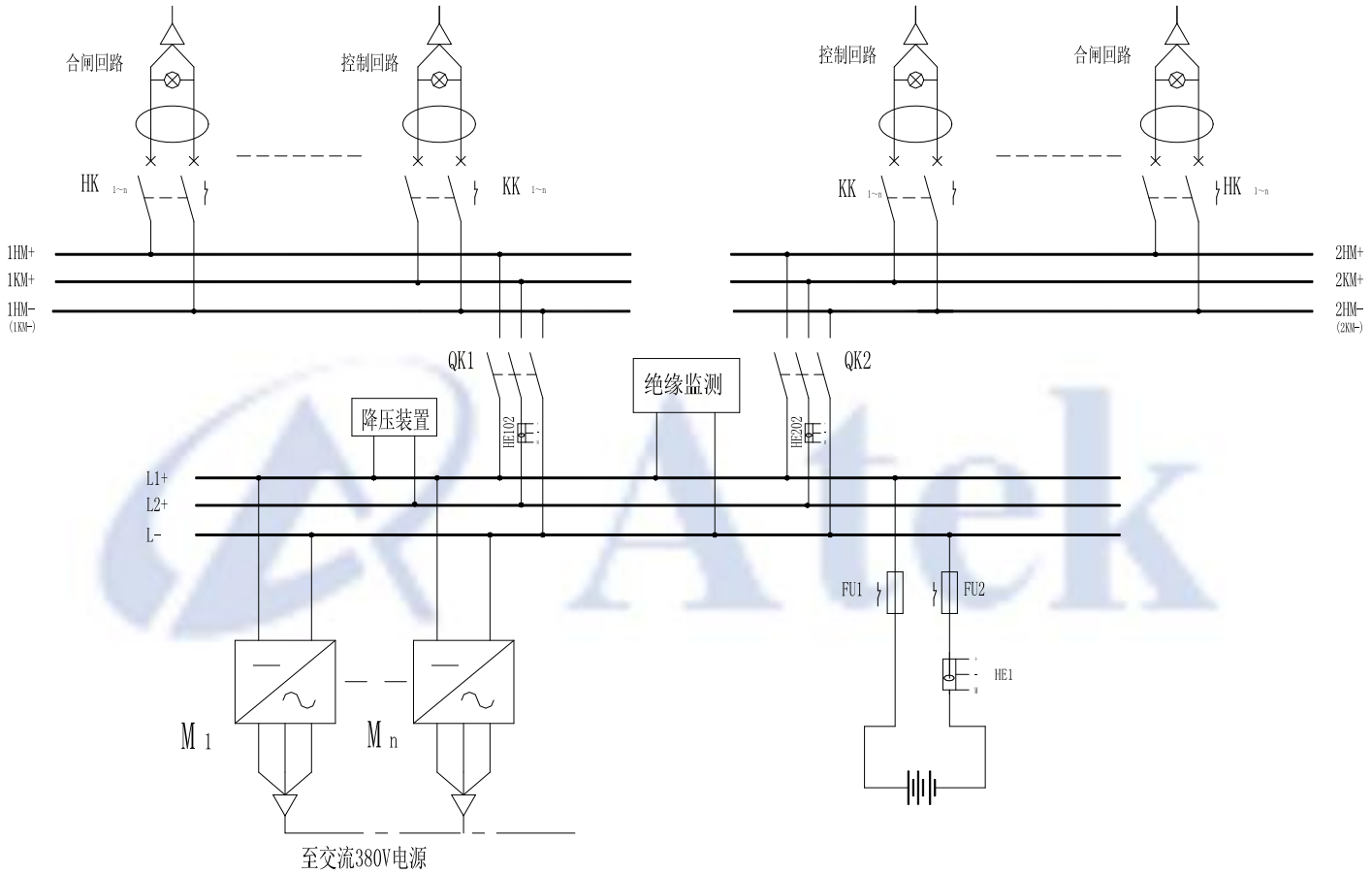


Fig 6-3 ATGZDW32 wiring schemes

Single battery group, single bus with section, with silicon diode chain

6.4 ATGZDW-33 wiring schemes

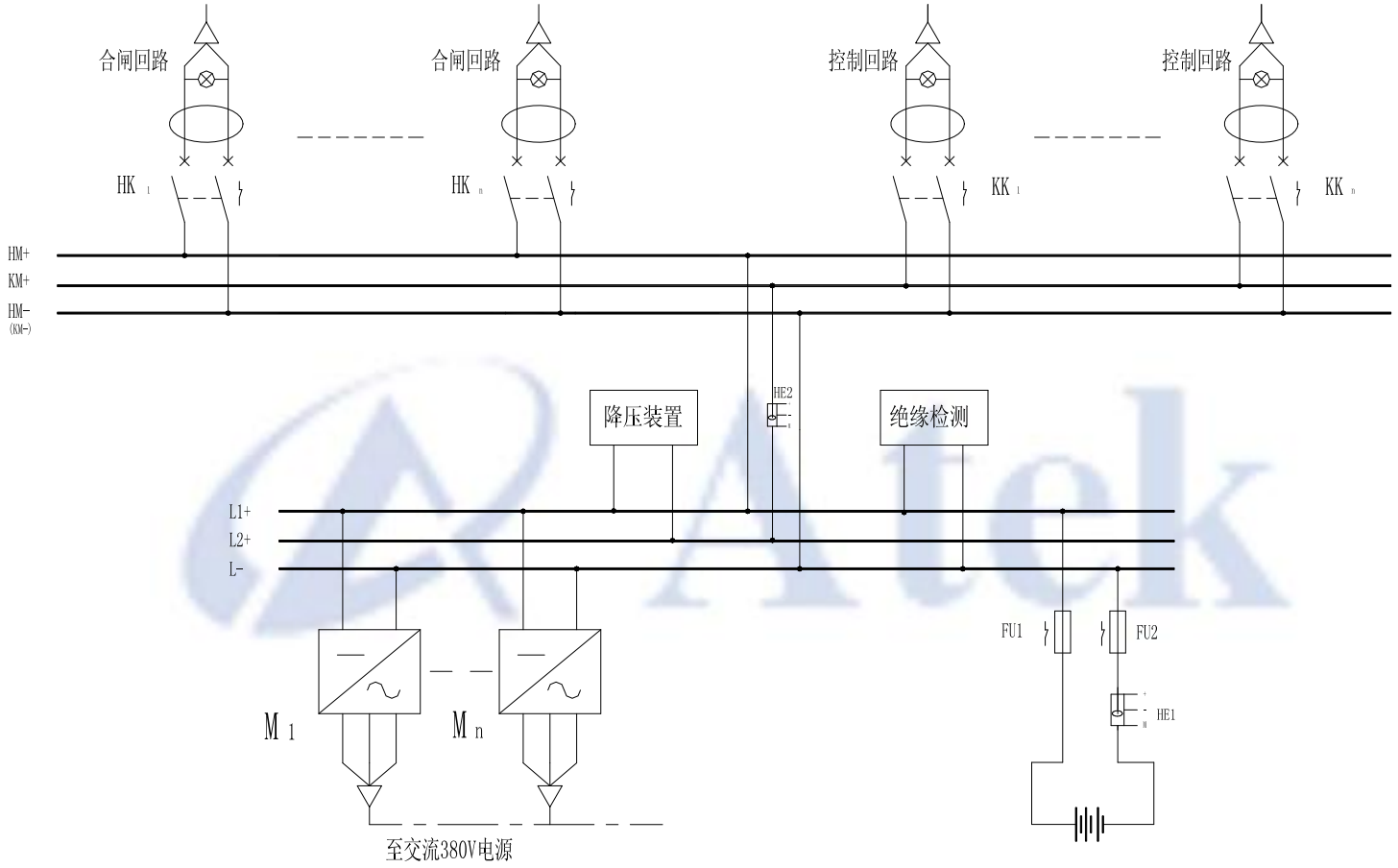


Fig 6-4 ATGZDW33 wiring schemes

Single battery group, single bus without section, with silicon diode chain

6.5 ATGZDW-34 wiring schemes

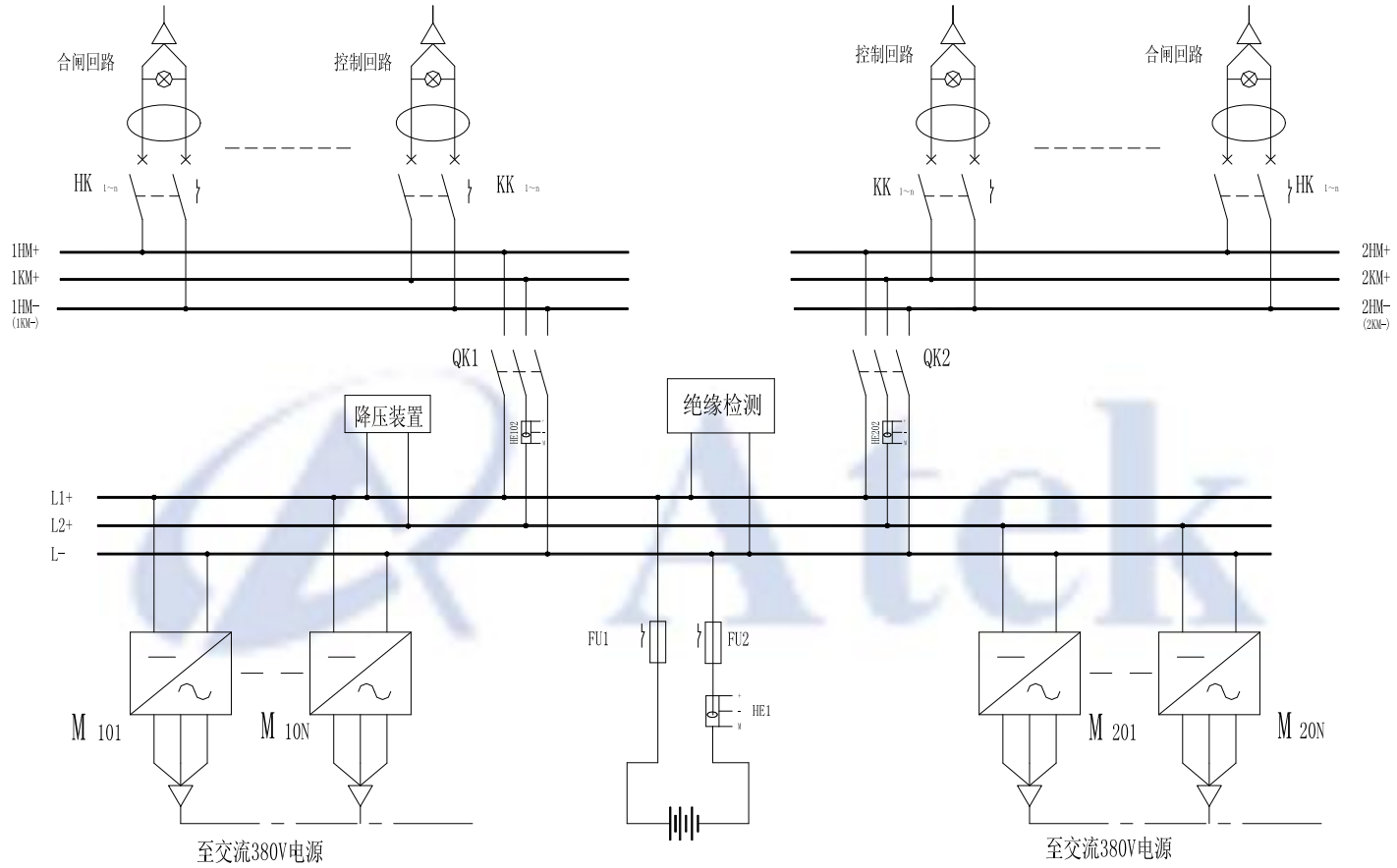


Fig 6-5 ATGZDW34 wiring schemes

Single battery group, single bus with section, with silicon diode chain（control bus with module output）

6.6 ATGZDW-35 wiring schemes

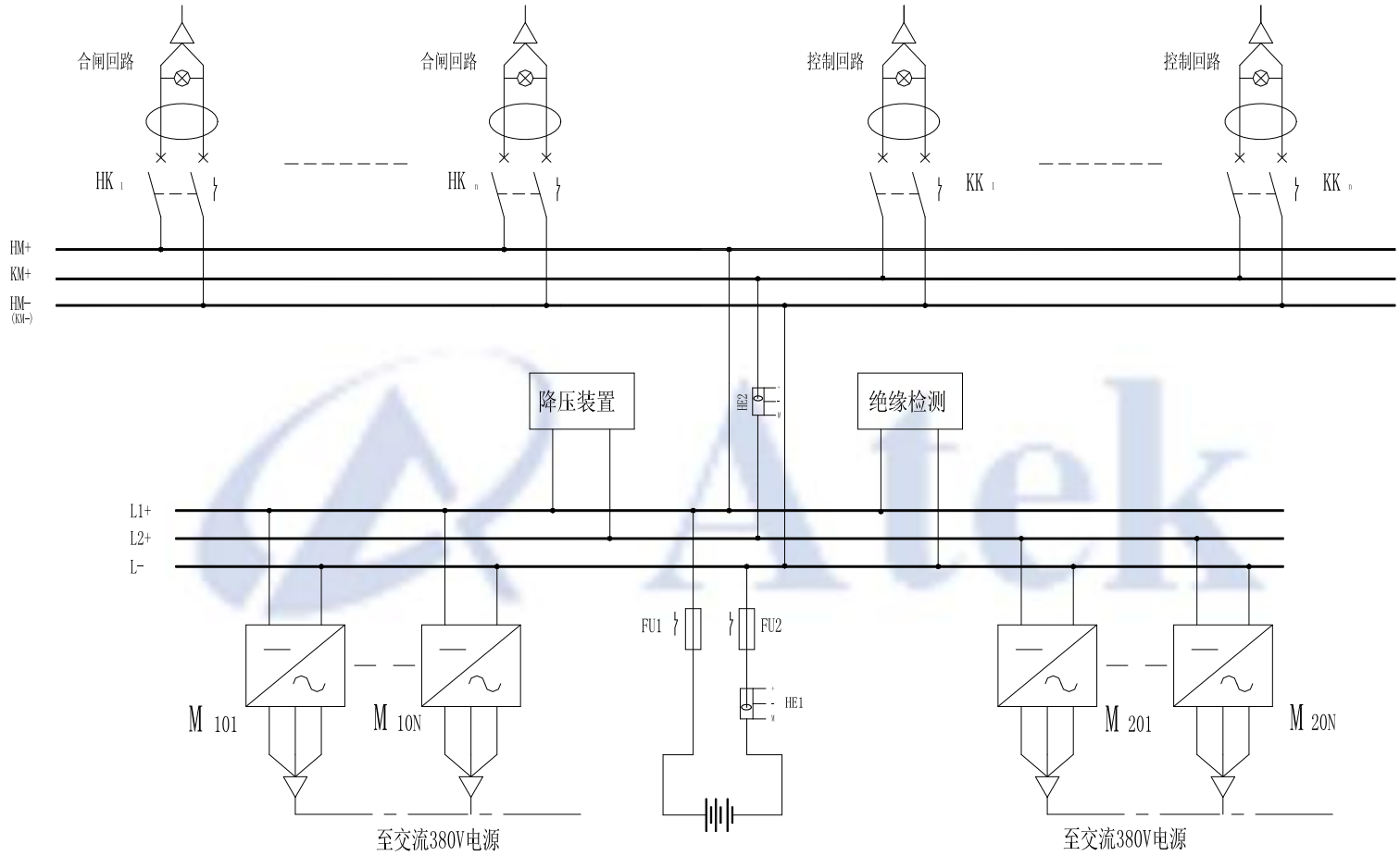


Fig 6-6 single battery group, single bus without section, with silicon diode chain（control bus with module output）

6.7 ATGZDW-40 wiring schemes

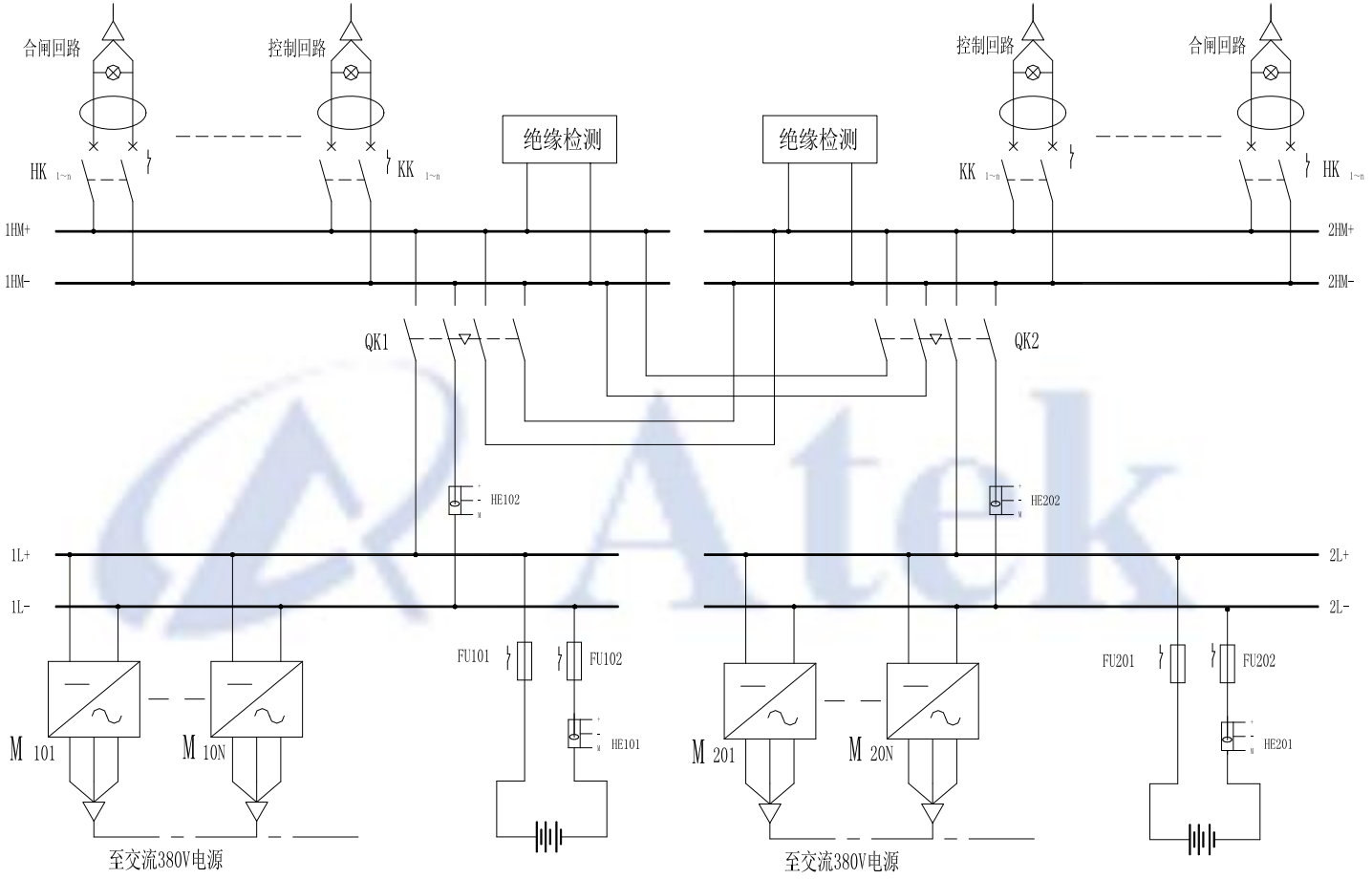


Fig 6-7 Two battery groups, double bus, without silicon diode chain

6.8 ATGZDW-42 wiring schemes

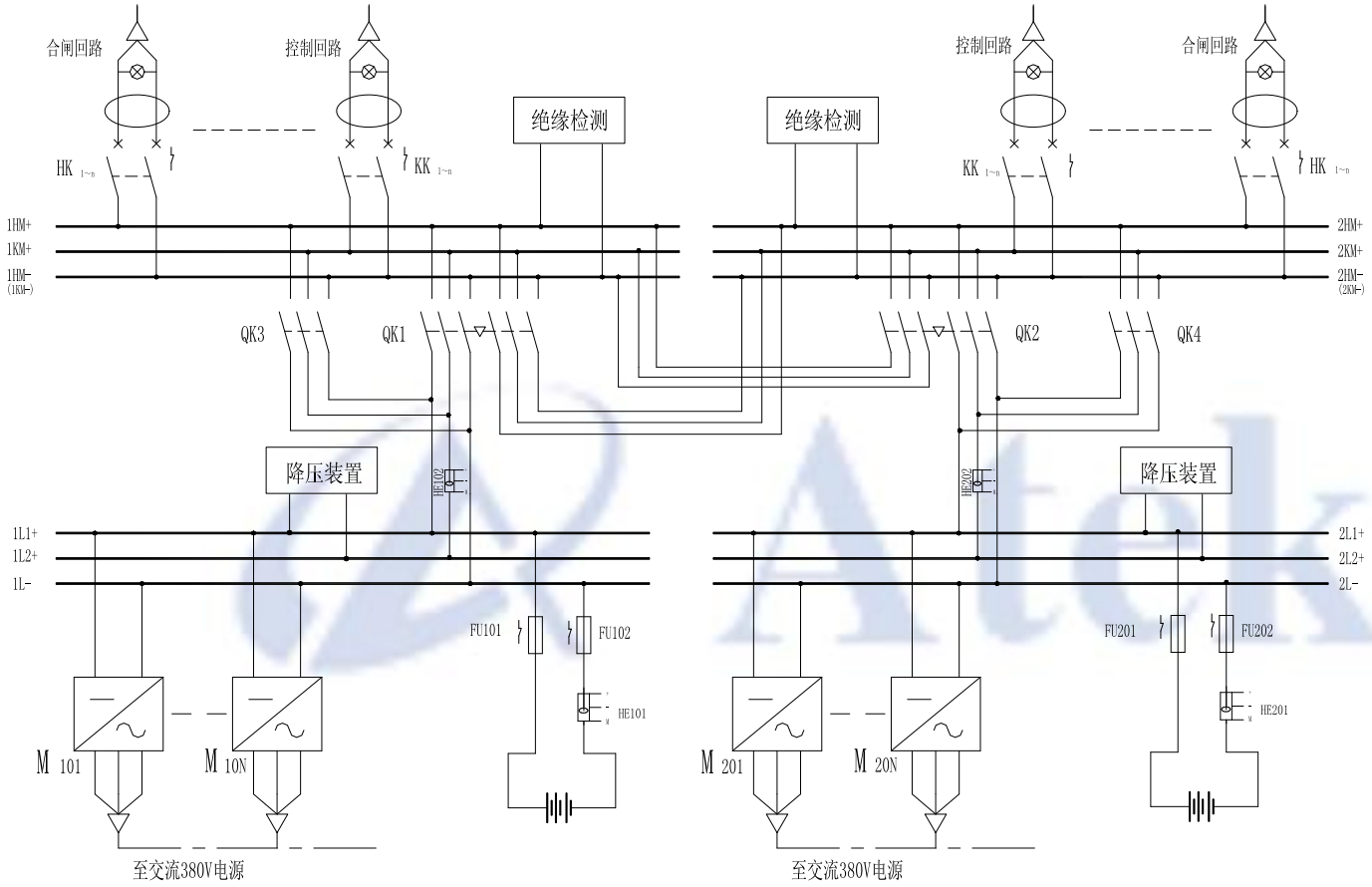


Fig 6-8 Two battery groups, double bus, with silicon diode chain

Atek