

ARD-KHD-S03 Voltage Sag Protector

Installation and Instruction Manual V1.1

State

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1 General

As an important control component of the motor circuit, the AC contactor plays an important role in industrial production. The phenomenon of voltage sag caused by lightning strike, short-circuit re-closing, power grid failure, high-power equipment startup and other reasons seriously affects the normal operation of the contactor, and causes the related interlocking equipment to shut down, thus causing huge economic losses to the enterprise.

Acrel ARD-KHD-S03 series voltage sag protector has the function of " Contactor hold + restart", which can effectively resist the release of the contactor caused by the shock of the contactor control circuit, guarantee the continuous operation of equipment, and escort the efficient production of enterprises.

2 Characteristic

- The combination of Contactor hold and restart is convenient for wiring and can effectively resist the release of the contactor caused by voltage sag.
- Voltage sag programmable settings to meet different customers' needs.
- 4-channel programmable DI inputs with built-in DC24V power supply; 4-channel programmable passive DO output.
- Optional 1 channel MODBUS_RTU communication.
- Optionally record shaking events, switching events, contactor events, device events, power-on events, swell and sag events, 16 events can be recorded of each kind, which is convenient for user maintenance and management.
- The main body is equipped with a LCD display as standard, and with an optional external embedded display unit at the same time.
- External display unit supports U disk program upgrade.

3 Model

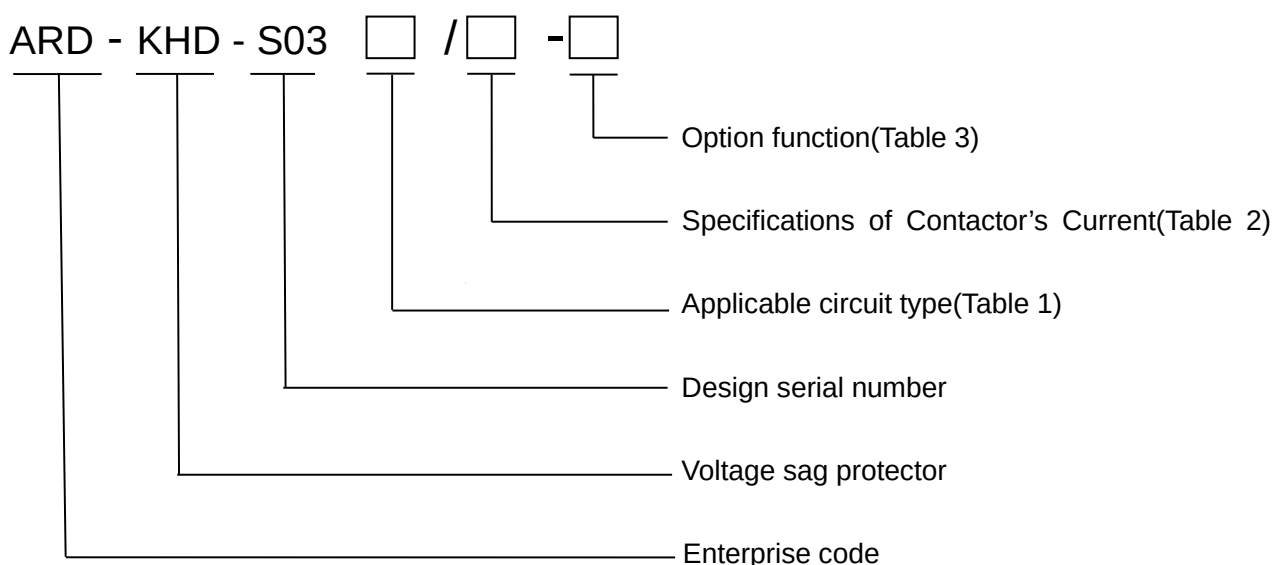


Table1

Circuit type	A	AC220V Contactor
	B	AC380V Contactor
	F	Frequency conversion circuit

Table 2

Specifications of Contactor's Current	C1	Rated current of contactor<125A
	C2	125A≤Rated current of contactor≤630A

Table 3

Function module	Code
1 channel ModbusRTU	C
SOE	SR
Black and white dot matrix LCD display, the module size is 98×60, the cut-out size is 92×55 (unit mm)	60L

Note: 1. This product cannot be used for DC contactor or contactor with energy saving function;
 2. When the applicable circuit type is "S03F", there is no need to choose the contactor's current specification.

4 Technical parameters

4.1 Technical indicators

ARD-KHD-S03 technical indicators as table 4:

Table 4

Technical parameters	Technical indicators	
Power supply	S03A:AC220V±20%,S03B:AC380V±20%	
Rated working voltage of contactor	AC220V / 380V	
Capacity of relay output contact	Resistive load	AC250V,10A
Switch input	4-channel passive dry nodes, built-in DC24V power supply	
Communication	1-channel MODBUS RTU	
Environment	Working temperature	-10°C~55°C
	Storage temperature	-25°C~70°C
	Relative humidity	≤95% no condensation, no corrosive gas
	Humidity	≤2000m
Pollution level	Level 3	
Protection level	Main body is IP30, external embedded display module is IP65 (when installed on the cabinet panel)	
Installation level	Level III	

5 Dimension and installation

5.1 Appearance and dimension

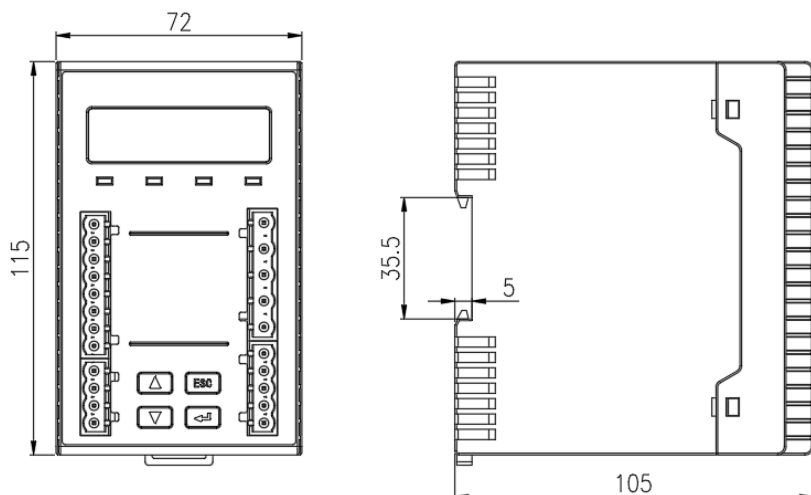


Figure 1 Dimensions of the main body

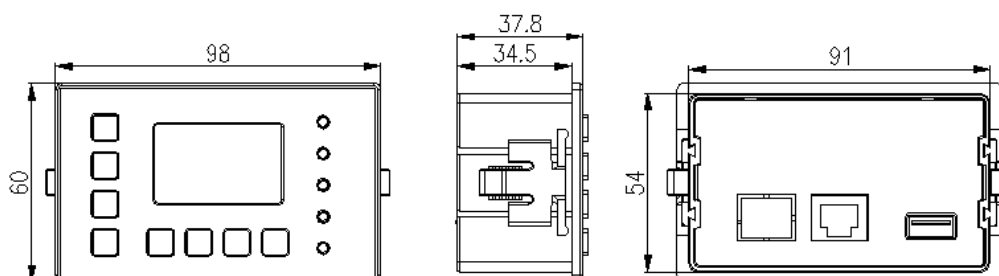


Figure 2 Dimensions of display module

5.2 Definition of terminal number function

ARD-KHD-S03 terminal number function and definition as table 5:

Table 5

No.	Definition of function	Remark
11	Auxiliary power input L	Auxiliary power supply is connected to these two terminals
14	Auxiliary power input N	
21	A1	Modbus_RTU
22	B1	
40,41	DO1	4-channel programmable relay outputs (DO) (Users can set it on their own according to their needs, or note the factory settings when place an order)
42,43	DO2	
44,45	DO3	
46,47	DO4	
30	DI1	4-channel programmable relay inputs (DI) (Users can set it on their own according to their needs, or note the factory settings when place an order)
31	DI2	
32	DI3	
33	DI4	
39	COM,DI input	
94	Control circuit button side contact	Control circuit contacts, please refer to the following example for specific wiring.
95	Control circuit KM+ contact	
96	Control circuit KM-contact	

6 Introduction of the menu

ARD-KHD-S03 Menu introduction see Table 6:

Table 6

No.	Main Menu	Function	Type	Setting range	Defaults	Unit
1	Fixed value setting	Voltage drop settings	Hold action threshold	99.9~399.9V(0.1V)	180.0	V
			Hold return threshold	99.9~399.9V(0.1V)	190.0	V
			Hold time	0.020~10.999s(0.001s)	3.000	S
			Closing state detection of breaker	Voltage,DI	DI	
		Restart setting	Function switch	Close, Restart, VFD restart	Close	
			Restart action threshold	99.9~499.9V(0.1V)	200.0	V
			Restart delay	0.1~99.9s (0.1s)	20.0	S
			Maximum allowed time	Hold time ~999.9s	60.0	S
		Switch setting	DO1	Normally open, Normally closed	—	V
				No input, Under-voltage alarm, Restart output, Process interlock, Reset, VFD error reset, Over/ under voltage alarm	No input	
				0.0-20.0	0.0	S
			DO2	Same as above		
			DO3			
			DO4			
			DI1	Normally Open, Normally Closed	Normally Open	
				No input, Breaker closed state, Function off, VFD error, VFD running	No input	
			DI2	Same as above		
			DI3			
			DI4			
		Voltage sag setting	Voltage swell threshold	199.9-499.9	250.0	V
			Voltage sag threshold	99.9-399.9	180.0	V
			No action voltage range	0.1-19.9	10.0	V
			Alarm delay		3.000	S
2	Current	Harmonic	—	—	—	%

	parameters	Switch status	DI1-4	—	—	
			DO1-4	—	—	
		Voltage drop times	—	—	—	Times
		Breaker closed times	—	—	—	Times
		Power-on times	—	—	—	Times
3	Communication settings	Address	—	001-254	001	
		Baud rate	—	2400,4800,9600,19200,38400	9600	
		Check digit	—	None/2stop/Odd/Even	None	
4	SOE	Voltage drop events	—	—	—	
		Switch events	—	—	—	
		Contactor events	—	—	—	
		Device events	—	—	—	
		Power-on events	—	—	—	
		Swell and sag event	—	—	—	
5	System settings	Time setting	Time	—	—	
		Remove event	Clear voltage drop events	Yes,No	No	
			Clear switch events	Yes,No	No	
			Clear contactor events	Yes,No	No	
			Clear device events	Yes,No	No	
			Clear power-on events	Yes,No	No	
			Clear swell and sag events	Yes,No	No	
			Clear voltage drop times	Yes,No	No	
			Clear breaker closed times	Yes,No	No	
			Clear power-on times	Yes,No	No	
		Contrast	—	0-100%	050%	%
		Backlight settings	—	Normally on,0000-9999	Normally on	S
		User password	—	0001-9999	0001	
		Manufacturer information	—	—	—	

7 Settings and instructions of communication

7.1 General introduction of Modbus RTU

Electrical interface: RS485 half duplex

Baud rate: 1200/2400/4800/9600/19200/38400

Address: consists of one byte (8-bit binary), decimal is 0~255, only 1 to 247 is used in the system, others are reserved

Error detection: CRC

Data Format:

Address code	Function code	Data area	CRC check
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Length of data:

1 byte	1 byte	N byte	2 byte
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Each byte bit: 1 start bit, 8 data bits (the least significant bit is sent first), no parity, and 1 stop bit

MODBUS function code supported by the protection device:

01 (0x01) Function code: read coil status (relay output DO, address 0 corresponds to DO1)

02 (0x02) Function code: read switch input state (DI, address 0 corresponds to DI1)

03/04 (0x03, 0x04) Function code: Read hold register

05 (0x05) Function code: write coil status (control relay output DO, address 0 corresponds to DO1)

06 (0x06) Function code: Writes to a single register

16 (0x10) Function code: Write multiple registers

Note: Operation control bit and output control bit are written by 16 function code.

Communications applications

The examples in this section use the following tabular format (in hexadecimal data) whenever possible

Addr.	Fun	Data start		Data		CRC16	
		reg Hi	reg Lo	reg Hi	reg Lo	Lo	Hi
01H	03H	00H	00H	00H	06H	C5H	C8H
Address	Function code	Data start address		Number of data read		Cyclic redundancy check code	

Read data

Example 1: Use 01 function to read the register: read the DO1-DO4 relay output status of the 01 protector

Query data frame	01 01 00 00 00 04 3D C9
Return data frame	01 01 01 <u>02</u> D0 49 (02: bit1 1 means DO2 is closed)

Example 2: Use the function 02 to read the register: read the DI1-DI4 switch input status of the 01 protector

Query data frame	01 02 00 00 00 04 79 C9
Return data frame	01 02 01 <u>01</u> 60 48 (01: bit0 1 means DI1 is close)

Example 3: Use 03 or 04 to read register: read protector 01 and read 3 data starting at address 00

Query data frame	01 03 00 00 00 03 05 CB
Return data frame	01 03 06 09 3C 00 00 03 E8 71 57

Write data

Example 4: Write a register using function 05

Close DO1 relay of No. 01 protection instrument:

Query data frame	01 05 00 00 FF 00 8C 3A
Return data frame	01 05 00 00 FF 00 8C 3A

Disconnect the DO1 relay of No. 01 protector:

Query data frame	01 05 00 00 00 00 CD CA
Return data frame	01 05 00 00 00 00 CD CA

Example 5: Write register with 06 function: output DO2 (BIT1) of 01 protector and disconnect other DO.

Query data frame	01 06 00 05 00 02 18 0A
Return data frame	01 06 00 05 00 02 18 0A

Example 6: Write register with 16 function: output DO2 (BIT1) of 01 protector and disconnect other DO.

Query data frame	01 10 00 05 00 01 02 00 02 27 C4
Return data frame	01 10 00 05 00 01 11 C8

7.2 Data read conversion

For example:

1. Take the power voltage RMS reading of the power supply as an example: the value read from address 0 is 2300, and the actual voltage is 230.0V.

7.3 Modbus communication address list

The parameter setting address is shown in Table 7, and the SOE address is shown in Table 8.:

Table 7

Classification	Addr.	Addr.	Parameter	Read and write properties	Ranges	Type
Parameter	0	0x00	Auxiliary power voltage (full wave)	R	0-456.0(0.1V)	word
	1	0x01	Contactor AC voltage	R		word
	2	0x02	Super-capacitor charge percentage	R	0-100%	word
	3	0x03	Frequency		0~75.00(Hz)	
	4	0x04	Auxiliary power voltage (fundamental wave)	R	0-456.0(0.1V)	word
	5	0x05	DO output status	R/W	Bit0~ Bit3 corresponds to DO1~DO4	word
	6	0x06	DI input status	R	Bit0~ Bit3 corresponds to DI1~DI4	word
	7	/	/	R	/	
	8	0x08	Current state	R	Bit0 breaker state, Bit13 voltage drop	word

					Bit14 voltage rise, Bit15 voltage sag	
	9-19	/	/	R	/	word
	20	0x14	Voltage drop times	R/W	0-65535 Write 0 to clear	word
	21	0x15	Breaker closed times	R/W		word
	22	0x16	Power-on times	R/W		word
	22-35	/	/	R	/	word
Event record location	30	0x1E	Voltage drop events record position	R	0-15, the latest event is the SOE of the x+1 group. For example, if the switch events record position reads 5, it means that the latest event is the 6th group, the current event address is 2230, the last event address is 2224, and the last event address is 2218. and so on	word
	31	0x1F	Switch events record position	R		word
	32	0x20	Contactor events record position	R		word
	33	0x21	Device events record position	R		word
	34	0x22	Power-on events record position	R		word
	35	0x23	Swell and sag events record position	R		word
Date time	36	0x24	Year and month	R/W	High byte year, low byte month (decimal)	word
	37	0x25	Day and hour	R/W	High byte day, low byte hour (decimal)	word
	38	0x26	Minutes and seconds	R/W	High byte minutes, low byte seconds (decimal)	word
	39	/	/	R	/	
Protection parameters	40	0x28	Hold action threshold	R/W	99.9~399.9V(0.1V)	word
	41	0x29	Hold return threshold	R/W	99.9~399.9V(0.1V)	
	42	0x2A	Hold time	R/W	0.100~10.999 s(0.001s)	word
	43	0x2B	Closing state detection of breaker	R/W	0 voltage identification 1DI access detection	word
	44	0x2C	Restart function switch	R/W	0 off 1 on	word
	45	0x2D	Restart action voltage	R/W	99.9~499.9V(0.1V)	word
	46	0x2E	Restart delay	R/W	0.1~99.9s (0.1s)	word
	47	0x2F	Restart maximum allowable time	R/W	Hold time~999.9s	word
	48	0x30	Voltage swell Threshold	R/W	199.9~499.9V(0.1V)	word
	49	0x31	Voltage sag threshold	R/W	99.9~399.9V(0.1V)	word
	50	0x32	No action voltage range	R/W	0.1~19.9V(0.1V)	word
	51	0x33	Alarm delay	R/W	0.00-9.99s	word
	52-59	/	/	R	/	word
	60	0x3C	DI1 function	R/W	High byte: 0 normally open 1 normally	word
	61	0x3D	DI2 function	R/W		word

	62	0x3E	DI3 function	R/W	closed; Low byte: 0 no input, 1 contactor status, 2 VFD error signal, 3 VFD running signal	word
	63	0x3F	DI4 function	R/W		word
	64	0x40	DI5 function(reserved)	R/W		word
	65	0x41	DO1 function	R/W	High byte: 0 normally open 1 normally closed; Low byte: 0 no input, 1 under-voltage alarm, 2 restart output, 3 process interlock, 4 reset, 5 VFD error reset, 6 over and under voltage alarm	word
	66	0x42	DO2 function	R/W		word
	67	0x43	DO3 function	R/W		word
	68	0x44	DO4 function	R/W		word
	69	0x45	DO1 delay time setting	R/W	0.0~20.0s 0 is level output, others are pulse output	word
	70	0x46	DO2 delay time setting	R/W		word
	71	0x47	DO3 delay time setting	R/W		word
	72	0x48	DO4 delay time setting	R/W		word
System	73-74	/	/	R	/	word
	75	0x4B	User password	R/W	0-9999	word
	76	0x4C	LCD backlight	R/W	0(Normally on)~9999s	word
	77	0x4D	LCD contrast ratio	R/W	0~100%	word
	78	0x4E	Split LCD backlight	R/W	0(Normally on)~9999s	word
Communication	79	0x4F	Split LCD contrast ratio	R/W	0~100%	word
	80	0x50	Communication address	R/W	1-247	word
	81	0x51	Communication baud rate	R/W	0~5(38400,19200,9600,4800,2400,1200)	word
	82	0x52	Communication check digit	R/W	0~3(No check, 2 stop bits, odd check, even check)	word

Table 8

Classification	Addr.	Addr.	Parameter	Read and write properties	Ranges	Type
Clear records	2000	0x07D0	Clear voltage drop events	R/W	Write 0 to clear the corresponding event record	word
	2200	0x0898	Clear switch events	R/W		word
	2400	0x0960	Clear contactor events	R/W		word
	2600	0x0A28	Clear device events	R/W		word
	2800	0x0AF0	Clear power-on events	R/W		word
	3000	0x0BB8	Clear voltage swell and sag events	R/W		word
Harmonic	1800-		Total harmonics and	R	0.0~200.0%	word

	1863		2-63 harmonics in turn			
Voltage drop event	2000	0x07D0	Year and month	R/W	High byte year, low byte month (decimal)	word
	2001	0x07D1	Day and hour	R	High byte day, low byte hour (decimal)	word
	2002	0x07D2	Minutes and seconds	R	High byte minutes, low byte seconds (decimal)	word
	2003	0x07D3	Millisecond	R	0-999mS	word
	2004	0x07D4	Voltage drop in milliseconds	R	xxxxxx.xxx mS (high word in the back, low word in front)	word
	2005	0x07D5		R		word
	2006	0x07D6	Minimum voltage	R	xxx.xV(0.1V)	word
	2007	0x07D7	Condition	R	low byte 1: Start and stop under voltage 2: Undercharge 3: Voltage drop hold 4: Overtime trip 5: Restart success 6: Restart failure 7: Restart timeout 8: Manual restart 9,10: Function off 11: Manual reset	word
	2008-2015	0x07D8-0x07DF	Group 2 Voltage drop event	R	Same as above (each group of 8 characters)	word
	2016-2023	0x07E0-0x07E7	Group 3 Voltage drop event	R	Same as above	word
	2024-2127	0x07E8-0x084F	Group 4-16 Voltage drop event	R	Same as above	word
Switch event	2200	0x0898	Year and month	R/W	High byte year, low byte month (decimal)	word
	2201	0x0899	Day and hour	R	High byte day, low byte hour (decimal)	word
	2202	0x089A	Minutes and seconds	R	High byte minutes, low byte seconds (decimal)	word
	2203	0x089B	Millisecond	R	0-999mS	word
	2204	0x089C	Channel number	R	0-3 for DI1-DI4	word
	2205	0x089D	Condition	R	0 open 1 closed	word
	2206-2211	0x089E-0x08A3	Group 2 Switch event	R	Same as above (each group of 6 words)	word
	2212-2217	0x08A4-0x08A9	Group 3 Switch event	R	Same as above	word

	2218-2295	0x08AA-0x08F7	Group 4-16 Switch event	R	Same as above	word
Contactor event	2400	0x0960	Year and month	R/W	High byte year, low byte month (decimal)	word
	2401	0x0961	Day and hour	R	High byte day, low byte hour (decimal)	word
	2402	0x0962	Minutes and seconds	R	High byte minutes, low byte seconds (decimal)	word
	2403	0x0963	Millisecond	R	0-999mS	word
	2404	0x0964	Condition	R	0 open 1 closed	word
	2405	0x0965	/	R	/	word
	2406-2411	0x0966-0x096B	Group 2 Contactor event	R	Same as above (each group of 6 characters)	word
	2412-2417	0x096C-0x0971	Group 3 Contactor event	R	Same as above	word
	2418-2495	0x0972-0x09BF	Groups 4-16 Contactor event	R	Same as above	word
Device Event	2600	0x0A28	Year and month	R/W	High byte year, low byte month (decimal)	word
	2601	0x0A29	Day and hour	R	High byte day, low byte hour (decimal)	word
	2602	0x0A2A	Minutes and seconds	R	High byte minutes, low byte seconds (decimal)	word
	2603	0x0A2B	Millisecond	R	0-999mS	word
	2604	0x0A2C	Mode switch		1 AC ~ Energy save 2 Energy save ~ Contactor hold 3 Contactor hold ~ Energy save 4 Contactor hold ~ AC 5 Energy save ~ AC	word
	2605	0x0A2D	Auxiliary power voltage when switching		0-456.0(0.1V)	word
	2606	0x0A2E	Super-capacitor voltage when switching		0-15.0V(0.1V)	word
	2607	0x0A2F	Contactor AC voltage when switching		0-456.0(0.1V)	word
	2608-2615	0x0A30-0x0A37	Group 2 Device event	R	Same as above (each group of 8 characters)	word
	2616-2623	0x0A38-0x0A3F	Group 3 Device event	R	Same as above	word
	2624-2727	0x0A40-0x0AA7	Group 4-16 Device event	R	Same as above	word

Power-on event	2800	0x0AF0	Year and month	R/W	High byte year, low byte month (decimal)	word
	2801	0x0AF1	Day and hour	R	High byte day, low byte hour (decimal)	word
	2802	0x0AF2	Minutes and seconds	R	High byte minutes, low byte seconds (decimal)	word
	2803	0x0AF3	Millisecond	R	0-999mS	word
	2804	0x0AF4	Start counts		0-65536	word
	2805	0x0AF5	/	R	/	word
	2806-2811	0x0AF6-0x0AFB	Group 2 Power-on event	R	Same as above (each group of 6 characters)	word
	2812-2817	0x0AFC-0x0B01	Group 3 Power-on event	R	Same as above	word
	2818-2895	0x0B02-0x0B4F	Group 4-16 Power-on event	R	Same as above	word
Voltage swell and sag event	3000	0x0BB8	Year and month	R/W	High byte year, low byte month (decimal)	word
	3001	0x0BB9	Day and hour	R	High byte day, low byte hour (decimal)	word
	3002	0x0BBA	Minutes and seconds	R	High byte minutes, low byte seconds (decimal)	word
	3003	0x0BBB	Millisecond	R	0-999mS	word
	3004	0x0BBC	Voltage swell/sag	R	0:Voltage sag 1:Voltage swell	word
	3005	0x0BBD	Voltage during swell or sag	R	0-456.0(0.1V)	word
	3006	0x0BBE	Duration	R	xxxxx.xxx mS (high word in the back, low word in front)	
	3007	0x0BBF		R		
	3008-3015	0x0BC0-0x0BC7	Group 2 Voltage swell and sag event	R	Same as above (each group of 8 characters)	word
	3016-3023	0x0BC8-0x0BCF	Group 3 Voltage swell and sag event	R	Same as above	word
	3024-3127	0x0BD0-0x0C37	Groups 4-16 Voltage swell and sag event	R	Same as above	word

8 Wring

8.1 Figure 3 shows the typical wiring in the "Contactor hold" mode:

AC380V,50/60Hz

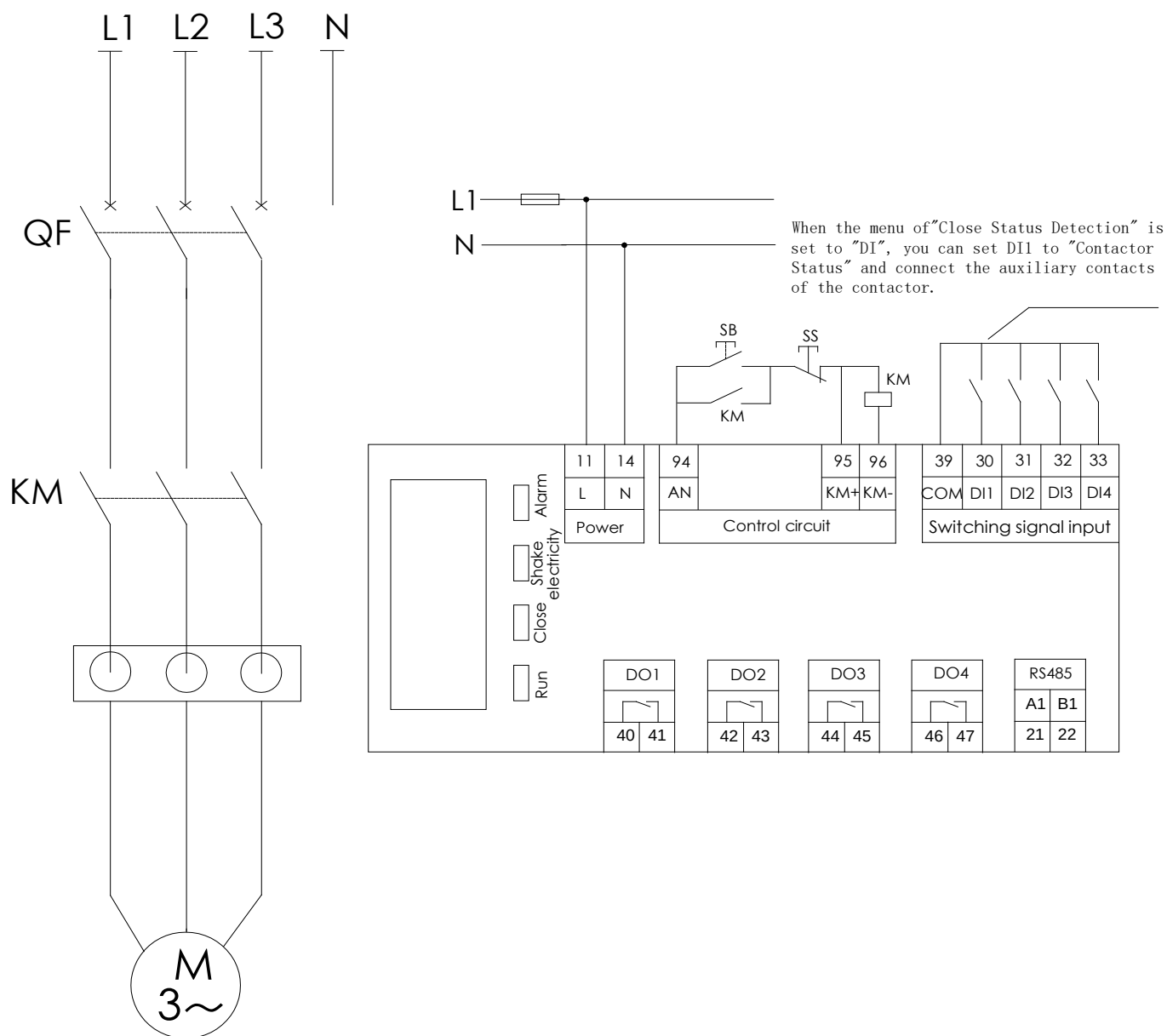


Figure 3 Wiring diagram of the Contactor hold mode

8.2 Figure 4 shows the typical wiring of contactor hold + restart:

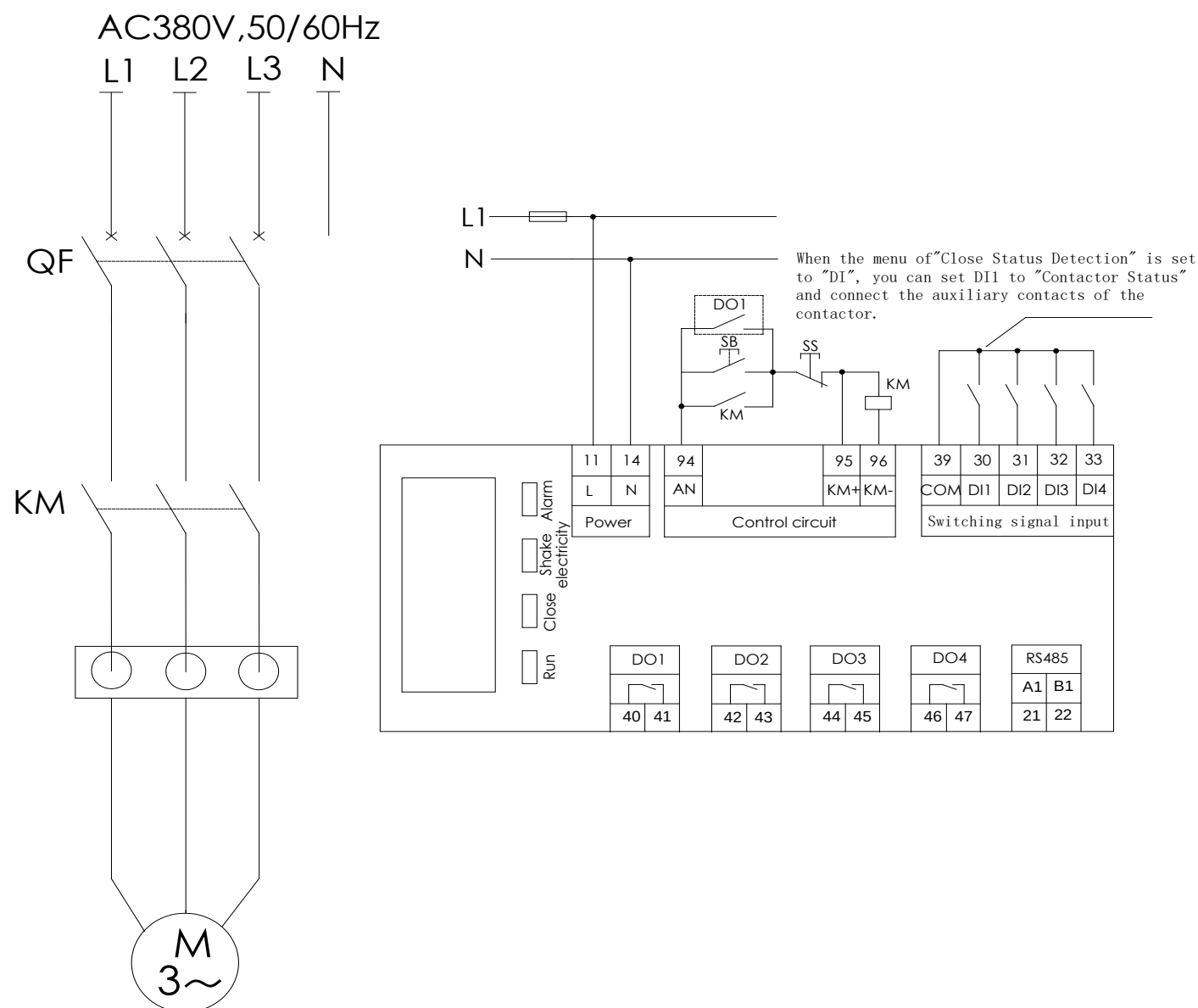


Figure 4 Wiring diagram of Contactor hold + restart

Note: (1) The control circuit terminals 94, 95, and 96 must be wired in strict accordance with the wiring instructions, and cannot be reversed!

(2) When using the "restart" function, it is necessary to set the DO used for restart as "restart output".

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