MITSUBISHI ELECTRIC

Numerical Protection Relay

MELPRO™-D Series

OVERCURRENT RELAY

MODEL

COC3-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** TM – DASH Series Digital Protection Relay.

Please read this manual carefully before use 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	JEPO - IL9313

－ Safety section －

This Safety section should be read before starting any work on the relay. Be sure to read the instruction manuals and other related documents prior to commencing any work on the relay in order to maintain them in a safe condition. Be sure to be familiar with the knowledge, safety information and all caution items of the product prior to use.

CAUTION

Caution means that failure to un-observe safety information, incorrect use, or improper use may endanger personnel and equipment and cause personnel injury or physical damage.

Items as classified to the caution may become to occur more sever results according to the circumstance. Therefore, all items described in the safety section are important and to be respected without fail.

CAUTION

1. Items concerning transportation
   (1) Be sure the equipment to be kept in normal direction
   (2) Avoid the bumps, shock, and vibration, otherwise the product performance /life might be unfavorably affected.
2. Items concerning storage
   (1) Environment shall be as below, otherwise the product performance/life might be unfavorably affected.
   -Ambient temperature: -20℃～+60℃ (with no condensation nor freezing)
   -Relative humidity: 30~80% average of a day
   -Altitude: Less than 2000m
   -Avoid applying unusual shock, vibration or leaning or magnetic field
   -Not expose to harmful smoke, gas, salty air, water, vapor, dust, powder, explosive material or wind, rain.
3. Items concerning mounting/wiring work
   (1) Mounting and wiring work should be done correctly.
   Otherwise, damage, burning or erroneous operation might occur.
   (2) Screw terminal should be tightened securely.
   Otherwise, damage and burning might occur.
   (3) Grounding should be done correctly in case it is required.
   Otherwise, electric shock, damage, burning or erroneous operation might occur.
   (4) Wiring should be done without mistake especially observing the correct polarity.
   Otherwise, damage, burning or erroneous operation might occur.
   (5) Wiring should be done without mistake especially observing the phase ordering.
   Otherwise, damage, or erroneous operation might occur.
   (6) Auxiliary power source, measuring transformer and power source which have enough capacity for correct operation of product should be used.
   Otherwise, an erroneous operation might occur.
   (7) Be sure to restore the front cover, terminal cover, protection cover, etc to the original position, which have been removed during the mounting/ wiring work.
   Otherwise, electrical shock might occur at the time of checking.
   (8) Connection should be done correctly using designated and right connectors.
   Otherwise, damage or burning might occur.
   (9) Fully insert the sub unit into the case until you can hear a click while pressing the handles located on both sides of the sub unit front face.
   Otherwise, incomplete inserting the sub unit might only establish a poor contact with the terminals located on the back side of unit, which might cause erroneous operation or heating.
4. Concerning equipment operation and settings
   (1) Operational condition should be as below.
   Otherwise, the product performance/life might be unfavorably affected.
   -Deviation of auxiliary power: within +10%~-15% of rated voltage
   -Deviation of frequency: within ±5% of rated frequency
   -Ambient temperature: 0℃～+40℃ (-10℃～+50℃ is permissible during couples of hour per day, with no condensation nor freezing)
   -Relative humidity: 30~80% average of a day
   -Altitude: Less than 2000m

-Avoid to be exposed to unusual shock, vibration, leaning or magnetic field
-Not expose to harmful smoke, gas, salty air, water, vapor, dust, powder, explosive material, wind or rain.

(2) Qualified personnel may work on or operate this product, otherwise, the product performance/life might be unfavorably affected and/or burning or erroneous operation might occur.

(3) Be sure to read and understand the instruction manuals and other related documents prior to commencing operation and maintenance work on the product. Otherwise, electrical shock, injury, damage, or erroneous operation might occur.

(4) While energizing product, be sure not to remove any unit or parts without permissible one. Otherwise, damage, or erroneous operation might occur.

(5) While energizing product, be sure to make short circuit of current transformer secondary circuits before setting change or drawing out the sub unit. Otherwise, secondary circuit of live current transformer might be opened and damage or burning might occur due to the high level voltage.

(6) While energizing product, be sure to open trip lock terminal before setting change or drawing out the internal unit of product. Otherwise, erroneous operation might occur.

(7) Be sure to use the product within rated voltage and current.
Otherwise, damage or mal-operation might be occurred.

(8) While energizing product, be sure not to clean up the product.
Only wiping a stain on the front cover of product with a damp waste might be allowable. (Be sure to wring hardly the water out of the waste.)

5. Items concerning maintenance and checking

(1) Be sure that only qualified personnel might work on or operate this product.
Otherwise, electrical shock, injury, damage, or erroneous operation might occur.

(2) Be sure to read and understand the instruction manuals and other related documents prior to commencing operation and maintenance work on the product. Otherwise, electrical shock, injury, damage, or erroneous operation might occur.

(3) In case of replacing the parts, be sure to use the ones of same type, rating and specifications, etc.
If impossible to use above parts, be sure to contact the sales office or distributor nearest you.
Otherwise, damage or burning might occur.

(4) Testing shall be done with the following conditions.
-Ambient temperature: 20℃±10℃
-Relative humidity: Less than 90%
-Magnetic field: Less than 80A/m
-Atmospheric pressure: 86~106×10^3 Pa
-Installation angle: Normal direction±2°
-Deviation of frequency: within ±1% of nominal frequency
-Wave form(in case of AC): Distortion factor less than 2%
(Distortion factor=100%×effective value of harmonics/effective value of fundamental)
-Ripple (in case of DC): Ripple factor less than 3%
(Ripple factor=100%×(max-min)/average of DC)
-Deviation of auxiliary power: within ±2% of nominal voltage
-Be sure not to inject the voltage or current beyond the overload immunity.
Otherwise, damage or burning might occur.
-Be careful not to touch the energized parts.
Otherwise, the electric shock might occur.

6. Items concerning modification and/or repair work

Be sure to ask any modification and/ or repair work for product to the sales office or distributor nearest you.

Unless otherwise, any incidents occurred with modification or repair works (including software) done by any other entity than MITSUBIHI ELECTRIC CORPORATION shall be out of scope on warranty covered by MITSUBISHI ELECTRIC CORPORATION.

7. Items concerning disposal

Particular regulations within the country of operation shall be applied to the disposal.

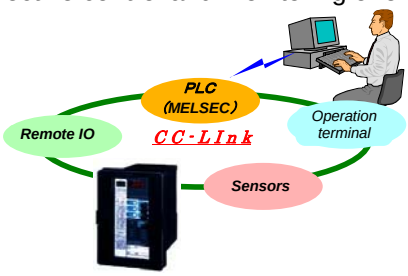
– CONTENTS –

1 Features

1.1 General description

Mitsubishi Electric MELPRO ™ – DASH Series is a digital protection relay product with a microprocessor for protecting high/extra-high-voltage electric power system (3.3 to 77 kV).

With its improved functions including support for the advanced communication networks, data saving in the occurrence of an accident and input measurement, this series of protection relay will allow stable and effective control and monitoring of electric power systems as well as the high-reliable protective function.



MEL : **M**itsubishi **El**ectric corporation's

PRO : **PRO**tection relay

D : for **D**istribution (for power distribution facilities)

A : **A**dvanced

S : **S**ophisticated

H : **H**uman oriented

1.2 Features

(1) High-reliable protection

The product includes 3 phase-fault overcurrent protection elements. Only using a unit of this relay will be enough to protect a 3-phase system from phase fault.

(2) Enriched Measurement Functions

- Real time monitor of relay input data

  The relay can measure steady state relay input values, supporting energy efficiency.

- Fault Data Monitor

  When a fault occurs, the relay saves the past 5 effective input values and harmonics data to assist with fault analysis.

(3) 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.

(4) Flexible Programmable Contacts (DO)

The operating output contacts (DO) can be combined and set with internal element outputs using 'OR' logic, thereby simplifying sequence design.

(5) High Accurate Digital Computation

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

In addition, since the operation characteristics are given by software, the stabilized characteristics can be ensured without any secular change.

(6) Reliable self-diagnostic function

The relay continually monitors electronic circuits from input to output so that, in the unlikely event that part failure occurs, it can detect internal failure before that failure causes damage thereby improving reliability.

- For normal conditions: illuminate RUN LED lamp.
- In the event of failure: lock the protection elements to prevent incorrect outputs and output a monitor abnormality contact (ALARM) signal.

(7) Easy Replacement

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

(8) Easy Maintenance

The relays are adopted as draw-out subunit mechanisms with automatic CT shorting at drawing, thereby improving maintenance ease.

(9) Easy sequence check

- It is possible to carry out forced operation of the output contacts independently. This will allow you to have an easy sequence check.

2 Rating and specifications

2.1 General information

<table>
<tr><td colspan="3">Type name</td><td colspan="4">COC3-A03D1</td></tr>
<tr><td>Style</td><td colspan="2">Relay without RS232C I/F</td><td>455PMB</td><td>456PMB</td><td>457PMB</td><td>458PMB</td></tr>
<tr><td rowspan="2">Element</td><td colspan="2" rowspan="2">Protection</td><td colspan="4">Time-lag element × 3</td></tr>
<tr><td colspan="4">Instantaneous element × 3</td></tr>
<tr><td></td><td colspan="2">Measurement</td><td colspan="4">Current</td></tr>
<tr><td rowspan="4">Rating</td><td colspan="2">Frequency</td><td>50 Hz</td><td>60 Hz</td><td>50 Hz</td><td>60 Hz</td></tr>
<tr><td colspan="2">Current</td><td colspan="2">5 A</td><td colspan="2">1 A</td></tr>
<tr><td rowspan="2">Auxiliary supply circuit ＊21</td><td>Voltage</td><td colspan="4">Common use for 100 ~ 220VDC / 100 ~ 220VAC</td></tr>
<tr><td>Fluctuation range</td><td colspan="4">DC : 85 ~ 242 V (Range of 80 ~ 286VDC is allowable temporarily.)
AC : 85 ~ 242 V (Range of 80 ~ 253VAC is allowable temporarily.)</td></tr>
<tr><td rowspan="3">Display</td><td colspan="2">RUN</td><td colspan="4">Indicate the result of automatic self-check. The lamp is lit for normal conditions and off for abnormal.</td></tr>
<tr><td colspan="2">Unit</td><td colspan="4">Indicate the unit symbol for measurements or other information displayed.</td></tr>
<tr><td colspan="2">Item No., Item data</td><td colspan="4">Display measurement, status, setting and option data selected with an item number.</td></tr>
<tr><td></td><td colspan="2">Communication</td><td colspan="4">Not supporting communication features.</td></tr>
<tr><td colspan="3">Automatic self-check (ALARM)</td><td colspan="4">Monitor the electronic circuit and internal power supply to output signal to the RUN LED and monitor abnormality (ALARM) contact.</td></tr>
<tr><td rowspan="5">Output contact</td><td rowspan="3">Configuration</td><td>For trip</td><td colspan="4">1a×2 : Contacts X_4 and X_5 (programmable contacts)</td></tr>
<tr><td>For control</td><td colspan="4">1a×4 : Contacts X_0 to X_3 (programmable contacts)</td></tr>
<tr><td>For monitor error</td><td colspan="4">1b×1 : Contact Y (closed for normal result of self-check with power on)</td></tr>
<tr><td rowspan="2">Capacity</td><td>For trip</td><td colspan="4">Closed circuit : 110VDC, 15A, 0.5 s (L/R = 0 s)
220VDC, 10A, 0.5 s (L/R = 0 s)
Open circuit : 110VDC, 0.3A (L/R ≦ 40 ms)
220VDC, 0.15A (L/R ≦ 40 ms)
Continuation : 1.5 A</td></tr>
<tr><td>For control/monitor error</td><td colspan="4">Open/close capacity : 500 VA (cos. ϕ 0.4), 60W (L/R = 0.007 s)
Max. current : 5 A
Max voltage : 380VAC, 125VDC</td></tr>
<tr><td rowspan="3">Burden</td><td colspan="2">Phase circuit</td><td colspan="4">0.5 VA or less (with rated current)</td></tr>
<tr><td colspan="2">Zero-phase circuit</td><td colspan="4">0.5 VA or less (with rated current)</td></tr>
<tr><td colspan="2">Auxiliary supply circuit</td><td colspan="4">For 100VDC: approx. 5 W
For 100VAC: approx. 7 VA
For 220VDC: approx. 6 W
For 220VAC: approx. 12 VA</td></tr>
<tr><td colspan="3">Mass</td><td colspan="4">Net weight of unit : approx. 2.3 kg
Including case : approx. 3.0 kg</td></tr>
<tr><td colspan="3">Case/cover</td><td colspan="4">Size : D1 type
Color : N1.5</td></tr>
</table>

*21 When an uninterruptible AC power source is not provided in your system for the auxiliary supply voltage, use the type B-T1 back up power supply or commercially available uninterruptible power supply (UPS).
Type B-T1 back up power supply unit can be applied for DASH series protection relay with 100V～200V auxiliary power supply voltage rating only.
In addition, the power supply duration of the type B-T1 back up power supply 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 B-T1 back up power supply.

2.2 Protective elements

Style	Relay without RS232C I/F		455PMB	456PMB	457PMB	458PMB
Setting ＊23	Time-lag	Operation current	LOCK – 0.5 ~ 8A (0.1A step)		LOCK - 0.1 ~ 1.6A (0.02A step)	
		Operation time multiplier	0.25 - 0.5 ~ 50 (0.5 step)			
		Operation characteristics	Normal inverse time-lag×3, Very inverse time-lag×2, Extremely inverse time-lag×3, Long inverse time-lag×3, Definite time-lag			
		Reset characteristics	Inverse, definite time-lag ×2			
	Instantaneous	Operation current	LOCK - 2 ~ 80A (1A step)		LOCK - 0.4 ~ 16A (0.2A step)	
		Operation time	INST - 0.1 ~ 0.5 s (0.1s step)			
Forced operation			Trip and control contacts can be forcefully tripped independently.			
Operation indication			Operation indicator LED (red) comes on when the relay operates.			

2.3 Measurement elements

Style		Relay without RS232C I/F		455PMB	456PMB	457PMB	458PMB
Option ＊23		CT primary 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]	
Display	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	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]			

＊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.

CT primary setting		1[A]	5 ~ 40[A]	50 ~ 400[A]	500 ~ 4000[A]	5000 ~ 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]

＊23 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 guaranteed conditions	(1) Rated frequency (2) Ambient temperature: 20℃ (3) Aux. supply voltage : Rated voltage	The guarantee conditions shown in the left should be applied unless otherwise specified.

3.1 Protective elements

Items		Guaranteed conditions	Guaranteed performance
Operation value	Time-lag element	(Common guaranteed conditions)	・For setting of 0.5 ~ 0.6A (5A rating product) For setting of 0.1 ~ 0.12A (1A rating product) Setting value ±15% ・For setting of 0.7 ~ 1.5A (5A rating product) For setting of 0.14 ~ 0.3A (1A rating product) Setting value ±15% ・For setting of other range Setting value ±5%
	Instantaneous element		Setting value ±10%
Reset value	Time-lag element	(Common guaranteed conditions)	・For setting of 0.5 ~ 0.6A (5A rating product) For setting of 0.1 ~ 0.12A (1A rating product) Setting value × 85% or more ・For setting of 0.7 ~ 1.5A (5A rating product) For setting of 0.14 ~ 0.3A (1A rating product) Setting value × 90% or more ・For setting of other range Setting value × 95% or more
	Instantaneous element		Setting value × 95% or more
Operation time	Time-lag 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.
	Instantaneous element	Operation setting: Minimum Input: 0 → 200% of setting	Setting value ±25ms INST = 40 ms or less.
Reset time	All elements	300% of setting → 0 [A]	See Figure 3.3 and Table 3.13.

Items	Guaranteed conditions		Guaranteed performance
Inertia characteristic	Phase fault time-lag element	Time-lag 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
Temperature characteristic	Ambient temperature variation range 20℃ (normal temperature) ±20℃		Operation value: Within±5% of value at 20℃
			Operation time: Within±10% of value at 20℃
	Ambient temperature variation range 20℃ (normal temperature) ±30℃		Operation value: Within±10% of value at 20℃
			Operation time: Within±20% of value at 20℃
Humidity characteristic	Ambient temperature : 40℃ Ambient humidity : 95% (non-condensing) Application time : 4 d		Operation value: Within ± 5% of value under normal service condition
			Operation time: Within ± 10% of value under normal service condition
Frequency characteristic	Frequency variation range Rated frequency ±5%		Operation value: Within ± 5% of value at rated frequency
			Operation time: Within ± 10% of value at rated frequency
Auxiliary supply voltage characteristic	Auxiliary supply voltage variation range 80VDC ~ 286VDC 85VAC ~ 253VAC		Operation value: Within ± 5% of value at rated voltage
			Operation time: Within ± 10% of value at rated voltage
Wave distortion characteristic	3rd higher harmonic: Distortion ratio 30%, superimpose		Operation value: Within 10% of value by input of fundamental wave form only
	5th higher harmonic: Distortion ratio 30%, superimpose		
	7th higher harmonic: Distortion ratio 30%, superimpose		
Overload capacity	・Phase current circuit, zero-phase current circuit (CT circuit) Application of "rated current×40" two times for 1 s at interval of 1 min. ・Auxiliary supply circuit Application of "max. permissible voltage" one time for 3h		No abnormalities
Insulation resistance	500VDC megger	・Between all electrical circuit and earth (Serial communication bus circuit excluded)	10 MΩ or more
		・Across circuits, across contact terminals (Serial communication bus circuit excluded)	5 MΩ or more

<table>
<tr><th>Items</th><th colspan="3">Guaranteed conditions</th><th>Guaranteed performance</th></tr>
<tr><td rowspan="2">Withstand voltage</td><td colspan="2">Application of 2,000VAC, commercial frequency for 1 min.</td><td>・Between all electrical circuit and earth
・Across circuits (Serial communication bus circuit excluded)</td><td rowspan="2">No abnormalities</td></tr>
<tr><td colspan="2">Application of 1,000VAC, commercial frequency for 1 min.</td><td>・Across contact terminals (across poles)</td></tr>
<tr><td rowspan="2">Lighting impulse withstand voltage</td><td rowspan="2">Application of standard shock voltage waveform (1.2/50 μs) 3 times to each of negative/ positive polarity</td><td>5,000V</td><td>・Between all electrical circuit and earth
・Across metering transformer circuits
・Between metering transformer circuit and control circuit (Serial communication bus circuit excluded)</td><td rowspan="2">No abnormalities</td></tr>
<tr><td>3,000V</td><td>・Across control circuits
・Across metering transformer circuit terminals
・Across contact circuit terminals (across poles)
・Across auxiliary supply circuit terminals (Serial communication bus circuit excluded)</td></tr>
<tr><td>Shock</td><td colspan="3">・Shock acceleration: 294 m/s^2
・Shock application direction: 3 directions of transverse, horizontal and vertical
・Shock application times: 3 times</td><td>No abnormalities</td></tr>
<tr><td>Dust-proof</td><td colspan="3">IP51 (IEC-529)
No entrance of dust of such amount as to affect the protective function.</td><td>No abnormalities</td></tr>
</table>

The input and setting for the following items (noise resistance, radio disturbance and vibration) should be as follows:

(1) Input current I_A, I_B, I_C : Setting value × 80%

(2) Minimum setting

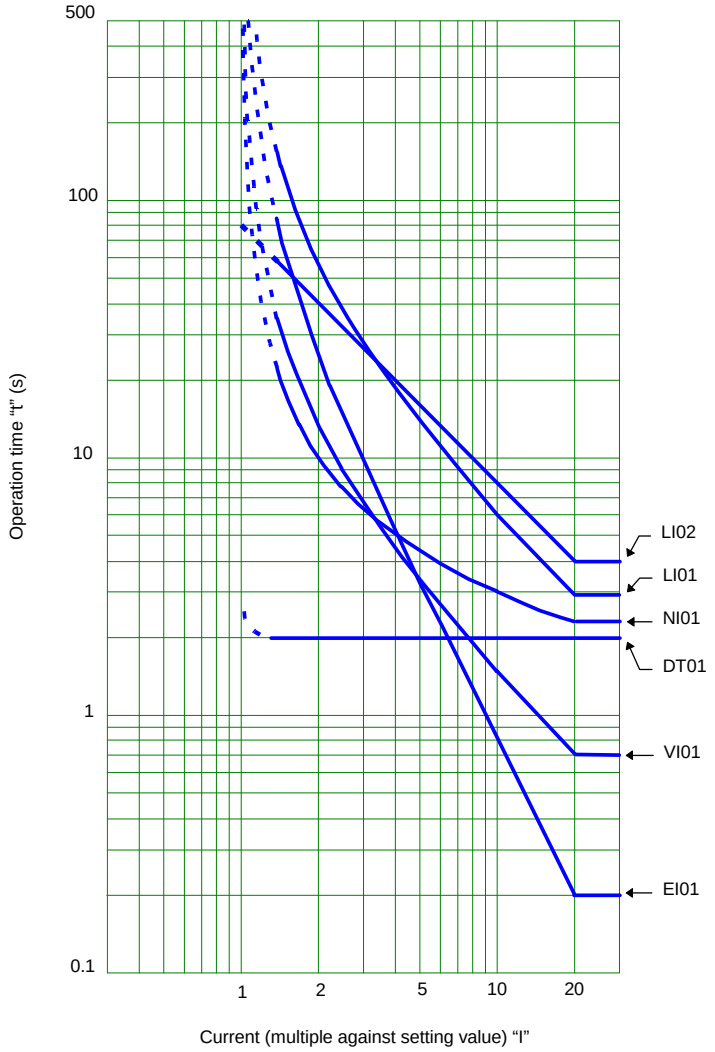
<table>
<tr><th>Items</th><th colspan="2">Guaranteed condition</th><th>Guaranteed performance</th></tr>
<tr><td>Noise resistance</td><td rowspan="3">・1st wave crest value:
2.5 kV
・Vibration frequency:
1 MHz±10%
・1/2 damping time :
3 ~ 6 cycles
・Cycle period: 6 to 10 times / a cycle of commercial frequency (asynchronous)
・Test circuit output Impedance:
200Ω ±10%</td><td>Between all transformer circuit and earth</td><td rowspan="3">No erroneous operation</td></tr>
<tr><td>Between auxiliary supply circuit and earth</td></tr>
<tr><td>Across auxiliary supply circuit terminals</td></tr>
<tr><td>Radio disturbance</td><td colspan="2">Make the antenna of a transceiver of 5W output for 150, 400 and 900 MHz bands contact with the front surface of the unit to turn on and off the switch of the transceiver.</td><td>No erroneous operation</td></tr>
<tr><td>Vibration</td><td colspan="2">(1) JEC – 2500
<table>
<tr><th rowspan="2">Vibration frequency [Hz]</th><th colspan="3">Double amplitude [mm]</th><th rowspan="2">Application time [s] (in every direction)</th><th colspan="3">Acceleration (for reference) [m/s²]</th></tr>
<tr><th>Transverse</th><th>Horizontal</th><th>Vertical</th><th>Transverse</th><th>Horizontal</th><th>Vertical</th></tr>
<tr><td>10</td><td colspan="2">5</td><td>2.5</td><td>30</td><td colspan="2">9.8</td><td>4.9</td></tr>
<tr><td>16.7</td><td colspan="3">0.4</td><td>600</td><td colspan="3">1.96</td></tr>
</table>
(2) IEC255 – 1 Severity Class: 1
①Reply test
・Frequency range: 10 ~ 150 Hz
・Cross over frequency: 58 ~ 60 Hz
・Sweep rate: 1 octave / min.
・Test time: 8 min×1 time.
<table>
<tr><th>Cross over frequency or less: peak single amplitude [mm]</th><th>Cross over frequency or more: peak acceleration [m/s²]</th><th>Sweep count</th></tr>
<tr><td>0.035±15%</td><td>4.9±15%</td><td>1</td></tr>
</table>
②Endurance test
・Frequency range: 10 ~ 150 Hz
・Double amplitude: 5 ~ 0.022mm
・Acceleration: 4.9m/s²
・Sweep rate: 1 octave / min.
・Test time: 8 min×20 times.
＊Supply and input are 0.</td><td>No erroneous operation

No abnormalities</td></tr>
</table>

3.2 Measurement elements

Items	Guaranteed condition	Guaranteed performance
Real time and max. records	CT primary setting / rated current × 10	±1%
Fault record		

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



NI01: Normal inverse time-lag characteristic

$$t = \frac{0.14}{I^{0.02} - 1} \times \frac{M}{10}(s)$$

VI01: Very inverse time-lag characteristic

$$t = \frac{13.5}{I - 1} \times \frac{M}{10}(s)$$

EI01: Extremely inverse time-lag characteristic

$$t = \frac{80}{I^{2} - 1} \times \frac{M}{10}(s)$$

LI01: Long inverse time-lag characteristic

$$t = \frac{54}{I - 1} \times \frac{M}{10}(s)$$

LI02: Long inverse time-lag characteristic

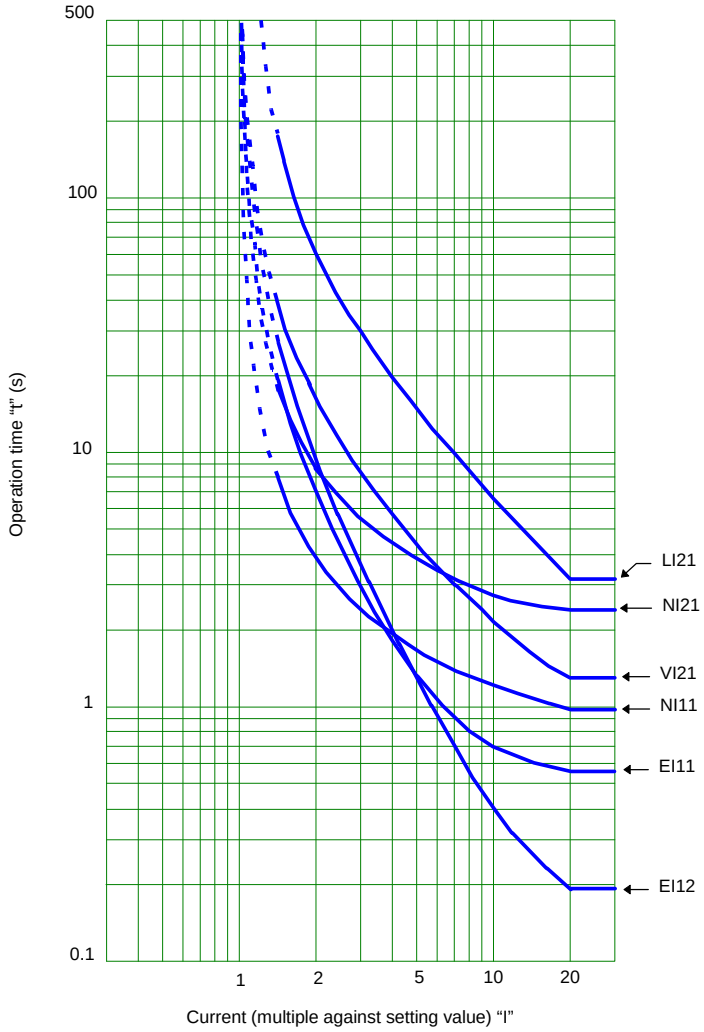
$$t = \frac{80}{I} \times \frac{M}{10}(s)$$

DT01: Definite time-lag characteristic

$$t = 2 \times \frac{M}{10}(s)$$

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-lag characteristic

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

EI11: Extremely inverse time-lag characteristic

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

EI12: Extremely inverse time-lag characteristic

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

NI21: Normal inverse time-lag characteristic

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

VI21: Very inverse time-lag characteristic

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

LI21: Long inverse time-lag characteristic

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

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)

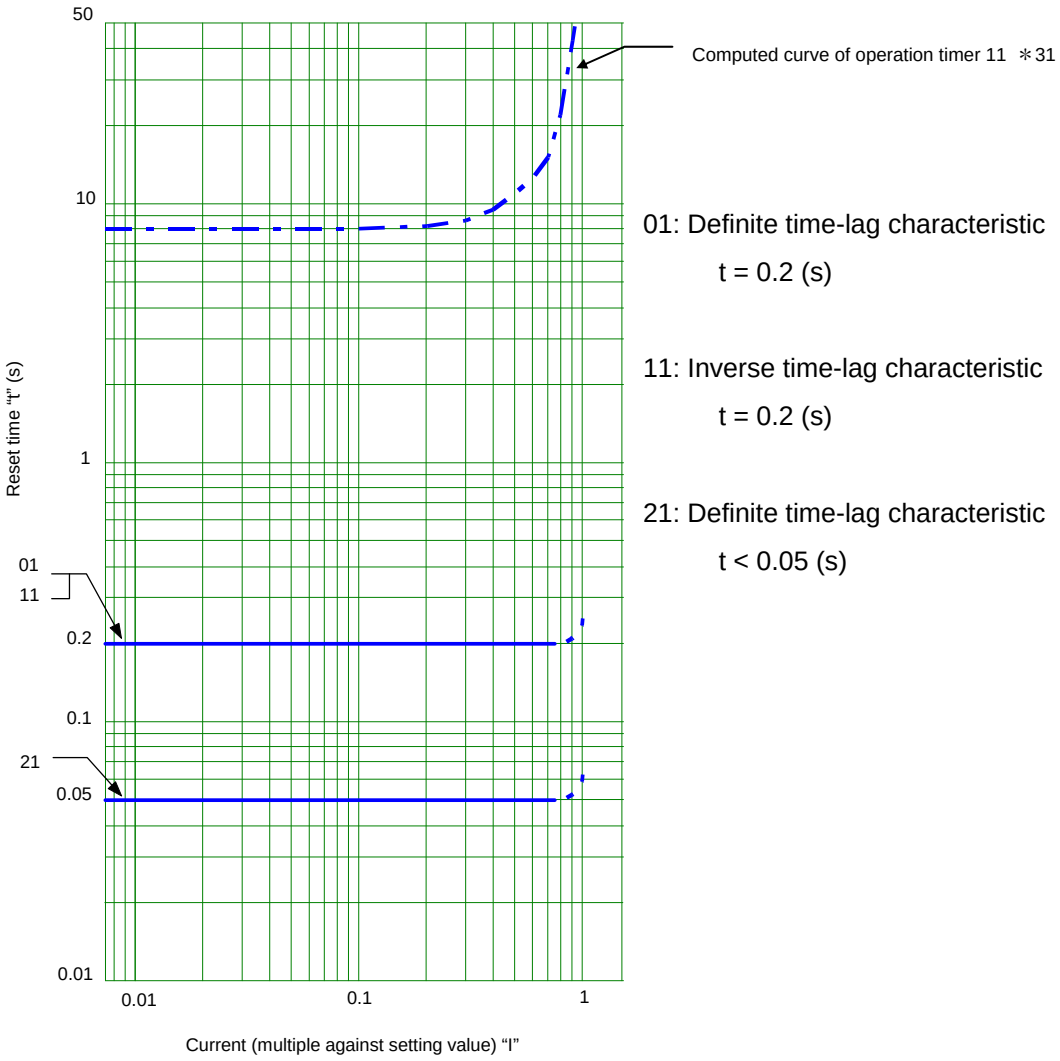


Figure 3.3　Reset time characteristic

＊31　Inverse time-lag characteristic for resetting

Following the principle of resetting an electromagnetic mechanical type induction disc, the inverse time-lag 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-lag characteristic may be useful for detecting recurrent overload, which typically occurs in starting a motor. For further information, see the section 4 “Functions”.

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

Table 3.1 Operation time control table for Normal inverse time-lag characteristic (NI01)

＊32 ~ 35

Operation time multiplier (M)	Input against operation time		
	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

Unit : s

Table 3.2 Operation time control table for Very inverse time-lag characteristic (VI01)

＊32 ~ 35

Operation time multiplier (M)	Input against operation time		
	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

Unit : s

Table 3.3 Operation time control table for Extremely inverse time-lag characteristic (EI01)

＊32 ~ 35

Operation time multiplier (M)	Input against operation time		
	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

Unit : s

Table 3.4 Operation time control table for Long inverse time-lag characteristic (LI01)

＊32 ~ 35

Operation time multiplier (M)	Input against operation time		
	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

Unit : s

Table 3.5 Operation time control table for Long inverse time-lag characteristic (LI02)

＊32 ~ 35

Operation time multiplier (M)	Input against operation time		
	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

Unit : s

Table 3.6 Operation time control table for Definite time-lag characteristic (DT01)

＊32 ~ 35

Operation time multiplier (M)	Input against operation time		
	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

Unit : s

Table 3.7 Operation time control table for Normal inverse time-lag characteristic (NI11)

＊32 ~ 35

Operation time multiplier (M)	Input against operation time		
	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

Unit s

Table 3.8 Operation time control table for Extremely inverse time-lag characteristic (EI11)

＊32 ~ 35

Operation time multiplier (M)	Input against operation time		
	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

Unit : s

Table 3.9 Operation time control table for Extremely inverse time-lag characteristic (EI12)

＊32 ~ 35

Operation time multiplier (M)	Input against operation time		
	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

Unit : s

Table 3.10 Operation time control table for Normal inverse time-lag characteristic (NI21)

＊32 ~ 35

Operation time multiplier (M)	Input against operation time		
	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

Unit : s

Table 3.11 Operation time control table for Very inverse time-lag characteristic (VI21)

＊32 ~ 35

Operation time multiplier (M)	Input against operation time		
	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

Unit : s

Table 3.12 Operation time control table for Long inverse time-lag characteristic (LI21)

＊32 ~ 35

Operation time multiplier (M)	Input against operation time		
	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

Unit : s

Table 3.13 Reset time characteristic

Input: Setting value × 300% → 0

	Output contact	Reset of operation timer inside relay
01 : Definite time-lag (200 ms)	200ms ± 25ms	Immediately
11 : Inverse time-lag	200ms ± 25ms	Approx. 8 s ＊36
21 : Definite time-lag (50 ms)	50ms or less	Immediately

＊32 The numbers “300%”, “500%” and “1000%” represent multiples against the current setting.

＊33 The numbers shown in the upper section of each box in the table represent the theoretical operation time and tolerance, and those in the lower section the calculated 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;

T_{10} : 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 error control values change as condition varies. This way of thinking is based on the JEC-2500 and JEM-TR156 (reference-1).

＊36 The elapsed time of reset of the operation timer can be checked through the “Elapse of time-lag timer (LAPSE) indicator”.

4 Functions

4.1 Protection

4.1.1. Overcurrent elements

Fig. 4.1 “Overcurrent element internal function block diagram” shows operation of the overcurrent elements.

The time-lag element compares input currents with the operation setting in each pahse. If an input current is more than a specified operation level, the element outputs an operation signal when the time-lag timer expires. The expiring time depends on the input current amount and the setting in the operation time characteristic.

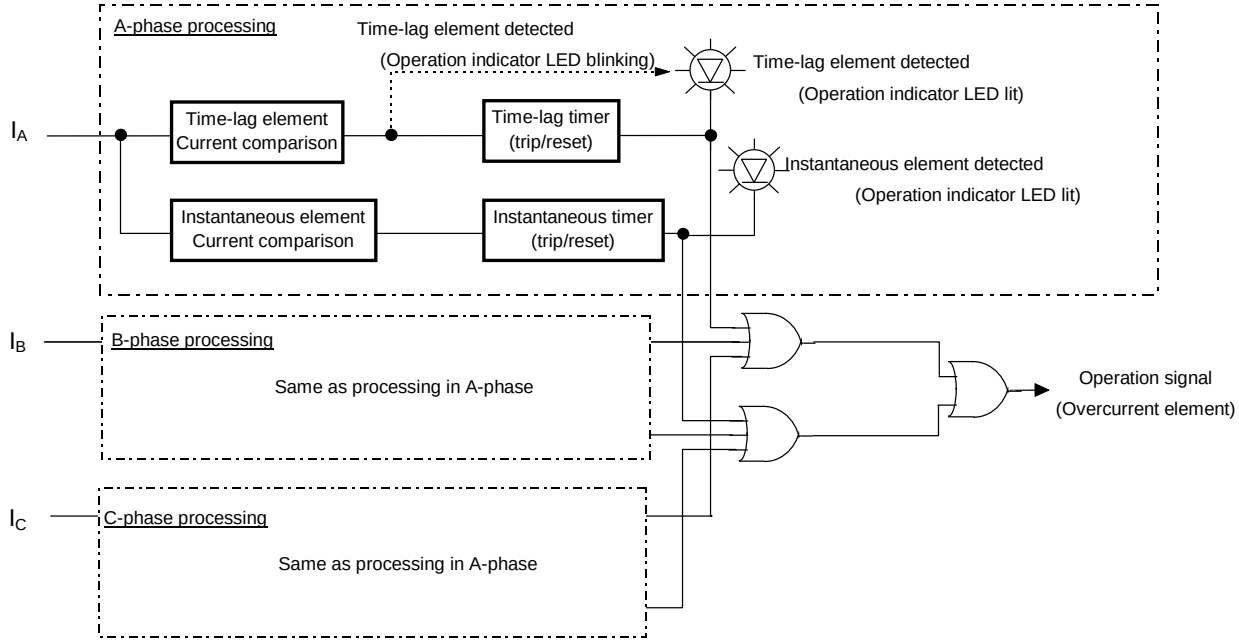


Figure 4.1 Overcurrent element Internal function diagram

Like the time-lag 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.

4.1.2 General functions

(1) Setting of operation current

The operation current settings for the instantaneous and time-lag 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 operation time characteristic (value for the letter “M” in the operation characteristic formula shown in Figure 3.1).

(3) Setting of operation characteristic

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

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

(4) Setting of reset characteristic

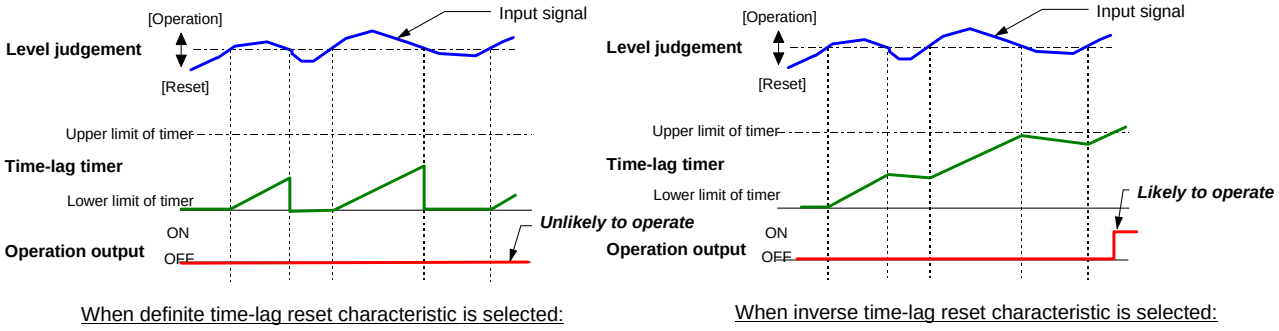
A time-lag element includes a type of inverse and two types of definite time-lag characteristics for reset action that meet the requirements specified by IEC60255-3. One of them can be selected by operation characteristic setting.

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

Characteristic		Reset when relay input is less than operation setting		Response to recurrent 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: $t_r = \frac{8}{1-I^2} \times \frac{M}{10}(s)$	Definite time-lag of 200ms	Likely to operate

For the definite time-lag characteristic, the internal timer will reset quickly when the input current becomes less than the operation setting. The definite time-lag characteristic is not suitable for detecting recurrent overloads or intermittent earth fault, which are likely to occur in starting a motor. For the inverse time-lag characteristic in turn, the internal timer will reset according to an inverse time lag 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-lag characteristic to detect repetitive faults. 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.



When definite time-lag reset characteristic is selected:

When inverse time-lag reset characteristic is selected:

Figure 4.2 Comparison of relay operation with intermittent overload input between two reset characteristics

(5) Operation display

For the time-lag element, when the input current becomes more 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 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	1st phenomena	Latest fault record data
312	2nd phenomena	↓
313	3rd phenomena	↓
314	4th phenomena	↓
315	5th phenomena	Oldest fault record data

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

For the time-lag elements, the elapsed time of the internal operation timer is indicated in the display. As the elapsed time is counted, operators may imagine the then 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 control output contacts X_0 to X_3 and trip output contacts X_4 and X_5 are all programmable type.

The factory default setting of the arrangement of these contacts 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 operation.

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

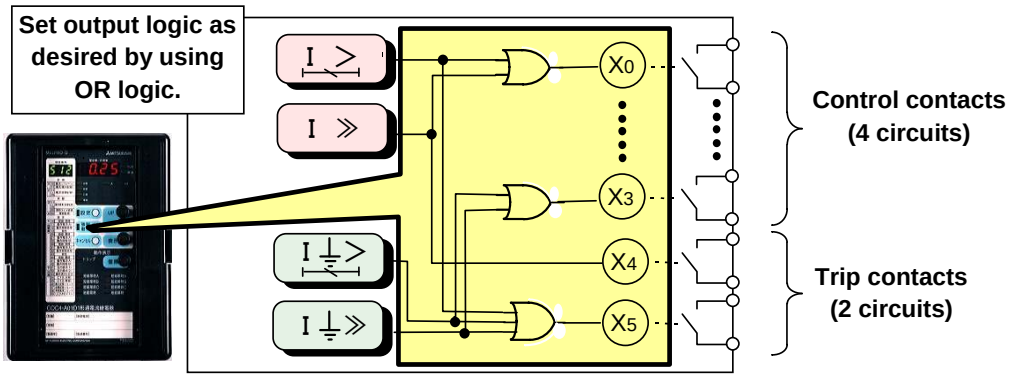


Figure 4.3 Schematic image of Programmable Contacts (example: COC4-A01)

(8) Forced operation

It is possible to carry out forced operation of any of the control output contacts X_0 to X_3 and trip output contacts X_4 and X_5 independently. Forced operation is useful for checking the sequence.

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

4.2 Measurement

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

(1) Real time measurement

The effective current input to the relay under steady state is 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. supply OFF” or “max. record reset” operation is made.

(3) Fault record

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

With “aux. supply OFF” , only the wave form 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	1st phenomena	Latest fault record data
212	2nd phenomena	↓
213	3rd phenomena	↓
214	4th phenomena	↓
215	5th phenomena	Oldest fault record data

4.3 Automatic self-check (ALARM)

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

(1) Checking defect code in the event of monitor abnormality

When a monitor abnormality output occurs, the defect code will be recorded. This defect code can be checked through the automatic self-check (ALARM) status indication.

(2) Resetting monitor abnormality output

If a monitor abnormality is detected, **the error status can be reset by turning off/on the power**.

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

(3) Clearing defect code

The defect code data stored upon monitor error 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 occurred since the previous “auto self-check reset” (RESET ALARM) operation was made are accumulated in the memory.

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

Table 4.1 Output for protection relay errors

Status	Detected items	Output			
		Display		ALARM (break contact)	Operation output lock
		RUN	Defect code		
Normal	—	On	No display	Open	Not locked
Power circuit error	—	Off		Closed	Locked
CPU error	—				Not locked
Self-check error	ROM check		0001		Locked
	RAM check		0002		
	A/D accuracy check		0003		
	A/I check		0004		
	A/D check		0005		
	SRAM check		0006		
	D/O status check		0008		
	D/O operation check		0009		
	Analog filter check		0010		
	A/I double check		0011		
	D/I check ＊41		0012		
	E^2PROM check		0013		
	Computing function check		0014		
	WDT check		0015		
	Data transfer check ＊42		0016		
	Differential current check ＊43		0017		

＊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.

4.4 Communication

No communication (Both CC-Link and direct PC)

5 Configuration

5.1 Internal configuration

(1) I/O and CPU circuits

Fig. 5.1 shows the internal block diagram of the model COC3-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 several channels sharing a same time in the sample hold circuit. The multiplexer selects a channel to take the signal and sent 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” , then issue output signals to the display and output relay.

(2) Automatic self-check circuit

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

The monitor abnormality contact (break contact) will be closed when an error occurs in the circuits above or when the built-in power fuse burns.

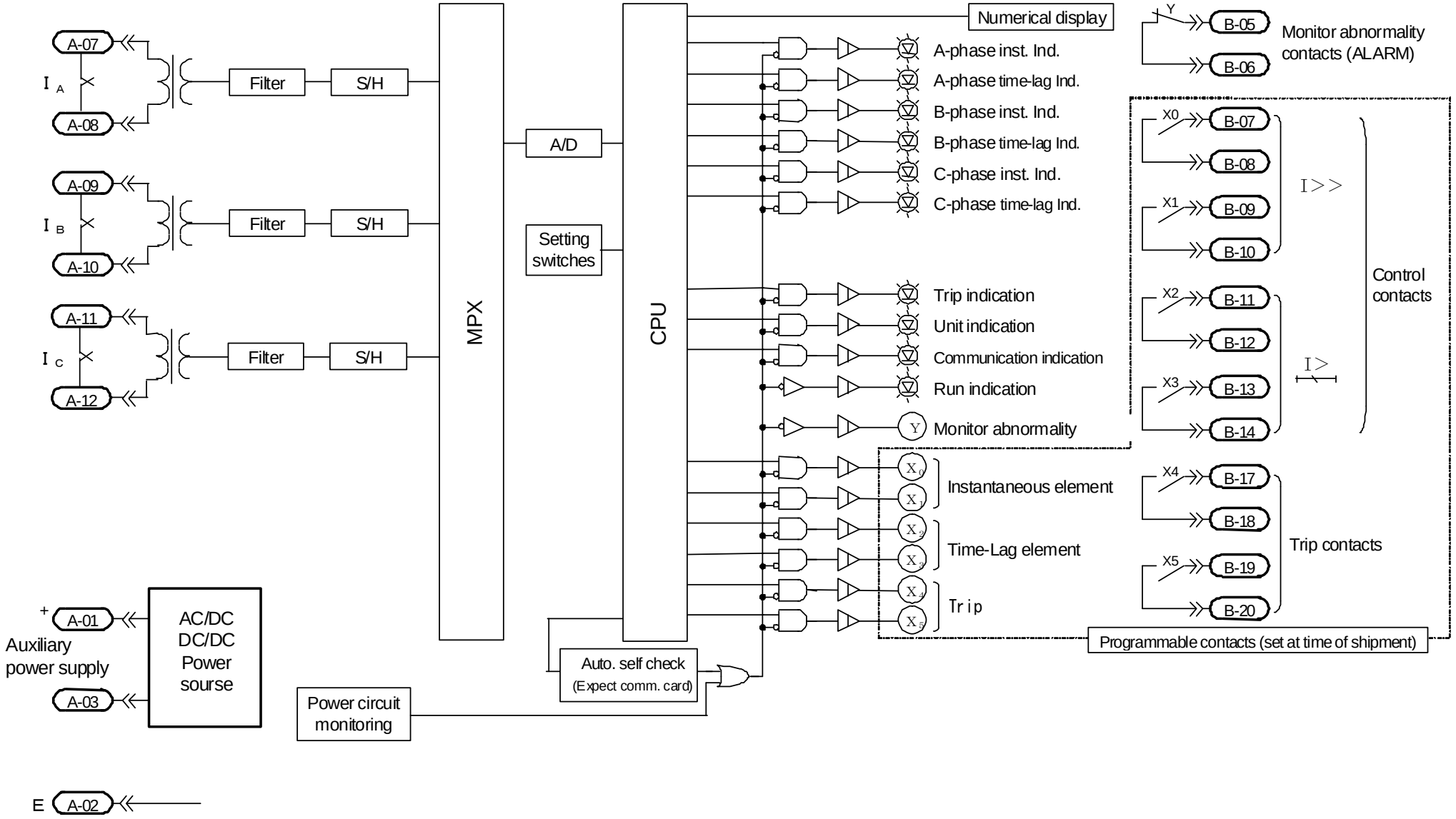


Figure 5.1 Internal block diagram of Type COC3-A03D1 relay

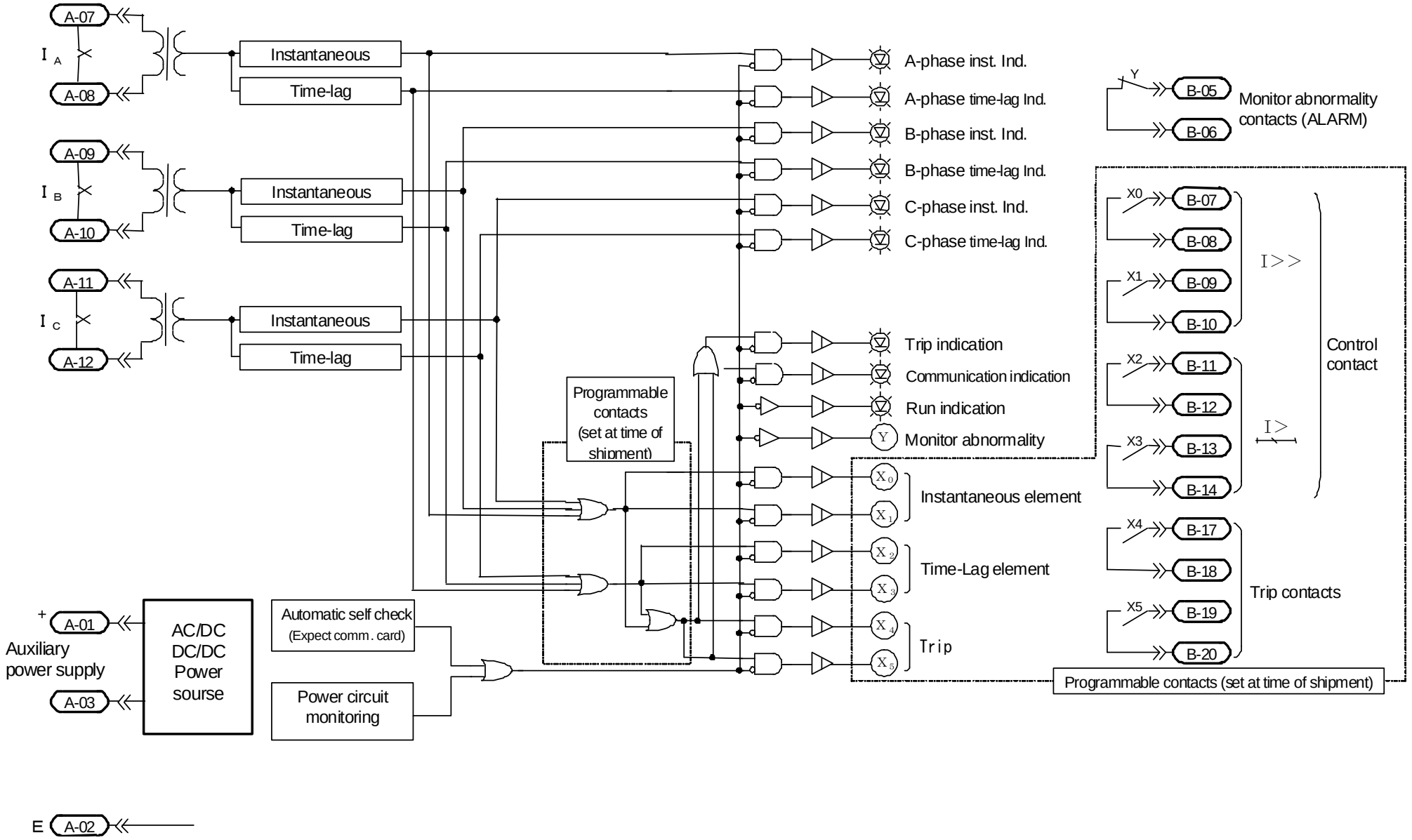


Figure 5.2 Internal function block diagram of Type COC3-A03D1 relay

5.2 External connection

(1) Connection diagram

Figures 5.4 shows example of input circuit (AC circuit) connection, Figure 5.5 an example of control circuit (DC circuit) connection and Figure 5.6 a terminal arrangement.

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

(2) Precautions for wiring work

① Important facilities should be provided with fail safe measures such as dual system to improve reliability of the facilities.

② Effects of external surge

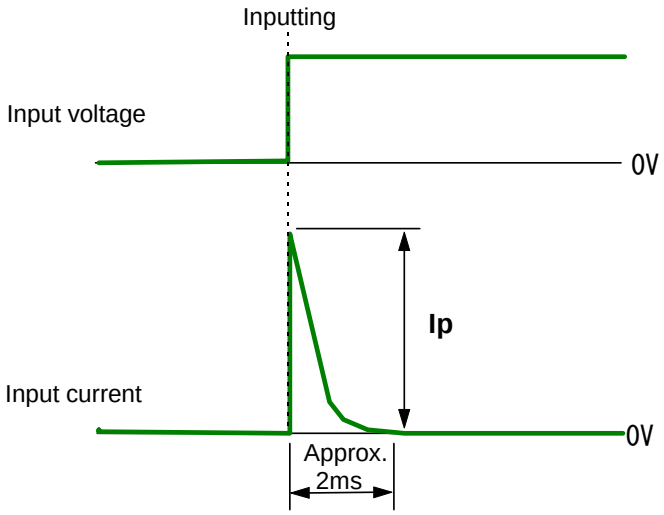
Some type of surge with a certain condition may inversely affect the relay. If so, take it into account to install **MF type surge absorbers made by Mitsubishi**.

③ Guarantee of AC auxiliary supply against power interruption

The AC auxiliary supply of the relay is not **guaranteed against power interruption**. When you do not have an uninterruptive AC power source, use an **type B-T1 back up power supply manufactured by Mitsubishi** or uninterruptive power source (UPS) that is commercially available.

④ Inrush current of auxiliary supply

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



Input voltage		Inrush current Ip
DC	110V	**Approx. 20A**
	220V	**Approx. 55A**
AC	100V	**Approx. 25A**
	220V	**Approx. 65A**

Figure 5.3 Inrush current of auxiliary supply

⑤ Trip circuit

Only the contacts X_4 and X_5 can be used for the trip circuit. Please keep in mind that the contacts X_0 to X_3 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.

⑥ Monitor abnormality circuit

The monitor abnormality 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. 5.5 “DC circuit connection diagram”) .

⑦ Earth circuit

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

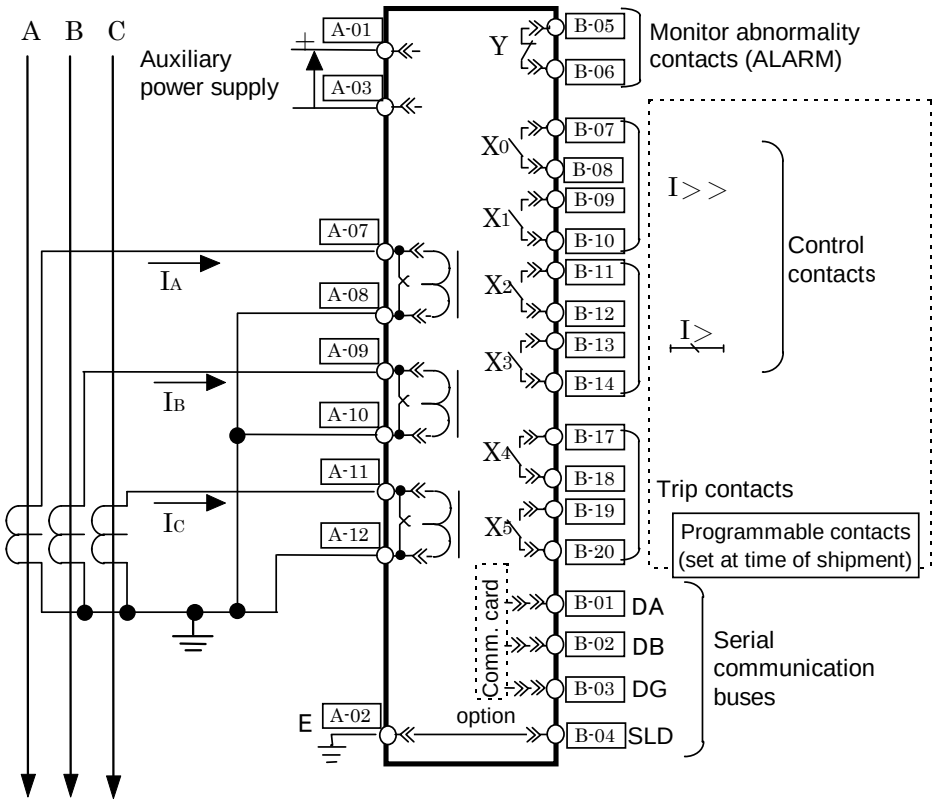
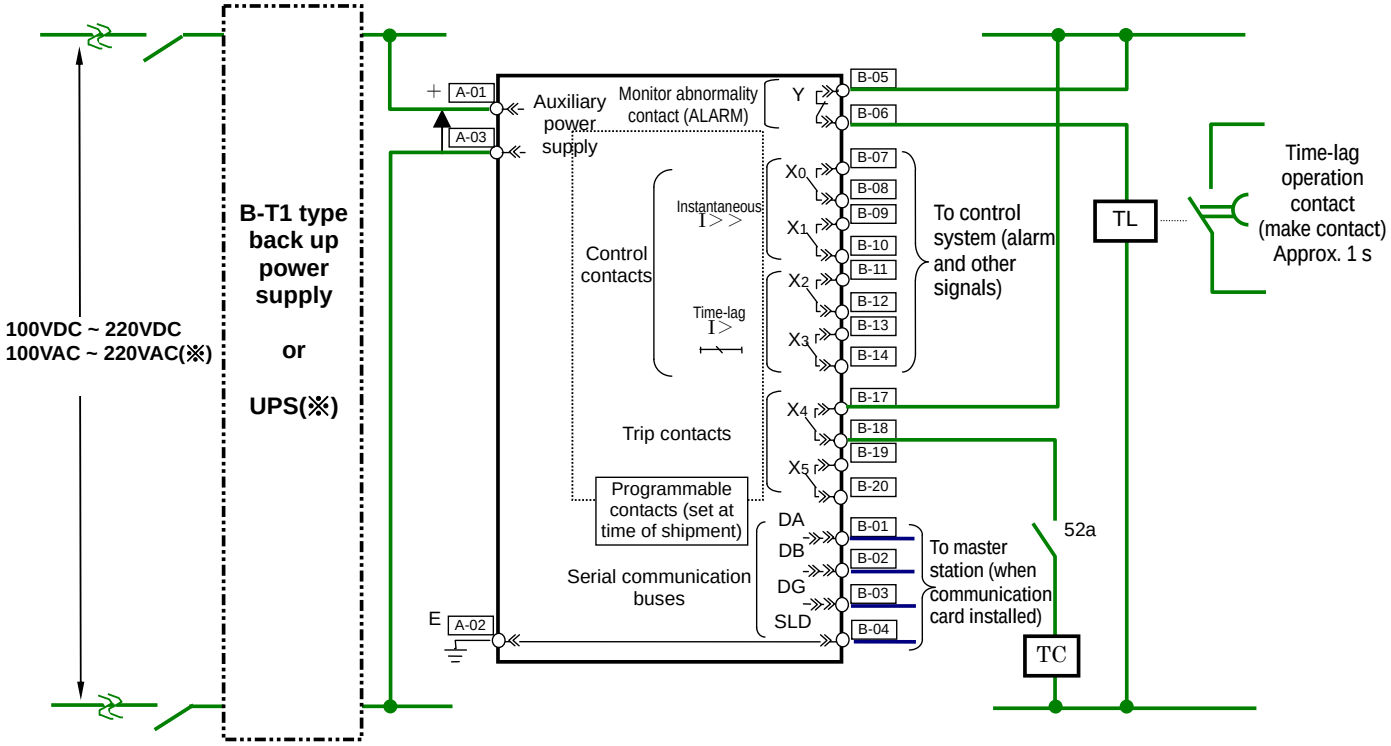


Figure 5.4 External connection diagram for COC3-A03D1 relay



Note 1)	The self-diagnosis output contact is so configured as below mentioned that alarm can be issued even after the built-in power fuse burns. This type of auxiliary relay circuit configured such that relay will be energized ("break contact" opened) when normal result of self-diagnosis is received. 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.

(※) Refer to the page 39, 5.2 External connection (2) Precautions for wiring work ③. Guarantee of AC auxiliary power supply against power interruption.

Figure 5.5 Auxiliary supply circuit connection example of type COC3-A03D1 relay

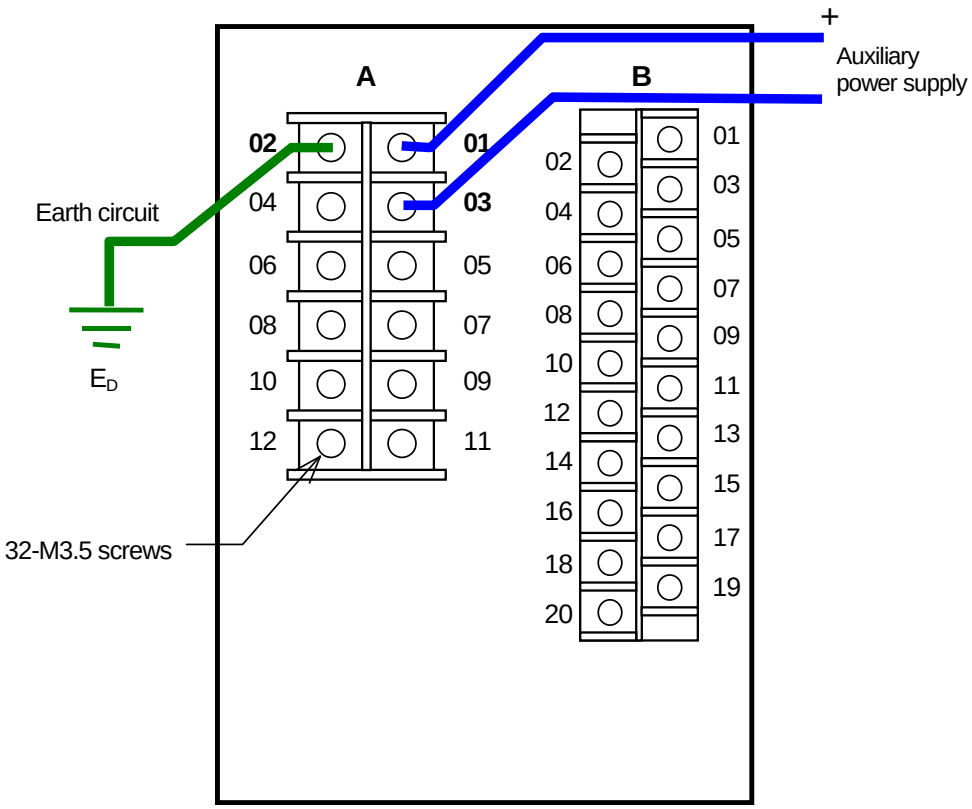


Figure 5.6 Rear view of type COC3-A03D1 relay

6 Handling

6.1 Unpacking

Usually this relay is packed in a D1 case for transportation. However, it may occurs that the sub unit is transported independently for the convenience of 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 can not 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 as shown in the JEM-TR 156 “Guideline for protective relay”.

- Lock the tripping circuit including breakers.
- Stop the main circuit.
- Isolate the CT circuit.
- Open the auxiliary 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 auxiliary supply 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.

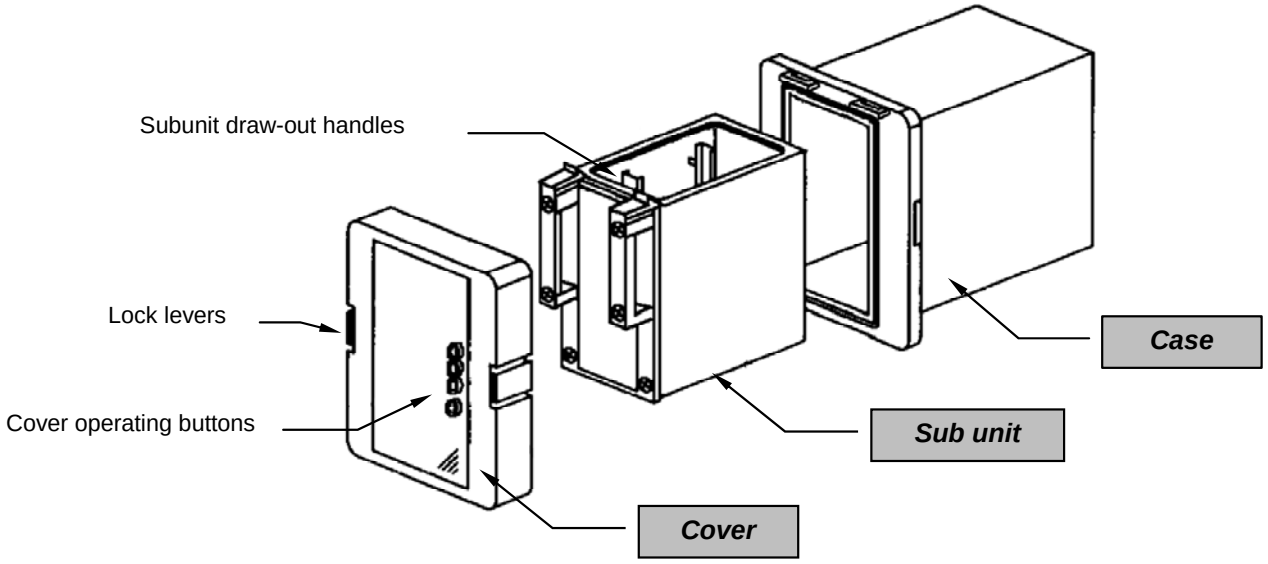
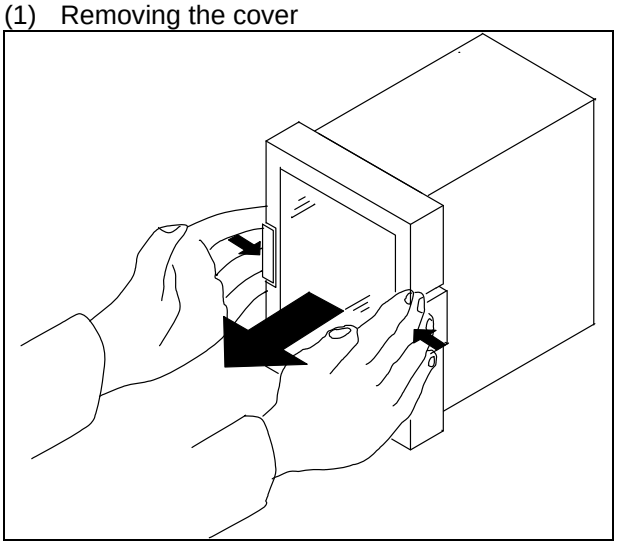


Figure 6.1 Outside view of type COC3-A03D1 relay

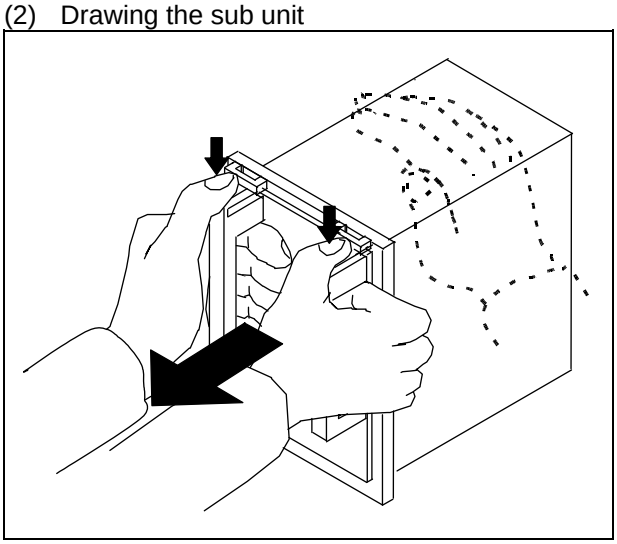
6.3.1 How to draw sub unit out

(1) Removing the cover



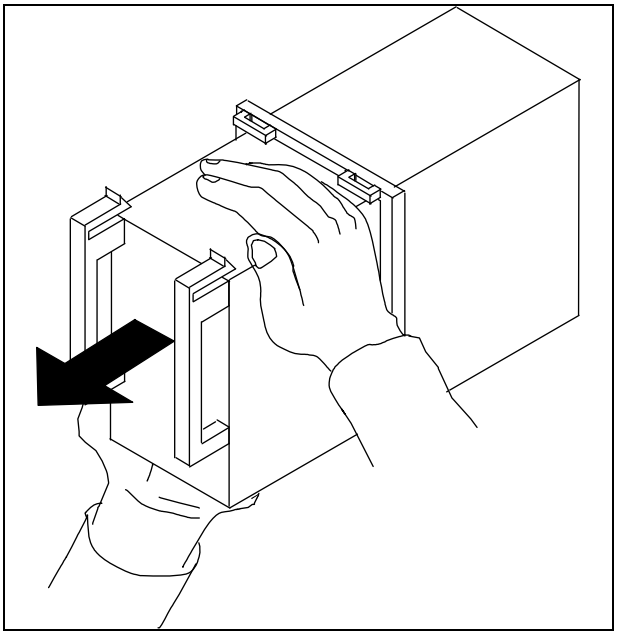
Hold the **lock levers**, which located at the both sides of the cover, on their front sections. Take off the cover **straight toward you** while pushing the levers **inwards**.

(2) Drawing the sub unit



Grip the draw-out handles (located at the 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.

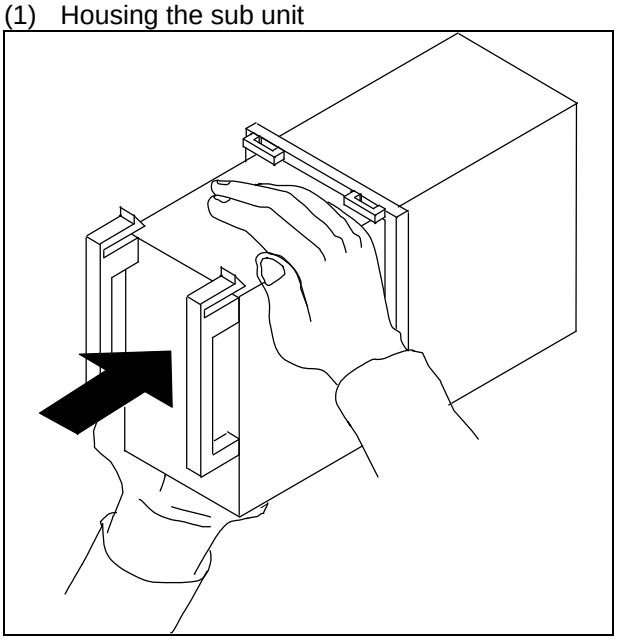


When about a half portion of the sub unit is pulled out of the case, just stop the drawing motion. Then, **hold the top and bottom of the sub unit to pull it out completely**, in order to prevent the unit from falling.

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

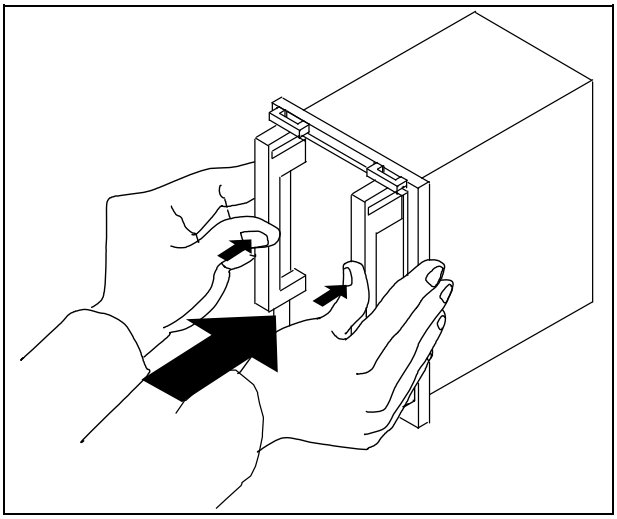
6.3.2 Housing the sub unit

(1) Housing the sub unit



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

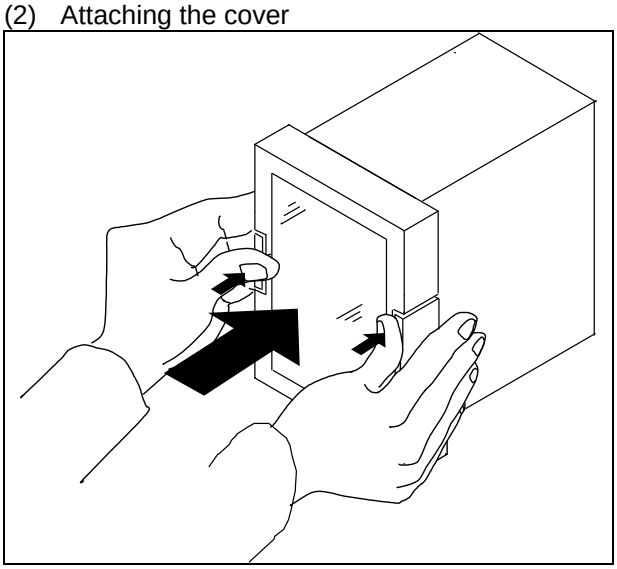
Note) ・ Be careful no to touch the PCB and parts inside the sub unit.
・ The sub unit is so constructed that it can not be housed in the case with its upside down.



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, and also the front face of subunit (ie, 4 corners of front face) is becoming flush with the vertical surface of the case.

Note) Please note that inserting the sub-unit incompletely may only establish a poor contacts 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 lock levers, located both side of the cover, to case side 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

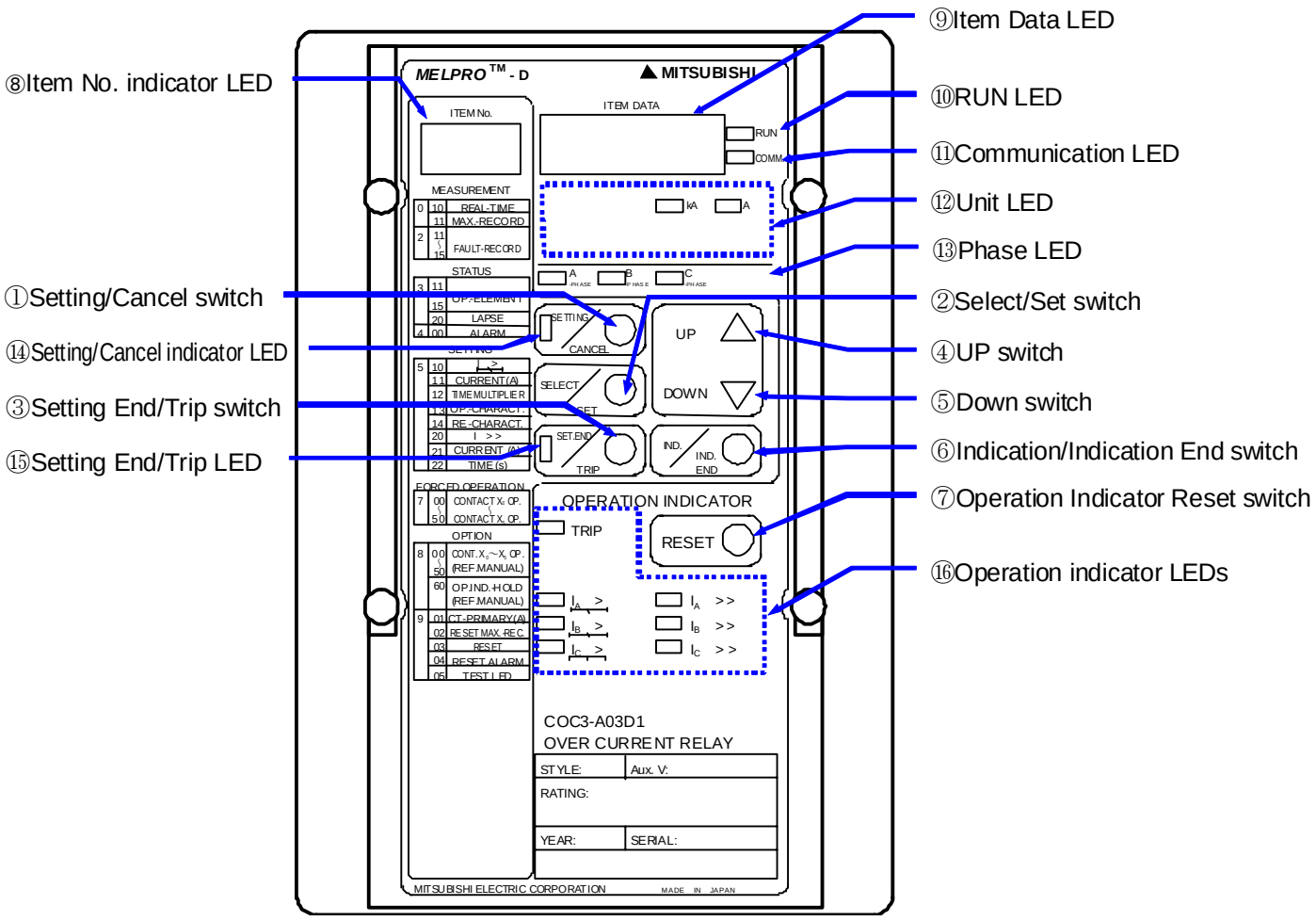
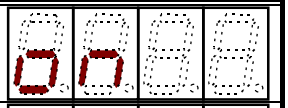
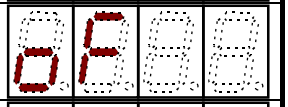
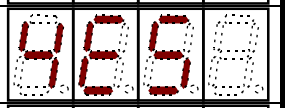
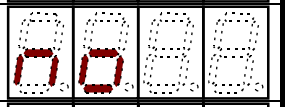
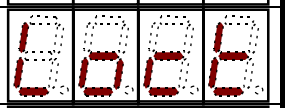
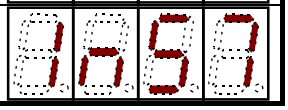


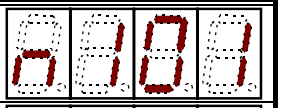
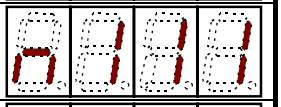
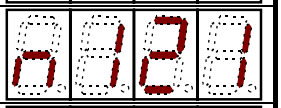
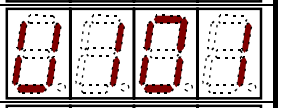
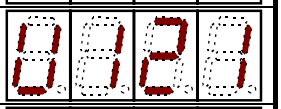
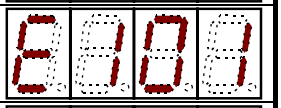
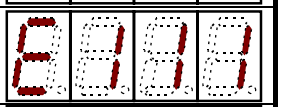
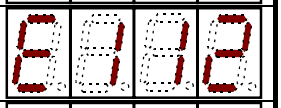
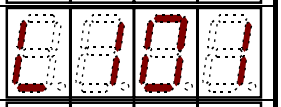
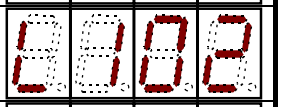
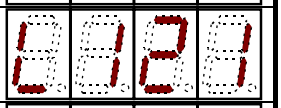
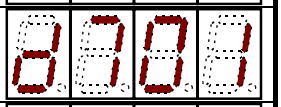
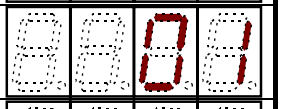
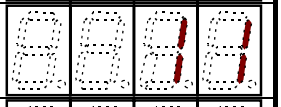
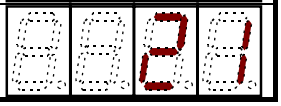
Figure 6.2 Front view of type COC3-A03D1 relay

Table 6.1 Front control panel guide

No.	Designation			Symbol	Description
①	Operational key switches	Setting / Cancel		SETTING/CANCEL	Pressing this switch will start the procedure for setting, forced operation or option. When this switch is pressed again instead of the SET.END/TRIP 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		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		SET. 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		UP	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		DOWN	
⑥		Indication / Indication End		IND./IND.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		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	Indicator LEDs	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 instruction manual specifically prepared for each model.
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-lag	NI01	
		NI11	
		NI21	
	Very inverse time-lag	VI01	
		VI21	
	Extremely inverse time-lag	EI01	
		EI11	
		EI12	
	Long inverse time-lag	LI01	
		LI02	
		LI21	
	Definite time-lag	DT01	
Reset characteristics	Definite time-lag	01	
	Inverse time-lag	11	
	Definite time-lag	21	

6.4.2 Operational procedure

For more information about the operational procedure shown below, see the MELPRO-D Series General Operation Manual (JEPO-IL9313).

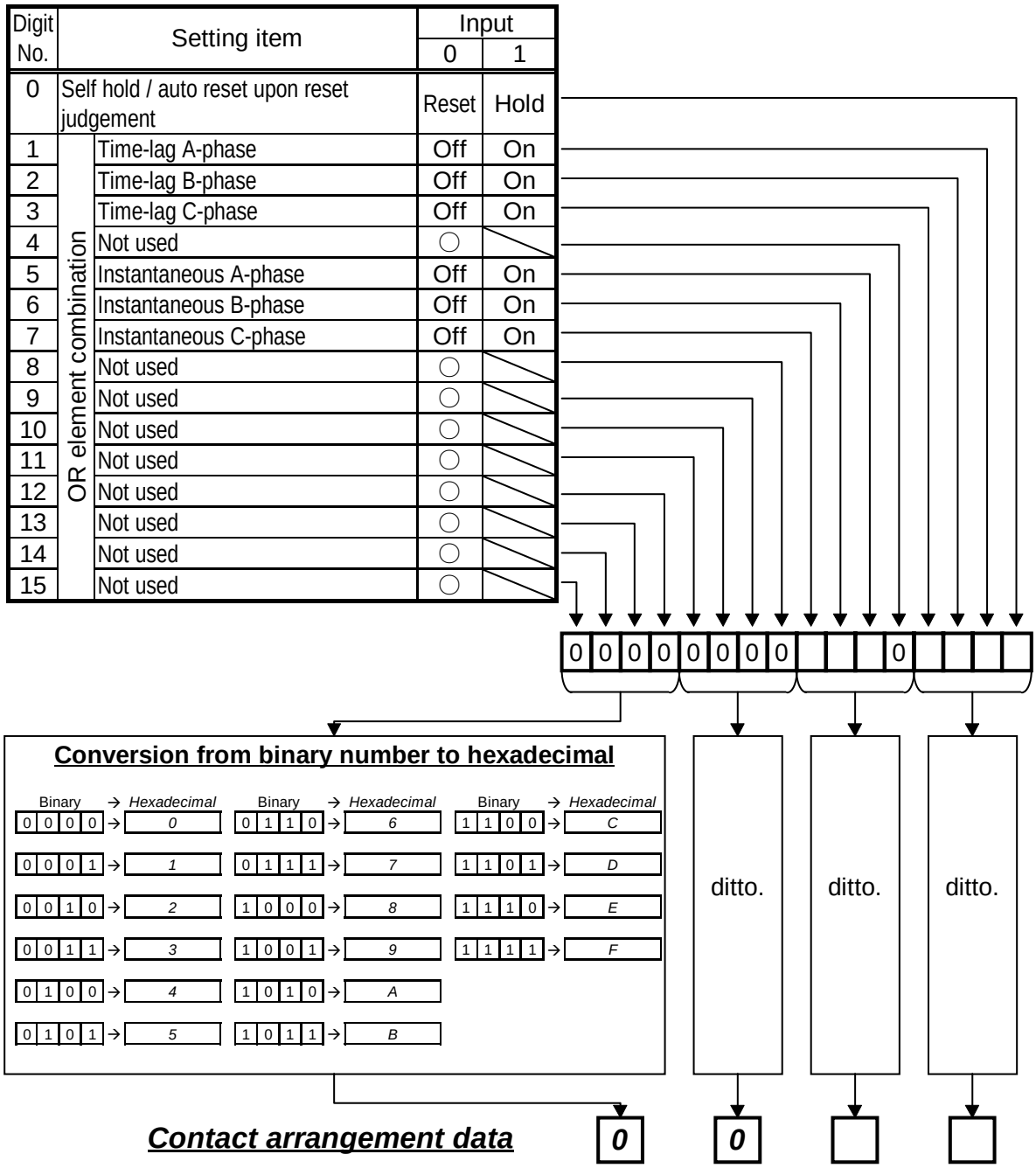
Table 6.3 Operational procedure

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 value currents input to the relay all the time.	A-1	
011		Max. record		Display the max. effective value current.	A-2	
211		Fault record	1st phenomena	Keep in record and display effective value currents for up to five latest phenomena of relay trip caused by system failure. The 1st phenomena is the latest trip and the 5th the oldest.	A-3	
212			2nd phenomena			
213			3rd phenomena			
214			4th phenomena			
215			5th phenomena			
311	Status	Operation elements	1st 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 failure. The 1st phenomena is the latest trip and the 5th the oldest.	A-4	
312			2nd phenomena			
313			3rd phenomena			
314			4th phenomena			
315			5th phenomena			
320		Elapse of time-lag timer (LAPSE)		Display the count of the elapsed time of operation of time-lag elements.	A-5	
400		Automatic self-check (ALARM)		Keep in record and display defect codes in the case where an abnormal condition is detected by the automatic self-check.	A-6	
511	Setting	Time-lag	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]			
700	Forced operation	Contact X_0 operation		Carry out forced operation of output contacts independently. The setting of the programmable contacts can be checked through the operation indicator LEDs.		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 contacts. Also, set and display self-hold/reset setting of the programmable contacts. For the guide for setting, see the section (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. For the guide for setting, see the section (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		Max. record reset		Clear data of the max. record.		D-4
903		Fault record reset		Clear data of the fault record.		
904		Automatic self-check (ALARM) reset		Clear data of the automatic self-check record.		
905		LED lamp test		Carry out forced illumination of all the LED lamps on the front of the relay unit.		D-5

(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.

Digit No.	Setting item		Input 0	Input 1
0	Self hold / auto reset upon reset judgement		Reset	Hold
1	OR element combination	Time-lag A-phase	Off	On
2		Time-lag B-phase	Off	On
3		Time-lag C-phase	Off	On
4		Not used	○	
5		Instantaneous A-phase	Off	On
6		Instantaneous B-phase	Off	On
7		Instantaneous C-phase	Off	On
8		Not used	○	
9		Not used	○	
10		Not used	○	
11		Not used	○	
12		Not used	○	
13		Not used	○	
14		Not used	○	
15		Not used	○	



When the product is shipped from the factory, above setting is following.

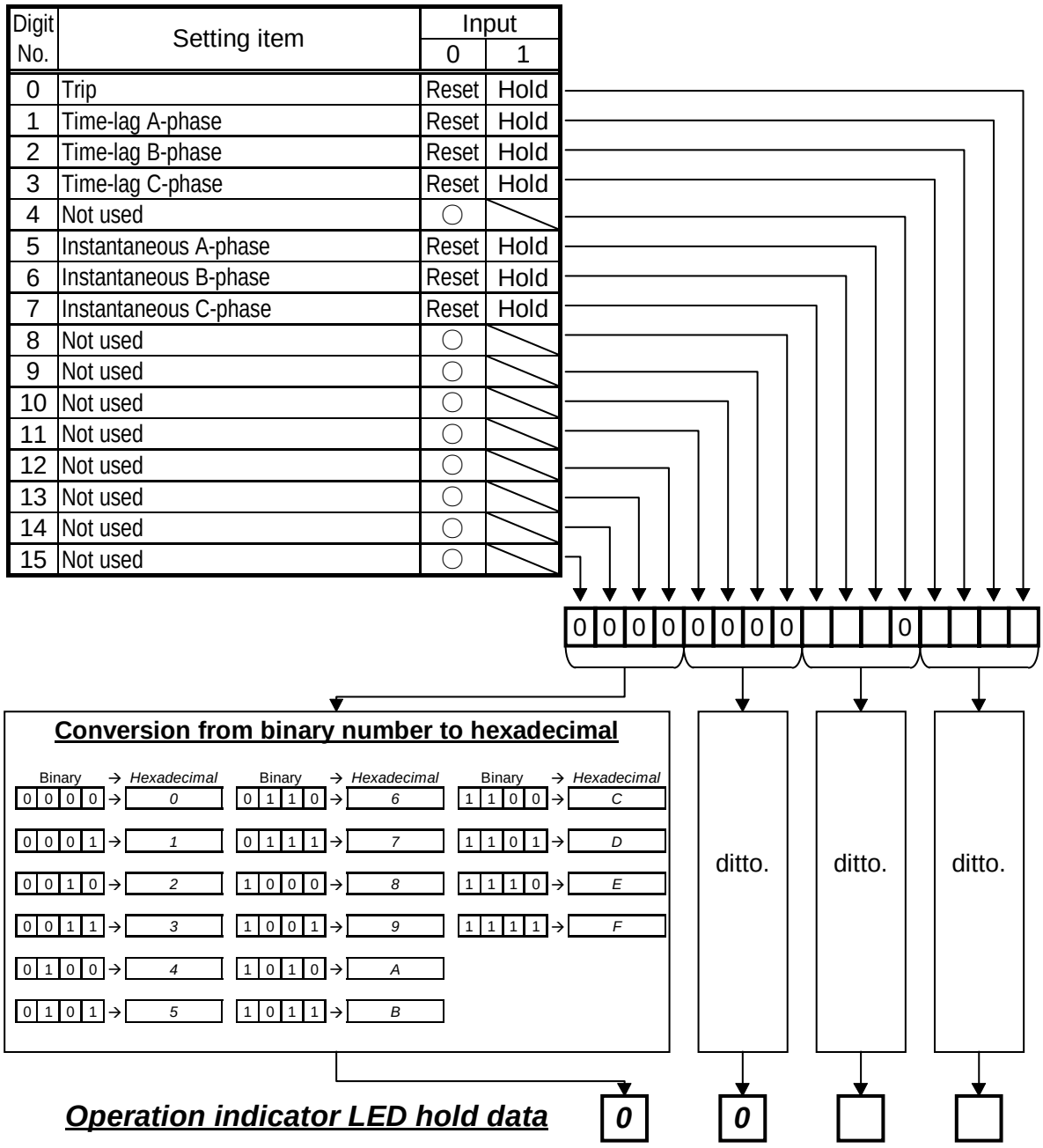
Contact	Item number	Contact arrangement data	Setting of the element	Contact	Item number	Contact arrangement data	Setting of the element
X0	800	00E0	Instantaneous	X3	830	000E	Time-lag
X1	810	00E0	Instantaneous	X4	840	00EE	OR of all the elements
X2	820	000E	Time-lag	X5	850	00EE	OR of all the elements

＊The “Self hold/auto reset upon reset judgement” setting of all the contacts are “Reset”.

(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.

Digit No.	Setting item	Input 0	Input 1
0	Trip	Reset	Hold
1	Time-lag A-phase	Reset	Hold
2	Time-lag B-phase	Reset	Hold
3	Time-lag C-phase	Reset	Hold
4	Not used	○	
5	Instantaneous A-phase	Reset	Hold
6	Instantaneous B-phase	Reset	Hold
7	Instantaneous C-phase	Reset	Hold
8	Not used	○	
9	Not used	○	
10	Not used	○	
11	Not used	○	
12	Not used	○	
13	Not used	○	
14	Not used	○	
15	Not used	○	



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

Item number	Operation indicator LED hold data
860	00EF

7 Mounting

7.1 Mounting dimension

Mount the case to the panel according to Fig. 7.1 “Mounting dimension”.

7.2 Standard operating environment

Install the relay in an environment that meets the following requirements:

(1) Temperature

- Operating temperature : - 10℃ ~ + 55℃
- Storage temperature : - 25℃ ~ + 70℃

(2) Relative humidity

30 ~ 80%, non-condensing

(3) Altitude

2,000m or lower

(4) Auxiliary supply voltage fluctuation

Rate voltage	100VDC ~ 220VDC 100VDC ~ 220VAC
Fluctuation range	85VDC ~ 242VDC (Temporary fluctuation of 80VDC ~ 286VDC is allowable) 85VAC ~ 242VAC (Temporary fluctuation of 85VAC ~ 253VAC is allowable)

(5) Frequency fluctuation

Within ±5% of rated frequency

(6) Other conditions

- 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.

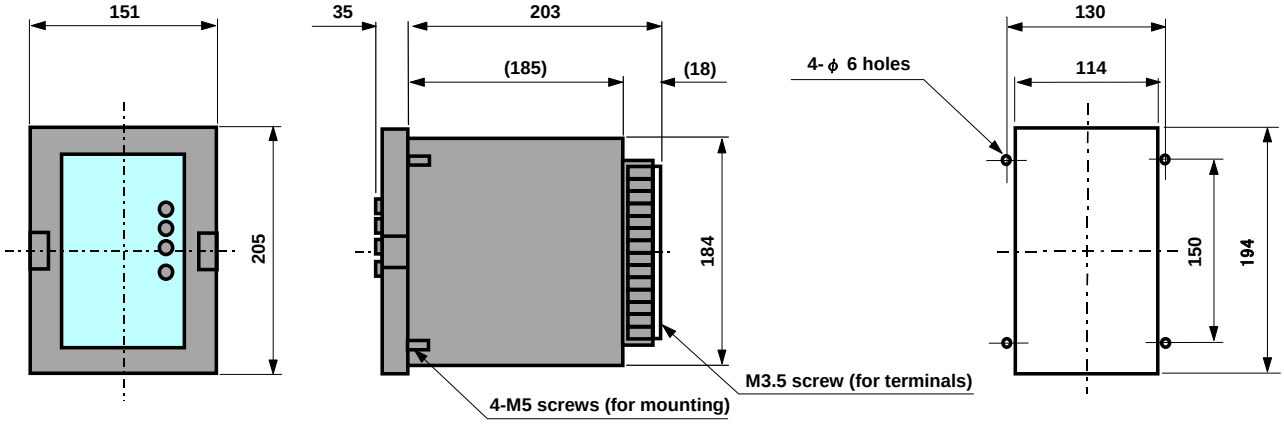


Figure 7.1 Outside dimension /drilling drawing

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 ambient conditions whenever possible:

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

- Ambient temperature : 20℃±10℃
- Rated frequency : ±5%
- Waveform (AC) : 2% (distortion ratio)
- Auxiliary supply voltage : rated voltage ±2%

(2) Characteristic control point

See the section 3 “Characteristics”.

The characteristic control point refers to the characteristic of a single 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 judgement

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-lag elements of overcurrent relay, which can not be checked through the output contact, read the display of “elapsed time of time-lag timer”.

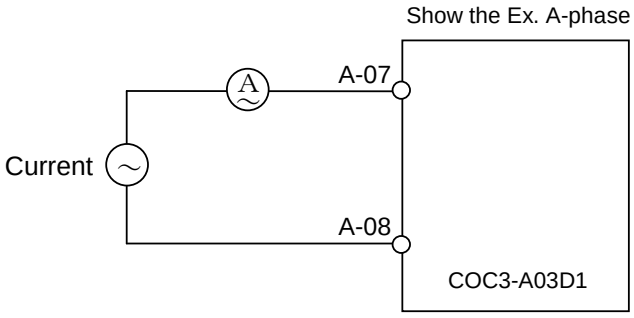
(5) Communication card

Even if the communication card is not inside, for the test of withstand voltage and lightning impulse withstand voltage, please avoid inputting test voltage to the serial communication network circuit (B-01,B-02,B-03,B-04 terminals).

8.2.2 Characteristic test

(1) Test circuit

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



Test Phase	Teraminal No.
A-phase	A-07～A-08
B-phase	A-09～A-10
C-phase	A-11～A-12

(2) Test items and characteristic control point

① Forced operation test

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

② Operation value test

See the “Operation and reset values” in the section 3 “Characteristic”.

③ Operation time test

See the “Operation time” in the section 3 “Characteristic”.

④ 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
General specification	Model	COC3-A03D1	For more information, see the section 2 "Rating and specification".
	Frequency	50 Hz	Select 50Hz or 60Hz.
	Rating	Current: 5A	For more information, see the section 2 "Rating and specification".
	Setting range	Time-lag element (51) : 0.5 ~ 8A Instantaneous element (50) : 2 ~ 80A	For more information, see the section 2 "Rating and specification".

11 Guarantee

11.1 Guarantee period

The guarantee period of this product should be one year after delivery, unless otherwise specified by both parties.

11.2 Scope of guarantee

When any fault or defect is detected during the period of guarantee and such fault or defect is proved to be caused apparently at the responsibility of MITSUBISHI ELECTRIC CORPORATION, the defective unit concerned will be repaired or replaced with substitute with free of charge.

However, the fee for our engineer dispatching to site has to be covered by the user.

Also, site retesting or trial operation caused along with replacing the defect units should be out of scope of our responsibilities.

It is to be acknowledged that the following faults and defects should be out of this guarantee.

①When the faults or defects are resulted from the use of the equipment at the range exceeding the condition/environment requirements stated in the catalogue and manual.

②When the faults or defects are resulted from the reason concerning without our products.

③When the faults or defects are resulted from the modification or repair carried out by any other entity than MITSUBISHI ELECTRIC CORPORATION.

④When the faults or defects are resulted from a phenomenon which can not be predicted with the science and technology put into practical use at the time of purchase or contract

⑤In case of integrating our products into your equipment, when damages can be hedged by the proper function or structure in the possession of your equipment which should be completed according to the concept of the de facto standard of industry.

⑥In case of that the faults or defects are resulted from un-proper application being out of instruction of MITSUBISHI ELECTRIC CORPORATION.

⑦In case that the faults or defects are resulted from force majeure such a fire or abnormal voltage and as an act of God such as natural calamity or disaster.

11.3 Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, MITSUBISHI ELECTRIC CORPORATION shall not be liable for compensation of damages caused by any cause found not be the responsibility of MITSUBISHI ELECTRIC CORPORATION, loss in opportunity, lost profits incurred to the user by failures of MITSUBISHI ELECTRIC CORPORATION products, special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than MITSUBISHI ELECTRIC CORPORATION products and other tasks

11.4 Applications of products

①The user is requested to confirm the standards, the regulations and the restrictions which should be applied, in case of utilizing products described in this catalogue and another one in combination.

Also, the user is requested to confirm the suitability of our products to your applied system or equipment or apparatus by yourself.

MITSUBISHI ELECTRIC CORPORATION shall not be liable for any suitability of our products to your utilization.

②This MITSUBISHI ELECTRIC CORPORATION products described in the catalogue have been designed and manufactured for application in general industries, etc. Thus, application in which the life or an asset could be affected by special application such as medical system for life-sustaining, in nuclear power plants, power plants, aerospace, transportation devices(automobile, train, ship, etc)shall be excluded from the application. In addition to above, application in which the life or an asset could be affected by potentially chemical contamination or electrical interference and also in which the circumstances and condition are not mentioned in this catalogue shall be excluded from the application.

Note even if the user wants to use for these applications with user's responsibility, the user to be requested to approve the specification of MITSUBISHI ELECTRIC CORPORATION products and to contact to the technical section of MITSUBISHI ELECTRIC CORPORATION prior to such applications.

If the user applies MITSUBISHI ELECTRIC CORPORATION products to such applications without any contact to our technical section, MITSUBISHI ELECTRIC CORPORATION shall not be liable for any items and not be insured, independently from mentioned in this clause.

③In using MITSUBISHI ELECTRIC CORPORATION product, the working conditions shall be that the application will not lead to a major accident even if any problem or fault occur, and that backup or duplicate system built in externally which should be decided depend on the importance of facility, is recommended.

④The application examples given in this catalogue are reference only and you are requested to confirm function and precaution for equipment and apparatus and then, use our products

⑤The user is requested to understand and to respect completely all warning and caution items so that unexpected damages of the user or the third party arising out of un-correct application of our products would not be resulted.

11.5 Onerous repair term after discontinuation of product

①MITSUBISHI ELECTRIC CORPORATION shall accept onerous product repairs for 7(seven) years after production of the product is discontinued. (However, please consider the replacement of products

after 15 years have been passed from ex-work of products.)

②Product supply (including repair parts) is not available after production is discontinued.

11.6 Changes in product specification

The specification given in the catalogue, manuals or technical documents are subject to change without prior to notice.

11.7 Scope of service

The technical service fee such as engineer dispatching fee is excluded in the price of our products. Please contact to our agents if you have such a requirement.

12 Improvement on the reliability of protection function

Any parts and materials applied to the protection relay have limited life time which will bring the degradation to the relay.

The degree of degradation will be variable and depend on the purpose, period in use, applied circumstance and unevenness on the performance of each part.

MITSUBISHI ELECTRIC CORPORATION design the relay so as to realize that the recommended replaced duration is more them 15 years.

However, there may be some possibilities to occur some defects before reaching 15 years due to above mentioned the degree of degradation of parts and materials being depended on the condition in use.

To prevent unwanted operation or no operation of relay due to above reasons, it is recommended to apply the relay with self-diagnosis function and/or multiplexing relay system such as dual or duplex scheme.

MITSUBISHI ELECTRIC CORPORATION

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