



Numerical Protection Relay

MELPRO™-A Series
DIRECTIONAL EARTH FAULT RELAY
MODEL
MDG-A2V-R,MDG-A2V-RD

INSTRUCTION MANUAL

Request

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

— 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 observe safety information, incorrect use, or improper use may endanger personnel and equipment and cause personnel injury or physical damage.
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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 below, otherwise the product performance/life might be unfavorably affected.
 - Ambient temperature: $-20^{\circ}\text{C} \sim +60^{\circ}\text{C}$ (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.

Tightened torque of screw shall be as below table

Material	Size	Standard torque	Permissible range	Application
Steel	M3.5	1.10N · m (11.2kgf · cm)	0.932~1.27N · m (9.5~12.9kgf · cm)	Terminals of back side
Brass	M4	0.961N · m (9.8kgf · cm)	0.824~1.11N · m (8.4~11.3kgf · cm)	Type MZT Secondary terminal(k,ℓ)

- (3) Grounding should be as 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.
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 $\pm 5\%$ of rated frequency
 - Ambient temperature: $0^{\circ}\text{C} \sim +40^{\circ}\text{C}$ ($-20^{\circ}\text{C} \sim +50^{\circ}\text{C}$ 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 erroneous might occur.
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: $20^{\circ}\text{C}\pm 10^{\circ}\text{C}$
 - Relative humidity: Less than 90%
 - Magnetic field: Less than 80A/m
 - Atmospheric pressure: $86\sim 106\times 10^3$ Pa
 - Installation angle: Normal direction $\pm 2^{\circ}$
 - Deviation of frequency: within $\pm 1\%$ of nominal frequency
 - Wave form(in case of AC): Distortion factor less than 2%
(Distortion factor= $100\%\times$ effective value of harmonics/effective value of fundamental)
 - Ripple (in case of DC): Ripple factor less than 3%
(Ripple factor= $100\%\times(\text{max}-\text{min})/\text{average of DC}$)
 - (5) Deviation of auxiliary power: within $\pm 2\%$ of nominal voltage
 - (6) Be sure not to inject the voltage or current beyond the overload immunity.
Otherwise, damage or burning might occur.
 - (7) Be careful not to touch the energized parts.
Otherwise, the electric shock might occur.
 - (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.)
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 MITSUBISHI 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.

— 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 by a 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 can not 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 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
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, such as medical system for life-sustaining, in nuclear power plants, power plants, aerospace, and 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.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, are 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.
5. Onerous repair term after discontinuation of product
 - ①MITSUBISHI ELECTRIC CORPORATION shall accept onerous product repairs for 7(seven) years after production is terminated. (However, please consider the replacement of products being in operation during 15 years from ex-work.)
 - ②Product 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 to 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.

MDG-A2 Series Directional Ground Relay [Standard: JIS C 4609]

Features

1. A digital type relay corresponding EVT, which has high accuracy and stable operating characteristics.
2. High sensibility and wide setting range.
3. High reliability by the self-monitoring function
The relay monitors control circuit, electric circuit and program data at all times, which are indicated by the LED "RUN". (The LED "RUN" lights up in the normal condition and goes out in the abnormal condition.)
4. Enriched measurement and display functions
It is available to measure and display the input voltage, current and phase. The settings are also can be displayed.
5. Fault record function
It can record and save the last 2 fault data including zero-phase voltage and zero-phase current and phase. So can assist with fault analysis.
6. High vibration and impulse resisting performance
The use of a filter circuit allows the relay to operate without the effect of higher harmonics on the distorted wave input, and this relay is also resisting to electromagnetic interference and noise and noise surge.
7. Forced operation is available by a test button.
8. Not need outside auxiliary power supply.
The auxiliary power supply can be supplied by inside circuit of relay.

1. Rating and Specifications

Type Name		MDG-A2V-R		MDG-A2V-RD																																																																		
Style No.		093PGA		512PGA																																																																		
Element	Protection		Directional earth-fault element (MZT, EVT correspondence ^{※2}) × 1																																																																			
	Measure	Zero-phase current																																																																				
		Zero-phase voltage																																																																				
		Phase																																																																				
Rating	Frequency		50/60Hz (Changeover)																																																																			
	Zero-phase Current		0.2A (MZT type ZCT primary)																																																																			
	Zero-phase Voltage		AC100/190V																																																																			
	Auxiliary Power Supply		AC100/110V (90~120V)																																																																			
Setting ※1	Zero-phase Current (I ₀) Operation Value		0.1-0.2-0.4-0.6-0.8-1.0A (MZT type ZCT primary Conversion)																																																																			
	Zero-phase Voltage (V ₀) Operation Value		V ₀ (complete earth fault) = Lock-2.5-5-7.5-10% (100%=110V/190V)																																																																			
	Operation Time		Instantaneous (50~100ms)-0.2-0.3-0.4-0.5-0.6-0.7-0.8-0.9-1.0s																																																																			
	Using Condition		Frequency : 50Hz (SW1-ON)/60Hz (SW1-OFF) changeover																																																																			
Measure	Zero-phase Current	Real Time	Range	0.05~1.5A																																																																		
			Update	Approx. 200ms																																																																		
	Zero-phase Voltage	Real Time	Range	1.0~12.0%																																																																		
			Update	Approx. 200ms																																																																		
	Phase	Real Time	Range	0~359° (V ₀ standard, I ₀ lag display)																																																																		
			Update	Approx. 200ms																																																																		
		Fault Record	Range	1.0~100%																																																																		
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Display	Self Monitoring		The LED "RUN" (green) lights up in normal relay condition.																																																																			
	Operation Display		The operating display target turns from black into orange color when relay operates. (Manual resetting type)																																																																			
	Numerical Display		<table border="1"> <thead> <tr> <th>SW No.</th> <th colspan="3">Indication function</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>V₀ Measure (%)</td> <td colspan="2">: 1.0~12.0 (0.1 step)</td> </tr> <tr> <td>1</td> <td>I₀ Measure (A)</td> <td colspan="2">: 0.05~0.1 (0.01 step), 0.1~1.5 (0.1 step)</td> </tr> <tr> <td>2</td> <td>Phase Measure (°)</td> <td colspan="2">: 0~359 (1° step V₀ standard, I₀ lag display)</td> </tr> <tr> <td>3</td> <td>V₀, I₀ Pickup</td> <td colspan="2">: U. - I.</td> </tr> <tr> <td>4</td> <td>V₀ Settings (%)</td> <td colspan="2">: Lo, 2.5~10</td> </tr> <tr> <td>5</td> <td>I₀ Settings (A)</td> <td colspan="2">: 0.1~1.0</td> </tr> <tr> <td>6</td> <td>T Settings (s)</td> <td colspan="2">: Inst., 0.2~1.0</td> </tr> <tr> <td>7</td> <td>F Settings (Hz)</td> <td colspan="2">: 50/60</td> </tr> <tr> <td>8</td> <td>Fault record V₀ (Newest)</td> <td colspan="2">: 1.0~100%</td> </tr> <tr> <td>9</td> <td>Fault record I₀ (Newest)</td> <td colspan="2">: 0.05~1.5 (A)</td> </tr> <tr> <td>A</td> <td>Fault record phase (Newest)</td> <td colspan="2">: 0~359 (°) (V₀ standard, I₀ lag)</td> </tr> <tr> <td>B</td> <td>Fault record V₀ (Last time)</td> <td colspan="2">: 1.0~100%</td> </tr> <tr> <td>C</td> <td>Fault record I₀ (Last time)</td> <td colspan="2">: 0.05~1.5 (A)</td> </tr> <tr> <td>D</td> <td>Fault record Phase (Last time)</td> <td colspan="2">: 0~359 (°) (V₀ standard, I₀ lag)</td> </tr> <tr> <td>E</td> <td>Fault record reset</td> <td colspan="2">: In holding 5s, reset with O.K. displayed.</td> </tr> </tbody> </table>				SW No.	Indication function			0	V ₀ Measure (%)	: 1.0~12.0 (0.1 step)		1	I ₀ Measure (A)	: 0.05~0.1 (0.01 step), 0.1~1.5 (0.1 step)		2	Phase Measure (°)	: 0~359 (1° step V ₀ standard, I ₀ lag display)		3	V ₀ , I ₀ Pickup	: U. - I.		4	V ₀ Settings (%)	: Lo, 2.5~10		5	I ₀ Settings (A)	: 0.1~1.0		6	T Settings (s)	: Inst., 0.2~1.0		7	F Settings (Hz)	: 50/60		8	Fault record V ₀ (Newest)	: 1.0~100%		9	Fault record I ₀ (Newest)	: 0.05~1.5 (A)		A	Fault record phase (Newest)	: 0~359 (°) (V ₀ standard, I ₀ lag)		B	Fault record V ₀ (Last time)	: 1.0~100%		C	Fault record I ₀ (Last time)	: 0.05~1.5 (A)		D	Fault record Phase (Last time)	: 0~359 (°) (V ₀ standard, I ₀ lag)		E	Fault record reset	: In holding 5s, reset with O.K. displayed.	
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Output		Configuration		2a																																																																		

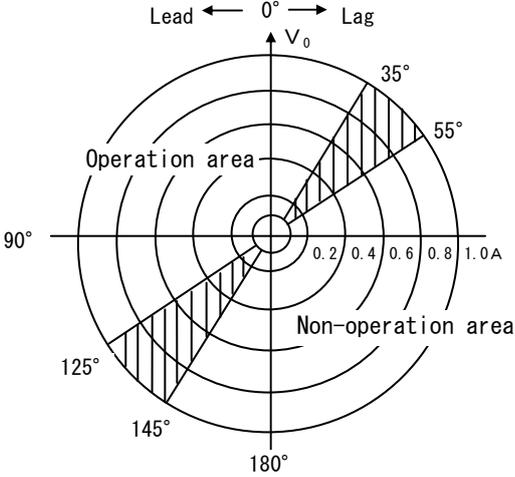
Contact	Capacity	Closed circuit : AC110V 10A (Power factor=0.5) DC220V 10A (L/R=0s) DC110V 15A (L/R=0s) Opened circuit: AC110V 5A (Power factor=0.5) AC220V 1A (Power factor=0.5) DC110V 0.2A (L/R=40ms)	
Forced Operation		Executed by pressing the TEST switch located panel.	
Power Consumption VA		Normal : Approx. 4.0VA, Operating : Approx. 7.0VA	
Mass		Approx. 1.0kg	Approx. 1.1kg
Case		Compact cylindrical fixed type (R type) Color : N1.5	Compact cylindrical draw-out type (RD type) Color : N1.5
Cover		Open-close type Color : Transparent	
Applicable Standard		JIS C 4609— ₁₉₉₀	

※1 “Lock” means that to let this element not to operate.

※2 It is necessary to combine the MZT type ZCT and EVT with MDG-A1 relay.

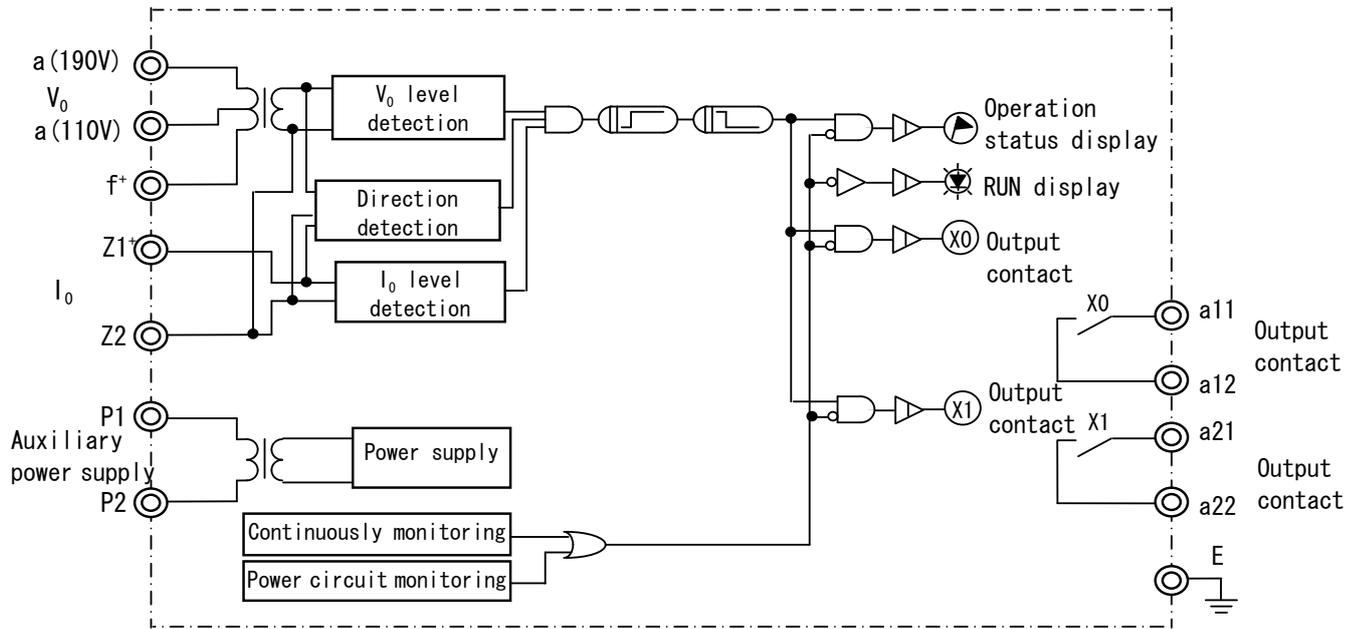
Don' t combine other MZT types with this relay please.

2. Phase Characteristics

Guaranteed conditions	Guaranteed performance						
<p>Rating frequency</p> <p>Ambient temperature : 20°C</p> <p>Auxiliary voltage : Rated voltage</p> <p>Operation time settings : 0.2s</p> <p>Zero-phase current setting : 0.1A</p> <p>Zero-phase voltage setting : 2.5%</p> <p>Zero-phase current input : Setting value × 1000%</p> <p>Zero-phase voltage input : Settings value × 150%</p> <p>Io operating area at Max. sensitivity angle. (V₀ standard)</p>	<table border="1"> <thead> <tr> <th></th> <th>Operating phase</th> </tr> </thead> <tbody> <tr> <td>Lag</td> <td>45° ±10°</td> </tr> <tr> <td>Lead</td> <td>135° ±10°</td> </tr> </tbody> </table> 		Operating phase	Lag	45° ±10°	Lead	135° ±10°
	Operating phase						
Lag	45° ±10°						
Lead	135° ±10°						

3. Internal Connection

3.1 MDG-A2V-R



3.2 MDG-A2V-RD

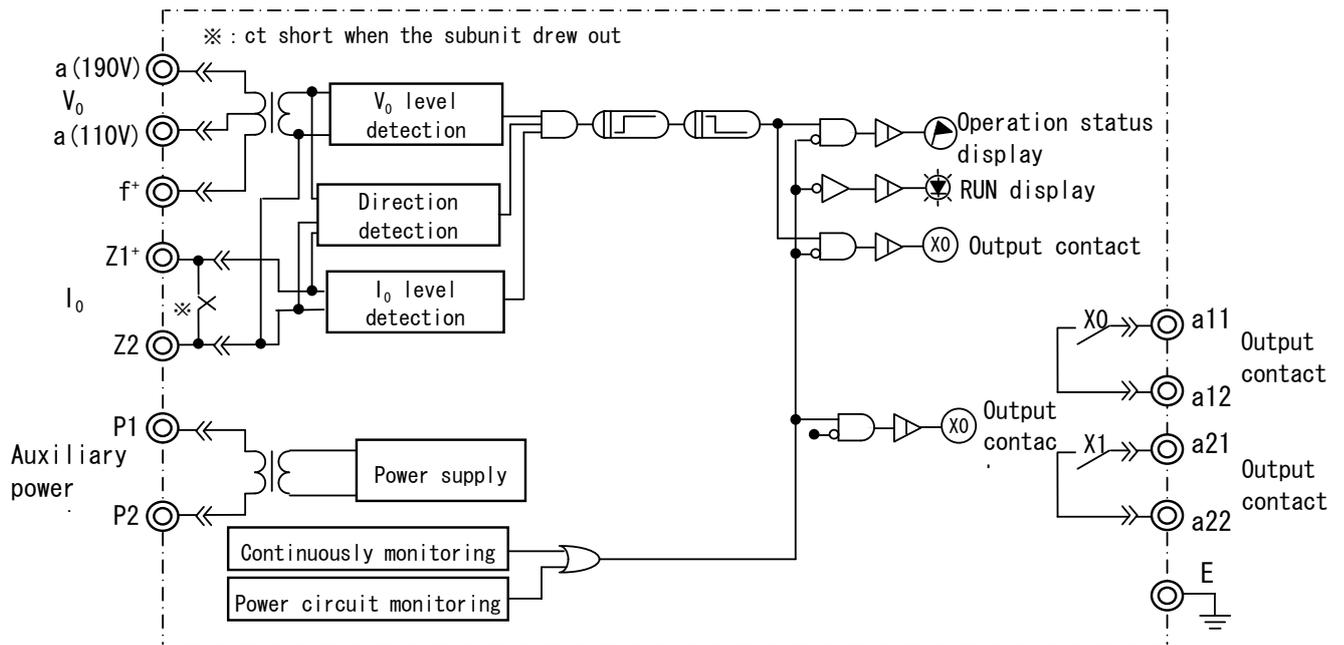


Fig. 7-1 Internal Connection Diagram

4. Construction

LED for numerical display

By switch setting, the following operation is available.

- V_0 measurement and display
Residual V_0 or test input: 1.0~12.0%
(realtime values and fault records)
- I_0 measurement and display
Residual I_0 or test input: 0.05~1.50A
(ZCT primary) (realtime values and fault records)
- Phase measurement and display
Phase: 0~359° (I_0 based on V_0)
(realtime values and fault records)
- V_0/I_0 pickup display
“U” and “I” light up at each picked up.
- Settings display
- Frequency display

RUN indicated LED (Green)

Continuously monitor the auxiliary power supply circuit, electric circuit, program data, etc., and the RUN LED lights up in normal condition.

Test switch

By pressing the TEST button, forced operation is available.

Selector switch for display selection

- Set the display item
- To change the setting with hand or a small (-) screwdriver.

Switches for V_0 , I_0 and operation time setting

- Set the setting value
- To change the setting with hand or a small (-) screwdriver.

Frequency setting switch

The used frequency can be set with ON/OFF switch.

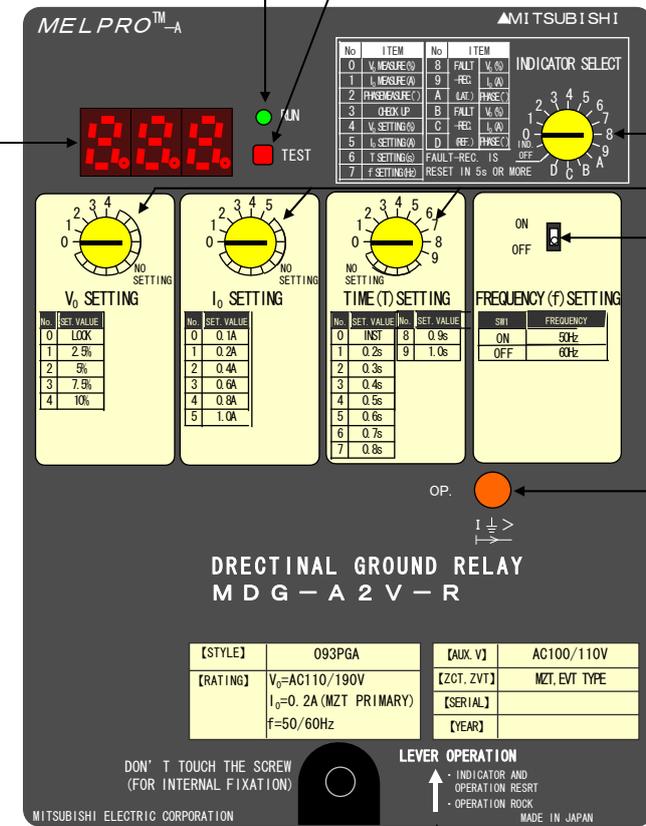
50Hz setting → ON 

60Hz setting → ON 

When the switch is set, do not use any tool with a sharp point. (It may cause damage to the switch lever.)

Operation flag indicator

During relay operating, this indicator changes from black to orange.



Display reset lever on the operation flag unit

Pushing reset lever makes it possible to reset the operation display unit.

While the lever is being pushed up, the relay function is locked.

Note) Since the display plug of the operation display unit is of a very precise structure, avoid touching it directly by hand.

Fig 7-2 MDG-A2 series construction (panel)

5. Operation Description

5.1 Relay Function

- ① This relay has a built-in regulated voltage circuit which derives control voltage from the voltage (VT secondary voltage) input, therefore, particular control power supply is not required.
- ② Set the frequency which is used with the frequency setting switch.
- ③ The zero-phase input voltage is supplied by EVT secondary. And this zero-phase voltage will be changed to digital signal by an A/D converter and as data input microcomputer.
Zero phase voltage input, after passing through the filter circuit, is derived to V_0 expanded output terminals (M .N) through small current transformer as a signal or V_0 expansion besides the above.
- ④ Zero phase input current is supplied from secondary output of type MZT zero-phase current detector combined with the relay. And this zero-phase current will be changed to digital signal by an A/D converter and as data input microcomputer.
- ⑤ To judge the direction based on the phase relation of zero-phase voltage and zero-phase current.
- ⑥ The microcomputer allows level judgment and computation by comparison of zero phase current and voltage signal data with the respective set point data, while the operation phase is judged and computed with each rectangular wave data. If both zero phase current signal and zero phase voltage signal exceed the setting value, reaching the operation phase, the timer starts, and if the signals are present continuously longer than the operation time setting value the output relay and operation flag unit are actuated.

5.2 RUN Indication (Self-monitoring Function)

This relay monitors control voltage, electric circuit and Program data at all time. The green LED (RUN) lights up in the normal condition, and goes out in the abnormal condition. Since control voltage is derived from VT secondary voltage input, the LED goes out when the control voltage lower than approx. 85V.

5.3 Fault Record Function

When a fault occurs, the relay will output an operating signal, and as the same time the operating information (V_0 , I_0 , phase) will be record. It can save and update the last 2 times fault records.

The fault records are save in a static memory inside relay, thereby the fault records can be read again after re-put power on.

About the fault record reset, please refer the item of 4. ⑨

5.4 Numerical Display Function

By change the position of the selector switch, the following values can be displayed on the numerical display LED.

① V_0 measurement (%) ... (switch position : 0) ...

According to zero phase voltage signal data, zero phase voltage is measured and computed, then to display the input value of V_0 . The display range is 1.0% to 12.0%. (When more than 12.0%, "O.F." is displayed. And when less than 1.0%, nothing be displayed)

Here, "100%" means the percent of rated input voltage.

This function makes it possible to measure residual V_0 detection sensitivity setting.

② I_0 measurement (A) ... (switch position : 1) ...

According to zero phase current signal data, zero phase current is measured and computed, then to display the input value of I_0 . The display range is 0.05A to 1.5A.

(when less than 0.05A, nothing be display. When more than 1.5A, "O.F." is displayed.)

③ Phase measurement (°) ... (switch position : 2) ...

According to zero phase voltage and zero phase current signal data, phase is measured and computed, then to display the I_0 phase based on V_0 . The display range is 0° to 359° (lag).

④ V_0 , I_0 pick up... (switch position : 3) ...

When the V_0 and I_0 input exceed each setting value,

U.	—	I.
----	---	----

 is displayed.

When set switch position 3

	—	
--	---	--

 is displayed,

When the input are more than each settings (V_0 and I_0 setting)

U.	—	I.
----	---	----

 is displayed.

(V_0 pick up :

U.	—	
----	---	--

 I_0 pick up :

	—	I.
--	---	----

)

Using this function, easy to test the Min. operating value.

When pressing the TEST button

U.	—	I.
----	---	----

 is displayed

⑤ Setting value display... (Switch position : 4~6) ...

This function displays the relay setting condition: it displays the zero-phase voltage V_0 settings (%), zero-phase current I_0 settings (A) and operation time T settings (s).

⑥ Frequency display... (Switch position : 7) ...

Once set the switch on position 7, the setting frequency can be displayed.

⑦ Fault records (Newest) display... (Switch position : 8~A) ...

To display the newest fault data including V_0 , I_0 and phase* value recorded when fault occurred.

⑧ Fault records (last time) display... (Switch position : B~D) ...

To display the fault data including V_0 , I_0 and phase* value recorded when fault occurred last time.

⑨ fault records reset... (Switch position : E) ...

This function uses to clear all of fault records.

When set the switch on this position and holding 5s, "O.K." will be displayed, all of the fault record data will be cleared.

※The display range of the I_0 phase based on the V_0 is 0° to 359° (lag).

6. External Connection Diagram

Type EG-4 current limiting resistance value

V ₀ Rating	System Voltage		
	EG-4 Style No.	6.6KV	3.3KV
190V	P7971	25 Ω	50 Ω
110V	PB991	8 Ω	16 Ω

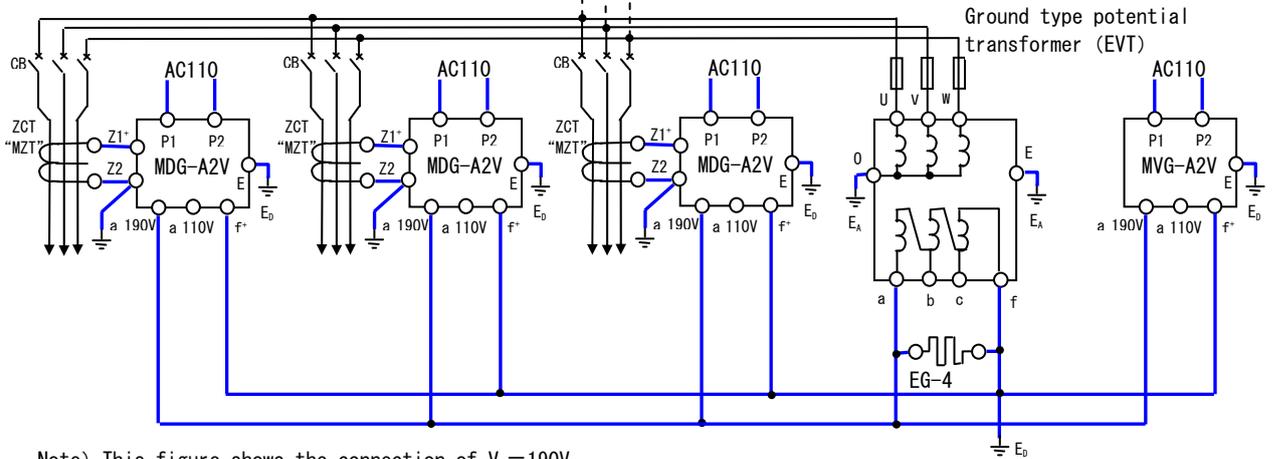


Fig. 7-3 External Connection Diagram

7. Setting

- ① Normally, considering with the conditions of system and protective coordination to carry out setting.
In addition, when carry out V₀ setting, in order to avoid unwanted operation, please use the measurement function and set the tap value more than V₀ measured value.
- ② Please set the frequency with the using frequency.

9. Precautions for Design and Installation

<Connection>

(1) ZCT test terminal

Use the test terminals K_t and I_t of the zero-phase current transformer only when letting dummy fault current flow during the test, and keep them open after the test.

(Short circuit, affects to the relay operation.)

(2) Wiring material

Since the MDG-A2 is a high sensitivity static type relay, it is necessary to suppress surge and noise from the main circuit and other contact lines where applicable.

Consequently, use a 0.75 to 1mm² 2-core shielding cable (black) to connect ZCT with relay, and connect the shield with relay terminal "E" or ground port E₀.

In this case, both ways load shall be less than 5 Ω.
(The cable length, at case of 0.75mm² 2-core shield, is

approx. less than 100m in one way.)

(3) Polarity

Polarity is very important to this relay. Please pay a special care to polarity for connecting ZCT and EVT with relay. (Refer to the external connection diagram) Grounding point is also important. Please pay attention.

(4) Power cable shield earth

When an electric power cable is used at the primary side of ZCT, note the shield earth as specified in the "shield Earth" section of "Guideline for High-voltage Power Receiving & Distribution Facilities".

(5) Power cable handling

Take care in handling not to damage the outer sheath of ZCT primary conductor.

The bending radius should be more than 10 times the conductor outside diameter. Locate the cable symmetrically in 3-phase in the ZCT thru-section.

(6) EVT grounding

Please take ground the terminal “0” of EVT primary and terminal “E” of relay case with a “A” type grounding.

(7) MDG-A2V relay grounding

Since terminals Z_2 -f are short-circuited inside the MDG-A2V relay, so to ground the V_0 circuit and I_0 circuit only one point for each one please.

(1) When only to test the relay unit, do not to apply voltage to Z1 and Z2 circuit please.

(2) When the test is performed between high-voltage circuit to earth, and high-voltage circuit to low-voltage circuit after the relay is assembled into panel, make sure that EVT secondary side (or ZCT secondary side) and VT secondary side is in grounding status.

(3) For the test between low-voltage circuit and earth, make sure that to remove the EVT secondary side (or ZCT secondary side) and VT secondary side from earth.

<Withstand voltage test>

10. Handling Method

10.1 Panel assemble

① Do connect the relay terminal “E” to earth at Class D please.

② Type MDG-A2V-RD is a draw-out type that the sub-unit can be drawn out from case.

For detail, refer to section of “Drawing out and Housing operation of Sub-unit” please.

10.2 Use and operation

① Before in-service, it is necessary to carry out the frequency setting again according to the used frequency.

(It is set OFF side at the time of shipment.)

Refer to the page 19, Cover Handling.

② Avoid changing the settings during operation, since it is possible to occurs unwanted operation. However, if setting change is unavoidable, please push up the display reset lever in order to lock relay operating.

③ To change the setting may be realized manually by the setting switch. It is also possible by using a small minus (-) screwdriver. If a large minus (-) screwdriver is used, it may damage the groove of the switch knob.

④ The switch for setting is a rotary one utilizing snap action. When the setting is changed, turn the switch smoothly so as not to stop it in mid-position.

⑤ The position of the display selector switch is not specified in particular, but if it is normally set to

0|V₀ Measure (%). The input zero phase voltage value can be measured conveniently.

⑥ Since the RUN indicator LED is lighting during the normal operation, check it in routine checking please.

If it turns off, check input voltage value at first, and if it is still in OFF state even the input voltage is approx 85V or more, please contact our local agent and branch office since the relay may fail.

11. Test

This relay is tested sufficiently before shipment. In the following cases, however, it is recommended that the test should be carried out.

- After the products are unpacked when received
- When the equipment starts operation
(Power receiving starts)
- When periodical checkup is carried out
(Normally once per year)

11.1 Testing

- For voltage and current input waveforms, use a sine wave without distortion please.
- To select the switch for each setting with hand or use a small regular screwdriver.
- Adjust selector switch position to

0	V ₀ Measure (%)
---	----------------------------

1	I ₀ Measure (A)
---	----------------------------

2	Phase Measure (°)
---	-------------------

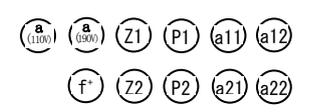
3	V ₀ /I ₀ pick up
---	--

as appropriate according to the test item. Set other switches for setting according to the test conditions in the operation characteristic control points.
- If the operation characteristics are tested specially in individual control points (for example, when tested with the in-service setting conditions), the test should be performed with the operation characteristic points when the products are received, a receiving test should be carried out with individual control point after judging the performance of this relay. Please use this data as a later standard.

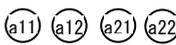
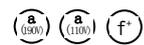
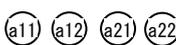
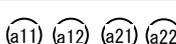
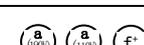
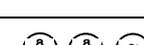
11.2 Withstand Voltage Test

Perform the unit test as follows.

- Apply 2000V AC (commercial frequency) between all electric circuits and case (E terminal) for one minute, and make sure that no problem.

Voltage Applied Terminals	
	

- Apply 2000V AC (commercial frequency) between all electric circuits and case (E terminal) for one minute, and make sure that no problem.

Voltage Applied Terminals	
	
	
	
	
	
	

11.3 Operation Characteristic Test

[Combined with MDG+ZCT]

- For job-site test, it is necessary to check the wiring, that is, the directivity is necessary to be checked. For this check, voltage V₀ is applied from the primary side (high-voltage side) of zero-phase voltage detector. And current I₀ is applied from the primary side of zero-phase current detector (or test terminals Kt, It).
Refer to Fig. 7-4 Test circuit example, please.
- When this test is carried out, be sure that the main circuit is turned OFF.
- Increase the control voltage gradually, the RUN indicator LED (green) will light up at approx. 85V. This indicates that the electronic circuit has started to operate normally.
- With the rated voltage and press the TEST button located relay panel, make sure that the forced operation is available please.

When the display selector switch is set at "3", once the TEST button is pressed, the display will be changed from

—	—
---	---

 to

U	—	I
---	---	---

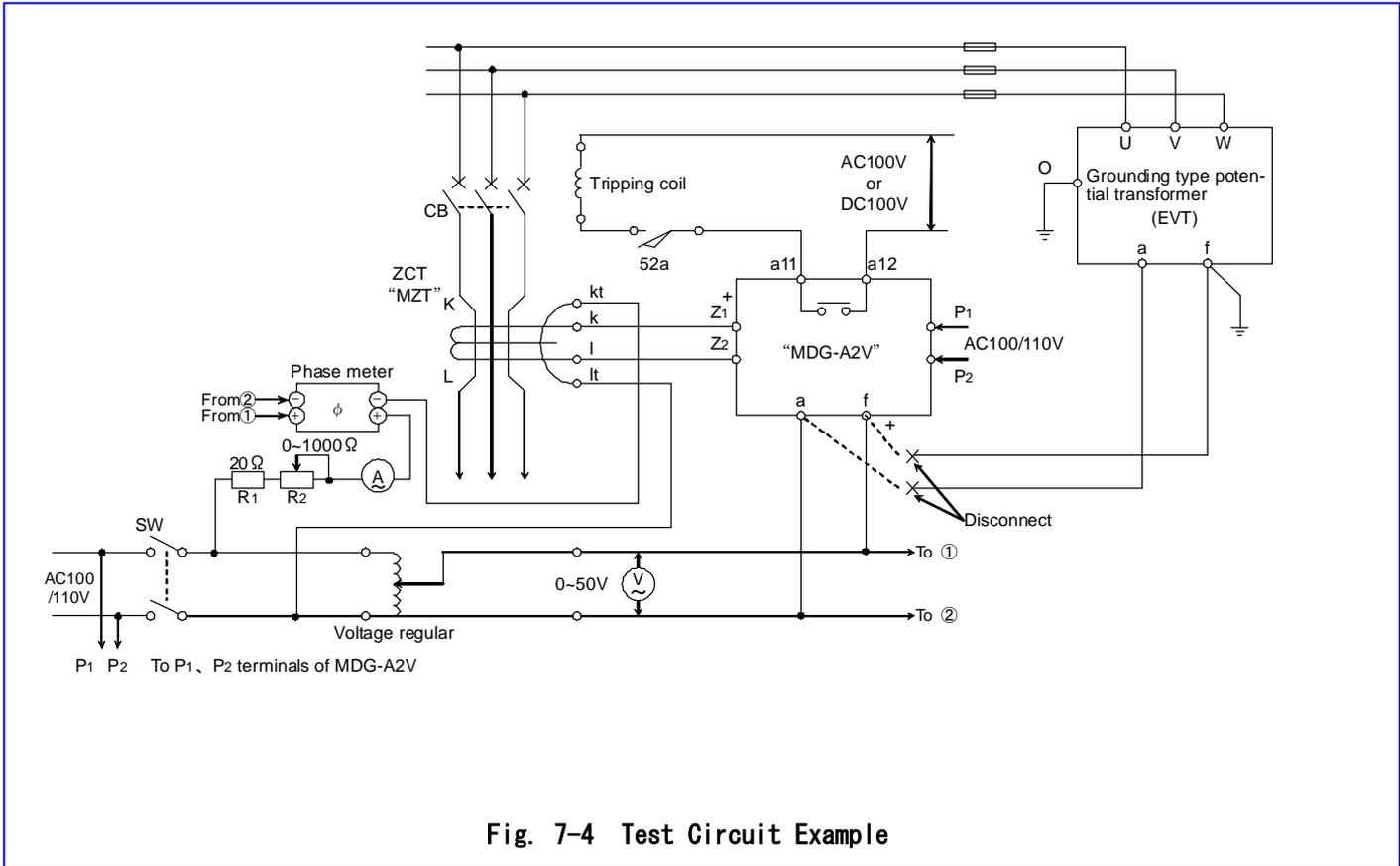
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Note) In the case of that V₀ and I₀ are inputting, it is possible that the relay does not operate even the TEST button was pressed. That is related to the value of V₀/I₀ and the phase. At this time, it is not available to test relay operation.

11.4 Operation Characteristic Control Point

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

Test Item	Test Condition				Criterion
	I ₀ settings	V ₀ settings	Operating Time	Inputs	
I ₀ Operation Value	All settings	Minimum	0.2s	V ₀ =150% of setting Value at maximum sensitivity angle	±10% of setting value
V ₀ Operation Value	Minimum	All settings	0.2s	I ₀ =150% of setting Value at maximum sensitivity angle	±10% of setting value
Phase Characteristics	Minimum	Minimum	0.2s	V ₀ =150% of setting value I ₀ =1000% of setting value	Lag : 35~55° Lead : 125~145°
Operation Time Characteristics	Minimum	All settings	Instantaneous	V ₀ =150% of setting value I ₀ =130% of setting value	50~100ms
			0.2s	Applied at the same time	0.1~0.3s
			Other than the above	at maximum sensitivity angle	±20% of setting value



12. Terminal Layout

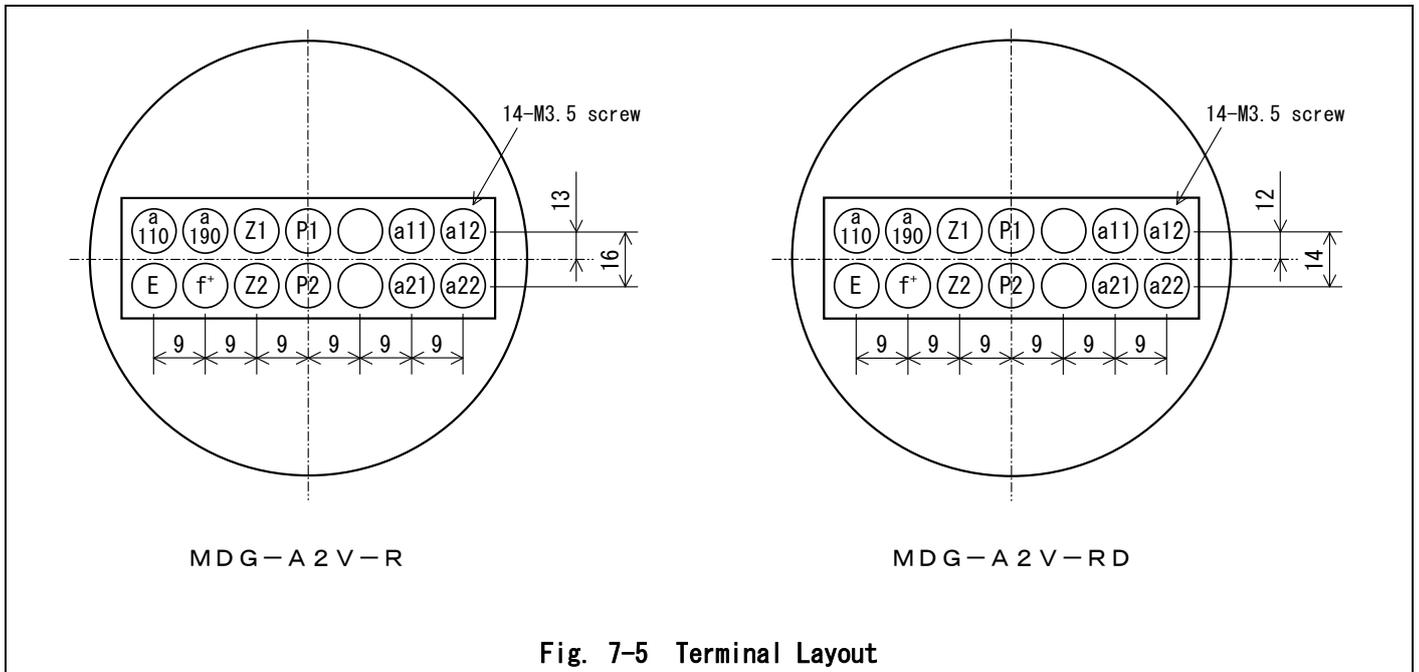


Fig. 7-5 Terminal Layout

● Drawing out and Housing operation of Sub-unit

— For compact cylindrical draw-out type (RD type)

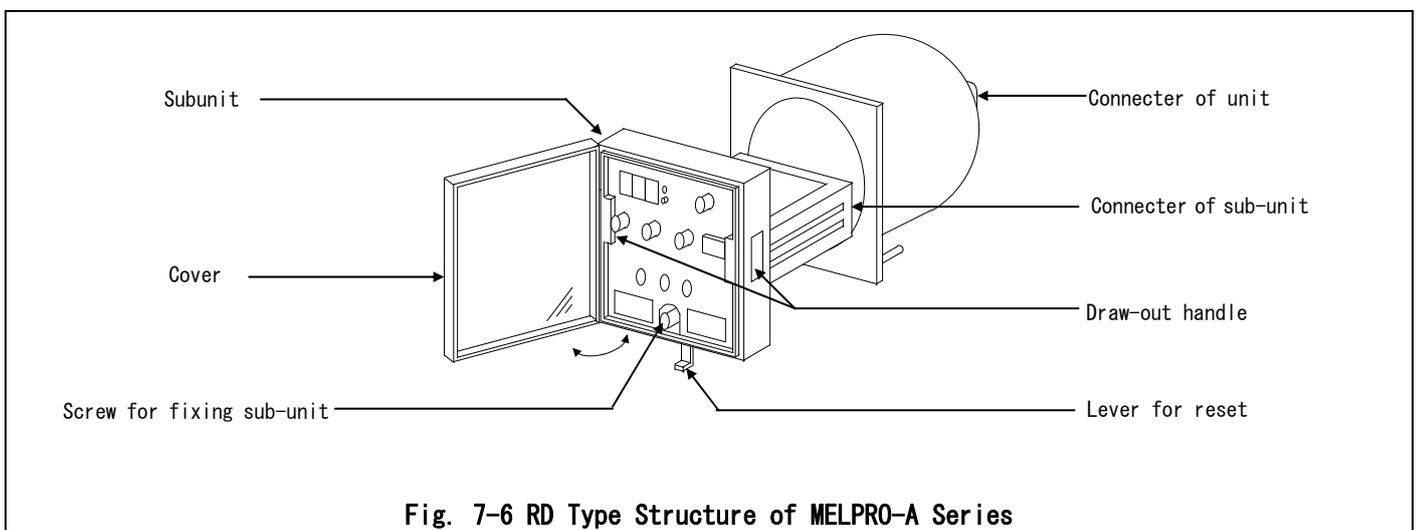
It is available to draw out the sub-unit from the relay case instead of removing the external wires. So that easier to carry out checking and testing.

When drawing out and housing, please pay attention to not to touch the electric circuit and move the sub-unit by handing the lever or from. Otherwise, it is possible to get an electric shock or make internal electric parts damage.

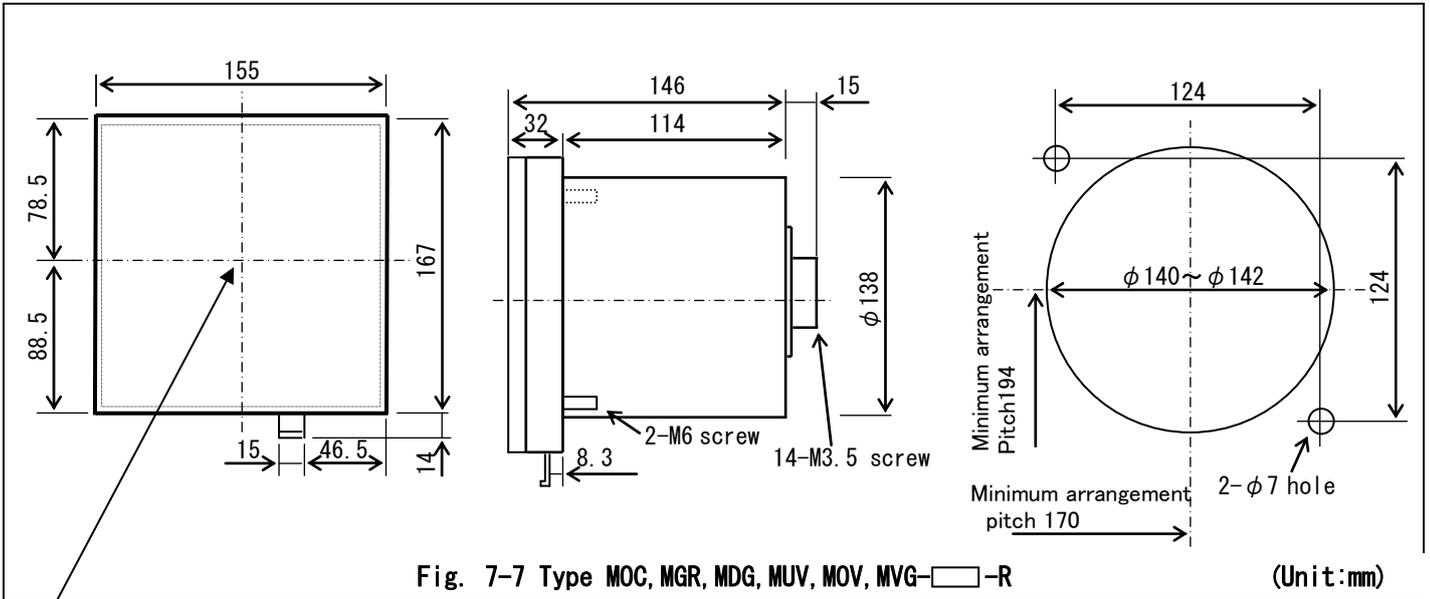
The following operation should be checked when sub-unit be drawn out from relay case.

- Lock the tripping circuit
- Turn off the power supply into relay
- Disconnect CT circuit
- Disconnect VT circuit
- Open the auxiliary power supply (only the drawn out relay)

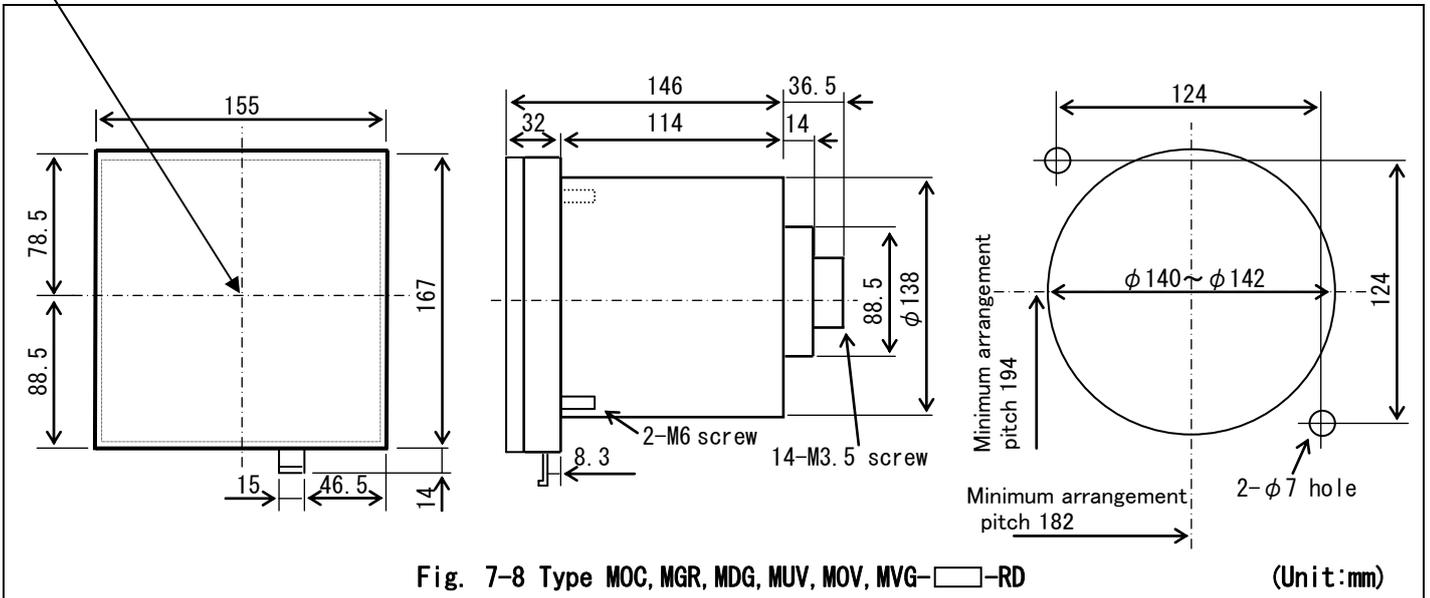
Note) This relay has the function that make the CT secondary automatically short-circuit when draw out the sub-unit from case.



13. Mounting and Dimensions

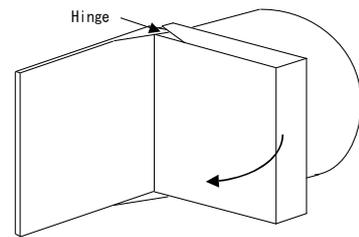


Same as the center lines of $\phi 140\sim 142$ hole

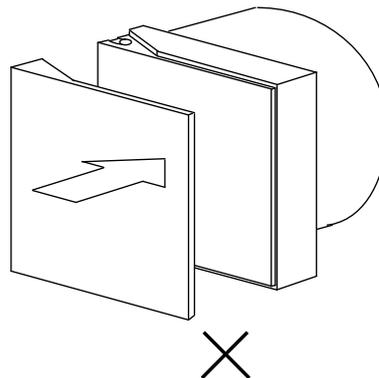
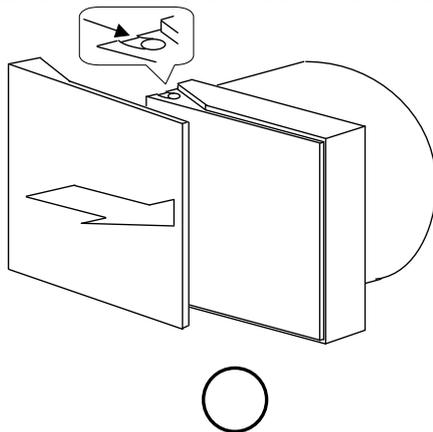


● Cover Handling

Relay cover is opening-and-closing door type. Once forces the cover overload when open it, it will be removed from case. Please refer to the figure shown below to assemble the cover at horizontal direction. (Do not assemble it at the direction of the front.)



[Cover opening-and-closing]



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 than 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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