

Motor Protection Controller

User Manual

Applied to: WDH-31-530

JIANGSU SFERE ELECTRIC CO., LTD.

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Precautions

This instruction is intended for use by professionals who are trained and familiar with standards in electrical installation and control and automation engineering.

The responsible person must ensure that the application or use of the product meets all safety requirements.

Abbreviation

DCS	Distributed Control System
PLC	Programmable Logic Controller
GSD	General Station Description (PROFIBUS)
NO/NC	Normal close / Normal open
DI	Digital input
DO	Digital output
AI	Analog input
AO	Analog output
MC	Main Control module
SCT	Current transformer module
OP	Operation panel

Related document

WDH-31-530	Modbus-RTU	protocol	manual
WDH-31-530	Modbus-TCP	protocol	manual
WDH-31-530	Profibus-DP	protocol	manual
WDH-31-530	Profinet	protocol	manual

1. Introduction

1.1 Product Overview

WDH-31-530 series motor protection controller (hereinafter referred to as controller or WDH) is applicable to the application place of three-phase low-voltage AC motor with rated frequency of 50 / 60Hz, rated voltage of 690V AC and rated current of 800A. The product has the functions of monitoring, control, protection and communication to provide perfect protection and control for the motor.

The main body of the controller is composed of three modules: current transformer and protection module; The main body of the controller and the transformer are installed and used as a whole.

Application

- Low voltage three phase AC motor
- Motor independent control box or MCC cabinet
- Reversing and Reduced voltage applications
- Industrial automation, such as belt-transportation, mixing system etc.
- Fire pumps and fans

Advantages

- A variety of protection functions are built in, and the on / off, alarm or trip functions of the protection function are programmable
- Rich starting control, single-step starting (direct / two-way, etc.); Two step starting (star delta / soft start coordination, etc.)
- Under voltage hoisting, power on and self starting function ensure the uninterrupted operation of the motor
- With residual current transformer, additional residual current transformer and external wiring can be avoided
- 1-way PTC / NTC thermistor input for motor temperature monitoring and protection
- 5-way programmable switching value input and 4-way programmable relay output
- 2 Channel Programmable 4 ~ 20mA analog output
- Rich SOE event records, tripping, alarm, start stop, input displacement, etc
- Standard RS485 communication interface, optional Modbus RTU or PROFIBUS DP protocol
- Optional Ethernet communication interface with switch function, Modbus TCP protocol

- Optional black-and-white or color Chinese LCD module to visually display and indicate various parameters, information and status
- Equipped with upper computer management software to realize parameter configuration, debugging and monitoring
- Modular structure design, flexible combination of main body, transformer, display module and optional function
- The installation method is flexible and the overall size is reasonable. It can be installed in 1 / 4 drawer cabinet

1.2 Application scenario

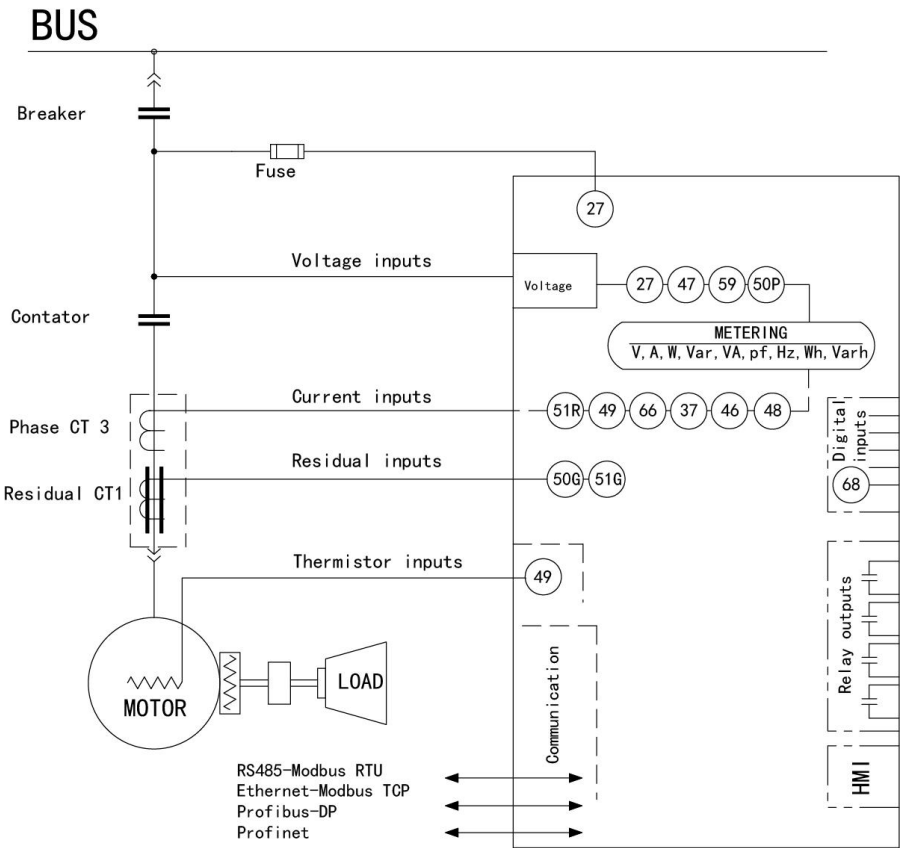


Figure 1 WDH-31-530 Function block diagram

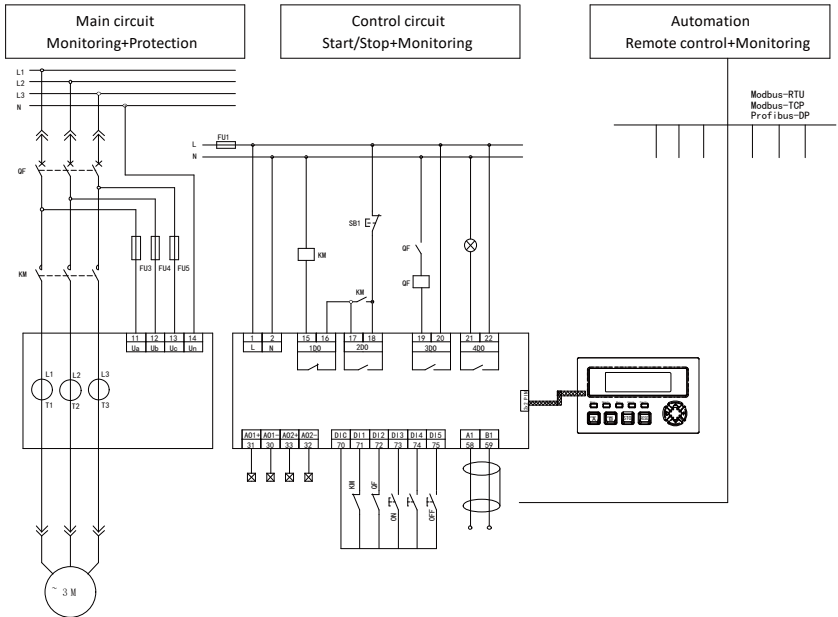


Figure 2 WDH-31-530 Typical application

1.3 Overview of functions

1.3.1 Monitoring functions

The controller completes the measurement of important electrical parameters (voltage, current, power, power factor, electric energy, etc.) of the motor circuit through the main module.

- direct input line voltage up to 690V
- direct input current up to 100A (hole type)
- Fundamental/full wave measuring mode

Measuring parameter		Range	Accuracy/Defenition
Voltage	Voltage RMS (U)	5% ~ 120%Ue	1.0% / 0.1V
	Imbalance (imb U)	0% ~ 100%	--- / 0.1%
	Frequency (F)	45 ~ 65Hz	0.5% / 0.01Hz
Current	Current RMS (I)	2% ~ 1000%Ie	1.0% / 0.1A
	Ground current (Ig)	2% ~ 1000%Ie	1.0% / 0.1A
	Residual current (Ir)	2%~ 400%I△n	1.0% / 1mA
	Sequence current (I1/I2)	2% ~ 120%Ie 0% ~ 100%	1.0% / 0.1% --- / 0.1%
	Imbalance (unb I)	0% ~ 100%	--- / 1%
	Thermal capacity (Cc)		
Power	Active Power (P)	0% ~ 120%Pe	1.0% / 0.01kW
	Reactive Power (Q)	0% ~ 120%Pe	1.0% / 0.01kvar
	Power Factor (PF)	0 ~ ±1	1.0% / 0.001
	Active energy (EP)	---	2.0% / 0.01kWh
	Reactive energy (EQ)	---	---/ 0.01kvarh
Motor temperature	Thermistors (PTC / NTC)	0 ~ 10kΩ	3.0% / 0.01 kΩ

Table 1.WDH-31-530 Measuring parameter

1.3.2 Protection functions

- WDH-31-530 support multiple ANSI standard protection functions
- Each protection could be selected as drop in or drop out respectively
- Each protection could be configure as alarm/ trip stage respectively
- The protection object could be setting as the circuit breaker for the large current protection

	Protection	ANSI code
Current	Thermal Overload	49
	Under Load (current or power)	37
	Stall	51LR/50S
	Jam	51R
	Current imbalance	46
	Phase loss	46
	Short Circuit	50/51
	Ground Fault	50N/51N
	Residual Current	50G/51G
	Start overtime time tE	48
Voltage	Under voltage	27/27P
	Over voltage	59
	Phase sequence	47
	Voltage imbalance	46
	PT breaking	50P
Non-electric	Thermistor	49
	External fault	68

Table 2.WDH-31-530 Protection overview & ANSI code

1.3.3 Control functions

WDH-31-530 by the main control module to achieve the control of the motor stop/start.

- Main module contains 5 DI, 4 relay output and 2 analog output
- By simple programming to achieve the logical control as following:

<p>Motor start type</p> <p>Uncontrolled : ·Overload relay</p> <p>Single step starting:</p> <p style="padding-left: 40px;">·Direct start</p> <p style="padding-left: 40px;">·Reversing</p> <p style="padding-left: 40px;">·Two speed</p> <p style="padding-left: 40px;">·Electro valve</p> <p>Double-step starting:</p> <p style="padding-left: 40px;">·Star/Delta start</p> <p style="padding-left: 40px;">·S-AutoTF start</p> <p style="padding-left: 40px;">·Soft startor</p> <p style="padding-left: 40px;">·Transducer</p>
<p>Control authority</p> <p>·Panel Position</p> <p>·Local terminal Position</p> <p>·Remote terminal Position</p> <p>·Communication control Position</p>
<p>Uninterrupted operation</p> <p>·Under voltage restart</p> <p>·On-power self-start</p>

Table 3.WDH-31-530 control functions overview

1.3.4 Communication functions

RS485	
Protocol	Modbus-RTU
Interface	3-pin terminal
Slave address	1~247
Baud rate	4800bps~9600bps
Data format	N.8.1、0.8.1、E.8.1、N.8.2
Networking capacity	< 32
Profibus-DP	
Protocol	DP(V0)
Interface	3-pin terminal / DSUB-9
Slave address	1~127
Baud rate	9.6kb/s--3Mb/s
Networking capacity	< 32
Ethernet	
Protocol	Modbus-TCP
Interface	2*RJ45 (10M)
Standard	IEEE 802.3
Working mode	Server
Maximum connection	4 Socket
MAC	IEEE certification
Profinet	
Protocol	Profinet
Interface	2*RJ45 (10M/100M)
Cycle	1ms ~ 4ms

Table 4.WDH-31-530 communication functions overview

1.3.5 I/O interface

DI

- Main control module contains 5 DI
- DI dry contact (internal DC24V)
- Each DI function could be customized

DI: Setting descriptions	
Function	Descriptions
Contactor state	Contactor auxiliary contact feedback signal for monitoring
Local Start	Local terminal start signal input
Local Stop	Local terminal stop signal input
Local STA/STP	Local terminal start, stop signal input
Remote Start	Remote terminal start signal input (connected to DCS output signal)
Remote Stop	Remote terminal stop signal input (connected to DCS output signal)
Remote STA/STP	Remote terminal start, stop signal input (connected to DCS output signal)
Emergency Stop	Emergency stop signal input (no control permission limit)
Interlock Stop	Interlocking stop signal input (no control permission limit)
External Fault	External fault signal input, can be connected to non-electrical sensors, relays, etc.
L/R Switch	Local, remote control permission switching signal input, generally connected to the switch

Table 5.WDH-31-530 DI common functions

Relay output

- Main control module contains 4 relay output(1NC/3NO)
- Functions of each relay output could be customized

Relay output: Function customized	
Function	Descriptions
start A	Start control relay A output for single step start
start B	Start control relay B output for double step start
protection trip	Trip relay or stop relay output
Short circuit fault	Large current overflow fault relay output, connected to circuit breaker OFF coil
Self-diagnostic output	Device equipment fault diagnosis relay output
Device ready output	Device ready relay output (no fault + no stop signal + circuit breaker in position)
Running signal output	Motor running status signal output
Total alarm signal	Motor alarm status signal output
Total trip signal	Motor fault status signal output

Table 6. WDH-31-530 Relay common functions

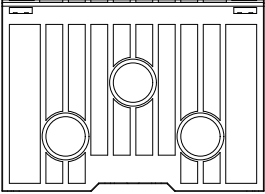
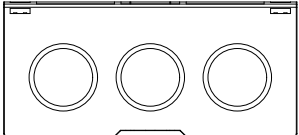
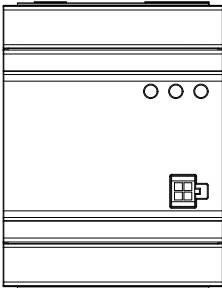
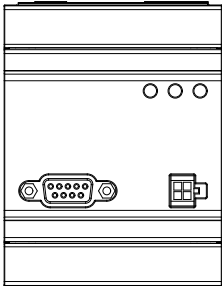
1.3.6 Management functions

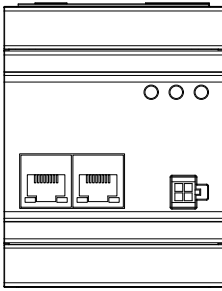
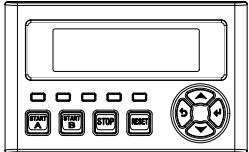
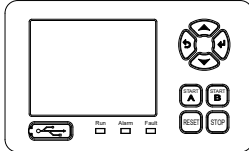
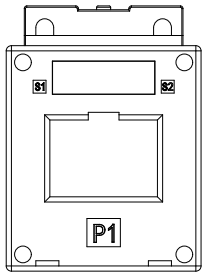
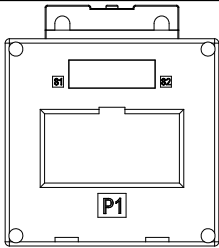
The data management of the motor protector is accomplished by the main control module and could be record the relative data by the display module or the communication interface.

Motor running data management
<ul style="list-style-type: none">·Current maximum current during a starting process·Maximum current during historical starting process·The maximum current of the current running process·Maximum current during historical operation·current running time·Accumulated running time·Current stop time·Total stop time·Start and stop operations·Contactor ON/OFF times·The total number of alarms & trips·The latest modification of parameter information
SOE record
<ul style="list-style-type: none">·12 times Trip Record·12 times Alarm Record·12 times Start Record·12 times Stop Record·12 times DI Switch Record·12 times Reset Record

Table 7.WDH-31-530 Management functions overview

1.4 Overview of system components

Components	Image	Descriptions
Special protective type current transformer		
Hole type(25A) 5A (0.2A~5A) 25A (2.5A~25A)		<ul style="list-style-type: none"> -Three phase current measurement access -It must be installed integrally with the main body (splicing type) -100A current perforated access
Hole type(100A) 100A (10A~100A)		<ul style="list-style-type: none"> -If the circuit current exceeds 100A, an external primary transformer is required
Main control module		
Main control module (RS485)		<ul style="list-style-type: none"> ·Din rail mount ·5 Digital input ·4 Relay output (1NC, 3NO) ·1 Analog output ·10 motor start type ·16 motor protections ·64 SOE records
Main control module (Profibus)		<ul style="list-style-type: none"> ·Multiple comm interfaces available

Main body(Ethernet)		
Display module (Optional)		
Display module (Black and White) OP1		<ul style="list-style-type: none"> ·Embed installation ·Localized display and control ·Parameter configuration
Display module (Colorful) OP2		
External CT		
SHI-ZT40 (core size: 40mm)		<ul style="list-style-type: none"> ·External CT is inevitable for the current of the main loop is over 100A · SHI-ZT40 (300A:5A) · SHI-ZT40 (500A:5A) · SHI-ZT40 (800A:5A)
SHI-ZT60 (core size: 60mm)		<ul style="list-style-type: none"> ·External CT is inevitable for the current of the main loop is over 100A · SHI-ZT60 (300A:5A) · SHI-ZT60 (500A:5A) · SHI-ZT60 (800A:5A)

Appendix		
<p>Appendix 1 Anti-swinging module</p>		<p>·It is used to prevent the controller body from shaking power for a short time</p>
<p>Appendix 2 4-core (2 * 2) cable connected</p>		<p>For connecting the master control module (MC) to the display module (OP) Default length is 50mm, and is customizable</p>

1.5 Order codes

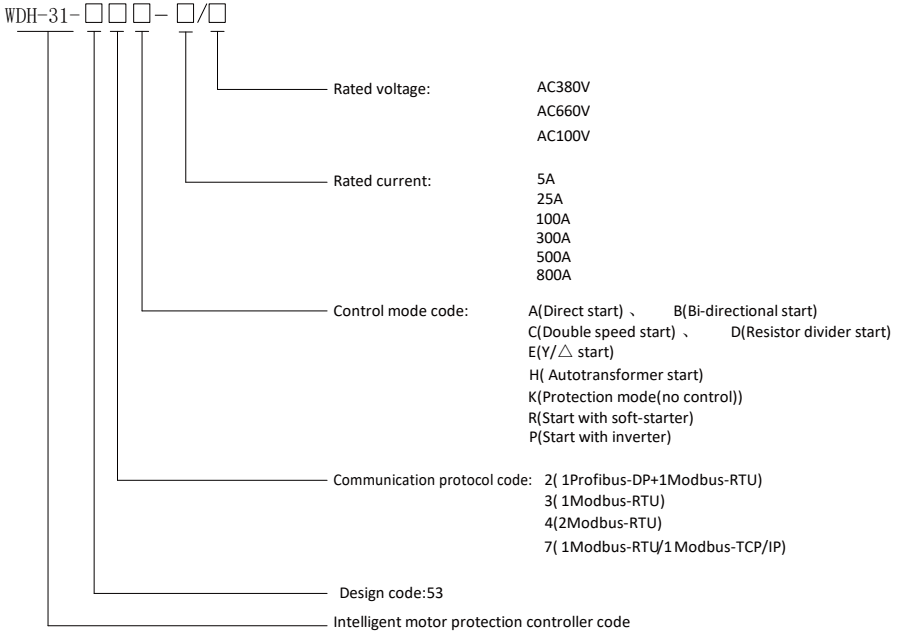


Figure 1.WDH-31-530 Order codes

Type selection by rated current			
Code	Range	Motor Power(380VSystem)	Hole size
5A	0.2A~5A	0.13~2kW	Φ10.5mm
25A	5A~25A	2~11kW	Φ10.5mm
100A	25A~100A	11~55kW	Φ18mm
250A	100A~250A	45~115kW(External CT 300A:5A)	Φ10.5mm
500A	200A~500A	90~280kW(External CT 500A:5A)	Φ10.5mm
800A	500A~800A	280~400kW(External CT 800A:5A)	Φ10.5mm

External CT: SHI-ZT40/ZT60

When the rated current of the motor is over 100A, the current of the measuring module should be at 5A, the external CT is inevitable. The transform ratio should be 500A:5A, 800A:5A etc. The protection accuracy of the CT is 5P10, the measurement accuracy is 0.5 class, 3pcs as 1 set.

SHI-ZT40 (300A:5A)	Cable diameter Φ40mm
--------------------	----------------------

SHI-ZT40 (500A:5A)	Cable diameter Φ 40mm
SHI-ZT40 (800A:5A)	Cable diameter Φ 40mm
SHI-ZT60 (800A:5A)	Cable diameter Φ 60mm
SHI-ZT60 (500A:5A)	Cable diameter Φ 60mm

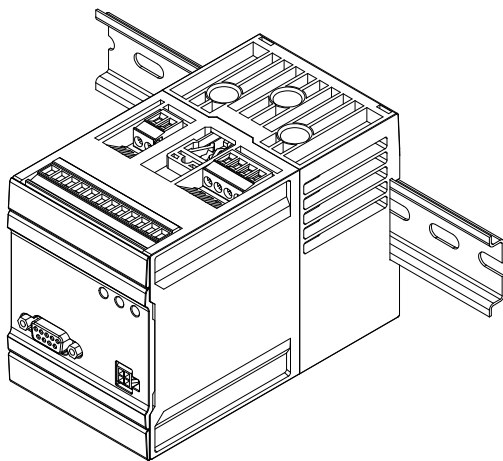
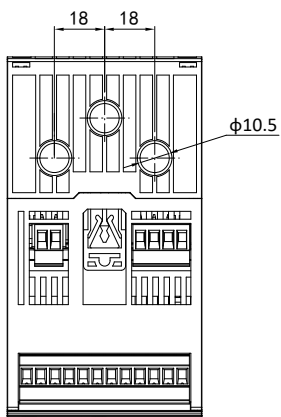
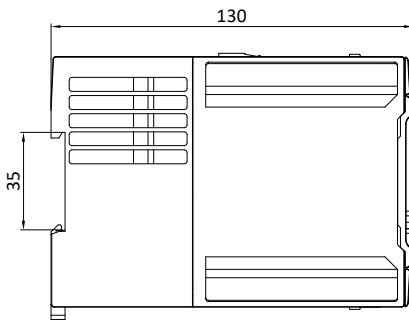
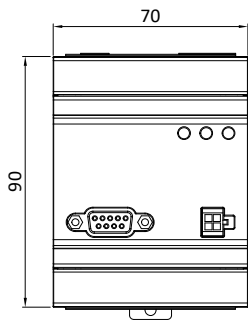
Additional option accessories		
Functions	Type	Descriptions
Display operation panel (black and white screen)	WDH-31-53X	LCD operation panel, query measurement, operation, management
Display the operation panel (color screen)	WDH-31-53XC	information, setting parameters and control motor start and stop operation
External anti-sway power module	WDH-P	When the main circuit loses power, the working power supply of the protector can be maintained for 3 to 5s

Mode Selection Example		
	WDH-31-533-25A/380V/ + WDH-31-53X	WDH-31-537-100A/660V + WDH-31-53XC
Protocol	2*Modbus	1*Modbus + 1*Modbus-TCP/IP
rated current	25A (5A~25A)	100A (25A~100A)
rated voltage	AC380V	AC660V
Additional attachment	Display module (LCD)	Display module (colorful screen)

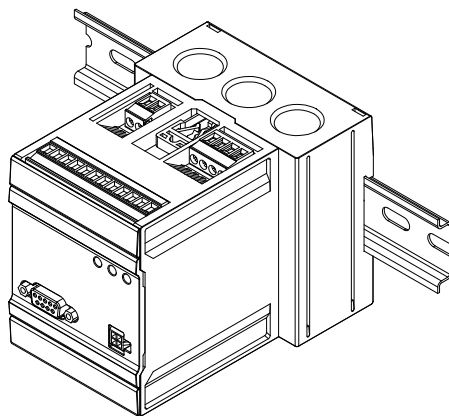
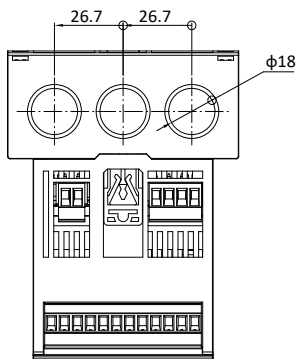
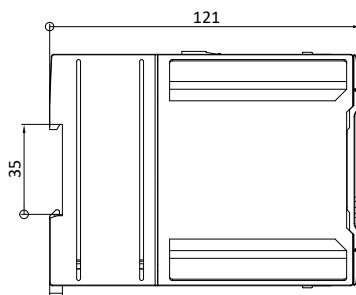
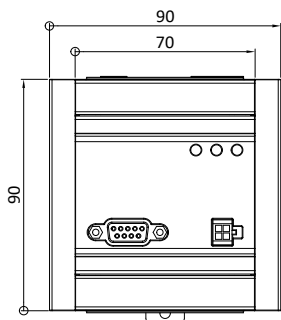
2. Installation

2.1 Size

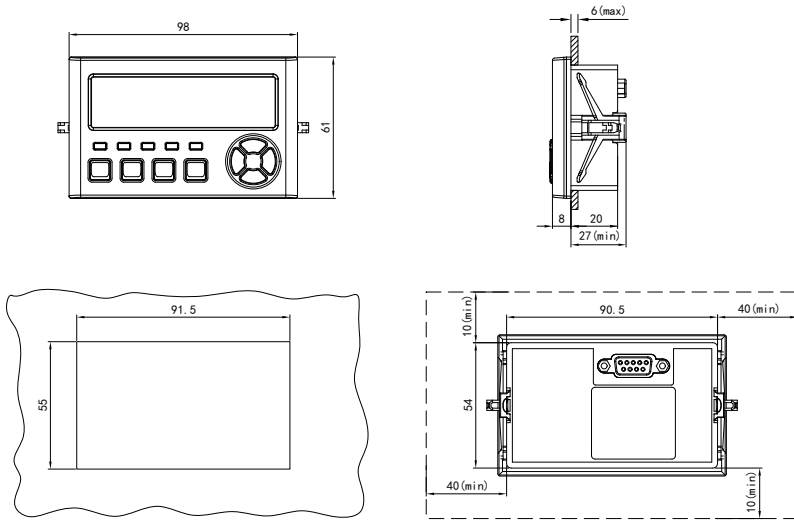
2.1.1 Controller main body installation (5A/25A hole type)



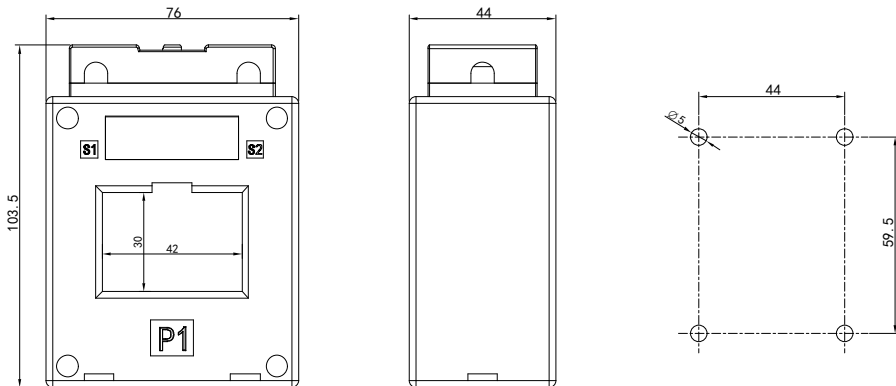
2.1.2 Controller main body installation (100A hole type)



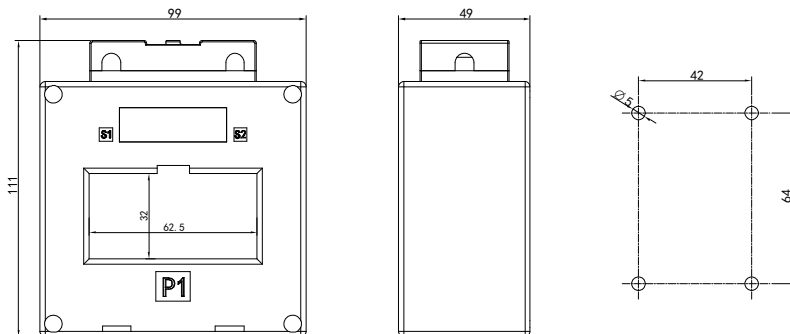
2.1.3 Display panel Module installation



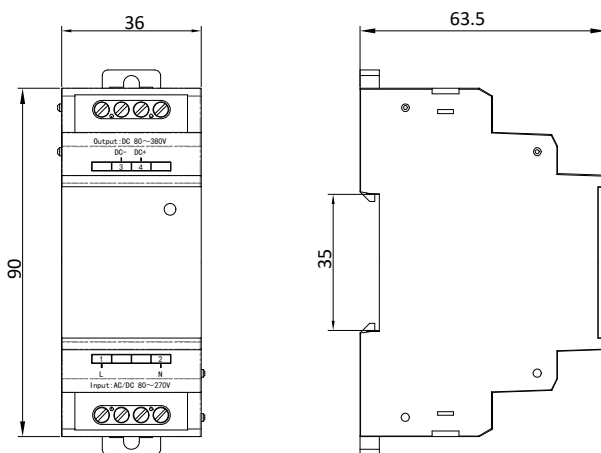
2.1.4 External current transformer SHI-ZT40 (Hole size 40 x 30)



SHI-ZT60 (Hole size 60 x 40)

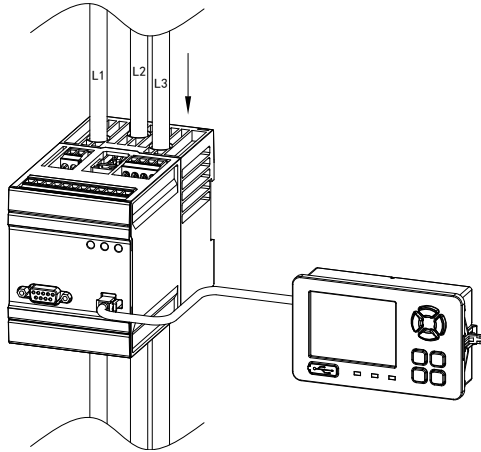


2.1.5 Anti-swinging module

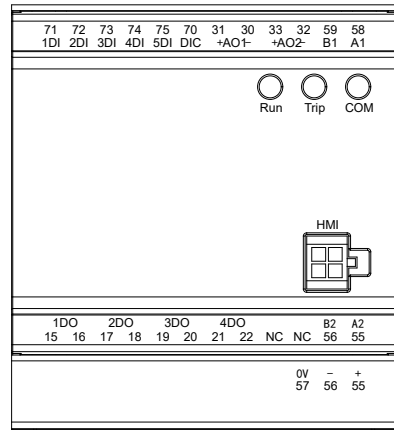
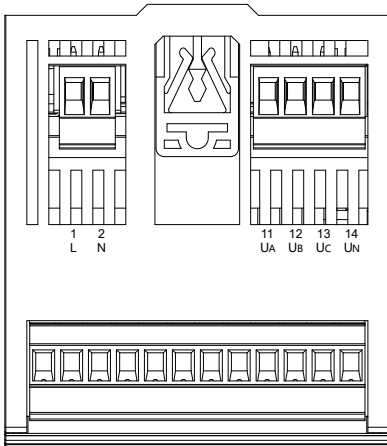


2.2 Terminal Wiring

2.2.1 Diagram of connection between main body and display panel



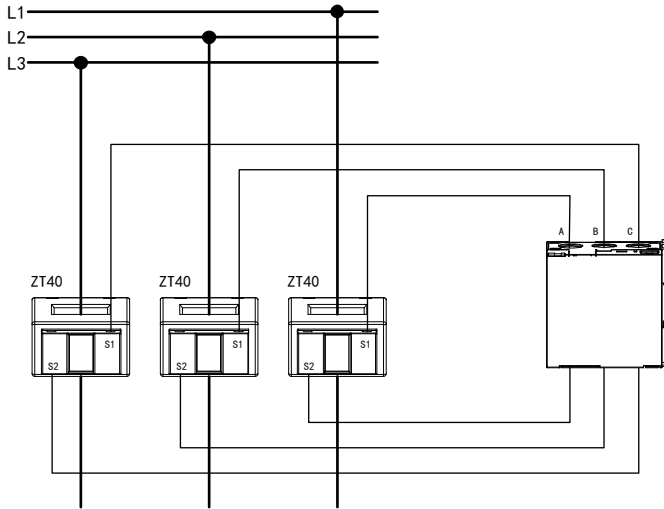
2.2.2 Main terminal definition



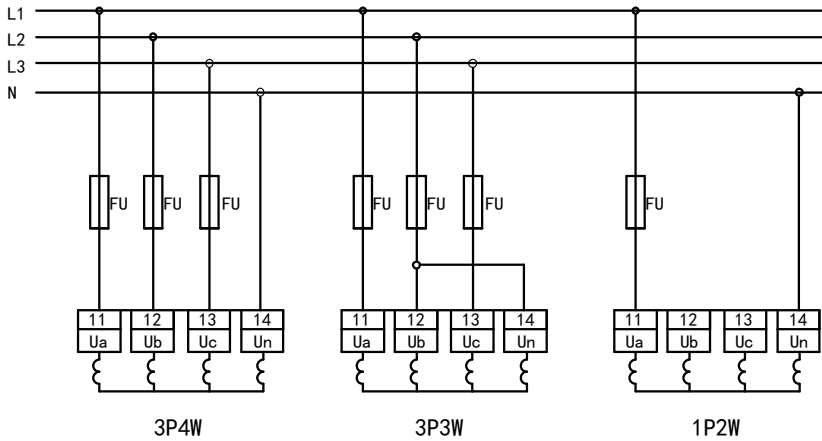
Function	Terminal	Sign	Description
Power supply input	1	L	Power supply input (L / +)
	2	N	Power supply input (N / -)
Voltage measurement input	11	UA	Phase A voltage input
	12	UB	Phase B voltage input

	13	UC	C phase voltage input	
	14	UN	Zero line voltage input	
Digital input	70	DIC	The main control module enters the common end	
	71	1DI	# 1 Switch quantity input	
	72	2DI	# 2 Switch quantity input	
	73	3DI	# 3 Switch quantity input	
	74	4DI	# 4 Switch quantity input	
	75	5DI	# 5 Switch quantity input	
Digital output	15	1DO	# 1 Relay output	
	16		# 2 Relay output	
	17	2DO	# 3 Relay output	
	18		# 4 Relay output	
	19	3DO	Simulation quantity output (-)	
	20		Simulation quantity output (+)	
	21	4DO	Thermal resistance input	
22	#1- RS485-Modbus A			
Analog output	30	AO1-	#1- RS485-Modbus B	
	31	AO1+	#2- RS485-Modbus A / DP(+)	
PT100 input	65	PTC/NTC	#2- RS485-Modbus B / DP(-)	
	66		#2- RS485-Modbus S / DP(0V)	
Communication output	58	A1	#1- RS485-Modbus A	
	59	B1	#1- RS485-Modbus B	
	55	A2 / (+)	#2- RS485-Modbus A / DP(+)	
	56	B2 / (-)	#2- RS485-Modbus B / DP(-)	
	57	S2 / (0V)	#2- RS485-Modbus S / DP(0V)	
			DB9	C phase voltage input
		RJ45	Zero line voltage input	

2.2.3 External residual current transformer wiring



2.3.4 Voltage input wiring



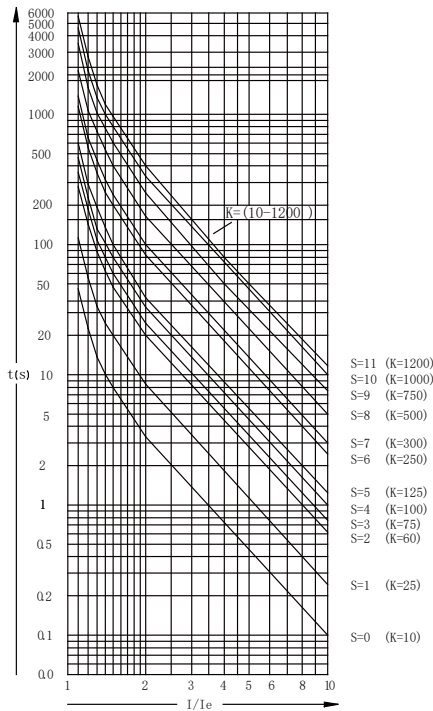
3. Motor protection

3.1 Thermal Overload

The thermal overload protection is monitoring the motor heating status by stimulating the motor heat capacity under star/running circumstance so as to eliminate the motor repetitive start under over heat for ensuring the motor running in normal circumstance.

Thermal overload protection provides 12 inverse-time protection curve (trip class), comforts to IEC 60947-4-1.

Overload curve No	IEC Trip Class	Rectification Times	1.2	1.5	7.2
125	10A	Trip time	≤60min	≤2min	2s<T≤10s
250, 300	10			≤4min	4s<T≤10s
500	20			≤8min	6s<T≤20s
750	30			≤12min	9s<T≤30s



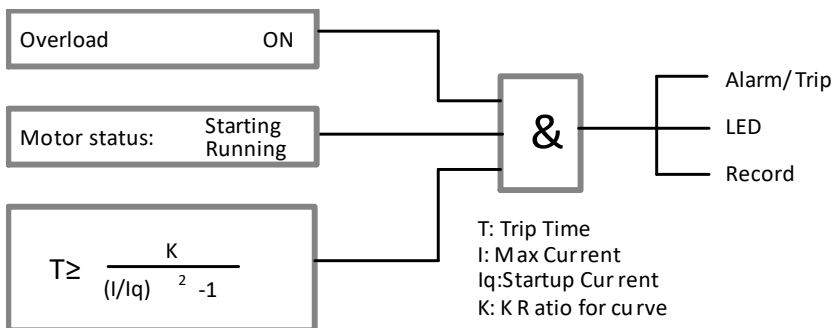


Figure 2.Overload protection logic

Parameters	Range	Defaults
Protection Enable	OFF / Alarm/ Trip / Alarm&Trip	Alarm&Trip
Startup current	90%Ie ~ 200%Ie	100%Ie
Overload curve	10 ~ 1200	125
Alarm level	20% ~ 100%	90%
Cooling time	0 min ~ 120 min	5min
Reset Cc Level	0% ~ 50%	15%
Trip reset mode	Manual / Auto	Manu

Table 8.Overload protection related parameters

Startup current: For the production continuance, the overload running of the motor in a certain range is accepted, therefore enhance the protection startup current to reduce the trip current ratio.

Cooling time: Cooling time should be defined as the require time from the motor overload trip to a stable environmental temperature (maximum tolerance temperature), normally refer to the period which the heat capacity decet from 100% to 15%. The user could set it as 30 minutes for complete chilling. The thermal overload fault could not be reset unless the cooling time is up.

Trip reset mode: After thermal overload tripping, the heat capacity decet to the resettable level or below, as for the cooling time is up, the reset type chose "Auto" than the fault status will be reset, on the contrary, the reset type chose "Manual" than the fault status could not be clear automatically, it has to reset by manual.

3.2 Stall

Stall protection is the time-limited current protection during start-up, and automatically exits after the start.

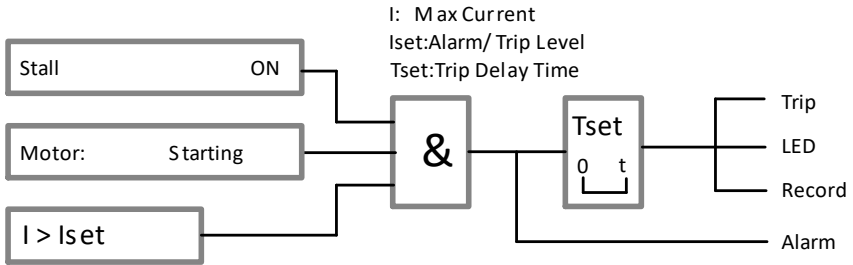


Figure 3. Jam protection logic

Parameter	Range	Default
Protection enable	OFF / Alarm / Trip / Alarm&Trip	OFF
Alarm level	100%Ie ~ 1000%Ie	300%Ie
Trip level	100%Ie ~ 1000%Ie	400%Ie
Trip-delay starting	0.1s ~ 600.0s	3.0s

Table 9. Stall protection related parameters

3.3 Current imbalance

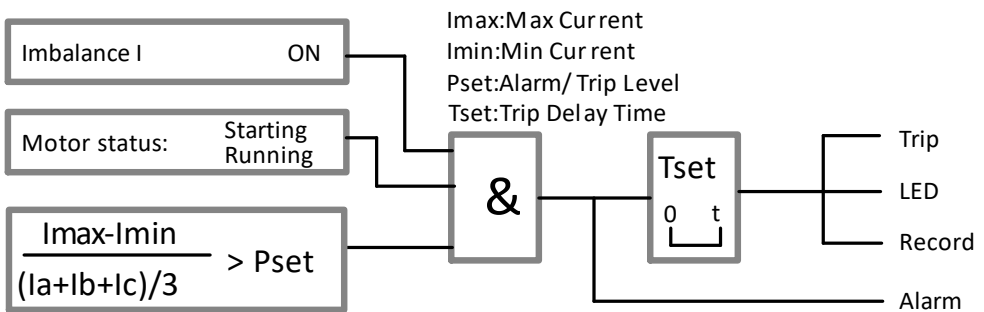


Figure 4. current imbalance protection logic

Parameter	Range	Default
Protection enable	OFF / Alarm / Trip / Alarm&Trip	Alarm&Trip
Alarm level	1.0% ~ 100.0%	15.0%
Trip level	1.0% ~ 100.0%	25.0%
Trip Delay-starting	0.1s ~ 600.0s	5.0s
Trip Delay-running	0.1s ~ 600.0s	3.0s

Table 10.Current unbalance protection related parameters

3.4 Phase Loss

Phase loss is an extreme expressive of the current imbalance. It cause serious heating of the rotor to burn and damage the motor. It accounts 30% of the motor damage by phase loss.

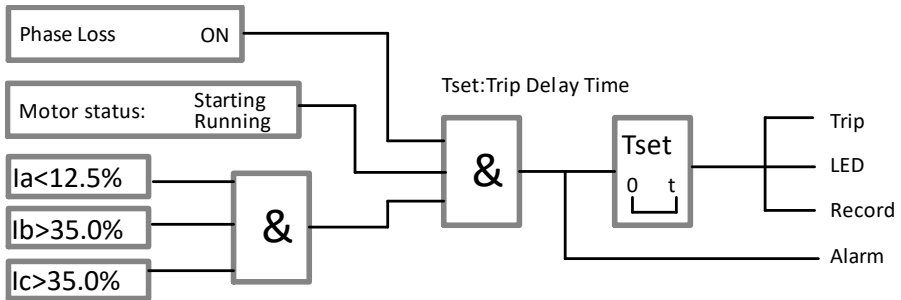


Figure 5.Current phase loss protection logic

Parameter	Range	Default
Protection enable	OFF/ Alarm / Trip	Trip
Trip delay-starting	0.1s ~ 600.0s	3.0s
Trip delay-running	0.1s ~ 600.0s	0.5s

Table 11.Phase loss protection related parameters

3.5 Under Load

Under load protection is particular for the abnormal sudden change cause by the under load of the motor such as the belt broken or water pump idling. Generally user could alarm such situation by configuration to remind the operator.

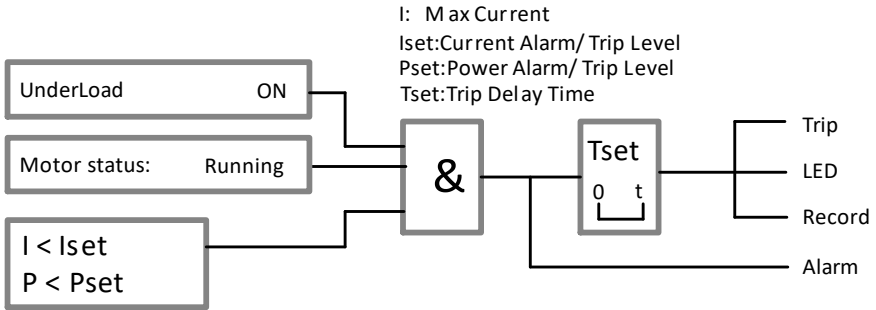


Figure 6.Under load protection logic

Parameter	Range	Default
Protection enable	OFF/ Alarm / Trip/ Alarm&Trip	OFF
Under load type	Current / Power	Current
Alarm level	5% ~ 100%Ie(Pe)	40%Ie
Trip level	5% ~ 100%Ie(Pe)	20%Ie
Trip delay time	0.1s ~ 600.0s	10.0s

Table 12.Underload protection related parameters

3.6 Jam Protection

Jam protection is a time over current protection during the running process of the motor by preventing serious jam or heat burn which cause by the motor over loading.

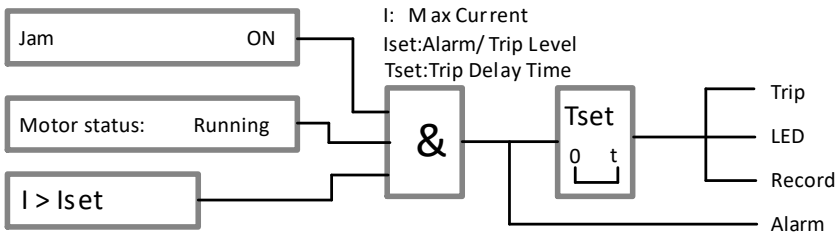


Figure 7.Jam protection logic

Parameter	Range	Default
Protection enable	OFF/ Alarm / trip / Alarm&Trip	Alarm&Trip
Alarm level	80%Ie ~ 1000%Ie	130%Ie
Trip level	80%Ie ~ 1000%Ie	150%Ie
Trip delay time	0.1s ~ 600.0s	2.0s

Table 13.Jam protection related parameters

3.7 Short-Circuit

Short-circuit protection preventing oversized fault current damage the motor. If the trip object refers to the circuit breaker, the controller will break the circuit breaker (instantly) when short-circuit was happened and break the contactor after 500ms.

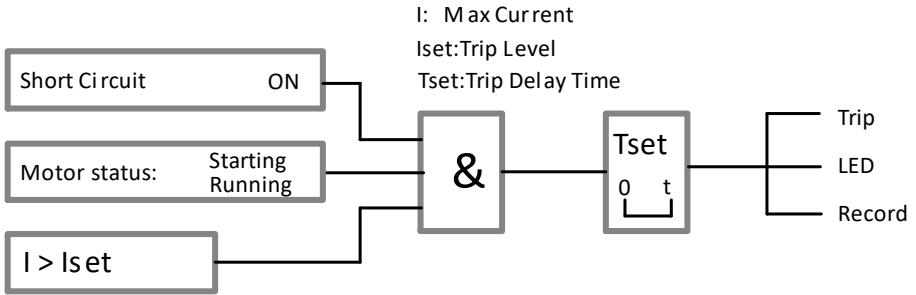


Figure 8.Short-circuit protection logic

Parameter	Range	Default
Protection enable	OFF / Alarm / Trip	OFF
Trip level-starting	100%I _e ~ 1000%I _e	700%I _e
Trip level -running	100%I _e ~ 1000%I _e	500%I _e
Trip delay-starting	0.0s ~ 600.0s	2.0s
Trip delay-running	0.0s ~ 600.0s	0.0s
Tripping object	Contactors / breaker	Circuit breaker

Table 14.Short circuit protection related parameters

3.8 Ground Fault

Ground fault protection is particular for the phase/line to the metal housing of the motor short-circuit fault. By using the ground current value (3-phase current vector) as time protection quantitative basis.

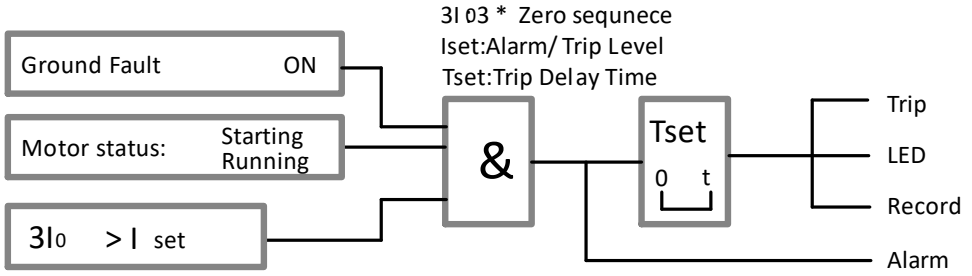


Figure 9. Single-phase ground fault protection logic

Parameter	Range	Default
Protection enable	OFF / Alarm / Trip / Alarm&Trip	OFF
Alarm Level	20%Ie ~ 1000%Ie	40%Ie
Trip Level	20%Ie ~ 1000%Ie	60%Ie
Trip delay-starting	0.0s ~ 600.0s	3.0s
Trip delay-running	0.0s ~ 600.0s	0.5s
Tripping object	Contactora / Breaker	Breaker

Table 15. Ground protection related parameters

3.9 Residual Current

When the application site requires more accurate ground fault detection, the residual current transformer is used to measure the ground current.

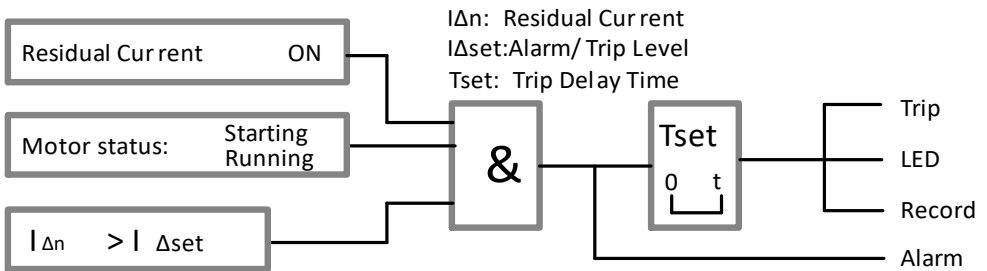


Figure 10. Residual Current protection logic

Parameter	Range	Default
Protection enable	OFF / Alarm / Trip / Alarm&Trip	OFF

Alarm level	20%I _{Δn} ~ 1000%Δn	30%Δn
Trip level	20%Δn ~ 1000%Δn	50%Δn
Trip delay-starting	0.0s ~ 600.0s	3.0s
Trip delay-running	0.0s ~ 600.0s	0.5s
Trip object	Contactora / Breaker	Breaker

Table 16.Residual Current protection related parameters

3.10 Start Overtime

Start over time protection will be implemented when proceeding start and exit from motor running automatically. The start overtime protection will be proceed when it detected the current is less than 10%I_e or more than the setting delay-running time after the start motion.

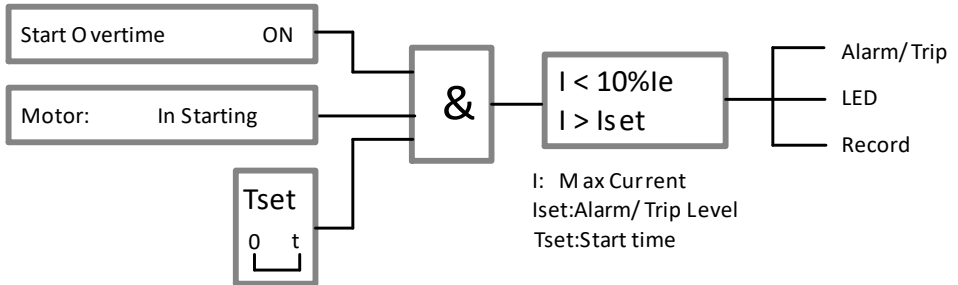


Figure 11.Start overtime protection logic

Parameter	Range	Default
Protection enable	OFF / Alarm/ Trip	Trip
Start time	1.0s ~ 600.0s	10.0s
Start overtime level	30%I _e ~ 300%I _e	110%I _e

Table 17.Start overtime protection related parameters

3.11 Phase sequence

Phase sequence will cause motor reversal

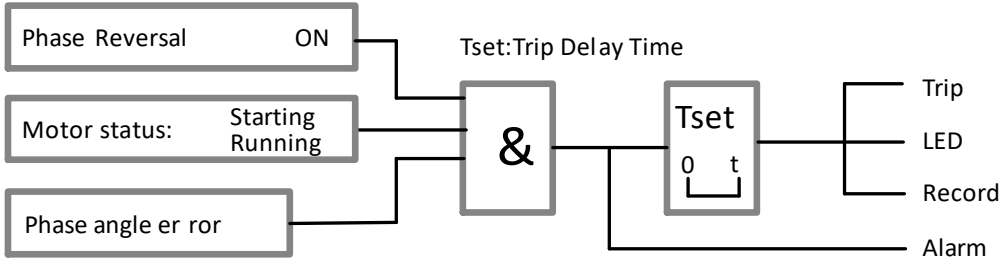


Figure 12.Voltage phase sequence protection logic

Parameter	Range	Default
Protection enable	OFF / Alarm / Trip	OFF
Trip delay time	0.0s ~ 5.0s	3.0s

Table 18.Voltage phase sequence protection related parameters

3.12 Under Voltage

Under voltage will cause the reduction of motor rotation speed and stop running, large current circuit break will cause voltage dip.

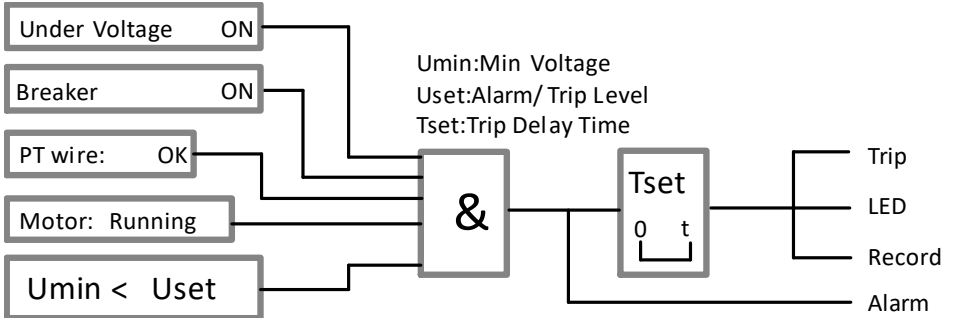


Figure 13.low voltage protection logic

Parameter	Range	Default
Protection enable	OFF / Alarm / Trip/ Alarm&Trip	OFF
Alarm level	45%Ue ~ 95%Ue	80%Ue

Trip level	45%Ue ~ 95%Ue	60%Ue
Trip delay time	0.1s ~ 600.0s	5.0s
Tripping object	Contactors / Breaker	Breaker

Table 19.Under voltage protection related parameters

3.13 Over Voltage

Over voltage will cause motor isolation damage

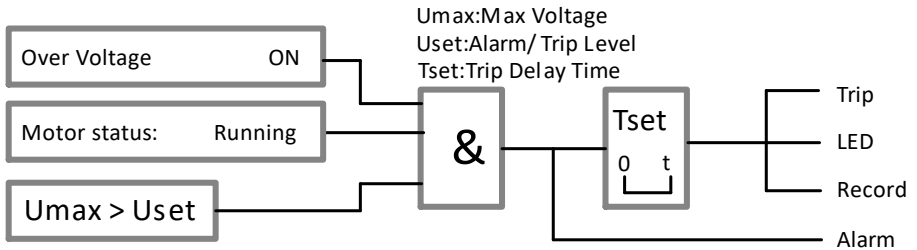


Figure 14.Over voltage protection logic

Parameter	Range	Default
Protection enable	OFF / Alarm/ Trip/ Alarm&Trip	OFF
Alarm level	100%Ue ~ 150%Ue	110%Ue
Trip Level	100%Ue ~ 150%Ue	120%Ue
Trip delay time	0.1s ~ 60.0s	5.0s

Table 20.Over voltage protection related parameters

3.14 Voltage Imbalance

Grid voltage instability will cause reduction of the motor rotation speed and stop running consequently.

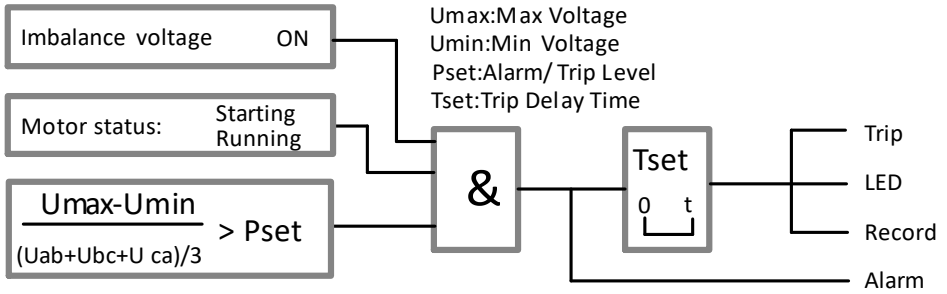


Figure 15.Voltage imbalance protection logic

Parameter	Range	Default
Protection enable	OFF / Alarm/ Trip / Alarm&Trip	Alarm&Trip
Alarm level	0.1% ~ 20.0%	3.0%
Trip level	0.1% ~ 20.0%	5.0%
Trip delay-starting	0.1s ~ 600.0s	3.0s
Trip delay-running	0.1s ~ 600.0s	1.0s

Table 21.voltage imbalance protection related parameters

3.15 PT Breaking

The primary or secondary fusing of the voltage transformer or loose contact will cause PT breaking. When the PT breaking alarm was tripping the low voltage protection will exit automatically.

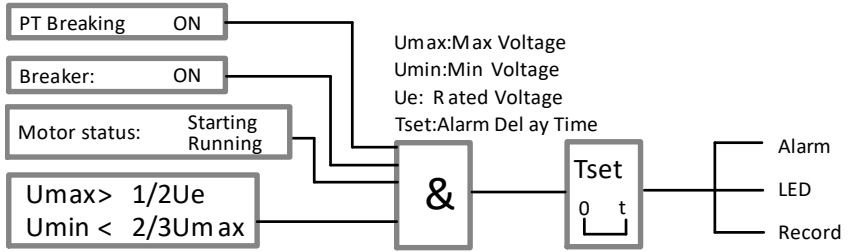


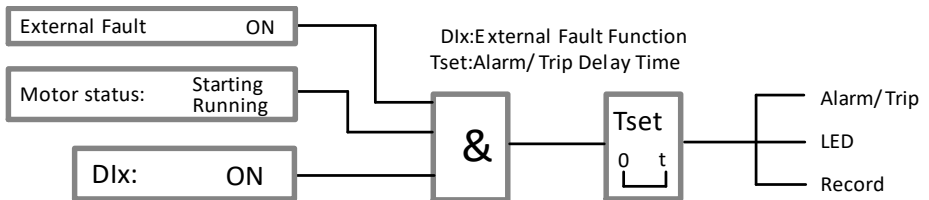
Figure 16.PT breaking protection logic

Parameter	Range	Default
Protection enable	OFF / Alarm	OFF
Trip delay time	0.1s ~ 60.0s	3.0s

Table 22.PT breaking protection related parameters

3.16 External Fault

External fault signal (such as temperature, liquid level) should connect to the DI input port and implement the tripping or alarm motion to fulfill the production continuity.



Parameter	Range	Default
Protection enable	OFF / Alarm/ Trip	OFF
Trip delay time	0.0s ~ 5.0s	3.0s
Trip reset mode	Manual / Auto	Manual

Table 23.External fault protection related parameters

3.17 Time tE (Increased Safety Motor)

Time tE protection conform to the regulation of GB/T 3836.3-2000,it suitable for the increased safety motor .

Time tE protection fault must reset by manual

Overload protection is automatically turned off when tE time protection is active

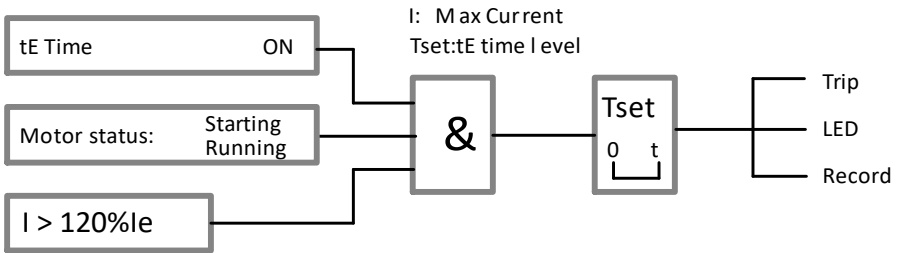
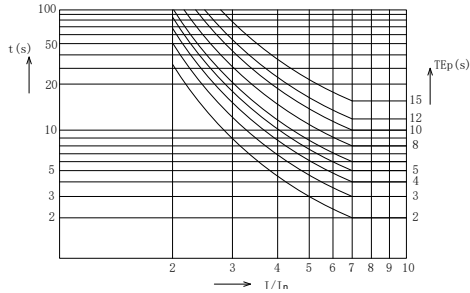


Figure 17.Time tE protection logic

Parameter	Range	Default
Protection enable	OFF / Trip	OFF
Time tE level	1.0s ~ 15.0s	5.0s

Table 24.tE time protection related parameters

3.18 Thermistor

The thermistor could receive 1 Thermistor input (pre-install in the winding or fixed in the distribution cabinet)for fulfill monitoring or protection function in which the working temperature or environmental temperature during the motor running

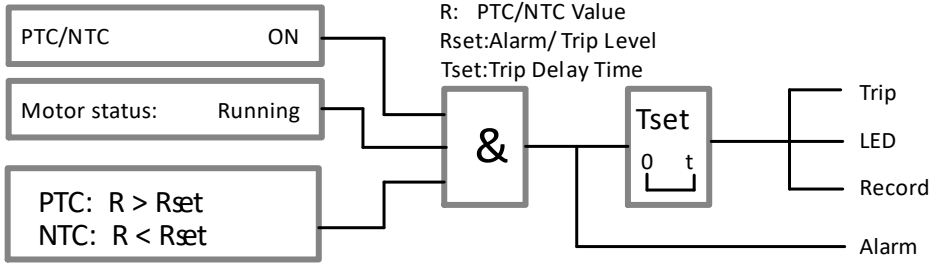


Figure 18. Thermistor tripping logic

Parameter	Range	Default
Protection enable	OFF/ Alarm / Trip / Alarm & Trip	OFF
Sensor type	PTC / NTC	PTC
Alarm level	0 ~ 10.00 kΩ	1.60 kΩ
Trip level	0 ~ 10.00 kΩ	3.60 kΩ
Allow reset level	0 ~ 10.00 kΩ	1.50 kΩ
Trip reset mode	Manual / Auto	Manual
Trip delay time	0.1s ~ 600.0s	3.0s

Table 25. thermistor protection related parameters

3.19 Thermal resistance protection RTD

The device could accept 1 thermal resistance input (pre-install in the winding or fixed in the distribution cabinet) for fulfill monitoring or protection function in which the working temperature or environmental temperature during the motor running.

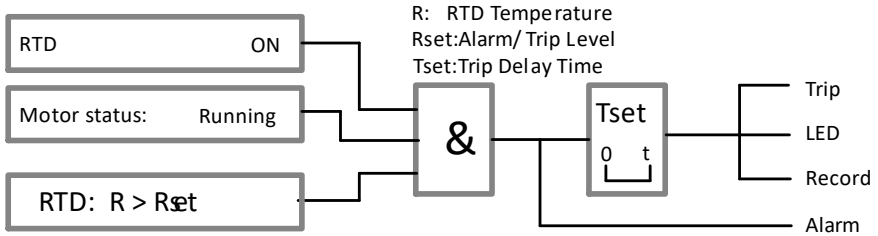


Figure 19. Thermal resistance protection logic

Value setting	Setting range	Default
Protection enable	OFF / Alarm / Trip / Alarm & Trip	OFF
Sensor type	Pt100	Pt100
Alarm level	0 ~ 200.0°C	65.0°C
Trip level	0 ~ 200.0°C	85.0°C
Allow reset level	0 ~ 200.0°C	45.0°C
Trip reset mode	Manual/ Auto	Auto
Trip delay time	0.1s ~ 120.0s	3.0s

Table 26. Thermal resistance protection related parameters

4. Motor control

4.1 Start/stop control logic

4.1.1 Command start and stop

Command start:

- The motor is ready to start
- The controller receives the start command (display module, input terminal, communication bus)
- Controller action relay, contactor pull-in, motor start

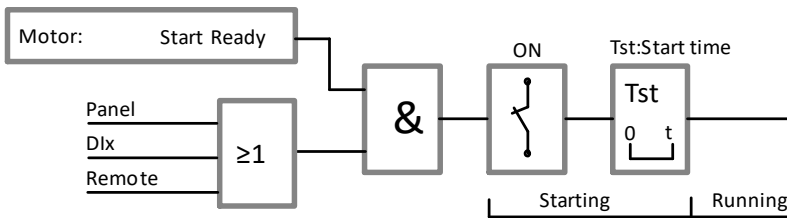


Figure 20.Start logic - normal start command

Command stop:

- The motor is running
- The controller receives the stop command (display module, input terminal, communication bus, fault trip)
- Controller disconnects relay, contactor is released, motor stop

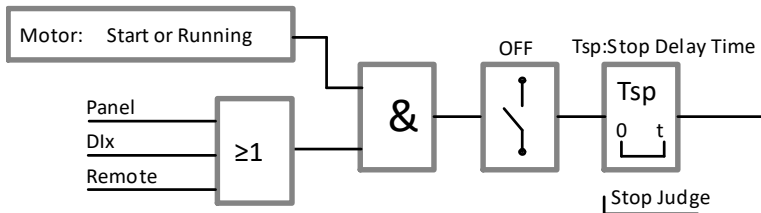


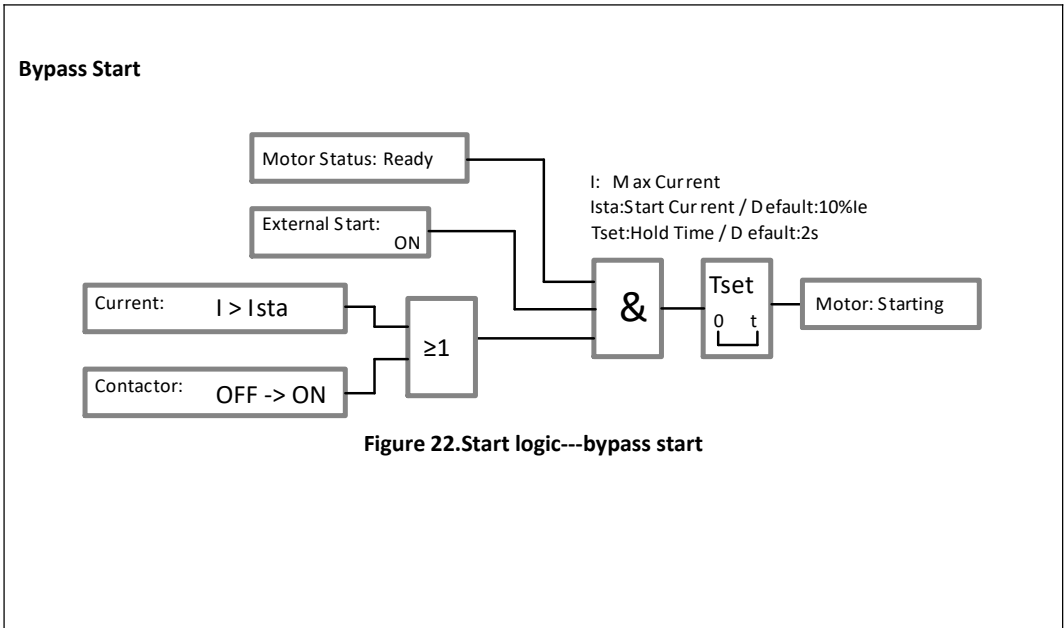
Figure 21.stop logic ---normal stop command

4.1.2 External bypass start/stop

If the external start/stop button does not go through the controller but connect to the contractor circuit directly, the controller will trace the current or the status of the contractor to judging the motor start or stop.

Note: In the thermal relay mode, the external bypass start and stop function is forced to be effective.

Related parameters	Explain	Range
Start/Stop Logic	Controller start and stop logic criterion source	0: current (10% Ie as the current start and stop criterion threshold) 1: Contactor (with the contactor change state as the start and stop criterion)
External Start	External bypass start permission enabled	0: OFF 1: ON
External Stop	External bypass stop permission enabled	0: OFF 1: ON



Bypass Stop

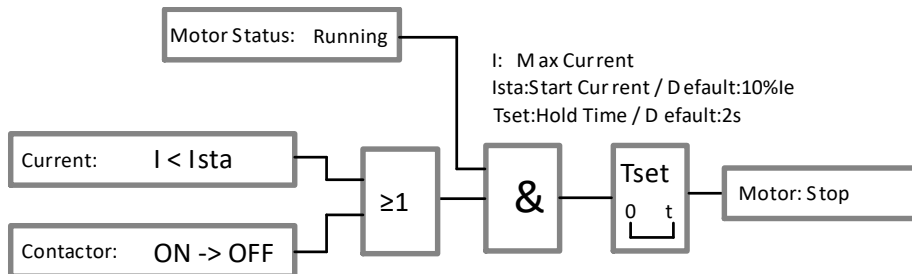


Figure 23. Stop logic ---bypass stop

4.2 Control authority

The WDH-31-530 defines local and remote control locations as described below:

Control position	Definition Description
Local	<ul style="list-style-type: none"> · Display panel · DI terminals defined as local properties
Remote	<ul style="list-style-type: none"> · DI terminals defined as remote properties · Communication bus

The user can select the currently active control position via "Control Rights".

Control authority option	Description	Effective control position
Local	Control position forced to be local	<ul style="list-style-type: none"> · Panel Position · Local DI Position
Remote	The control location is forced to be remote	<ul style="list-style-type: none"> · Remote Comm · Remote DI Position
DI-M1	<p>Connect the 2-position switch to the DIx terminal, which is defined as the "L/ R Switch" function.</p> <p>Determined by the position of the transfer switch Local/remote status</p>	<p>Local:</p> <ul style="list-style-type: none"> · Panel Position · Local DI <p>Position</p> <p>Remote:</p> <ul style="list-style-type: none"> · Remote Comm

		<ul style="list-style-type: none"> · Remote DI Position
DI-M2	<p>No switch required</p> <p>Controlled by the DP master of the DCS system Local/Remote Status</p>	Local: <ul style="list-style-type: none"> · Panel Position · Local DI Position Remote <ul style="list-style-type: none"> · Remote Comm

4.3 Power on self-starting

During the system power on process, the motor controller will judge whether allow self-starting to implement the self-starting the by time or by batches after power-up.

If the self-start is configured as “ON”, self-starting mode is configured as “Start” than the motor will be running by which the pre-setted time delay when power on.

If the self-start is configured as “ON”, self-starting mode is configured as “Resume” than the control system will consider the status before power off to decide whether restart or not. If the motor was at the running status before power off than it will self-starting according to the time delay regular after power on, if the motor was at the stop status before power off than the motor will not self-starting when the system is power on.

If the self-start is configured as “OFF”, self-star will be closed.

Parameter	Description	Range
Self-Start Enable	Self-Start enable	0: OFF 1: ON
Self-Start Mode	Self-Start working mode	0: Start 1: Resume
Self-Start Delay	Delay start time for batch starting	0~650.0s

Table 27.Self Start related parameters

4.4 Under voltage restart

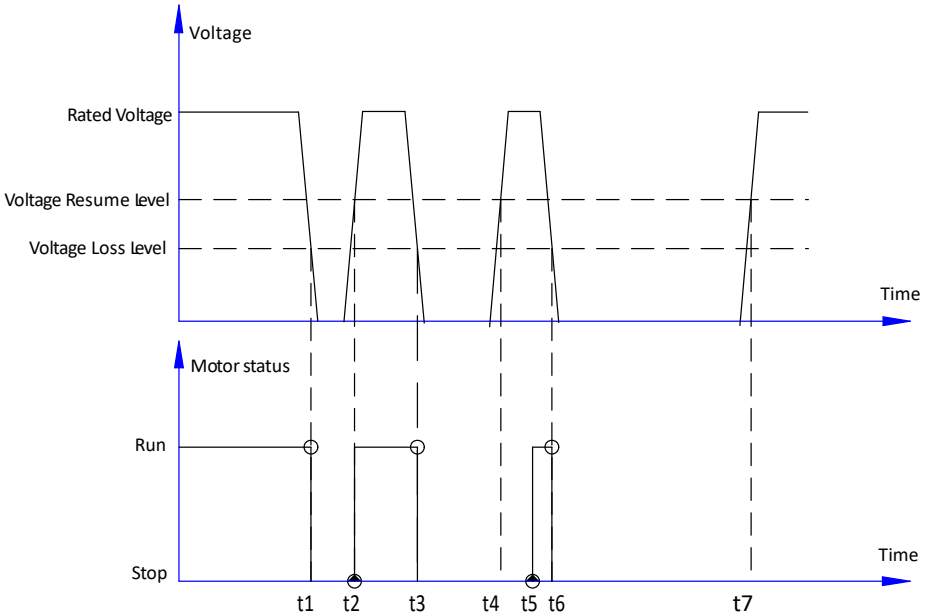
4.4.1 Instant restart

When the main circuit was short circuit by lightning stroke or ground fault, the causes of dramatic grid voltage fluctuation in short-term was called power shaking. Normally the power shaking duration is less than 0.5S, the running motor could not stop completely by interface. The motor controller no need to tripping which ensuring the running breaker keep closing, the related contractor could close immediately.

4.4.2 Under voltage restart

If there is under voltage fault happened (below "Voltage Loss Level") during the motor was running, the motor will stop and the motor controller will accumulate the power off duration. When it detects the voltage of the motor return to the “Voltage Resume Level” or beyond, if the accumulate power off time duration is within the range of “Delay.U-Loss Time”, the motor will delay restart as the setting command “Restart Delay Time”, if the accumulate power off time is beyond limit, the motor will not restart again.

Note: The under voltage protection function is automatically turned off when the restart function is enabled.



Restart instantly

- t1 voltage drop to power off threshold value
- t2 voltage return to normal value of t1-t2 is less than the power shaking time
- execute instant restart: close the contactor immediately (without start process)

Restart delay

- t3 voltage drop to power off threshold value
- t4 voltage return to normal,
 - Value of (t3-t4) is more than Inst.U-Loss Time (instant restart is invalid)
 - and value of (t3-t4) is less than Delay.U-Loss Time
- Execute delay restart: t5 Restart Delay Time
 - contactor close again, motor restart

Parameter	Explain	Range	Defaults
Instantly Restart	Under voltage Instantly Restart enable	0:OFF 1:ON	0
Delay Restart	Under voltage Delay Restart enable	0:OFF 1:ON	0
Voltage Loss Level	Restart drop voltage value	20~ 95%Ue	65
Voltage Resume Level	Restart recovery voltage value	20~ 95%Ue	85
Inst.U-Loss Time	Inst.U-Loss maximum Time	0.1 ~2.0s	0.5
Delay.U-Loss Time	Delay.U-Loss maximum Time	0.5 ~ 650.0s	3.0
Restart Delay Time	Restart Delay start Time	1.0 ~ 650.0s	10.0

Table 28.Under voltage Restart Related parameters

4.5 Analog Output

WDH-31-530 supports 2 channel 4-20mA analog output, various electric parameter is available and the output multiplying rate could be configured as well. The output multiplying rate means the corresponding rated value to 20mA (rated current or rated voltage is available)

Set the current measuring value is X_i , rated value is X_n , output multiplying rate is N , analog output value is Y , the computing formula is :

$$Y = 4mA + (X_i/X_n) \times 16mA / N$$

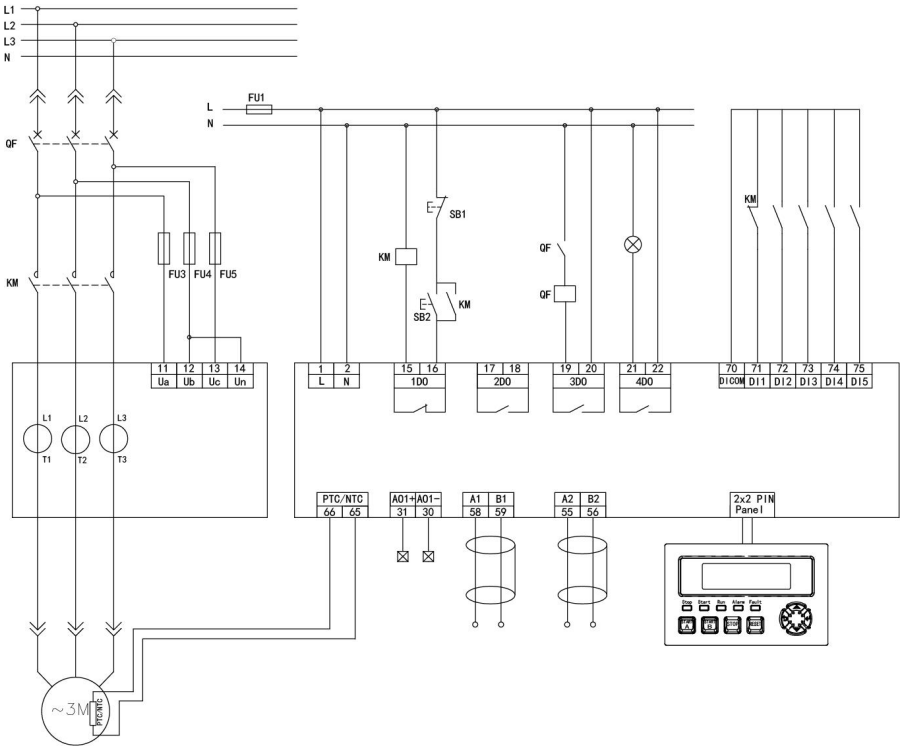
e.g.

Output electric parameter	Output multiplying rate	Measuring value /rated value	Analog output value
Ia	1.0	12.5A / 25A	$4mA + (12.5/25) \times 16mA = 12mA$
Uab	2.0	190V / 380V	$4mA + (190/380) \times 16mA = 8mA$

Table 29.Analog output value count example

4.6 Start mode

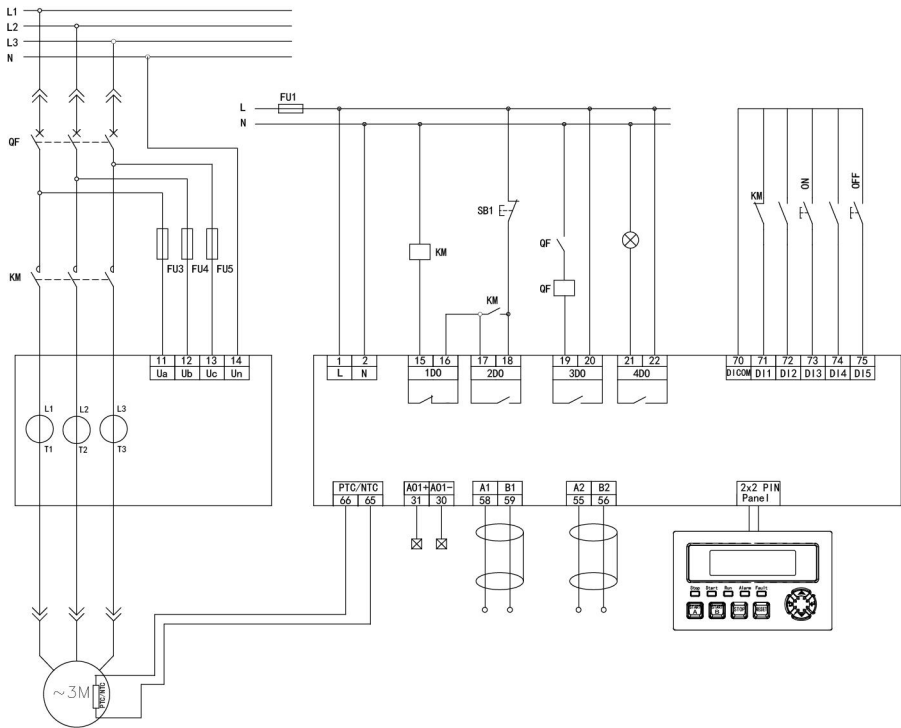
4.6.1 Thermal relay



Under the thermal relay mode, WDH does not participate in the start and stop operation of motor (DI terminal and panel control are invalid).

- The start/stop running of the motor must implement by the Start/Stop external button
- As drawing shown, press the start button SB2, motor start, press stop button SB1, motor stop
- Protection trip relay 1DO is NC contract, when fault was detected, 1DO open, contactor(KM) off, motor will stop
 - After fault reset, 1DO closed, allow the motor start again.

4.6.2 Direct start



--Under the direct start mode, WDH controls the motor start/stop by relay 1DO(NC)/2DO(NO).

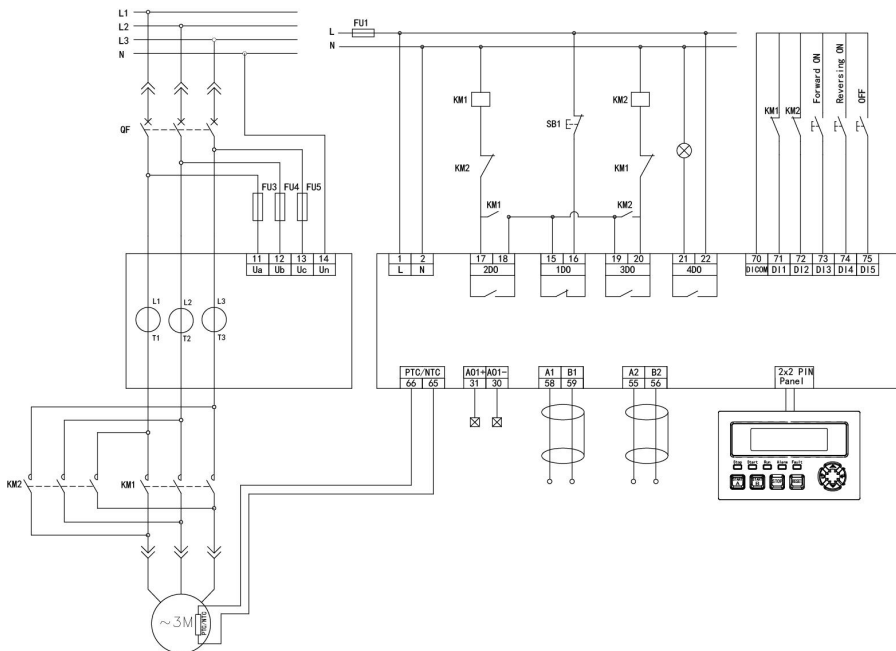
·As drawing shown, when the controller receive the start command(such as 3DI terminal or display interface), 2DO closed(pulse), contactor(KM) power on, motor start

·When the controller receives the stop command(such as 5DI terminal or display interface),1DO open(pulse), contractor KM power off, motor stop.

·When faults were detected,1DO open(level), contractor KM power off, motor stop.

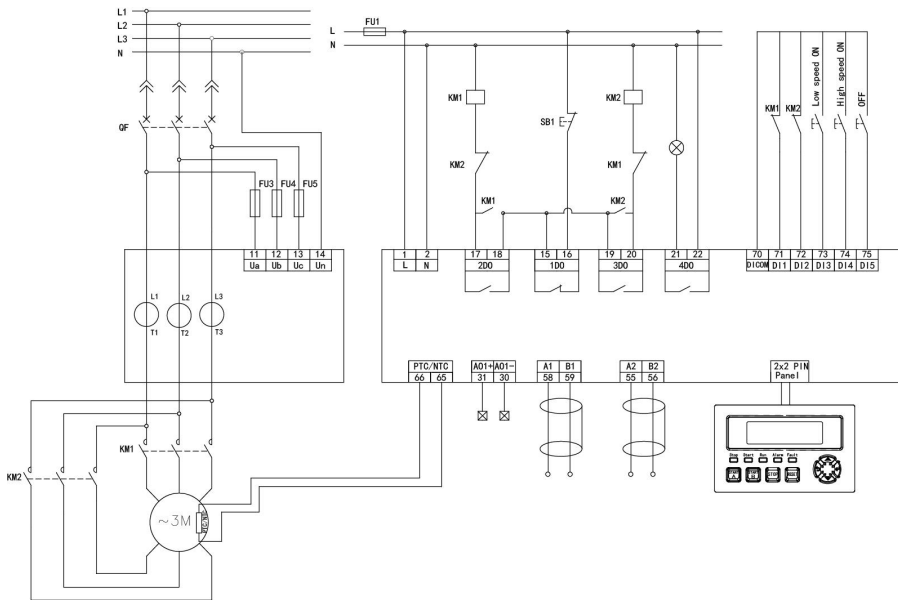
·After reset, 1DO closed, controller allows the motor restart again.

4.6.3 Reversing



- Under the reversing mode (forward and reverse), WDH controls the motor forward rotation start/stop by relay 1DO(NC)/2DO(NO) and by relay 1DO (NC)/3DO(NO) to the reverse direction start/stop of the motor.
- As the drawing shown, when the controller receives the forward directional start command(such as 3DI terminal or display interface), 2DO closed(pulse), contactor KMI power on, the motor start with forward direction.
- When the controller receives the reverse direction start command (such as 4DI terminal or display interface), 3DO closed(pulse), contractor KM2 power on, the motor starts with reverse direction.
- When the controller receives the stop command (such as 5DI terminal or display interface), 1DO open (pulse), contractor KM1/2 power off, the motor stop.
- If enable "Continuous Switching" , if the current rotation direction is forward, the controller receives the reverse start signal, the motor will stop than delay 1s and start in reverse, or vice version.

4.6.4 Two speed start



-In the two speed start mode, its control logic is same as the reversing start mode, WDH controls the motor with low speed start/stop by relay 1DO(NC)/2DO(NO) and the motor will start/stop with high speed by relay 1DO(NC)/3DO(NO)

·In the two speed start mode

·In the stop status, the motor could start with low speed;

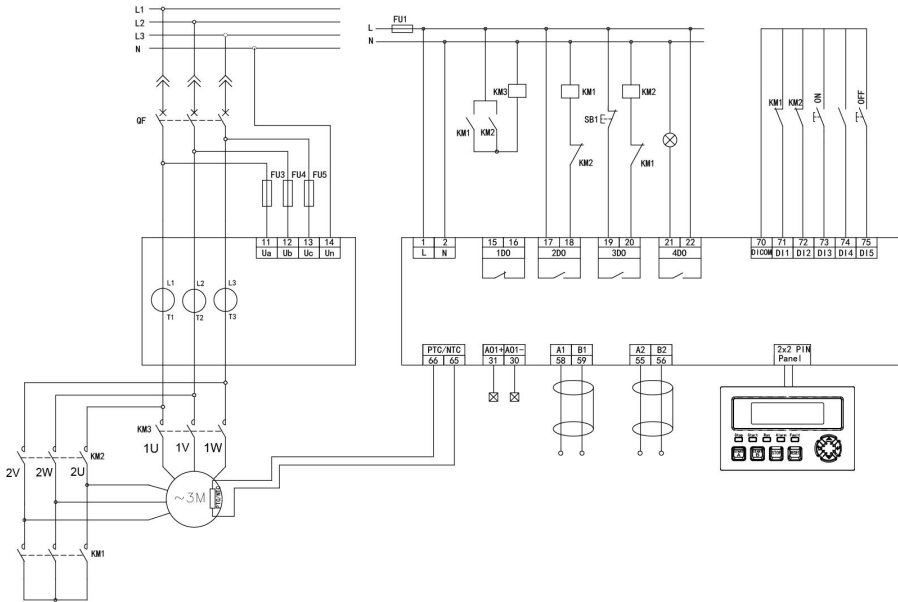
·In the stop status, if enable “high speed direct start”, the motor could start with high speed;

·In low speed running, it could switch to high speed running(stop first and start with high speed after delay);

·In high speed running, switching to low speed running is prohibit;

·In high speed running, if enable” Fire Application” , all protection's “Trip” function is disabled.

4.6.5 Star Delta start



In the star-Delta start mode(2 relays), controller command the motor to start in star mode by relay 2DO(NO), command the motor to start in delta start mode for running by relay 3DO(NO)

As drawing shown, when the controller receives the start command(such as 3DI terminal or display interface), 2DO closed, contractor KM1/KM3 is power on, the motor was be at the star mode for start running, when the switch time is up, 2DO opened, KM1/KM3 power off and 3DO closed at the same time, when KM2/KM3 is power on, the motor will be at the delta start mode, when the starting was accomplished, the motor will be at normal status.

Action sequence of the contactor					
Contactor	start	switch		run	Star mode: 2U 2V 2W short circuit Delta mode: 1U--2V short circuit 1V--2W short circuit 1W--2U short circuit
		1	2		
KM1	●	○	○	○	
KM2	○	○	●	●	

5. Communication

5.1 RS485 network

The WDH main control module has a maximum of 2 RS485 communication interfaces and supports the standard Modbus-RTU protocol (corresponding model: WDH-31-533 / 534).

5.1.1 Network topology

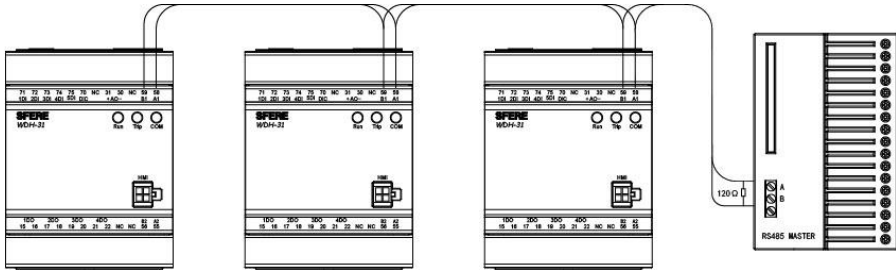


Figure RS485 line connection

5.1.2 Interface definition

<p>71 72 73 74 75 70 NC 31 30 NC 59 58 1DI 2DI 3DI 4DI 5DI DIC +AO- B1 A1</p> <p>Run Trip COM</p> <p>HMI</p> <p>1DO 2DO 3DO 4DO B2 A2 15 16 17 18 19 20 21 22 NC NC 56 55</p>	RS485-1 (Modbus-RTU)	
	58	A1
	59	B1
	RS485-2 (Modbus-RTU)	
	55	A2
	56	B2

5.1.3 Related parameters

Parameter name	Description	Options/Values	Default
Address 1	COMM 1 Address No	1~247	1
Baud rate1	COMM 1 Baud rate	0:4800	1:9600

		1:9600	
Data format1	COMM 1 data format	0:n.8.1 1:o.8.1 2:e.8.1 3:n.8.2	0:n.8.1
Address 2	COMM 2 Address No	1~247	1
Baud rate 2	COMM 2 Baud rate	0:4800 1:9600	1:9600
Data format 2	COMM 2 Data format	0:n.8.1 1:o.8.1 2:e.8.1 3:n.8.2	0:n.8.1

5.1.4 Modbus instruction sets

Modbus command	Modbus definition	WDH-31-530 definition
0x03/0x04	Read register value	<ul style="list-style-type: none"> ·Read the motor state information ·Read the motor running power value. ·Read the motor management information ·Read SOE event logging ·Read setting parameters
0x05	control a single coil	<ul style="list-style-type: none"> ·Start and stop control command ·Remote control single relay
0x06	Write a single register	<ul style="list-style-type: none"> ·Write setting parameters ·Start and stop control command ·Remote control single relay
0x10	Write multiple registers	<ul style="list-style-type: none"> ·Write setting parameters

5.2 Ethernet / Modbus-TCP network

The 2 COMM interface of the WDH main body can be selected as Ethernet network interface (only one independent MAC address), with switch function, and supports standard Modbus-TCP protocol (corresponding product model: WDH-31-537).

5.2.1 Network Topology

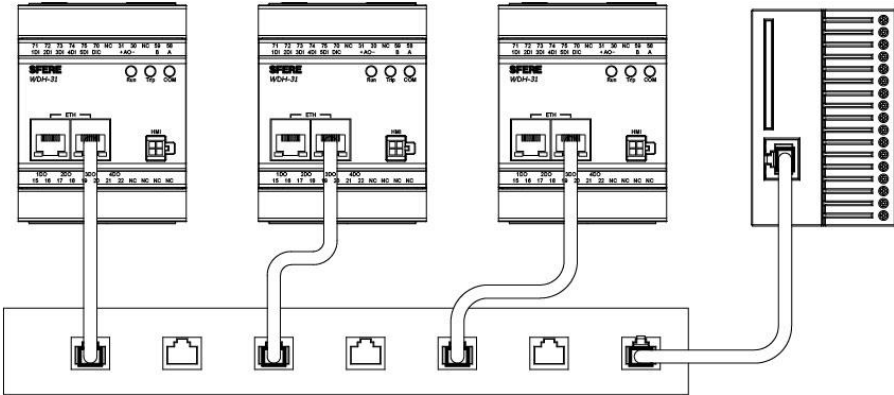


Figure Ethernet star connection

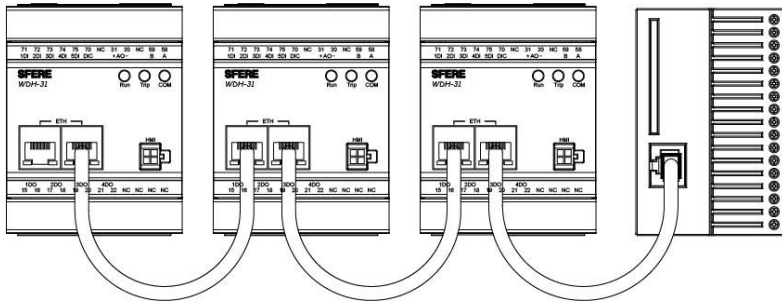
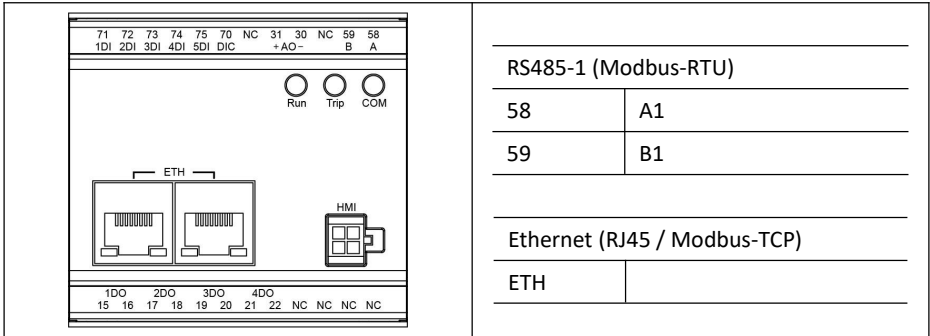


Figure Ethernet Line Connection

5.2.2 Terminal definition



RS485-1 (Modbus-RTU)

58	A1
59	B1

Ethernet (RJ45 / Modbus-TCP)

ETH

5.2.3 Related parameters

Parameter Name	Options/Values	Default
DHCP	0: OFF 1: ON	0: OFF
TCP port	0~65535	502
IP address	xxx.xxx.xxx.xxx	10.2.4.122
Subnet mask address	xxx.xxx.xxx.xxx	255.255.255.0
Gateway address	xxx.xxx.xxx.xxx	10.2.4.1
MAC address	XX-XX-XX-XX-XX-XX	

5.3 Profibus-DP network

The 2 COMM interface of the WDH main body can also be selected as a Profibus-DP network interface (corresponding product model: WDH-31-532)

5.3.1 Network topology

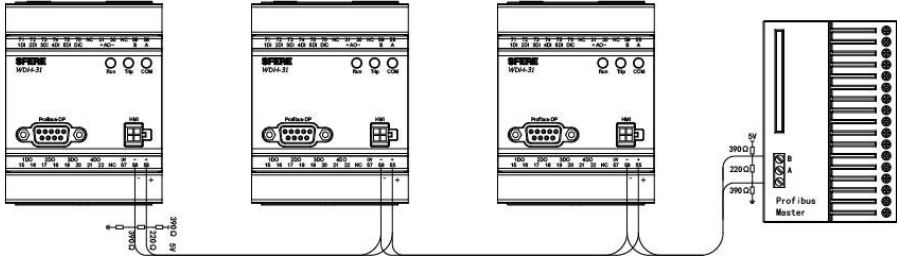


Figure Profibus-DP line connection

5.3.2 Interface definition

	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="2" style="text-align: left;">Profibus-DP</th> </tr> <tr> <td style="width: 30%;">55</td> <td style="text-align: center;">+</td> </tr> <tr> <td>56</td> <td style="text-align: center;">-</td> </tr> <tr> <td>57</td> <td style="text-align: center;">0V</td> </tr> <tr> <th colspan="2" style="text-align: left;">Or D-SUB9</th> </tr> <tr> <th colspan="2" style="text-align: left;">RS485-1</th> </tr> <tr> <td>58</td> <td style="text-align: center;">A1</td> </tr> <tr> <td>59</td> <td style="text-align: center;">B1</td> </tr> </table>	Profibus-DP		55	+	56	-	57	0V	Or D-SUB9		RS485-1		58	A1	59	B1
Profibus-DP																	
55	+																
56	-																
57	0V																
Or D-SUB9																	
RS485-1																	
58	A1																
59	B1																

5.3.3 Slave address

Parameter Name	Description	Options/Values	Default
Address (No. 2 serial port)	DP slave address number	1~127	1

5.3.4 DP(V0) parameter distribution

In cyclic data exchange, each information frame conveys a fixed amount of user data. Cyclic data exchange is especially suitable for the transmission of information that needs to be delivered continuously and quickly.

The valid data types that PROFIBUS can transmit are defined in the GSD file related to WDH. The maximum input data is 96 bytes, and the output data is maximum 2 bytes. For ease of use, three basic data types are predefined, and the user can also freely select the state or measurement module to be transmitted.

Basic type 1:

The data structure of basic type 1 is fixed and consists of 3 bytes of input data and 1 byte of output data (control byte A). The input and output data are defined as follows:

Byte	Data name	Symbol	Format	Unit
Input byte				
0	running status data	RS1	byte	
1 ~ 2	Maximum phase current	Imax	int	0.1 A
Output byte				
0	Control byte A	CBA	byte	

Basic type 2:

The data structure of basic type 2 is fixed and consists of 20 bytes of input data and 1 byte of output data (control byte A). The input and output data are defined as follows:

Byte	Data name	Symbol	Format	Unit
Input byte				
0	Running status information	RS1	byte	
1	1~8 DI status	DI8	byte	
2	9~12 DI status	DI12	byte	
3	1~8 relay status	RY8	byte	
4 ~ 5	Phase A current	I1	int	0.1 A
6 ~ 7	Phase B current	I2	int	0.1 A
8 ~ 9	Phase C current	I3	int	0.1 A
10 ~ 11	Current imbalance	Inb	int	%

12 ~ 13	Residual current	Io	int	mA
14 ~15	AB line voltage	V12	int	V
16 ~ 17	BC line voltage	V23	int	V
18 ~ 19	CA line voltage	V31	int	V
Output byte				
0	Control byte A	CBA	byte	

Special type 1:

The data structure of special type 1 is fixed and consists of 4 bytes of input data and 1 byte of output data (control byte B). The input and output data are defined as follows:

Byte	Data name	Symbol	Format	Unit
Input byte				
0	Programmable data status 1	PS1	byte	
1	Programmable data status 2	PS2	byte	
1 ~ 2	Maximum phase current	Imax	int	0.1 A
Output byte				
0	Control byte B	CBB	byte	

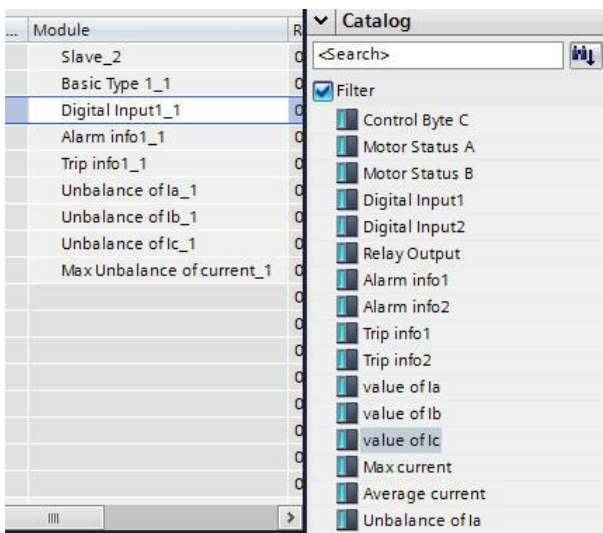
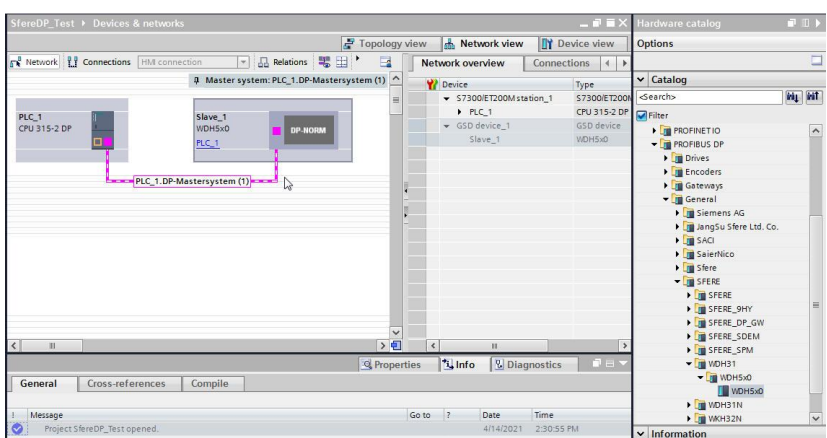
Self-definition type:

The DP master programmer can specify the status or measurement module to be transmitted through the self-definition type (please see appendix xxx), please note that the maximum length of the input data is 48 bytes. For example, according to the actual needs of the project and considering the memory space of the PLC, the input and output data structure is selected as 8 bytes of input data and 1 byte of output data, as shown below:

Byte	Data name	Symbol	Format	Unit
Input byte				
0	Running status information	RS1	byte	
1	1~8 DI status	DI8	byte	
2~ 3	Maximum phase current	Imax	int	0.1 A
4~ 5	Maximum line voltage	Umax	int	V
6~ 7	Active power	P	int	0.01kW

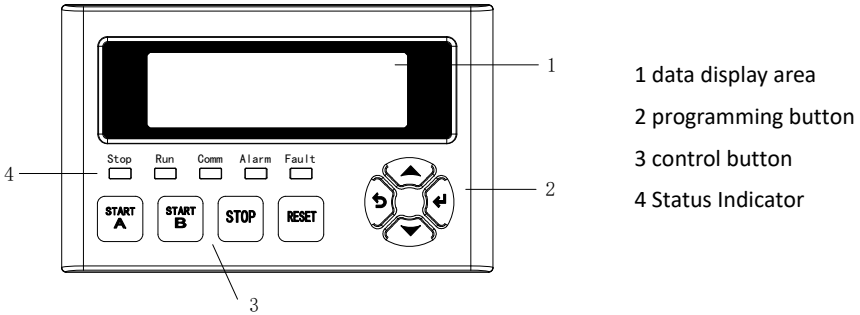
Output byte				
0	Control byte B	CBB	byte	

In the PLC configuration software, freely select Module and define the required I/O parameters



6. Operation panel

6.1 Panel



Control button	
START A	Forward start button/low speed start button
START B	Reverse start button / high speed start button
STOP	Stop button
RESET	Fault reset button

Programming button		
↶	Return	<ul style="list-style-type: none"> ·Cancel/Exit ·Return to menu focus ·Return to the previous menu
↵	Enter	<ul style="list-style-type: none"> ·Enter ·Enter the data focus ·Enter into next menu
▲	Up	<ul style="list-style-type: none"> ·Menu item shifting ·Data shifting ·Modify the value (increase)
▼	Down	<ul style="list-style-type: none"> ·Menu item shifting ·Data shifting ·Modify the value (decrease)

Status Indicator	
Stop	Stop status/Start ready
Run	Running
Comm	Communication
Alarm	Alarm
Fault	Fault trip

6.2 Control interface

In the control interface, user could command the start/stop order by control button, take the direct start as example:

Start by Panel:

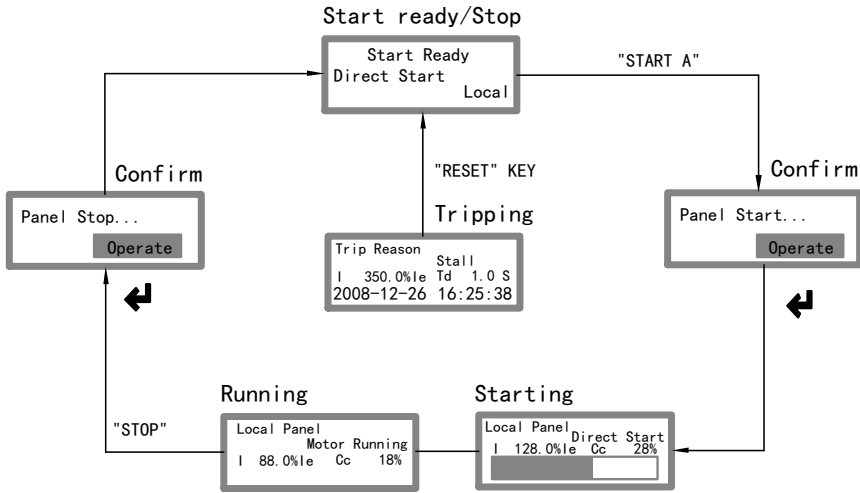
- ◆ The operation panel displays "Ready to start", and this window contains information: start mode (such as direct start), control authority (such as local)
- ◆ Press the "START A" button to enter "Start running confirmation"
- ◆ Press "←" to confirm execution
- ◆ Enter the "start state"
- ◆ After the start time is up, it will automatically enter the "running state"
- ◆ Complete panel startup

Stop by Panel:

- ◆ Control panel display "starting status" or "running status"
- ◆ Press the "STOP" button to enter "Stop running confirmation"
- ◆ Press "←" to confirm execution
- ◆ After completing the stop logic, it automatically returns to "Ready to start"
- ◆ Complete panel stop

Panel fault reset

- ◆ Panel interface display "Fault status"
- ◆ Press the "RESET" button
- ◆ After completing the reset logic, it automatically returns to "Ready to start"
- ◆ Complete panel reset



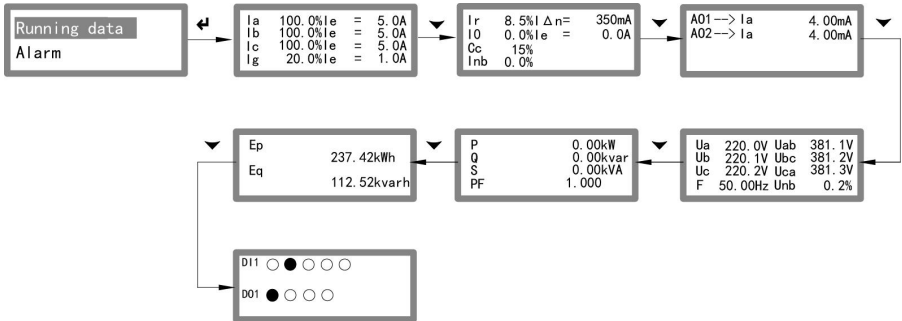
6.3 System menu

In the control interface, press the "←" button to enter the menu interface, and press the "↶" button to return.

In the query interface, it includes menu items such as "Running data", "Alarm", "Record", "Maintenance", "Setup", "Calibration", etc, user could select the them by "▲", "▼" button. After selecting a menu item, click the "←" button to enter the next level menu and display more related information.

6.3.1 Running data

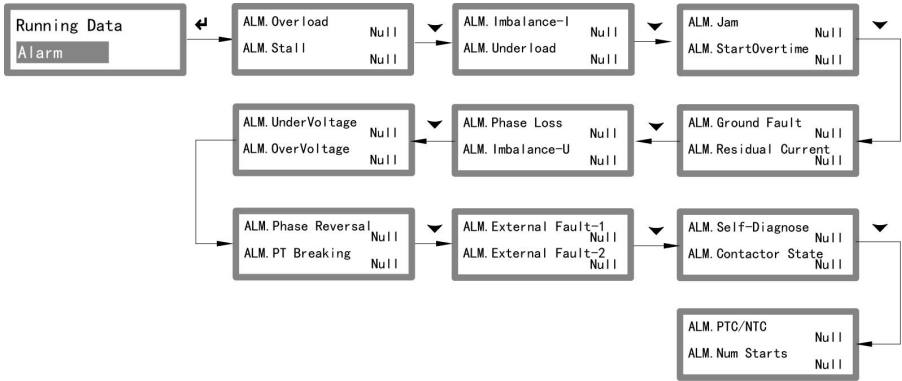
“Running data” includes electric energy parameter data, power data, I/O status, etc.



Running Data Prompt Instructions			
I	3-phase maximum current %	Td	Fault trip delay time
Ia	Phase-A current (%)	Ua	Phase-A voltage value
Ib	Phase-B current (%)	Ub	Phase-B voltage value
Ic	Phase-C current (%)	Uc	Phase-C voltage value
Ig	Ground current (%)	Uab	AB line voltage value
Ir	Residual current (%)	Ubc	BC line voltage value
I0	Zero-sequence current (%)	Uca	CA line voltage value
F	Grid frequency	Unb	Voltage imbalance value
Cc	Thermal capacity(%)	P	Total active power
Inb	Current imbalance level	Q	Total reactive power
AO1	1#analog output value	S	total apparent power
PTC	Thermistor value	PF	total power factor
Ep	Total active energy	Eq	total reactive energy
DI(n)	The (nth) DI signal status	DO(n)	ON/OFF state of the (nth) relay
○	Digital input --- no signal	●	Digital input --- with signal
	Relay status --- OFF		Relay Status --- ON

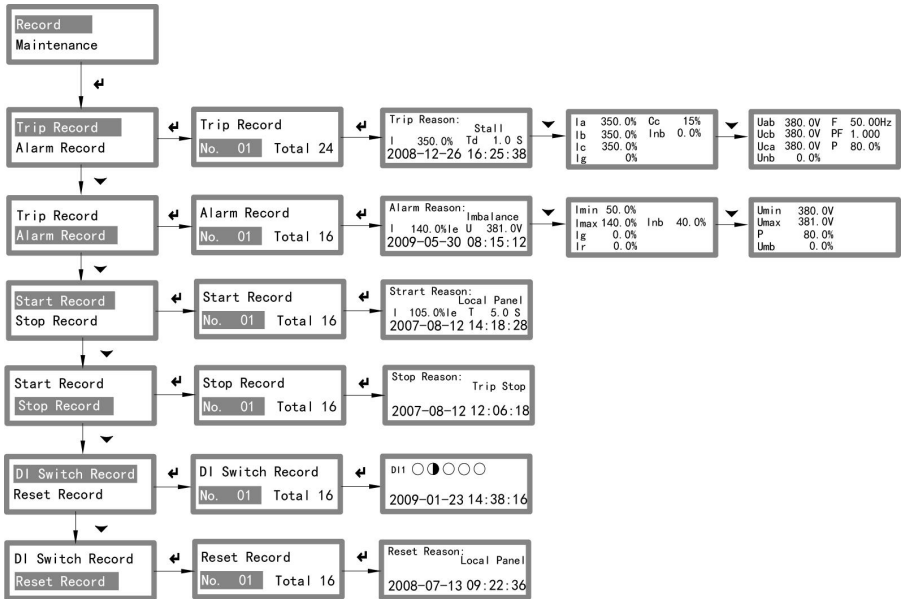
6.3.2 Alarm

In "Alarm", you can view the current related real-time alarm information.



6.3.3 Record

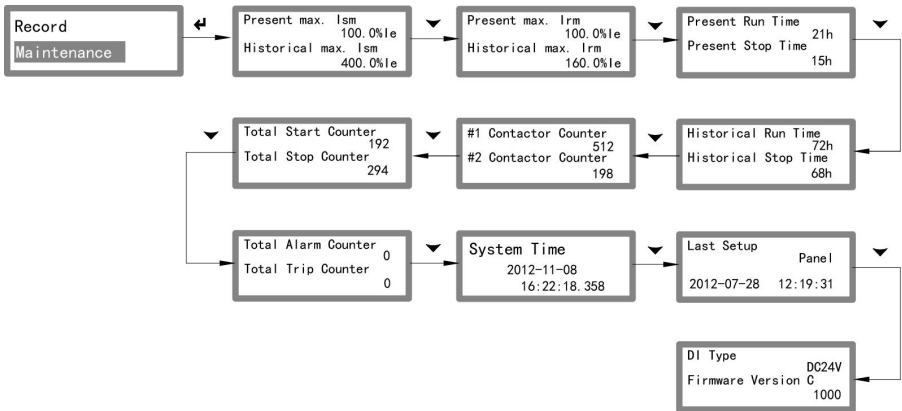
"Record " includes "Trip record", "Alarm record", "Start record", "Stop record", "DI switch record", "Reset record", select the corresponding query times to display the current detailed record information.



Record query prompt description			
I	3-phase current %(max)	U	Line Voltage(Max)
Imin	3-phase current %(min)	Umin	Line Voltage(Min)
Imax	3-phase current %(max)	Umax	Line Voltage(Max)
T	Start time		DIx 0->1
Td	Fault trip delay time		DIx 1->0

6.3.4 Maintenance information

“Maintenance” includes relevant motor running data and other information.



Maintenance Information Prompt Description	
Present max Ism	Record the max current of the motor starting process(latest 1)
Historical max Ism	Record the historical max current of motor starting process
Present max Irm	Record the max current of the motor running process(latest 1)
Historical max Irm	Record the historical max current of motor running process
Present stop time	Record the current stop time of the motor
Historical stop time	Record the accumulated total stop time of the motor
Present running time	Record the current running time of the motor
Historical running time	Record the accumulated total running time of the motor

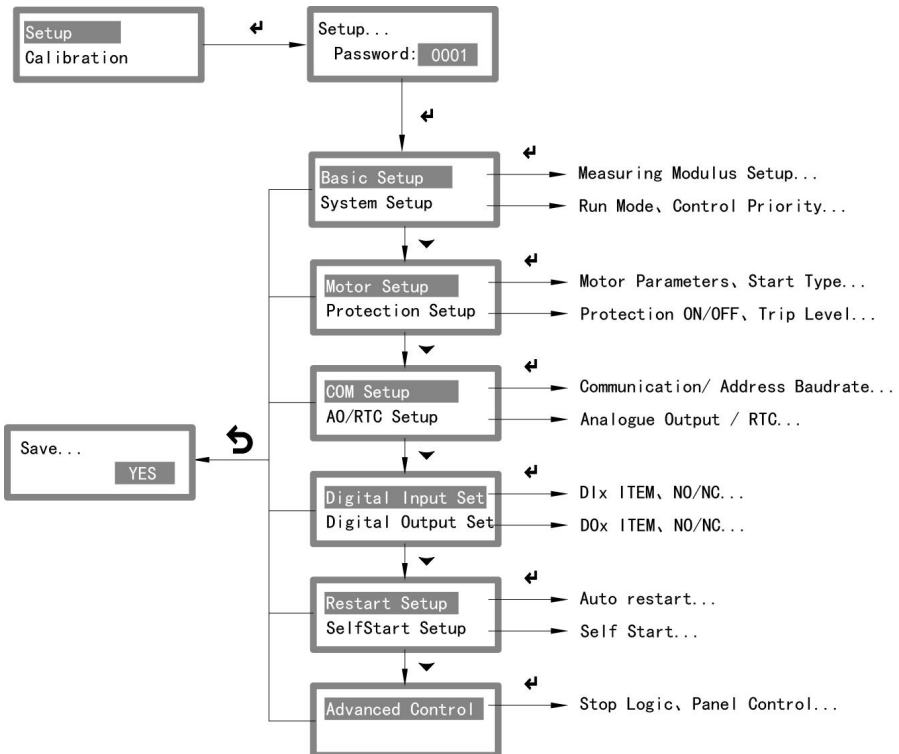
6.4 Setting interface

Enter into the setting interface

- ◆ Select "Setup"
- ◆ Press the "←" button to enter in "password->setup"
- ◆ Enter the correct password through the "▲" and "▼" buttons, (the default is 0001)
- ◆ Press the "←" button to enter the setup interface

Exit the setting interface

- ◆ In the main menu of the setting interface, press the "↻" button to enter the "parameter save"
- ◆ Select "YES"/"NO" through the "▲", "▼" buttons, whether to save the modification
- ◆ Press "←" button to return to the query interface



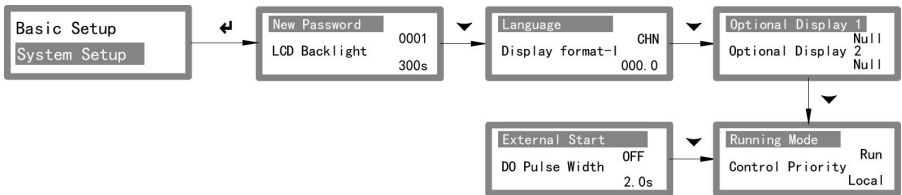
6.4.1 Basic setup

Select "Basic Setup" and press "←" to enter. Press the "←" button in the selected corresponding menu item to enter the setting value associated with the menu, and the value (or option) can be modified by the "▲" and "▼" buttons.



Name	Range	Default
CT Ratio	1 ~ 9999	1
PT Ratio	1.00 ~ 20.00	1.00
Wiring Mode	0: 3P4W 1: 3P3W 2: 1P2W	0
Residual CT	50 ~ 30000mA	1000

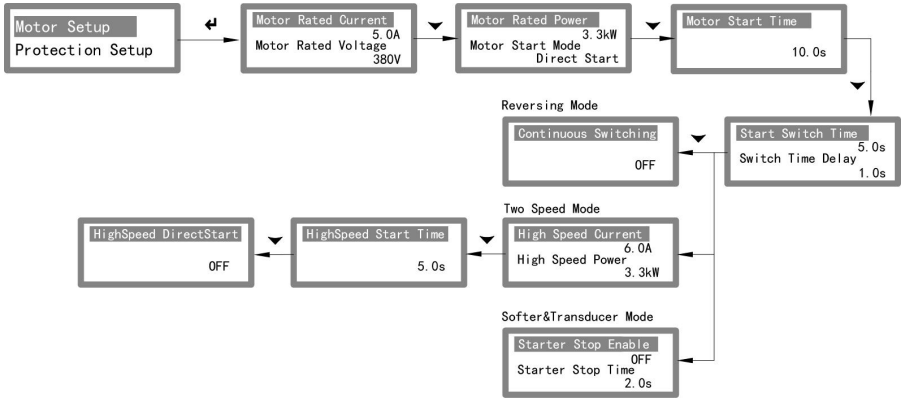
6.4.2 System Setup



Name	Range	Default
New Password	0000~9999	1
LCD Backlight	0:OFF 1: 60s 2: 180s 3: 300s	2
Language	0: Chinese 1: English	0
Display format-l	0: 0000 1: 000.0 2: 00.00	1
Optional Display 1	0:Null 1:lavg 2:lavg(%) 3:lmax 4:lmax(%)	0

	5:Ig 6:Ig(%) 7:Ir 8:Ir(%) 9:I1(%) 10:I2(%) 11:Inb 12: Unb 13:Cc 14:Uavg 15:Umax 16:F 17:PF 18:P 19:Q 20:S 21:AO1 22:AO2 23:Trun 24:NTC	
Optional Display 2	Same as above " Optional Display 1"	0
Running Mode	0: (Run) normal operation mode 1: (Test) The protection function is blocked for testing the control loop 2: (Auto) If the breaker is in ON, running mode; if the breaker is in OFF, test mode.	0
Control Priority	0: Local (Local) 1: Remote (Remote) 2: 2 position DI (DI-M1) 3: 2 position AT (DI-M2) 4: 4 position DIA(DI-M3) 5: 4 position DIB (DI-M4)	0
External start	0: OFF 1: ON	0
DO Pulse Width	0 ~ 60.0s	2.0

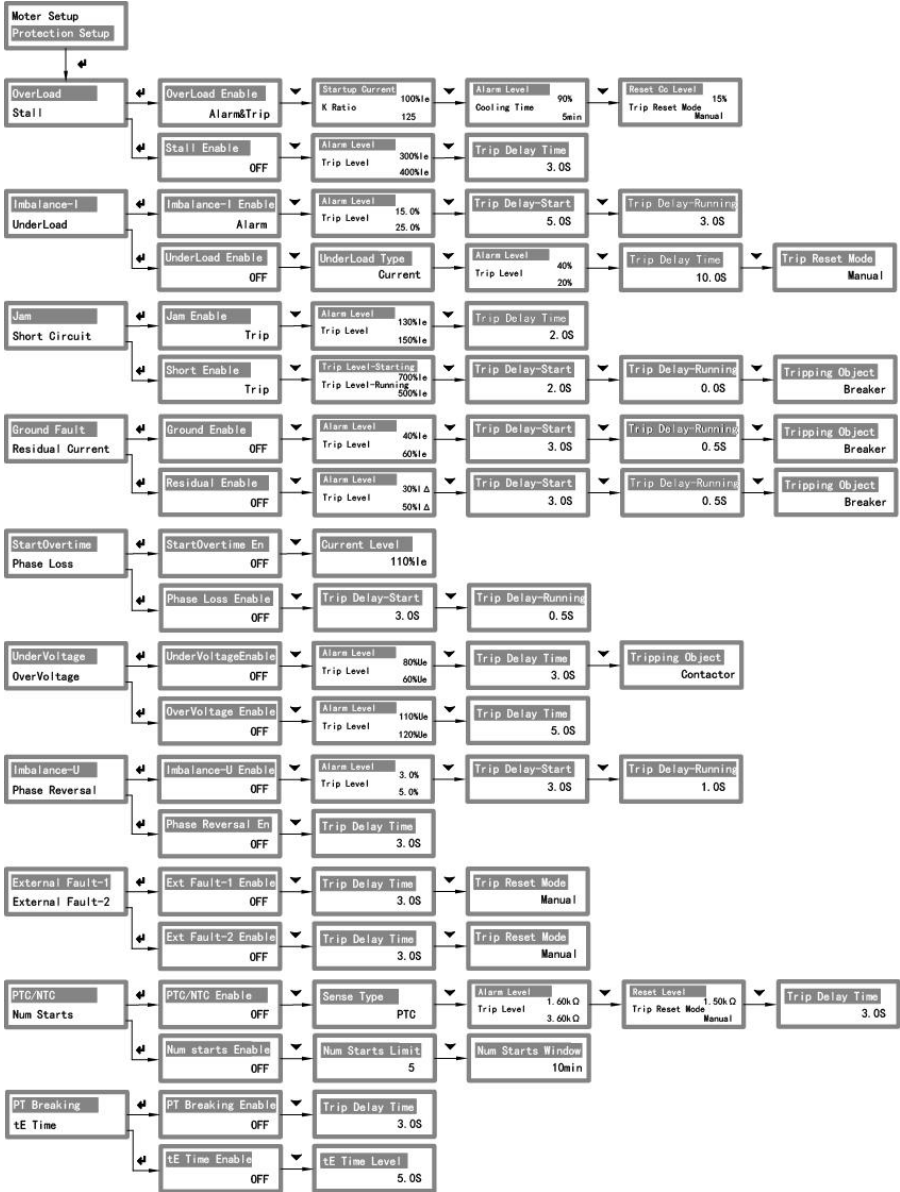
6.4.3 Motor Setup



Name	Range	Default
Motor Rated Current	0.1~2500.0 A	5.0
Motor Rated Voltage	100~1200V	380
Motor Rated Power	0.1~2000.0 kW	3.3
Motor Start Mode	0: Direct start 1: Reversing start 2: Two-speed start 3: Star/delta 4: Overload relay 5: Resistor 6: Star/delta 3RO 7: Star/delta 3RC 8: S-AutoTF 9: S-AutoTF 3RO 10: S-AutoTF 3RC 11: Soft startor 12: Transducer 13: Electric valve	0
Motor Start Time	0.1~600.0 s	5.0
Start Switch Time	0.1~600.0 s For example: in star-delta starting, switching time is the star time	3.0
Switch Time Delay	0.1~600.0 s For example: after star start, delta start after delay	1.0

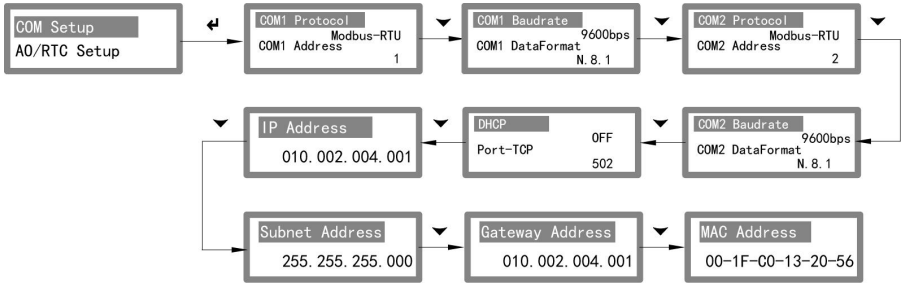
Continuous Switching	0: OFF 1: ON	0
High Speed Current	0.1~2500.0 A	5.0
High Speed Power	0.1~2000.0 kw	3.3
High Speed Start Time	0.1~600.0 s	5.0
High Speed Direct Start	0: OFF 1: ON	0
Starter Stop Enable	0: OFF 1: ON	0
Starter Stop Time	0.1~600.0 s	2.0
Open Valve Time	0~9999s	5
Close Valve Time	0~9999s	5

6.4.4 Protection Setup



Please refer to Chapter 3 for the description of protection related parameters.

6.4.5 Communication Setup



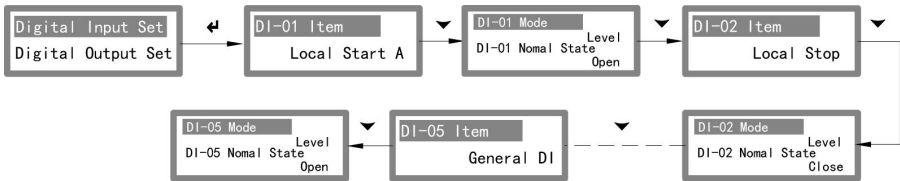
Name	Range	Default
COM1 Protocol	0: Modbus 1:Profibus	0
COM1 Address	1~247	1
COM1 Baud Rate	0:4800 1:9600	1
COM1 Data Format	0:n.8.1 1:o.8.1 2:e.8.1 3:n.8.2	0
COM2 Protocol	0: Modbus 1: Profibus 2: Modbus-TCP	0
COM2 Address	1~247	1
COM2 Baud Rate	0:4800 1:9600	1
COM2 Data Format	0:n.8.1 1:o.8.1 2:e.8.1 3:n.8.2	0
DHCP	0: Off 1: On	0
Port-TCP	0~65535	502
IP Address	xxx.xxx.xxx.xxx	
Subnet Address	xxx.xxx.xxx.xxx	
Gateway Address	xxx.xxx.xxx.xxx	
MAC Address	xx-xx-xx-xx-xx-xx	

6.4.6 AO/RTC Setup



Name	Range	Default
AO1 Item	0:1a 1:1b 2:1c 3:1max 4:1avg 5:Uab 6:Ubc 7:Uca 8:Umax 9:Uavg 10:Freq 11:Power	0
AO1 Ratio	1.0~10.0	1.0
System Time	---	---

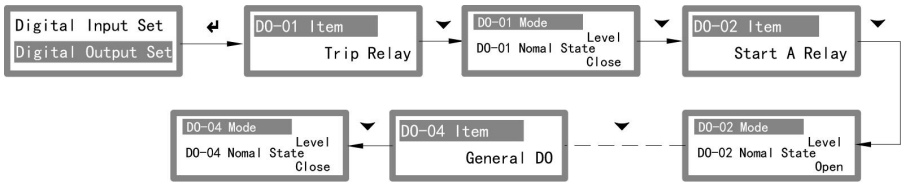
6.4.7 Digital input Setup



Name	Range	Default
DI (n) mode	0: Level 1: Pulse	0
DI (n) Normal State	0: NO (Open) 1: NC (Close)	0
DI (n) Item	0: Contactor A 1: Contactor B 2: Contactor C 3: Breaker 4: Local Start A	24

	5: Local Start B 6: Local Stop 7: Local Reset 8: Local STA/STP A 9: Local STA/STP B 10: Remote Start A 11: Remote Start B 12: Remote Stop 13: Remote Reset 14: Remote STA/STP A 15: Remote STA/STP B 16: Emergency Stop 17: Emergency Reset 18: Interlock Stop A 19: Interlock Stop B 20: External Fault 1 21: External Fault 2 22: L/R Switch 23: Complex Switch 24: General DI 25: Softer Run State 26: Fire STA/STP A 27: Fire STA/STP B 28: Protection OFF	
--	---	--

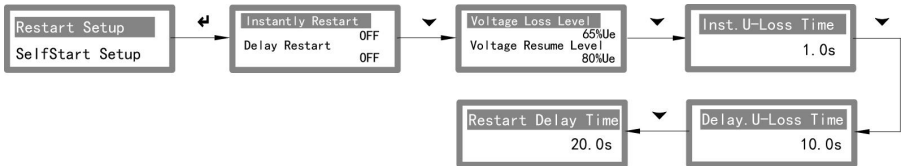
6.4.8 Digital output Setup



Name	Range	Default
DO (n) Mode	0: level 1: pulse	0
DO (n) Normal State	0: NO (Open) 1: NC (Close)	0
DO (n) Item	0: Start A relay 1: Start B relay 2: Start C relay 3: Trip protection 4: Short circuit fault 5: Self-diagnostic output	12

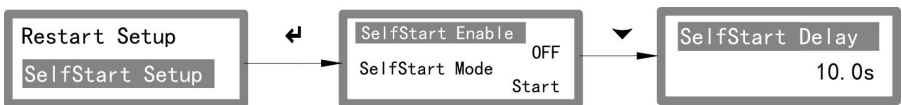
- 6: Device is ready for output
- 7: Remote ready output
- 8: Remote control output
- 9: Running signal output
- 10: Total alarm signal
- 11: Total fault signal
- 12: General DO output
- 13: Overload trip
- 14: Stall trip
- 15: Current unbalance
- 16: Under load trip
- 17: Jam trip
- 18: Single-phase ground trip
- 19: Residual current trip
- 20: Under voltage trip
- 21: Overvoltage trip
- 22: Phase loss trip
- 23: Thermistor trips
- 24: Reserved
- 25: External fault 1 trip
- 26: External fault 2 trip
- 27: Single-phase grounding alarm
- 28: Residual current alarm
- 29: Thermistor alarm
- 30: Reserved

6.4.9 Restart Setup



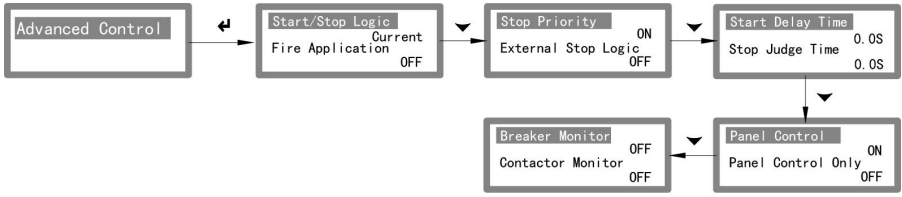
<Please refer to Chapter 4.4 for the description of parameters >

6.4.10 Self-start Setup



<Please refer to Chapter 4.3 for the description of parameters >

6.4.11 Advanced Control Setup



Name	Range	Default
Start/Stop Logic	0: current (10% Ie as the current start and stop criterion threshold) 1: Contactor (with the contactor change state as the start and stop criterion)	0
Fire Application	0: OFF 1: ON(measurement control mode) Two-speed start mode, if the fire circuit is effective, the protection is effective at low speed operation and the protection is closed at high speed. In other starting modes, if the fire circuit is valid, the protection is turned off (the trip is invalid and the alarm is valid).	0
Stop Priority	0: OFF (stop is not controlled by permission, such as remote location, local button can also stop) 1:ON (stop is controlled by authority, such as remote locations, the local button disabled)	1
External Stop Logic	0: OFF 1: ON	0
Start Delay Time	0 ~ 600.0s The panel start is invalid, only for the DI terminal or communication start.	0
Stop Judge Time	0 ~ 10.0s (0: Turn off this feature) Current Criterion: If the stop command is received, if the current is higher than 10% Ie after the delay, the stop will fail.	0

	<p>Contactor criterion: If the stop command is received, if the contactor is not divided after the delay, the stop will fail.</p> <p>This fault is automatically reset.</p>	
Panel Control	<p>0: OFF (Prohibit panel start and stop)</p> <p>1: ON</p>	
Panel Control Only	<p>0: OFF</p> <p>1: ON (only panel start and stop is valid, all other positions are prohibited)</p>	
Breaker Monitor	<p>0: OFF</p> <p>1: ON (the circuit breaker is in the joint position, the starting operation is valid)</p>	
Contactor Monitor	<p>0: OFF</p> <p>1: ON</p> <p>Valid only for current criteria. Check the contactor status during the start and stop process, if not, give an alarm.</p>	

7. Replacement & Compatibility

7.1 Scene description

In retrofit projects, the following scenarios that need to be upgraded related motor protection devices are often encountered:

- ◆ Replace the simple function thermal relay
- ◆ Replace the damaged protection devices
- ◆ Replace the protection device that has reached its service life
- ◆ Replace the protection devices whose functions do not meet existing needs

As we all know, the products of various manufacturers have certain differences in design. If you need to use WDH to replace or upgrade the original protection device, please be sure to confirm the following three aspects: installation, function, and communication protocol.

7.2 Installation

The installation method and dimensions are very important parameters. It is not acceptable to replace other products and affect the layout of the original components. For example, in a small motor power distribution drawer cabinet, the positions of circuit breakers, contactors, fuses, intermediate relays and other components have been fixed, and only a small area is placed for protection devices. During replacement operations, other control components (such as contactors)) should not be moved as much as possible to improve the operability and reliability of replacement.

- ◆ WDH main module is din rail mounted, and it is necessary to confirm whether the installation space is sufficient.
- ◆ WDH display screen (optional) is panel-mounted, and it is necessary to confirm the opening hole size of the original panel. If the original hole size is small, the panel opening hole can be re-cut.
- ◆ If the original hole size is large, it can be realized through a customized adapter plate (simple operation)
- ◆ Because the position of the terminals may be different, the layout and direction of the power lines and control lines connected to the WDH also need to be paid attention to, and some adjustments may also be required.

7.3 Function

Functional confirmation is the most important step, including control, protection, communication, etc. Usually, the relevant functional requirements can be very clear by obtaining the electrical control diagram of the original motor circuit (or the original wiring diagram of the protection device).

Review the original electrical control diagram of the motor circuit and complete the function confirmation:

-->Function:

- ◆ Control, protection and communication interface
- ◆ Confirm the voltage class of the power supply of the protection device
- ◆ Confirm I/O voltage class and quantity
- ◆ Confirm the starting mode (1 step/2 steps)
- ◆ Confirm whether under-voltage start is required (optional)
- ◆ Confirm the original protection trip item
- ◆ Confirm the original communication interface and protocol

7.4 Communication protocol

Generally, the motor protection device will be connected to the DCS control system(Master: PLC). Although the standard interfaces and protocols are used, the input/output data structures are different.

The characteristics of data exchange of the motor protection controller are: the small data quantity, real-time reliability, and it is mainly used to control motor start/stop control and monitoring of important measurement parameters.

Modbus-RTU / Modbus-TCP protocol

Although the standard Modbus protocol is relatively simple, each manufacturer's register data sheet table is different (self-defined), so DCS master station personnel are required to modify the relevant device communication module. Of course, you can also upgrade the firmware of WDH to ensure that the address of the communication register of the replacement product is exactly the same.

Profibus-DP (V0) / Profinet

For Profibus-DP and Profinet protocols, the gsd file of the product needs to be provided to access the DCS configuration software. Since the gsd files of each manufacturer are different, when replacing the product, the DCS master station programmer needs to modify the slave station configuration software and import a new gsd file, that is, add a new device. The DP protocol of WDH is relatively flexible, the input/output data can be self-defined and selected, and communication protocol customization (implemented through firmware upgrade) can also be provided to ensure that there is no need to modify the control logic of the master station and simplify the replacement steps.

7.5 Running Steps

When the above installation and related function confirmation are completed, if the replacement can be realized, the following operations can be performed:

Replacement Steps:

-->Model selection

By functions

Attention to the power supply voltage class of the protective device

Attention to the input/output contact voltage class

Attention to the communication interface

Attention to the optional function module

--> Installation

According to the model selection, install all components of WDH

-->Setup

Setup the parameters by Panel interface or by PC software

(1) Measurement

Set up the measurement module

Set motor parameters (rated current, rated voltage...)

(2) Control

Select the start mode(1 step/2 steps)

Setup DI functions(define the start command, stop command...)

Setup relay functions(define relay NC, relay NO, relay fault...)

(3) Protection

Open the required protection items and setup the relevant parameters

Turn off other unused protection items

(4) Others(if needed)

Communication related (Address, baud rate...)

Analog output

Under voltage start

-->Testing control circuit(No load)

Local Start/Stop button control

Automatic control (Modbus/Profibus-DP/Profinet)

-->Motor testing(Load)

Measuring and display

Start/stop control

8. Fault detail

When the WDH detects a fault signal, the fault will remain (latched) until the fault reset command is received.

WDH can make fault indication in the following ways:

- ◆ Main control module Trip indicator is always on
- ◆ The main module is defined as the relay action of "total fault signal"
- ◆ The corresponding fault information is displayed on the display module screen

LCD display description	Code	Source	Possible reasons
Overload fault	1	Load	Trip due to thermal overload of the motor Check the overload protection trip level Check if the motor power is too small
Stall (Starting) fault	2	Load	Excessive current during motor start Check the motor for mechanical problems Check if the load is too heavy
Imbalance I	3	Power supply load contactor	One phase current is too low Check if the grid voltage is stable Check if the current terminals are reliable
Under Load fault	4	Load	Load current or power is too low Check if the pump is idling Check if the conveyor belt is broken
Jam(Running) fault	5	Load	Excessive current during motor operation Check the motor for mechanical failure Check if the load is too heavy
Ground Current fault	6	Load	At least one phase is connected to the ground Check motor wiring Check motor insulation

Residual Current fault	7	Load	At least one phase is connected to the ground Check motor wiring Check motor insulation
Start Overtime fault	8	Load	Light load or heavy load operation after motor start Check motor load Check if the motor starting time is too short
Phase Loss fault	9	Power supply load contactor	At least one phase current is too low Check if the grid voltage is stable Check if the current terminals are reliable Check contactor contacts for wear
Short Circuit fault	10	Power supply load	At least one phase current is too low Check if the grid voltage is stable Check if the current terminals are reliable Check contactor contacts for wear
Under Voltage fault	11	Power supply	Check if the grid voltage is too low Check voltage wiring Check if the fuse is normal
Over Voltage fault	12	Power supply	Check if the grid voltage is too high Check voltage wiring
Imbalance U	13	Power supply	Check if the grid voltage is stable Check if the fuse is normal
PT Breaking alarm	14	Power supply	Check if the grid voltage is stable Check if the fuse is normal
Phase sequence fault	15	Power supply	Check voltage wiring
External Fault 1	16	Custom	Check the external input signal
External Fault 2	17	Custom	Check the external input signal
tEFault	20	Load	Trip due to motor overload

			<p>Check tE protection trip level</p> <p>Check if the motor power is too small</p>
Stop fail fault	21	Contactor	<p>Current is also detected after stop operation</p> <p>Check if the contactor wiring is reliable</p> <p>Check contactor contacts for wear</p>
Start fail alarm	--	Circuit breaker contactor	<p>Received start command, but contactor and circuit breaker are not in normal state</p> <p>Check if the circuit breaker is in position</p> <p>Check if the contactor is in the grading</p>
Self Diagnose alarm	--	Device itself	Equipment hardware failure
Contactor State alarm	--	Contactor	<p>Contactor auxiliary contact feedback error</p> <p>Check contactor wiring</p>

9. Technical data

System parameter	
Rated voltage of motor	AC400V or AC690V, 50/60Hz
Rated current of motor	0.1 A ~800 A
Insulation resistance	≥100MΩ
Device auxiliary power supply	
Working range	AC/DC 80~270V
Power consumption	< 10VA
Use environment	
Environment temperature	-20℃ ~+60℃
Relative humidity	≤93%RH
storage temperature	-40℃ ~70℃
Protection level	Measurement module/master control module: IP20 Display panel: IP64
Withstand voltage characteristics	AC2kV/1min
Protection action accuracy	
Current/voltage starting value	set value±1%
Heat capacity accumulation value	set value±1%
Delay action time	Delay action setting value < 2s: ±100mS Delay action setting value ≥ 2s: ±5%
Relay output	
Control relay contact capacity	AC250V/5A (Resistive) AC250V/0.5A (Sensibility) DC30V/5A (Resistive)
Maximum break voltage	AC400V
Maximum break capacity	1000VA
Action time	10ms
Mechanical life	>1000000
DC24V Switch input	
Node type	Dry contact
Electrical isolation	Opto-isolated inputs

Internal voltage	DC24V	
Input resistance	5k Ω	
On current	1.5mA	
The sampling period	2mS	
Analog output		
Output type	DC 4~20mA	
Response time	< 100mS	
load	$R_L \leq 350\Omega$	
EMC Electromagnetic Compatibility Characteristics		
Electrostatic discharge immunity	IEC 61000-4-2	Level 3
Electrical fast transients/bursts immunity	IEC 61000-4-4	Level 3
Surge immunity	IEC 61000-4-5	Level 3
Oscillation waves immunity	IEC 61000-4-12	Level 3
Radio-frequency field immunity	IEC 61000-4-3	Level 3
Conducted RF disturbances immunity	IEC 61000-4-6	Level 3
Power frequency magnetic fields immunity	IEC 61000-4-8	Class A
Voltage dips and short interruptions	IEC 61000-4-11	Level 3
Radiated & Conducted Emissions	CISPR22	Class A
Reference Standard		
Low-voltage switchgear and controlgear	Part1:General rules	IEC 60947-1
Low-voltage switchgear and controlgear ---Electromechanical contactors and motor-starters(Including motor protector)	Part 4-1: Contactors and motor-starters	IEC 60947-4-1

10. Appendix

10.1 Overload protection time characteristic table

I/Iq	10	25	60	75	100	125	250	300	500	750	1000	1200
1.1	47.62	119.05	285.71	357.14	476.19	595.24	119.048	142.857	238.095	357.143	476.190	571.428
1.2	22.73	56.82	136.36	170.45	227.27	284.09	568.18	681.82	113.636	170.455	227.273	272.727
1.3	14.49	36.23	86.96	108.70	144.93	181.16	362.32	434.78	724.64	108.696	144.928	173.913
1.4	10.42	26.04	62.50	78.13	104.17	130.21	260.42	312.50	520.83	781.25	104.167	125.000
1.5	8.00	20.00	48.00	60.00	80.00	100.00	200.00	240.00	400.00	600.00	800.00	960.00
2.0	3.33	8.33	20.00	25.00	33.33	41.67	83.33	100.00	166.67	250.00	333.33	400.00
2.5	1.90	4.76	11.43	14.29	19.05	23.81	47.62	57.14	95.24	142.86	190.48	228.57
3.0	1.25	3.13	7.50	9.38	12.50	15.63	31.25	37.50	62.50	93.75	125.00	150.00
3.5	0.89	2.22	5.33	6.67	8.89	11.11	22.22	26.67	44.44	66.67	88.89	106.67
4.0	0.67	1.67	4.00	5.00	6.67	8.33	16.67	20.00	33.33	50.00	66.67	80.00
4.5	0.52	1.30	3.12	3.90	5.19	6.49	12.99	15.58	25.97	38.96	51.95	62.33
5.0	0.42	1.04	2.50	3.12	4.17	5.20	10.40	12.50	20.83	31.25	41.67	50.00
5.5	0.34	0.85	2.00	2.50	3.40	4.25	8.55	10.26	17.09	25.64	34.19	41.03
6.0	0.28	0.70	1.70	2.10	2.80	3.50	7.14	8.57	14.29	21.43	28.57	34.29

	9	1	1	4	6	7			9	3	7	9
6.5	0.2 4	0.6 1	1.4 5	1.8 2	2.4 2	3.0 3	6.06	7.27	12.1 2	18.1 8	24.2 4	29.0 9
7.0	0.2 1	0.5 2	1.2 5	1.5 6	2.0 8	2.6 0	5.21	6.25	10.4 2	15.6 3	20.8 3	25.0 0
7.2	0.2 0	0.4 9	1.1 8	1.4 8	1.9 7	2.4 6	4.92	5.90	9.83	14.7 5	19.6 7	23.6 0
7.5	0.1 8	0.4 5	1.0 9	1.3 6	1.8 1	2.2 6	4.52	5.43	9.05	13.5 7	18.1 0	21.7 2
8.0	0.1 6	0.4 0	0.9 5	1.1 9	1.5 9	1.9 8	3.97	4.76	7.94	11.9 0	15.8 7	19.0 5

10.2 tE Time Protection Characteristic Table

tEp I/le	1.0(s)	4.0(s)	4.3(s)	4.6(s)	5.0(s)	5.5(s)	6.0(s)	15.0(s)
3.00	4.00	16.00	17.20	18.40	20.00	22.00	24.00	60.00
3.20	3.48	13.92	14.96	16.01	17.40	19.14	20.88	52.20
3.40	3.08	12.32	13.24	14.17	15.40	16.94	18.48	46.20
3.60	2.76	11.04	11.87	12.70	13.80	15.18	16.56	41.40
3.80	2.50	10.00	10.75	11.50	12.50	13.75	15.00	37.50
4.00	2.29	9.16	9.85	10.53	11.45	12.60	13.74	34.35
4.20	2.11	8.44	9.07	9.71	10.55	11.61	12.66	31.65
4.40	1.95	7.80	8.39	8.97	9.75	10.73	11.70	29.25
4.60	1.82	7.28	7.83	8.37	9.10	10.01	10.92	27.30
4.80	1.70	6.80	7.31	7.82	8.50	9.35	10.20	25.50
5.00	1.60	6.40	6.88	7.36	8.00	8.80	9.60	24.00
5.20	1.51	6.04	6.49	6.95	7.55	8.31	9.06	22.65
5.40	1.43	5.72	6.15	6.58	7.15	7.87	8.58	21.45
5.60	1.36	5.44	5.85	6.26	6.80	7.48	8.16	20.40
5.80	1.29	5.16	5.55	5.93	6.45	7.10	7.74	19.35
6.00	1.23	4.92	5.29	5.66	6.15	6.77	7.38	18.45

6.20	1.18	4.72	5.07	5.43	5.90	6.49	7.08	17.70
6.40	1.13	4.52	4.86	5.20	5.65	6.22	6.78	16.95
6.60	1.08	4.32	4.64	4.97	5.40	5.94	6.48	16.20
6.80	1.04	4.16	4.47	4.78	5.20	5.72	6.24	15.60
7.00	1.00	4.00	4.30	4.60	5.00	5.50	6.00	15.00
8.00	1.00	4.00	4.30	4.60	5.00	5.50	6.00	15.00

The information in this document is subject to change without further notice.

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