MITSUBISHI ELECTRIC

Numerical Protection Relay

MELPRO™-A Series

OVERCURRENT RELAY

MODEL

MOC-A3V-R, MOC-A3V-RD
MOC-A3T-R

INSTRUCTION MANUAL

Request

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

Before installation, operation, maintenance, and inspection, please be sure to read this instruction manual and all other attached documents thoroughly in order to work safely with the equipment. Please ensure that you fully understand the equipment, safety information, and precautions that need to be taken before working with the equipment. Safety precautions are classified as “Caution.”

⚠ Caution	The case where a dangerous situation can arise and there is the possibility that moderate or minor injuries can occur, or property damage can take place if the equipment is handled incorrectly.

Furthermore, even with items described as ⚠Caution, there is the possibility of serious consequences depending on the situation. All of the described contents are important. Therefore, be sure to comply with them.

⚠ Caution

1. Installation and Wiring work

⚠ Caution

- ∗ Ensure that the equipment is mounted and connected correctly. Otherwise, there are risks of failure, burning, or maloperation.
- ∗ Securely tighten the terminal connection screws. Otherwise, there are risks of failure and burning.
  For tightening torque of screws, refer to the following Table.

Material	Nominal dia.	Standard value of torque	Allowable range	Place of use
Steel	M3.5	1.10N・m (11.2kgf・cm)	0.932～1.27N・m (9.5～12.9kgf・cm)	Terminal block
Steel	M4	1.65N・m (16.8kgf・cm)	1.39～1.89N・m (14.2～19.3kgf・cm)	Drawer fixing screw of unit-drawer type (RD type)
Steel	M6	5.49N・m (56kgf・cm)	4.71～6.37N・m (48～65kgf・cm)	Fixing screw for mounting
Steel	M10	26.5N・m (270kgf・cm)	22.6～30.4N・m (230～310kgf・cm)	MPD-3C bottom screw
Brass	M4	0.961N・m (9.8kgf・cm)	0.824～1.11N・m (8.4～11.3kgf・cm)	MZT primary terminal (k, ℓ) MPD-3T terminal

- ∗ The equipment must be correctly grounded using the designated grounding terminals where they exist. Failure to do so may lead to the risk of electric shock, equipment failure, malfunction or failure to operate.
- ∗ Ensure that the equipment is connected correctly in accordance with the details (e.g.: polarity or phase sequence) shown on the connection terminals. Otherwise, there is the risk of failure, burning, malfunction, or maloperation.
- ∗ All power supplies and transformers to the equipment must be of suitable capacity and rated load to avoid the risk of malfunction and maloperation.
- ∗ Be sure to return all terminal covers, protection covers to their original positions once any work is complete. If they remain uncovered there is a risk of electrical shock.
- ∗ The appropriate connectors must be used to ensure compatibility with the connector terminals to avoid the risks of failure or fire.
- ∗ When inserting subunit into the case, please ensure that there is no gap between front side of the subunit and the case. In addition, tighten lower screw surely. If the subunit is inserted inadequately, there are risks of malfunction or generation of heat.

2. Operating and Setting

The equipment must be used within the following range limits. Otherwise, there is a risk of reducing the performance and life of the product.

- ・Variation range of auxiliary power supply voltage — Within –15 to +10% of the rated voltage
- ・Frequency variation — Within ±5% of the rated frequency
- ・Ambient temperature — –20 to +60℃ (under the state where dew condensation or freezing does not occur)
- ・Relative humidity — 30 to 80% on daily average
- ・Altitude — 2000m or lower
- ・The state where abnormal vibration, shock, inclination, magnetic field(※) are not applied
- ・The state where it is not exposed to harmful smoke/gas, saline gas, water droplet or vapor, excessive dust or fine powder, explosive gas or fine powder, wind & rain

(※) If there is a large amount of current on main circuit surrounding the relay, the operation indicator may be magnetized and turned from black to orange color. In that case, please shield back of the relay by iron plate.

⚠ Caution	∗ The equipment must only be operated and handled by qualified personnel. Otherwise, there are risks of electric shock, injury, failure, malfunction, and maloperation. ∗ Handling and maintenance of the equipment must only be carried out after gaining a thorough understanding of the instruction manual. Otherwise, there is the risk of electric shock, injury, failure, malfunction, or maloperation. ∗ While energized, do not remove any components other than those which have been designated. Otherwise, there is a risk of failure, malfunction, or maloperation. ∗ While energized, do not draw out the internal unit (subunit). Otherwise, there is a risk of electric shock, injury, failure, malfunction, or maloperation. ∗ When changing the setting value during the energized state, ensure that all trip circuits are locked in order not to operate. Otherwise, there is a risk of malfunction. ∗ Use in rated range. Otherwise, there is a risk of malfunction.

3. Maintenance and Inspection

We recommend that any tests or inspections are carried out under the following conditions, as well as any additional conditions described in the instruction manual.

- ・Ambient temperature 20±10℃
- ・Relative humidity 90% or less
- ・External magnetic field 80A/m or less
- ・Atmospheric pressure $86 \sim 106 \times 10^3$ Pa
- ・Mounting angle Regular direction ±2°
- ・Frequency Rated frequency ±1%
- ・Waveform (in the case of AC) Distortion factor: 2% or less

$$\text{Distortion factor} = \frac{\text{Effective value of higher harmonics only}}{\text{Effective value of fundamental wave}} \times 100(\%)$$

- ・AC component (in the case of DC) Ripple factor: 3% or less

$$\text{Ripple factor} = \frac{\text{Max. value} - \text{Min. value}}{\text{Average value of DC}} \times 100(\%)$$

- ・Auxiliary power supply voltage Rated voltage ±2%

⚠ Caution	∗ The equipment must only be operated and handled by qualified personnel. Otherwise, there are risks of electric shock, injury, failure, malfunction, and maloperation. ∗ Handling and maintenance of the equipment must only be carried out after gaining a thorough understanding of the instruction manual. Otherwise, there is the risk of electric shock, injury, failure, malfunction, or maloperation. ∗ When replacing the equipment, use a product of same model, rating, and specifications. Otherwise, there is the risk of failure or fire.. If any other product is to be used, the manufacturer must be consulted. ∗ Do not exceed the overload capacity for voltage and current. Otherwise,equipment failure or fire could occur. ∗ Do not touch any live parts, such as terminals, etc. Otherwise, there is a risk of electric shock. ∗ Do not clean the equipment while energised. When the cover needs to be cleaned, make use of a damp cloth.

4. Transportation

∗ Transport the equipment in the correct orientation.
∗ Do not apply excessive shock and/or vibration as this could affect the performance and life of the product.

5. Storage

The storage environment shall comply with the following conditions. Otherwise, there is a risk of reducing the performance and life of the product.

- ・Ambient temperature –20 to +60℃ (under the state where dew condensation or freezing does not occur)
- ・Relative humidity 30 to 80% on daily average
- ・Altitude 2000m or lower
- ・The equipment must not be exposed to abnormal vibration, shock, inclination, or magnetic fields.
- ・The equipment must not be exposed to harmful smoke/gas, saline gas, water droplets or vapor, excessive dust or fine powder, explosive gas or fine powder, wind & rain.

6. Repair and Modification

∗ When carrying out repair and/or modification, please consult with the manufacturer in advance. We will not take any responsibility for any repair and/or modification (including software) which has been carried out without prior consent.

7. Disposal

Disposal must take place in accordance with the applicable legislation

Guarantee

1. Guarantee period

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

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.

(1) When 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.

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

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

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

(5) In 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 fact standard of industry.

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

(7) In 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.

3. Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of whether in guarantee period or not, 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.

4. Applications of products

(1) The user is requested to confirm the standards, the regulations and the restrictions which should be applied, in case of utilizing this product 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.

(2) This product has 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 manual 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.

(3) In using this 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 based on the importance of facility, is recommended.

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

(5) The 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 incorrect application of our products would not be resulted.

5. Onerous repair term after discontinuation of product

(1) MITSUBISHI ELECTRIC CORPORATION shall accept onerous product repairs for 7 years after production is discontinued. (However, the product which was made over 15 years is recommended to replace.)

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

6. Changes in product specification

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

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.

MOC-A3 Series Over Current Relay [Standard: JIS C 4602 (2017)]

Features

1. Various operating time characteristics.
   Time-lag element: 4 types (EI, VI, NI, DT)
   Instantaneous element: 2 types (2 steps, 3 steps)
2. Alert function which detects the difference between setting frequency and injected frequency.
3. The fault value record function is installed.
4. Good operability and visibility design is adopted.
   The numerical display turns on for 3 seconds when the setting value is changed, which enables to check setting values easily.
5. The power supply can be derived from CT secondary.
6. Panel cutout is the same as previous MELPRO-A series and E series.

Ratings and Specifications

<table>
<tr><td colspan="3">Type name</td><td>MOC-A3V-R</td><td>MOC-A3V-RD</td><td>MOC-A3T-R</td></tr>
<tr><td colspan="3">Style No.</td><td>102PGA</td><td>518PGA</td><td>103PGA</td></tr>
<tr><td colspan="3">Tripping method</td><td colspan="2">Voltage tripping</td><td>Current tripping</td></tr>
<tr><td rowspan="2">Ratings</td><td colspan="2">Phase current</td><td colspan="3">5A</td></tr>
<tr><td colspan="2">Frequency</td><td colspan="3">50/60Hz (switchable)</td></tr>
<tr><td rowspan="6">Setting</td><td colspan="2">Time-lag element
Operation value</td><td colspan="3">LOCK(*)-3-3.5-4-4.5-5-6A</td></tr>
<tr><td colspan="2">Dial</td><td colspan="3">0.25(*)-0.5-1-1.5-2-2.5-3-3.5-4-5-6-7-8-9-10-20</td></tr>
<tr><td colspan="2">Instantaneous element
Operation value</td><td colspan="3">LOCK(*)-10-15-20-25-30-35-40-50-60A</td></tr>
<tr><td rowspan="3">Using condition</td><td>Frequency</td><td colspan="3">50Hz(SW1-ON) - 60Hz(*)(SW1-OFF)</td></tr>
<tr><td>Instantaneous step number</td><td colspan="3">3steps(SW2-ON) - 2steps(*)(SW2-OFF)</td></tr>
<tr><td>Instantaneous sensitivity</td><td colspan="3">20%(*) (SW3-OFF, SW4-OFF) 60% (SW3-ON, SW4-OFF)
40% (SW3-OFF, SW4-ON) 80% (SW3-ON, SW4-ON)
(Caution) If the operation value of instantaneous element is set to 10A, the sensitivity setting of 20% is not allowed. If you do that, the relay operates as 2-step characteristic.</td></tr>
<tr><td>Operating time characteristics (Time-lag)</td><td colspan="3">Extremely inverse (EI)(*) (SW5-OFF, SW6-OFF)
Very inverse (VI) (SW5-OFF, SW6-ON)
Normal inverse (NI) (SW5-ON, SW6-OFF)
Definite time (DT) (SW5-ON, SW6-ON)</td></tr>
<tr><td rowspan="3">Display</td><td colspan="2">Self-monitoring</td><td colspan="3">The "RUN" indicator (green-color) is lighted when current exceeds 1.5A in normal condition.</td></tr>
<tr><td colspan="2">Operation indicator</td><td colspan="3">R-phase, T-phase, Instantaneous: The indicator turns from black into orange color when the protection element is put into operation.
(Manual resetting type)</td></tr>
<tr><td colspan="2">Numerical display</td><td colspan="3">
<table>
<tr><th>Indication item</th><th>Range</th></tr>
<tr><td>Current measurement</td><td>2.0～9.9A, 10～30A</td></tr>
<tr><td>Time lapse</td><td>0～10</td></tr>
<tr><td>Time-lag element current setting</td><td>Lo. (※1), 3～6A</td></tr>
<tr><td>Dial setting</td><td>0.25～20</td></tr>
<tr><td>Instantaneous element current setting</td><td>Lo. (※1), 10～60A</td></tr>
<tr><td>Number of step setting</td><td>2, 3 steps</td></tr>
<tr><td>Sensitivity setting (※2)</td><td>20, 40, 60, 80%</td></tr>
<tr><td>Operating time characteristics setting</td><td>EI, VI, NI, DT</td></tr>
<tr><td>Frequency setting</td><td>50, 60Hz</td></tr>
<tr><td>Fault record</td><td>3.0～9.9A, 10～80A</td></tr>
<tr><td>Clear fault record</td><td>0.K.</td></tr>
</table>
※1 "Lo." means LOCK setting (the protection element is locked).
※2 This shows current sensitivity (ratio to operation value) when setting 3-step characteristic in instantaneous element. None is displayed when setting 2-step characteristic.
</td></tr>
</table>

Power consumption (CT)	Normal : 3.5VA Operating : 4.5VA		
Case (Munsell color)	Unit-fixed type (Fig. 1-11) (0.6B7.6/0.2)	Unit-drawer type (Fig. 1-12) (0.6B7.6/0.2)	Unit-fixed type (Fig. 1-11) (0.6B7.6/0.2)
Mass	Approx. 1.0kg	Approx. 1.1kg	Approx. 1.0kg

(*) shows factory setting.

Characteristics

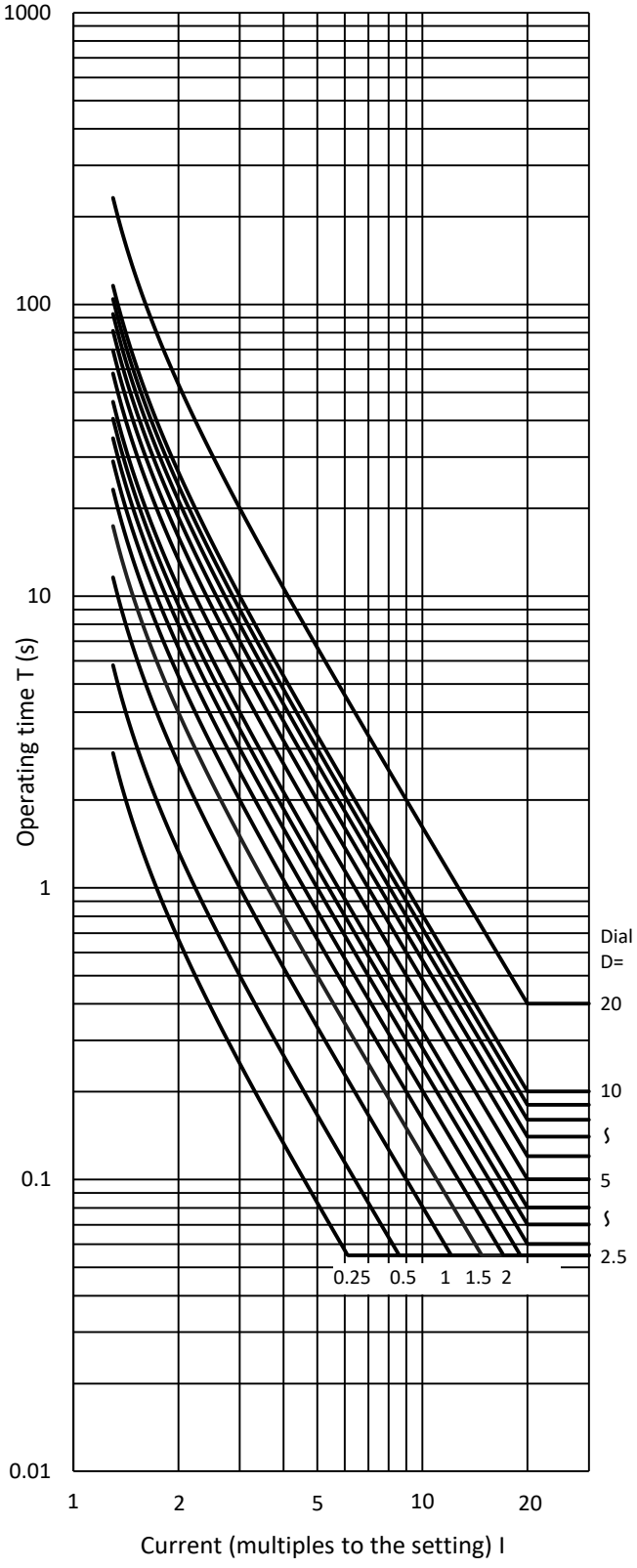
<table>
<tr><th>Item</th><th>Characteristics</th></tr>
<tr><td>Standard use conditions</td><td>Ambient temperature: -20 to +60℃ (Under the state where dew condensation or freezing does not occur)
Relative humidity: 30 to 80% on daily average
Altitude: 2000m or lower
・The state where abnormal vibration, shock, and inclination are not applied.
・The state where it is not exposed to harmful gas, excessive dust, and water droplet or vapor.</td></tr>
<tr><td>Operation value characteristics</td><td>Time-lag element: Within ±10% of each setting value</td></tr>
<tr><td></td><td>Instantaneous element: Within ±15% of each setting value</td></tr>
<tr><td>Reset value characteristics</td><td>80% or more of each operating value</td></tr>
<tr><td>Operating time characteristics</td><td>Time-lag element (setting: 3A)　　Refer to Fig. 1-1-1,2 for characteristic example
①Extremely inverse (EI)
<table>
<tr><th>Dial</th><th>Multiple of input current (%)</th><th>Operating time (s)</th></tr>
<tr><td rowspan="7">10</td><td>300</td><td>10.00±17%</td><td rowspan="2">Nominal value</td></tr>
<tr><td>700</td><td>1.67±12%</td></tr>
<tr><td>(200)</td><td>(26.67±17%)</td><td rowspan="3">Reference value</td></tr>
<tr><td>(500)</td><td>(3.33±12%)</td></tr>
<tr><td>(1000)</td><td>(0.81±12%)</td></tr>
</table>
<table>
<tr><th>Dial</th><th>Multiple of input current (%)</th><th>Operating time (s)</th></tr>
<tr><td rowspan="7">6</td><td>300</td><td>6.00±17%</td><td rowspan="2">Characteristic control point</td></tr>
<tr><td>700</td><td>1.00±12%</td></tr>
<tr><td>(200)</td><td>(16.00±17%)</td><td rowspan="3">Reference value</td></tr>
<tr><td>(500)</td><td>(2.00±12%)</td></tr>
<tr><td>(1000)</td><td>(0.48±12%)</td></tr>
</table>
②Very inverse (VI)
<table>
<tr><th>Dial</th><th>Multiple of input current (%)</th><th>Operating time (s)</th></tr>
<tr><td rowspan="7">10</td><td>300</td><td>6.75±17%</td><td rowspan="2">Nominal value</td></tr>
<tr><td>700</td><td>2.25±12%</td></tr>
<tr><td>(200)</td><td>(13.50±17%)</td><td rowspan="3">Reference value</td></tr>
<tr><td>(500)</td><td>(3.38±12%)</td></tr>
<tr><td>(1000)</td><td>(1.50±12%)</td></tr>
</table>
<table>
<tr><th>Dial</th><th>Multiple of input current (%)</th><th>Operating time (s)</th></tr>
<tr><td rowspan="7">6</td><td>300</td><td>4.05±17%</td><td rowspan="2">Characteristic control point</td></tr>
<tr><td>700</td><td>1.35±12%</td></tr>
<tr><td>(200)</td><td>(8.10±17%)</td><td rowspan="3">Reference value</td></tr>
<tr><td>(500)</td><td>(2.03±12%)</td></tr>
<tr><td>(1000)</td><td>(0.90±12%)</td></tr>
</table>
③Normal inverse (NI)
<table>
<tr><th>Dial</th><th>Multiple of input current (%)</th><th>Operating time (s)</th></tr>
<tr><td rowspan="7">10</td><td>300</td><td>6.30±17%</td><td rowspan="2">Nominal value</td></tr>
<tr><td>700</td><td>3.53±12%</td></tr>
<tr><td>(200)</td><td>(10.03±17%)</td><td rowspan="3">Reference value</td></tr>
<tr><td>(500)</td><td>(4.28±12%)</td></tr>
<tr><td>(1000)</td><td>(2.97±12%)</td></tr>
</table>
<table>
<tr><th>Dial</th><th>Multiple of input current (%)</th><th>Operating time (s)</th></tr>
<tr><td rowspan="7">4</td><td>300</td><td>2.52±17%</td><td rowspan="2">Characteristic control point</td></tr>
<tr><td>700</td><td>1.41±12%</td></tr>
<tr><td>(200)</td><td>(4.01±17%)</td><td rowspan="3">Reference value</td></tr>
<tr><td>(500)</td><td>(1.71±12%)</td></tr>
<tr><td>(1000)</td><td>(1.19±12%)</td></tr>
</table>
④Definite time (DT)
<table>
<tr><th>Dial</th><th>Multiple of input current (%)</th><th>Operating time (s)</th></tr>
<tr><td rowspan="7">10</td><td>300</td><td>2.00±17%</td><td rowspan="2">Nominal value</td></tr>
<tr><td>700</td><td>2.00±12%</td></tr>
<tr><td>(200)</td><td>(2.00±17%)</td><td rowspan="3">Reference value</td></tr>
<tr><td>(500)</td><td>(2.00±12%)</td></tr>
<tr><td>(1000)</td><td>(2.00±12%)</td></tr>
</table>
<table>
<tr><th>Dial</th><th>Multiple of input current (%)</th><th>Operating time (s)</th></tr>
<tr><td rowspan="7">9</td><td>300</td><td>1.80±17%</td><td rowspan="2">Characteristic control point</td></tr>
<tr><td>700</td><td>1.80±12%</td></tr>
<tr><td>(200)</td><td>(1.80±17%)</td><td rowspan="3">Reference value</td></tr>
<tr><td>(500)</td><td>(1.80±12%)</td></tr>
<tr><td>(1000)</td><td>(1.80±12%)</td></tr>
</table>
Instantaneous element
50ms or less (Input: 200% of setting value)　　Refer to Fig. 1-1-3 for characteristic example</td></tr>
<tr><td>Overshoot time characteristics</td><td>Time-lag element: Dial: 10, Input: 1000% of setting value, Applied time: 90% of theoretical operating time
The relay shall not operate.</td></tr>
<tr><td>Temperature characteristics</td><td>Time-lag element: Ambient temperature: -20℃ or +60℃
Operation value: Within ±20% of the value at 20℃
Operating time: Within ±20% of the time at 20℃ (Input current multiplier = 300%)</td></tr>
<tr><td>Frequency characteristics</td><td>Frequency variations: ±5% of rated frequency
Operation value of time-lag element: Within ±10% of the value at rated frequency
Operating time of time-lag element (except for DT element):
Input current multiplier = 300%: Within ±17% of the time at rated frequency
Input current multiplier = 700%: Within ±12% of the time at rated frequency
Operation value of instantaneous element: Within ±15% of the value at rated frequency</td></tr>
<tr><td>Distorted wave characteristics</td><td>Time-lag element: Setting: Minimum operation value and minimum operating time
3rd, 5th, and 7th harmonic content: 30% of fundamental wave
Criteria for operation value: Within ±15% of the value at fundamental wave only</td></tr>
<tr><td>Overload capacity</td><td>20 times of rated current, for 1s, twice, at intervals of 1min</td></tr>
<tr><td>Vibration</td><td>
<table>
<tr><th rowspan="2">Frequency (Hz)</th><th colspan="3">Peak-to-peak amplitude mm (Acceleration m/s²)</th><th rowspan="2">Vibration time (s)</th></tr>
<tr><th>Forward/ backward</th><th>Right/left</th><th>Up/down</th></tr>
<tr><td>10</td><td colspan="2">5 (10)</td><td>2.5 (5)</td><td>30</td></tr>
<tr><td>16.7</td><td colspan="3">0.4 (2)</td><td>600</td></tr>
</table>
Setting: Minimum operation value and minimum operating time
Input: 80% of time-lag element operation value
Criteria: No malfunction and no abnormal indication</td></tr>
</table>

<table>
<tr><td>Shock</td><td colspan="3">Maximum acceleration: 300m/s^2
Direction: 3 directions in forward/backward, right/left, and up/down
Criteria: No abnormality when applying two shocks in each direction</td></tr>
<tr><td>Insulation resistance</td><td colspan="3">Test circuit: Between all circuits and external box, between separate circuits, and between the poles of contacts
Criteria: More than 10MΩ by DC500V megger.
(Note) The test is held under the condition that relative humidity is less than 80%.</td></tr>
<tr><td>Withstand voltage</td><td colspan="3">Between all circuits and external box: AC2000V, for 1 minute
Between separate circuits: AC2000V, for 1 minute
Between the poles of contacts (T1-T2, a1-a2): AC1000V for 1 minute</td></tr>
<tr><td>Lightning impulse withstand voltage</td><td colspan="3">Apply standard waveform (1.2/50 μs) to positive/negative pole for 3 times respectively.
Between all circuits and external box, between mutual CT circuits, between CT circuit and control circuit: 4.5kV
Between terminals of CT circuit, between mutual control circuits (only for MOC-A3V): 3.0kV
Criteria: No abnormality</td></tr>
<tr><td>Noise-proof</td><td colspan="3">Apply damped oscillatory wave prescribed in JIS C 4602 for 2 seconds.
・Between all CT circuits and external box
・Between all control circuits and external box
Setting: Minimum operation value and minimum operating time
Input: 80% of time-lag element operation value
Criteria: No malfunction</td></tr>
<tr><td>Radio disturbance</td><td colspan="3">Intermittently irradiate radio waves to the front panel of the relay with a transceiver of 150MHz or 400MHz band (5W output) from a distance of 0.5m.
Setting: Minimum operation value and minimum operating time
Input: 80% of time-lag element operation value
Criteria: No malfunction</td></tr>
<tr><td rowspan="3">Contact capacity</td><td>Tripping method</td><td>Voltage tripping type</td><td>Current tripping type</td></tr>
<tr><td>For trip</td><td><table><tr><td>Making (Closing)</td><td>DC110V 15A (L/R=0ms)
DC220V 10A (L/R=0ms)
AC110V 10A (cosϕ=0.1)</td></tr><tr><td>Breaking (Opening)</td><td>DC110V 0.3A (L/R=7ms)
AC110V 5A (cosϕ=0.1)
AC220V 1A (cosϕ=0.1)</td></tr></table></td><td>Breaking (Opening): AC110V 60A
The 2Ω (power factor = 0.5) loads in parallel to the contacts</td></tr>
<tr><td>For alarm</td><td><table><tr><td>Making (Closing)</td><td>DC110V 15A (L/R=0ms)
DC220V 10A (L/R=0ms)
AC110V 10A (cosϕ=0.1)</td></tr><tr><td>Breaking (Opening)</td><td>DC110V 0.3A (L/R=7ms)
AC110V 5A (cosϕ=0.1)
AC220V 1A (cosϕ=0.1)</td></tr></table>Rating: 5A AC250V/DC24V (Resistance load)
Maximum voltage: AC400V, DC300V</td><td>Making and breaking: AC100V 2A (cosϕ=0.4)
DC24V 2A (L/R=7ms)
Rating: 3A AC250V/DC24V (Resistance load)
Maximum voltage: AC277V, DC30V</td></tr>
</table>

Note) For details, refer to JIS C 4602 (2017).

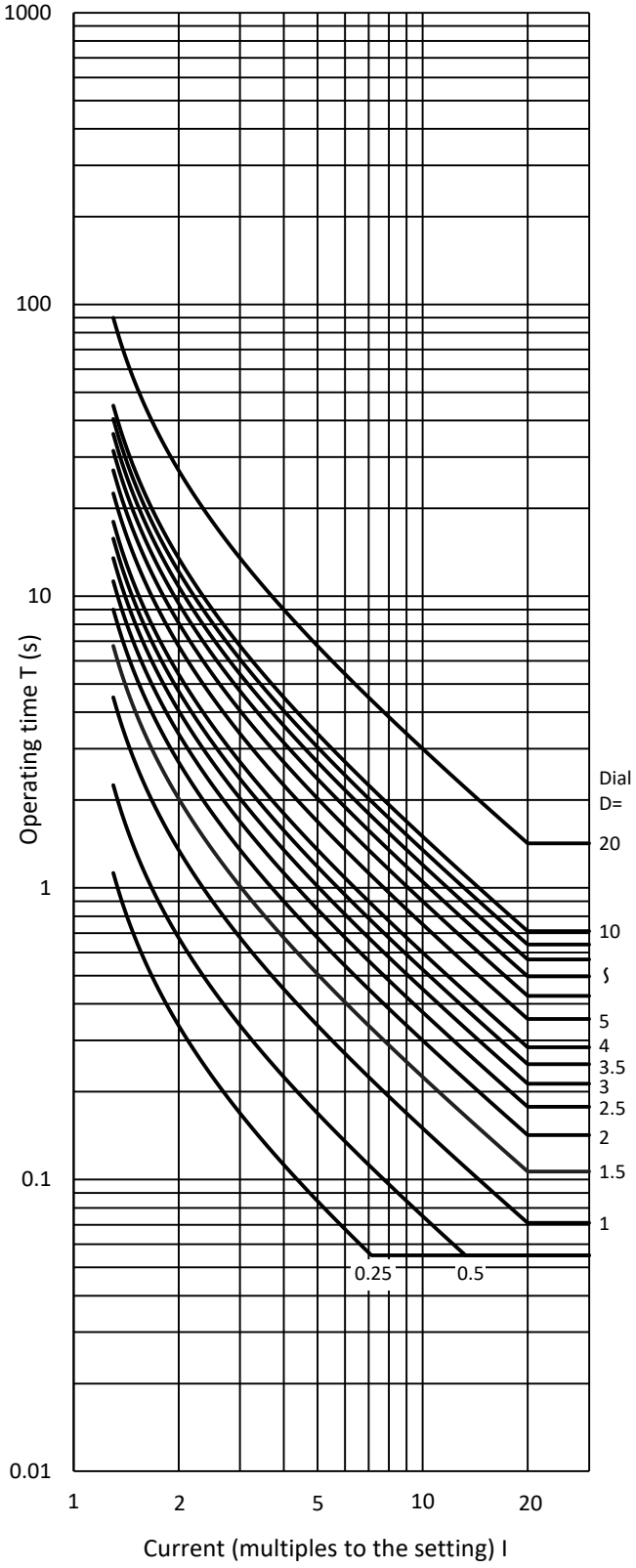
Time-lag element

EI characteristic



Extremely inverse (EI): $T = \frac{80}{I^2-1} \times \frac{D}{10}(s)$

VI characteristic

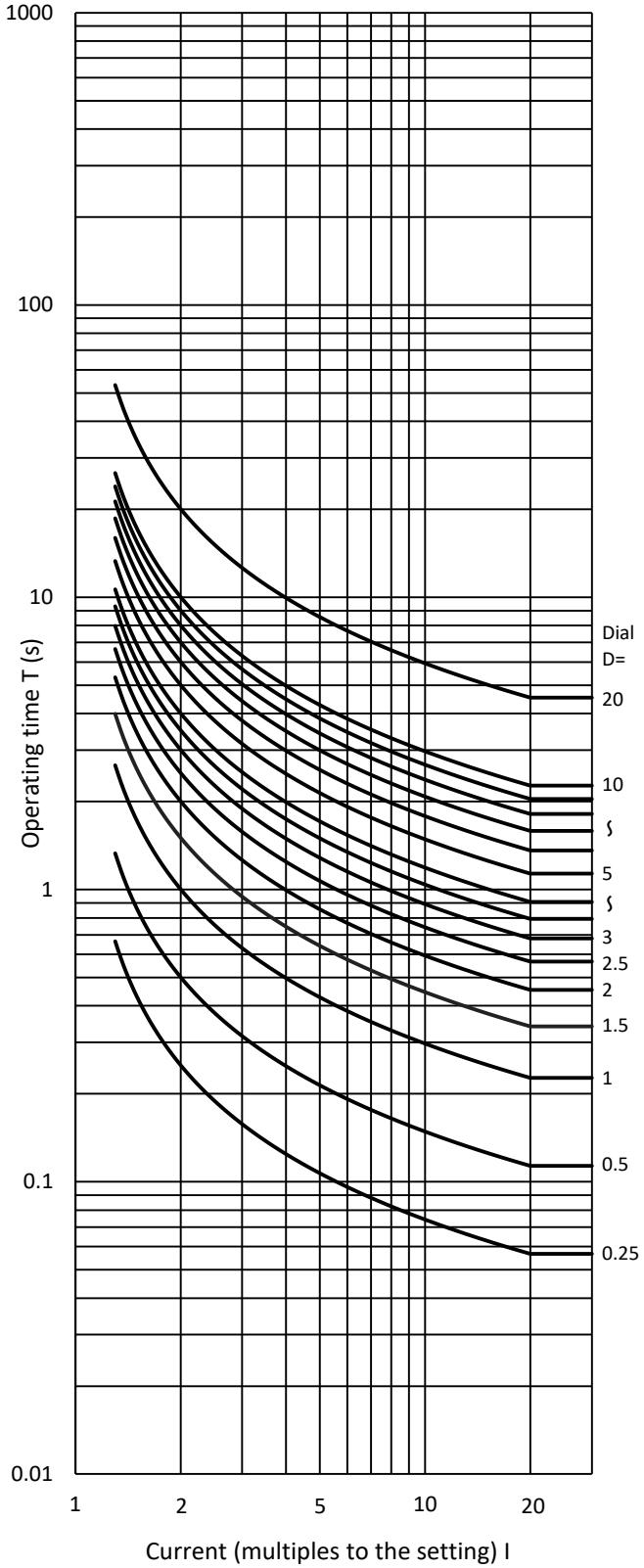


Very inverse (VI): $T = \frac{13.5}{I-1} \times \frac{D}{10}(s)$

Fig. 1-1-1 Operating time characteristics

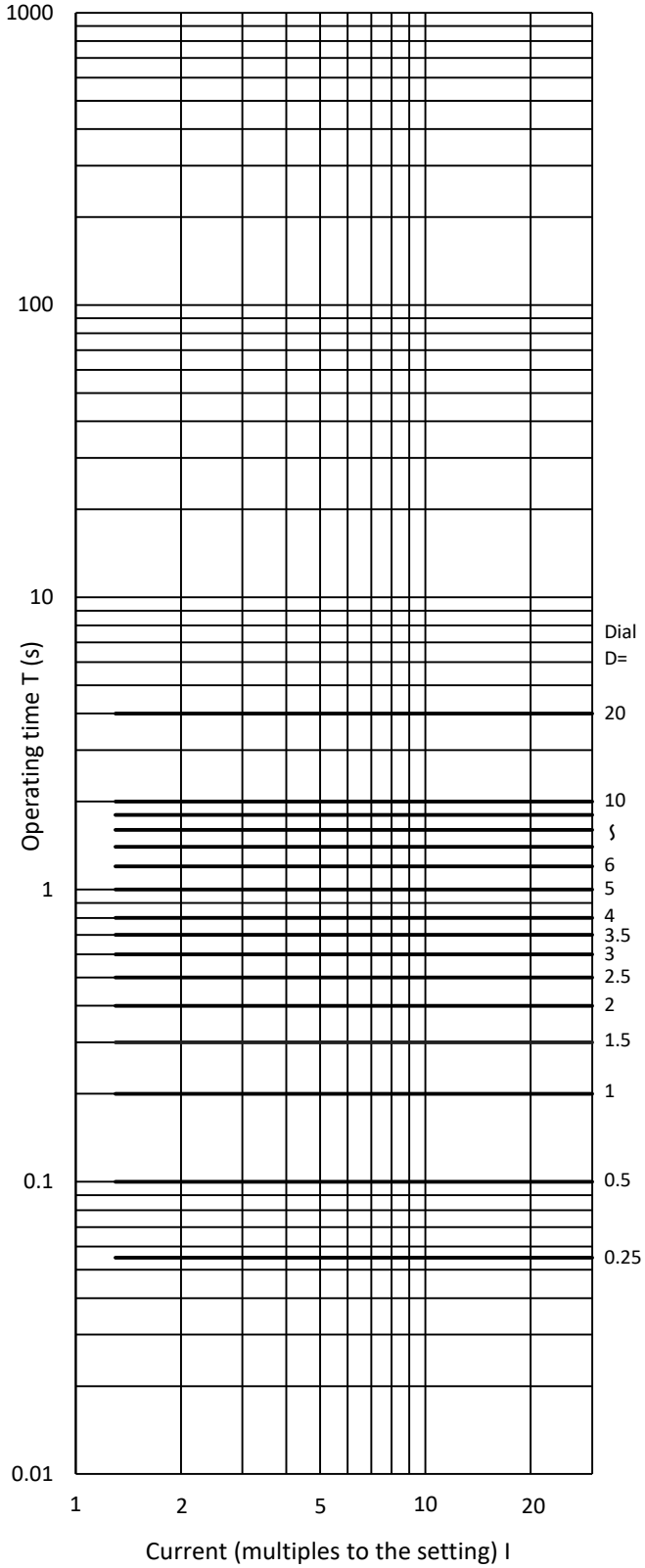
Time-lag element

NI characteristic



Normal inverse (NI): $T = \frac{0.14}{I^{0.02}-1} \times \frac{D}{10}(s)$

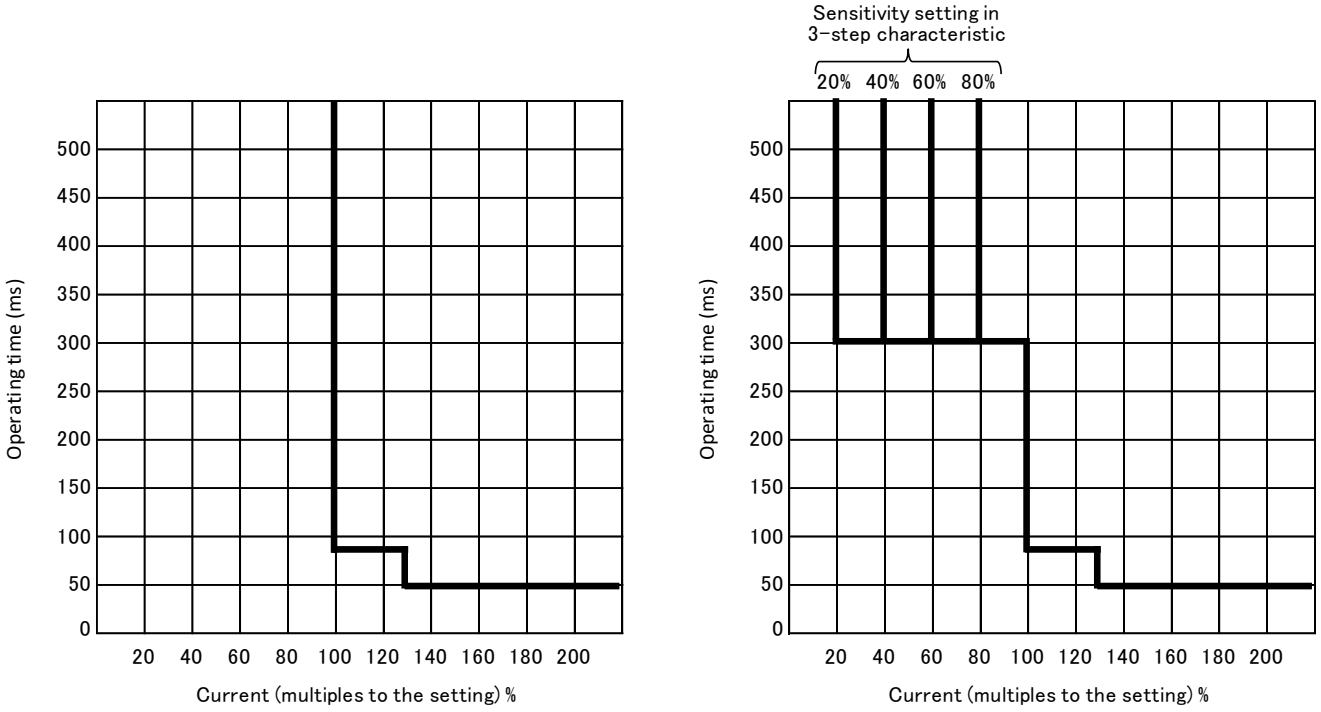
DT characteristic



Definite time (DT): $T = 2 \times \frac{D}{10}(s)$

Fig. 1-1-2 Operating time characteristics

Instantaneous element



2-step characteristic　　3-step characteristic

Fig. 1-1-3 Operating time characteristics

Structure

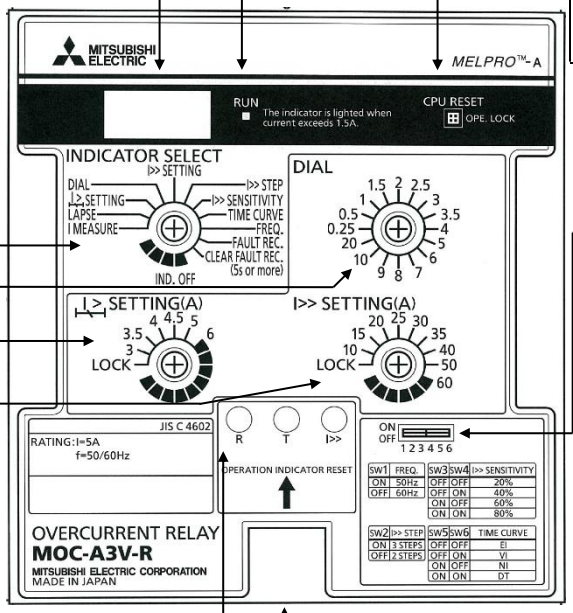
Numerical display LED
Following item is displayed by indicator select switch setting.
・Current measurement
・Time lapse
・Setting value
・Fault record
・Clear fault record

Indicator select switch
The numerical display shows according to this selection switch. Don't leave this switch with halfway state.

Setting switches for operation value and dial
Set the setting values. The black part is equal to maximum value, but the numerical display is turned off.
Don't leave the switches with halfway state.

Operation indicator
The indicator turns from black into orange color when the protection element is put into operation.

Operation indicator reset lever
Move this lever up and down, then the operation indicator resets.
(Note) Don't pull the lever strongly.



RUN indicated LED (Green)
It shows the result of self-monitoring. It lights up in normal condition.

CPU reset button
While this button is pressed, the relay function is locked and the RUN indicated LED is turned off.

Setting switches for using condition
Don't use any tool with a sharp point when the switches are set.
(It may cause damage to the switch lever.)

SW1	Frequency
ON	50Hz
OFF	60Hz

SW2	Inst. Step No.
ON	3steps
OFF	2steps

SW3	SW4	Inst. Sensitivity
OFF	OFF	20%
OFF	ON	40%
ON	OFF	60%
ON	ON	80%

SW5	SW6	Time curve
OFF	OFF	EI
OFF	ON	VI
ON	OFF	NI
ON	ON	DT

Factory settings are set to a default of OFF.

Fig. 1-2 Structure of MOC-A3 series (front view)

Operating Description

1. Protection function

①The power supply can be derived from CT secondary.

②Operating time characteristics of time-lag element is expressed in the following formula.

・Extremely inverse (EI): $T = \frac{80}{I^2-1} \times \frac{D}{10}(s)$

・Very inverse (VI): $T = \frac{13.5}{I-1} \times \frac{D}{10}(s)$

・Normal inverse (NI): $T = \frac{0.14}{I^{0.02}-1} \times \frac{D}{10}(s)$

・Definite time (DT): $T = 2 \times \frac{D}{10}(s)$

③For switching step number of instantaneous element (2steps or 3steps) and 3rd step sensitivity (20%, 40%, 60%, or 80% of operation value), use setting switches (SW2～4). Note that the sensitivity setting of 20% is not allowed if the operation value of instantaneous element is set to 10A. If you do that, the relay operates as 2-step characteristic.

④The relay calculates and compares input current of each phase with the setting value. When the relay operates, the operation indicator turns according to the fault phenomena. If you reset operation indicator, move reset lever up and down.

(● : Operation indication)

Fault phenomena		Display of operation indicator		
Type	Phase	R-phase	T-phase	Inst.
Overload	R-S	●	○	○
	S-T	○	●	○
	T-R	●	●	○
	R-S-T	●	●	○
Short circuit	R-S	●	○	●
	S-T	○	●	●
	T-R	●	●	●
	R-S-T	●	●	●

⑤As for the output contact of the relay, once it operated, it will reset in approx. 60ms after holding when input current is less than the setting value.

2. RUN display (Self-monitoring function)

This relay monitors control voltage, electric circuit, and program data at all time. The RUN LED (green) lights up in the normal condition.

In the abnormal condition, the RUN LED goes out and the error message [Err] is displayed on the numerical display LED, with the output contact locked.

Since power supply is derived from CT secondary current, the RUN LED lights up when the current input exceeds approx. 1.5A.

3. Numerical display function

By switching the position of the indicator select switch, following items can be displayed on the numerical display LED.

①Current measurement

The display shows the input current value of larger one among two phases. The display range is from 2.0A to 30A.

(If input current is less than 2.0A, the display goes out. If input current is more than 30A, the error message [O.F.] is displayed.)

②Time lapse (including pickup display)

The pickup and time lapse of time-lag element is displayed with the number from [0] to [10].

Pickup: When input current exceeds setting value of time-lag element, [0] is displayed.

Time lapse: The number from [1] to [10] is displayed according to a lapse of time of time-lag element. The output contact operates once [10] is displayed.

③Setting value

It displays the setting condition of the relay including time-lag current, dial, instantaneous current, number of step, sensitivity, operation characteristic, and frequency.

4. Fault record function

①Display of fault records

When a fault occurs, the relay outputs the operating signal, and at the same time the current value of larger one among two phases is recorded. The relay can save the newest single phenomenon. The record is saved in the non-volatile memory, therefore the record can be read again after shutting the power off.

Note that the fault record may not be saved if the input current is turned off soon after the relay operation.

②Clearing of fault records

Set indicator select switch to "CLEAR FAULT REC." and hold for 5s or more, then [O.K.] is displayed and all of the fault record are cleared.

5. Display function of setting change

When a setting is changed, the setting value after changing is displayed for approx. 3s preferentially.

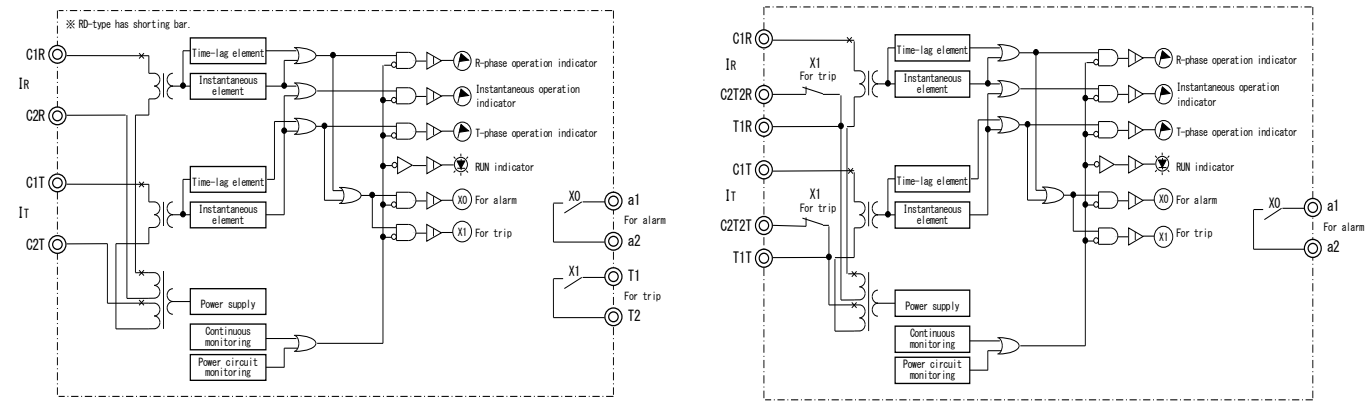
6. Detection function of frequency difference

If there is a difference between setting frequency and injected frequency, the alert message [F.E.] is displayed.

The detection is executed one second after the relay is activated or the frequency setting is changed.

If the alert message [F.E.] is displayed, please check the frequency setting switch.

Internal connection diagram



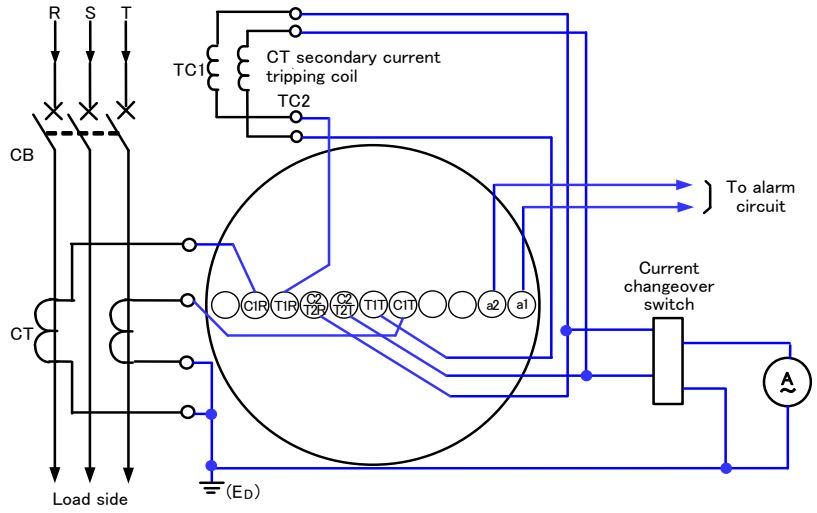
a) MOC-A3V-R、MOC-A3V-RD　　b) MOC-A3T-R

Fig. 1-3 Internal connection diagram

External connection diagram (Example)

In regard to terminal layout, refer to Fig. 1-7.

a. CT secondary current tripping type (MOC-A3T)



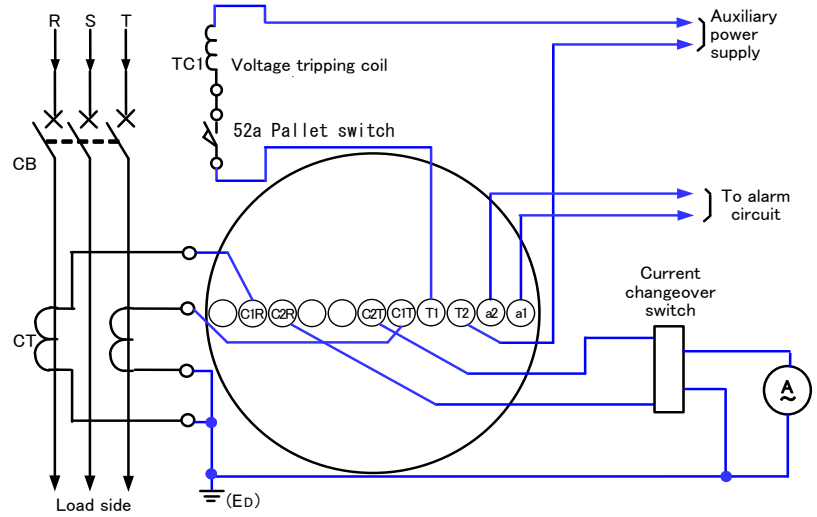
【Tripping route】

In no-fault condition, the CT secondary current flows between C1R and C2 T2R.

When a fault occurs, the CT secondary current flows between C1R and T1R and make the CB trip.

In the case of T-phase, the end of terminal name should be changed from "R" to "T".

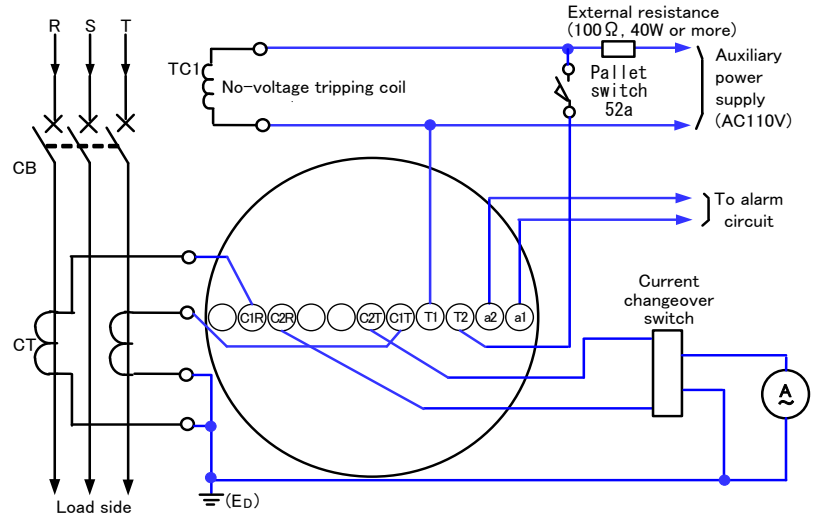
b. Voltage tripping type (MOC-A3V)



【Tripping route】

When a fault occurs, the trip contact between T1 and T2 closes, then trip coil of CB is energized and make CB trip.

c. No-voltage tripping type (MOC-A3V)



【Tripping route】

When a fault occurs, the trip contact between T1 and T2 closes, then trip coil of CB is de-energized and make CB trip.

- Connect ——— line.
- Make sure to earth CT secondary at D-class grounding.
- Please check the relation of CT secondary polarity and relay terminals according to the diagram above.

Fig. 1-4 External connection diagram

Handling precautions

1. Panel mounting

① Please connect the input terminals of relay corresponding to the polarity of CT secondary output. (Refer to Fig. 1-5)
If the connection of polarity is in the wrong, the relay may not operate when a fault occurs.

②When the existing product is replaced by MOC-A3 type, the adapter may be necessary for some type.

③The relay of unit-drawer type (RD type) can be drawn out from the case.

2. Use and operation

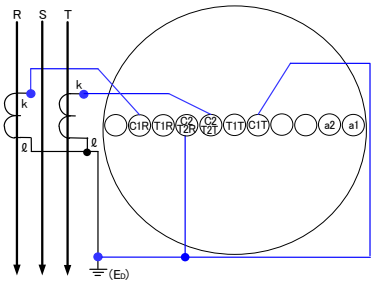
①About the setting switches for using condition, factory settings are set to a default of OFF. So it is necessary to set the switches according to the conditions.

②About MOC-A3T-R relay
In regard to this current tripping relay, current flows into the tripping coil of CB by opening the b contact of this relay, so the contact may be damaged if the current is too big.
Therefore, please disconnect the output contact from the tripping coil of CB and see if b contacts (between T1R and C2T2R, T1T and C2T2T) are normally closed.

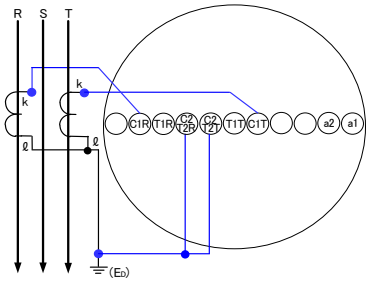
③Please refrain from changing the setting value during operation, since unwanted operation may occur. However, if the setting change is unavoidable, please press the CPU reset button in order to lock the relay function.

④Don't leave rotary switches with halfway (indefinite) state.

⑤The RUN LED lights up in the normal condition when the current input is 1.5A or more. If it still turns off when the current input exceeds 1.5A, please contact our local agent and branch office since the relay may fail.



a) Incorrect connection



b) Correct connection

This figure shows the connection of current tripping type. For voltage tripping type, the terminal number should be changed as below.
T1R⇒T1, T1T⇒T2, C2T2R⇒C2R, C2T2T⇒C2T

Fig. 1-5 Connection example

Test

A relay test is carried out sufficiently before shipment, but at the following cases, it is recommended the test should be carried out again.

a. When the products are delivered and unpacked
b. At the time of starting operation of equipment
c. At the time of periodic inspection (Usually once a year)

1. At the time of testing

①The current input waveform should be a sine wave with little distortion.

②During the test, set the position of the indicator select switch to "LAPSE". Set the other setting switches according to the test conditions of the operating characteristic control point.

③ If user-defined control point is specified (e.g. accuracy of relay characteristic is controlled at service conditions), execute the test at the manufacturer-defined characteristic control point before in-service operation and then check accuracy of the relay. After that, execute the test at the user-defined control point, and use this data as a later reference.

2. Withstand voltage test

a. Apply 2000V AC (commercial frequency) between all circuits and external box (fixing screw for mounting) for one minute, and make sure that there is no problem.

Type	Voltage applied terminals	
MOC-A3V	C1R C1T T1 a1 C2R C2T T2 a2	External box (Fixing screw for mounting)
MOC-A3T	C1R C1T T1R a1 C2T2R C2T2T T1T a2	External box (Fixing screw for mounting)

b. Apply 2000V AC (commercial frequency) between separate circuits for one minute, and make sure that there is no problem.

Type	Voltage applied terminals	
MOC-A3V	C1R C2R	C1T C2T
	C1R C2R C1T C2T	T1 a1 T2 a2
	T1 T2	a1 a2
MOC-A3T	C1R C2T2R T1R	C1T C2T2T T1T
	C1R C2T2R T1R C1T C2T2T T1T	a1 a2

3. Operation characteristics test

①When the test current (single phase) is gradually increased, the RUN display LED (green) lights at around 1.5A. This indicates that the relay has started working properly.

②For the operation value test of time-lag element, set the indicator select switch to "LAPSE" and increase the test current gradually until the indication of O on the numerical display LED changes from blinking to completely lit. At this time, the input current is the operation value.

③For the operation value test of instantaneous element, as the input current is big, the time-lag element may operate during adjusting. Therefore, it is necessary to set the operation value of time-lag element to "LOCK".

④When adjusting the test current during the operating time test of time-lag element, it is recommended to press the CPU reset button to lock the operation of this relay. If the operation is locked and the test current is adjusted, an accurate test is possible. Also, if the operation is not locked, instantaneous elements may operate. In this case, setting the operation value of instantaneous element to "LOCK" enables accurate current adjustment.

⑤If the input current is more than 10A, pay attention to the overload capacity, and keep the energizing time within approx. 3～4s and the energizing interval at 20s or more.

4. Operation characteristic control point

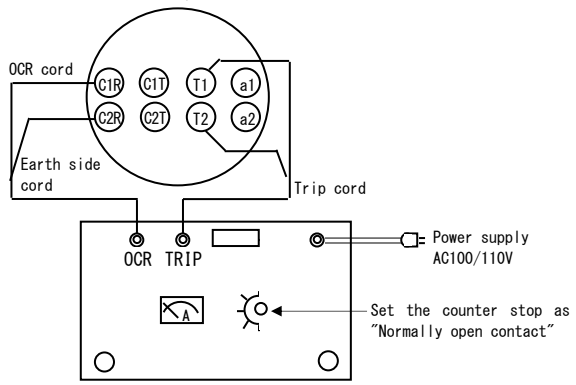
Perform the test periodically according to the following test conditions and criteria.

Test item		Test condition			Criteria
		Input	Operation value	Operating time	
Operation value	Time-lag	-	Each setting	Minimum setting	±10% of setting value
	Instantaneous	-	Each setting	-	±15% of setting value
Operating time	Time-lag	300% of setting	Minimum setting	Characteristic control point of operating time	±17% of nominal value
		700% of setting			±12% of nominal value
	Instantaneous	200% of setting	Minimum setting	-	50ms or less

5. Example of operation test circuit

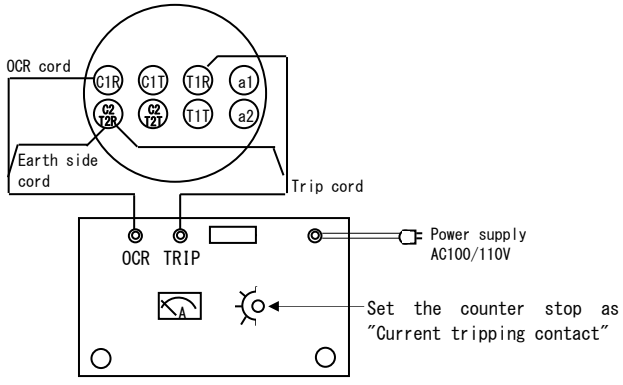
The circuit examples of the overcurrent relay test equipment and the actual loading test are shown below. About commercially available test equipment, please refer to the instruction manuals from each tester manufacturer.

a. MOC-A3V-R, MOC-A3V-RD



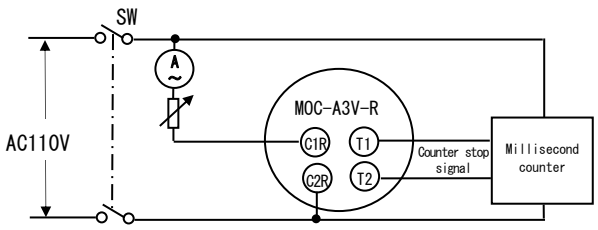
Note) This figure shows the case where the R-phase is tested. In the case of T-phase, change the connection terminal number as follows: C1R C2R ➡ C1T C2T

b. MOC-A3T-R

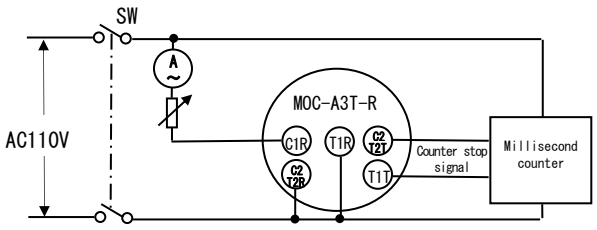


Note) This figure shows the case where the R-phase is tested. In the case of T-phase, change the connection terminal number as follows: C1R C2 T2R T1R ➡ C1T C2 T2T T1T

Relay test with a commercial overcurrent relay tester



The contact between T1 and T2 turns from open to close when relay operates, then the millisecond counter stops.

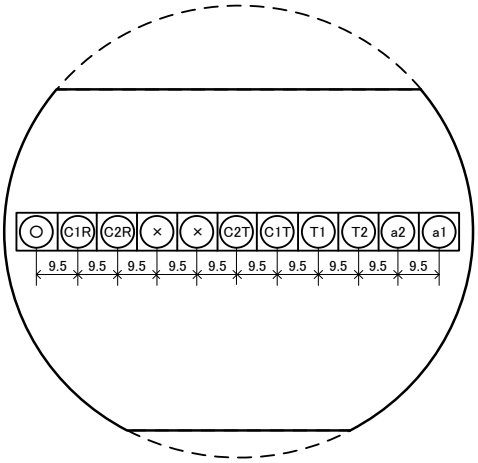


The contact between C2T2T and T1T turns from close to open when relay operates. In the case of T-phase: C1R⇒C1T、T1R⇒T1T、C2 T2R⇒C2 T2T、C2 T2T⇒C2 T2R、T1T⇒T1R

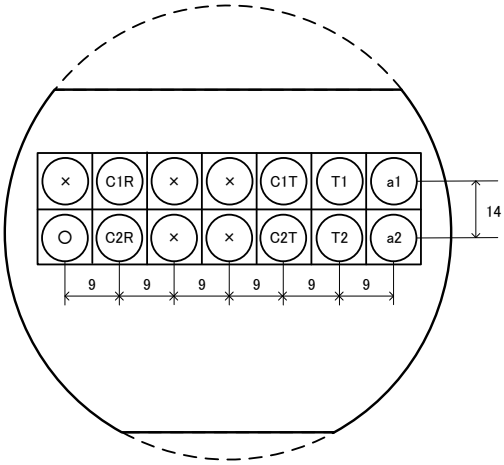
Actual loading test

Fig. 1-6 Example of test circuit

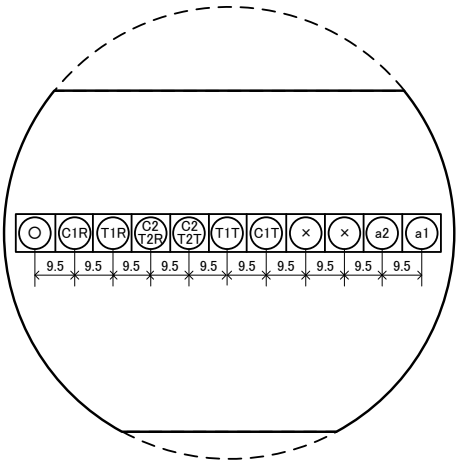
Terminal layout



MOC-A3V-R



MOC-A3V-RD



MOC-A3T-R

Do not connect to the "×" terminals, or the relay may not operate properly.
The "○" terminal is junction terminal for grounding wire
if there was grounding wire in the existing relay.

Fig. 1-7 Terminal layout

Drawing out and housing operation of subunit (Unit-drawer type)

For unit-drawer type (RD type), it is possible to draw out the subunit from the case without removing external wiring, which makes easier to carry out inspection and testing.

When drawing out and housing, be careful not to touch the electrical circuit (e.g. substrate, capacitor, and transformer) and be sure to hold the drawer handle or the frame part when transporting. (Touching the electrical circuit may cause electric shock or damage to the circuit.)

Before the subunit is to be drawn out, ensure that the following items are checked in order not to carry out the work in hot-line condition.

- Lock of the tripping circuit
- Turning off the main circuit
- Disconnect CT/VT circuit
- Turning off the auxiliary power supply

The CT circuit is equipped with an automatic short circuit piece so that the CT secondary circuit won't be opened even if the relay subunit is drawn out without disconnecting the CT circuit.

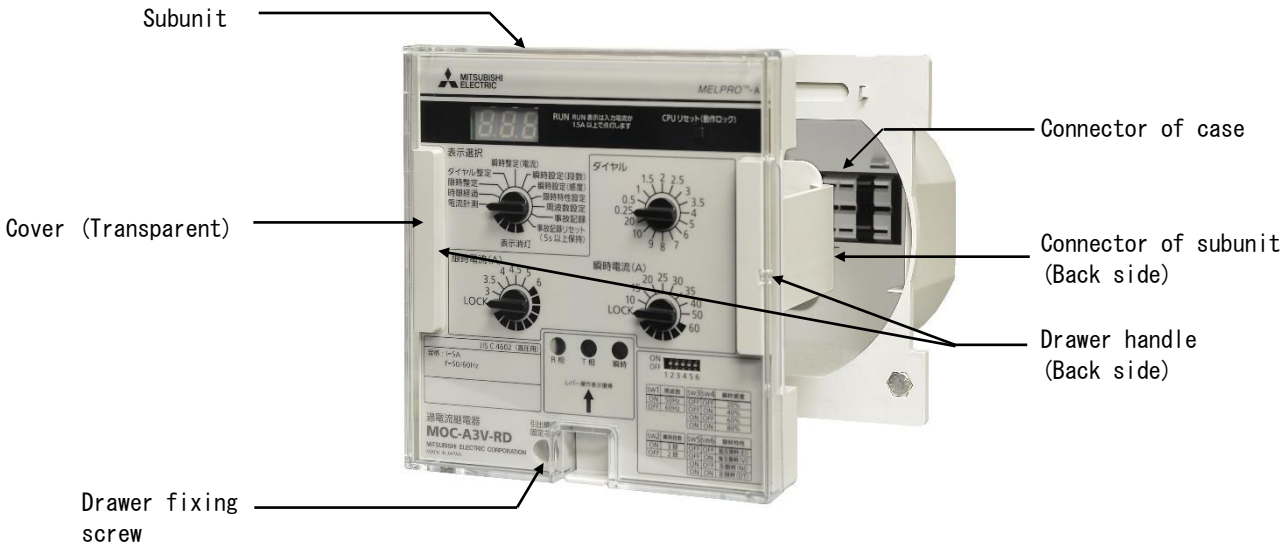
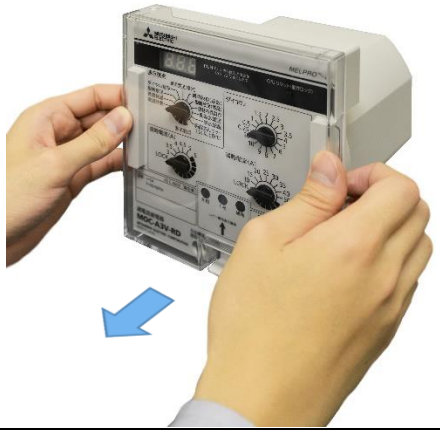
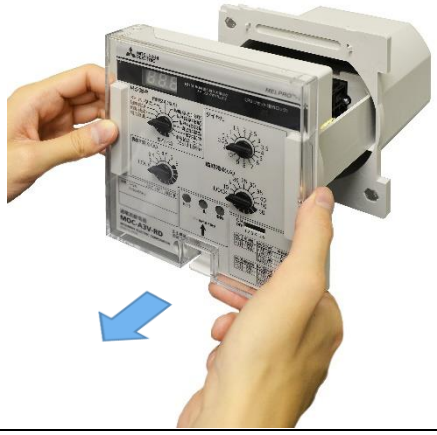
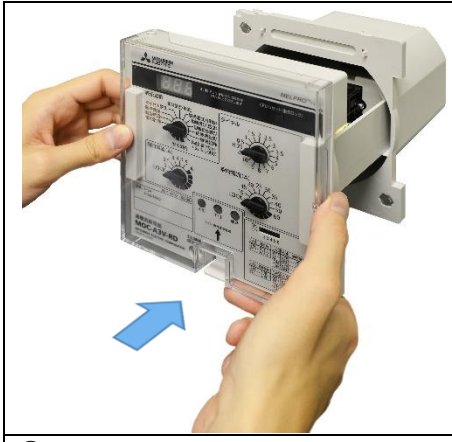
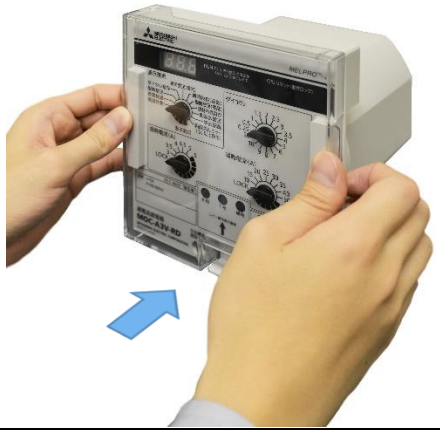


Fig. 1-8 Structures of unit-drawer type (RD type)

1. Procedure of drawing out

		
① Open the cover and remove the drawer fixing screw.	② Close the cover and pull out the subunit with your finger hooked on the drawer handle on both sides.	③ Support the frame of subunit and pull out.

2. Procedure of housing

		
① Support the frame of subunit and place the subunit in the case along the rails.	② Insert the subunit into the case horizontally.	③ Open the cover and tighten the drawer fixing screw.

Handling of the cover

1. Opening and closing

Please open the cover by placing your fingertip on the convex part in the right side of the cover as shown in Fig. 1-9.

Fig. 1-9

2. How to replace the cover

・Removing the cover

Open the cover, and lightly push up the upper side of the cover from the inner surface.
Then, remove from the protrusion of the body.

・Installing the cover

As shown in Fig. 1-10, mount the holes on the upper side of the cover to the protrusion of the body.
Then, press down lightly on the lower side of the cover and mount to the protrusion of the body
in the same way as above.

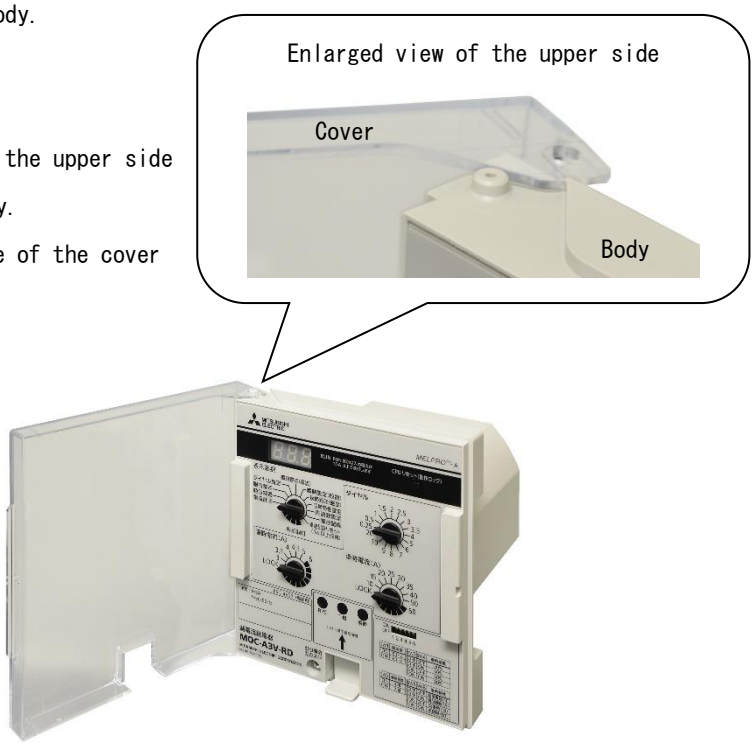


Fig. 1-10

・When replacing the cover during operation, **be careful not to touch the switches.**

External dimensions and Panel cut-out

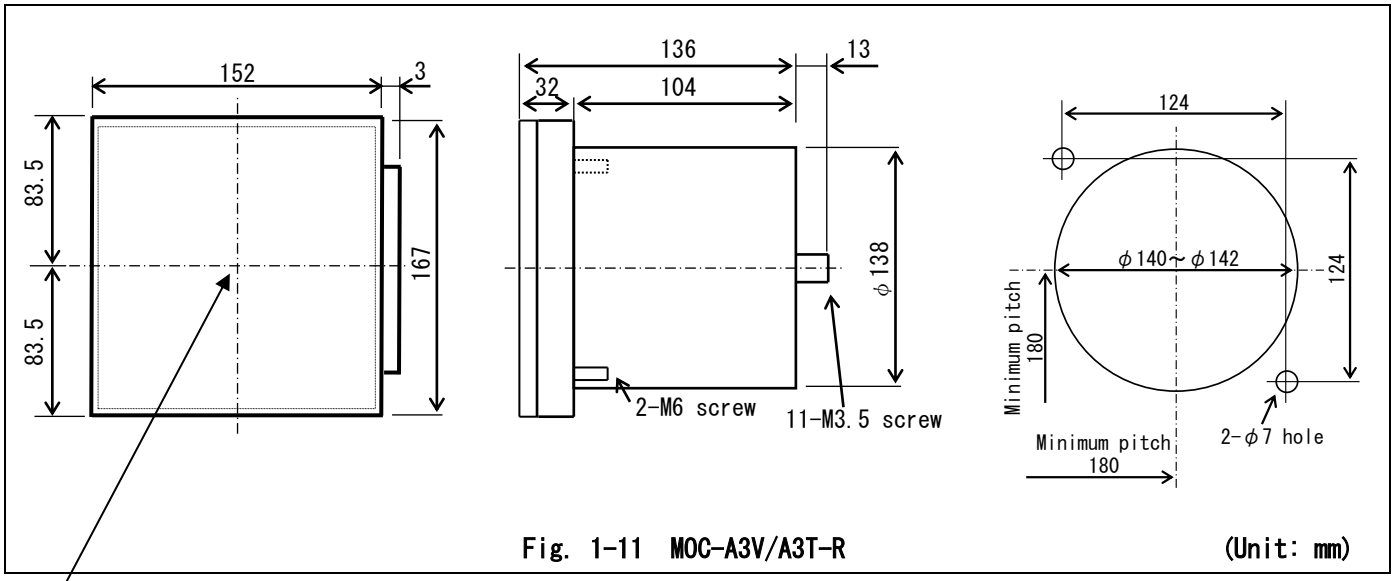


Fig. 1-11 MOC-A3V/A3T-R (Unit: mm)

Same as the center of panel cut-out

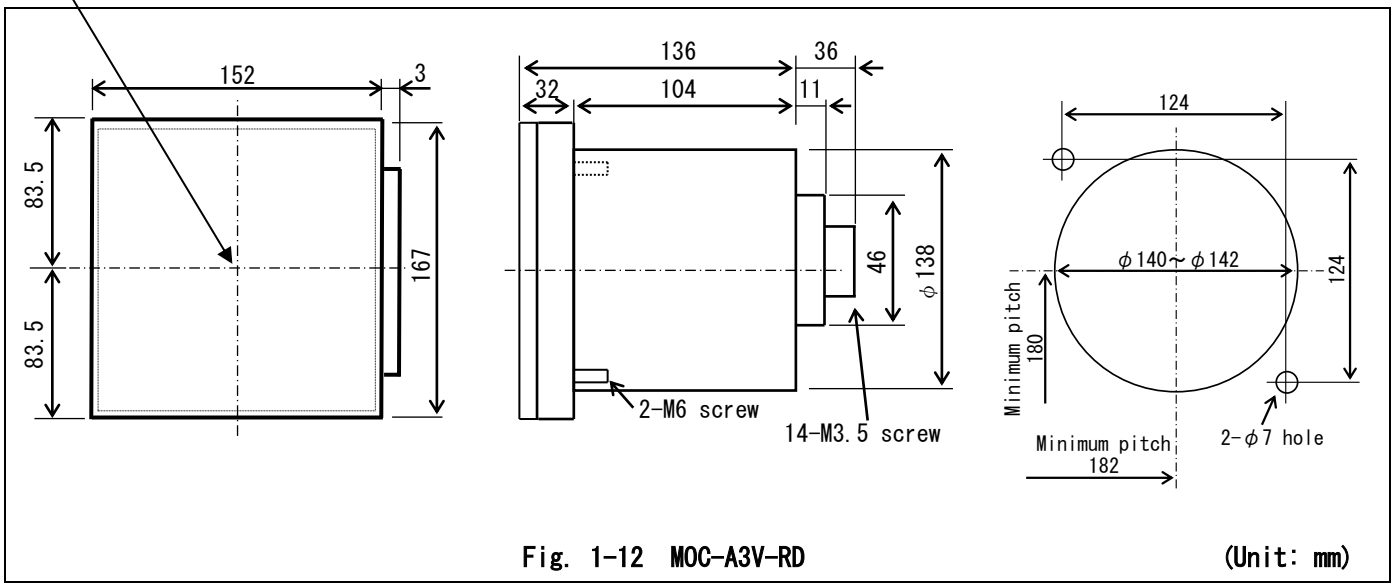


Fig. 1-12 MOC-A3V-RD (Unit: mm)

Improvement on the reliability of protection function

Any parts and materials applied to the protection relay have limited lifetime which will bring the degradation to the relay. The degree of degradation will be variable depending on the purpose, aging, usage environment, and unevenness on the performance of each part.

Our company designs its products so that the recommended renewal period is 15 years or more.

However, there may be some possibilities to occur any failures before reaching 15 years due to above reasons.

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

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