ЭНЕРГОМЕТРИКА
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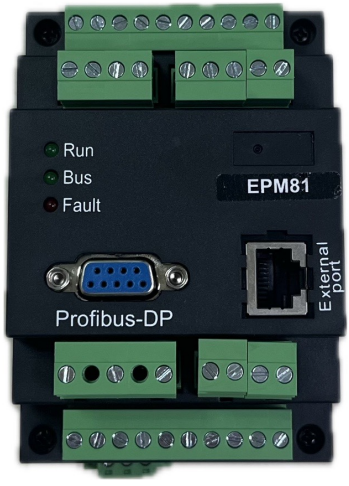
EPM81 Intelligent Motor Protection Controller

Installation & Operation Manual

V1.05



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Safety Precautions

Danger and Warning!

This equipment can only be installed by professionals.

For any fault resulting from the incompliance with these Instructions, the manufacturer shall undertake no responsibility.

Precautions!

Before unpacking, setting or using this instrument, please read and comprehend all contents in these Instructions. Please specially pay attention to the contents indicated with [Note].

In order to ensure the sound application of all protection functions of this motor protective equipment, please install, set and use as per the ways described in these Instructions.

These Instructions are not intended to include all details or device changes, nor provide all possibilities concerned with the installation, operation and maintenance of the equipment. For the purpose of further information or sufficient interpretation of any special question beyond these Instructions, please contact with our company.

CONTENTS

Chapter 1 Product Introduction

1.1 Design Instructions

EPM81 intelligent motor protection controller is a high-performance motor protection device integrating motor measurement, protection and control functions into one. It is applicable to the normal three-phase AC asynchronous motor with the rated voltage of AC380V or AC690V, and this product replaces the diverting device usually used by motor control center (MCC), thus significantly simplifying the motor structure of control circuit, improving the reliability and advancement of motor control and reducing overall application costs.

The controller adopts the modular design and split-type installation, with small size, compact structure, ensured extendibility and convenient installation and can be assembled into 1/4 drawer. It is divided into three parts, i.e. main body, CT module and display module.

1.2 Product Features

- With the modular design, this product consists of main module, CT module and display module;
- Over 21 protection functions can be provided;
- The three-phase current, grounding/ leakage current, current imbalance rate, three-phase line voltage, frequency, power factor, active power, Reactive power, active electrical degree and many other electrical parameters concerning to the motor circuits can be measured;
- With built-in direct startup mode, bidirectional reversible startup mode, star/delta startup mode, autotransformer startup mode and many other startup modes, users could independently select corresponding settings based on the startup ways of the motor;
- The controller body can provide 9-circuit switch inputs, for the inputting of such signals as start-stop signal, reset signal and contactor state;
- By providing 5-circuit relay outputs, this product can satisfy many startup ways and protection actions, together with protection tripping (or warning) signal outputs;
- Provide 1-circuit 4-20mA analog output for DCS, with many parameters selectable;
- Support one-circuit 4-20mA analog input, one-circuit 4-20mA analog output or one thermal resistance input (refer to ordering information for specific model selection);
- With 32 times of event logging, record device operation data and relevant information at the time of fault;

- Maintenance and management are convenient and display module or communication software can be used to detect various parameters including electric parameters, motor's operation states, fault information and stopping times;
- The flexible restart function can realize various startup demands based on parameter settings in case of short-time power outage of the motor's main circuit.
- Its installation is convenient, with standard 35mm guide rail, simple wiring and pluggable terminals;
- The communication is redundant, with 2-circuit Modbus communication and supporting PROFIBUS communication protocol;
- With wide power supply design, AC or DC power supply is in common use.

1.3 Product Composition

The main body and CT module of EPM81 is in split design and the smallest complete system consists of main body, display module and dedicated CT module, with fixed dimension for the main body and 2A, 6.3A, 10A, 25A, 50A, 100A, 250A, 400A, 500A and 820A for the dedicated CT module.

Chapter 2 Technical Parameters

2.1 System Parameters

The rated voltage of the motor: AC 380V or 690V

The rated current of the motor: 0.5 - 820A

Controller power supply voltage: AC 85V-265V and DC 100V-300V is interchangeable.

Switch input: Internally, it is of DC 24V power.

AC control relay: 250VAC/10A, 380VAC/5A, 110VDC/0.25A.

The signal relay: 250VAC/5A.

2.2 Symbol List

Refer to the list for the relevant meanings of some symbols, which will be used in these instructions and on the display interface:

Symbol	Meaning	Symbol	Meaning
Ie	The rated current of the motor	Iun	Three-phase current imbalance rate
Ue	The rated line voltage of the motor	Uab, Ubc, Uca	Three-phase line voltage
Pe	The rated power of the motor	f	Frequency
Ia, Ib, Ic	Phase A , Phase B, Phase C current	Pf	Power factor
Iav	Average current	P	Active power
Ig	Grounding current	Q	Reactive power
Id	Leakage current	E	Active energy

2.3 Scope and Precision of the Measurement Data

Project	Scope	Precision	Project	Scope	Precision
Current	10% - 50%Ie	±2%	Power factor	-1 - 1	±1%
	50%- 200%Ie	±0.5%	Frequency	50Hz	±0.05Hz
	200% - 800%Ie	±2%	Power	0.5 - 1000.0KW	±2%

Leakage current	100 - 1000mA	±1%	Analog output	4 - 20mA	±2%
Thermal resistance	10R - 10K	±5%	Analog input	4 - 20mA	±2%
Voltage	50% - 150%Ue	±0.5%	Electrical degree	99999999.9kWh	±2%

2.4 Scope and Precision of the Protection Data

Project	Scope	Precision	Project	Scope	Precision
Current	10% - 800%Ie	±3%	Voltage	50% - 150%Ue	±3%
Leakage current	100 - 1000mA	±1%	Analog output	4 - 20mA	±2%
Thermal resistance	10R - 10K	±5%	Analog input	4 - 20mA	±2%
Setting value of delay time		±3%			

2.5 Electromagnetic Characteristics

Electrical fast transient burst immunity test	EN 61000-4-4, Level 4
Surge immunity test (1.2/50μs)	EN 61000-4-5, Level 4
Electrostatic immunity test	EN 61000-4-2, Level 3
Radiation immunity test	EN 61000-4-3, Level 3
Conduction RF interference test	EN 55022, Class A
Radiation RF interference test	EN 55022, Class A
Harmonic current emission limit	EN 61000-3-2, Class A

2.6 Operating Environment

a) Operating temperature: -10- +55℃;

b) Storage temperature: -20- +70℃;

c) Relative humidity: not exceeding 95%;

d) Operation place shall be free from hazardous explosive media and surrounding media shall not contain corrosive metal or gas and conductive media that may damage insulation and no water vapor or shall be no severe mycete.

e) The using place shall be equipped with facilities against rain, snow, wind, sand and ash.

Chapter 3 Structure Dimension and Installation Ways

3.1 Overall Dimensions of the Controller Body

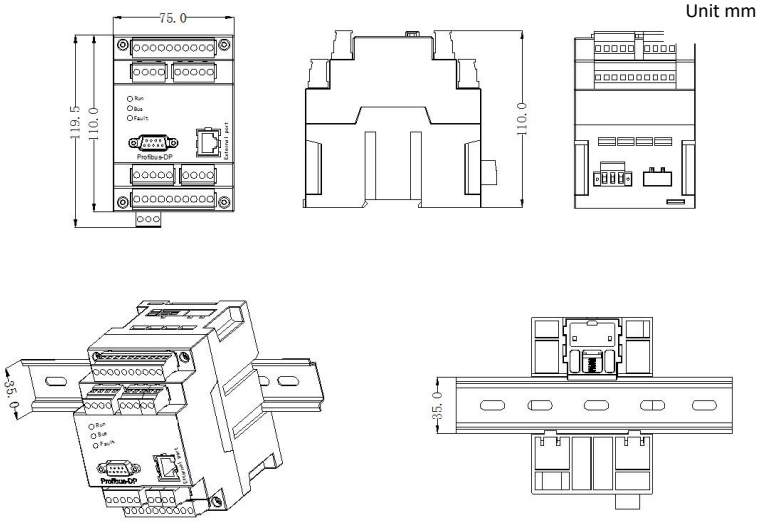


Figure 3-1 Diagram of Controller's Appearance Specification and Installation Dimension

[Note]:

The controller body is installed with standard 35mm guide rail.

3.2 Schematic Diagram of Display Module's Overall Dimension and Installation

Unit mm

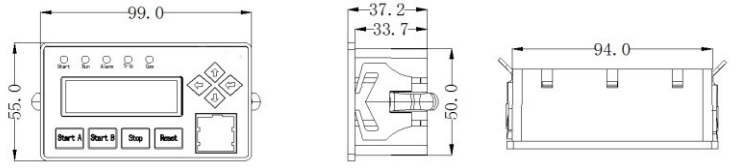


Figure 3-2 Diagram of Display Module's Appearance Specification

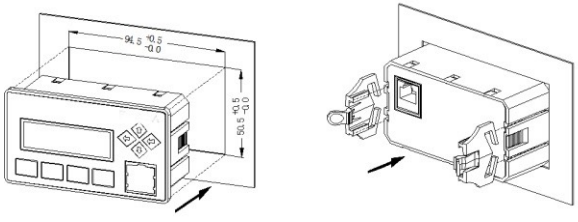
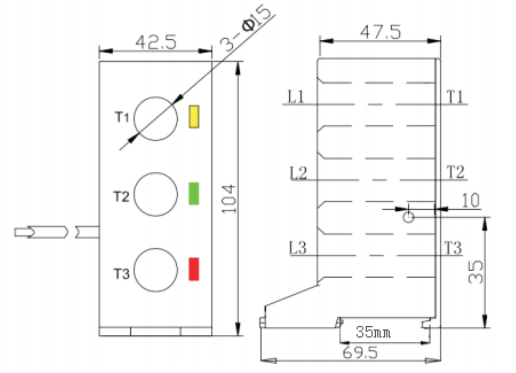


Figure 3-3 Diagram of Display Module's Installation Dimension

3.3 Overall Dimension of CT Module

Unit mm



Front view Left view

Figure 3-4 Overall Dimension of CT Module below 100A

[Note]:

The CT module is installed with standard 35mm guide rail.

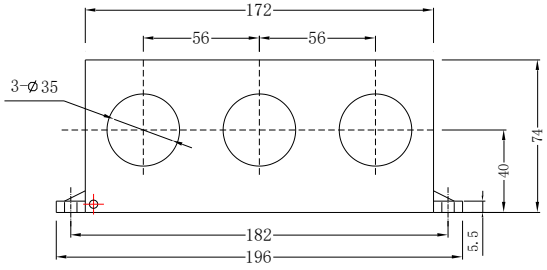


Figure 3-5 Overall Dimension of CT Module in 250A and 400A

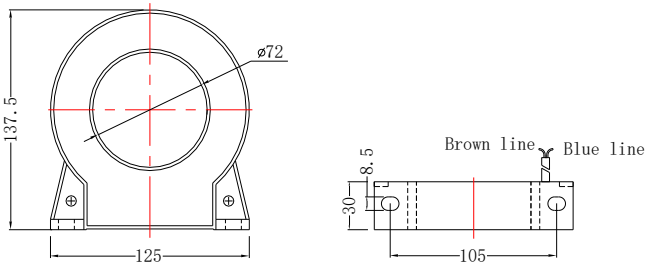


Figure 3-6 Overall Dimension of CT Module in 500A and 820A

3.4 Overall Dimension of Electric Leakage CT

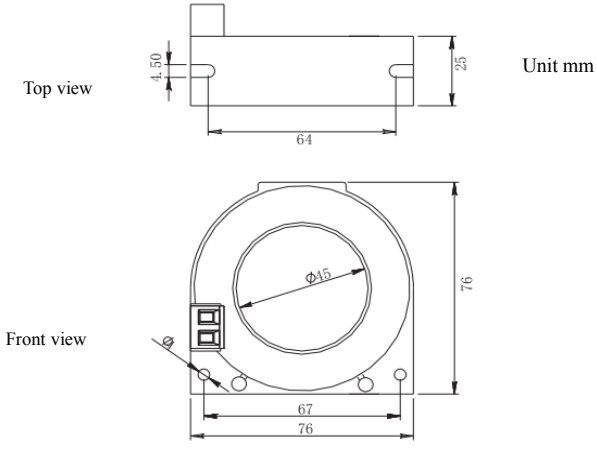


Figure 3-7 100A Electric Leakage CT Dimension

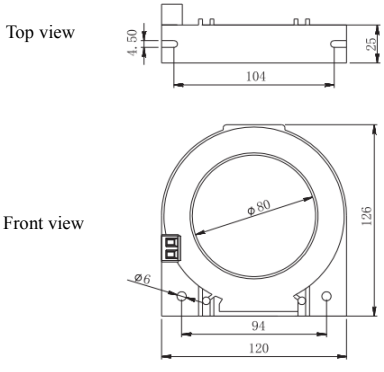
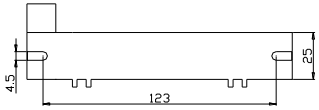


Figure 3-8 Overall Dimension of 250A Residual Current CT Module

Top view



Front view

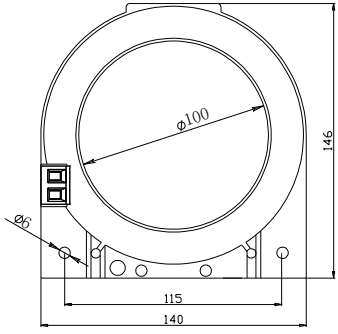
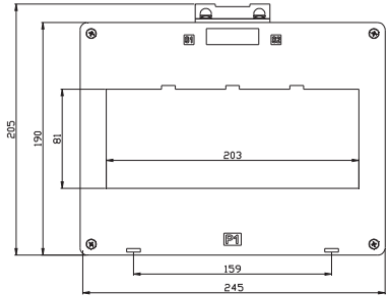


Figure 3-9 Overall Dimension of 400A Residual Current CT Module

Front view



Top view

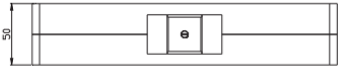


Figure 3-11 Overall Dimension of 800A Residual Current CT Module

[Note]:

1. The rated value of all electric leakage CT shall all be 1A.
2. With respect to the secondary side outgoing line, except that the protection CT is equipped with 1.5m long, the electric leakage transformer of all specifications are not configured and users shall independently prepare appropriate length based on site demands.

3.5 Schematic Diagram of Module Connection

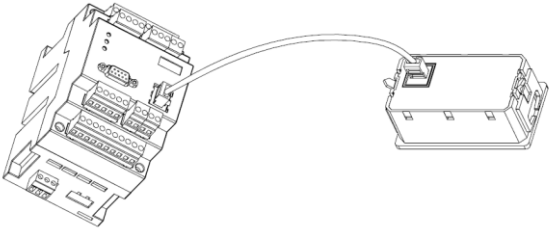


Figure 3-13 Schematic Diagram of Connection of Non-extensible Modules

[Note]:

The main body and display module shall be connected by dedicated cables, otherwise, the anti-interference performance of modules can be degraded. The standard line length shall be 1m long, and in case of any special requirements, please specify at the time of ordering.

Chapter 4 Configuration of Controller Functions

4.1 Function Configuration

The EPM81 has equipped with such protection functions as startup time-out protection, startup over-current protection, overload protection, tE time protection, over-current locked-rotor protection, open-phase protection, current imbalance protection, short-circuit protection, ground protection, under-load protection, external fault protection, leakage protection, temperature protection, over-voltage protection, under-voltage protection, under-power protection, phase sequence protection and analog input protection. Refer to Table 4-1 Controller Function Configuration for detailed functional configurations.

Table 4-1 Controller Function Configuration

		Function configuration	
		Standard configuration	Optional function
Protection Functions	Startup time-out protection	√	
	Startup over-current protection	√	
	Overload protection	√	
	tE time protection	√	
	Current locked-rotor protection	√	
	Open-phase protection	√	
	Imbalance protection	√	
	Short-circuit protection:	√	
	Ground protection	√	
	Leakage protection		√
	Under-load protection	√	
	External fault protection	√	

	Temperature protection (PTC/NTC)		√
	Over-voltage protection	√	
	Under-voltage protection	√	
	Under-power protection	√	
	Analog input protection		√
	Phase sequence protection	√	
	TV disconnection protection	√	
	Wiring check	√	
	Overflow protection	√	
Operation mode	Protection mode	√ (can be set)	
	Direct startup mode		
	Bidirectional reversible startup mode		
	Control breaker mode		
	Star/delta startup two- relay mode		
	Star/delta startup three- relay open-loop mode		
	Star/delta startup three- relay close-loop mode		
	Autotransformer startup two-relay mode		
	Autotransformer startup three-relay open-loop mode		
	Autotransformer startup three-relay close-loop mode		
Switch input (passive bus)	9 DIs, with different configurations for different operation modes	√	
Relay output	5 DOs, with different configurations for different operation modes	√	
Communication	1 MODBUS-RTU	√	

function	PROFIBUS-DP or MODBUS-RTU		√
Measurement	Three-phase current, grounding / leakage current, three-phase current imbalance rate, average current, positive/ negative sequence current, three-phase line voltage, frequency, power factor, active power, reactive power, active energy, positive/ negative/ zero sequence voltage		
Electric leakage input	One 100 - 1000mADC		√
Analog output	One 4-20mADC, with parameters programmable	√	
Analog input	One 4 - 20mADC		√
Event Logging	Record the information about 32 times of events recently occurred	√	
Statistical information	Record motor's overall operation time, current operation time, current stopping time, overall stopping time, overall stopping times, overall tripping times, the longest startup time and the largest startup current	√	
Control functions	Include the under-voltage restart and self-startup, and under-voltage restart is divided into instant restart and delay restart	√	

Note:

1. The current operation time refers to the time under current startup state and operation state of the motor, while the current stopping time refers to the time under the stopping state and ready state

upon current operation; these two items are real-time values and will not be saved in case of power outage, while other statistical data can be reserved.

2. The longest startup time refers to the longest time for starting the motor, while the largest startup current refers to the largest current occurred during motor starting.

Chapter 5 Motor Control and Other Functions

5.1 Division of Motor Operation States

EPM81 divide the motor into 4 operation states: ready state, startup state, operation state and stopping state.

Ready state: the motor can be immediately started for operation under this state;

Start-up state: the motor will start to run after receiving startup commands until achieving the state of steady operation;

Operation state: the motor is in normal operation in this state;

Stopping state: the motor enters into this state in case of fault stopping or receiving any stopping signal.

[Note]:

In case of fault stopping, only after relevant faults are removed with reset operation, can the motor transfer from the stopping state into ready state. In normal stopping, the motor will automatically transfer from stopping state into ready state.

5.2 Start-stop Operation

Motor start and stop can be controlled by many operation modes, such as the key operation of the display module, DI input and communication control.

5.3 Protection / Control

Relay output has dual functions of AC contactor, i.e. start-stop control and protection tripping. When the motor is in normal operation, users can operate relevant keys of corresponding relays to stop the motor normally. In case of any fault, if the protection action is set as tripping, tripping signals will be automatically associated with corresponding relays to stop motor operation.

One overflow fault output relay is installed and when the fault current of the motor overpasses the allowable breaking current of the contactor, it will output impulse signal to disconnect the breaker. (There shall be relay defined as overflow protection)

5.4 Fault Information Output

EPM81 has equipped with the relay to output motor fault information and its contacts are normally on. When EPM81 issues warning or tripping fault information, the fault relay's contacts will be closed; and if such faults are eliminated, the relay contacts will be opened again.

5.5 Resetting Way

Upon EPM81 protection warning or tripping and in the state of stopping, it needs to reset and eliminate relevant fault information before any operation. There are many ways for resetting: There is the resetting key on the display panel, the resetting terminal in the controller, and also the remote operation via the communication ports.

5.6 Power-losing Self-diagnosis

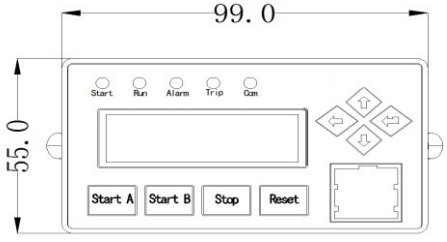
EPM81 has power-losing self-diagnosis relay outputs, the self-diagnosis contacts are normally off, and when the controller is powered on and puts into normal operation, the normal-off contacts will open; in case of power losing, the contacts will be closed. (There shall be relay defined as power-losing self-diagnosis)

5.7 Emergency Stop

EPM81 is equipped with emergency stop input terminal, and in case of any signal input, it will immediately stop the motor, which will not be restarted unless signal disconnection.

Chapter 6 Display Module

6.1 Introduction



Unit：mm

Display module is an integral part of the controller, mainly including control, data display and setting functions.

Indicator lights:

Logo	Light off	Constantly on	Flicker
Start	Non-startup state	Start-up state	-
Run	Non-operation state	Operation state:	-
Alarm	No warning	Warning	-
Trip	No-load release	Tripping	-
Com	No communication	-	Normal communication

Control key:

"Start A": start the motor positively.

"Start B": start the motor negatively and is valid only under the bidirectional reversible startup mode.

"Stop": stop the operation of the motor.

"Reset": the resetting fault information in case of fault warning or tripping of the motor.

Set key:

"←": used to return to the interface up one level or for setting shifting

"↑": increasing key, used to switch to the display interface or modify the setting value.

"↓": decreasing key, used to switch to the display interface or modify the setting value.

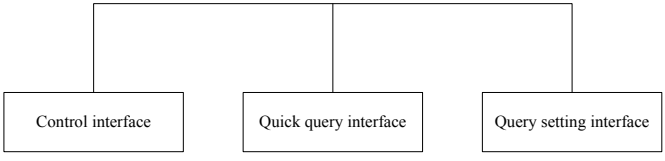
"↵": confirmation key, used to switch to the setting interface.

Interface:

Front panel interface: the debugging interface, which can be connected to the serial communication ports of the computer via dedicated connection cable.

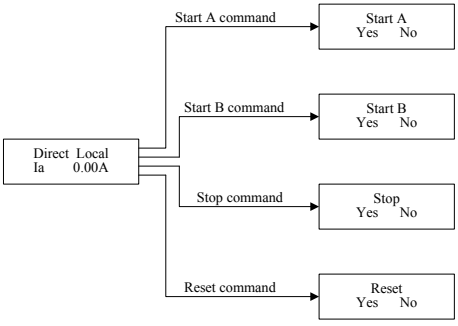
Rear panel interface: the interface connected with the controller, which can be connected to the controller body or extension module via dedicated connection cable.

6.2 Main Functions



Control interface:

After the display module is powered on and puts into operation, it is the control interface by default, when the operation ways of the motor will be displayed. Under such interface and quick query interface, if the operation authority of EPM81 is local, the user could control the start and stop of motor by clicking relevant keys.



It is able to switch from "Query" to "Setting" interface (vice verse) on the display interface by clicking "←" one or more times.

Query interface:

It is able to switch from the control interface to query interface by clicking "↑" and "↓", where users could query or set all measured parameters of EPM81 by relevant keys. Click "↑" and "↓" to switch displayed contents, " "to enter the menu of next level and "←" to return back. Under such interface users can control motor to start and stop through the key. Refer to the Figure 6-1:

Display content introductions:

The closed and open modes of DI and DO are respectively signified by "+" and "-".

Time format in event logging: YY-MM-DD

HH:MM:SS. MS

[Note]:

Specific contents displayed are connected with controller configurations.

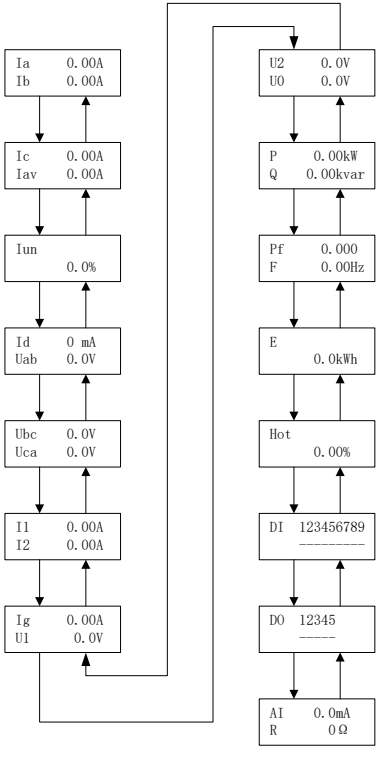


Figure 6-1

Setting interface:

Click "↵" to switch to the main menu, when it is allowed to query or set the real-time data, records, motor parameters, protection setting value, control parameters, system parameters, version information and manufacturer's maintenance of EPM81 via setting keys. s

Click "↑" and "↓" to switch displayed contents, "↵" to enter the menu of next level or the editing state, and "←" to return back the menu of last time.

Under the editing state, the scope in the process of editing will be light on. Click "↑" to increase

the setting value and "↓" to decrease.

See Figure 6-2 for the first-level menu of the setting interface:

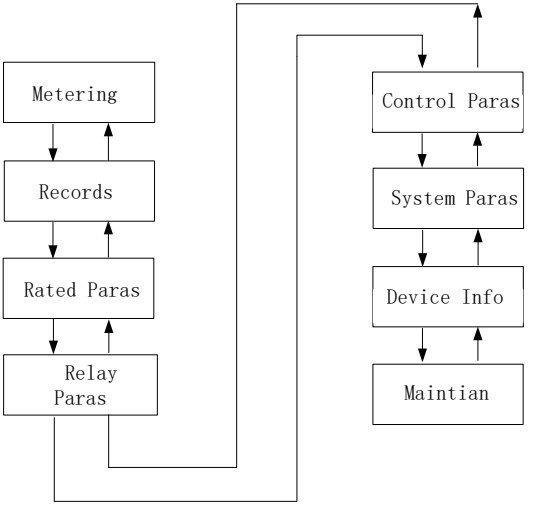


Figure 6-2

[Note]:

Specific contents displayed are connected with controller configurations.

See Figure 6-3 for the real-time data menu:

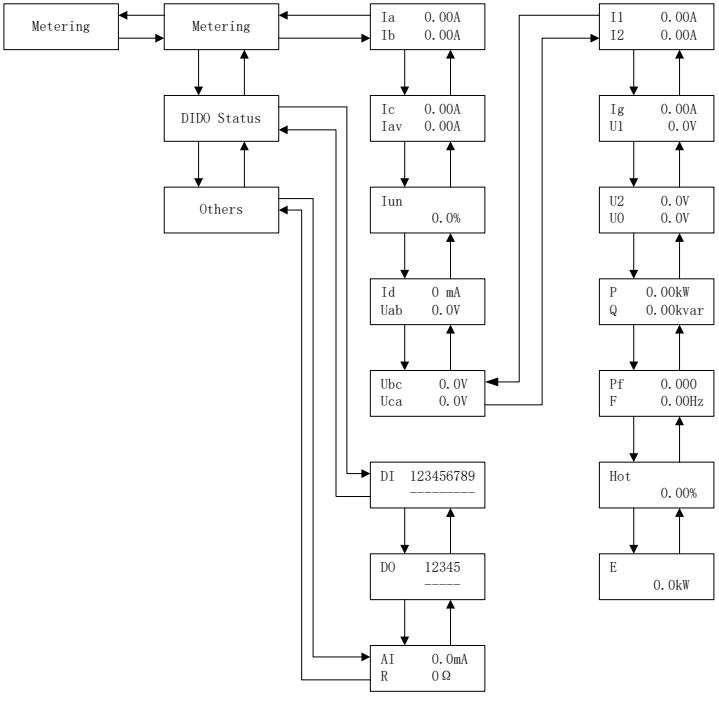


Figure 6-3

See Figure 6-4 for the recorded information menu:

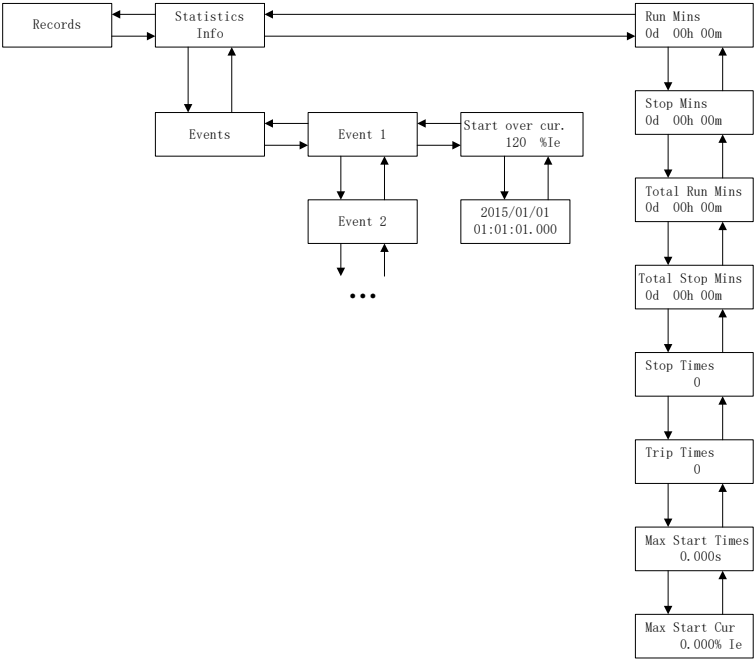


Figure 6-4

See Figure 6-5 for motor parameter menu:

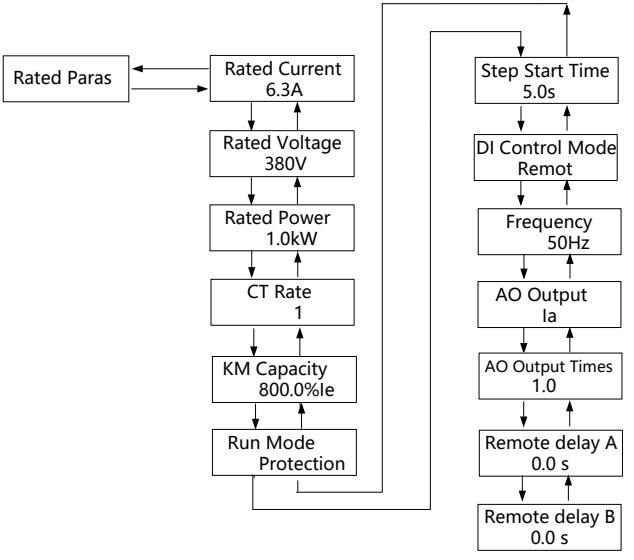


Figure 6-5

See Figure 6-6 for protection setting value menu:

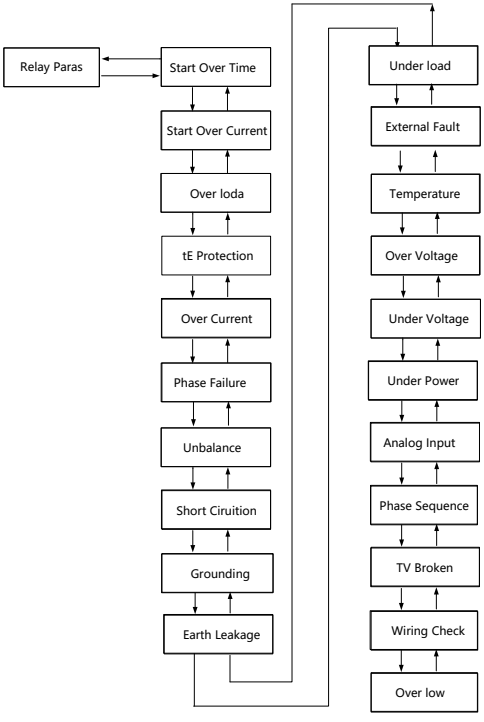


Figure 6-6

[Note]:

Refer to Chapter 9 Protection Parameter Setting for specific settings of relevant protection parameters

See Figure 6-7 for the control parameter menu:

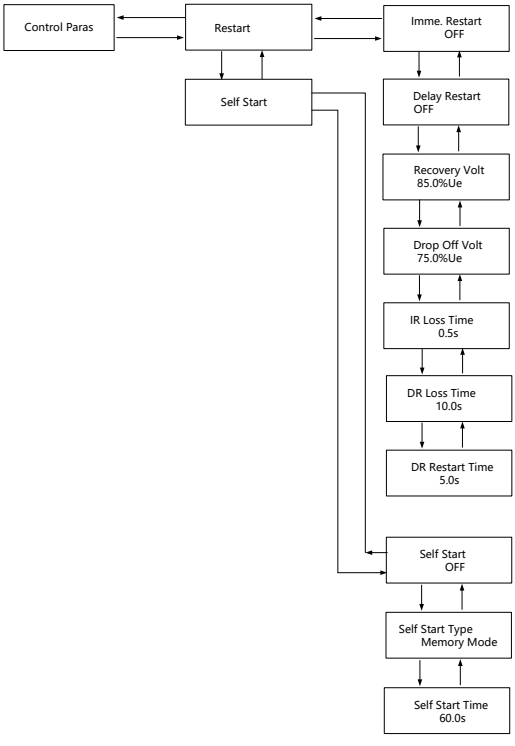


Figure 6-7

See Figure 6-8 for system parameter menu:

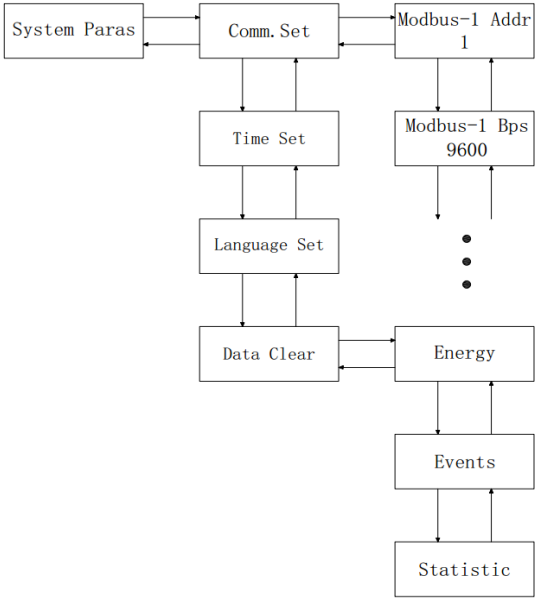


Figure 6-8

[Note]:

1. Communication parameters include the address and baud rate of circuit 1 and 2's 485 and Profibus-DP address.

2. Language settings are of two options, i.e. Chinese and English.

3. As for clear history, it needs to mark "√" for the items to be eliminated and then select "Yes" at the time of exiting as confirmation. If "No" is selected, the elimination will be abandoned.

See Figure 6-9 for device information menu:

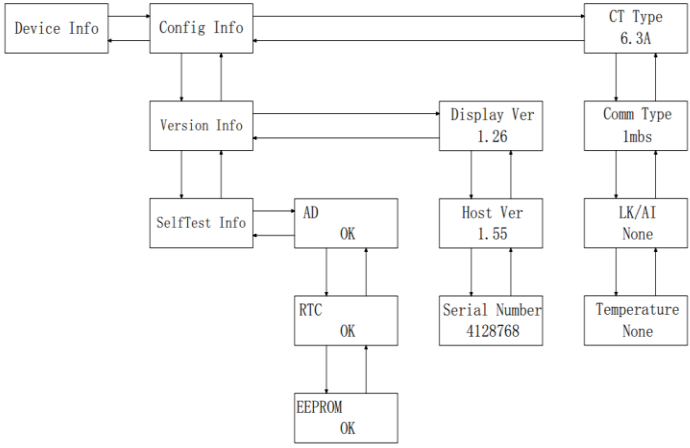
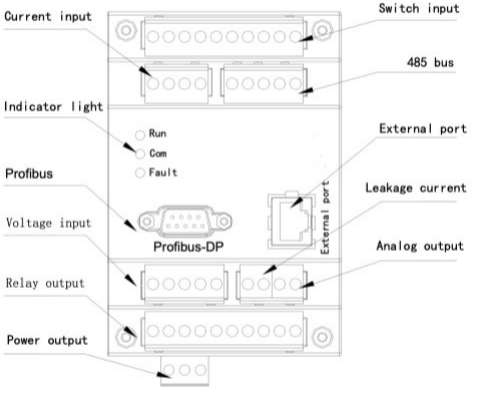


Figure 6-9

Manufacturer's maintenance interface is for self-use by the manufacturer and no authority will be open to users.

Chapter 7 Various Module Terminals and Function Instructions

7.1 Main Module



Indicator lights:

Logo	Light off	Constantly on	Flicker
Run	Without power on	Power up	
Bus	No communication	Receive communication messages	
Fault	No fault	With tripping	With warning

Terminal function:

Terminal encoding	Terminal logo	Terminal function	Initial state
1	DC	Common terminal of DI input	-

2	DI1	Switch input 1	-
3	DI2	Switch input 2	-
4	DI3	Switch input 3	-
5	DI4	Switch input 4	-
6	DI5	Switch input 5	-
7	DI6	Switch input 6	-
8	DI7	Switch input 7	-
9	DI8	Switch input 8	-
10	DI9	Switch input 9	-
11	IA	Phase A current input	-
12	IB	Phase B current input	-
13	IC	Phase C current input	-
14	IN	Common terminal of current input	-
15	T1 /RS1+	Positive terminal of RS485 communication port 1 (or positive terminal of temperature)	-
16	T2/ RS1-	Negative terminal of RS485 communication port 1 (or negative terminal of temperature)	-
17	SHLD	RS485 Shield grounding	
18	RS2+	Positive terminal of RS485 communication port 2	-
19	RS2-	Negative terminal of RS485 communication port 2	-
20	UA	Phase A voltage input	-
21	None	-	-
22	UB	Phase B voltage input	-
23	None	-	-
24	UC	Phase C voltage input	-
25	Ln1/AI-	Leakage current input 1 (or analog input's negative terminal)	-

26	Ln2/AI+	Leakage current input 2 (or analog input's positive terminal)	-
27	NA+	Positive terminal of analog output	-
28	NA-	Negative terminal of analog output	-
29	R11	Relay 1	Normally open
30	R12/R21	Common terminals of Relay 1 and Relay 2	-
31	R22	Relay 2	Normally off
32	R31	Relay 3	Normally open
33	R32		
34	R41	Relay 4	Normally open
35	R42		
36	R51	Relay 5	R51, R52 normally open R52, R53 normally off
37	R52		
38	R53		
39	L/+	Positive electrode of power supply	-
40	N/-	Negative electrode of power supply	-
41	⏚	Protection grounding	-

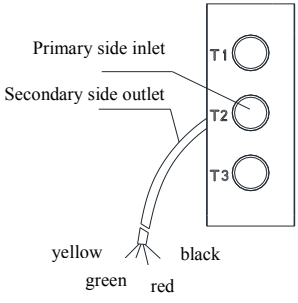
[Note]:

1. The Phase A, B and C current input terminals on main module shall be connected with dedicated CT module, instead of randomly connected with 5A or 1A inputs.

2. As for the wiring terminals (IA, IB, IC and IN) at the secondary side of the transformer on the main module, if only one or two phases are used, the input terminals of the rest unused ones shall be connected with IN. For example, if only Phase A transformer is connected, at the same time of connecting the transformer's secondary side into IA and IN, it needs to connect IB and IC with IN short-circuit via jumpers, otherwise, current zero-drift of IB and IC will be presented on the measurement display screen.

7.2 CT Module (the rated output at secondary side is mV-level voltage)

■ **Specifications of 100A and below**



Current inlet:

T1, Phase A current inlet

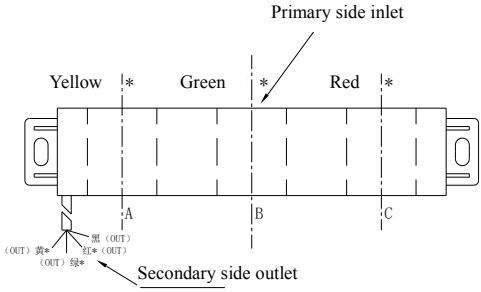
T2, Phase B current inlet

T3, Phase C current inlet

Current outlet:

The yellow, green, red and black cables at the secondary side outlets respectively represent the secondary outlet terminals of Phase A, B and C current and common terminals, which shall be connected to the corresponding current terminals, with the common terminal ungrounded. The length of secondary side outlet is 1.5m long.

■ **Specifications of 250A and 400A:**

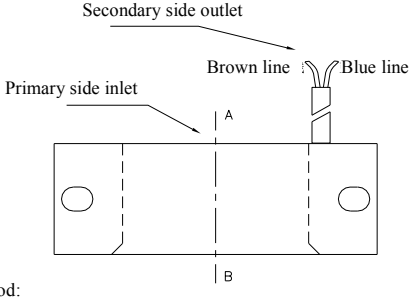


黄：yellow;绿：green; 红：red;黑：black

Connection method:

The yellow, green, red and black cables at the secondary side outlets respectively represent the secondary outlet terminals of Phase A, B and C current and common terminals, which shall be connected to the corresponding current terminals, with the common terminal ungrounded. The length of secondary side outlet is 1.5m long.

■ **Specifications of 500A and 820A:**



Connection method:

500A and 820A CTs are individual units; 3 CTs are connected simultaneously and under the

state of Phase A, B and C at the primary side are all inlet at point A, the brown lines of these 3 CTs will respectively connect into the corresponding current input terminals of the main body, while all blue lines will be jointly connected into the common terminals, which shall not be grounded. The length of secondary side outlet is 1.5m long.

Chapter 8 Motor Parameter Settings

8.1 The Rated Current of the Motor

Setting scope: 0.5A - 820.0A (the minimum setting value of the rated current shall be 20% of CT specification, and the minimum setting value of the rated current shall be 0.5A when then CT specification is 2A.)

8.2 The Rated Voltage of the Motor

Setting scope: 380V/690V.

8.3 The Rated Power of the Motor

Setting scope: 0.5 - 1000kW.

8.4 CT Transformation Ratio of the Main Circuit of the Motor (when adds one CT)

Because EPM81 will equip itself with customized split-type CT module, with measuring range up to 820A, there is no need for the user to prepare external CT separately. If the external CT is equipped for special needs, the secondary side outlet of the external CT shall pass through the primary side thread hole corresponding to CT module of EPM81 as well as set the external CT transformation ratio.

Setting scope: 1 - 2000.

For example: The transformation ratio of the current transformer is 500:5, and the external setting value shall be 100.

If the user chooses the external CT for the main circuit separately, the CT with the secondary side rated current of 5A is recommended, and shall choose the controller with the rated current of 6.3A. If the secondary side rated current of the external CT is 1A, then the controller used for matching with the rated current of our company shall be 2A.

Note: The CT setting shall be effective only when the rated current is 2A or 6.3A.

8.5 Contactor Maximum Breaking Current

Setting scope: 6.0 - 10.0Ie.

The maximum breaking current shall be 8.0Ie by default.

8.6 The Operation Mode for Device

Setting scope: protection mode, direct startup mode, bidirectional reversible startup mode, control breaker mode, star-delta startup two-relay mode, star-delta startup three-relay open-loop mode, star-delta startup three-relay close-loop mode, autotransformer two-relay startup mode, autotransformer startup three-relay open-loop mode and autotransformer startup three-relay close-loop mode.

The operation mode by default is: Direct startup mode

8.7 Two-step Startup Time

This time is the control switching time for star-delta startup as well as autotransformer startup, and the wait-to-restart time after stopping in the process of bidirectional reversible startup.

Setting scope: 0.5 - 60.0s.

8.8 DI Control Authority

When DI5 is in close state, the operation authority of EPM81 is "Remote control"; when DI5 is in open state, the operation authority of EPM81 is "Local control" and the DI control authority can be set to "Local" or "Remote" on the panel;

If the authority of DI5 is "Local", the panel control is available, but communication control is unavailable; if the DI control mode is "Local", the DI control is available; if the DI control mode is "Remote", the DI control is unavailable;

If the DI5 authority is "Remote", the communication control is available, but the panel control is unavailable; if the DIDI control mode is "Remote", the DI control is available; if the DIDI control mode is "Local", DI control is unavailable.

[Note]:

1. There is no difference in operation authority under the protection mode.
2. The parameter setting function is irrelevant to control authority.

8.9 The Rated Frequency

Setting scope: 50Hz

8.10 Analog Output

When the analog output is 4 -20mA, the analog output object shall be A phase current by default.

The optional objects of analog output: Non, Phase A current, Phase B current, Phase C current, leakage current, imbalance rate of three-phase current, AB line voltage, BC line voltage, CA line voltage.

8.11 Analog Output Multiple

The analog output multiple shall be 1.0 - 10.0. If the analog output multiple is set as 10, 0 means 4mA, and 10Ie means 20mA; when the object is the three-phase current imbalance rate, the multiple setting is unavailable.

When the analog output multiple is set at 1, the corresponding relations of all variable output is as follows:

Type	Corresponding relation of 20mA	Type	Corresponding relation of 20mA
Phase A current	The rated current	Three-phase current imbalance rate	100%
Phase B current	The rated current	AB line voltage	The rated voltage
Phase C current	The rated current	BC line voltage	The rated voltage
Leakage current	The rated leakage current	CA line voltage	The rated voltage

Chapter 9 Protection Parameter Settings

9.1 Introduction

EPM81 conducts comprehensive protection and control for the motor by collecting three-phase current, three-phase line voltage, grounding current, thermistor, switch value state and other input data. The protection function compares the data collected after calculation with the protection setting value recorded by the controller set by the user, and conduct further actions by controlling the relay based on the results of the comparisons.

The parameter setting of the protection controller for EPM81 series motor shall be conducted via display module or communication interface. The communication software is provided for free; see Communication Software Instructions for more details.

When EPM81 leaves the factory, Only startup time-out protection, startup over-current protection, overload protection, over-current locked-rotor protection, open-phase protection and short-circuit protection of the device are opened by default, and other protection functions are all closed; the user can open and set other protection functions according to their own needs. Please be careful and avoid protection mal-operation or damaging the motor in the process of protection setting value setting.

[Note]: The protection parameter shall not be out of setting range in the process of setting, otherwise the setting is unavailable.

9.2 Start time-out Protection

Start time-out protection to provide protection for the motor in the starting process of the motor. In the process of motor operation, time-out protection will exit automatically.

The time-out protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Warning/ Trip	Tripping
Setting value of time	0.5s - 60.0s	6s

The setting for startup time can refer to the actual startup time of the motor, which is calculated from the startup to the moment that the revolving speed of the motor reaches up to the rated speed; and it can be set as 1.2 times of the actual startup time of the motor for keeping sufficient time.

The characteristics of protection actions: In the starting process of the motor, if the maximum current of three-phase current is more than 1.2Ie and the duration exceeds the time setting value for startup time-out protection, then the time-out protection action starts.

9.3 Start Over-current Protection

Start over-current protection to provide over-current protection for the motor in the starting process of the motor. In the process of motor operation, over-current protection will exit automatically.

The characteristics of protection action: If the maximum current of the three-phase current is no less than the protection setting value with reaching up to setting time within the startup time, the protection action works.

The startup time-out protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Warning/ Trip	Tripping
Setting value of current	100.0 - 1000.0%Ie	800%Ie
Setting value of time	0.0-60.0s	1s

9.4 Overload Protection

The overload protection is one common protection function of the motor, which is used for protecting the motor against from burning due to overheating and insulation dropping, resulting from operating in long run with the current higher than the rated current. The overload protection function provides protections for the motor based on inverse time overload protection curve, and the curve formula shall be: $T = KxLn[N^2/(N^2-1.15)]/1.15$, with the N =Iav/Ie in the formula. The overload protection function will work after entering the operational process instead of starting process. When the tE time protection works, the overload protection will close.

The overload protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Warning/ Trip	Tripping
Curve rate	1 - 18	1
Cooling time	1min - 1000min, with differential at 1min	30min
Resetting way	Manual/Automatic	Manual
Reset heat capacity	0.0-85.0%	50%

The user can select different curve coefficient based on the level of motor overload protection, and the K factor corresponding to curve rate is as follows:

Curve rate	K factor	Curve rate	K factor
1	10	2	16
3	24	4	40
5	60	6	80
7	100	8	130
9	180	10	280
11	400	12	600
13	800	14	1000
15	1100	16	1200
17	1400	18	1800

The cooling time will occur after the overload of the motor, and the motor will reset after the cooling time.

The setting for the cooling time: The heat dissipation process after stopping the motor is simulated as the attenuation exponent process, with the heat dissipation rate depending on this setting value, and conduct settings based on the heat dissipation conditions, then input 30min as a typical time for sufficient cooling. If a shorter cooling period is needed, especially for the small motor, the different time can be input. If the cooling time is too short, the motor will be damaged due to restart the overheat motor by the user; so be careful when short cooling time needed to be chosen.

Heat capacity is the heat accumulated in the simulation process of motor operation; the setting of reset heat capacity in overload protection is to prevent starting the overheated motor. The heat capacity of the motor shall be lower than the value of reset heat capacity, which will meet the resetting conditions.

If the fault resetting way is set as manual mode, and the reset operation shall be conducted manually after overload protection actions; restart the motor after eliminating the fault indicator and fault tripping output. If the fault resetting way is set as automatic mode, no need to conduct the reset operation manually after overload protection actions; when the heat capacity drops down below the reset heat capacity, and overload fault indicator and fault tripping output will be eliminated automatically (other protection tripping will not be affected by this function), the motor will be allowed to restart.

The characteristics of protection actions: In the operational process of the motor, if the current is no less than 1.2 times of Ie, then the overload protection will conduct actions according to the selected protection curve.

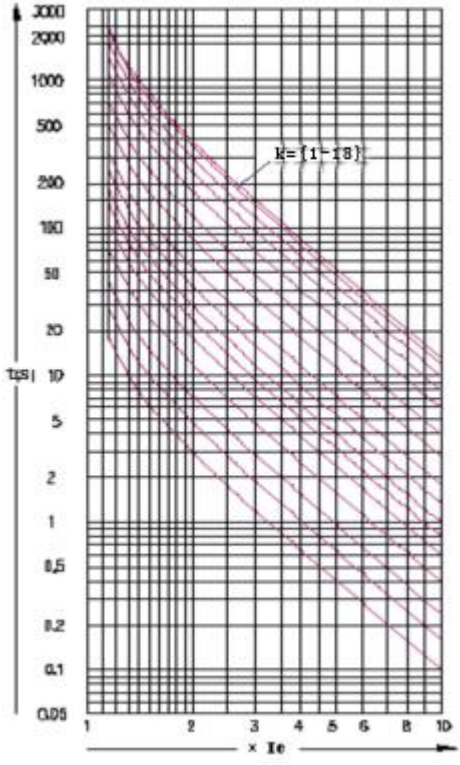


Figure 8-1 Overload Protection Characteristics Curve

9.5 tE Time Protection

The tE time protection function has taken the ration of motor locked-rotor current and nominal current as well as the highest motor temperature allowed by corresponding environmental rating.

The overload protection function will be automatically switched off when tE time protection

function is switched on. tE time protection function is in line with the relevant stipulations of GB3836.3-2000 standard and suitable for continuous operating state, including motors started easily and non-frequency starting without significant additional temperature rise; it is allowed to be adopted in the increased safety explosion-proof motor (such as YA and YA2 series) with inverse time overload protection device, and not suitable for motors difficult to start or being started frequently. Faults of tE time protection shall be manually reset.

The tE time protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Warning/ Trip	Exit
Setting value of time	1.0-15.0s	4.8s

This protection function will conduct tE time protection for the motor according to the following curve.

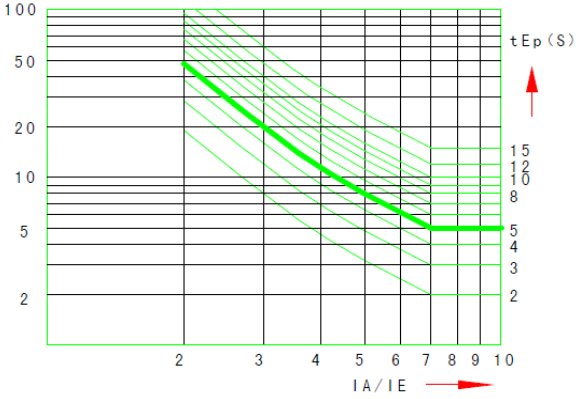


Figure 8-2 tE Protection Characteristics Curve

Wherein, ① is Figure 3 in 5.1.4.3 of GB3836.3-2000 standard

② is the tE time protection action curve of this product

[Note]:

1 In the actual system, the outlet time of protection shall also take the fixed action delay of the relay and fixed delay of external mechanical structure into account.

2 When products of this series conduct tE time protection, the rated current Ie of the controlled (protected) motor shall not exceed the maximum current value required by its specification and model.

3 When products of this series conduct tE time protection, the setting value of the action time shall not exceed 1.7 times of the tE time of the controlled (protected) motor (subject to the actual data on motor nameplate).

9.6 Over-current Locked-rotor Protection

The over-current locked-rotor protection is one protection specific to the motor, and is suitable for providing great protection to fault current, such as the motor shaft seizure (commonly known as "Brake seizure") of transmission device, pump, fan, cutter and compressor and other device due to overload or own mechanical reasons. Over-current locked-rotor protection can be closed; When the user startup this protection, it will work automatically after entering the operational process instead of working in the starting process.

The over-current locked-rotor protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Warning/ Trip	Tripping
Setting value of current	100.0%Ie - 800.0%Ie	300.0%Ie
Setting value of time	0.5s - 60.0s	3s

The setting value of the locked-rotor current shall be set to half of the allowable locked-rotor current value, generally being 1.5-2.5Ie, based on the maximum allowable locked-rotor current provided by the motor manufacturer.

The locked-rotor delay time can be set by referring to the allowable locked-rotor time of the motor, generally being 0.9 times of the allowable locked-rotor time.

The characteristics of protection actions: If the maximum current of the three-phase is no less than the protection setting value with reaching up to setting duration in the operational process of the motor, the protection action works.

9.7 Open-phase Protection

The open-phase fault damages the motor greatly. Customers can consider equipping with this protection in the actual running.

The open-phase protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Warning/ Trip	Tripping
Delay time	0.20s - 120.0s,	4.0s

The characteristics of protection actions: During the starting or running of the device, the open-phase protection action will work when the controller detects the occurrence of open phase with reaching up to the setting duration.

9.8 Imbalance Protection

Another main reason leading to thermal damage of the motor is the imbalanced current supplied by three-phase. Imbalance protection can be closed, and if the user starts this function, it will work in the starting process.

The current imbalance protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Warning/ Trip	Exit
Setting value of imbalance rate	20% - 60%	40%
Setting value of time	0.5s- 120.0s	5.0s

The standards for setting the imbalance is based on experience as the motor data provided are relatively few. For one known balance situation, 40% of the starting value is recommended as one initial point, and the starting value can be down-regulated to the level higher than the level that will result in frequent trip. For the motor with light load, one large imbalanced current will not damage the motor; in such case, the starting value can be up-regulated or relatively long delay time can be set.

See below for the calculation formula of imbalance rate:

$$\mathrm{Im}ax - \mathrm{Im}in \Big/ \max(Iav, Ie) \times 100\%$$

Includes Imax: the maximum three-phase current value;

Imin: the minimum three-phase current value;

The characteristics of protection actions: The device will conduct actions to protect the output, if the imbalance rate of three-phase current≥ the setting value of the imbalance rate with reaching up to the setting time in the process of the starting or running of the device.

9.9 Short-circuit Protection:

Motor short-circuit protection is set for the interphase short circuit of motor and inter-turn short circuit of motor winding. The short-circuit protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Warning/ Trip	Tripping
Setting value of current	400% - 1000%Ie	400.0%Ie
Setting value of time	0.0s - 30.0s	0.5s

When the fault current exceeds the set allowable breaking current of the contactor, the controller will output one signal via the overflow fault relay to operate the breaker to break the motor circuit.

The characteristics of protection actions: The device will conduct actions to protect the output if the current of any phase is ≥ the setting value with reaching up to the setting time in the operational process of the device.

[Note]:

In the application that any short circuit current is higher than the allowable breaking current of the contactor, one fuse or breaker shall be used to cut off the short circuit current for preventing the damage of the contactor or expanding of the fault.

9.10 Ground Protection

Ground protection is used to protect the phase lines from the short circuit fault with the motor metal enclosure. Ground protection can be closed, and if the user starts this function, it will work in the starting process. When earth leakage protection works, the ground protection will close.

The ground protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Warning/ Trip	Exit
Setting value of current	50.0% - 800.0%Ie	100.0%Ie
Setting value of time	0.0s- 30.0s	2.0s

The current size of the earth fault current depends on the position of the fault point on the motor coil; it is suggested that lower ground fault operation value can be set to protect stator coils as many as possible and prevent the motor enclosure from becoming very dangerous due to electrification.

In the solidly grounded system, delay time shall be set to be as short as possible to avoid system damage; in the grounded system with the resistance, grounding current value is restricted to a

relatively safe scope, thus relatively longer delay time can be selected.

The characteristics of protection actions: The protection action will work if the grounding current is no less than the setting value with reaching up to the setting delay time in the process of starting or running of the device.

9.11 Leakage Protection

Leakage protection function provides more accurate grounding fault detection, and is mainly used to make sure the personal safety. Current signal of the leakage protection depends on the external l electric leakage transformer. Either leakage protection or ground protection can be chosen.

The leakage protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Warning/ Trip	Exit
Setting value of current	50 - 1000mA	200mA
Setting value of time	0.0s - 30.0s	2.0s

Leakage protection is used to make sure the personal safety; therefore it is suggested that low protection operation value and short delay time can be set.

The characteristics of protection actions: The device will conduct actions to protect the output if the leakage current is no less than the setting value with reaching up to the setting delay time in the operational process of the device.

[Note]:

Leakage protection is optional functions which cannot be valid at the same time with the ground protection function. Ground protection will be automatically closed once leakage protection function is selected by the user.

9.12 Under-load Protection

Generally, the motor under-load requires no protection, but under-load protection is required when the abnormal sudden changes occur in the load situation, such as sudden breaking of the conveyor belt of the assembly line.

The under-load protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Warning/ Trip	Exit
Setting value of current	20.0 - 95.0%Ie	50.0%Ie
Setting value of time	1.0s - 1200.0s	5.0s

Relatively low action setting value can be set for equipment such as water pump and conveyor belt of assembly line, such as 60% Ie. The operation way of under-load protection can generally be

set as warning, to remind staff to pay attention.

The characteristics of protection actions: The device will conduct actions to protect the output if the average value of three-phase current is no more than the setting value with reaching up to the setting delay time in the operational process of the motor.

9.13 External Fault Protection

External fault protection can be accessed via the switch input node; the controller will send the warning signal or shut down the motor when there is any external fault regardless of the ready state or the operation state of the motor; the motor can be restarted only after the external fault is reset and eliminated.

The external fault protection parameters needed to be set include:

Parameter	**Scope**	**Default value**
Operation way	Exit/ Warning/ Trip	Exit
Delay time	0.1 - 30.0s	0.1s

9.14 Temperature Protection

The main reason causing the motor failure under overload conditions is the insulation damage of the stator coil due to overheating. The thermistor pre-embedded in the motor stator can generate quick resistance change according to the temperature change, and the controller can receive the input of one thermistor and issue the shutdown command or the warning command when the setting value is reached.

The temperature protection parameters needed to be set include:

Parameter	**Scope**	**Default value**
Operation way	Exit/ Warning/ Trip	Exit
Thermistor type:	PTC/NTC	PTC
Setting value of action resistance	0.1kΩ- 10.0 kΩ	1.0kΩ
Setting value of time	0.1 - 300.0s	1.0s

Input the operation value of the thermistor by referring to the resistance-temperature curve provided by the manufacturer of the thermistor installed in the motor.

The characteristics of protection actions: When the thermistor type is PTC: The controller will conduct actions to protect output if the measured resistance value is no less than the setting value of action resistance with reaching up to the setting delay time.

When the thermistor type is NTC: The controller will conduct actions to protect the output if

the measured resistance value is no more than the setting value of action resistance with reaching up to the setting delay time in the process of operation.

9.15 Over-voltage Protection

Too high voltage will result in the insulation damage of the motor, and the over-voltage protection function can protect the over-voltage fault of the primary line of the motor.

The over-voltage protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Warning/ Trip	Exit
Scope of the action setting value	105.0 - 150.0%Ue	110.0%Ue
Delay time	0.1s - 300.0s	5.0s

Considering that the motor can generally continuously work under 1.2 times of Ue, the setting value can be set as 120% of Ue or higher.

The characteristics of protection actions: The controller will conduct actions to protect the output if the voltage of any phase line is no less than the setting value with reaching to the end of the delay time in the process of the operation.

9.16 Under-voltage Protection

Too low voltage will result in the decreasing of the revolving speed of the motor and the operation stopping. Under-voltage protection function can protect the under-voltage fault of the primary line of the motor. When TV disconnection protection works, the under-voltage protection will close.

The under-voltage protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Warning/ Trip	Exit
Scope of the action setting value	45.0 - 95.0%Ue	80.0%Ue
Delay time	1.0s - 30.0s	5.0s

Considering that when the voltage of the motor decreases to below 70%, the revolving speed of the motor will be unstable and the heating will rapidly increase in general, so the action setting value can be set to about 70% or be adjusted according to the load situation.

The characteristics of protection actions: The controller will conduct actions to protect the output if the voltage of any phase line is no more than the setting value with reaching to the end of the delay time in the process of the operation.

9.17 Under-power Protection

Considering that the motor current may not be too small due to the relatively low power factor in under-load running of the motor, the under-power protection function will provide better under-load protection for the motor.

The under-power protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Warning/ Trip	Exit
Scope of the action setting value	20.0 - 95.0%Pe	50.0%Pe
Delay time	1.0s - 1200.0s	5.0s

The characteristics of protection actions: The controller will conduct actions to protect the output if the gross power of three-phase is no more than the setting value with reaching to the end of the delay time in the process of the operation.

9.18 Analog Input Protection

Analog input protection is used to protect the relevant non-electric parameters of the motor.

The analog input protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Warning/ Trip	Exit
Setting value of current	4.0 - 20.0mA	10mA
Setting value of time	0.1s - 60.0s	5.0s

9.19 Phase Sequence Protection

The wrong phase sequence may lead to the motor reversal, and the phase sequence protection function can prevent the starting of the motor in the case of wrong phase sequence.

The phase sequence protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/Warning/ Trip	Exit

9.20 TV Disconnection Protection

After the occurrence of TV disconnection, the controller will receive abnormal voltage signal, thus leading to abnormity in control of the motor.

The voltage disconnection protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/Warning	Exit

9.21 Wiring Check

If the wiring check is available, the controller will check the state of external contactor after power on; and output the warning relay if there is any fault. See Chapter 11 for the details. Close the wiring check in protection mode.

The wiring check is closed by default.

The wiring check parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Entering	Exit

9.22 Overflow Protection

When the fault current is stronger than the allowable breaking current of the contactor, the controller will output a disconnecting signal via overflow fault relay to control the breaker trip, therefore cut off the main circuit current of the motor via the disconnecting breaker and prevent contacts of the contactor from being burnt in case of short-circuit with excessive current. Overflow fault shall be configured with overflow fault relay outlet; otherwise, it will be invalid.

The phase sequence protection parameters needed to be set include:

Parameter	Scope	Default value
Operation way	Exit/ Entering	Exit

[Note]:

The overflow fault will be invalid in control breaker mode, star-delta startup two-relay mode, star-delta startup three-relay open-loop mode, star-delta startup three-relay close-loop mode, autotransformer startup two-relay mode, autotransformer startup three-relay open-loop mode, autotransformer startup three-relay lose-loop mode.

Chapter 10 Control Parameter Settings

10.1 Under-voltage Restart

Concerning the motor circuit in continuous operation, there will be short power-losing in the system, it is necessary for the motor to be restarted automatically in power recovery for restoring the technological process as soon as possible.

The restart function provides the system with the automatic restart function of the motor in short power-losing and sets two restart functions, "Instant restart" and "Delay restart". The two restart functions can be entered and exited separately. Instant restart is equipped with the anti-interference electricity function.

The parameters needed to be set include:

Parameter	Scope	Default value
Instant restart settings	Exit/ Entering	Exit
Delay restart settings	Exit/ Entering	Exit
Recovery voltage settings	70.0%- 95.0%Ue	85%Ue
Dropout voltage settings	50.0% - 90.0%Ue	75%Ue
The power loss time in instant restart	0.1 - 1.0s	0.5s
The power loss time in delay restart	2.0 - 300s	10.0s
The delay time in delay restart	0.1- 300.0s	5.0s

When the motor is in operation state, its power supply circuit voltage loses power or drops to below the setting dropout voltage, the protector will start timing.

If the main circuit voltage is recovered to the "Recovery voltage" in the "Power loss time in instant restart", the protector will instantly issue the startup commands and restart the motor as well as the device will not conduct logical judgment on "Delay restart" anymore.

If the "Instant restart" fails (namely after exiting or entering the "Instant restart", the voltage is not recovered to the "Recovery voltage" in "Power-losing time in instant restart"), and the voltage is recovered to the "Recovery voltage" in "Power-losing time in delay restart", the protector will issue the startup commands and restart the motor after setting the "Delay time in delay restart".

Note: 1. Motors can be started in batches by setting different "Delay time in delay restart".

2. The setting value of recovery voltage shall be higher than the setting value of dropout voltage.

10.2 Self-startup

The self-startup function is also known as "Power-on restart" function.

After starting this function, the controller can realize the restart after voltage recovery (refer to the recovery voltage settings in voltage-loss restart for the value of voltage recovery) in the process that the controller is powered on or voltage drops out and recovers.

The parameters needed to be set include:

Parameter	Scope	Default value
Self-startup entering and exit	Exit/ Entering	Exit
Self-startup way	Memory mode/ Startup mode	Memory mode
Delay time in self-startup	0.1 - 300.0s	60.0s

If set the entering and exit of the automatic startup of the system to be "Input" with the startup way of "Memory mode", then the controller will make judgment on whether to restart depending on the state before the power outage. If the motor in operation state before power outage, the controller will issue the restart command via "Delay time in self-startup" after it is powered on; if it is any other state before the power outage, the controller will not issue the restart command. If set the self-startup entering and exit of the device to be "Exit", its function will exit.

If set the entering and exit of the automatic startup of the system to be "Input" with the startup way of " Startup mode", the device will automatically issue the restart command via "Delay time in self-startup" when it is powered on and detects the voltage recovery. If set the self-startup entering and exit of the device to be "Exit", its function will exit.

Note: If the under-voltage restart function is started, the self-startup function will be invalid.

Chapter 11 System Parameter Settings

11.1 Communication Setting

Address setting scope: 1 - 247 (Modbus-RTU),

1 - 123 (Profibus-DP).

Baud rate setting scope: 4800, 9600, 19200, 38400. Baud rate is set to be 9600 by default.

11.2 Time Settings

Setting scope: From 2001 to 2099

11.3 Language Setting

Setting scope: 0 Chinese

1 English

11.4 Clear History

Clear history includes: Electric energy clear, event clear and statistics clear.

Chapter 12 Switch Input and Relay Output Settings

12.1 Protection Mode

Terminal encoding	Signal input	Application	Relay output	Application
2	DI1	DI1 general	DO1	Start A (only for under-voltage restart or self-startup)
3	DI2	DI2 general		
4	DI3	DI3 general	DO2	Motor tripping signal output
5	DI4	Reset		
6	DI5	DI5 general	DO3	---
7	DI6	Contactor state 1		
8	DI7	DI7 general	DO4	Motor fault signal output
9	DI8	DI8 general		
10	DI9	DI9 general	DO5	Motor overflow fault output

12.2 Direct Startup Mode

Terminal encoding	Signal input	Application	Relay output	Application
2	DI1	Positive startup	DO1	Start A
3	DI2	DI2 general		
4	DI3	Stop	DO2	Motor stop/ Tripping signal output
5	DI4	Reset		
6	DI5	Local/Remote	DO3	---
7	DI6	Contactor state 1		
8	DI7	DI7 general	DO4	Motor fault signal output
9	DI8	DI8 general		
10	DI9	DI9 general	DO5	Motor overflow fault output

12.3 Bidirectional Reversible Startup Mode

Terminal encoding	Signal input	Application	Relay output	Application
2	DI1	Positive startup	DO1	Start A
3	DI2	Negative startup		
4	DI3	Stop	DO2	Motor tripping signal output
5	DI4	Reset		
6	DI5	Local/Remote	DO3	Start B
7	DI6	Contactor state 1		
8	DI7	Contactor state 2	DO4	Motor fault signal output
9	DI8	DI8 general		
10	DI9	DI9 general	DO5	Overflow fault output

12.4 Control Breaker Mode

Terminal encoding	Signal input	Application	Relay output	Application
2	DI1	Starting signal	DO1	The motor protects and controls the switching signal output of Relay A.
3	DI2	DI2 general		
4	DI3	Stop	DO2	-- -
5	DI4	Reset		
6	DI5	Local/Remote	DO3	Motor stop/Tripping
7	DI6	DI6 general		
8	DI7	DI7 general	DO4	Motor fault signal output
9	DI8	DI8 general		
10	DI9	DI9 general	DO5	Self-diagnosis fault output

12.5 Star/delta Startup Mode and Autotransformer Startup Two-Relay Mode

Terminal encoding	Signal input	Application	Relay output	Application
2	DI1	Starting signal	DO1	The motor protects and

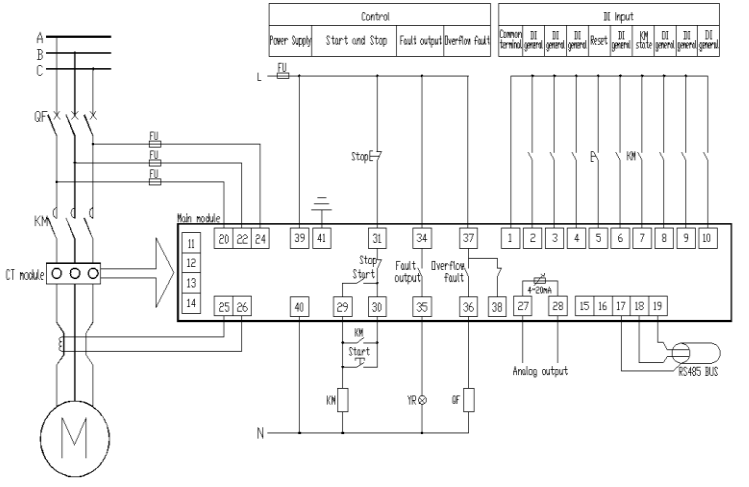
3	DI2	DI2 general		controls the output of Relay A
4	DI3	Stop	DO2	
5	DI4	Reset		
6	DI5	Local/Remote	DO3	The motor protects and controls the output of Relay B
7	DI6	Contactor state 1		
8	DI7	Contactor state 2	DO4	Motor fault signal output
9	DI8	DI8 general		
10	DI9	DI9 general	DO5	Self-diagnosis fault output

12.6 Star/delta Startup Mode and Autotransformer Startup Three-relay Mode

Terminal encoding	Signal input	Application	Relay output	Application
2	DI1	Positive startup	DO1	The motor protects and controls the output of Relay A
3	DI2	DI2 general		
4	DI3	Stop	DO2	---
5	DI4	Reset		
6	DI5	Local/Remote	DO3	The motor protects and controls the output of Relay B
7	DI6	Contactor state 1		
8	DI7	Contactor state 2	DO4	The motor protects and controls the output of Relay C
9	DI8	Contactor state 3		
10	DI9	DI9 general	DO5	Motor fault signal output

Chapter 13 Typical Operation Modes Wiring

13.1 Protection Mode Wiring



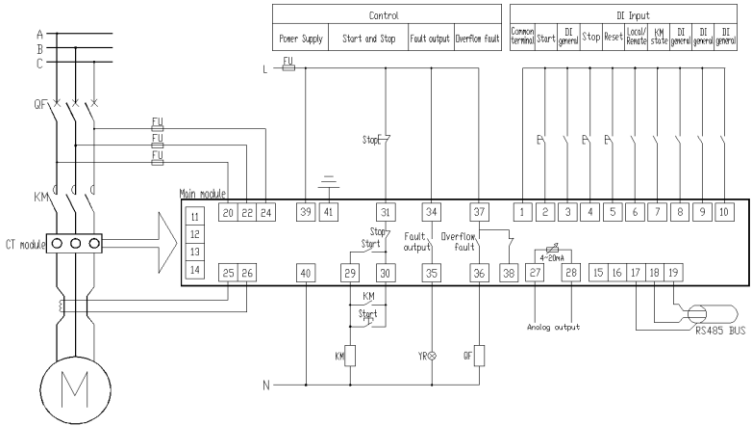
In the protection mode, tripping relay in the controller is in series connection in the coil circuit of control motor Contactor KM1. When the action of protection tripping occurs, tripping relay will disconnect, the coil of Contactor KM1 will lose power, then be released, motor stopping. After fault tripping, press the resetting key to eliminate the fault indicator, then tripping relay will close automatically and enter ready state, and allow to restart the motor.

[Note]:

1. RC circuit connected to both ends of the contactor coil in the figure is a surge suppressor for enhancing the service life of the controller contact.

2. Please do not ground the common terminal of the secondary side output of CT module supporting the protector.

13.2 Direct Startup Mode Wiring

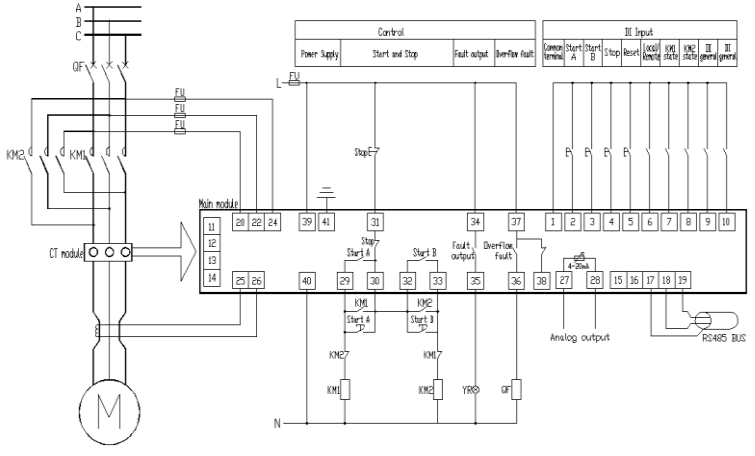


In the direct startup mode, when the controller is powered on, and the wiring check is started, it shall, first of all, detect whether Contactor KM1 is in release state. If Contactor KM1 is not in release state, report "Wiring error" and close the fault relay; if the wiring is correct, enter the ready starting state. When the controller receives the startup command, Start A relay will actuate and send the starting pulse, Contactor KM1 will be powered on, actuate and realize self-hold and the "Start" indicator of the display module will be on in the starting process; after startup, the "Start" indicator of the display module will be off, and "Operation" indicator will be on. When the controller receives the stop command or there is the action of protection tripping, the stop/tripping relay will disconnect, Contactor KM1 will lose power and release, and the motor will stop; After stop, if there is no fault, enter the ready state directly; If there is a fault, eliminate the fault before entering the ready state, then reset the motor.

[Note]:

1. RC circuit connected to both ends of the contactor coil in the figure is a surge suppressor for enhancing the service life of the controller contact.
2. Please do not ground the common terminal of the secondary side output of CT module supporting the protector.

13.3 Bidirectional Reversible Startup Mode Wiring



In the bidirectional reversible startup mode, when the controller is powered on, and the wiring check is started, it shall, first of all, detect whether Contactor KM1 and KM2 are in release state. If Contactor KM1 and KM2 are not in release state, report "Wiring error" and close the fault relay; if the wiring is correct, enter the ready starting state. When the controller receives the command from Start A, Start A relay will actuate, Contactor KM1 will be powered on, actuate and realize self-hold, and "Start" indicator of the display module will be on in the starting process, indicating that the motor is in the process of positive starting; after startup, "Operation" indicator of the display module will be on. When the controller receives the stop command or there is the action of protection tripping, the stop/tripping relay will disconnect, Contactor KM1 will release, and the motor will stop; Press "Start B" and start motor in a negative direction. The Start B relay will actuate, Contactor KM2 will be powered on, actuate and realize self-hold, and "Start" indicator of the display module will be on in the starting process; After startup, "Start" indicator will be off and "Operation"

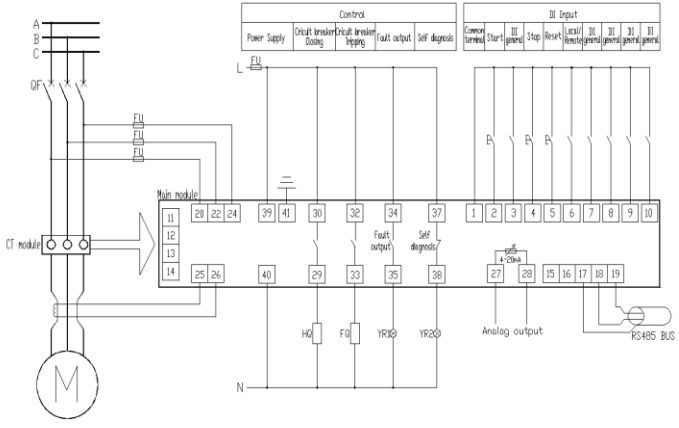
indicator will be on. When the controller receives the stop command or there is the action of protection tripping, the stop/tripping relay will disconnect, Contactor KM2 will release, and the motor will stop; after stopping, it will enter ready state. If the controller receives the startup command in the negative direction of the motor operation in the operational process of the motor, it shall, first of all, stop, and conduct the startup process after passing the two-step startup time.

[Note]:

1.RC circuit connected to both ends of the contactor coil in the figure is a surge suppressor for enhancing the service life of the controller contact.

2.Please do not ground the common terminal of the secondary side output of CT module supporting the protector.

13.4 Control Breaker Mode



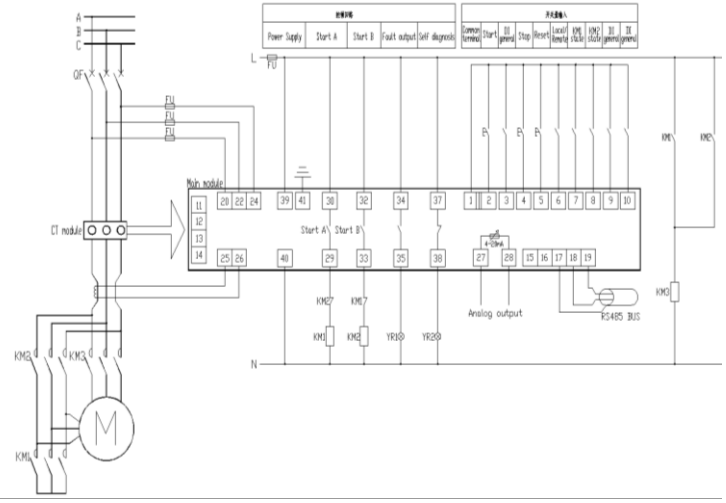
In the control breaker mode, when the controller receives the startup command, Start A relay will output impulse as the disconnecting impulse of the breaker, and "Start" indicator of the display panel will be on in the starting process; after startup, the "Start" indicator will be off, and "Operation" indicator will be on. When the controller receives the stop command or there is the action of protection tripping, the stop/tripping relay will output impulse as the disconnecting impulse of the breaker, and the motor will stop; after stopping, it will enter ready state.

[Note]:

1.The wiring check is invalid under the control breaker mode.

2.Please do not ground the common terminal of the secondary side output of CT module supporting the protector.

13.5 Star/delta Startup Two-relay Mode Wiring



In the star-delta startup mode, when the controller is powered on, and the wiring fault check is started, it shall, first of all, detect whether Contactor KM1 and KM2 are in release state. If Contactor KM1 and KM2 are not in release state, report "Wiring error" and close the fault relay; if the wiring is correct, enter the ready starting state. When the controller receives the startup command, Start A relay will actuate, Contactor KM1 and KM3 will be powered on and actuate, and "Start" indicator of the display module will be on in the starting process, indicating that the motor is in the Y staring process; After reaching the two step startup time, Relay A cuts off while Relay B actuates, and then Contactor KM1 will lose power and release, meanwhile, Contactor KM2 will power on and actuate, switching to delta operation state automatically. After startup, "Start" indicator will be off and "Operation" indicator will be on. When the controller receives the stop command or there is the action of protection tripping, Relay B will disconnect, Contactor KM2 and KM3 will release, and the motor will stop; after stopping, it will enter ready state.

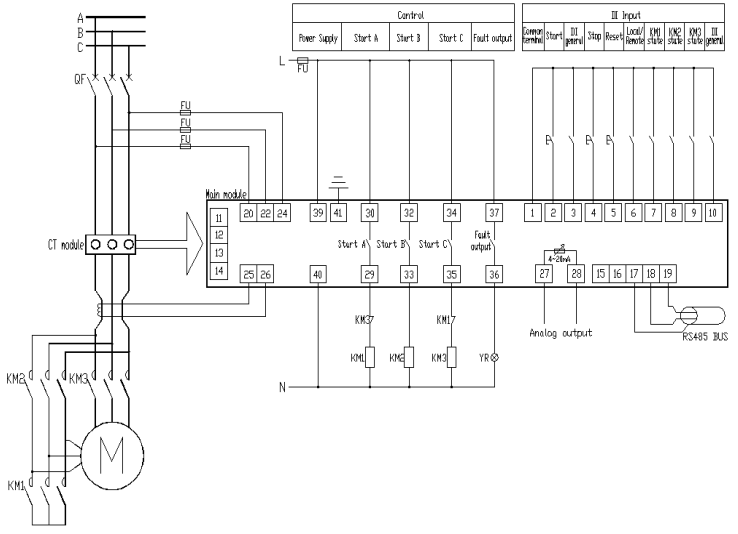
[Note]:

1. RC circuit connected to both ends of the contactor coil in the figure is a surge suppressor for

enhancing the service life of the controller contact.

2. Please do not ground the common terminal of the secondary side output of CT module supporting the protector.

13.6 Star/delta Startup Three-relay Open-loop Mode Wiring



In the star/delta startup three-relay open-loop mode, when the controller is powered on, and the wiring fault check is started, it shall, first of all, detect whether Contactor KM1, KM2 and KM3 are in release state. If Contactor KM1, KM2 and KM3 are not in release state, report "Wiring error" and close the fault relay; if the wiring is correct, enter the ready starting state. When the controller receives startup commands, the inner Relay C and B will actuate successively, while Contactor KM3 and KM2 will power on and actuate, and the "Start" indicator of the display module will be on in the starting process, which means the motor is in the Y starting process. After reaching the two step startup time, Relay C cuts off while Relay A actuates, and then Contactor KM3 will lose power and release, meanwhile, Contactor KM1 will power on and actuate, switching to delta operation state automatically. After startup, the "Start" indicator of the display module will be off, and "Operation" indicator will be on. When the controller receives the stop command or there is the action of

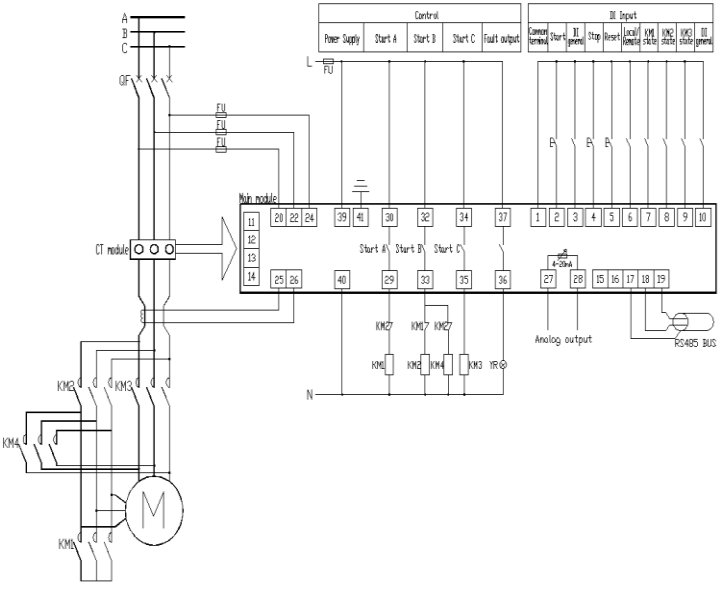
protection tripping, Relay A and B will disconnect, Contactor KM1 and KM2 will release, and the motor will stop; after stopping, it will enter ready state.

[Note]:

1. RC circuit connected to both ends of the contactor coil in the figure is a surge suppressor for enhancing the service life of the controller contact.

2. Please do not ground the common terminal of the secondary side output of CT module supporting the protector.

13.7 Star/delta Startup Three-relay Close-loop Mode Wiring



In the star/delta startup three-relay close-loop mode, when the controller is powered on, and the wiring fault check is started, it shall, first of all, detect whether Contactor KM1, KM2 and KM3 are in release state. If Contactor KM1, KM2 and KM3 are not in release state, report "Wiring error" and close the fault relay; if the wiring is correct, enter the ready starting state. When the controller receives startup commands, the inner Relay A and C will actuate successively, while Contactor KM1 and KM3 will power on and actuate, and the "Start" indicator of the display module will be on in the starting process, which means the motor is in the Y starting process. After reaching the two step startup time, Relay B actuates while Relay A cuts off, and then Contactor KM4 will power on and actuate, meanwhile, Contactor KM1 will lose power and release, switching to delta operation state automatically. After startup, the "Start" indicator of the display module will be off, and "Operation" indicator will be on. When the controller receives the stop command or there is the action of protection tripping, Relay B and C will disconnect, Contactor KM2 and KM3 will release, and the

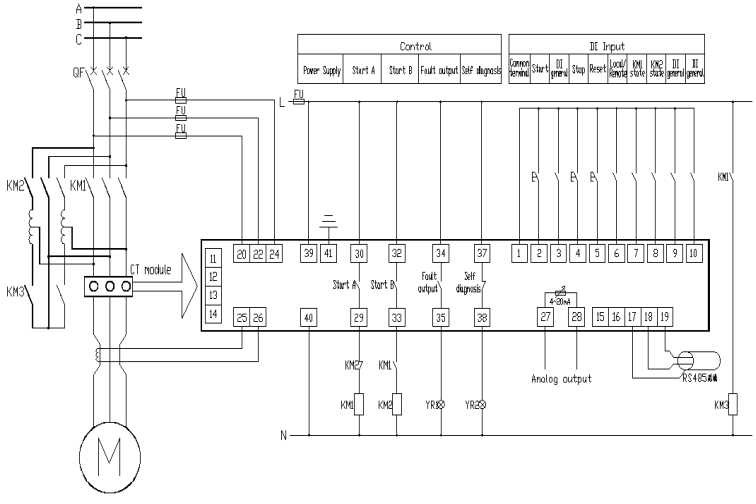
motor will stop; after stopping, it will enter ready state.

[Note]:

1. RC circuit connected to both ends of the contactor coil in the figure is a surge suppressor for enhancing the service life of the controller contact.

2. Please do not ground the common terminal of the secondary side output of CT module supporting the protector.

13.8 Autotransformer Startup Two-relay Mode Wiring



In the autotransformer startup two-relay mode, when the controller is powered on, and the wiring fault check is started, it shall, first of all, detect whether Contactor KM1and KM2 are in release state. If Contactor KM1 and KM2 are not in release state, report "Wiring error" and close the fault relay; if the wiring is correct, enter the ready starting state. When the controller receives startup commands, Relay A actuates, while Contactor KM1 and KM3 will power on and actuate, so the motor will start up in the form of self-coupling decompression. The "Start" indicator of the display module is on in the starting process, and after reaching the two-step startup time, Start A relay will release, Start B relay will actuate, while Contactor KM1 and KM3 will lose power and release, Contactor KM2 will power on and actuate, switching to the full-voltage operation state automatically. After startup, the "Start" indicator of the display module will be off and "Operation" indicator will be on. When the

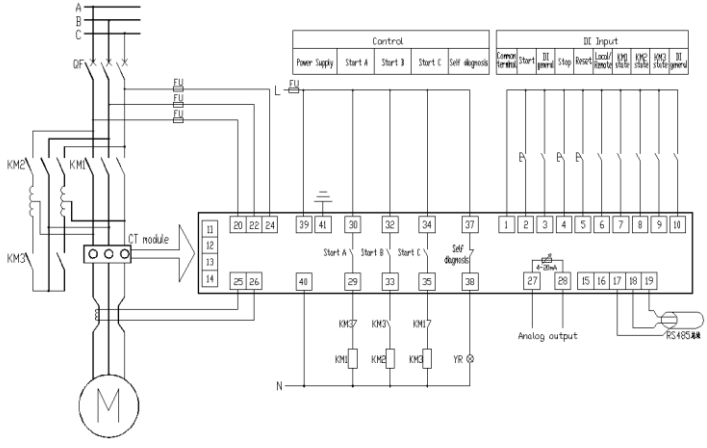
controller receives the stop command or there is the action of protection tripping, Start B relay will disconnect, Contactor KM2 will release, and the motor will stop; after stopping, it will enter ready state.

[Note]:

1. RC circuit connected to both ends of the contactor coil in the figure is a surge suppressor for enhancing the service life of the controller contact.

2. Please do not ground the common terminal of the secondary side output of CT module supporting the protector.

13.9 Autotransformer Startup Three-relay Open-loop Mode Wiring



In the autotransformer startup three-relay open-loop mode, when the controller is powered on, and the wiring fault check is started, it shall, first of all, detect whether Contactor KM1, KM2 and KM3 are in release state. If Contactor KM1, KM2 and KM3 are not in release state, report the "Wiring error" and close the fault relay; if the wiring is correct, enter the ready starting state. When the controller receives startup commands, Relay C and B actuates, while Contactor KM3 and KM2 will actuate, so the motor will start up in the form of self-coupling decompression. The "Start" indicator is on in the starting process, and after reaching the two-step startup time, the controller disconnect Relay B and C, close the Relay A, while Contactor KM2, KM3 and KM1 will disconnect, disconnect and close successively, switching to the full-voltage operation state automatically. After startup, the

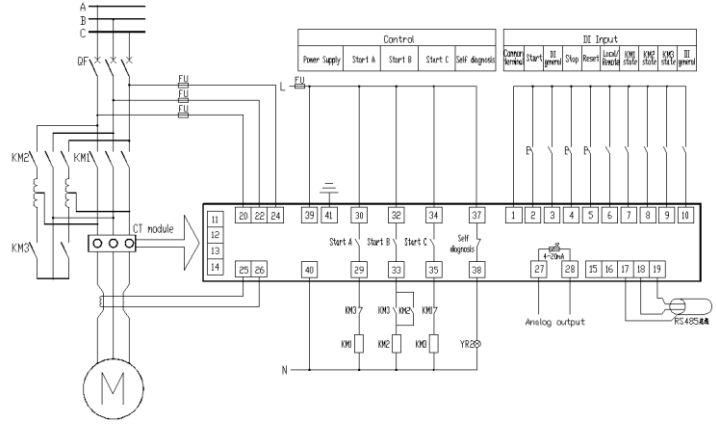
"Start" indicator of the display module will be off and "Operation" indicator will be on. When the controller receives the stop command or there is the action of protection tripping, Relay A will disconnect, Contactor KM1 will release, and the motor will stop; after stopping, it will enter ready state.

[Note]:

1. RC circuit connected to both ends of the contactor coil in the figure is a surge suppressor for enhancing the service life of the controller contact.

2. Please do not ground the common terminal of the secondary side output of CT module supporting the protector.

13.10 Autotransformer Startup Three-relay Close-loop Mode Wiring



In the autotransformer startup three-relay close-loop mode, when the controller is powered on, and the wiring fault check is started, it shall, first of all, detect whether Contactor KM1, KM2 and KM3 are in release state. If Contactor KM1, KM2 and KM3 are not in release state, report the "Wiring error" and close the fault relay; if the wiring is correct, enter the ready starting state. When the controller receives startup commands, Relay B and C actuates, while Contactor KM3 and KM2 will actuate, so the motor will start up in the form of self-coupling decompression. The "Start" indicator of the display module is on in the starting process, and after reaching the two-step startup time, disconnect the Relay C, close the Relay A, then disconnect Relay B, while contactor KM3, KM1 and

KM2 will disconnect, close, disconnect successively, switching to the full-voltage operation state. After startup, the "Start" indicator of the display module will be off and "Operation" indicator will be on. When the controller receives the stop command or there is the action of protection tripping, Relay A will disconnect, Contactor KM1 will release, and the motor will stop; after stopping, it will enter ready state.

[Note]:

1. RC circuit connected to both ends of the contactor coil in the figure is a surge suppressor for enhancing the service life of the controller contact.

2. Please do not ground the common terminal of the secondary side output of CT module supporting the protector.

Appendix A Basic Setting and FAQ

1. Basic Setting

Before normal operation, please be sure to conduct the following system parameter settings:

(1) The rated current of the motor;

(2) Besides the build-in dedicated CT module, the controller is equipped with the external CT used for measuring primary current of the motor, then input correct CT transformation ratio;

(3) Set proper breaking current of the contactor, 8 times of Ie by default.

(4) Confirm the operation mode;

(5) Confirm the operation authority;

(6) Confirm whether the equipment address and the communication baud rate are consistent with the upper computer or not;

Before normal operation, please conduct parameter settings for the protection functions prepared to be used:

Only startup time-out protection, startup over-current protection, overload protection , over-current locked-rotor protection, open-phase protection and short-circuit protection of the device are opened by default, if other protections needed to be opened, please set the scope of the operation values and delay time of each protection action according to Chapter 8.

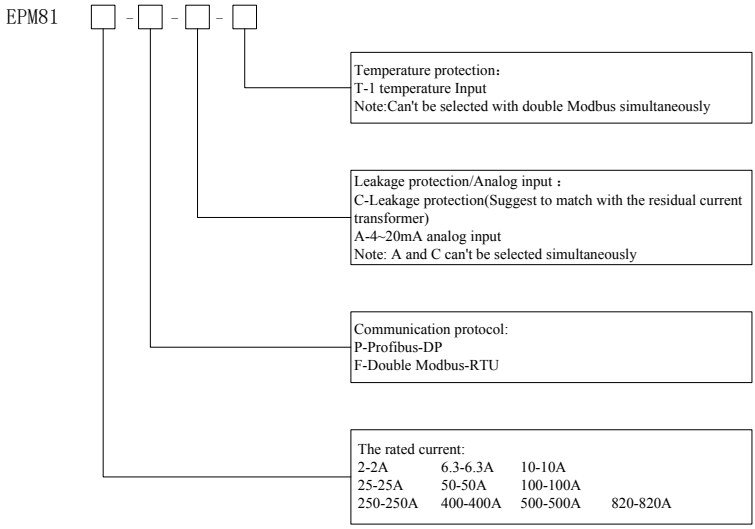
2. Frequent Problems and Solutions

Possible problems	Possible causes	Possible solutions
The equipment fails to operate normally after power on	The power supply of the equipment is not on	Check whether the L/+ and N/ terminals of the equipment are accessed to correct working voltage
The measured value is incorrect or not consistent with expectations	The voltage is measured wrong	Check whether the measured voltage matches with the rated parameters of the equipment
	The voltage is measured wrong	Check whether the measured current matches with the rated parameters of the equipment Check whether the parameter setting of CT transformation ratio is correct

	The power is measured wrong	Check whether corresponding phase sequences of voltage and current are correct Check whether there is any error at the dotted terminal of the current
The switch value state remains unchanged	Wiring error	Check whether the external wiring is correct
The inaction of the relay	No control command received	Check whether communication links are correct
The malfunction of the relay	The working mode of the relay is incorrect	Check whether the current relay is under the correct mode
Upper computer cannot communicate with the equipment	The communication address of the equipment is incorrect	Check whether the equipment address is consistent with the definition
	The communication baud rate of the equipment is incorrect	Check whether the communication baud rate of the equipment is consistent with the definition
	Communication link does not connect with terminal resistance	Check whether the 120Ω resistance can be accessed
	The communication link is disturbed	Check whether the communication shielding layer is soundly grounded
	The communication line is interrupted	Check whether the communication cable is disconnected
Upper computer cannot start/ stop the motor	The authority is incorrect	Check whether the settings of control authority are correct

Appendix B Ordering Information

1. Ordering Information of Controller Body:



[Note]:

1. The product with standard configurations includes: Main module, display module, current transformer, 1-circuit RS485 and 1-circuit analog output; anti-interference electricity and complete protection function for current/ voltage/ power measurement.
2. The leakage protection function shall be accomplished by the electric leakage transformer with standard configurations by our company.
3. The current transformer wiring with standard configurations is 1.5m long.
4. The main module wiring and display module wiring with standard configuration are all 1m long. In case of installation by fixed switchgear, please notify specially and adopt the wiring

with 3.5m long.

5. Basic protection includes: Startup time-out protection, startup over-current protection, overload protection, over-current locked-rotor protection, tE time protection, current locked-rotor protection, open-phase protection, current imbalance protection, short-circuit protection, ground protection, under-load protection, over-voltage protection, under-voltage protection, under-power protection, external fault input protection, phase sequence protection, TV disconnection protection and overflow fault.

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