



Numerical Protection Relay

MELPRO™-D Series

OVERCURRENT WITH 2f BLOCKING RELAY

MODEL

COC4-A03D1

INSTRUCTION MANUAL

Request

Ensure that this Instruction Manual is delivered to
the end users and the maintenance manager.

- Introduction -

Thank for your purchasing MITSUBISHI ELECTRIC **MELPRO**™ – D Series Digital Protection Relay.

Please read this manual carefully to be familiar with the functions and performances enough to use the product properly.

Please note end users are required to be provided with this instruction manual.

For operation of the product, this manual should be used in conjunction with the following materials:

Title of document	Document No.
MELPRO – D Series Protection Relay General Operation Manual	JEP0-IL9416

When the protection relay is used together with a communication card, use the following documents too:

(For CC-Link)

Title of document	Document No.
MELPRO – D Series Protection Relay CC-COM Communication Card (CC-Link) Operation Manual (General information)	JEP0-IL9417
MELPRO – D Series Protection Relay CC-COM Communication Card (CC-Link) Operation Manual (Model-specific information)	JEP0-IL9418

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1 Features

1.1 General description

Mitsubishi Electric MELPRO-D Series is a digital protection relay product with a microprocessor for protecting high/extra-high-voltage electric power system.

With its improved functions, including operation support using the advanced communication networks, data saving at the power system faults and power system voltage/current measurement, this series of protection relay will allow stable and effective control and monitoring of electric power systems as well as provide high-reliable protection.

1.2 Features

(1) High-reliable protection

The product includes a three-phase overcurrent protection element and an earth-fault overcurrent protection element. Just this one relay is enough to protect a power system with a resistance earthed neutral system from phase and earth faults.

Furthermore, the second harmonic blocking function against transformer inrush current is equipped.

(2) Diverse operation and reset characteristics

The product is provided with diversified operation and reset characteristics that meet the requirements of IEC 60255-3, and can be used for protecting various types of electric systems.

(3) Communication Network

- With an open field bus system, the relays can be used to build a high-speed, high-performance network system. In addition, the relay's multi-drop serial wiring reduces the amount of labor required for communication wiring.
- Control of measurement values, operation status, as well as setting changes, etc., can be performed from a remote location.
- In consideration of future network system variations and compatibility with communication networks, communication features are mounted in the relay using a replaceable card.

(4) Measurement & Recording Functions

- Real time monitoring of relay input data
The relay can measure steady state relay input values, supporting energy management.
- Fault Data Monitoring
When a fault occurs, the relay saves the past 5 effective input values and waveform data to assist with fault analysis.

(5) Programmable Output Configuration

The operating output contacts (DO) can be set by combining the outputs of the protection relay element using 'OR' logic, thereby simplifying sequence design.

(6) High Accurate Digital Computation

The digital computation using high-speed sampling minimizes the effect of high harmonics, etc., and results in highly accurate protection.

(7) Self-diagnosis

The relay continuously monitors electronic circuits from input to output so that it can detect internal failure before that failure causes damage on the power system, thereby improving reliability.

(8) Easy Replacement

The dimensions of the panel cutout are the same as the prior MULTICAP series. Changing from an existing relay type to this new type is easy.

(9) Easy Maintenance

The relays are adopted as draw-out unit mechanisms with automatic CT shorting at drawing, thereby making maintenance easy.

(10) Easy wiring check

It is possible to carry out forced operation of the output contacts individually. This will allow an easy wiring check.

2 Rating and specifications

2.1 General information

Type name		COC4-A03D1				
Style	Relay without RS232C I/F	079PQB	080PQB	081PQB	082PQB	
	Relay with RS232C I/F	459PMB	460PMB	461PMB	462PMB	
Element	Protection	Phase fault time–delayed element × 3 (with 2 nd harmonics blocking)				
		Phase fault instantaneous element × 3 (with 2 nd harmonics blocking)				
		Earth fault time–delayed element × 1 (with 2 nd harmonics blocking)				
		Earth fault instantaneous element × 1 (with 2 nd harmonics blocking)				
Measurement		Phase current, zero-phase current				
Rating	Frequency	50 Hz	60 Hz	50 Hz	60 Hz	
	Phase current	5 A		1 A		
	Zero-phase current	1 A		0.2 A		
	Auxiliary Power supply *21	Voltage	Common use for 100 ~ 220VDC / 100 ~ 220VAC			
		Operative range	DC : 85 ~ 242 V (Range of 80 ~ 286VDC is allowable temporarily.) AC : 85 ~ 242 V (Range of 80 ~ 253VAC is allowable temporarily.)			
Display	RUN		Indicate the result of self-diagnosis. The lamp is lit for normal conditions and off for abnormal.			
	Unit		Indicate the unit symbol for measurements.			
	Item No., Item data		Display measurement, status, setting and option data selected with an item number.			
	Communication		With a communication card installed: the lamp is lit for normal conditions, blinking during communication and off for abnormal. With a communication card not installed: the lamp is off.			
Self-diagnosis		Monitor the electronic circuit and internal power supply to output signal to the RUN LED and self-diagnosis output (ALARM).				
Output contacts	Configurations	For trip	2 make contacts: X ₄ and X ₅ (programmable output)			
		For signaling	4 make contacts: X ₀ to X ₃ (programmable output)			
		For self-diagnosis output	1 break contact: Y (open for normal result of self-diagnosis with power on)			
	Capacity	For trip	Make	110VDC, 15A, 0.5 s (L/R = 0 s) 220VDC, 10A, 0.5 s (L/R = 0 s)		
			Break	110VDC, 0.3A (L/R ≤ 40 ms) 220VDC, 0.15A (L/R ≤ 40 ms)		
			Carry	1.5 A, continuously		
		For signaling and self-diagnosis output	Make and Break	500 VA (cosφ = 0.4), 60W (L/R = 0.007 s)		
	Max. current	5 A				
	Max. voltage	380VAC, 125VDC				
Burden	Phase circuit		0.5 VA or less (with rated current)			
	Zero-phase circuit		0.5 VA or less (with rated current)			
	Auxiliary power supply circuit		For 100VDC: approx. 5 W (approx. 7W including communication card) For 100VAC: approx. 7 VA (approx. 9VA including communication card) For 220VDC: approx. 6 W (approx. 8W including communication card) For 220VAC: approx. 12 VA (approx. 14VA including communication card)			
Mass		Net weight of relay unit	: approx. 2.3 kg			
		Including case	: approx. 3.0 kg			
Case/cover		Size	: D1 type			
		Color	: N1.5			

*21 When an uninterruptible AC power source is not included in your system for the auxiliary supply voltage, use the type CPS1 AC/DC converter or commercially available uninterruptible power supply (UPS).
24VDC auxiliary power supply rating of relay is also available if ordered (non-standard product).
In addition, the power supply duration of the type CPS1 AC/DC converter is confirmed about 2 seconds in combination with one MELPRO-D series relay. Therefore, in the case that the required power supply duration after power source loss exceeds 2 seconds, please use a suitable commercial uninterruptible power supply.
When the power supply back up for the control power supply of a circuit breaker is required, it is necessary to prepare the backup power supply different from the type CPS1 AC/DC converter.

2.2 Protective elements

Style	Relay without RS232C I/F		079PQB	080PQB	081PQB	082PQB	
	Relay with RS232C I/F		459PMB	460PMB	461PMB	462PMB	
Setting *24	Phase fault time-delayed	Operation current	LOCK - 1 ~ 12A (0.1A step)		LOCK - 0.2 ~ 2.4A (0.02A step)		
		Operation time multiplier	0.25 - 0.5 ~ 50 (0.5 step)				
		Operation time characteristics	Normal inverse time-delayed×3, Very inverse time-delayed×2, Extremely inverse time-delayed×3, Long inverse time-delayed×3, Definite time-delayed				
		Reset time characteristics	Inverse, definite time-delayed×2				
	Phase fault instantaneous	Operation current	LOCK - 2 ~ 80A (1A step)		LOCK - 0.4 ~ 16A (0.2A step)		
		Operation time	INST - 0.1 ~ 0.5 s (0.1 s step)				
	Earth fault time-delayed	Operation current	LOCK - 0.1 ~ 0.8A (0.05A step)		LOCK - 0.02 ~ 0.16A (0.01A step)		
		Operation time multiplier	0.25 - 0.5 ~ 50 (0.5 step)				
		Operation time characteristics	Normal inverse time-delayed×3, Very inverse time-delayed×2, Extremely inverse time-delayed×3, Long inverse time-delayed×3, Definite time-delayed				
		Reset time characteristics	Inverse, definite time-delayed ×2				
	Earth fault instantaneous	Operation current	LOCK - 1 ~ 8A (0.1A step)		LOCK - 0.2 ~ 1.6A (0.02A step)		
		Operation time	INST - 0.1 ~ 0.5 s (0.1 s step)				
	2 nd harmonics blocking		I2f/I1f =10 ~ 25% (5% step)				
Forced operation			Forced operation is available for any trip or signaling contact individually.				
Operation indication			Operation indicator LED (red) comes on when the relay operates.				

2.3 Measurement elements

Style		Relay without RS232C I/F	079PQB	080PQB	081PQB	082PQB		
		Relay with RS232C I/F	459PMB	460PMB	461PMB	462PMB		
Option *24	CT primary	Phase current	5-10-12-12.5-15-20-25-30-40-50-60-75-80-100-120-125-150-200-250-300-400-500-600-750-800-1000-1200-1250-1500-2000-2500-3000-4000-5000-6000-7500-8000[A]		1-5-10-12-12.5-15-20-25-30-40-50-60-75-80-100-120-125-150-200-250-300-400-500-600-750-800-1000-1200-1250-1500-2000-2500-3000-4000-5000-6000-7500-8000[A]			
		Zero-phase current						
Display	Phase current	Real time	Conversion	Indication value = Relay input value ×CT primary setting / 5		Indication value = Relay input value ×CT primary setting		
			Range *22	0.00 ~ CT primary setting ×2 [A]				
			Update	Approx. 200 ms				
		Max. record	Conversion	Indication value = Relay input value ×CT primary setting / 5		Indication value = Relay input value ×CT primary setting		
			Range *22	0.00 ~ CT primary setting ×2 [A]				
		Fault record *23	Conversion	Indication value = Relay input value ×CT primary setting / 5		Indication value = Relay input value ×CT primary setting		
			Range *22	0.00 ~ CT primary setting ×40 [A]				
		Zero-phase current	Real time	Conversion	Indication value = Relay input value ×CT primary setting / 5		Indication value = Relay input value ×CT primary setting	
				Range *22	0.00 ~ CT primary setting ×0.4 [A]			
	Update			Approx. 200 ms				
	Max. record		Conversion	Indication value = Relay input value ×CT primary setting / 5		Indication value = Relay input value ×CT primary setting		
			Range *22	0.00 ~ CT primary setting ×0.4 [A]				
	Fault record *23		Conversion	Indication value = Relay input value ×CT primary setting / 5		Indication value = Relay input value ×CT primary setting		
			Range *22	0.00 ~ CT primary setting ×1.6 [A]				
	I2f/ I1f		Real time	Range *22	0.0 ~ 999.9 [%]			
				Update	Approx. 200ms			

- *22 The form of display depends on value range as shown in the tables below:
 CT primary setting value determines the minimum number of digits to be displayed on each measurement display.
 When a value to be displayed exceeds the max. value of the display range, the max. value will blink.

a. Phase current & zero-phase current

Phase current primary setting		1[A]	5 ~ 40[A]	50 ~ 400[A]	500 ~ 4000[A]	5000 ~ 8000[A]
Zero-phase current primary setting		1 ~ 5[A]	10 ~ 80[A]	100 ~ 800[A]	1000 ~ 8000[A]	-
Form of display	0.00 ~ 9.99[A]	□.□□[A]	□.□[A]	□[A]	-	-
	10.0 ~ 99.9[A]	□□.□[A]	□□.□[A]	□□[A]	□.□□[kA]	-
	100 ~ 999[A]	□□□[A]	□□□[A]	□□□[A]	□.□□[kA]	□.□[kA]
	1.00 ~ 9.99[kA]	□.□□[kA]	□.□□[kA]	□.□□[kA]	□.□□[kA]	□.□[kA]
	10.0 ~ 99.9[kA]	□□.□[kA]	□□.□[kA]	□□.□[kA]	□□.□[kA]	□□.□[kA]
	100 ~ 999[kA]	□□□[kA]	□□□[kA]	□□□[kA]	□□□[kA]	□□□[kA]

b. I2f/I1f

Form of display	□.□[%]
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- *23 When a communication card is connected, waveform data in the event of system failure can be read.
 (See the section 4 "Function").
- *24 When the product is shipped from the factory, each setting value is "Lock" (With lock setting element) or "minimum setting value" (Without lock setting element).

3 Characteristics

Common conditions	(1) Rated frequency: $\pm 1\%$ (2) Ambient temperature: $20^{\circ}\text{C} \pm 10^{\circ}\text{C}$ (3) Aux. supply voltage: Rated voltage $\pm 2\%$	The conditions shown on the left should be applied unless otherwise specified.
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3.1 Protective elements

Items		Conditions	Guaranteed performance
Operation value	Phase fault time-delayed element	(Common conditions)	- For setting of 1.0 ~ 2.0A (5A rating product) For setting of 0.2 ~ 0.4A (1A rating product) Setting value $\pm 10\%$
	Phase fault instantaneous element		Setting value $\pm 10\%$
	Earth fault time-delayed element		- For setting of 0.1 ~ 0.2A (5A rating product) For setting of 0.02 ~ 0.04A (1A rating product) Setting value $\pm 10\%$
	Earth fault instantaneous element		Setting value $\pm 10\%$
	I2f/I1f blocking		- For setting of 10% Setting value $\pm 15\%$ - For setting of 15% to 25% Setting value $\pm 10\%$
Reset value	Phase fault time-delayed element	(Common conditions)	- For setting of 1.0 ~ 2.0A (5A rating product) For setting of 0.2 ~ 0.4A (1A rating product) Operation value $\times 90\%$ or more
	Phase fault instantaneous element		Operation value $\times 95\%$ or more
	Earth fault time-delayed element		- For setting of 0.1 ~ 0.2A (5A rating product) For setting of 0.02 ~ 0.04A (1A rating product) Operation value $\times 90\%$ or more
	Earth fault instantaneous element		Operation value $\times 95\%$ or more
	I2f/I1f blocking		Operation value $\times 85\%$ or more

Items		Conditions	Guaranteed performance
Operation time	Phase fault time-delayed element	Operation setting: Minimum, Operation time multiplier: 10 Input: 0 → Operation setting×300, 500, 1000 %	See Figures 3.1 and 3.2. See Tables 3.1 to 3.12.
	Phase fault instantaneous element	Operation setting: Minimum Input: 0 → 200% of setting	Setting value ±25ms INST = 50 ms or less.
	Earth fault time-delayed element	Operation setting: Minimum, Operation time multiplier: 10 Input: 0 → Operation setting×300, 500, 1000%	See Figures 3.1 and 3.2. See Tables 3.1 to 3.12.
	Earth fault instantaneous element	Operation setting: Minimum Input: 0 → 200% of setting	Setting value ±25ms INST = 50 ms or less.
Reset time	Phase fault time-delayed element	300% of setting → 0 [A]	See Figure 3.3 and Table 3.13.
	Phase fault instantaneous element	300% of setting → 0 [A]	200ms ± 25ms
	Earth fault time-delayed element	300% of setting → 0 [A]	See Figure 3.3 and Table 3.13.
	Earth fault instantaneous element	300% of setting → 0 [A]	200ms ± 25ms
Overshoot characteristic	Phase fault time-delayed element	Time-delayed operation value: Minimum Operation time multiplier : 10 Operation characteristics : All Input current : 0A → Setting value×1000%	No-operation limit time / operation time = 90% or more
	Earth fault time-delayed element	Same as the above	Same as the above

3.2 Measurement elements

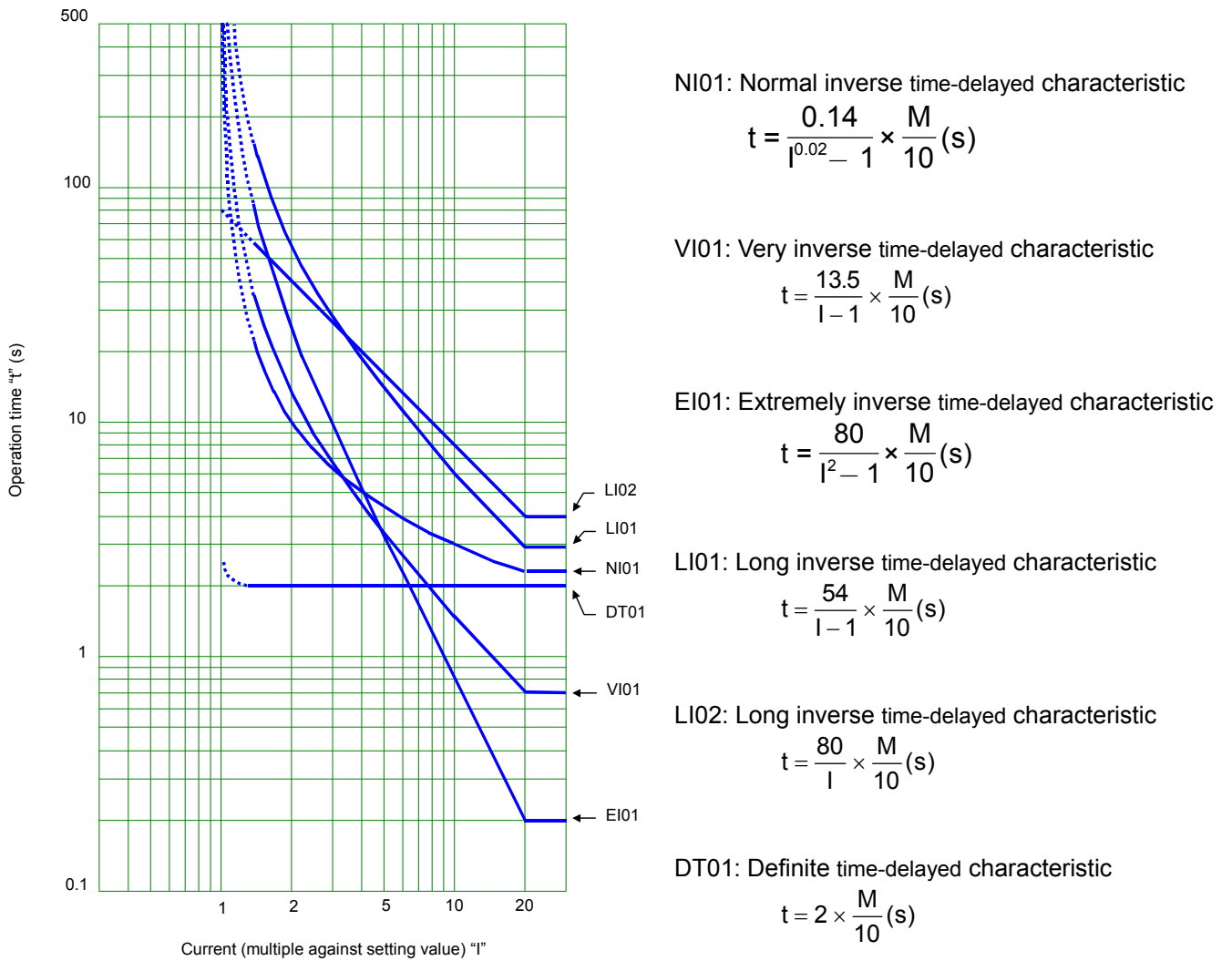
Items		Condition	Guaranteed performance
Real time	Phase current	CT primary setting ×2	±1%
	Zero-phase current	CT primary setting ×0.4	
	I _{2f} /I _{1f}	—	
max. records	Phase current	CT primary setting ×2	
	Zero-phase current	CT primary setting ×0.4	

3.3 Common technical data

ITEM		DESCRIPTION	CONDITION	STANDARD
Environment	Ambient operating temperature	-10°C to +55°C		IEC60255-6
	Ambient storage and transport temperature	-25°C to +70°C		IEC60255-6
	Damp heat	+40°C, 95%RH, 4 days		IEC60068-2-3
Thermal withstand	VT	1.15Vn, 3h		
	CT	40In, 1s		
Dielectric test	Circuit of 60V or below	500VAC, 1min.	1) Between each circuit and the exposed conductive parts, the terminals of each independent circuit being connected together 2) Between independent circuits, the terminals of each independent circuit being connected together	IEC60255-5
	Circuit of more than 60V and 500v or below	2000VAC 1min.		
	Open contact	1000VAC, 1min.	Between open contact poles	
Impulse voltage test		5kV, 1.2µs/50µs	1) Between each circuit and the exposed conductive parts, the terminals of each independent circuit being connected together 2) Between independent circuits, the terminals of each independent circuit being connected together	IEC60255-5
High-frequency disturbance test	Common mode	2.5kV peak, 1MHz with 200Ω source impedance for 2s	Between independent circuits, and between independent circuit and earth	IEC60255-22-1 class 3
	Differential mode	1.0kV peak, 1MHz with 200Ω source impedance for 2s	Across terminals of the same circuit	
Electrostatic discharge test		8kV	Contact discharge	IEC60255-22-2 Class 4
		15kV	Air discharge	
Radiated electromagnetic field disturbance test		68 to 87Mhz 146 to 174MHz 420 to 470MHz		IEC60255-22-3 class 3
Fast transient disturbance test		2.0kV, 5ns/50ns, 1min		IEC60255-22-4
Vibration test		Refer to class 1		IEC60255-21-1 Class 1
Shock response		Refer to class 2		IEC60255-21-2 Class 2
Shock withstand		Refer to class 1		IEC60255-21-2 Class 1
Bump		Refer to class 1		IEC60255-21-2 Class 1
Enclosure protection		IP51		IEC60529

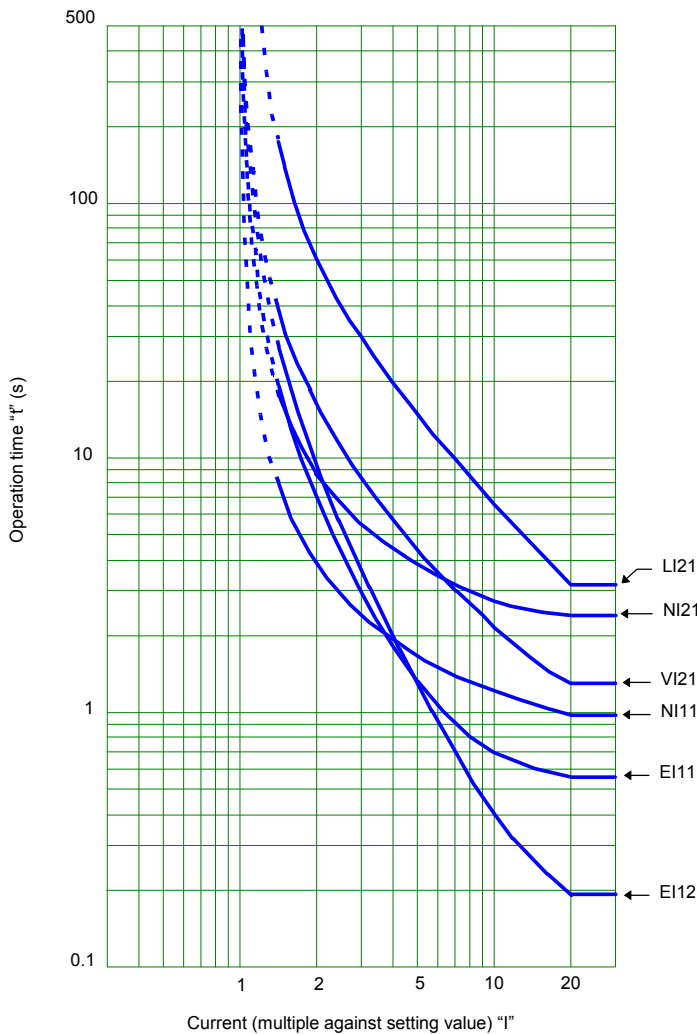
Vn: Rated voltage, In: Rated current

12 types of operation time characteristics and 3 types of reset time characteristics as shown in Figures 3.1 to 3.3 are integrated in both of the phase fault and earth fault time-delayed elements.



- t : Operation time (s)
- I : Multiple of input current against setting value (times)
- M : Operation time multiplier (times)

Figure 3.1 Operation time characteristic (1)



NI11: Normal inverse time-delayed characteristic

$$t = \left(\frac{0.0515}{I^{0.02} - 1} + 0.114 \right) \times \frac{M}{10} \text{ (s)}$$

EI11: Extremely inverse time-delayed characteristic

$$t = \left(\frac{19.61}{I^2 - 1} + 0.491 \right) \times \frac{M}{10} \text{ (s)}$$

EI12: Extremely inverse time-delayed characteristic

$$t = \left(\frac{28.2}{I^2 - 1} + 0.1217 \right) \times \frac{M}{10} \text{ (s)}$$

NI21: Normal inverse time-delayed characteristic

$$t = \left(\frac{2.4}{I^{0.4} - 1} + 1.2 \right) \times \frac{M}{10} \text{ (s)}$$

VI21: Very inverse time-delayed characteristic

$$t = \left(\frac{16}{I - 1} + 0.4 \right) \times \frac{M}{10} \text{ (s)}$$

LI21: Long inverse time-delayed characteristic

$$t = \frac{60}{I - 1} \times \frac{M}{10} \text{ (s)}$$

- t : Operation time (s)
- I : Multiple of input current against setting value (times)
- M : Operation time multiplier (times)

Figure 3.2 Operation time characteristic (2)

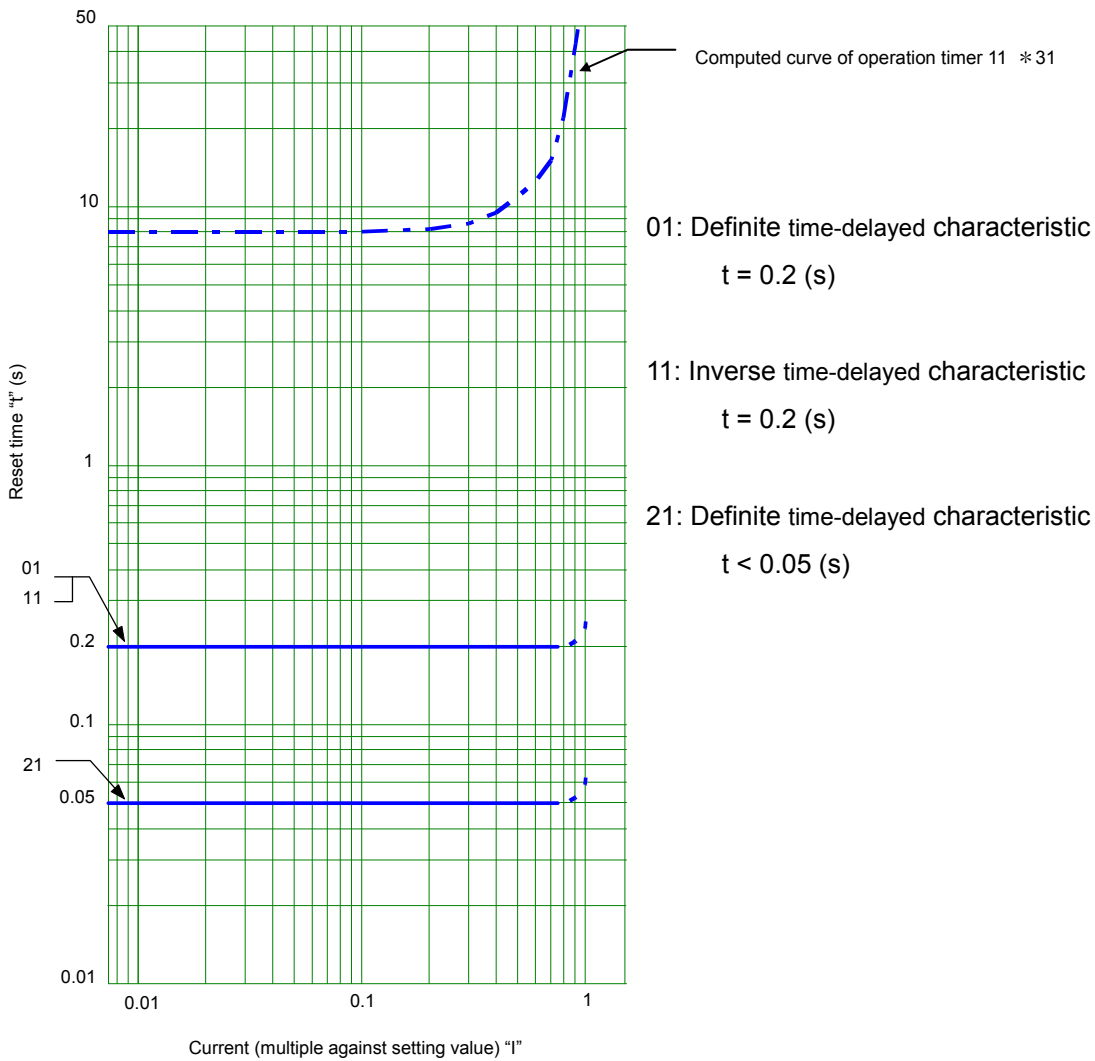


Figure 3.3 Reset time characteristic

***31 Inverse time-delayed characteristic for resetting**

Following the principle of resetting an electromagnetic mechanical type induction disc, the inverse time-delayed characteristic given by the equation below is used for computing the reset time of the internal operation timer, although the output contact will be reset after a definite period of time (0.2 s). The inverse time-delayed characteristic may be useful for detecting recurrent overload, which typically occurs in starting a motor. For further information, see the section 4 "Functions".

$$t_r = \frac{8}{1-I^2} \times \frac{M}{10} \text{ (s)}$$

Table 3.1 Operation time range for Normal inverse time-delayed characteristic (NI01)

Unit: s

Operation time multiplier (M)	Input		
	300%	500%	1000%
0.25	0.158 ± 5.50%	0.107 ± 3.75%	0.074 ± 3.75%
	* 0.040 ~ 0.504	* 0.040 ~ 0.267	* 0.040 ~ 0.186
0.5	0.315 ± 5.67%	0.214 ± 3.83%	0.149 ± 3.83%
	* 0.040 ~ 0.672	* 0.040 ~ 0.378	* 0.040 ~ 0.262
1	0.630 ± 6.00%	0.428 ± 4.00%	0.297 ± 4.00%
	0.252 ~ 1.008	0.257 ~ 0.599	0.178 ~ 0.416
1.5	0.945 ± 6.33%	0.642 ± 4.17%	0.446 ± 4.17%
	0.546 ~ 1.344	0.464 ~ 0.820	0.322 ~ 0.569
2	1.260 ± 6.67%	0.856 ± 4.33%	0.594 ± 4.33%
	0.840 ~ 1.681	0.670 ~ 1.041	0.465 ~ 0.723
2.5	1.575 ± 7.00%	1.070 ± 4.50%	0.743 ± 4.50%
	1.134 ~ 2.017	0.877 ~ 1.263	0.609 ~ 0.876
3	1.891 ± 7.33%	1.284 ± 4.67%	0.891 ± 4.67%
	1.428 ~ 2.353	1.084 ~ 1.484	0.753 ~ 1.030
3.5	2.206 ± 7.67%	1.498 ± 4.83%	1.040 ± 4.83%
	1.723 ~ 2.689	1.291 ~ 1.705	0.896 ~ 1.183
4	2.521 ± 8.00%	1.712 ± 5.00%	1.188 ± 5.00%
	2.017 ~ 3.025	1.498 ~ 1.926	1.040 ~ 1.337
4.5	2.836 ± 8.33%	1.926 ± 5.17%	1.337 ± 5.17%
	2.311 ~ 3.361	1.705 ~ 2.147	1.183 ~ 1.490
5	3.151 ± 8.67%	2.140 ± 5.33%	1.485 ± 5.33%
	2.605 ~ 3.697	1.912 ~ 2.368	1.327 ~ 1.644
6	3.781 ± 9.33%	2.568 ± 5.67%	1.782 ± 5.67%
	3.193 ~ 4.369	2.325 ~ 2.810	1.614 ~ 1.951
7	4.411 ± 10.00%	2.996 ± 6.00%	2.079 ± 6.00%
	3.781 ~ 5.042	2.739 ~ 3.253	1.901 ~ 2.258
8	5.042 ± 10.67%	3.424 ± 6.33%	2.376 ± 6.33%
	4.369 ~ 5.714	3.153 ~ 3.695	2.188 ~ 2.565
9	5.672 ± 11.33%	3.852 ± 6.67%	2.674 ± 6.67%
	4.958 ~ 6.386	3.566 ~ 4.137	2.475 ~ 2.872
10	6.302 ± 12.00%	4.280 ± 7.00%	2.971 ± 7.00%
	5.546 ~ 7.058	3.980 ~ 4.579	2.763 ~ 3.179
15	9.453 ± 12.00%	6.420 ± 7.00%	4.456 ± 7.00%
	8.319 ~ 10.587	5.970 ~ 6.869	4.144 ~ 4.768
20	12.604 ± 12.00%	8.559 ± 7.00%	5.941 ± 7.00%
	11.091 ~ 14.116	7.960 ~ 9.159	5.525 ~ 6.357
30	18.906 ± 12.00%	12.839 ± 7.00%	8.912 ± 7.00%
	16.637 ~ 21.174	11.940 ~ 13.738	8.288 ~ 9.536
40	25.208 ± 12.00%	17.119 ± 7.00%	11.882 ± 7.00%
	22.183 ~ 28.233	15.921 ~ 18.317	11.051 ~ 12.714
50	31.510 ± 12.00%	21.399 ± 7.00%	14.853 ± 7.00%
	27.728 ~ 35.291	19.901 ~ 22.897	13.813 ~ 15.893

Note: The values shown in the upper column of each box represent the theoretical operation time and error limit, and those in the lower column represent the permissible range
Refer to the note *32 to *35.

Table 3.2 Operation time range for Very inverse time-delayed characteristic (VI01)

Unit: s

Operation time multiplier (M)	Input		
	300%	500%	1000%
0.25	0.169 ± 5.50%	0.084 ± 3.75%	0.038 ± 3.75%
	* 0.040 ~ 0.540	* 0.040 ~ 0.211	* 0.040 ~ 0.094
0.5	0.338 ± 5.67%	0.169 ± 3.83%	0.075 ± 3.83%
	* 0.040 ~ 0.720	* 0.040 ~ 0.298	* 0.040 ~ 0.133
1	0.675 ± 6.00%	0.338 ± 4.00%	0.150 ± 4.00%
	0.270 ~ 1.080	0.203 ~ 0.473	0.090 ~ 0.210
1.5	1.013 ± 6.33%	0.506 ± 4.17%	0.225 ± 4.17%
	0.585 ~ 1.440	0.366 ~ 0.647	0.163 ~ 0.288
2	1.350 ± 6.67%	0.675 ± 4.33%	0.300 ± 4.33%
	0.900 ~ 1.800	0.529 ~ 0.821	0.235 ~ 0.365
2.5	1.688 ± 7.00%	0.844 ± 4.50%	0.375 ± 4.50%
	1.215 ~ 2.160	0.692 ~ 0.996	0.308 ~ 0.443
3	2.025 ± 7.33%	1.013 ± 4.67%	0.450 ± 4.67%
	1.530 ~ 2.520	0.855 ~ 1.170	0.380 ~ 0.520
3.5	2.363 ± 7.67%	1.181 ± 4.83%	0.525 ± 4.83%
	1.845 ~ 2.880	1.018 ~ 1.344	0.453 ~ 0.598
4	2.700 ± 8.00%	1.350 ± 5.00%	0.600 ± 5.00%
	2.160 ~ 3.240	1.181 ~ 1.519	0.525 ~ 0.675
4.5	3.038 ± 8.33%	1.519 ± 5.17%	0.675 ± 5.17%
	2.475 ~ 3.600	1.344 ~ 1.693	0.598 ~ 0.753
5	3.375 ± 8.67%	1.688 ± 5.33%	0.750 ± 5.33%
	2.790 ~ 3.960	1.508 ~ 1.868	0.670 ~ 0.830
6	4.050 ± 9.33%	2.025 ± 5.67%	0.900 ± 5.67%
	3.420 ~ 4.680	1.834 ~ 2.216	0.815 ~ 0.985
7	4.725 ± 10.00%	2.363 ± 6.00%	1.050 ± 6.00%
	4.050 ~ 5.400	2.160 ~ 2.565	0.960 ~ 1.140
8	5.400 ± 10.67%	2.700 ± 6.33%	1.200 ± 6.33%
	4.680 ~ 6.120	2.486 ~ 2.914	1.105 ~ 1.295
9	6.075 ± 11.33	3.038 ± 6.67%	1.350 ± 6.67%
	5.310 ~ 6.840	2.813 ~ 3.263	1.250 ~ 1.450
10	6.750 ± 12.00%	3.375 ± 7.00%	1.500 ± 7.00%
	5.940 ~ 7.560	3.139 ~ 3.611	1.395 ~ 1.605
15	10.125 ± 12.00%	5.063 ± 7.00%	2.250 ± 7.00%
	8.910 ~ 11.340	4.708 ~ 5.417	2.093 ~ 2.408
20	13.500 ± 12.00%	6.750 ± 7.00%	3.000 ± 7.00%
	11.880 ~ 15.120	6.278 ~ 7.223	2.790 ~ 6.357
30	20.250 ± 12.00%	10.125 ± 7.00%	4.500 ± 7.00%
	17.820 ~ 22.680	9.416 ~ 10.834	4.185 ~ 4.815
40	27.000 ± 12.00%	13.500 ± 7.00%	6.000 ± 7.00%
	23.760 ~ 30.240	12.555 ~ 14.445	5.580 ~ 6.420
50	33.750 ± 12.00%	16.875 ± 7.00%	7.500 ± 7.00%
	29.700 ~ 37.800	15.694 ~ 18.056	6.975 ~ 8.025

Note: The values shown in the upper column of each box represent the theoretical operation time and error limit, and those in the lower column represent the permissible range
Refer to the note *32 to *35.

Table 3.3 Operation time range for Extremely inverse time-delayed characteristic (EI01)

Unit: s

Operation time multiplier (M)	Input		
	300%	500%	1000%
0.25	0.250 ± 5.50%	0.083 ± 3.75%	0.020 ± 0.05
	* 0.040 ~ 0.800	* 0.040 ~ 0.208	* 0.040 ~ 0.070
0.5	0.500 ± 5.67%	0.167 ± 3.83%	0.040 ± 0.05
	* 0.040 ~ 1.067	* 0.040 ~ 0.294	* 0.040 ~ 0.090
1	1.000 ± 6.00%	0.333 ± 4.00%	0.081 ± 0.05
	0.400 ~ 1.600	0.200 ~ 0.467	* 0.040 ~ 0.131
1.5	1.500 ± 6.33%	0.500 ± 4.17%	0.121 ± 0.05
	0.867 ~ 2.133	0.361 ~ 0.639	0.071 ~ 0.171
2	2.000 ± 6.67%	0.667 ± 4.33%	0.162 ± 0.05
	1.333 ~ 2.667	0.522 ~ 0.811	0.112 ~ 0.212
2.5	2.500 ± 7.00%	0.833 ± 4.50%	0.202 ± 0.05
	1.800 ~ 3.200	0.683 ~ 0.983	0.152 ~ 0.252
3	3.000 ± 7.33%	1.000 ± 4.67%	0.242 ± 0.05
	2.267 ~ 3.733	0.844 ~ 1.156	0.192 ~ 0.292
3.5	3.500 ± 7.67%	1.167 ± 4.83%	0.283 ± 0.05
	2.733 ~ 4.267	1.006 ~ 1.328	0.233 ~ 0.333
4	4.000 ± 8.00%	1.333 ± 5.00%	0.323 ± 0.05
	3.200 ~ 4.800	1.167 ~ 1.500	0.273 ~ 0.373
4.5	4.500 ± 8.33%	1.500 ± 5.17%	0.364 ± 0.05
	3.667 ~ 5.333	1.328 ~ 1.672	0.314 ~ 0.414
5	5.000 ± 8.67%	1.667 ± 5.33%	0.404 ± 0.05
	4.133 ~ 5.867	1.489 ~ 1.844	0.354 ~ 0.454
6	6.000 ± 9.33%	2.000 ± 5.67%	0.485 ± 0.05
	5.067 ~ 6.933	1.811 ~ 2.189	0.435 ~ 0.535
7	7.000 ± 10.00%	2.333 ± 6.00%	0.566 ± 0.05
	6.000 ~ 8.000	2.133 ~ 2.533	0.516 ~ 0.616
8	8.000 ± 10.67%	2.667 ± 6.33%	0.646 ± 6.33%
	6.933 ~ 9.067	2.456 ~ 2.878	0.595 ~ 0.698
9	9.000 ± 11.33%	3.000 ± 6.67%	0.727 ± 6.67%
	7.867 ~ 10.133	2.778 ~ 3.222	0.673 ~ 0.781
10	10.000 ± 12.00%	3.333 ± 7.00%	0.808 ± 7.00%
	8.800 ~ 11.200	3.100 ~ 3.567	0.752 ~ 0.865
15	15.000 ± 12.00%	5.000 ± 7.00%	1.212 ± 7.00%
	13.200 ~ 16.800	4.650 ~ 5.350	1.127 ~ 1.297
20	20.000 ± 12.00%	6.667 ± 7.00%	1.616 ± 7.00%
	17.600 ~ 22.400	6.200 ~ 7.133	1.503 ~ 1.729
30	30.000 ± 12.00%	10.000 ± 7.00%	2.424 ± 7.00%
	26.400 ~ 33.600	9.300 ~ 10.700	2.255 ~ 2.594
40	40.000 ± 12.00%	13.333 ± 7.00%	3.232 ± 7.00%
	35.200 ~ 44.800	12.400 ~ 14.267	3.006 ~ 3.459
50	50.000 ± 12.00%	16.667 ± 7.00%	4.040 ± 7.00%
	44.000 ~ 56.000	15.500 ~ 17.833	3.758 ~ 4.323

Note: The values shown in the upper column of each box represent the theoretical operation time and error limit, and those in the lower column represent the permissible range
Refer to the note *32 to *35.

Table 3.4 Operation time range for Long inverse time-delayed characteristic (LI01)

Unit: s

Operation time multiplier (M)	Input		
	300%	500%	1000%
0.25	0.675 ± 5.50%	0.338 ± 3.75%	0.150 ± 3.75%
	* 0.040 ~ 2.160	* 0.040 ~ 0.844	* 0.040 ~ 0.375
0.5	1.350 ± 5.67%	0.675 ± 3.83%	0.300 ± 3.83%
	* 0.040 ~ 2.880	0.158 ~ 1.193	0.070 ~ 0.530
1	2.700 ± 6.00%	1.350 ± 4.00%	0.600 ± 4.00%
	1.080 ~ 4.320	0.158 ~ 1.890	0.360 ~ 0.840
1.5	4.050 ± 6.33%	2.025 ± 4.17%	0.900 ± 4.17%
	2.340 ~ 5.760	1.463 ~ 2.588	0.650 ~ 1.150
2	5.400 ± 6.67%	2.700 ± 4.33%	1.200 ± 4.33%
	3.600 ~ 7.200	2.115 ~ 3.285	0.940 ~ 1.460
2.5	6.750 ± 7.00%	3.375 ± 4.50%	1.500 ± 4.50%
	4.860 ~ 8.640	2.768 ~ 3.983	1.230 ~ 1.770
3	8.100 ± 7.33%	4.050 ± 4.67%	1.800 ± 4.67%
	6.120 ~ 10.080	3.420 ~ 4.680	1.520 ~ 2.080
3.5	9.450 ± 7.67%	4.725 ± 4.83%	2.100 ± 4.83%
	7.380 ~ 11.520	4.073 ~ 5.378	1.810 ~ 2.390
4	10.800 ± 8.00%	5.400 ± 5.00%	2.400 ± 5.00%
	8.640 ~ 12.960	4.725 ~ 6.075	2.100 ~ 2.700
4.5	12.150 ± 8.33%	6.075 ± 5.17%	2.700 ± 5.17%
	9.900 ~ 14.400	5.378 ~ 6.773	2.390 ~ 3.010
5	13.500 ± 8.67%	6.750 ± 5.33%	3.000 ± 5.33%
	11.160 ~ 15.840	6.030 ~ 7.470	2.680 ~ 3.320
6	16.200 ± 9.33%	8.100 ± 5.67%	3.600 ± 5.67%
	13.680 ~ 18.720	7.335 ~ 8.865	3.260 ~ 3.940
7	18.900 ± 10.00%	9.450 ± 6.00%	4.200 ± 6.00%
	16.200 ~ 21.600	8.640 ~ 10.260	3.840 ~ 4.560
8	21.600 ± 10.67%	10.800 ± 6.33%	4.800 ± 6.33%
	18.720 ~ 24.480	9.945 ~ 11.655	4.420 ~ 5.180
9	24.300 ± 11.33%	12.150 ± 6.67%	5.400 ± 6.67%
	24.300 ± 11.33%	12.150 ± 6.67%	5.400 ± 6.67%
10	27.000 ± 12.00%	13.500 ± 7.00%	6.000 ± 7.00%
	23.760 ~ 30.240	12.555 ~ 14.445	5.580 ~ 6.420
15	40.500 ± 12.00%	20.250 ± 7.00%	9.000 ± 7.00%
	35.640 ~ 45.360	18.833 ~ 21.668	8.370 ~ 9.630
20	54.000 ± 12.00%	27.000 ± 7.00%	12.000 ± 7.00%
	47.520 ~ 60.480	25.110 ~ 28.890	11.160 ~ 12.840
30	81.000 ± 12.00%	40.500 ± 7.00%	18.000 ± 7.00%
	71.280 ~ 90.720	37.665 ~ 43.335	16.740 ~ 19.260
40	108.00 ± 12.00%	54.000 ± 7.00%	24.000 ± 7.00%
	95.040 ~ 120.96	50.220 ~ 57.780	22.320 ~ 25.680
50	135.00 ± 12.00%	67.500 ± 7.00%	30.000 ± 7.00%
	118.80 ~ 151.20	62.775 ~ 72.225	27.900 ~ 32.100

Note: The values shown in the upper column of each box represent the theoretical operation time and error limit, and those in the lower column represent the permissible range
Refer to the note *32 to *35.

Table 3.5 Operation time range for Long inverse time-delayed characteristic (LI02)

Unit: s

Operation time multiplier (M)	Input		
	300%	500%	1000%
0.25	0.667 ± 5.50%	0.400 ± 3.75%	0.200 ± 3.75%
	* 0.040 ~ 2.133	* 0.040 ~ 1.000	* 0.040 ~ 0.500
0.5	1.333 ± 5.67%	0.800 ± 3.83%	0.400 ± 3.83%
	* 0.040 ~ 2.844	0.187 ~ 1.413	0.093 ~ 0.707
1	2.667 ± 6.00%	1.600 ± 4.00%	0.800 ± 4.00%
	1.067 ~ 4.267	0.960 ~ 2.240	0.480 ~ 1.120
1.5	4.000 ± 6.33%	2.400 ± 4.17%	1.200 ± 4.17%
	2.311 ~ 5.689	1.733 ~ 3.067	0.867 ~ 1.533
2	5.333 ± 6.67%	3.200 ± 4.33%	1.600 ± 4.33%
	3.556 ~ 7.111	2.507 ~ 3.893	1.253 ~ 1.947
2.5	6.667 ± 7.00%	4.000 ± 4.50%	2.000 ± 4.50%
	4.800 ~ 8.533	3.280 ~ 4.720	1.640 ~ 2.360
3	8.000 ± 7.33%	4.800 ± 4.67%	2.400 ± 4.67%
	6.044 ~ 9.956	4.053 ~ 5.547	2.027 ~ 2.773
3.5	9.333 ± 7.67%	5.600 ± 4.83%	2.800 ± 4.83%
	7.289 ~ 11.378	4.827 ~ 6.373	2.413 ~ 3.187
4	10.667 ± 8.00%	6.400 ± 5.00%	3.200 ± 5.00%
	8.533 ~ 12.800	5.600 ~ 7.200	2.800 ~ 3.600
4.5	12.000 ± 8.33%	7.200 ± 5.17%	3.600 ± 5.17%
	9.778 ~ 14.222	6.373 ~ 8.027	3.187 ~ 4.013
5	13.333 ± 8.67%	8.000 ± 5.33%	4.000 ± 5.33%
	11.022 ~ 15.644	7.147 ~ 8.853	3.573 ~ 4.427
6	16.000 ± 9.33%	9.600 ± 5.67%	4.800 ± 5.67%
	13.511 ~ 18.489	8.693 ~ 10.507	4.347 ~ 5.253
7	18.667 ± 10.00%	11.200 ± 6.00%	5.600 ± 6.00%
	16.000 ~ 21.333	10.240 ~ 12.160	5.120 ~ 6.080
8	21.333 ± 10.67%	12.800 ± 6.33%	6.400 ± 6.33%
	18.489 ~ 24.178	11.787 ~ 13.813	5.893 ~ 6.907
9	24.000 ± 11.33%	14.400 ± 6.67%	7.200 ± 6.67%
	20.978 ~ 27.022	13.333 ~ 15.467	6.667 ~ 7.733
10	26.667 ± 12.00%	16.000 ± 7.00%	8.000 ± 7.00%
	23.467 ~ 29.867	14.880 ~ 17.120	7.440 ~ 8.560
15	40.000 ± 12.00%	24.000 ± 7.00%	12.000 ± 7.00%
	35.200 ~ 44.800	22.320 ~ 25.680	11.160 ~ 12.840
20	53.333 ± 12.00%	32.000 ± 7.00%	16.000 ± 7.00%
	46.933 ~ 59.733	29.760 ~ 34.240	14.880 ~ 17.120
30	80.000 ± 12.00%	48.000 ± 7.00%	24.000 ± 7.00%
	70.400 ~ 89.600	44.640 ~ 51.360	22.320 ~ 25.680
40	106.67 ± 12.00%	64.000 ± 7.00%	32.000 ± 7.00%
	93.867 ~ 119.47	59.520 ~ 68.480	29.760 ~ 34.240
50	133.33 ± 12.00%	80.000 ± 7.00%	40.000 ± 7.00%
	117.33 ~ 149.33	74.400 ~ 85.600	37.200 ~ 42.800

Note: The values shown in the upper column of each box represent the theoretical operation time and error limit, and those in the lower column represent the permissible range
Refer to the note *32 to *35.

Table 3.6 Operation time range for Definite time-delayed characteristic (DT01)

Unit: s

Operation time multiplier (M)	Input		
	300%	500%	1000%
0.25	0.050 ± 2.56%	0.050 ± 2.56%	0.050 ± 2.56%
	* 0.040 ~ 0.101	* 0.040 ~ 0.101	* 0.040 ~ 0.101
0.5	0.100 ± 2.63%	0.100 ± 2.63%	0.100 ± 2.63%
	0.048 ~ 0.153	0.048 ~ 0.153	0.048 ~ 0.153
1	0.200 ± 2.75%	0.200 ± 2.75%	0.200 ± 2.75%
	0.145 ~ 0.255	0.145 ~ 0.255	0.145 ~ 0.255
1.5	0.300 ± 2.88%	0.300 ± 2.88%	0.300 ± 2.88%
	0.243 ~ 0.358	0.243 ~ 0.358	0.243 ~ 0.358
2	0.400 ± 3.00%	0.400 ± 3.00%	0.400 ± 3.00%
	0.340 ~ 0.460	0.340 ~ 0.460	0.340 ~ 0.460
2.5	0.500 ± 3.13%	0.500 ± 3.13%	0.500 ± 3.13%
	0.438 ~ 0.563	0.438 ~ 0.563	0.438 ~ 0.563
3	0.600 ± 3.25%	0.600 ± 3.25%	0.600 ± 3.25%
	0.535 ~ 0.665	0.535 ~ 0.665	0.535 ~ 0.665
3.5	0.700 ± 3.38%	0.700 ± 3.38%	0.700 ± 3.38%
	0.633 ~ 0.768	0.633 ~ 0.768	0.633 ~ 0.768
4	0.800 ± 3.50%	0.800 ± 3.50%	0.800 ± 3.50%
	0.730 ~ 0.870	0.730 ~ 0.870	0.730 ~ 0.870
4.5	0.900 ± 3.63%	0.900 ± 3.63%	0.900 ± 3.63%
	0.828 ~ 0.973	0.828 ~ 0.973	0.828 ~ 0.973
5	1.000 ± 3.75%	1.000 ± 3.75%	1.000 ± 3.75%
	0.925 ~ 1.075	0.925 ~ 1.075	0.925 ~ 1.075
6	1.200 ± 4.00%	1.200 ± 4.00%	1.200 ± 4.00%
	1.120 ~ 1.280	1.120 ~ 1.280	1.120 ~ 1.280
7	1.400 ± 4.25%	1.400 ± 4.25%	1.400 ± 4.25%
	1.315 ~ 1.485	1.315 ~ 1.485	1.315 ~ 1.485
8	1.600 ± 4.50%	1.600 ± 4.50%	1.600 ± 4.50%
	1.510 ~ 1.690	1.510 ~ 1.690	1.510 ~ 1.690
9	1.800 ± 4.75%	1.800 ± 4.75%	1.800 ± 4.75%
	1.705 ~ 1.895	1.705 ~ 1.890	1.705 ~ 1.895
10	2.000 ± 5.00%	2.000 ± 5.00%	2.000 ± 5.00%
	1.900 ~ 2.100	1.900 ~ 2.100	1.900 ~ 2.100
15	3.000 ± 5.00%	3.000 ± 5.00%	3.000 ± 5.00%
	2.850 ~ 3.150	2.850 ~ 3.150	2.850 ~ 3.150
20	4.000 ± 5.00%	4.000 ± 5.00%	4.000 ± 5.00%
	3.800 ~ 4.200	3.800 ~ 4.200	3.800 ~ 4.200
30	6.000 ± 5.00%	6.000 ± 5.00%	6.000 ± 5.00%
	5.700 ~ 6.300	5.700 ~ 6.300	5.700 ~ 6.300
40	8.000 ± 5.00%	8.000 ± 5.00%	8.000 ± 5.00%
	7.600 ~ 8.400	7.600 ~ 8.400	7.600 ~ 8.400
50	10.000 ± 5.00%	10.000 ± 5.00%	10.000 ± 5.00%
	9.500 ~ 10.500	9.500 ~ 10.500	9.500 ~ 10.500

Note: The values shown in the upper column of each box represent the theoretical operation time and error limit, and those in the lower column represent the permissible range
Refer to the note *32 to *35.

Table 3.7 Operation time range for Normal inverse time-delayed characteristic (NI11)

Unit: s

Operation time multiplier (M)	Input		
	300%	500%	1000%
0.25	0.061 ± 5.50%	0.042 ± 3.75%	0.030 ± 0.05
	* 0.040 ~ 0.195	* 0.040 ~ 0.106	* 0.040 ~ 0.080
0.5	0.122 ± 5.67%	0.084 ± 3.83%	0.060 ± 0.05
	* 0.040 ~ 0.259	* 0.040 ~ 0.149	* 0.040 ~ 0.110
1	0.243 ± 6.00%	0.169 ± 4.00%	0.121 ± 0.05
	0.097 ~ 0.389	0.101 ~ 0.236	0.071 ~ 0.171
1.5	0.365 ± 6.33%	0.253 ± 4.17%	0.181 ± 4.17%
	0.211 ~ 0.519	0.183 ~ 0.324	0.131 ~ 0.231
2	0.486 ± 6.67%	0.338 ± 4.33%	0.241 ± 4.33%
	0.324 ~ 0.649	0.265 ~ 0.411	0.189 ~ 0.294
2.5	0.608 ± 7.00%	0.422 ± 4.50%	0.302 ± 4.50%
	0.438 ~ 0.778	0.346 ~ 0.498	0.247 ~ 0.356
3	0.730 ± 7.33%	0.506 ± 4.67%	0.362 ± 4.67%
	0.551 ~ 0.908	0.428 ~ 0.585	0.306 ~ 0.418
3.5	0.851 ± 7.67%	0.591 ± 4.83%	0.422 ± 4.83%
	0.665 ~ 1.038	0.509 ~ 0.673	0.364 ~ 0.481
4	0.973 ± 8.00%	0.675 ± 5.00%	0.483 ± 5.00%
	0.778 ~ 1.167	0.591 ~ 0.760	0.422 ~ 0.543
4.5	1.094 ± 8.33%	0.760 ± 5.17%	0.543 ± 5.17%
	0.892 ~ 1.297	0.673 ~ 0.847	0.481 ~ 0.605
5	1.216 ± 8.67%	0.844 ± 5.33%	0.603 ± 5.33%
	1.005 ~ 1.427	0.754 ~ 0.934	0.539 ~ 0.668
6	1.459 ± 9.33%	1.013 ± 5.67%	0.724 ± 5.67%
	1.232 ~ 1.686	0.917 ~ 1.109	0.656 ~ 0.792
7	1.703 ± 10.00%	1.182 ± 6.00%	0.845 ± 6.00%
	1.459 ~ 1.946	1.081 ~ 1.283	0.772 ~ 0.917
8	1.946 ± 10.67%	1.351 ± 6.33%	0.965 ± 6.33%
	1.686 ~ 2.205	1.244 ~ 1.458	0.889 ~ 1.042
9	2.189 ± 11.33%	1.519 ± 6.67%	1.086 ± 6.67%
	1.913 ~ 2.465	1.407 ~ 1.632	1.006 ~ 1.167
10	2.432 ± 12.00%	1.688 ± 7.00%	1.207 ± 7.00%
	2.140 ~ 2.724	1.570 ~ 1.807	1.122 ~ 1.291
15	3.648 ± 12.00%	2.532 ± 7.00%	1.810 ± 7.00%
	3.211 ~ 4.086	2.355 ~ 2.710	1.683 ~ 1.937
20	4.864 ± 12.00%	3.377 ± 7.00%	2.414 ± 7.00%
	4.281 ~ 5.448	3.140 ~ 3.613	2.245 ~ 2.582
30	7.297 ± 12.00%	5.065 ± 7.00%	3.620 ± 7.00%
	6.421 ~ 8.172	4.710 ~ 5.420	3.367 ~ 3.874
40	9.729 ± 12.00%	6.753 ± 7.00%	4.827 ± 7.00%
	8.561 ~ 10.896	6.281 ~ 7.226	4.489 ~ 5.165
50	12.161 ± 12.00%	8.442 ± 7.00%	6.034 ± 7.00%
	10.702 ~ 13.620	7.851 ~ 9.033	5.611 ~ 6.456

Note: The values shown in the upper column of each box represent the theoretical operation time and error limit, and those in the lower column represent the permissible range
Refer to the note *32 to *35.

Table 3.8 Operation time range for Extremely inverse time-delayed characteristic (EI11)

Unit: s

Operation time multiplier (M)	Input		
	300%	500%	1000%
0.25	0.074 ± 5.50%	0.033 ± 0.05	0.017 ± 0.05
	* 0.040 ~ 0.235	* 0.040 ~ 0.082	* 0.040 ~ 0.067
0.5	0.147 ± 5.67%	0.065 ± 3.83%	0.034 ± 0.05
	* 0.040 ~ 0.314	* 0.040 ~ 0.116	* 0.040 ~ 0.084
1	0.294 ± 6.00%	0.131 ± 4.00%	0.069 ± 0.05
	0.118 ~ 0.471	0.078 ~ 0.183	* 0.040 ~ 0.119
1.5	0.441 ± 6.33%	0.196 ± 4.17%	0.103 ± 0.05
	0.255 ~ 0.628	0.142 ~ 0.251	0.053 ~ 0.153
2	0.588 ± 6.67%	0.262 ± 4.33%	0.138 ± 0.05
	0.392 ~ 0.785	0.205 ~ 0.318	0.088 ~ 0.188
2.5	0.736 ± 7.00%	0.327 ± 4.50%	0.172 ± 0.05
	0.530 ~ 0.942	0.268 ~ 0.386	0.122 ~ 0.222
3	0.883 ± 7.33%	0.392 ± 4.67%	0.207 ± 0.05
	0.667 ~ 1.098	0.331 ~ 0.453	0.157 ~ 0.257
3.5	1.030 ± 7.67%	0.458 ± 4.83%	0.241 ± 0.05
	0.804 ~ 1.255	0.395 ~ 0.521	0.191 ~ 0.291
4	1.177 ± 8.00%	0.523 ± 5.00%	0.276 ± 0.05
	0.942 ~ 1.412	0.458 ~ 0.589	0.226 ~ 0.326
4.5	1.324 ± 8.33%	0.589 ± 5.17%	0.310 ± 0.05
	1.079 ~ 1.569	0.521 ~ 0.656	0.260 ~ 0.360
5	1.471 ± 8.67%	0.654 ± 5.33%	0.345 ± 0.05
	1.216 ~ 1.726	0.584 ~ 0.724	0.295 ~ 0.395
6	1.765 ± 9.33%	0.785 ± 5.67%	0.413 ± 0.05
	1.491 ~ 2.040	0.711 ~ 0.859	0.363 ~ 0.463
7	2.060 ± 10.00%	0.916 ± 6.00%	0.482 ± 0.05
	1.765 ~ 2.354	0.837 ~ 0.994	0.432 ~ 0.532
8	2.354 ± 10.67%	1.046 ± 6.33%	0.551 ± 0.05
	2.040 ~ 2.668	0.964 ~ 1.129	0.501 ~ 0.601
9	2.648 ± 11.33%	1.177 ± 6.67%	0.620 ± 0.05
	2.315 ~ 2.981	1.090 ~ 1.264	0.570 ~ 0.670
10	2.942 ± 12.00%	1.308 ± 7.00%	0.689 ± 0.05
	2.589 ~ 3.295	1.217 ~ 1.400	0.639 ~ 0.739
15	4.413 ± 12.00%	1.962 ± 7.00%	1.034 ± 7.00%
	3.884 ~ 4.943	1.825 ~ 2.099	0.961 ~ 1.106
20	5.885 ± 12.00%	2.616 ± 7.00%	1.378 ± 7.00%
	5.178 ~ 6.591	2.433 ~ 2.799	1.282 ~ 1.475
30	8.827 ± 12.00%	3.924 ± 7.00%	2.067 ± 7.00%
	7.768 ~ 9.886	3.650 ~ 4.199	1.923 ~ 2.212
40	11.769 ± 12.00%	5.232 ± 7.00%	2.756 ± 7.00%
	10.357 ~ 13.181	4.866 ~ 5.599	2.563 ~ 2.949
50	14.711 ± 12.00%	6.540 ± 7.00%	3.445 ± 7.00%
	12.946 ~ 16.477	6.083 ~ 6.998	3.204 ~ 3.687

Note: The values shown in the upper column of each box represent the theoretical operation time and error limit, and those in the lower column represent the permissible range
Refer to the note *32 to *35.

Table 3.9 Operation time range for Extremely inverse time-delayed characteristic (EI12)

Unit: s

Operation time multiplier (M)	Input		
	300%	500%	1000%
0.25	0.091 ± 5.50%	0.032 ± 0.05	0.010 ± 0.05
	* 0.040 ~ 0.292	* 0.040 ~ 0.082	* 0.040 ~ 0.060
0.5	0.182 ± 5.67%	0.065 ± 3.83%	0.020 ± 0.05
	* 0.040 ~ 0.389	* 0.040 ~ 0.115	* 0.040 ~ 0.070
1	0.365 ± 6.00%	0.130 ± 4.00%	0.041 ± 0.05
	0.146 ~ 0.583	0.078 ~ 0.182	* 0.040 ~ 0.091
1.5	0.547 ± 6.33%	0.195 ± 4.17%	0.061 ± 0.05
	0.316 ~ 0.778	0.140 ~ 0.249	* 0.040 ~ 0.111
2	0.729 ± 6.67%	0.259 ± 4.33%	0.081 ± 0.05
	0.486 ~ 0.972	0.203 ~ 0.316	* 0.040 ~ 0.131
2.5	0.912 ± 7.00%	0.324 ± 4.50%	0.102 ± 0.05
	0.656 ~ 1.167	0.266 ~ 0.383	0.052 ~ 0.152
3	1.094 ± 7.33%	0.389 ± 4.67%	0.122 ± 0.05
	0.827 ~ 1.361	0.328 ~ 0.450	0.072 ~ 0.172
3.5	1.276 ± 7.67%	0.454 ± 4.83%	0.142 ± 0.05
	0.997 ~ 1.556	0.391 ~ 0.517	0.092 ~ 0.192
4	1.459 ± 8.00%	0.519 ± 5.00%	0.163 ± 0.05
	1.167 ~ 1.750	0.454 ~ 0.584	0.113 ~ 0.213
4.5	1.641 ± 8.33%	0.584 ± 5.17%	0.183 ± 0.05
	1.337 ~ 1.945	0.517 ~ 0.651	0.133 ~ 0.233
5	1.823 ± 8.67%	0.648 ± 5.33%	0.203 ± 0.05
	1.507 ~ 2.139	0.579 ~ 0.718	0.153 ~ 0.253
6	2.188 ± 9.33%	0.778 ± 5.67%	0.244 ± 0.05
	1.848 ~ 2.528	0.705 ~ 0.851	0.194 ~ 0.294
7	2.553 ± 10.00%	0.908 ± 6.00%	0.285 ± 0.05
	2.188 ~ 2.917	0.830 ~ 0.985	0.235 ~ 0.335
8	2.917 ± 10.67%	1.037 ± 6.33%	0.325 ± 0.05
	2.528 ~ 3.306	0.955 ~ 1.119	0.275 ~ 0.375
9	3.282 ± 11.33%	1.167 ± 6.67%	0.366 ± 0.05
	2.869 ~ 3.695	1.081 ~ 1.253	0.316 ~ 0.416
10	3.647 ± 12.00%	1.297 ± 7.00%	0.407 ± 0.05
	3.209 ~ 4.084	1.206 ~ 1.387	0.357 ~ 0.457
15	5.470 ± 12.00%	1.945 ± 7.00%	0.610 ± 0.05
	4.814 ~ 6.126	1.809 ~ 2.081	0.560 ~ 0.660
20	7.293 ± 12.00%	2.593 ± 7.00%	0.813 ± 7.00%
	6.418 ~ 8.169	2.412 ~ 2.775	0.756 ~ 0.870
30	10.940 ± 12.00%	3.890 ± 7.00%	1.220 ± 7.00%
	9.627 ~ 12.253	3.618 ~ 4.162	1.134 ~ 1.305
40	14.587 ± 12.00%	5.187 ± 7.00%	1.626 ± 7.00%
	12.836 ~ 16.337	4.824 ~ 5.550	1.512 ~ 1.740
50	18.234 ± 12.00%	6.484 ± 7.00%	2.033 ± 7.00%
	16.045 ~ 20.422	6.030 ~ 6.937	1.890 ~ 2.175

Note: The values shown in the upper column of each box represent the theoretical operation time and error limit, and those in the lower column represent the permissible range
Refer to the note *32 to *35.

Table 3.10 Operation time range for Normal inverse time-delayed characteristic (NI21)

Unit: s

Operation time multiplier (M)	Input		
	300%	500%	1000%
0.25	0.139 ± 5.50%	0.096 ± 3.75%	0.070 ± 3.75%
	* 0.040 ~ 0.444	* 0.040 ~ 0.241	* 0.040 ~ 0.174
0.5	0.277 ± 5.67%	0.193 ± 3.83%	0.139 ± 3.83%
	* 0.040 ~ 0.592	0.045 ~ 0.341	* 0.040 ~ 0.246
1	0.555 ± 6.00%	0.386 ± 4.00%	0.279 ± 4.00%
	0.222 ~ 0.888	0.231 ~ 0.540	0.167 ~ 0.390
1.5	0.832 ± 6.33%	0.578 ± 4.17%	0.418 ± 4.17%
	0.481 ~ 1.184	0.418 ~ 0.739	0.302 ~ 0.534
2	1.110 ± 6.67%	0.771 ± 4.33%	0.557 ± 4.33%
	0.740 ~ 1.480	0.604 ~ 0.938	0.437 ~ 0.678
2.5	1.387 ± 7.00%	0.964 ± 4.50%	0.697 ± 4.50%
	0.999 ~ 1.776	0.790 ~ 1.137	0.571 ~ 0.822
3	1.665 ± 7.33%	1.157 ± 4.67%	0.836 ± 4.67%
	1.258 ~ 2.072	0.977 ~ 1.337	0.706 ~ 0.966
3.5	1.942 ± 7.67%	1.350 ± 4.83%	0.976 ± 4.83%
	1.517 ~ 2.368	1.163 ~ 1.536	0.841 ~ 1.110
4	2.220 ± 8.00%	1.542 ± 5.00%	1.115 ± 5.00%
	1.776 ~ 2.664	1.350 ~ 1.735	0.976 ~ 1.254
4.5	2.497 ± 8.33%	1.735 ± 5.17%	1.254 ± 5.17%
	2.035 ~ 2.959	1.536 ~ 1.934	1.110 ~ 1.398
5	2.775 ± 8.67%	1.928 ± 5.33%	1.394 ± 5.33%
	2.294 ~ 3.255	1.722 ~ 2.134	1.245 ~ 1.542
6	3.329 ± 9.33%	2.314 ± 5.67%	1.672 ± 5.67%
	2.812 ~ 3.847	2.095 ~ 2.532	1.514 ~ 1.830
7	3.884 ± 10.00%	2.699 ± 6.00%	1.951 ± 6.00%
	3.329 ~ 4.439	2.468 ~ 2.930	1.784 ~ 2.118
8	4.439 ± 10.67%	3.085 ± 6.33%	2.230 ± 6.33%
	3.847 ~ 5.031	2.841 ~ 3.329	2.053 ~ 2.406
9	4.994 ± 11.33%	3.470 ± 6.67%	2.509 ± 6.67%
	4.365 ~ 5.623	3.213 ~ 3.727	2.323 ~ 2.695
10	5.549 ± 12.00%	3.856 ± 7.00%	2.787 ± 7.00%
	4.883 ~ 6.215	3.586 ~ 4.126	2.592 ~ 2.983
15	8.324 ± 12.00%	5.784 ± 7.00%	4.181 ± 7.00%
	7.325 ~ 9.322	5.379 ~ 6.189	3.888 ~ 4.474
20	11.098 ± 12.00%	7.712 ± 7.00%	5.575 ± 7.00%
	9.766 ~ 12.430	7.172 ~ 8.252	5.185 ~ 5.965
30	16.647 ± 12.00%	11.568 ± 7.00%	8.362 ± 7.00%
	14.649 ~ 18.645	10.758 ~ 12.377	7.777 ~ 8.948
40	22.196 ± 12.00%	15.424 ± 7.00%	11.150 ± 7.00%
	19.533 ~ 24.860	14.344 ~ 16.503	10.369 ~ 11.930
50	27.745 ± 12.00%	19.279 ± 7.00%	13.937 ± 7.00%
	24.416 ~ 31.075	17.930 ~ 20.629	12.962 ~ 14.913

Note: The values shown in the upper column of each box represent the theoretical operation time and error limit, and those in the lower column represent the permissible range
Refer to the note *32 to *35.

Table 3.11 Operation time range e for Very inverse time-delayed characteristic (VI21)

Unit: s

Operation time multiplier (M)	Input		
	300%	500%	1000%
0.25	0.210 ± 5.50%	0.110 ± 3.75%	0.054 ± 3.75%
	* 0.040 ~ 0.672	* 0.040 ~ 0.275	* 0.040 ~ 0.136
0.5	0.420 ± 5.67%	0.220 ± 3.83%	0.109 ± 3.83%
	* 0.040 ~ 0.896	0.051 ~ 0.389	* 0.040 ~ 0.192
1	0.840 ± 6.00%	0.440 ± 4.00%	0.218 ± 4.00%
	0.336 ~ 1.344	0.264 ~ 0.616	0.131 ~ 0.305
1.5	1.260 ± 6.33%	0.660 ± 4.17%	0.327 ± 4.17%
	0.728 ~ 1.792	0.477 ~ 0.843	0.236 ~ 0.417
2	1.680 ± 6.67%	0.880 ± 4.33%	0.436 ± 4.33%
	1.120 ~ 2.240	0.689 ~ 1.071	0.341 ~ 0.530
2.5	2.100 ± 7.00%	1.100 ± 4.50%	0.544 ± 4.50%
	1.512 ~ 2.688	0.902 ~ 1.298	0.446 ~ 0.642
3	2.520 ± 7.33%	1.320 ± 4.67%	0.653 ± 4.67%
	1.904 ~ 3.136	1.115 ~ 1.525	0.552 ~ 0.755
3.5	2.940 ± 7.67%	1.540 ± 4.83%	0.762 ± 4.83%
	2.296 ~ 3.584	1.327 ~ 1.753	0.657 ~ 0.867
4	3.360 ± 8.00%	1.760 ± 5.00%	0.871 ± 5.00%
	2.688 ~ 4.032	1.540 ~ 1.980	0.762 ~ 0.980
4.5	3.780 ± 8.33%	1.980 ± 5.17%	0.980 ± 5.17%
	3.080 ~ 4.480	1.753 ~ 2.207	0.867 ~ 1.093
5	4.200 ± 8.67%	2.200 ± 5.33%	1.089 ± 5.33%
	3.472 ~ 4.928	1.965 ~ 2.435	0.973 ~ 1.205
6	5.040 ± 9.33%	2.640 ± 5.67%	1.307 ± 5.67%
	4.256 ~ 5.824	2.391 ~ 2.889	1.183 ~ 1.430
7	5.880 ± 10.00%	3.080 ± 6.00%	1.524 ± 6.00%
	5.040 ~ 6.720	2.816 ~ 3.344	1.394 ~ 1.655
8	6.720 ± 10.67%	3.520 ± 6.33%	1.742 ± 6.33%
	5.824 ~ 7.616	3.241 ~ 3.799	1.604 ~ 1.880
9	7.560 ± 11.33%	3.960 ± 6.67%	1.960 ± 6.67%
	6.608 ~ 8.512	3.667 ~ 4.253	1.815 ~ 2.105
10	8.400 ± 12.00%	4.400 ± 7.00%	2.178 ± 7.00%
	7.392 ~ 9.408	4.092 ~ 4.708	2.025 ~ 2.330
15	12.600 ± 12.00%	6.600 ± 7.00%	3.267 ± 7.00%
	11.088 ~ 14.112	6.138 ~ 7.062	3.038 ~ 3.495
20	16.800 ± 12.00%	8.800 ± 7.00%	4.356 ± 7.00%
	14.784 ~ 18.816	8.184 ~ 9.416	4.051 ~ 4.660
30	25.200 ± 12.00%	13.200 ± 7.00%	6.533 ± 7.00%
	22.176 ~ 28.224	12.276 ~ 14.124	6.076 ~ 6.991
40	33.600 ± 12.00%	17.600 ± 7.00%	8.711 ± 7.00%
	29.568 ~ 37.632	16.368 ~ 18.832	8.101 ~ 9.321
50	42.000 ± 12.00%	22.000 ± 7.00%	10.889 ± 7.00%
	36.960 ~ 47.040	20.460 ~ 23.540	10.127 ~ 11.651

Note: The values shown in the upper column of each box represent the theoretical operation time and error limit, and those in the lower column represent the permissible range
Refer to the note *32 to *35.

Table 3.12 Operation time range for Long inverse time-delayed characteristic (LI21)

Unit: s

Operation time multiplier (M)	Input		
	300%	500%	1000%
0.25	0.750 ± 5.50%	0.375 ± 3.75%	0.167 ± 3.75%
	* 0.040 ~ 2.400	* 0.040 ~ 0.938	* 0.040 ~ 0.417
0.5	1.500 ± 5.67%	0.750 ± 3.83%	0.333 ± 3.83%
	* 0.040 ~ 3.200	0.175 ~ 1.325	0.078 ~ 0.589
1	3.000 ± 6.00%	1.500 ± 4.00%	0.667 ± 4.00%
	1.200 ~ 4.800	0.900 ~ 2.100	0.400 ~ 0.933
1.5	4.500 ± 6.33%	2.250 ± 4.17%	1.000 ± 4.17%
	2.600 ~ 6.400	1.625 ~ 2.875	0.722 ~ 1.278
2	6.000 ± 6.67%	3.000 ± 4.33%	1.333 ± 4.33%
	4.000 ~ 8.000	2.350 ~ 3.650	1.044 ~ 1.622
2.5	7.500 ± 7.00%	3.750 ± 4.50%	1.667 ± 4.50%
	5.400 ~ 9.600	3.075 ~ 4.425	1.367 ~ 1.967
3	9.000 ± 7.33%	4.500 ± 4.67%	2.000 ± 4.67%
	6.800 ~ 11.200	3.800 ~ 5.200	1.689 ~ 2.311
3.5	10.500 ± 7.67%	5.250 ± 4.83%	2.333 ± 4.83%
	8.200 ~ 12.800	4.525 ~ 5.975	2.011 ~ 2.656
4	12.000 ± 8.00%	6.000 ± 5.00%	2.667 ± 5.00%
	9.600 ~ 14.400	5.250 ~ 6.750	2.333 ~ 3.000
4.5	13.500 ± 8.33%	6.750 ± 5.17%	3.000 ± 5.17%
	11.000 ~ 16.000	5.975 ~ 7.525	2.656 ~ 3.344
5	15.000 ± 8.67%	7.500 ± 5.33%	3.333 ± 5.33%
	12.400 ~ 17.600	6.700 ~ 8.300	2.978 ~ 3.689
6	18.000 ± 9.33%	9.000 ± 5.67%	4.000 ± 5.67%
	15.200 ~ 20.800	8.150 ~ 9.850	3.622 ~ 4.378
7	21.000 ± 10.00%	10.500 ± 6.00%	4.667 ± 6.00%
	18.000 ~ 24.000	9.600 ~ 11.400	4.267 ~ 5.067
8	24.000 ± 10.67%	12.000 ± 6.33%	5.333 ± 6.33%
	20.800 ~ 27.200	11.050 ~ 12.950	4.911 ~ 5.756
9	27.000 ± 11.33%	13.500 ± 6.67%	6.000 ± 6.67%
	23.600 ~ 30.400	12.500 ~ 14.500	5.556 ~ 6.444
10	30.000 ± 12.00%	15.000 ± 7.00%	6.667 ± 7.00%
	26.400 ~ 33.600	13.950 ~ 16.050	6.200 ~ 7.133
15	45.000 ± 12.00%	22.500 ± 7.00%	10.000 ± 7.00%
	39.600 ~ 50.400	20.925 ~ 24.075	9.300 ~ 10.700
20	60.000 ± 12.00%	30.000 ± 7.00%	13.333 ± 7.00%
	52.800 ~ 67.200	27.900 ~ 32.100	12.400 ~ 14.267
30	90.000 ± 12.00%	45.000 ± 7.00%	20.000 ± 7.00%
	79.200 ~ 100.80	41.850 ~ 48.150	18.600 ~ 21.400
40	120.00 ± 12.00%	60.000 ± 7.00%	26.667 ± 7.00%
	105.60 ~ 134.4	55.800 ~ 64.200	24.800 ~ 28.533
50	150.00 ± 12.00%	75.000 ± 7.00%	33.333 ± 7.00%
	132.00 ~ 168.00	69.750 ~ 80.250	31.000 ~ 35.667

Note: The values shown in the upper column of each box represent the theoretical operation time and error limit, and those in the lower column represent the permissible range
Refer to the note *32 to *35.

Table 3.13 Reset time characteristic

Input: Setting value×300% →0

	Output contact	Reset of operation timer inside relay
01 : Definite time-delayed (200 ms)	200ms ± 25ms	Immediately
11 : Inverse time-delayed	200ms ± 25ms	Approx. 8 s (for M=10 , l=0) *36
21 : Definite time-delayed (50 ms)	50ms or less	Immediately

Note:

- *32 The numbers “300%”, “500%” and “1000%” represent multiples against the current setting.
- *33 The values shown in the upper column of each box in the table represent the theoretical operation time and error limit, and those in the lower column represent the permissible range (see the formula below).

a. Operation time multiplier “M” ≤10	b. Operation time multiplier “M” > 10
$\varepsilon = \frac{T_M - \frac{M}{10} \cdot T_{10}}{T_{10}} \cdot 100$	$\varepsilon = \frac{T_M - \frac{M}{10} \cdot T_{10}}{\frac{M}{10} \cdot T_{10}} \cdot 100$

where;

- T₁₀ : Nominal operation time for reference operation time setting (M = 10)
- T_M : Actual measurement of operation time for operation time setting “M”
- ε : Error (%)
- M : Operation time multiplier

If an error range determined using the formula above is smaller the lower error limit of ± 50ms, this lower error limit should be used as the error range.

- *34 “40ms” given at the underlined part (marked with “*”) in the table indicates the time determined as minimum operation time.
- *35 The table is prepared on the basis of minimum operation setting under normal temperature, and the operation time ranges change as condition varies.
- *36 The elapsed time of reset of the operation timer can be checked through the “Elapse of time-delayed timer (LAPSE) indicator”.

4 Functions

4.1 Protection

4.1.1 Phase fault elements

Fig. 4.1 “Phase fault element internal function block diagram” shows operation of the phase fault elements. The time-delayed element compares input currents with the operation setting in each phase. If an input current is larger than the specified operation level, the element outputs an operation signal when the time-delayed timer expires. The expiring time depends on the input current amount and the setting in the operation time characteristic. But if one of I_{2f}/I_{1f} value in any phase is larger than the setting, all phases will be locked. And when all of the I_{2f}/I_{1f} values are less than the setting, the operation lock of all phases will be removed. The 2nd harmonic blocking signal of any phase is detected out, the LED (yellow) of 2f blocking will blink.

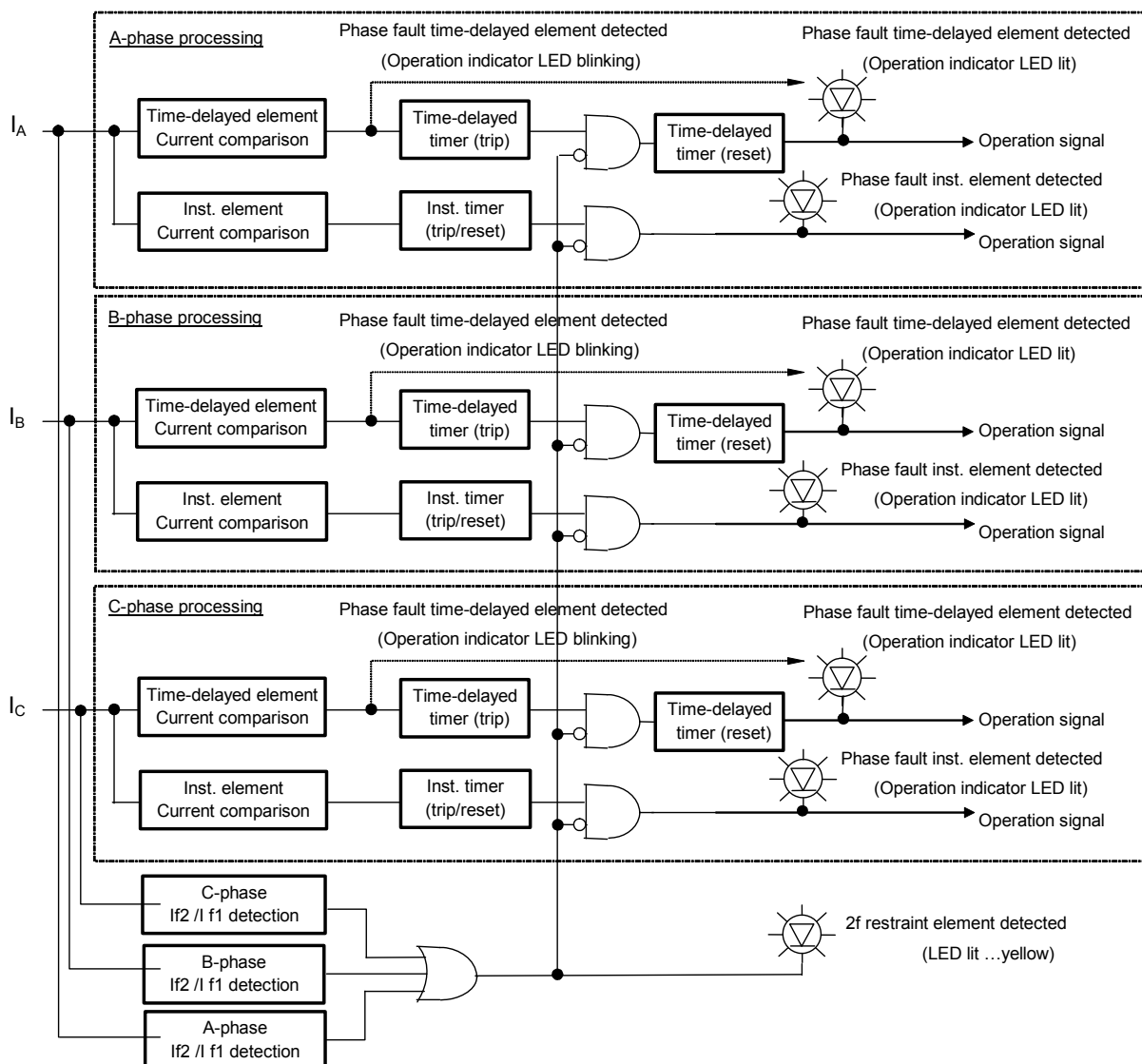


Figure 4.1 Phase fault element internal function diagram

Like the time-delayed element, the instantaneous element also compares the input current with the operation setting to output an operation signal when a period of time set in the instantaneous timer has elapsed. And like as the time-delayed element, the instantaneous elements will be also locked when the 2nd harmonic blocking signal is detected out.

4.1.2 Earth fault elements

Fig. 4.2 “Earth fault element internal function block diagram” shows operation of the earth fault elements. The time-delayed element compares input currents with the operation setting in the zero-phase. If an input current is larger than the specified operation level, the element outputs an operation signal when the time-delayed timer expires. The expiring time depends on the input current amount and the setting in the operation time characteristic. Like as time-delayed element, if one of I_{2f}/I_{1f} value in any phase is larger than the setting, all phases will be locked. And when all of the I_{2f}/I_{1f} values are less than the setting, the operation lock of all phases will be removed. The 2nd harmonic blocking signal of any phase is detected out, the LED (yellow) of 2f blocking will blink.

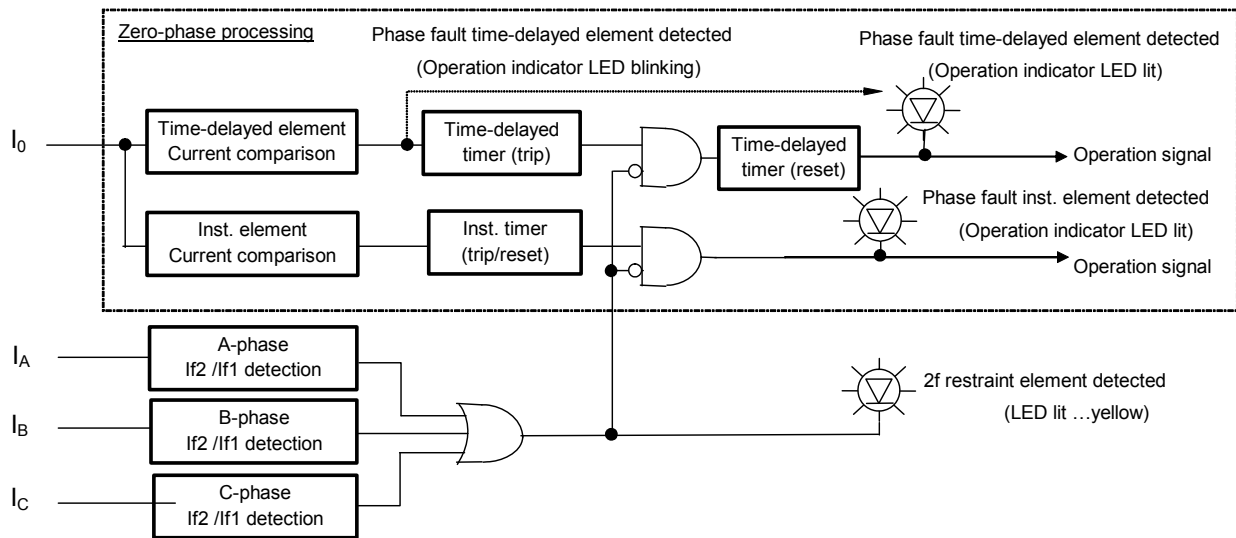


Figure 4.2 Earth fault element internal function diagram

Like the time-delayed element, the instantaneous element also compares the input current with the operation setting to output an operation signal when the instantaneous operation timer expires. And like as the time-delayed element, the instantaneous elements will be also locked when the 2nd harmonic blocking signal is detected out.

4.1.3 At the time of exciting inrush current inflow

- 2nd harmonic blocking function

In the exciting inrush current, a large quantity of 2nd harmonic component is included as shown the below table but in the system fault current it is not so much included. This difference is utilized for this relay to prevent the unnecessary operation at the time of transformer excitation by the adoption of 2nd harmonic blocking element. At the operating status of phase fault element and earth fault element, once the 2nd harmonic component was detected, the operation indication LED (yellow) comes on.

When 2nd harmonic component includes more than the setting value of 2nd harmonic blocking ratio, it operates and prevents the operation of phase-fault and earth-fault elements. So that the erroneous operation caused by exciting inrush current can be prevented. According this way that 2nd harmonic blocking element locks the phase-fault and earth-fault elements, that is, the All Phase OR Lock method (Once inrush is detected in any phase, all phase will be locked) is used.

	Exciting inrush current		
	1 st cycle	2 nd cycle	8 th cycle
DC component	58	58	58
Fundamental component	100	100	100
2 nd harmonic component	62	63	65
3 rd harmonic component	25	28	30
4 th harmonic component	4	5	7
5 th harmonic component	2	3	3

4.1.4 General functions

(1) Setting of operation current

The operation current settings for the instantaneous and time-delayed elements are indicated with current values [A].

When the setting “Lock”, the elements selected are locked for operation.

(2) Setting of operation time multiplier

This parameter is indicated with a multiplier against the basic operation time characteristic (value for the letter “M” in the operation characteristic formula shown in Figure 3.1).

(3) Setting of operation time characteristic

A time-delayed element includes 11 types of inverse and a type of definite time-delayed characteristics for trip action that meet the requirements specified by IEC60255-3. One of them can be selected by operation time characteristic setting.

Figures 3.1 and 3.2 show the operation time characteristic curves and operation time characteristic formulas.

(4) Setting of reset time characteristic

A time-delayed element includes a type of inverse and two types of definite time-delayed characteristics for reset action that meet the requirements specified by IEC60255-3. One of them can be selected by reset time characteristic setting.

Figure 3.3 shows the reset time characteristic curves and reset time characteristic formula.

Characteristic		Reset when relay input is less than operation setting		Response to intermittent inputs
Designation	Symbol	Reset of time-lag timer inside relay	Output contact	
Definite time-lag	01	Quick reset	Definite time-lag of 200ms	Unlikely to operate
	21	Quick reset	Definite time-lag of 50ms	
Inverse time-lag	11	Inverse time-lag reset according to the formula below: $t_r = \frac{8}{1 - I^2} \times \frac{M}{10} (\text{s})$	Definite time-lag of 200ms	Likely to operate

For the definite time-delayed reset characteristic, the internal timer will reset quickly when the input current becomes less than the operation setting. The definite time-delayed reset characteristic is not suitable for detecting intermittent overloads which are likely to occur in starting a motor or intermittent earth fault. For the inverse time-delayed reset characteristic in turn, the internal timer will reset according to an inverse time-delayed reset characteristic even when the input current becomes less than the operating setting by following the principle of resetting the electromagnetic mechanical type induction disc. Therefore, it is relatively easy for the inverse time-delayed reset characteristic to detect intermittent phenomena. Select either depending on your application.

Note that the output contact will reset after a definite period of time whichever characteristic is selected for resetting.

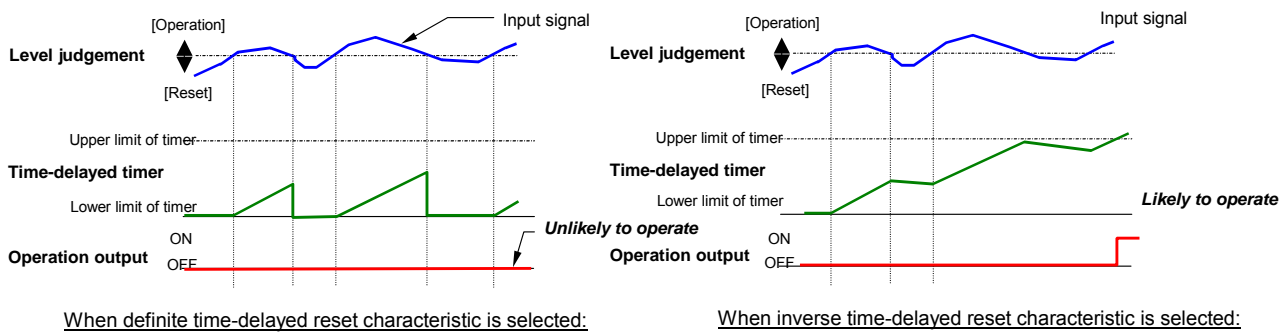


Figure 4.3 Comparison of relay operation with intermittent overload input between two reset characteristics

(5) Operation display

For the time-delayed element, when the input current becomes larger than the operation setting, the corresponding operation indicator LED will blink to allow you check the starting value.

The LED lamp will come on as soon as an operation output is made when a period of operation time has elapsed.

For the instantaneous element in turn, the LED lamp will come on at the same time when an operation output is made.

The operation indicator LED has been set to “self-hold” in the factory. This setting can be freely changed to “auto reset”.

With the “self-hold” setting, data of the latest operation indication will be stored in the internal memory even if the auxiliary power supply runs down.

The data stored will be cleared when the “indicator reset” switch is pressed.

Up to latest five phenomena can be stored and displayed as a history record. (Older data than the latest five phenomena will automatically be cleared).

Item No.	History	Sequence of recording
311	1 st phenomena	Latest fault record data ↓ ↓ ↓ ↓ Oldest fault record data
312	2 nd phenomena	
313	3 rd phenomena	
314	4 th phenomena	
315	5 th phenomena	

(6) Display of elapsed time of time-delayed timer

For the time-delayed elements, the elapsed time of the internal operation timer is indicated in the display. As the elapsed time is counted, operators may imagine the current status of the electromagnetic mechanical induction disc, which will help detect the starting value.

When an input current is detected to have reached the operation setting or more, “0” will appear in the display. Counting will be made by dividing the operation time equally into ten parts and starting from “1”, “2” to “9” and “10”. An operation signal will be output as soon as the counter reaches “10”.

(7) Output contacts

The signaling outputs X_0 to X_3 and trip outputs X_4 and X_5 are all programmable type.

The factory default setting of the arrangement of these outputs is as shown in the internal function block diagram of Figure 5.2. This setting can be freely changed by specifying outputs of the internal elements based on the OR logic.

All the outputs have been set to “auto reset” in the factory. Any of them can be changed to “self hold”.

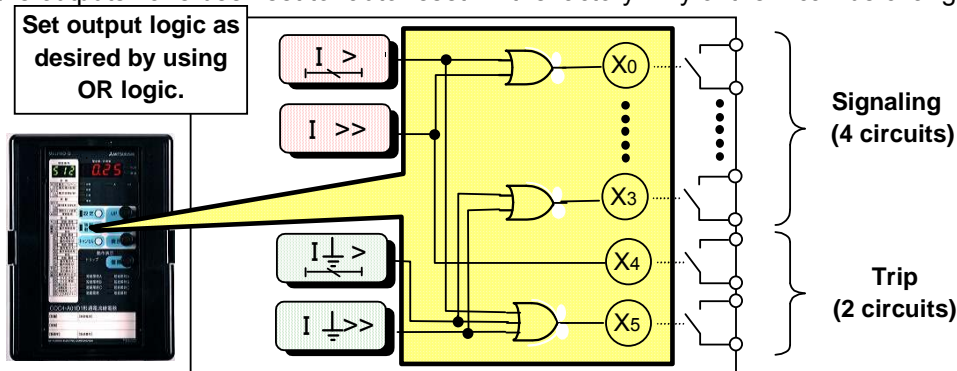


Figure 4.4 Schematic image of Programmable Outputs (example: COC4-A01)

(8) Forced operation

It is possible to carry out forced operation of any of the signaling outputs X_0 to X_3 and trip outputs X_4 and X_5 independently. Forced operation is useful for checking the wiring.

When forced operation is carried out, the corresponding LED lamps will come on to show the current status of the programmable outputs. Checking the lamp status will be useful not only for wiring check but also to check the programmable outputs arrangement.

4.2 Measurement

Currents input to the relay are measured and converted into freely set CT primary currents, then indicated on the display.

(1) Real time measurement

The effective values of input current and 2f ratio are displayed for each phase.

(2) Max. record

The maximum effective current is recorded and stored for each phase.

The max. record will be all cleared when “aux. power supply OFF” or “max. record reset” operation is made.

(3) Fault record

In the event of system fault, the effective current and waveform data that have been measured at the time when one of the protection elements operates to issue an output signal are stored. Data of up to five phenomena can be stored and displayed for each phase.

With “aux. power supply OFF”, only the waveform data will be cleared and the effective current data will remain. With “fault record reset” operation, however, both of the data items will be all cleared.

(Records older than the 5th phenomenon will automatically be cleared.)

Item No.	History	Sequence of recording
211	1 st phenomena	Latest fault record data ↓ ↓ ↓ Oldest fault record data
212	2 nd phenomena	
213	3 rd phenomena	
214	4 th phenomena	
215	5 th phenomena	

The following fault waveform data can be collected if a communication card is installed:

Item	Specification
Data sampling cycle	Fixed to the electric angle of 30° of rated frequency
Data storing capacity (for a phenomenon)	224 cycles of rated frequency (Data point: $224 \times 360^\circ / 30^\circ = 2688$ points)
Permissible setting range	224 cycles before trip ~ 224 cycles after trip
Collected data	The range for data collection can be set by cycle within the “data storing capacity” in the “permissible set range”.

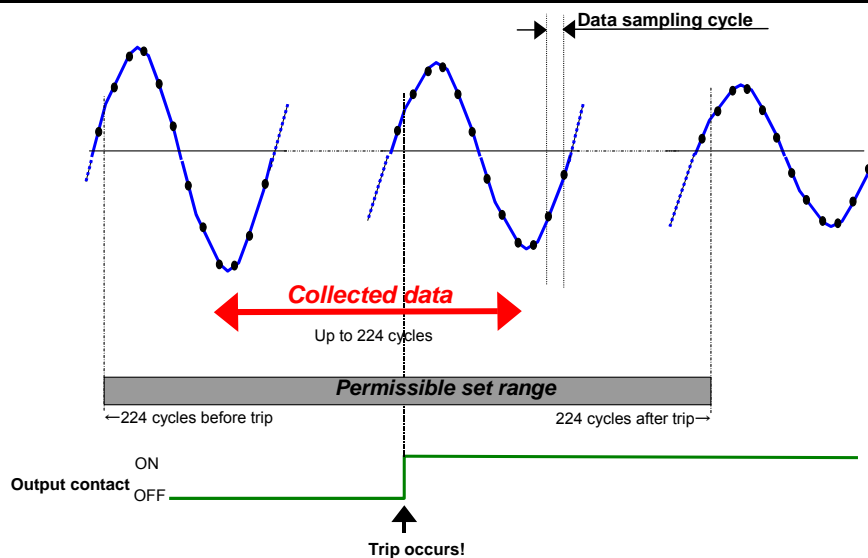


Figure 4.5 Concept of recording fault waveform

4.3 Self-diagnosis

The self-diagnosis function monitors the electronic circuit and built-in power source continuously. If an abnormal condition occurs, the protection elements will be locked for operation. Also, the RUN LED lamp will go off and the self-diagnosis output contact (break contact) will be closed.

(1) Checking defect code at failure detection

When a failure is detected, the defect code will be recorded. This defect code can be checked through the self-diagnosis (ALARM) status indication.

(2) Resetting self-diagnosis output

If a failure is detected, **the failure status may be reset by turning off/on the power.**

In this case, **be sure to lock the trip circuit on the external wiring of the relay** before resetting. (If the failure persists, an erroneous output may be caused).

(3) Clearing the defect code

The defect code data stored at failure detection can not be cleared only by carrying out the power on/off procedure in the item (2) above. All the defect code numbers that have been detected since the previous “self-diagnosis reset” (RESET ALARM) operation was made are accumulated in the memory.

To clear the record data, carry out “self-diagnosis reset” (RESET ALARM) operation.

Table 4.1 Output for protection relay failures

Status	Detected items	Output				
		Display		ALARM (break contact)	Operation output lock	
		RUN	Defect code			
Normal	—	On		Open	Not locked	
Power circuit failure	—	Off	No display	Closed	Locked	
CPU failure	—				* 45	
Monitor error	ROM check				Off	No display
	RAM check	0001				
	A/D accuracy check	0002				
	A/I check	0003				
	A/D check	0004				
	SRAM check	0005				
	D/O status check	0006				
	D/O operation check	0008				
	Analog filter check	0009				
	A/I double check	0010				
	D/I check * 41	0011				
	E ² PROM check	0012				
	Computing function check	0013				
	WDT check	0014				
	Data transfer check * 42	0015				
	Differential current check * 43	0016				
	Communication card check * 44	0017				
Communication card channel No. switch setting error * 44	0028	On	Open	Not locked		
Communication card baud rate switch setting error * 44	0029					
Communication card channel No. switch change error * 44	0030					
Communication card baud rate switch change error * 44	0031					
Communication card baud rate switch change error * 44	0032					

* 41 Monitored only in the models with built-in D/I function.

* 42 Monitored only in the models with D2 unit.

* 43 Monitored only the biased differential relay.

* 44 Monitored only when the relay is installed with communication card.

* 45 No necessary to lock the operation output as any signals can't be output in case of CPU stop.

4.4 Communication

Figure 4.6 shows an example of network system configuration.

For more information on the communication facilities, see the materials shown in the introduction (page 2).

Central Control System

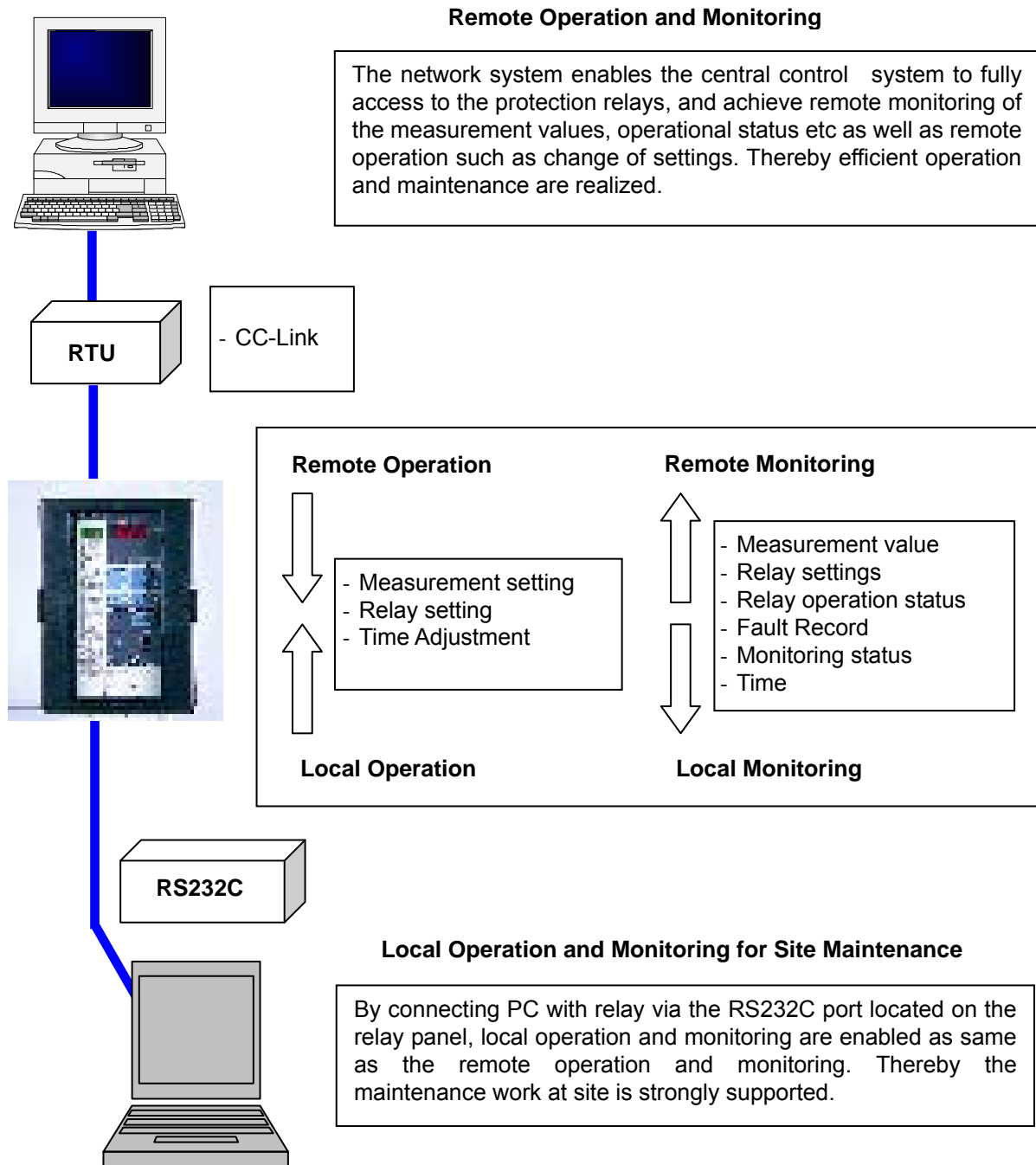


Figure 4.6 Example of communication network system configuration

Using the communication facilities, it is possible to perform Remote Monitoring and Remote Operation with the various useful functions shown in Table 4.2.

Table 4.2 Outline of functions enabled by communication network

Direction of communication	Item	Description
Remote Monitoring RTU ← Protection relay	Setting	Read the settings stored in the protection relay.
	Measurement	Read the measurements stored in the protection relay.
	Max. value	Read the max. values stored in the protection relay.
	Fault record	Read the measurements at the time of trip.
	Self-diagnosis (ALARM)	Read the result of self-diagnosis.
	Operation element	Read the elements that operated at the time of trip.
	Operation time	Read the time at the time of trip.
	Current time	Read the internal time of the communication card.
	Waveform record	Read the wave form at the time of trip.
Remote Operation RTU → Protection relay	Setting	Change the setting of the protection relay.
	Indicator reset	Reset the LED lamp that came on at the time of trip.
	Self-diagnosis (ALARM) reset	Clear the result of self-diagnosis.
	Fault record reset	Clear the fault record, operation elements and operation time data.
	Max. record reset	Clear the max. record.
	Forced operation	Carry out forced operation of output contact.
	Time	Set time of communicate card.

5 Configuration

5.1 Internal configuration

(1) I/O and CPU circuits

Fig. 5.1 shows the internal block diagram of the model COC4-A03D1.

Current input is converted into AC signals at the electronic circuit level via the auxiliary transformer and filter circuits. These signals are retained as a form of DC signal in the sample hold circuit on each channel sharing a same time. The multiplexer selects a channel to take the signal and sends it to an A/D converter. The signals are converted to digital signals sequentially in the converter to be sent to the CPU.

The setting circuit is used to input setting data into the CPU.

These inputs will be used to carry out the functions shown in Fig. 5.2 "Internal function block diagram", and then issue output signals to the display and output relay.

(2) Self-diagnosis circuit

When the self-diagnosis function detects that the electronic and power circuits are normal, the output relay will be energized to open the self-diagnosis output contact (break contact).

The self-diagnosis output contact (break contact) will be closed when a failure occurs in the circuits above or when the built-in power fuse burns.

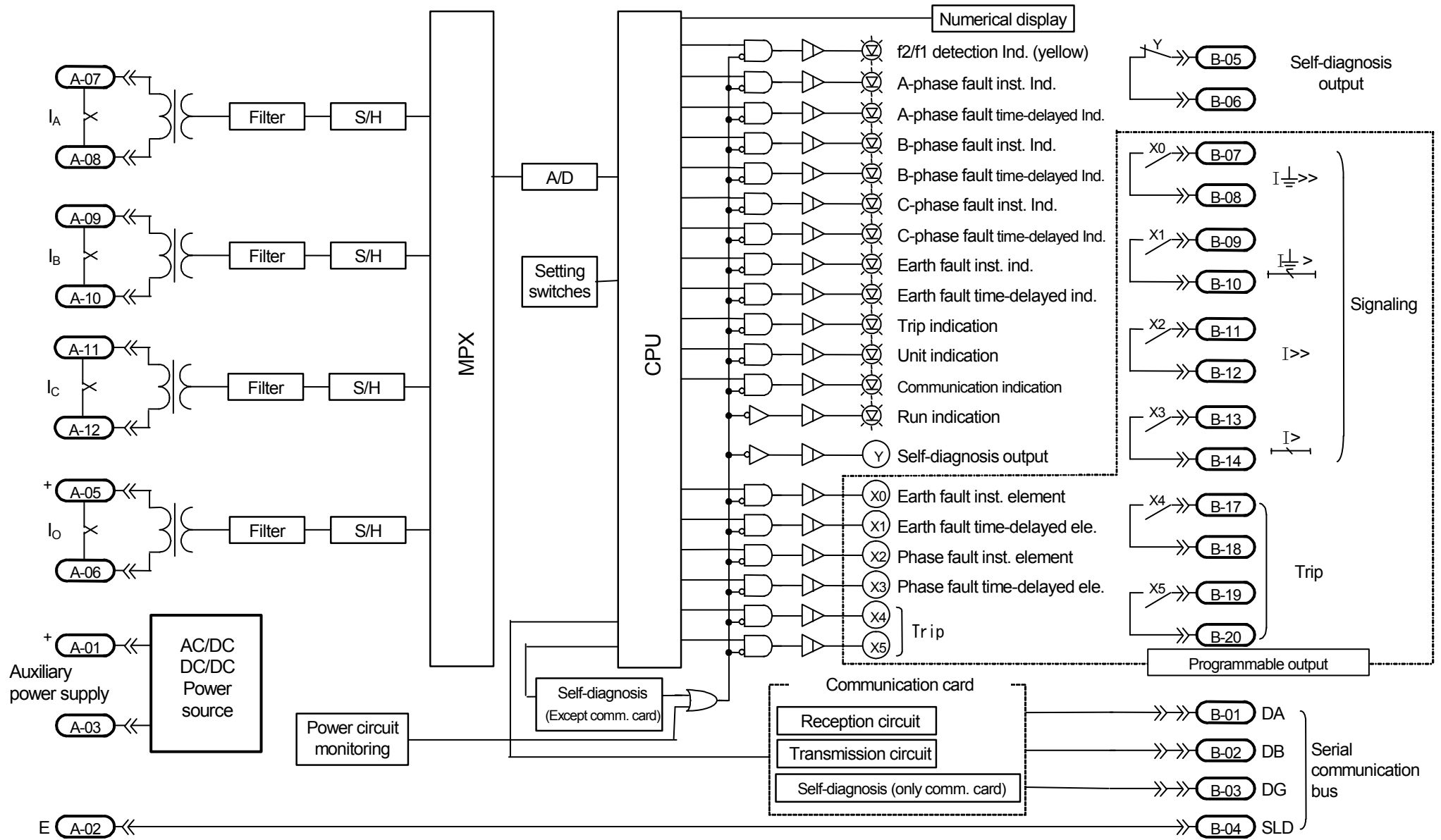


Figure 5.1 Internal block diagram of Type COC4-A03D1 relay

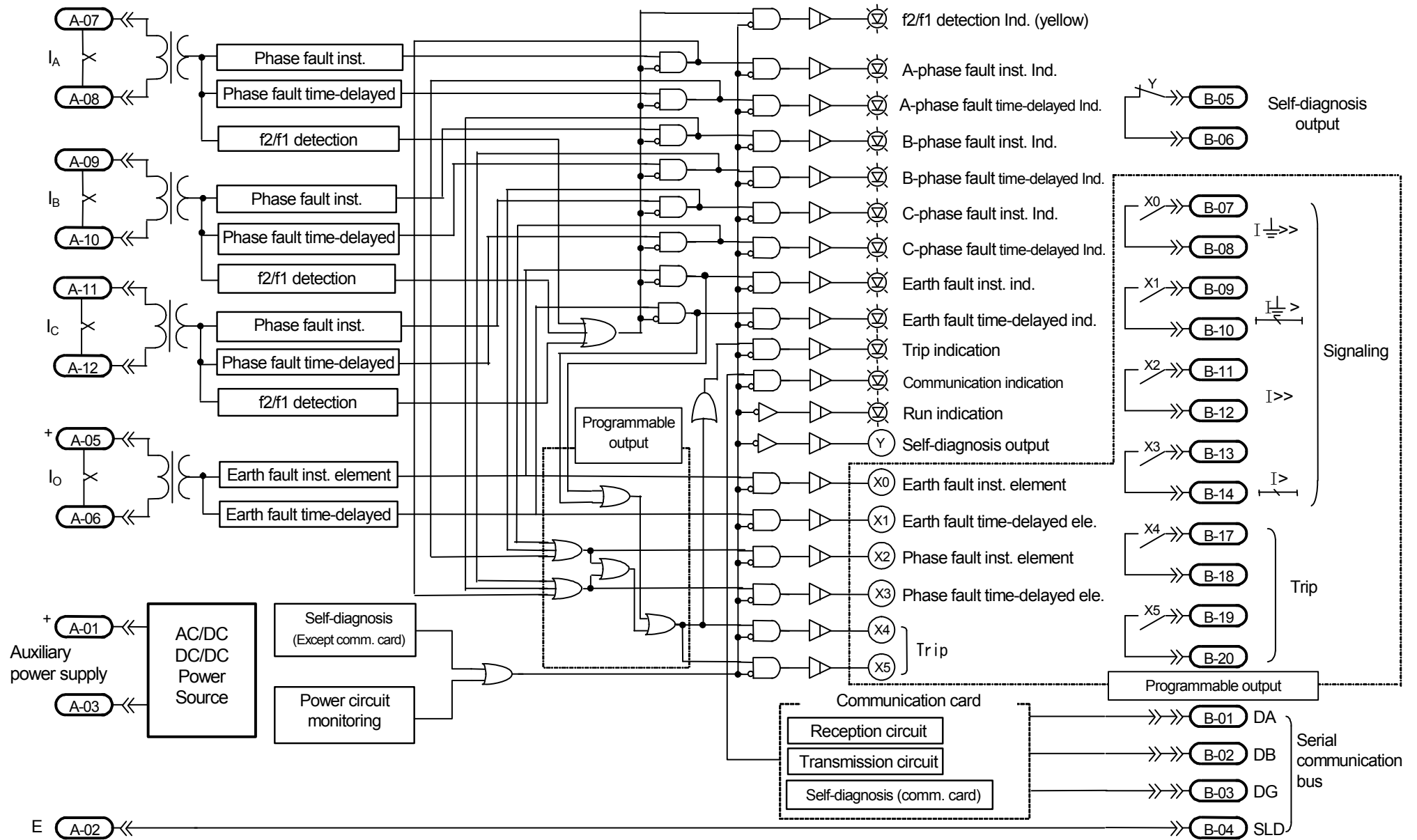


Figure 5.2 Internal function block diagram of Type COC4-A03D1 relay

5.2 External connection

(1) Connection diagram

Figures 5.4 to 5.7 show examples of input circuit (AC circuit) connection, Figure 5.8 an example of control circuit (DC circuit) connection and Figure 5.9 a terminal arrangement.

In the terminals, M3.5 screws and wires of 2 mm² or less are recommended to be used.

(2) Precautions for wiring work

a. Important facilities should be provided with fail safe measures such as dual system to improve reliability of the facilities.

b. Effects of external surge

Some type of surge with a certain condition may inversely affect the relay. If so, take it into account to install MF type surge absorbers made by Mitsubishi Electric.

c. Guarantee of AC auxiliary power supply against power interruption

The AC auxiliary power supply of the relay is not guaranteed against power interruption. When you do not have an uninterruptible AC power source, use an AC/DC converter of CPS1 type manufactured by Mitsubishi Electric or uninterruptible power source (UPS) that is commercially available.

d. Inrush current of auxiliary supply

Since inrush current may flow in the relay when the auxiliary power supply is turned on as shown in the figure below, make consideration of this point when selecting the breaker for the auxiliary power supply circuit.

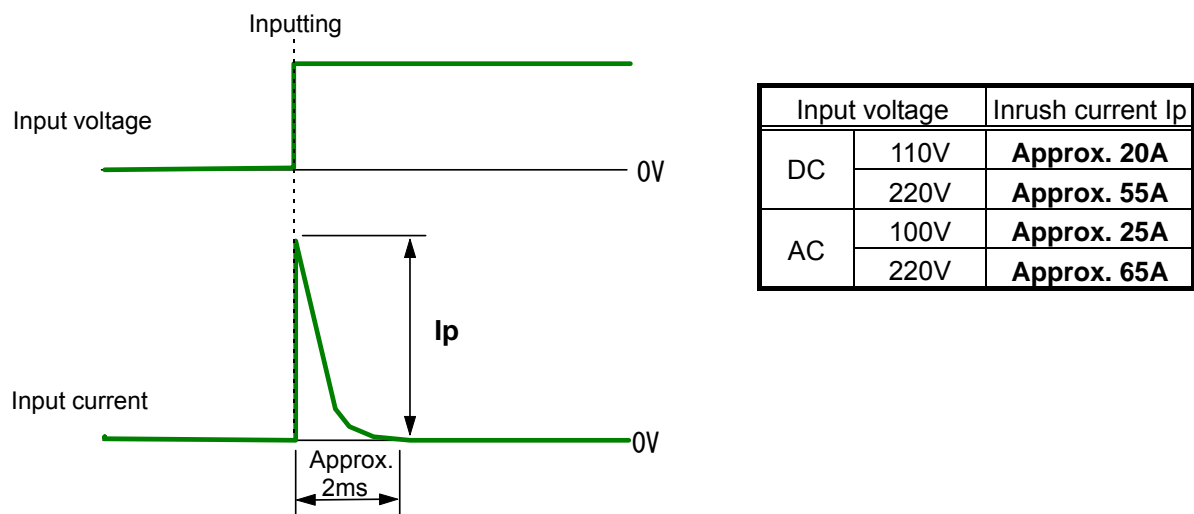


Figure 5.3 Inrush current of auxiliary power supply

e. Trip circuit

Only the contacts X₄ and X₅ can be used for the trip circuit. Please keep in mind that the contacts X₀ to X₃ can not be used for the trip circuit. (If used, the contact may burn).

Connect the pallet contact (52a) of the circuit breaker to the trip circuit.

f. Self-diagnosis output circuit

The self-diagnosis output contact is so configured that the auxiliary relay can be energized (break contact) with normal result of monitoring, in order to be able to continue monitoring even if the built-in power fuse burns. Therefore, connect the timer to the external wiring. (See Fig. 5.8 "DC circuit

connection diagram”)

g. Earth circuit

Be sure to earth the earth terminal located on the back of the relay according to the Class D earth wiring method.

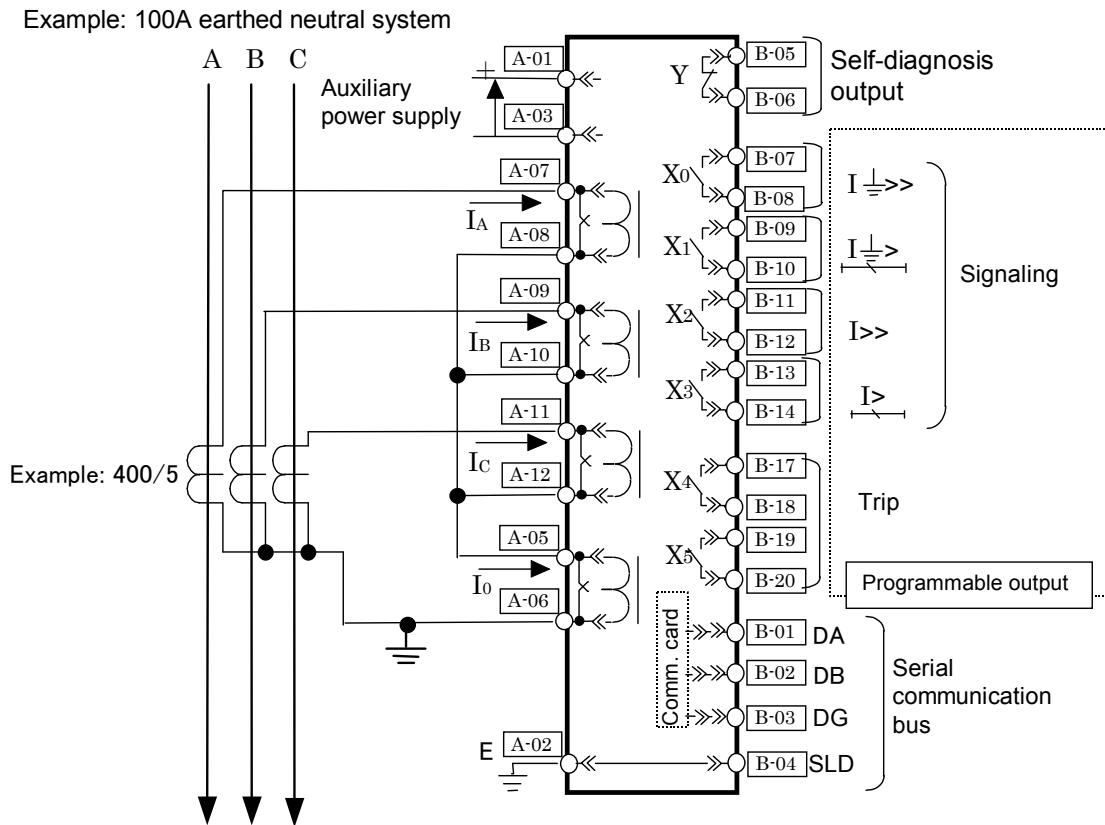


Figure 5.4 External connection diagram for COC4-A03D1 relay (1)

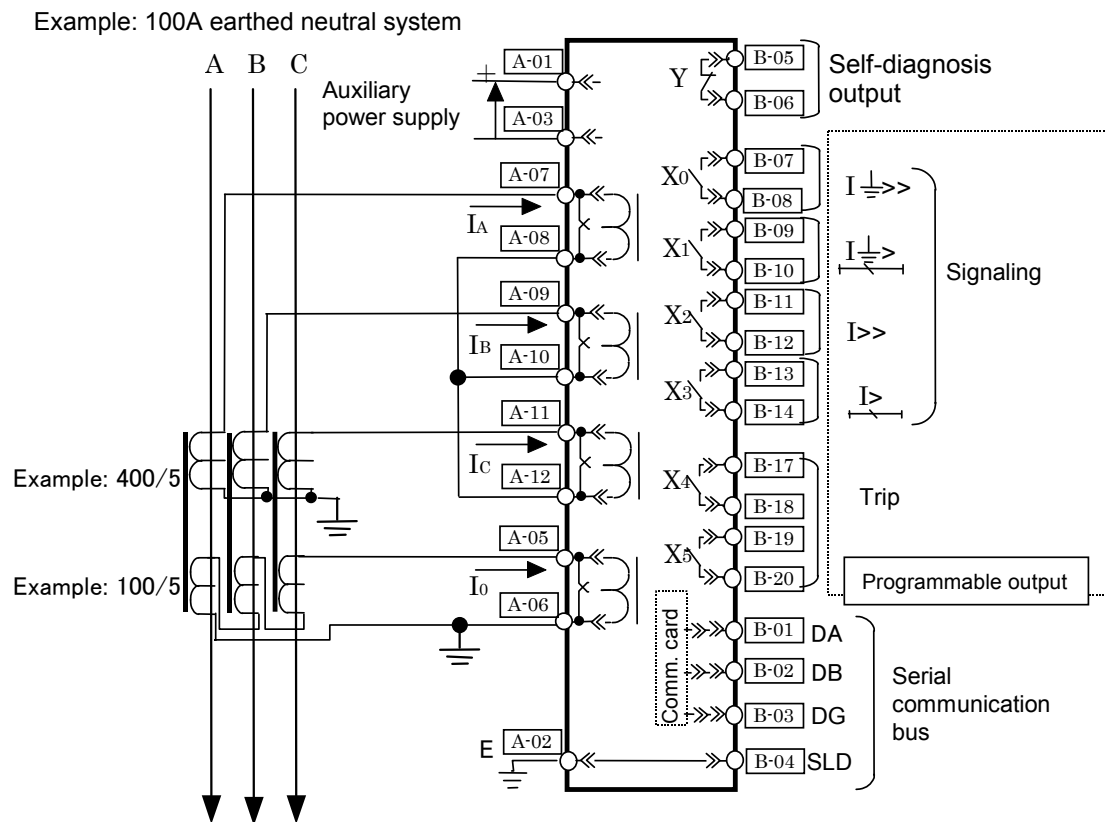


Figure 5.5 External connection diagram for COC4-A03D1 relay (2)

Example: 100A earthed neutral system

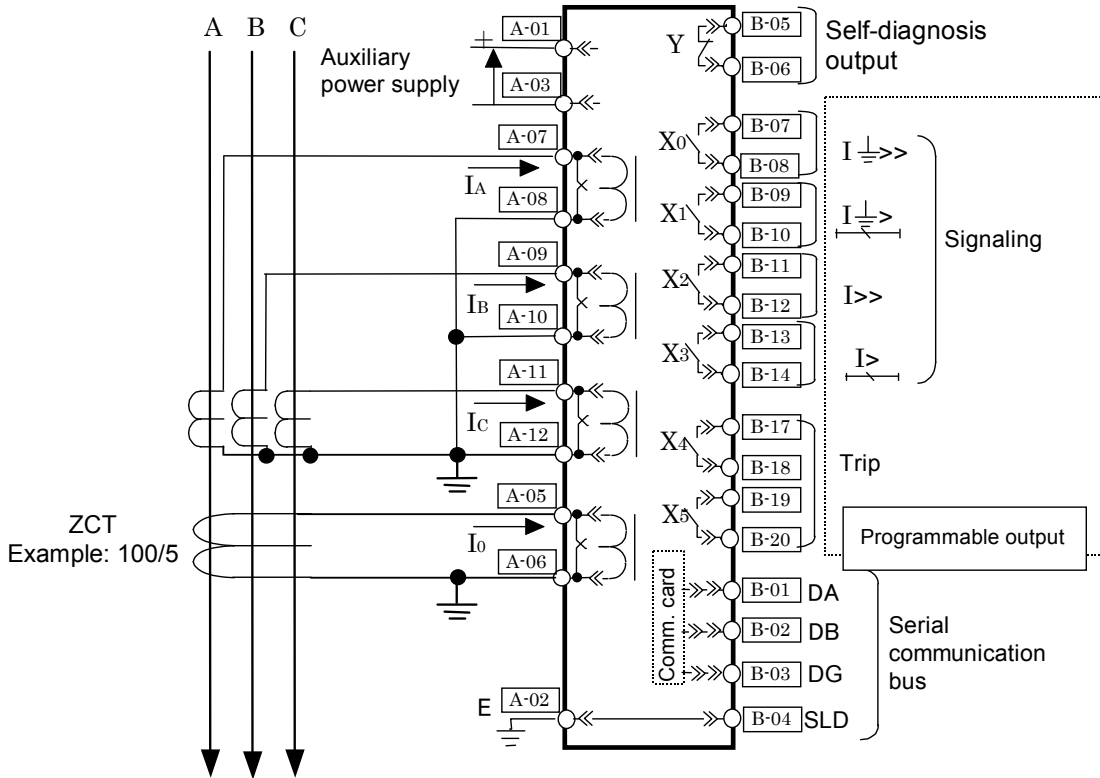


Figure 5.6 External connection diagram for COC4-A03D1 relay (3)

Example: 100A earthed neutral system

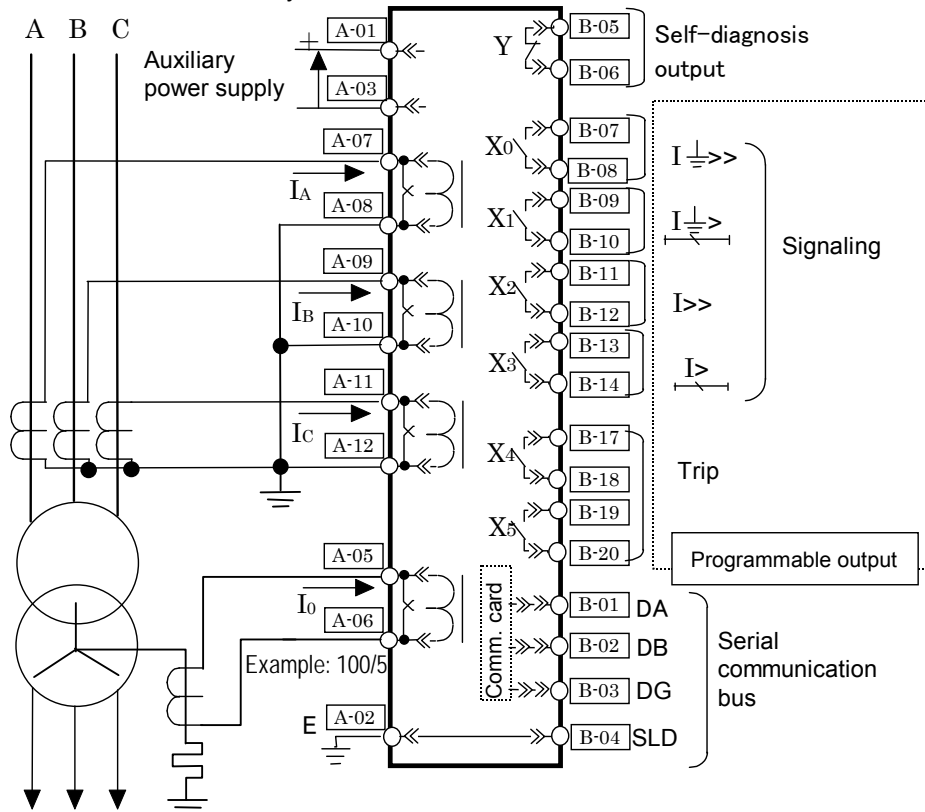
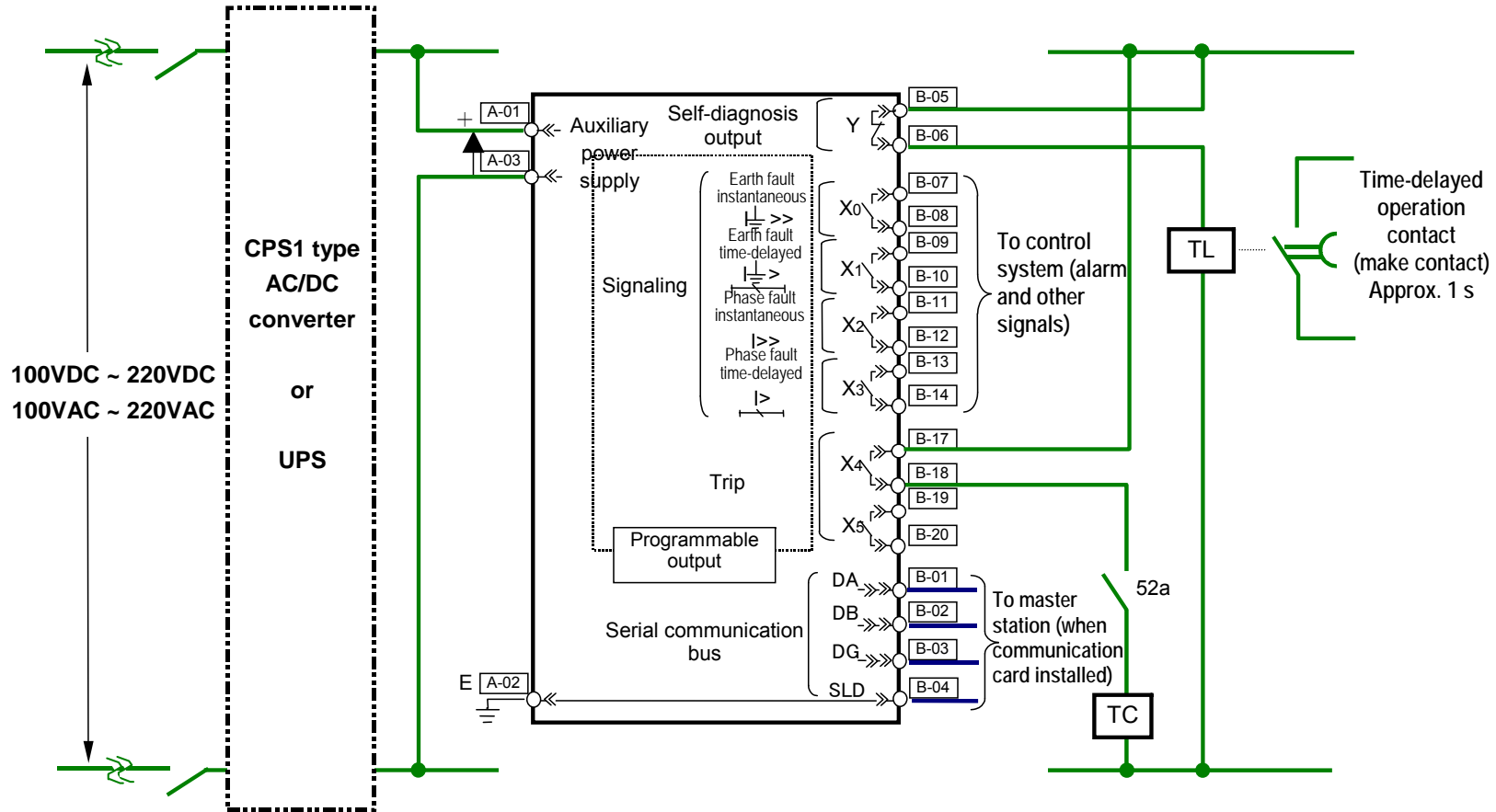


Figure 5.7 External connection diagram for COC4-A03D1 relay (4)



- Note 1) The self-diagnosis output contact is so configured that the auxiliary relay can be energized (“break contact” opened) when normal result of self-diagnosis is received. This type of contact will allow the relay to continue automatic self-check even after the built-in power fuse burns. Therefore, the “break contact” is closed when the power is applied and will be opened after about 50ms. If the auxiliary power supply of the relay and the self-diagnosis output contact shares a same power source, **the “break contact” will be closed temporarily after the auxiliary power supply is turned on.** In the case where the phenomenon stated in the above would conflict with your system requirement, it is recommended that the self-diagnosis output contact should be **connected via the time-delayed timer** as shown in the left of the figure.
- Note 2) Regarding to the type CPS1 AC/DC converter or commercially available uninterruptible power supply (UPS), refer to the note *21 in the section 2.1 General information.

Figure 5.8 Auxiliary power supply circuit connection example of type COC4-A03D1 relay

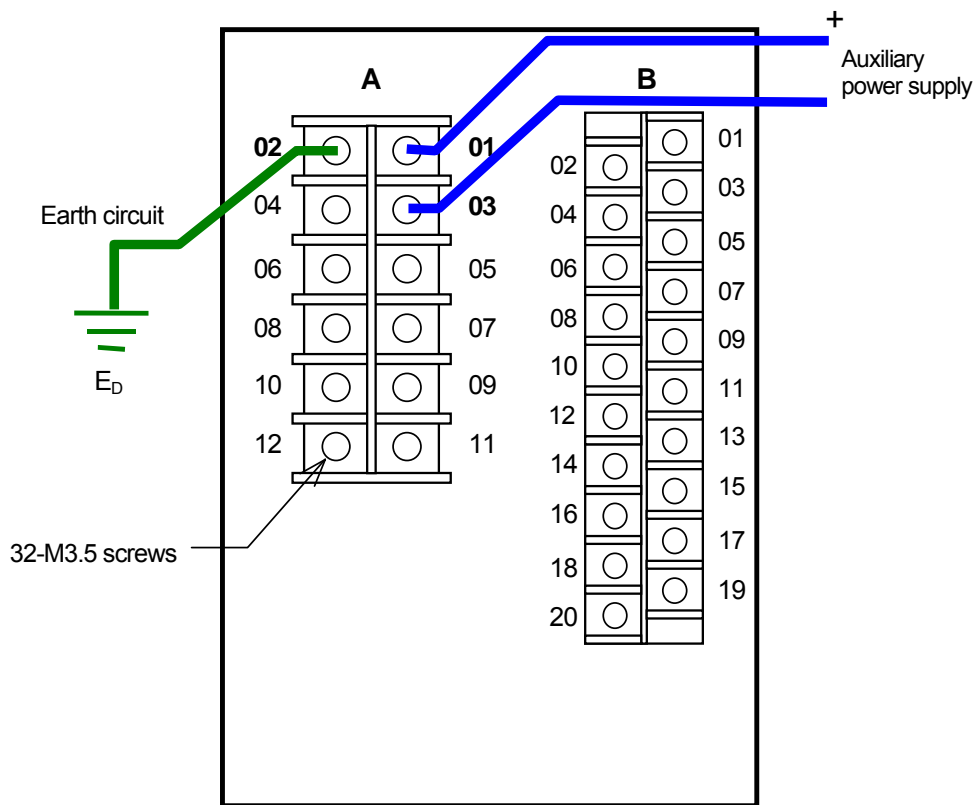


Figure 5.9 Rear view of type COC4-A03D1 relay

6 Handling

6.1 Unpacking

Usually this relay is packed in a D1 case for transportation. However, it may occur that only the sub unit is transported independently for the convenience at repair. In such a case, fully brush off the dust, dirt, etc. adhered to the sub unit after completion of unpacking, and further visually check that the parts mounted on the front panel or built in the sub unit are not damaged.

6.2 Transportation and storage

To carry the equipment within the place of use, handle it carefully so that the parts installed on the front panel of the sub unit or built-in parts cannot be deformed or broken.

6.3 Appearance and how to pull sub unit out

The relay is so constructed that the sub unit can be drawn out, in order to facilitate inspection or test. It is possible to pull the sub unit out without disconnecting the external wiring.

Note that the sub unit should not be drawn out with the line hot. Before drawing out, be sure to take the following actions.

- Lock the tripping circuit including breakers.
- Stop the main circuit.
- Shorten and isolate the CT circuit.
- Open the auxiliary power supply circuit.

Bear in mind that careless opening of circuits may result in opening the other control circuits too to impair the protective function. Be sure to only shut off the concerned circuit.

The CT circuit is provided with an automatic short circuit mechanism. In case that you have pulled the sub unit out without isolating the CT circuit by mistake, the automatic short circuit mechanism will work to prevent the CT secondary circuit from opening.

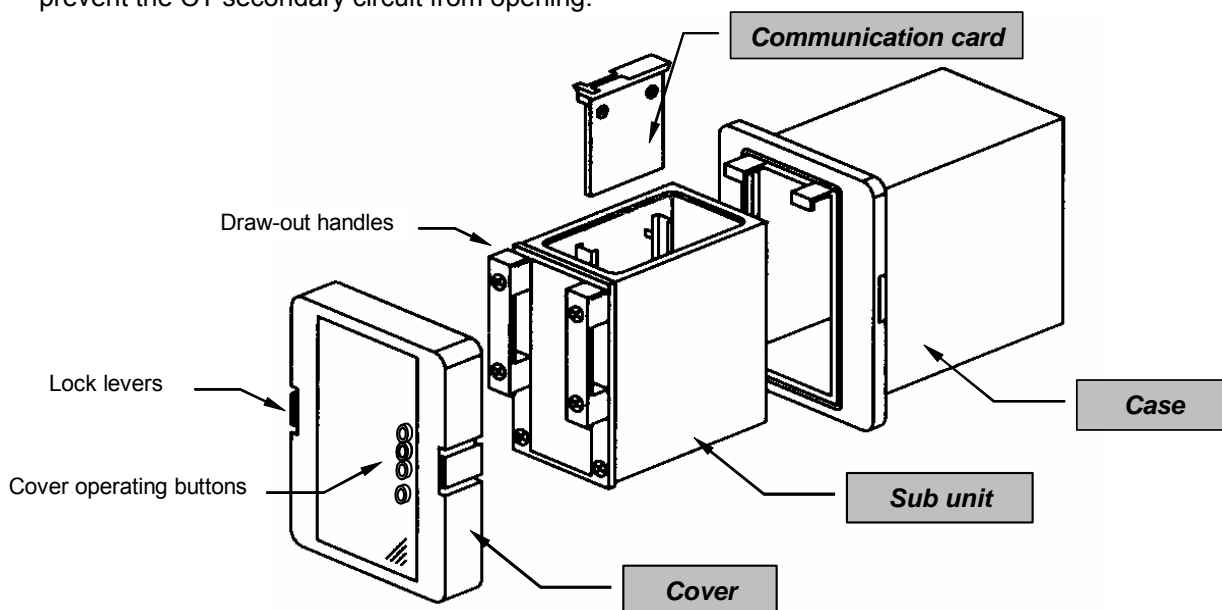
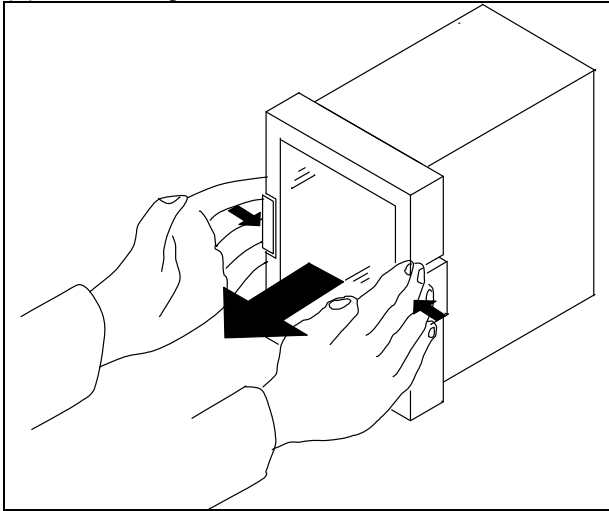


Figure 6.1 Outside view of type COC4-A03D1 relay

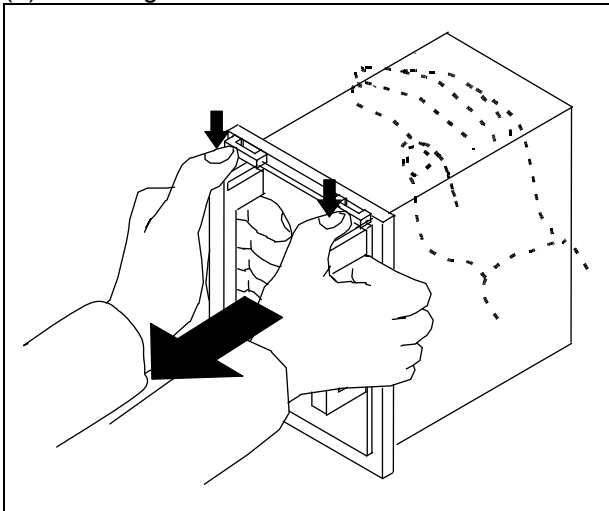
6.3.1 How to draw sub unit out

(1) Removing the cover



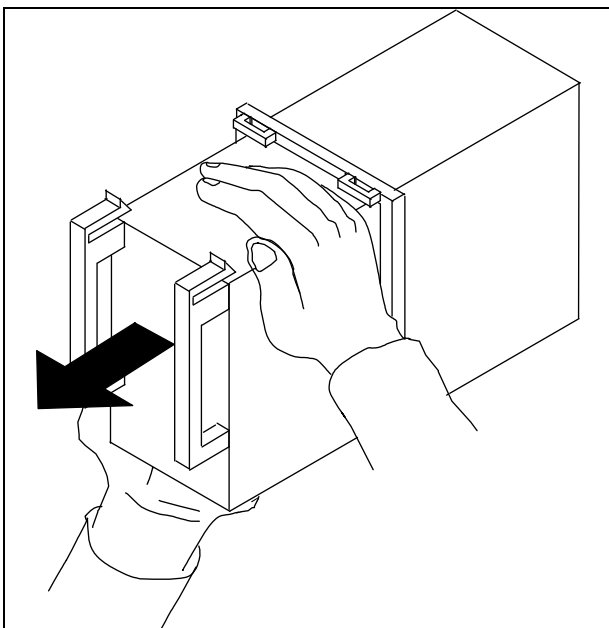
Hold the **lock levers**, which are located at both sides of the cover, on their front sections. Take off the cover **straight toward you** while pushing the levers **inwards**.

(2) Drawing the sub unit



Grip the draw-out handles (located at both sides of the front of the sub unit). **Press the locking pieces installed in the upper portion of the draw-out handles with your thumbs to pull the sub unit towards you.**

Note) The sub unit is so designed that it can not be removed unless it is pulled out with a relatively strong force, in consideration of quake-proof measures. When the relay unit is to be removed independently, it is recommended to draw it out with the case held by other operator.

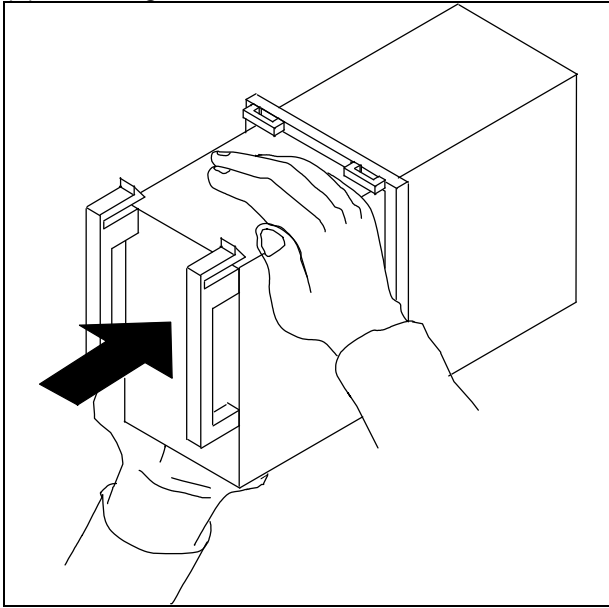


When about a half portion of the sub unit is pulled out of the case, just stop the drawing motion. Then, **hold the top and bottom of the sub unit to pull it out completely**, in order to prevent the unit from falling.

Note) Be careful not to touch the printed circuit board and parts inside the sub unit.

6.3.2 Housing the sub unit

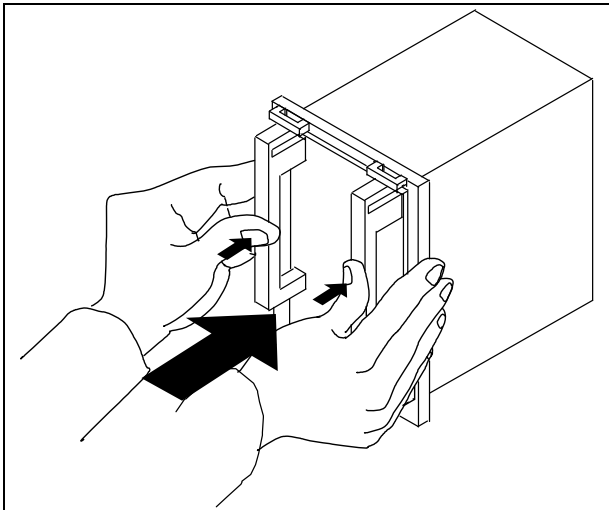
(1) Housing the sub unit



Hold the sub unit on the top and bottom to push the unit into the case approx. a half of the unit.

Note)

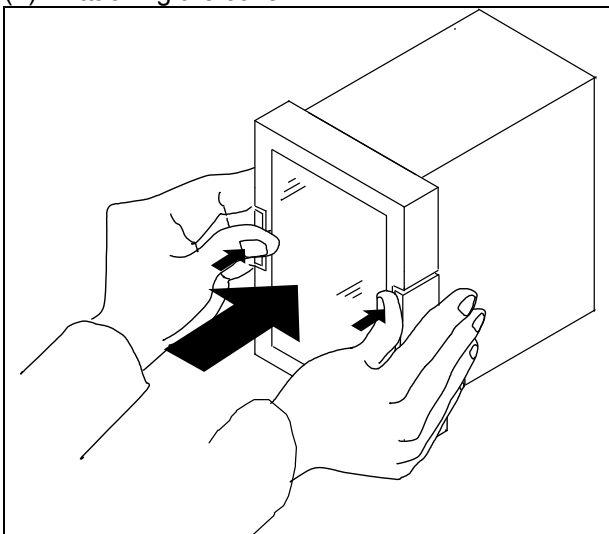
- Be careful not to touch the PCB and parts inside the sub unit.
- The sub unit is so constructed that it can not be housed in the case upside down.



Fully insert the sub unit into the case until you hear a click while pressing the handles located on both sides of the front of the sub unit.

Note) Please note that inserting the sub-unit incompletely may only establish a poor contact of the terminals located on the back of the unit, which may cause operational failure or heating.

(2) Attaching the cover



Fit the cover straight to the case. Hold the cover frame to **fully push the cover until it is clicked and locked**.

Note) After setting the cover, check if the buttons can be smoothly pressed from over the cover.

6.4 How to use front control panel

6.4.1 Front control panel layout

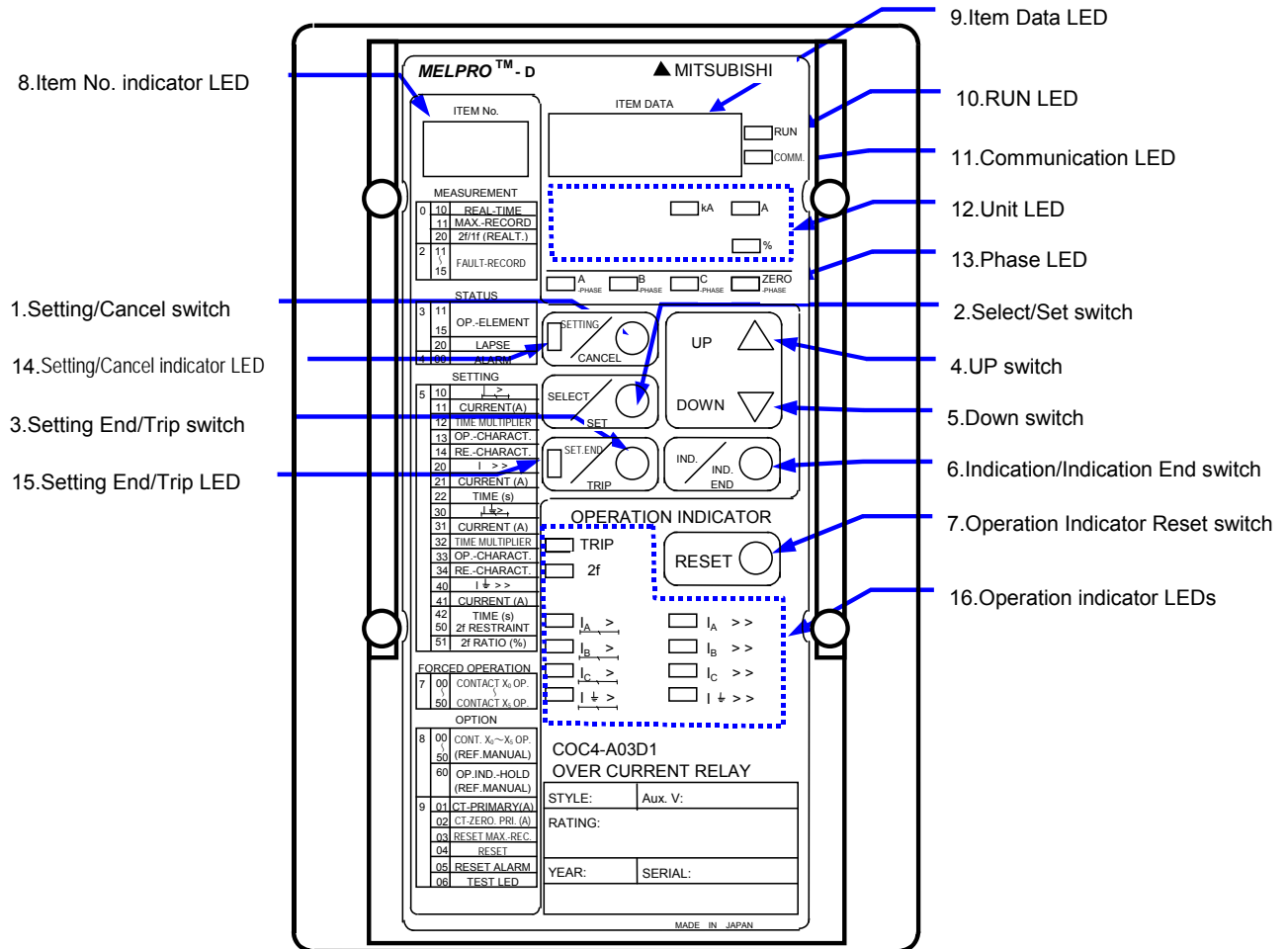


Figure 6.2 Front view of type COC4-A03D1 relay

Table 6.1 Front control panel guide

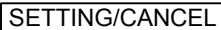







No.	Designation		Symbol	Description
1	Setting / Cancel			Pressing this switch will start the procedure for setting, forced operation or option. When this switch is pressed again instead of the  switch, data that has been programmed will be all cleared to terminate the selected procedure. The SETTING/CANCEL indicator LED is lit during the procedure.
2	Select / Set			This switch is used to select an item number and to program item data during setting, forced operation or option procedure. When data is programmed to be ready for replacing the currently used setting, the SET.END/TRIP LED will blink.
3	Setting End / Trip			When the SET.END/TRIP switch is pressed with its LED blinking during setting, forced operation or option procedure, the currently enabled setting will be replaced by data given by programming. The new setting will be thus enabled.
4	UP select			These switches are used for selecting data elements. Pressing these switches for a while will allow fast forwarding. With the cover operating buttons, you can use the switches without removing the cover.
5	DOWN select			
6	Indication / Indication End			Pressing this switch will start or end the display of settings and measurements. With the cover operating button, you can use the switch without removing the cover.
7	Reset			Pressing this switch will reset output contacts after the relay operated and extinguish the operation indicator LEDs. With the cover operating button, you can use the switch without removing the cover.
8	Item No.	Green	-	A number allocated to the selected setting, forced operation or option item is indicated here.
9	Item Data	Red	-	Data that corresponds to the item number selected is displayed here. For the indication of individual letters, see the Table 6.2.
10	RUN	Green	-	Indicate the result of the automatic self-check. The lamp will be lit for normal results while off for abnormal.
11	Communication	Green	-	Indicate the operational status of the communication card. - With a communication card installed: the lamp will be lit for normal conditions, blinking during communication and off for abnormal conditions. - With a communication card not installed: the lamp will be off.
12	Unit	Yellow	-	Indicate the unit used for the item data.
13	Phase	Yellow	-	Indicate the phase that corresponds to the item data.
14	Setting / Cancel	Yellow	-	This lamp will be lit during setting, forced operation or option procedure.
15	Setting End / Trip	Yellow	-	This lamp will blink when new data is programmed to be ready for replacing the currently enabled setting.
16	Operation	Red	-	Indicate the corresponding operation elements and phases of the relay.

Table 6.2 Letter representation of item data indicator LEDs

Item		Display in item data box
Designation	Letters	
On	ON	
Off	OFF	
Yes	YES	
No	NO	
Operation lock	LOCK	
Instantaneous	INST	

Item		Display in item data box	
Designation	Letters		
Operation characteristics	Normal inverse time-delayed	NI01	
		NI11	
		NI21	
	Very inverse time-delayed	VI01	
		VI21	
	Extremely inverse time-delayed	EI01	
		EI11	
		EI12	
	Long inverse time-delayed	LI01	
		LI02	
		LI21	
	Definite time-delayed	DT01	
Reset characteristics	Definite time-delayed	01	
	Inverse time-delayed	11	
	Definite time-delayed	21	

6.4.2 Operational procedure

For more information about the operational procedure shown below, see the MELPRO-D Series General Operation Manual (JEP0-IL9416).

6.4.2.1 Relay without RS232C communication I/F

Table 6.3 Operational procedure

Item				Corresponding section of general operation manual			
No.	Designation		Description	Indication mode Setting / forced operation / option mode			
010	Measurement	Real time	Measure and display effective current values of relay inputs all the time.	A-1			
011		Max. record	Display the max. effective current values.	A-2			
020		Real time	Measure and display 2f component ratio in effective current of relay inputs all the time.	A-1			
211		Fault record	1 st phenomena	Keep in record and display effective value currents for up to five latest phenomena of relay trip caused by system fault. The 1 st phenomena is the latest trip and the 5 th the oldest.	A-3		
212			2 nd phenomena				
213			3 rd phenomena				
214	4 th phenomena						
215	5 th phenomena						
311	Status	1 st phenomena	Keep in record and display the status of the operation indicator LEDs for up to five latest phenomena of relay trip caused by system fault. The 1 st phenomena is the latest trip and the 5 th the oldest.	A-4			
312		2 nd phenomena					
313		3 rd phenomena					
314		4 th phenomena					
315		5 th phenomena					
320		Elapse of time-delayed timer (LAPSE)			Display the count of the elapsed time of operation of time-delayed elements.	A-5	
400	Self-diagnosis (ALARM)	Keep in record and display defect codes in the case where an abnormal condition is detected by the self-diagnosis.	A-6				
511	Setting	Phase fault	Time-delayed	Operation current [A]	Set and display settings.	A-7	B-1
512				Operation time multiplier			
513				Operation characteristic			
514				Reset characteristic			
521		Instantaneous	Operation current [A]				
522			Operation time [s]				
531		Earth fault	Time-delayed	Operation current [A]			
532				Operation time multiplier			
533				Operation characteristic			
534				Reset characteristic			
541		Instantaneous	Operation current [A]				
542			Operation time [s]				
551	2f blocking rate [%]						
700	Forced operation	Contact X ₀ operation		Carry out forced operation of output contacts individually. The setting of the programmable outputs can be checked through the operation indicator LEDs.	A-7	C-1	
710		Contact X ₁ operation					
720		Contact X ₂ operation					
730		Contact X ₃ operation					
740		Contact X ₄ operation					
750		Contact X ₅ operation					
800	Option	Contact arrangement	Contact X ₀	Configure the programmable outputs. Also, set and display self-hold/reset setting of the programmable outputs. For the guide for setting, see 6.4.2.3 (1) below.	A-7	D-1	
810			Contact X ₁				
820			Contact X ₂				
830			Contact X ₃				
840			Contact X ₄				
850			Contact X ₅				
860	Operation indicator LED hold	Set and display self-hold/auto reset setting of the operation indicator LEDs, see 6.4.2.3 (2) below.			D-2		
901	CT primary side [A]	Set the CT primary current of the phase current circuit connected to the relay.			D-3		
902	CT zero-phase primary side [A]	Set the CT primary current of the zero-phase current circuit connected to the relay.					
903	Max. record reset	Clear data of the max. record.		A-7	D-4		
904	Fault record reset	Clear data of the fault record.					
905	Self-diagnosis (ALARM) reset	Clear data of the self-diagnosis record.					
906	LED lamp test	Carry out forced illumination of all the LED lamps on the front of the relay unit.			D-5		

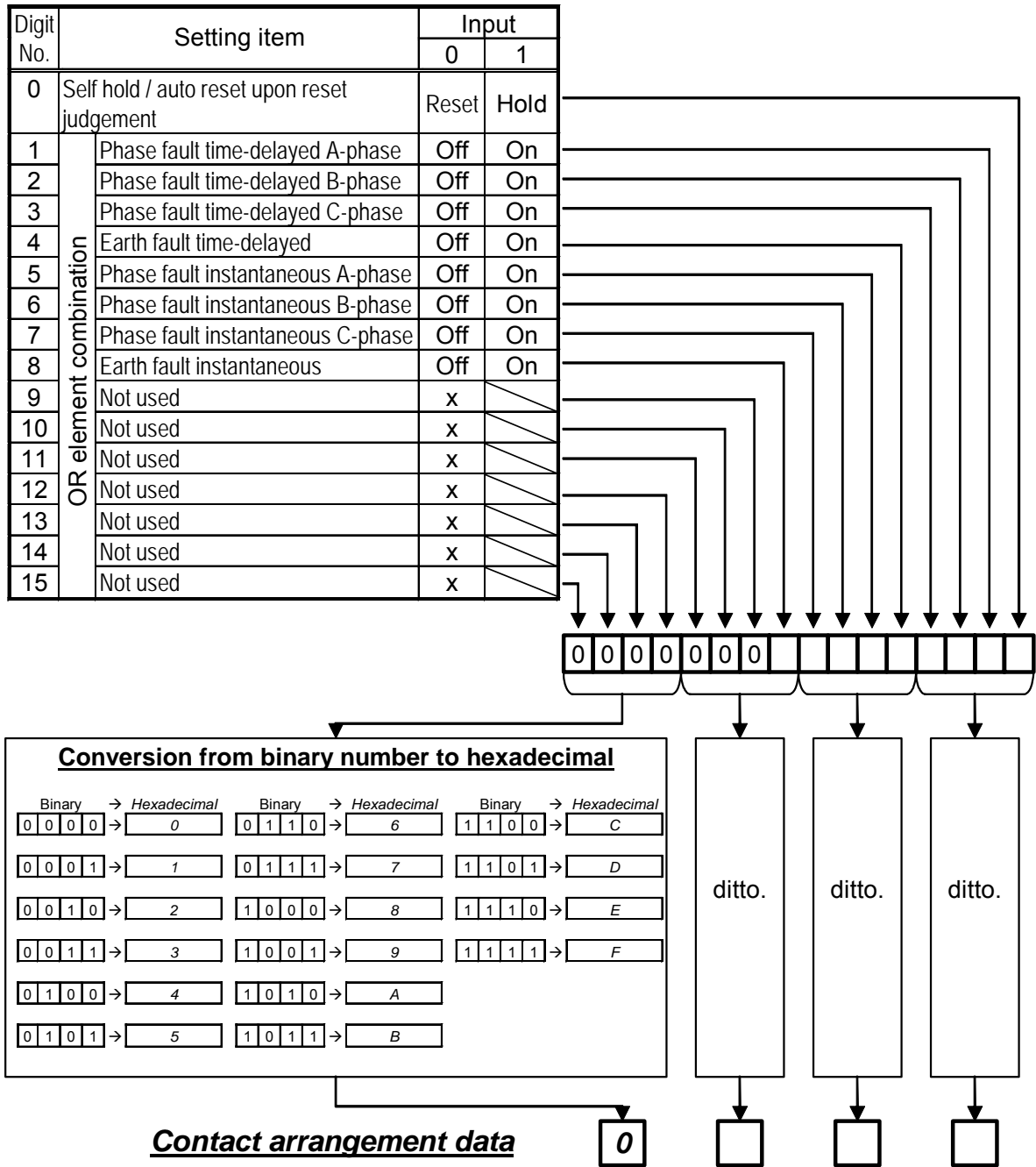
6.4.2.2 Relay with RS232C communication I/F

Item			Corresponding section of general operation manual	
No.	Designation	Description	Indication mode	Setting / forced operation / option mode
As the same as Table 6.3 described in item 6.4.2.1 about the No. 010~860.				
901	CT primary side [A]	Set the CT primary current of the phase current circuit connected to the relay.	A-7	D-3
902	CT zero-phase primary side [A]	Set the CT primary current of the zero-phase current circuit connected to the relay.		D-9
903	Relay password enable/disable option	Set relay password enable or disable for setting.	/	D-4
904	Max. record reset	Clear data of the max. record.		D-5
905	Fault record reset	Clear data of the fault record.		
906	Self-diagnosis (ALARM) reset	Clear data of the self-diagnosis record.		
907	LED lamp test	Carry out forced illumination of all the LED lamps on the front of the relay unit.		

6.4.2.3 Guide for option function

(1) Specifying contact arrangement data of output contacts

The table below shows the setting guide table. See the section **D-1** of the general operation manual for the detailed procedure.



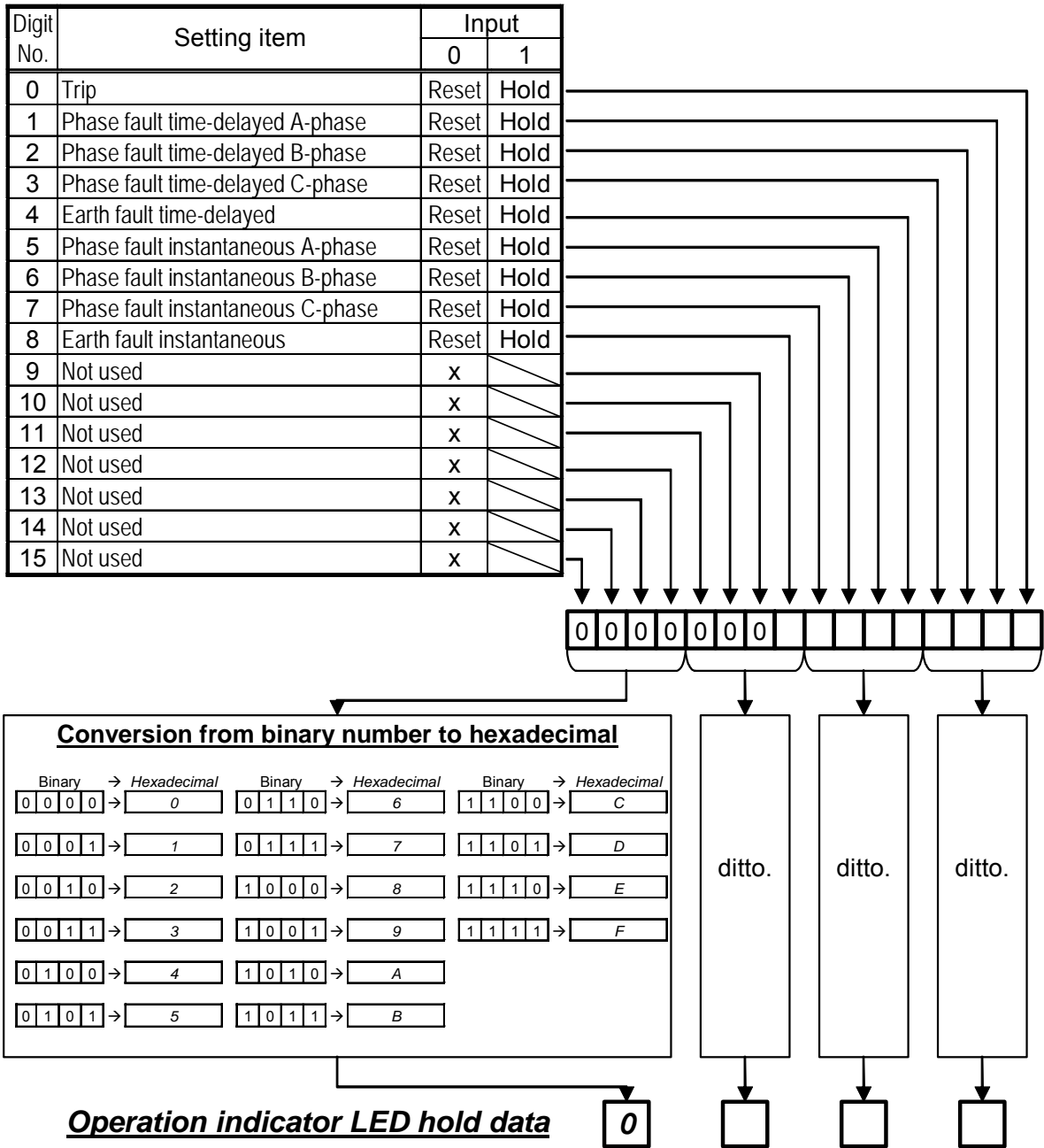
When the product is shipped from the factory, contact arrangement data are set as follows.

Contact	Item number	Contact arrangement data	Setting of the element	Contact	Item number	Contact arrangement data	Setting of the element
X0	800	0100	Earth fault instantaneous	X3	830	000E	Phase fault time-delayed
X1	810	0010	Earth fault time-delayed	X4	840	01FE	OR of all the elements
X2	820	00E0	Phase fault instantaneous	X5	850	01FE	OR of all the elements

*The "Self hold/auto reset" setting are "Reset" (auto reset) for all contacts.

(2) Specifying operation indicator LED hold data

The table below shows the setting guide table. See the section **D-2** in the general operation manual for the detailed procedure.



When the product is shipped from the factory, all LEDs are set to self-hold.

Item number	Operation indicator LED hold data
860	01FF

7 Mounting

7.1 Mounting dimension

Mount the case to the panel according to Fig. 7.1 "Mounting dimension".

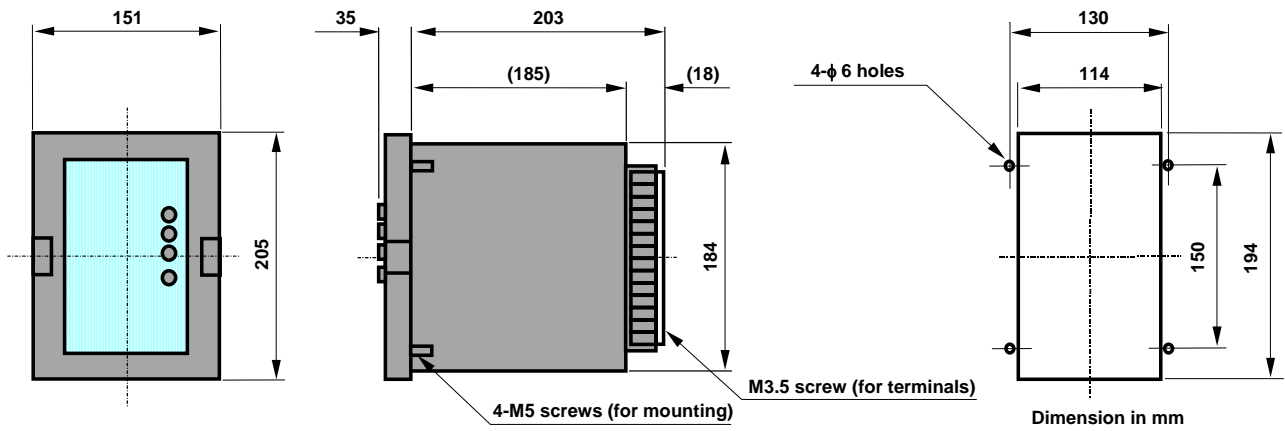


Figure 7.1 Outside dimension /drilling drawing

7.2 Standard operating environment

Install the relay in the environment described in section 3.3 Common technical data. In addition, the following conditions should be kept:

- Abnormal vibration, shock, inclination or magnetic field should be avoided.
- Harmful smoke or gas, salt gas, excessive humidity, water drop or vapor, excessive dust or fine powder, rain and wind should be avoided.

8 Test

The relay has been fully tested prior to shipment. However, it is recommended to carry out a test again by referring to the following test guide before use.

8.1 Appearance inspection

Check the relay for appearance according to the following procedure:

Objects		Check points
Unit	Coil/conductor	(1) Discoloring and burning due to overheat. (2) Abnormal conditions including loosened screws.
	Printed card	(1) Discoloring of the printed card due to overheated parts. (2) Contact between the printed card and connector
	Mechanism	(1) Deformation (2) Operation of the operating key switches. (3) Damage of the draw-out lever of the sub unit. (4) Discoloring and deformation of the name plate on the front panel. (5) Damage of the terminal section.
Case/cover		(1) Damage of the cover. (2) Stain of the cover. (3) Clouding of the cover. (4) Damage of the lock lever of the cover. (5) Damage of the operating buttons of the cover. (6) Operation of the operating buttons of the cover. (7) Damage of the terminal section.
Others		Invasion of foreign matters including dust and iron chips.

8.2 Characteristic test

8.2.1 Precautions in testing

(1) Standard test conditions

Ensure the following test conditions whenever possible:

Note that carrying out a test under an environment that significantly differs from the following conditions may produce an incorrect result.

- Ambient temperature : $20^{\circ}\text{C}\pm 10^{\circ}\text{C}$
- Rated frequency : $\pm 5\%$
- Waveform (AC) : 2% (distortion ratio)
- Auxiliary power supply voltage : rated voltage $\pm 2\%$

(2) Characteristic control point

See the section 3 “Characteristics”.

The characteristic control point refers to the characteristic of a relay unit only. Note that, when a characteristic test is carried out on a relay system connected with external equipment such as CT and ZCT, the result obtained would be a combined characteristic added with the fluctuation of the external equipment.

For special control in terms of a specific control point (for instance, using the operation setting), first carry out a test at “Characteristic control point” at the time when the relay is received or put in service to determine the acceptance/rejection. Thereafter, perform another test at each control point, so that the data obtained can be used for future reference.

(3) Changing setting

Change the setting according to the section 6 “Handling”.

(4) Operation judgment

Determine the operation currents and time and other values of the relay unit basically by turning on and off the corresponding output relay contact of each element.

To determine the starting value of the time-delayed elements of overcurrent relay, which cannot be checked through the output contact, read the display of “elapsed time of time-delayed timer”.

(5) Communication card

Whatever the communication card is inside or not, for the test of withstand voltage and lightning impulse withstand voltage, please avoid inputting test voltage to the serial communication network circuit (DA, DB, DG, SLD terminals).

Note: it is not necessary to take the communication card out when test if the communication card was inside unit.

(6) Cautions at the time of an excessive current input

The rating of phase circuit and zero-phase circuit differs. If the excessive input to zero-phase circuit same as phase circuit is passed, the circuit may be damaged by heat. When you test by making series connection of phase circuit and zero-phase circuit, an excessive input should not flow to zero-phase circuit, by such a method as short-circuiting between the terminals of zero-phase circuit using the wire more than 2 mm^2 .

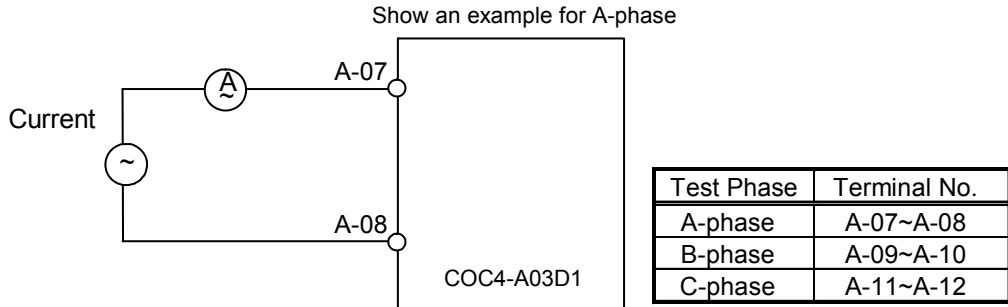
8.2.2 Characteristic test

(1) Test circuit

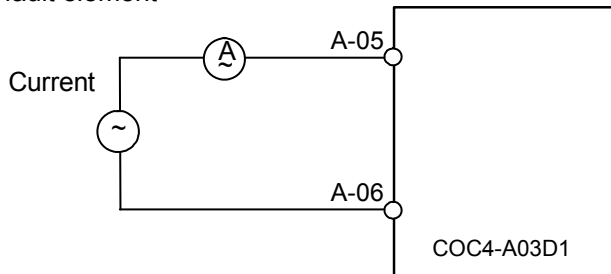
Connect the external wiring referring to the AC input circuit diagram shown below:

At test, be careful of "cautions at the time of an excessive current input" described in 8.2.1(6) especially.

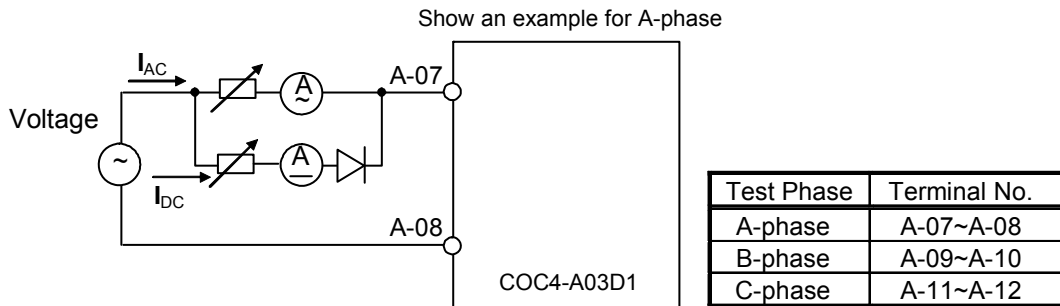
a. Phase fault element



b. Earth fault element



c. 2nd harmonic restraining characteristic



: Moving-iron alternating current meter (Class 5)

: Moving-coil directing current meter (Class 5)

$$\left[\text{2 f component ratio } \frac{I_{f2}}{I_{f1}} \% = \frac{\frac{2}{3} I_{DC}}{\sqrt{2} I_{AC} + \frac{\pi}{2} I_{DC}} \times 100 \right]$$

(2) Test items and characteristic control point

a. Forced operation test

See "Front control panel operational procedure" in the section 6 "Handling".

b. Operation value test

See "Operation and reset values" in the section 3 "Characteristic".

c. Operation time test

See "Operation time" in the section 3 "Characteristic".

d. Reset time test

See "Reset time" in the section 3 "Characteristic".

9 Maintenance

9.1 Daily inspection

Take every opportunity to carry out the following inspection:

- Check that the cover is not damaged and is attached properly.
- Check that no dust or iron chips have invaded into the unit.
- Check that the cover is not clouded notably.
- Check that abnormal noise is not generated.
- Check that the RUN LED lamp is lit.

9.2 Periodical inspection

It is recommended to carry out periodic inspections to check the relay for proper function.

For periodical inspections, perform the appearance inspection and characteristic test in accordance with the section 8 "Test".

10 Ordering

The product and specification shown in this manual may subject to changes (including specification change and production suspend) without notice. It is advisory to inquire the nearest Mitsubishi Electric's branch or sales office, if required, to confirm that the latest information is given in the manual, prior to placing an order.

Notify the following items when placing an order.

Item	Example of order	Remarks
Model	COC4-A03D1	For more information, see the section 2 "Rating and specification".
Frequency	50 Hz	Select 50Hz or 60Hz.
Rating	Phase current: 5A, Zero-phase current: 1A	For more information, see the section 2 "Rating and specification".
Setting range	Phase fault time-delayed element (51) : 1 ~ 12A Phase fault instantaneous element (50) : 2 ~ 80A Earth fault time-delayed element (51N) : 0.1 ~ 0.8A Earth fault instantaneous element (50N) : 1 ~ 8A	For more information, see the section 2 "Rating and specification".
Communication card	One of the followings can be selected: a. CC-Link communication card (Manual No.: JEP0-IL9417, JEP0-IL9418) b. No communication card	Only purchasing a communication card separately will allow customer to add the communication facilities. If customer does not need the communication facilitates at the time of introducing the system, just purchase the relay unit without communication card. Customer can add the communication facilities whenever he/she needs to introduce them. This will help decrease the initial cost and upgrade the system in stages.

11. Guarantee

11.1 Period of guarantee

The guarantee period for this product should be one year after delivery.

11.2 Range of guarantee

When any fault or defect is detected during the period of guarantee shown above, and such fault or defect is proved to be caused apparently at the responsibility of Mitsubishi Electric, the defective unit concerned will be repaired or replaced with a substitute. In such a case, contact the nearest Mitsubishi electric's branch or sales office.

It is to be acknowledged that the following faults and defects will not be covered by the guarantee:

- When the fault or defect results from modification or repair carried out by any other entity than Mitsubishi Electric and those who are authorized to carry out repair by Mitsubishi electric.
- When the fault or defect results from the use of the equipment at the range exceeding the condition/environment requirements stated in the manual.
- When the fault or defect results from user's carelessness.
- When the fault or defect results from an act of God such as natural calamity or disaster.
- When the fault or defect results from a phenomenon which can not be predicted with the technology put into practical use at the time of purchase or contract.

mitsubishi electric corporation

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