501

ARD2(II) Motor Protector

User's Manual V1.0

ACREL Co., Ltd

Declaration

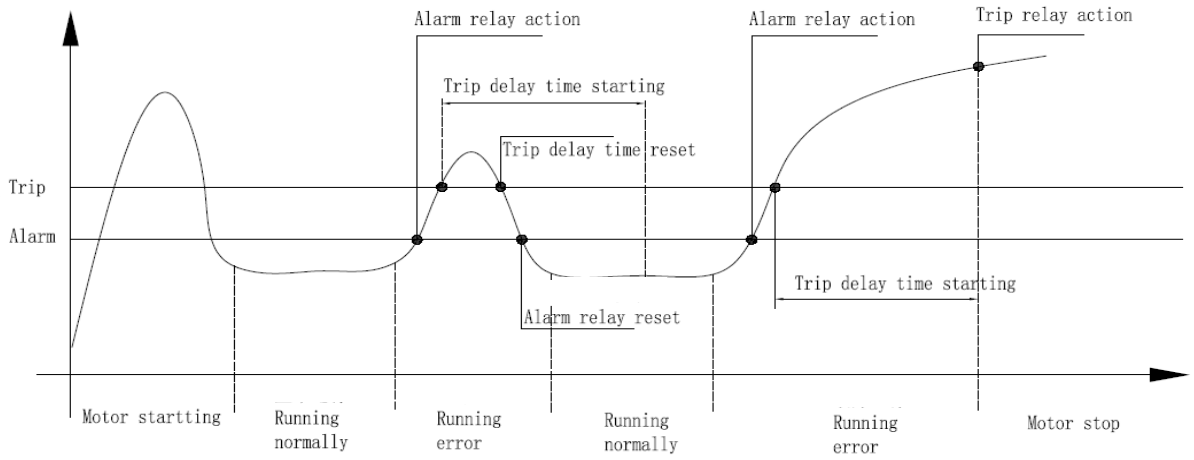
Acrel reserves the right to modify the product specifications herein without notification. Please consult the local agent about the latest specifications before placing a purchase order.

Contents

WARING:Before using the protector,the user must set the various protection functions and protection parameters according to the actual situation of all protection motors.

1 Overview

ARD2(II) series motor protect (hereinafter referred to as protect) can protect the faults during the motor running and display the running state clearly and intuitively through LCD.The protector has RS485 remote communication interface and DC4-20mA analog output, which is convenient to make up a network system with PLC,PC and other control machine.Realize the remote monitoring of motor operation.



Schematic diagram

2 Product type

ARD 2(L)(II)- □ / □

- Additional function（table 3）
- Current specification（table 2）
- Design serial number（table 1）
- Enterprise code

Table 1

Design serial number	Specification	Design serial number	Specification
2	LED display	2L	LCD display

Table 2

Current specifications	CT ratio set	Number of turns of transformer	Range of setting current Is	Power of motor（kW）

（A）			（A）	
1	Yes	5	0.1～9999	0.12～440
5		1	0.1～9999	0.12～440
1.6	No	1	0.4～1.6	0.12～0.55
6.3		1	1.6～6.3	0.75～2.2
25		1	6.3～25	3～11
100		1	25～100	15～45
250		1	63～250	55～132
800		1	250～800	160～440

Table3

Additional functions	Code	Additional functions	Code
Communication	C	8-way switching input, 1-way relay output (programmable 3)	K
Leakage protection	L	SOE event recorder	SR
Analog output 4-20mA	M	Alarm output (programmable 2)	J

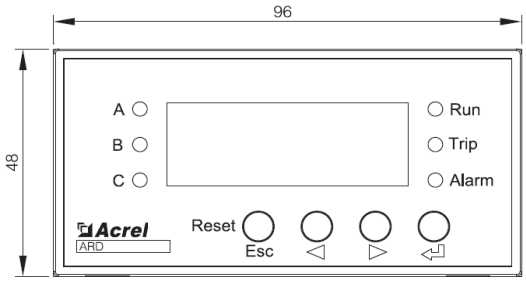
3 General technical index

Table 4

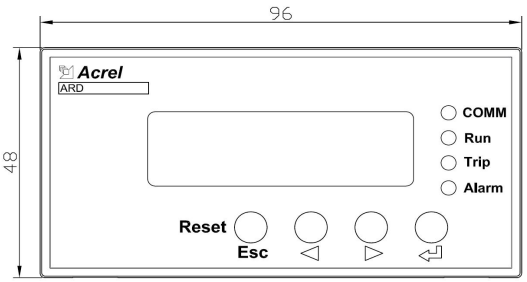
Technical parameters	Technical specification	
Auxiliary power	AC85V~265V/DC100V~350V，power consumption≤7VA	
Rated working voltage of motor	AC380V/AC660V，50Hz/60Hz	
Rated working current of motor	1A（0.1～999.9A）	Small specific current transformer
	5A（0.1～999.9A）	
	1.6A（0.4A～1.6A）	
	6.3A（1.6A～6.3A）	
	25A（6.3A～25A）	
	100A（25A～100A）	
	250A（63A～250A）	Small specific current transformer
	800A（250A～800A）	
Relay output contactor, rated load capacity	4-way，AC250V, 3A；DC30V, 3A	
Switching input	8-way, optical isolation	
Communication	RS485 Mod bus	
Volume of SOE event recorder	8 events record	
Environment	Working temperature	-10ºC～55ºC
	Storage temperature	-20ºC～65ºC
	Relative humidity	5%-95%, no dew
	Altitude	≤ 2000m
Class of pollution	2	
Protection level	IP20	

4 Overall dimensions and installation

4.1 Installation dimensions of protector Unit：mm

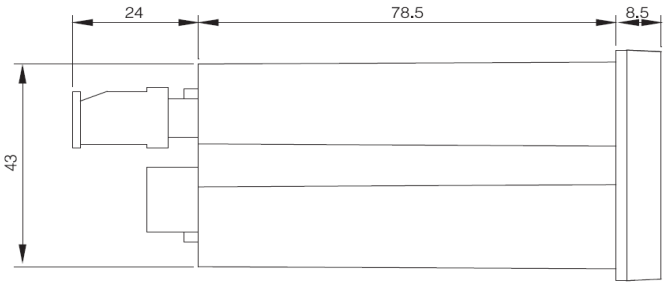


LED

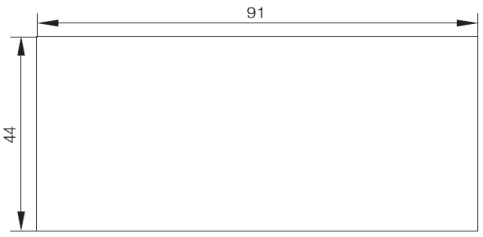


LCD

Front view



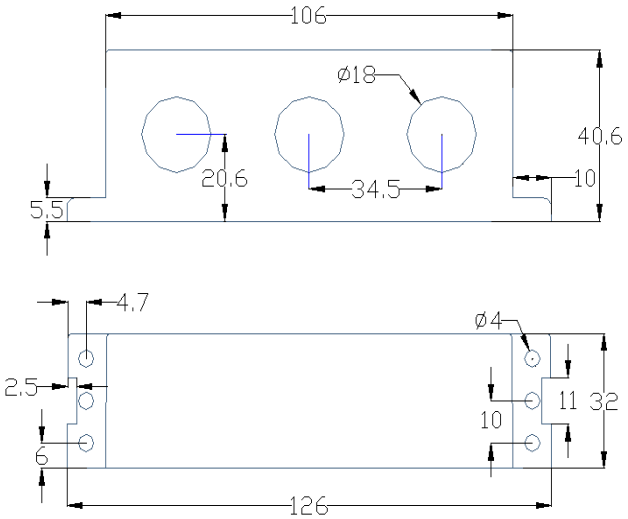
Left view



Opening on the surface

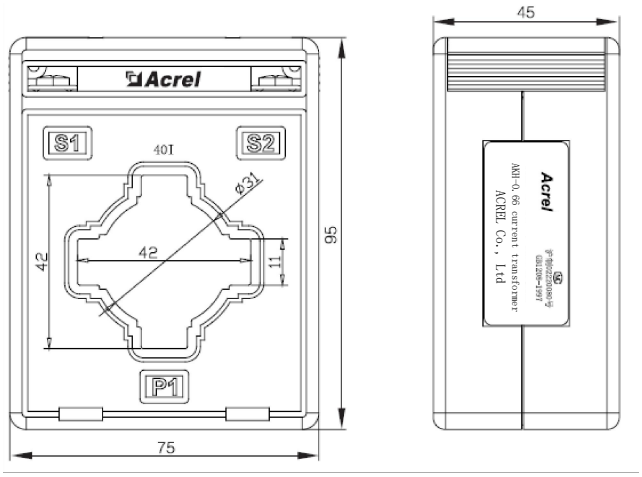
Main body

4.2 Installation dimensions of transformer

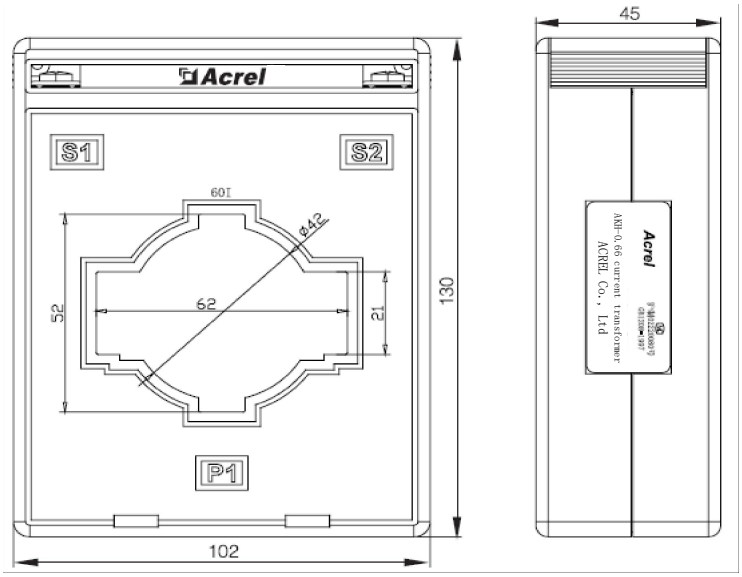


Note：Yellow，blue，red，black correspond to A，B，C and COM3.

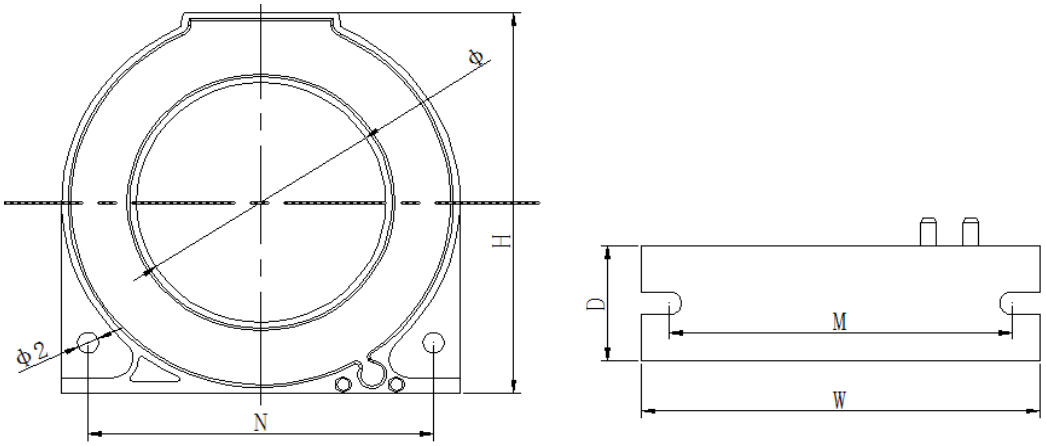
Current Transformer (0.1A-100A)



Current Transformer (63A-250A)



Current Transformer (250A-800A)

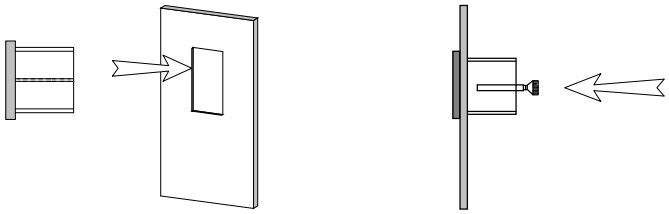


Leakage current transformer

Size / Standard	Current specification (A)	Outline dimension(mm)			Perforation Size(mm)	Installation size(mm)			Tolerance (mm)	Weight （g）
		W	H	D	Φ	M	N	Φ2		

L-45	16-100	75	75	22	46	65	65	4	±1	200±10
L-80	100-250	120	120	23	81	105	105	4		380±20
L-150	400-800	196	205	24	150	175	180	6		850±50

4.3 Installation method



Installation of main body

5 Display and user programming

5.1 Description of LED display

Table 5

No.	Name	Status	Function Description
1	A phase indicator	On	When it is on, the LED shows the current of phase A
2	B phase indicator	On	When it is on, the LED shows the current of phase A
3	C phase indicator	On	When it is on, the LED shows the current of phase A
4	Running indicator	On	When it is on， it indicates that the motor is running
5	Trip indicator	On	When it is on, it indicates that the trip relay is enabled
6	Alarm indicator	On	When it is on, it indicates that the protector has sent an alarm
7	↵key	Press	Select the operating function or return to the last menu
8	◀key (left)	Press	Review events, reduce the digital value or shift
9	▶key (right)	Press	Review the data or increase the digital value
10	Esc/Reset	Press	Exit from the menu, cancel the operation, reset the protector or test the relay
11	4-bit LED	0000	Show the measured value
Note	A、B、C phase indicator	On	When all light are on, it indicates that 11 shows the average current of three phases

5.1.1 User programming

Press the ↵key on the protector until “P001” is indicated. Press the ◀key (left) and the ▶key (right) to select options on the menu. When the cursor moves to the desired option, press the ↵key to set the value field. Press the ◀key to select data bits and the ▶key (right) to increase the value. After setting, press the ↵key to save the parameter. Then press the ESC key to exit from the menu. Indicate the enabling state of protective functions with ON and disabling state with OFF. Refer to the following table for parameter setting:

Table 6

Para meter	Type of setting	Default value	Setting range	Unit
P001	Overload/ full-load rated current setting	1 5 1.6 6.3 25 100 250 800	0.1-999 0.1-999 0.4-1.6 1.6-6.3 6.3-25 25-100 63-250 250-800	A
P002	Trip level setting	5	1, 2, 3, 5, 10, 15, 20, 25, 30, 35, 40	Level
P003	Starting time	10	0.1-999.9	Second
P004	Overload alarm threshold setting	85	1-99%	%
P005	Phase failure trip delay	1	0.1-600.0	s
P006	Leakage fault current setting	300	30-1000	Milliampere
	Ground percentage setting	80	1-100%	%
P007	Ground/ leakage fault trip delay setting	0.5	0.1-600.0	Second
P008	Under-load threshold setting	50	10-99%	%
P009	Under-load trip delay setting	5.0	0.1-600.0	Second
P010	Imbalance threshold setting	30	10-80%	%
P011	Imbalance trip delay setting	5.0	0.1-600.0	Second
P012	Imbalance alarm threshold setting	20	10-80%	%
P013	Alarm enabling On/Off	OFF	OFF/ON	Overload alarm
P014		OFF	OFF/ON	Imbalance alarm
P015	Trip enabling On/off	ON	OFF/ON	Overload trip
P016		OFF	OFF/ON	Ground/leakage trip
P017		OFF	OFF/ON	Under-load trip
P018		ON	OFF/ON	Phase failure trip
P019		ON	OFF/ON	Starting time-out trip
P020		OFF	OFF/ON	Short-circuit trip

P021		OFF	OFF/ON	Blocking trip
P022		OFF	OFF/ON	Imbalance trip
P023		OFF	OFF/ON	External fault trip
P024	External fault trip delay setting	5.0	0.1-600.0	Second
P025	Programmable 1 output setting setting	11	1. alarm; 2. trip; 3. overload; 4.short circuit; 5. ground/ leakage trip; 6. phase failure; 7. external fault; 8. remote starting; 9. leakage alarm; 10. short circuit and ground protection; 11. short circuit, leakage/ ground; 12. short circuit, leakage/ground (pulse: 1s)	
P026	Overload cooling time	0	0: manual reset; 1-30min: automatic reset	Second
P027	Blocking value setting	250	100~700	%
P028	Delay of blocking trip setting	5.0	0.1~600. 0	Second
P029	Baud rate of MODBUS setting	9600	2400, 4800, 9600, 19200, 38400	bps
P030	MODBUS address setting	1	1~247	
P031	Locked-rotor threshold setting	600	100~700	%
P032	Locked-rotor trip delay setting	5.0	0.1-600. 0	Second
P033	Locked-rotor release On/off	ON	0FF/0N	
P034	Short-circuit threshold setting	400	400-720	%
P035	Short-circuit trip delay	0. 1	0.1-600.0	Second
P036	Enabling of residual current transformer	OFF	OFF/ON	
P037	Programmable 2 output setting	2	Same as output setting of programmable 1	
P038	Programmable 3 output setting	2	Same as output setting of programmable 1	
P039	CT transformation ratio	1	1-9999	
P040	Under load alarm	70	10~99%	%

	threshold			
P041	Ground/leakage alarm threshold	20/200	20~100%/100~1000mA	%/mA
P042	Short-circuit alarm threshold	400	400~700%	%
P043	Locked-rotor alarm threshold	500	100~700%	%
P044	Blocking alarm threshold	150	100~700%	%
P045	Under-voltage trip threshold	80	55~90%	%
P046	Under-voltage trip delay	5.0	0.1~600.0	Second
P047	Under-voltage alarm threshold	90	55~90%	%
P048	Over-voltage trip threshold	120	110~150%	%
P049	Over-voltage trip delay	5.0	0.1~600.0	Second
P050	Over-voltage alarm threshold	110	110~150%	%
P051	Alarm allowed	OFF	OFF/ON	Ground/leakage alarm
P052		OFF	OFF/ON	Under load alarm
P053		OFF	OFF/ON	Phase failure alarm
P054		OFF	OFF/ON	Under-voltage alarm
P055		OFF	OFF/ON	Over-voltage alarm
P056		OFF	OFF/ON	Locked-rotor alarm
P057		OFF	OFF/ON	Blocking alarm
P058		OFF	OFF/ON	External fault alarm
P059		OFF	OFF/ON	Short-circuit alarm
P060	Trip allowed	ON	OFF/ON	Under-voltage trip
P061		ON	OFF/ON	Over-voltage trip

LCD parameters are set as follows:

No.	Function		Type of setting	Setting range	Default value	Unit
I	Alarm text					
II	Trip text					
III	Running text	1.Running of current cycle				h
		2. Stop of current cycle				h

		3. Running time				h
		4. Stopping time				h
		5. Number of starts				
		6. Number of trip				
IV	System parameters		Baud rate	2400, 4800, 9600, 19200, 38400	9600	bps
			Communication address	1-247	1	
			Bright backlight	ON/OFF	OFF	
			Transformation ratio transmission	1-8	2	
			Fundamental wave	ON/OFF	OFF	
			Version of software			
V	Protective parameters	Starting protection	Starting time	0.1-99.9	10.0	Second
			Trip	ON/OFF	ON	
		Overload protection	Rated current of motor	1.6-6.3 6.3-25 25-100 63-250 250-800	6.3 25.0 100 250 800	A
			Trip level	1, 2, 3, 5, 10, 15, 20, 25, 30, 35, 40	5	Level
			Alarm threshold	1-99%	85	%
			Alarm	on/off	OFF	
			Trip	on/off	ON	
			Cooling time	0: manual reset: 1-30min: automatic reset	30	Second
		Under-load protection	Trip threshold	10-99%	50	%
			Trip delay	0.1-600.0	5.0	Second
			Trip	on/off	OFF	
		Phase failure protection	Trip delay	0.1 -600.0	1.0	Second
			Trip	ON/OFF	ON	
		Imbalance protection	Alarm threshold	10-80%	20	%

			Trip threshold	10-80%	30	%
			Trip delay	0.1-600.0	5.0	Second
			Alarm	ON/OFF	OFF	
			Trip	ON/OFF	OFF	
		Ground/leakage protection	Enabling of transformer	ON/OFF	OFF	
			ground trip threshold	1~100	80	%
			leakage trip threshold	100~1000	300	Millia mpere
			Trip delay	0.1~600. 0	0.5	Second
			Trip	ON/OFF	ON	
		Short circuit protection	Trip threshold	Max. measurable overload 400%-700%	500	
			Trip delay	0.1~600. 0	0.1	
			Trip	ON/OFF	ON	
		Locked-rotor protection	Locked-rotor threshold	100~700	600	%
			Locked-rotor trip delay	0.1~600.0	5.0	Second
			Locked-rotor trip	OFF/ON	ON	
		Blocking protection	Blocking threshold	100%-700%	250	%
			Trip delay	0.1~600.0	5.0	Second
			Trip	ON/OFF	ON	
		External fault protection	External fault trip delay	0.1-600.0	5.0	Second
			Trip	ON/OFF	OFF	
		Under-voltage protection	Trip threshold	55~90%	80	%
			Alarm threshold	55~90%	90	%
			Trip delay	0.1~600.0	5.0	second
			trip	ON/OFF	ON	
			alarm	ON/OFF	OFF	
		Over-voltage protection	Trip threshold	110~150%	120	%
			Alarm threshold	110~150%	110	%
			Trip delay	0.1~600.0	5.0	second
			trip	ON/OFF	ON	
			alarm	ON/OFF	OFF	
IV.	Control	Setting of		1. alarm; 2. trip; 3.	11	

	parameters	programmable 1		overload; 4.short circuit; 5. ground/ leakage trip; 6. phase failure; 7. external fault; 8. remote starting; 9. leakage alarm; 10. short circuit and ground protection; 11. short circuit, leakage/ ground; 12. short circuit, leakage/ground (pulse: 1s)		
		Setting of programmable 2		Same as output setting of programmable 1	2	
		Setting of programmable 3		Same as output setting of programmable 1	2	
		Test	DO1	ON/OFF	OFF	
			DO2	ON/OFF	OFF	
			DO3	ON/OFF	OFF	
			DO4	ON/OFF	OFF	

5.1.2 Data view

View the measurement data. User can press the key (right) to view the average current of three phases, the current of individual phase (phase A, B or C), the leakage current or ground percentage and switch input.

View the event record. User can press the key. When the LED shows EUt 1, it indicates the event 1 (for the last trip of protector). Press the key. Then LED shows CAUS. Press the key again to view the cause. Press the Esc to return to the last menu. User can view the onth(month), dAY(day), hoUr(hour), inUt(minute) and SEc(second) of trip action with key. User can also view other events with key or key when the LED shows EUt 1. The protector records the latest eight trip events. The meaning of event record is given in the table 7.

Table 7 Meaning of Event Record

Code of communication fault	Message	Fault cause
1	hEAt	Overload
2	oUdF	Ground/Leakage
3	UdCU	Underload
4	LoPh	Phase failure
5	UdEU	Under voltage
6	oErU	Over voltage

7	Stal	Locked-rotor
8	JA	Blocking
9	CUIb	Current imbalance
11	oUtE	External fault
12	Stot	Starting time-out
16	shor	Short circuit

Test if the relay works normally.

Method 1. Press and hold the ESC for 8s and check if the relay is enabled. (The operation is available for both LED tube and LCD designs.)

Method 2. It is only available for LCD design. Set the Remote Starting (0008 by pressing the ↵key and the ▶key to enter the Control Program) for three programmable relay. Then press the ↵key and the ▶key to enter the Control Program and start the test.

Note: For method 1, press the ESC to restore to the original state of relay after test.

For method 2, it is necessary to restore to the original state of relay and reset the programmable setting after test.

5. 2 Description of LCD

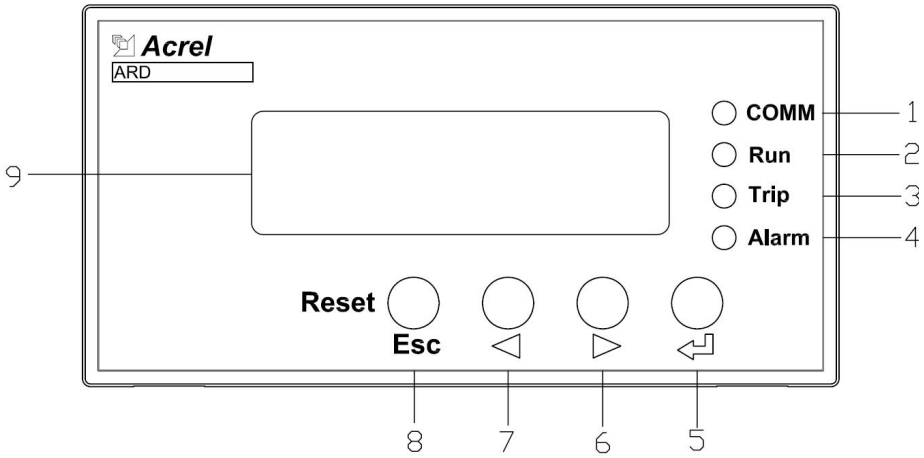


Table8

NO.	Name	Status	Function
1	COMM LED	ON	When it is on, it indicates that the communication bus is loading data
2	Run LED	ON	When it is on， it indicates that the motor is running
3	Trip LED	ON	When it is on, it indicates that the trip relay is enabled
4	Alarm LED	ON	When it is on, it indicates that the protector has sent the alarm
5	↵ key	Press	Select the operating function or return to the last menu
6	◀key (left)	Press	Review events, reduce the digital value or shift
7	▶key (right)	Press	Review the data or increase the digital value
8	Esc/Reset key	Press	Exit from the menu, cancel the operation, reset the protector or test the relay
9	LCD display		Show the measured value

5.2.1 User programming

Press the key on the protector to enter the request and setting screen. Refer to the operation of LED tube for operations of LCD. Set parameters in accordance with the table 6

5.2.2 Data view

User can press the key (right) to see different display menus. Display menus contain folLowing information:

1. current of phases (phase A, B and C) 、percentage of imbalance (Iuf)、power voltage
2. ratio of working current to rated current in percent
3. average current of three phases (phase A, B and C) (Iav), percentage of thermal capacity (Heat), ratio of average three current of

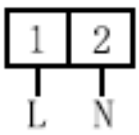
phases (phase A, B and C) to rated current (Iav/In) and ground ratio (Id/In) or leakage current (Id)

4. 2-way or 8-way DI state
5. 4-way relay output: 1-trip; 2-short-circuit/ground trip (programmable 1)

3-alarm (programmable 2); 4- programmable 3

6 Wiring Mode

6.1 Power and current signal

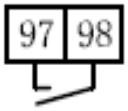


Auxiliary power

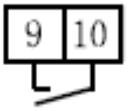
Input of current

6.2 Relay output

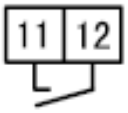
(DO1)
Trip



(DO2)
Short-circuit/ ground trip (programmable 1)

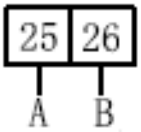


(DO3)
Alarm(programmable 2)



(DO4)
programmable 3

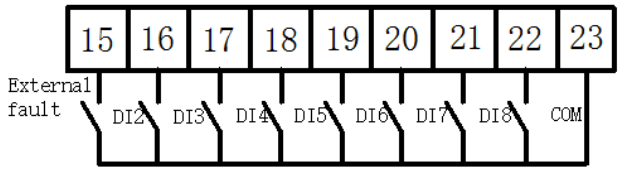
6.3 Communication



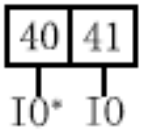
RS485

6.4 Analog output

6.5 Switching input



6.6 Input of leakage current



7 Communication protocol

7.1 Overview of communication protocol

7.1.1 Transmission mode

Adopt the asynchronous signal transmission in byte. The communication information between the master unit and the slave unit is an 11-bit format including one start bit, eight data bits (send the minimum significant bit first), non-parity check bit and one stop bit.

7.1.2 Format of information frame

Address code	Function code	Data field	CRC check code
1 byte	1 byte	n bytes	2 bytes

Address code. It is in the front of frame and consists of one byte (8-bit binary code). The decimal system ranges from 0 to 255. The protector just uses the range from 1 to 247 and others are reserved. These bits identify the address of the terminal unit that user designates to receive the data from connected master unit. The address of each terminal unit is exclusive. Except for addressed terminal unit, no terminal unit will respond to the request including the address. When a terminal unit sends back a response, the response address data enables the master unit to identify the terminal unit communicating with it.

Function code. The function code identifies the function being executed by the addressed terminal unit. The following table lists function codes of this series, their meanings and functions.

Function	Definition	Operation
03H/04H	Read the data register	Obtain the current binary value of one or more registers
10H	Preset multiple registers	Set the binary value in multiple registers
06H	Preset the single register	Set the binary value in the single register

Data field. It contains data that the terminal unit requires for specific function or data acquired when the terminal unit responds to the request. These data may be the numerical value, the reference address or setting. For example, the function code identifies a register and the data field must identify the first register and number of data read out. The embedded address and data vary with the type and slave unit.

CRC check code. The error-checking (CRC) field occupies two bytes including one 16-bit binary value. CRC value is calculated in the transmission unit and attached to the data frame. The receiving unit will re-calculate the CRC value upon receipt and compare the calculated CRC value with that in the CRC field. An error is recognized if two values are different.

A CRC is generated in the following process:

1. Preset 0FFFFH in a 16-bit register (all in 1) and identify such register as CRC register.
2. Perform the XOR operation for 8 bits in the first byte of data frame and Low byte in the CRC register and save the result in the CRC register.
3. Shift the CRC register one bit to the right, fill 0 in the most significant bit, move the least significant bit out and conduct the test.
4. If the least significant bit is 0, repeat the step 3 (next shift). If the least significant bit is 1, perform the XOR operation for the register and a presetting (0A001H).
5. Repeat the step 3 and step 4 eight times until eight bits are processed completely.
6. Repeat the step 2 to 5 to process the next eight bits until all bytes are processed.
7. The final value in the CRC register is the CRC value.

Alternatively, calculate the CRC with a preset table. The alternative method features the fast calculation. However, it requires a large memory. For more details, please refer to relevant data.

7.2 Brief description of function code

7.2.1Function code 03H or 04H: read the register

It enables the user to obtain the data and system parameters acquired and recorded by unit. Though there is no restriction on the number of data requested by master unit, the number of data cannot exceed the defined address range.

In the following example, the slave unit 01 reads basic data L1, L2 and L3 acquired (each address occupies two bytes in the data frame). The addresses of L1, L2 and L3 are 0000H, 0001H and 0002H respectively.

<table>
<tr><th colspan="2">Information sent by the master unit</th><th>Code</th><th colspan="2">Information sent by the slave unit</th><th>Code</th></tr>
<tr><td colspan="2">Address code</td><td>01H</td><td colspan="2">Address code</td><td>01H</td></tr>
<tr><td colspan="2">Function code</td><td>03H</td><td colspan="2">Function code</td><td>03H</td></tr>
<tr><td rowspan="2">Start address</td><td>High byte</td><td>00H</td><td colspan="2">Number of bytes</td><td>06H</td></tr>
<tr><td>Low byte</td><td>00H</td><td rowspan="2">Data in the register</td><td>High byte</td><td>00H</td></tr>
<tr><td rowspan="2">Number of registers</td><td>High byte</td><td>00H</td><td>Low byte</td><td>00H</td></tr>
<tr><td>Low byte</td><td>03H</td><td rowspan="2">Data in the register</td><td>High byte</td><td>00H</td></tr>
<tr><td rowspan="2">CRC check code</td><td>Low byte</td><td>CBH</td><td>Low byte</td><td>00H</td></tr>
<tr><td>High byte</td><td>05H</td><td rowspan="2">Data in the register</td><td>High byte</td><td>00H</td></tr>
<tr><td></td><td></td><td>Low byte</td><td>00H</td></tr>
<tr><td></td><td></td><td></td><td rowspan="2">CRC check code</td><td>High byte</td><td>75H</td></tr>
<tr><td></td><td></td><td></td><td>Low byte</td><td>21H</td></tr>
</table>

7.2.2 Function code 10H: preset the register

The code allows user to change the data in multiple registers. With the code, user can preset the system parameter, output state of relay and other data in the protector. The master unit permits the presetting of eight data (16 bytes) once at most.

In the following example, the switch output DO3 is preset for the instrument at the address 01. The switch input/output state indicates that the address of register is 0003H, bits 0 and 1 correspond to DI1 and DI2 and bits 8 to 11 correspond to DO1 to DO4.

Information sent by the master unit		Code	Information sent by the slave unit		Code
Address code		01H	Address code		01H
Function code		10H	Function code		10H
Start address	High byte	00H	Start address	High byte	00H
	Low byte	03H		Low byte	03H
Number of registers	High byte	00H	Number of registers	High byte	00H
	Low byte	01H		Low byte	01H
Number of bytes		02H	CRC check code	Low byte	C9H
Data to be preset in 0003H	High byte	04H		High byte	F1H
	Low byte	00H			
CRC check code	Low byte	A3H			
	High byte	A4H			

7.2.3 Function code 06H: preset the single register

The function code 06H allows the user to change the information in the single register. Preset the system parameters, switch output state and others relating to the system with 06H.

In the following example, the switch output DO3 is preset for the instrument at the address 01. The switch input/output state indicates that the address of register is 0003H, bits 0 and 1 correspond to DI1 and DI2 and bits 8 to 11 correspond to DO1 to DO4.

Information sent by the master unit		Code	Information sent by the master unit		Code
Address code		01H	Address code		01H
Function code		06H	Function code		06H
Start address	High byte	00H	Start address	High byte	00H
	Low byte	03H		Low byte	03H
Data to be preset 0003H	High byte	04H	Data to be preset 0003H	High byte	04H
	Low byte	00H		Low byte	00H
CRC check code	Low byte	0AH	CRC check code	Low byte	0AH
	High byte	7BH		High byte	7BH

7.3 Address parameter

Table 9

Address	Address	Parameter	Property (R/W)	Range of value	Type
1	0x00	Actual current of phase L1	R	0-65535	word
		Fundamental current of phase L1	R	0-65535	word
2	0x01	Actual current of phase L2	R	0-65535	word
		Fundamental current of phase L2	R	0-65535	word
3	0x02	Actual current of phase L3	R	0-65535	word
		Fundamental current of phase L3	R	0-65535	word
4	0x03	Switch output	R/W	Bits 0 to 3 correspond to relays DO1 to DO4	High byte
		Switch input	R	Bits 0 and 1 correspond to the switch input DI1 and DI2	Low byte
5	0x04	Voltage	R	0-65535	word
6	0x05	Current imbalance	R	0-100%	word
7	0x06	Accumulative percentage of thermal capacity	R	0-100%	word
8	0x07	Phase failure trip delay	R/W	0.1-600.0	word
9	0x08	Current specification	R	0-1. 6,1-6.3、2-25、3-100, 4-250, 5-800, 6-1, 7-5	word
		Current scaling factor	R	10, 100	
10	0x09	Average current	R	0-65535	word
		Average fundamental current	R	0-65535	word
11	0x0A	Leakage current	R	30~1000mA	word
		Percentage of ground current		1-100%	
12	0x0B	State of motor	R	Residual overload cooling time	High byte
				Bit 0: hold; Bit 1: stop; Bit 2: start; Bit 3: run; Bit 4: alarm; Bit 5: trip	Low byte
13	0x0C	Indication of trip	R	Bit 0: overload trip; Bit 1:	word

		fault		ground/ leakage trip; Bit 2: under-load trip; Bit 3: phase failure trip; Bit 4:under-voltage trip; Bit 5:over-voltage trip; Bit 6:locked-rotor trip; Bit 7: blocking trip; Bit 8: imbalance trip; Bit 10: external fault trip; Bit 11: start time-out trip; Bit 15: short circuit trip	
14	0x0D	Overload/ full-load current	R/W	0.4-800.0	word
15	0x0E	Trip level	R/W	1、 2、 3、 5、 10、 15、 20、 25、 30、 35、 40	word
16	0x0F	Starting time	R/W	0.1-999.9	word
17	0x10	Overload alarm threshold	R/W	1-99%	word
18	0xll	Hold	R		word
19	0x12	Leakage current	R/W	30-1000mA	word
		Ground trip percentage	R/W	20-100%	word
20	0x13	Ground/leakage trip delay	R/W	0.1-600.0	word
21	0x14	Enabling of residual current transformer	R/W	0: disabled;1:enabled	word
22	0x15	Under-load threshold	R/W	10-99%	word
23	0x16	Under-load trip delay	R/W	0.1-600.0	word
24	0x17	Hold	R	0	word
25	0x18	Imbalance threshold	R/W	10-80%	word
26	0x19	Imbalance trip delay	R/W	0.1-600.0	word
27	0x1 A	Imbalance alarm threshold	R/W	10-80%	word
28	0xlB	Alarm enabling on/off	R/W	Bit 0: overload alarm Bit 8: imbalance alarm	word
29	0xlC	Trip enabling on/off	R/W	Bit 0: overload trip; Bit 1: ground/ leakage trip; Bit 2: under-load trip; Bit 3: phase failure trip; Bit 4:under-voltage trip; Bit 5:over-voltage trip; Bit 6: locked-rotor trip; Bit 7:	word

				blocking trip; Bit 8: imbalance trip; Bit 10: external fault trip; Bit 11: start time-out trip; Bit 15: short circuit trip	
30	0xlD	System frequency	R	50、60	word
31	0xlE	MODBUS baud rate: 2400, 4800, 9600, 19200, 38400	R/W	2400、 4800、 9600、 19200、 38400	word
32	0xlF	MODBUS address	R/W	1-247	word
33	0x20	CT transformation ratio	R/W	1-2000	word
34	0x21	Fundamental wave on/off	R/W	0: effective value; 1: fundamental wave	High byte
		Hold type of motor	R/W	0: single-phase; 1: 3-phase 4-wire	Low byte
35	0x22	Short circuit threshold	R/W	400%-700%, max. measurable overload multiple	word
36	0x23	Short-circuit trip delay	R/W	0.1-600.0	word
37	0x24	Blocking value	R/W	100-700	word
38	0x25	Blocking trip delay	R/W	0.1-600.0	word
39	0x26	Remote reset	R/W	0: normal; 1: remote reset	word
40	0x27	External fault trip delay	R/W	0.1-600.0	word
41	0x28	Programmable 1 relay setting	R/W	1. alarm; 2. trip; 3. overload; 4. short circuit; 5. ground/ leakage trip; 6. phase failure; 7. external fault; 8. remote start; 9. leakage alarm; 10. short-circuit and ground protection; 11. short circuit, ground/ leakage; 12. short circuit, ground/ leakage (pulse 1s)	word
42	0x29	Overload cooling time	R/W	0: manual reset; automatic reset: 1-30min	word
43	0x2A	Programmable 2 relay setting	R/W	Same as the relay setting of programmable 1	word
44	0x2B	Programmable 3 relay setting	R/W	Same as the relay setting of programmable 1	word
45	0x2C	Initial relay state	R/W	0: open; 1: closed; bits 0 to 3: relays 1 to 4	word
46	0x2D	Locked-rotor trip threshold	R/W		word
47	0x2E	Locked-rotor trip	R/W		word

		delay			
48	0x2F	Event control parameter	R		word
49~73	0x30~0x48	Reserve	R/W		word
74	0x49	Software version NO.	R	0.1~100.0	word
75	0x4A	Year	R/W	2012-2099	
76	0x4B	Month	R/W	1-12	
77	0x4C	Day	R/W	1-31	
78	0x4D	Hour	R/W	0-24	
79	0x4E	Minute	R/W	0-59	
80	0x4F	Second	R/W	0-59	
81	0x50	Running time this time	R	0-65535hour	word
82	0x51	Stopping time this time	R	0-65535hour	word
83	0x52	Total running time	R/W	0-65535hour	word
84	0x53	Total stopping time	R/W	0-65535hour	word
85	0x54	Total start times	R/W	0-65535	word
86	0x55	Total trip times	R/W	0-65535	word
87	0x56	Under-voltage trip threshold	R/W	55-90%	word
88	0x57	Under-voltage trip delay	R/W	0.1-600.0	word
89	0x58	Under-voltage alarm threshold	R/W	55-90%	word
90	0x59	Over-voltage trip threshold	R/W	110-150%	word
91	0x5A	Over-voltage trip delay	R/W	0.1-600.0	word
92	0x5B	Over-voltage alarm threshold	R/W	110-150%	word
93	0x5C	Ground current percentage	R/W	20-100%	word
94	0x5D	Leakage alarm current	R/W	30-1000mA	word
95	0x5E	Under-load alarm threshold	R/W	10-99%	word
96	0x5F	Locked-rotor alarm threshold	R/W	100-700%	word
97	0x60	Blocking alarm threshold	R/W	100-700%	word
98	0x61	Short circuit alarm threshold	R/W	400%-700%	word
99	0x62	Overload return coefficient	R/W	5-50%	word
100	0x63	Ground return	R/W	5-50%	word

		coefficient				
101	0x64	Leakage return coefficient	R/W	5-50%	word
102	0x65	Under-load return coefficient	R/W	5-50%	word
103	0x66	under-voltage return coefficient	R/W	5-50%	word
104	0x67	over-voltage return coefficient	R/W	5-50%	word
105	0x68	Locked-rotor return coefficient	R/W	5-50%	word
106	0x69	Blocking return coefficient	R/W	5-50%	word
107	0x6A	Imbalance return coefficient	R/W	5-50%	word
108	0x6B	Short circuit return coefficient	R/W	5-50%	word
109	0x6C	Current shield percentage	R/W	0-10%	word
110	0x6D	Leakage shield value	R/W	0-389mA	word
111	0x6E	Voltage shield value	R/W	0-110V	word
112-181	0x6F-0xB4	Reserve	R/W		word
182	Event Record1	0xB5	STA1	R	Actuation of protection 1 1: overload trip; 2: ground/leakage trip; 3: under-load trip; 4: phase failure trip; 5:under-voltage trip; 6:over-voltage trip; 7:locked-rotor trip; 8: blocking trip; 9: imbalance trip; 11: external fault trip; 12: start time-out trip; 16: short-circuit trip	word
183		0xB6	Year1	R	Action 1 time- year	HIGH BYTE
			Month1	R	Action 1 time- month	LOW BYTE
184		0xB7	Day1	R	Action 1 time- day	HIGH BYTE
			Hour1	R	Action 1 time- hour	LOW BYTE
185		0xB8	Minute1	R	Action 1 time- minute	HIGH BYTE
			Second1	R	Action 1 time- second	LOW BYTE

186	event record 2	0xB9	STA2	R	Actuation of protection 2 1: overload trip; 2: ground/leakage trip; 3: under-load trip; 4: phase failure trip; 5:under-voltage trip; 6:over-voltage trip; 7:locked-rotor trip; 8: blocking trip; 9: imbalance trip; 11: external fault trip; 12: start time-out trip; 16: short-circuit trip	word
187		0xBA	Year2	R	Action 2 time- year	HIGH BYTE
			Month2	R	Action 2 time- month	LOW BYTE
188		0xBB	Day2	R	Action 2 time- day	HIGH BYTE
			Hour2	R	Action 2 time- hour	LOW BYTE
189		0xBC	Minute2	R	Action 2 time- minute	HIGH BYTE
			Second2	R	Action 2 time- second	LOW BYTE
190	event record 3	0xBD	STA3	R	Actuation of protection 3 1: overload trip; 2: ground/leakage trip; 3: under-load trip; 4: phase failure trip; 5:under-voltage trip; 6:over-voltage trip; 7:locked-rotor trip; 8: blocking trip; 9: imbalance trip; 11: external fault trip; 12: start time-out trip; 16: short-circuit trip	word
191		0xBE	Year3	R	Action 3 time- year	HIGH BYTE
			Month3	R	Action 3 time- month	LOW BYTE
192		0xBF	Day3	R	Action 3 time- day	HIGH BYTE
			Hour3	R	Action 3 time- hour	LOW BYTE
193		0xC0	Minute3	R	Action 3 time- minute	HIGH BYTE
			Second3	R	Action 3 time- second	LOW BYTE
194	eve	0xC1	STA4	R	Actuation of protection 4 1: overload trip; 2: ground/leakage trip; 3:	word

	n t r e c o r d 4				under-load trip; 4: phase failure trip; 5:under-voltage trip; 6:over-voltage trip; 7:locked-rotor trip; 8: blocking trip; 9: imbalance trip; 11: external fault trip; 12: start time-out trip; 16: short-circuit trip	
195		0xC2	Year4	R	Action 4 time- year	HIGH BYTE
			Month4	R	Action 4 time- month	LOW BYTE
196		0xC3	Day4	R	Action 4 time- day	HIGH BYTE
			Hour4	R	Action 4 time- hour	LOW BYTE
197		0xC4	Minute4	R	Action 4 time- minute	HIGH BYTE
			Second4	R	Action 4 time- second	LOW BYTE
198	e v e n t r e c o r d 5	0xC5	STA5	R	Actuation of protection 5 1: overload trip; 2: ground/leakage trip; 3: under-load trip; 4: phase failure trip; 5:under-voltage trip; 6:over-voltage trip; 7:locked-rotor trip; 8: blocking trip; 9: imbalance trip; 11: external fault trip; 12: start time-out trip; 16: short-circuit trip	word
199		0xC6	Year5	R	Action 5 time- year	HIGH BYTE
			Month5	R	Action 5 time- month	LOW BYTE
200		0xC7	Day5	R	Action 5 time- day	HIGH BYTE
			Hour5	R	Action 5 time- hour	LOW BYTE
201		0xC8	Minute5	R	Action 5 time- minute	HIGH BYTE
			Second5	R	Action 5 time- second	LOW BYTE
202	e v e n t r	0xC9	STA6	R	Actuation of protection 6 1: overload trip; 2: ground/leakage trip; 3: under-load trip; 4: phase failure trip; 5:under-voltage trip; 6:over-voltage trip;	word

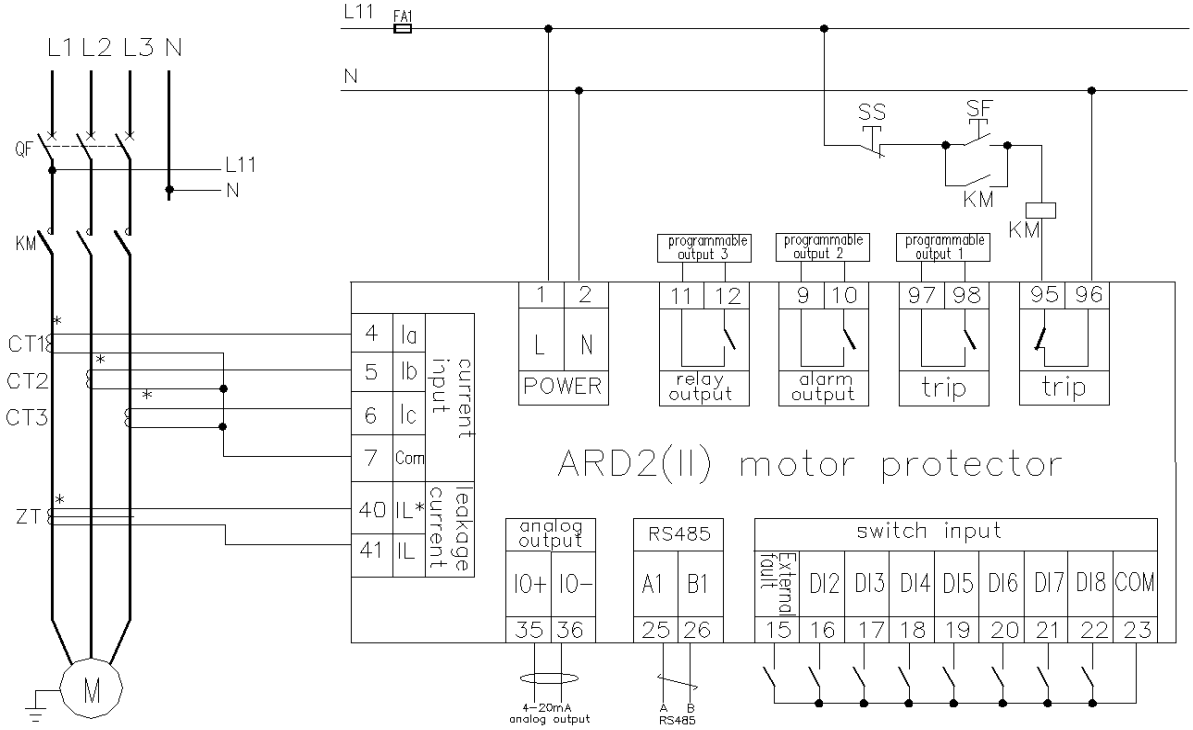
	event record 6				7:locked-rotor trip; 8: blocking trip; 9: imbalance trip; 11: external fault trip; 12: start time-out trip; 16: short-circuit trip	
203		0xCA	Year6	R	Action 6 time- year	HIGH BYTE
			Month6	R	Action 6 time- month	LOW BYTE
204		0xCB	Day6	R	Action 6 time- day	HIGH BYTE
			Hour6	R	Action 6 time- hour	LOW BYTE
205		0xCC	Minute1	R	Action 6 time- minute	HIGH BYTE
			Second1	R	Action 6 time- second	LOW BYTE
206	event record 7	0xCD	STA7	R	Actuation of protection 7 1: overload trip; 2: ground/leakage trip; 3: under-load trip; 4: phase failure trip; 5:under-voltage trip; 6:over-voltage trip; 7:locked-rotor trip; 8: blocking trip; 9: imbalance trip; 11: external fault trip; 12: start time-out trip; 16: short-circuit trip	word
207		0xCE	Year7	R	Action 7 time- year	HIGH BYTE
			Month7	R	Action 7 time- month	LOW BYTE
208		0xCF	Day7	R	Action 7 time- day	HIGH BYTE
			Hour7	R	Action 7 time- hour	LOW BYTE
209		0xD0	Minute7	R	Action 7 time- minute	HIGH BYTE
			Second7	R	Action 7 time- second	LOW BYTE
210	event reco	0xD1	STA8	R	Actuation of protection 8 1: overload trip; 2: ground/leakage trip; 3: under-load trip; 4: phase failure trip; 5:under-voltage trip; 6:over-voltage trip; 7:locked-rotor trip; 8: blocking trip; 9: imbalance trip; 11: external fault trip; 12: start	word

	r d 8				time-out trip; 16: short-circuit trip	
211		0xD2	Year8	R	Action 8 time-year	HIGH BYTE
			Month8	R	Action 8 time-month	LOW BYTE
212		0xD3	Day8	R	Action 8 time-day	HIGH BYTE
			Hour8	R	Action 8 time-hour	LOW BYTE
213		0xD4	Minute8	R	Action 8 time-minute	HIGH BYTE
			Second8	R	Action 8 time-second	LOW BYTE

8.Typical application solutions

Direct start mode: The local button controls the start and stop of motor in the drawing. The protector cannot start or stop the motor independently. The sucking coil of contactor KM is engaged in the NC contact of trip relay. When the electricity is supplied and the start button SF is pressed, the sucking coil of KM is energized to close the main contact of KM and activate the motor. If the stop button SS is pressed, the sucking coil of KM is de-energized to release the main contact of KM and deactivate the motor.

Note: The remote start is controlled by the host computer rather than protector.

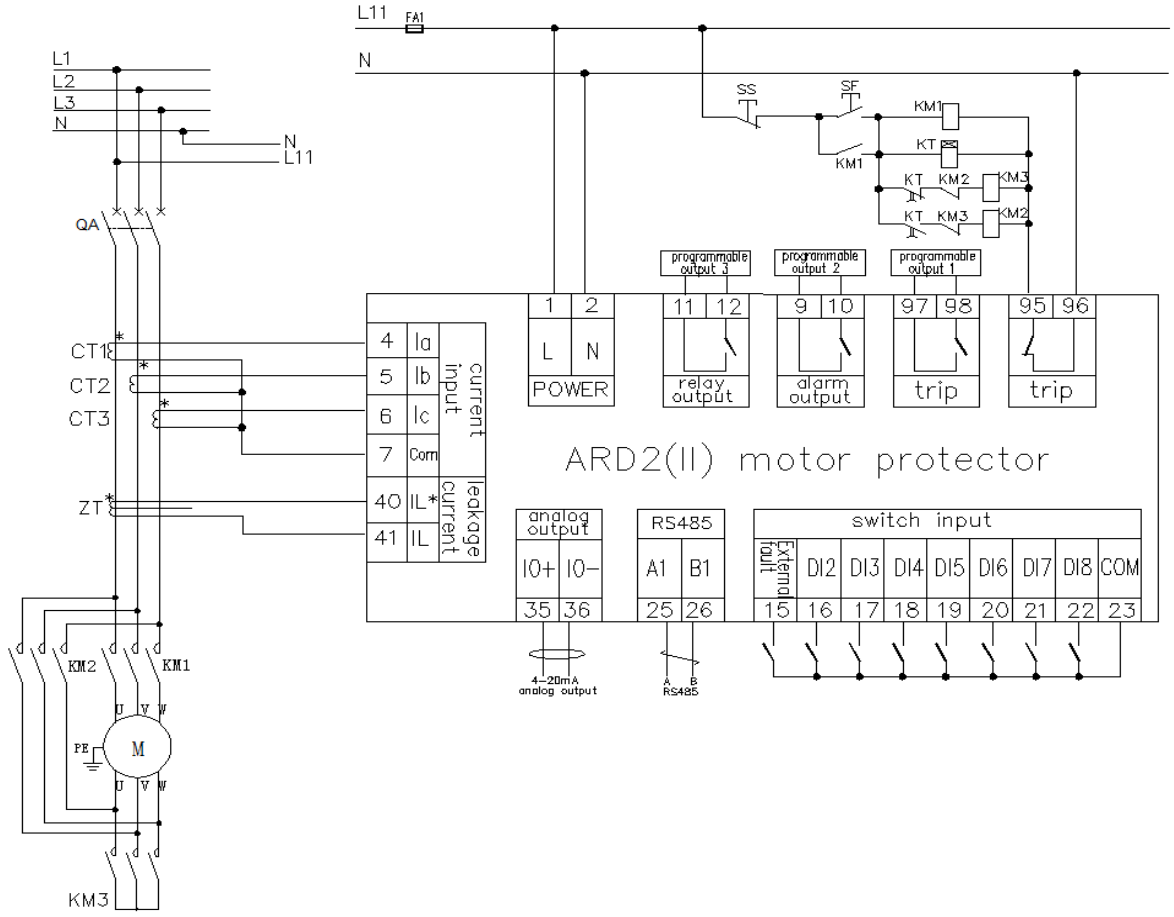


Direct Start Wiring of Motor Protector ARD2(II)

(Suitable for 1.6、6.3、25、100、250、800A specification)

Y-Δ start mode: The local button controls the start and stop of motor in the drawing. The protector cannot start or stop the motor independently. The sucking coil of contactor KM1 is engaged in the NC contact of trip relay. When the electricity is supplied and the start button SF is pressed, the sucking coils of KM1 and KM3 are energized to close the main contacts of KM1 and KM3 and activate the motor in the Y mode. When the delay time is reached, the time relay KT is enabled. The sucking coil of KM3 is de-energized and the main contact of KM3 is open while the sucking coil of KM2 is energized and the main contact of KM2 is closed. The motor starts in the normal Δ mode. If the stop button SS is pressed, the sucking coil of KM1 is de-energized to release the main contact of KM1 and deactivate the motor.

Note: The remote start is controlled by the host computer rather than protector.



Y-Δ Start Wiring of Motor Protector ARD2(II)

(Suitable for 1.6、6.3、25、100、250、800A specification)

9 Setting and instructions of protection functions

9.1 Setting of protective parameters Table 10

Function	Item	Content
Start time-out protection	Range of starting time	0.1s-999.9s
	Actuation time	Instant
	Actuation method	trip
Overload protection	Non-operating characteristic	<105% Ie, no operation in 2h

	Operating characteristic	>120%Ie, delay in 1h
	Trip level	1,2,3,5,10,15,20,25,30,35,40
	Alarm threshold	1%-99%
	Overload protection method	Alarm& trip
Locked-rotor protection	Setting range of operating value	（100%-700%）Ie
	Setting range of delay time	0.1s-600.0s, graduation in 0.1s
	Actuation method	Trip
Blocking protection	Setting range of operating value	100%-700% Ie
	Setting range of delay time	0.1s-600.0s, graduation in 0.1s
	Actuation method	Trip
Under-load protection	Setting range of operating value	（10%-99%）Ie
	Setting range of delay time	0.1s-600.0s, graduation in 0.1s
	Actuation method	Alarm& trip
Imbalance protection	Setting range of operating value	10%-80%
	Actuation time	0.1s-600.0s, graduation in 0.1s
	Actuation method	Trip
Earthing/leakage protection	Setting range	30-1000mA
	Delay time	0.1s-600.0s, graduation in 0.1s
	Actuation method	Trip
Short-circuit protection	Short-circuit setting	（400%-700%）Ie
	Actuation time	0.1s-600.0s, graduation in 0.1s
	Actuation method	Trip
External fault protection	Actuation time	0.1s-600.0s, graduation in 0.1s
	Actuation method	Trip
Phase failure protection	Actuation time	0.1s-600.0s, graduation in 0.1s
	Actuation method	Trip

9.2 Description of protective functions

Enabling time of protective functions:

Table 11

Type of protection	Working periods
External fault	Stopping
External fault, phase failure, leakage/ earthing, locked-rotor and start time-out	Starting
External fault, phase failure, leakage/ earthing, overload, imbalance, blocking, under-load, short circuit	Running

 Starting overtime protection

When the starting time reaches the setting value and the average current of phases exceeds 1.1 times (1.7 for Ex motor) than the rated current, the protection is activated according to the setting and a trip command is sent to stop the motor.

 Overload protection

When the motor runs under overload conditions (actual current above the rated value) for a long time, the overheating will occur and the insulation will be reduced and burnt. The protector calculates the thermal capacity of motor according to the heating characteristic and then protects

the motor by simulating the heating characteristic.

Refer to the table 12 for relationship between the overload current and the time. The following diagram illustrates the overload characteristic curve (curve K).

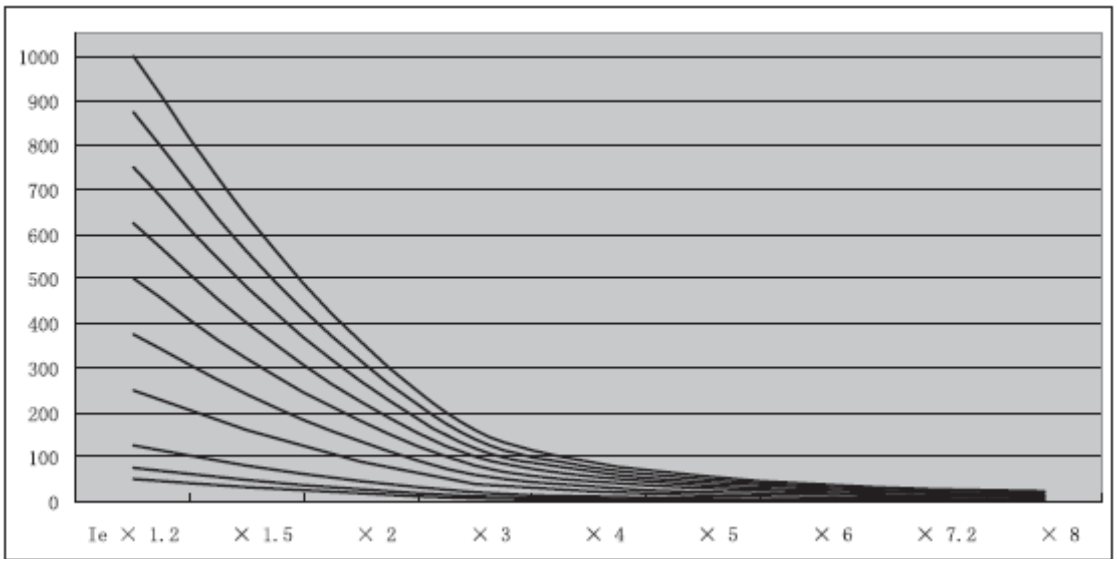
Relationship between the overload current and time

Table 12

Selectable trip curve level, K	1	2	3	5	10	15	20	25	30	35	40
Trip delay error, s, ±10%	Balanced three-phase load, starting from the cold state										
Rated value Ie * 1.2	25	50	75	125	250	375	500	625	750	875	1000
xl.5	16	32	48	80	160	240	320	400	480	560	640
x2	9	18	27	45	90	135	180	225	270	315	360
x3	4	8	12	20	40	60	80	100	120	140	160
x4	2.26	4.52	6.78	11.3	22.5	33.8	45	56.3	67.5	78.8	90
x5	1.44	2.88	4.32	7.2	14.4	21.6	28.8	36	43.2	50.4	57,6
x6	1	2	3	5	10	15	20	25	30	35	40
x7.2	0.7	1.4	2.1	3.5	6.9	10.4	13.9	17.4	20.8	24.3	27.8

When the protector detects the overload running of motor, it shall send the alarm or trip signal within the alarm or trip (delay) setting time.

Overload characteristic curve (curve K)



 Locked-rotor protection (over-current protection upon start)

If the motor shaft is caught due to the great load or mechanical troubles upon start or during running and the problem is not resolved promptly, the overheating will occur and the insulation will be reduced and burnt. The locked-rotor protection is available when the motor shaft is caught upon start. The blocking protection is available when the motor shaft is caught during running. After the current reaches the actuation setting, the protector performs the trip within the trip (delay) time setting to prevent the motor from burning.

 Under-load protection

The no-load or under-load operation of motor is hazardous for connected pump load, if any. In such case, the protector provides the under-load protection. When the ratio of average current of phases to rated current is lower than the setting, the protector performs the trip within the trip

(delay) time setting.

 Imbalance protection

When the motor is running and the three-phase imbalance rate reaches the setting, the protector provides the protection by sending the alarm or trip signal. It increases the running safety of motor.

Maximum difference between three-phase current and average current/maximum difference between rated current and average current

 Earthing/ leakage protection

The protector is provided with the earthing protection and leakage protection (user can just select one protective function). The earthing current is the vector sum of three-phase current. When the zero sequence transformer detects that the leakage current is above the setting, the protector trips within the trip (delay) setting time for human safety.

 Short-circuit protection

When the running current of motor exceeds the current setting, the protector provides the protection and trips within the trip (delay) setting time.

 External fault protection

When any external fault occurs, the external fault switching value is closed. Then the protector detects the input of external fault signal and trips within the trip (delay) setting time.

 Phase failure protection

The phase failure operation is hazardous for motor. In case of phase failure, the protector provides the protection and sends the trip command to guarantee the running safety of motor.

Note: The analog output 20mA (4—20mA) corresponds to the current two times than the rated current (P001).

10 Cautions

1. To improve the anti-interference capacity, the protector ARD2L may select the fundamental current for display and protection. Select the true RMS or fundamental mode with the fundamental switch option in the menu of system parameter.

2. The direction of primary circuit must be identical to that of three-phase current. Otherwise, the earthing protection may fail.

3. If the protector is provided with the earthing/leakage protection, recommend the shielded conductor to lead the zero sequence current transformer into the protector. Otherwise, the measured data may be inaccurate.

4. Set the rated current of protector (P001) properly. If the setting is below the normal rated current of motor, the motor may not start normally. If the setting is above the normal rated current of motor, the protector may not provide the normal protection for failed motor.

5. After the protector trips, resolve the fault and reset the protector before restarting the motor. Otherwise, the motor cannot start.

6. Cooling time of motor: 30min. After the overload protection is enabled (fault code: hEAt), cool the motor and then reset it because of heat accumulation.

7. It is necessary to reset the protector after changing any parameter. Then the current setting becomes valid.

8. If the protector is enabled as soon as the motor starts or is always disabled because the

parameter setting of protector is improper for the intended application, turn off all protective functions. Then reset the protector according to parameters measured during normal running of motor.

9. If the protector is enabled as soon as the motor starts and protective parameter settings are proven suitable, find out causes according to the displayed code.

10. The setting of protector is default when the protector is delivered (unless otherwise specified by user). User can turn on all protective functions and set them to actual demands.

11. Unless otherwise specified the length of connecting line is 1m between the transformer and protector.

12. User must specify the special requirements (e.g. single-phase motor protector and length of connecting line) in the order.

11 Order sample

Example: Model: ARD2(II)-25A/CLMKSR

Auxiliary power supply: AC220V

Display mode: digital tube

Rated current of motor: 6.3-25A

Application: three-phase motor

Measurement: three-phase current and average current of phases

Additional functions: RS485 Mod bus, leakage measurement, DC analog output 4-20mA, 8-way switch input, 1-way relay output and 8 event records

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