



Numerical Protection Relay

MELPRO™-A Series
DIRECTIONAL EARTH FAULT RELAY
MODEL
MDG-A1V-R,MDG-A1V-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°C~+60°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 ±5% of rated frequency

- Ambient temperature: 0°C~+40°C (-20°C~+50°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°C±10°C
 - Relative humidity: Less than 90%
 - Magnetic field: Less than 80A/m
 - Atmospheric pressure: 86~106×103 Pa
 - Installation angle: Normal direction±2°
 - Deviation of frequency: within ±1% of nominal frequency
 - Wave form(in case of AC): Distortion factor less than 2%
(Distortion factor=100%×effective value of harmonics/effective value of fundamental)
 - Ripple (in case of DC): Ripple factor less than 3%
(Ripple factor=100%×(max-min)/average of DC)
 - (5) Deviation of auxiliary power: within ±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 MITSUBIHI ELECTRIC CORPORATION shall be out of scope on warranty covered by MITSUBISHI ELECTRIC CORPORATION.
7. Items concerning disposal
- Particular regulations within the country of operation shall be applied to the disposal.

— 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-A1 Series Directional Ground Relay [Standard: JIS C 4609]

Features

1. A digital type relay corresponding ZVT, 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. Standardization of the model <all specification are covered by a single model>
The relay is compatible with each specification by item setting switch changing. (50/60 Hz switching, compatibility and switching with combined, phase characteristics 45° /10° switching, output contact reset system: Self reset/self-holding switching)
7. 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.
8. Forced operation is available by a test button.
9. Not need outside auxiliary power supply
The auxiliary power supply can be supplied by inside circuit of relay.
10. 20 relays can be connected from one relay with Vo expansion terminals.

1. Rating and Specifications

Type Name			MDG-A1V-R		MDG-A1V-RD	
Style No.			092PGA		511PGA	
Element	Protection		Directional earth-fault element (MZT, MPD 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		7V [MPD type ZVT secondary]			
	Auxiliary Power Supply		AC100 / 110V (90 ~ 120V)			
Setting ※ 1	Zero-phase Current (I ₀) Operation Settings		0.1-0.2-0.4-0.6-0.8-1.0A (MZT type ZCT primary Conversion)			
	Zero-phase Voltage (V ₀) Operation Settings		V ₀ (complete earth fault) = Lock-2.5-5-7.5-10% {When 6.6kV complete earth fault 100% V ₀ primary = 3810V, MPD-2 or MPD-3 type ZVT secondary = 7V}			
	Operation Time		Instantaneous-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			
			Max. sensitivity angle : Lead 10° (SW2-ON) / 45° (SW2-OFF) changeover			
Combined ZVT : MPD-1, 2 (SW3-ON) / MPD-3 (SW3-OFF) changeover						
Output contact : Self hold (SW4-ON) / Auto reset (SW4-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	0.05 ~ 1.5A		
			Range	1.0 ~ 100%		
Display	Self Monitoring		The LED "RUN" (green) lights up in normal relay condition.			
	Operation Display		The display turns from black into orange color as the relay is put in operation. (Manual resetting type)			
	Numerical Display		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 (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	Use condition : Condition display		
			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.					

Number of relay connection		Max. 20 relays can be connected through V ₀ extension terminals (M-N)	
Output Contact	Configuration	2 a	
	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 MPD type ZVT with MDG-A1 relay.

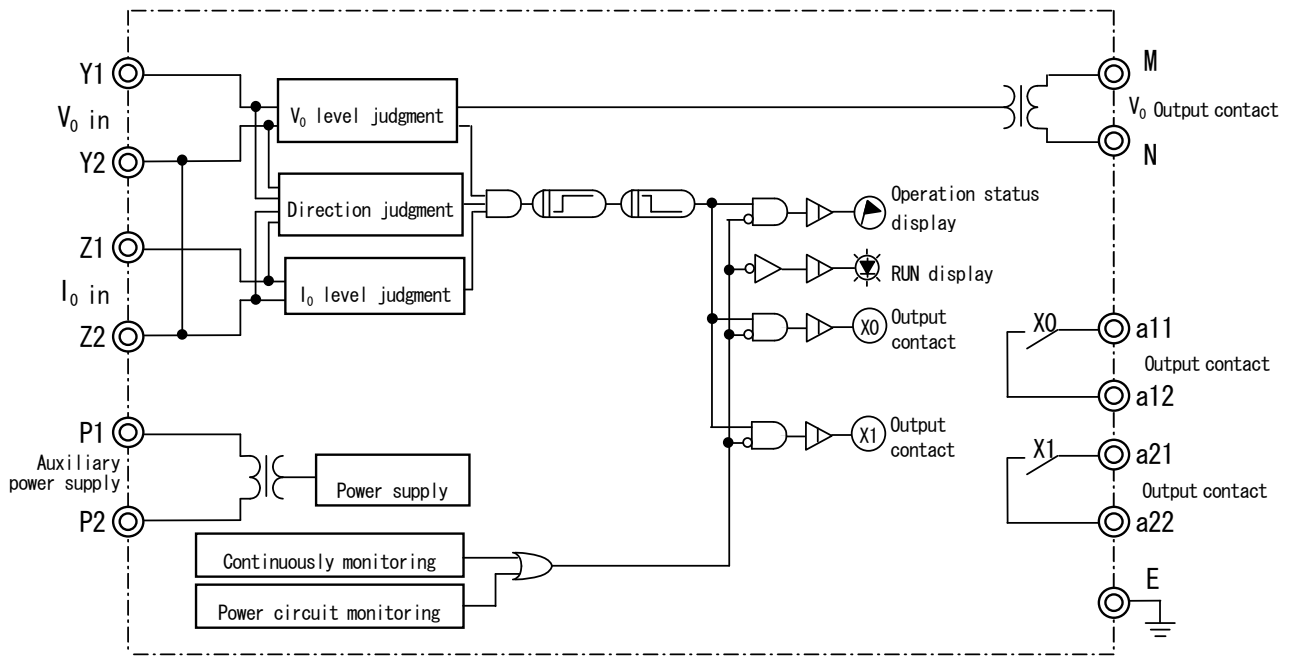
Don' t combine other types with this relay please.

2. Phase Characteristics

Guaranteed conditions	Guaranteed performance	
Rating frequency Ambient temperature : 20°C Auxiliary voltage : Rated voltage Operation time settings : 0.2s Zero-phase current setting : 0.1A Zero-phase voltage settings : 2.5% Zero-phase current input : Setting value × 1000% (1.0A) Zero-phase voltage input : Setting value × 150% (143V) I _o operating area at Max. sensitivity angle. (V ₀ standard)	Phase setting	Max. sensitivity angle
	Lag	45° ±20°
	Lead	135° ±20°
	Max. sensitivity angle	Max. sensitivity angle
	45°	10°
	80° +5° -30°	100° +30° -10°
	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Max. sensitivity angle 45° (For non-earthing)</p> </div> <div style="text-align: center;"> <p>Max. sensitivity angle 10° (For preacher earthing)</p> </div> </div>	

3. Internal Connection

3.1 MDG-A1V-R



3.2 MDG-A1V-RD

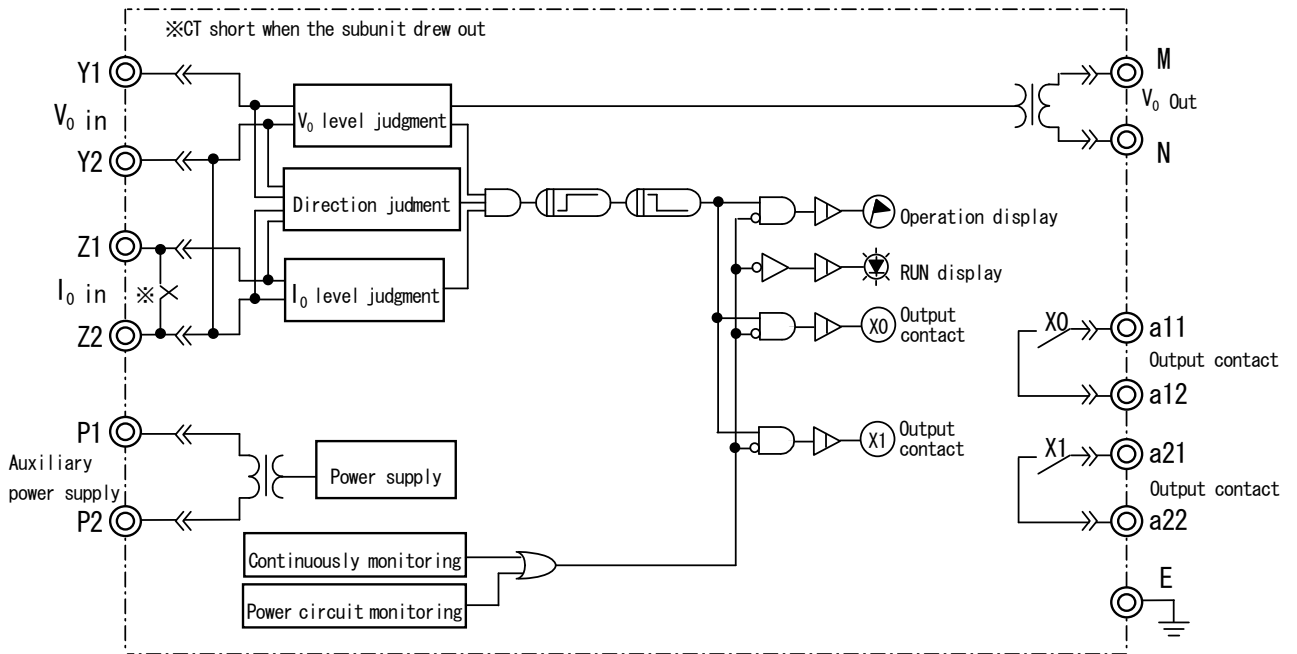


Fig. 3-1 Internal Connection Diagram

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: 0.05~1.50 A (ZGT 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
- Operating conditions display
The operating condition settings are displayed sequentially at intervals of 2 seconds.

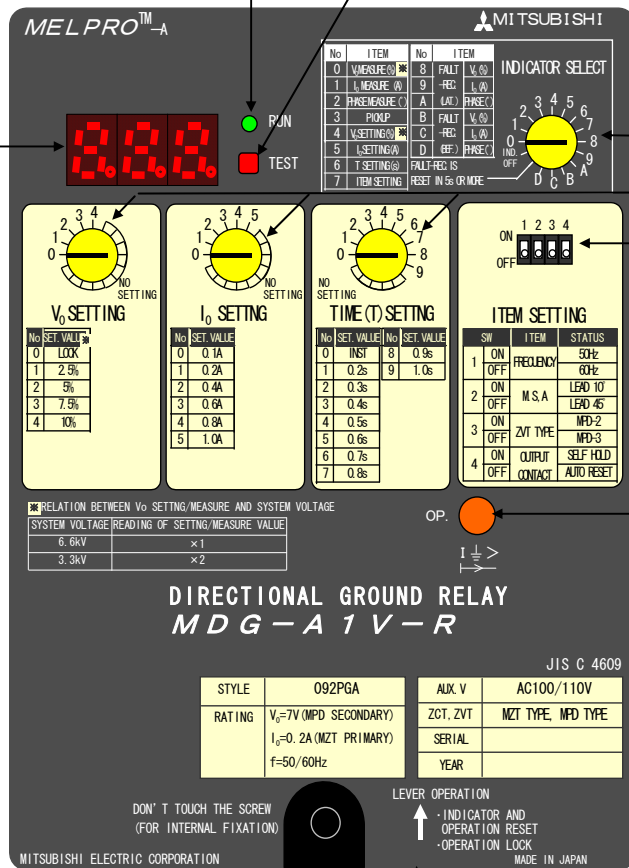
Display	50	10	2	HO.
Setting	ON	50Hz	Leading 10°	MPD-1,2
	OFF	60Hz	Leading 45°	MPD-3
Display	60	45	3	FU.

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

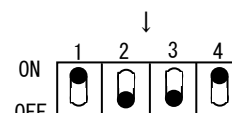
- Set the setting value
- To change the setting with hand or a small (-) screwdriver.

Operating conditions setting switch

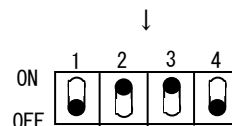
- Frequency
- Maximum senility angle (operating phase)
- Used ZVT
- Output contact reset system

The above operating condition can be set with the ON/OFF switch.

Example 1: 50Hz-leading 45° (isolated system)
<Case of self-holding and MPD-3 using>



Example 2: 60Hz-leading 10° (reactor grounding system)
<Case of self-reset and MPD-2 using>



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. 3-2 MDG-A1 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 respective operating conditions (frequency, maximum operating sensitivity angle, combined ZVT and output contact) with the operating condition setting switch.
- ③ Zero phase voltage input is supplied from secondary output of type MPD-2 or MPD-3 zero-phase voltage detector combined with the relay. And this zero-phase voltage will be changed to digital signal by a A/D converter and as data input microcomputer.
Zero phase voltage input, after passing through the filter circuit, is derived to Vo expanded output terminals (M .N) through small current transformer as a signal or Vo expansion besides the above.
- ④ Zero phase current input 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 a 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 (Vo, Io, 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 Vo 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 Vo. 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%” denotes the 6.6 kV system: 3,180V is obtained with single phase completely grounded, and 7 V is obtained with MPD type ZVT secondary output voltage.

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

- ② Io 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 Io. 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 Io phase based on Vo. The display range is 0° to 359° (lag).
- ④ Vo, Io pick up... (switch position : 3) ...
When the Vo and Io input exceed each setting value,

U.	—	I.
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 is displayed.
When set switch position 3

	—	
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 is displayed,
When the input are more than each settings (Vo and Io setting)

U.	—	I.
----	---	----

 is displayed.
(Vo pick up :

U.	—	
----	---	--

 Io pick up :

	—	I.
--	---	----

)
Using this function, easy to test the Min. operating value.
When pressing the TEST button

U.	—	I.
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 is displayed

- ⑤ Setting value display... (Switch position : 4~6) ...
This function displays the relay setting condition: it displays the zero phase voltage Vo settings (%), zero phase current Io settings (A) and operation time T settings (s).

- ⑥ Operating condition display... (Switch position : 7) ...
Once set the operating conditions setting switch on 7, with the setting of SW1~4, the following contents will be displayed in sequence at intervals of 2 seconds and then the LED goes out. If you want to display it again, please change the display switch to other position first, and then return back position 7 again.

Setting(example)	50Hz _z	leading10°	MPD-1.2	Self-holding
Display	50	10	2	HO.

Setting(example)	60Hz _z	leading45°	MPD-3	Auto-reset
Display	60	45	3	FU.

- ⑦ Fault records (Newest) display... (Switch position : 8~A) ...
To display the newest fault data including Vo, Io and phase* value recorded when fault occurred.

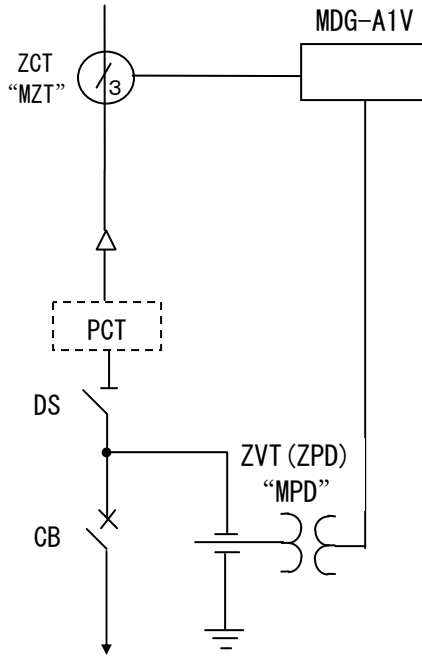
- ⑧ Fault records (last time) display... (Switch position : B~D)
To display the fault data including Vo, Io and phase* value recorded when fault occurred last time.

- 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.

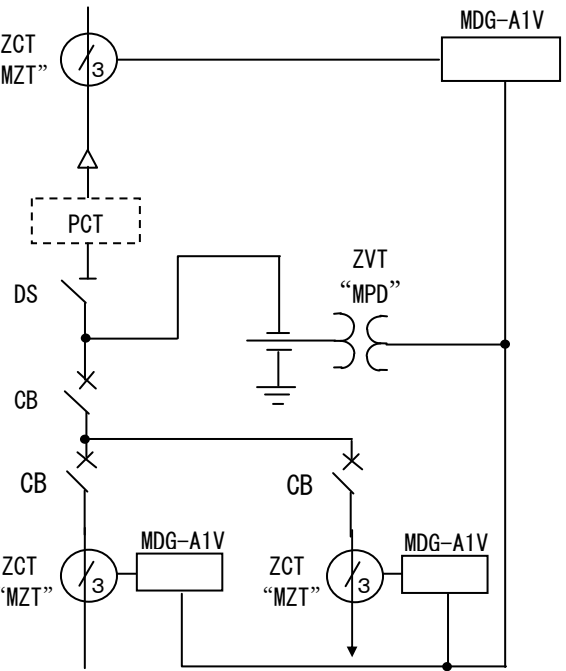
※The display range of the Io phase based on the Vo is 0° to 359° (lag)

6. Application Example

a) Single circuit

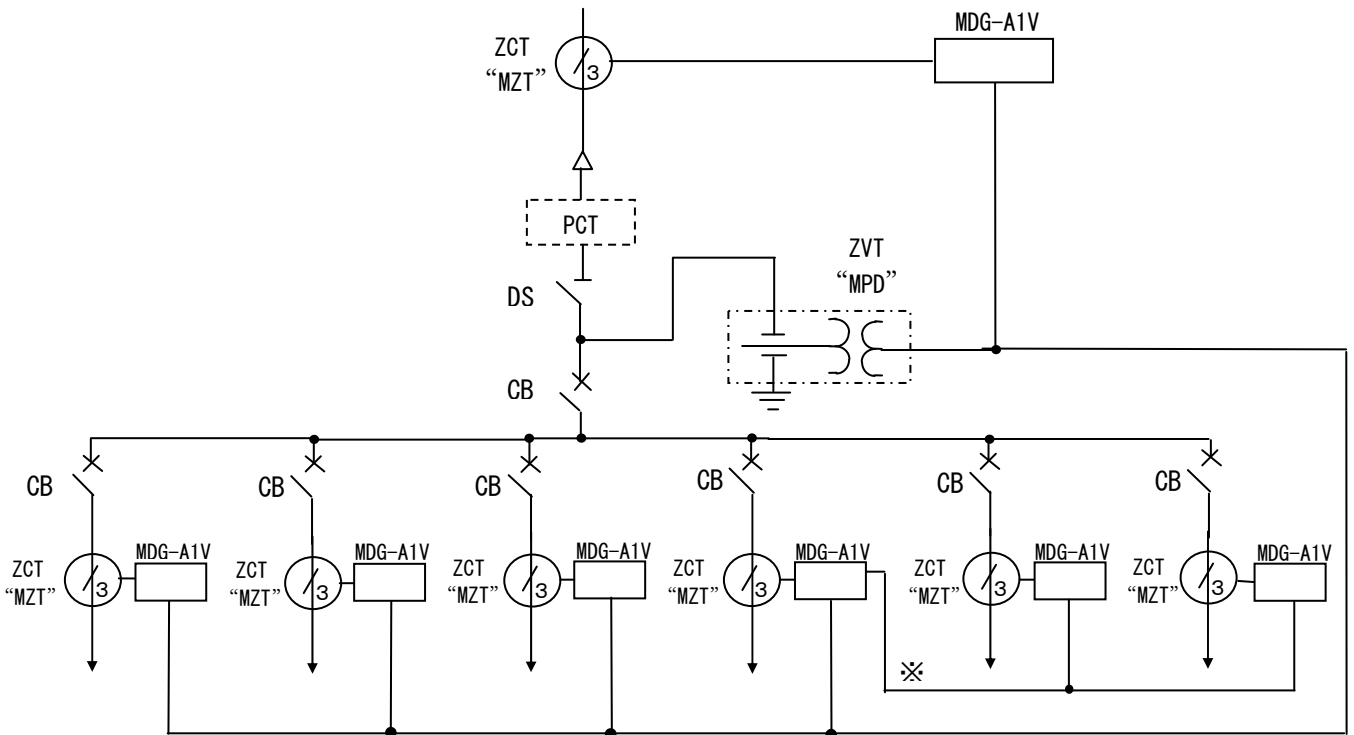


b) Multiple circuits (Directly supply V_0 from MPD type ZVT)



In case of MPD-2 type ZVT: V_0 supply to Max. 10 units available
 In case of MPD-3 type ZVT: V_0 supply to Max. 5 units available

c) Multiple circuits (Directly supply V_0 from MPD type ZVT and V_0 expansion terminals (M, N) of MDG-A1 type relay)

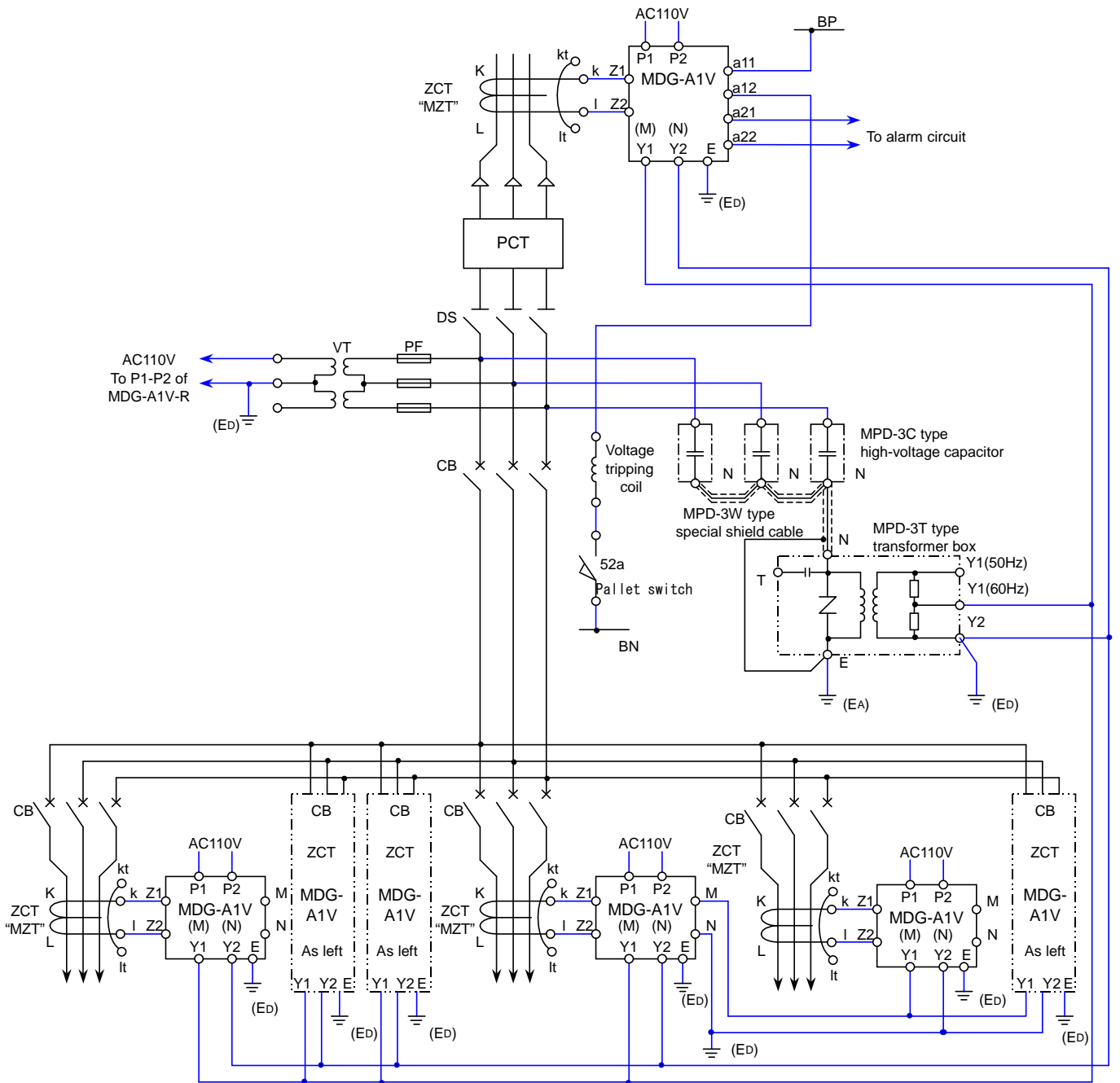


The ※ marked part means that the V_0 is supplied from V_0 expansion terminals (M, N) of MDG-A1 type relay. Consider that the MDG-A1V relays which supplies V_0 for expansion is supplied with V_0 directly from the MPD type ZVT. 20 relays can be connected for per unit.

Fig. 3-3 Application of MDG-A1V type relay

Note) For type MPD-2, provide DS or PCS on ZVT primary side please.

7. External Connection Diagram (Example)



Notes)

- For write materials from ZCT and ZVT to the relay , and write materials for connection from V_0 expansion terminals (M-N) , use 2-core shielded wire of $0.75\sim 1\text{mm}^2$ please.
The both ways load shall be less than $5\ \Omega$. (The cable length, at case of 0.75mm^2 2-core shield, is approx. less than 100m one way.)
- In case of multiple relays connected with ZVT, supply V_0 to each feeder, from V_0 expansion terminals (M, N) of MDG-A1V relay please. (Max. 20 relays can be connected. but for the MPD-2, Max. 10 relays can be connected, and for the MPD-3, Max. 5 relays can be connected.)
- The MDG-A1V relay which supplies V_0 to other units shall receive V_0 directly from the MPD type .
- The CB tripping circuit and alarm circuit of MDG-A1V relay for feeder protection are omitted in this figure above.
But the corresponding circuit of the power receiving part is required
- In this figure the voltage tripping system is shown. For CT tripping, the MGX-1 type auxiliary box is necessary.
- For MDG-A1V-RD type relay, please connect terminals Z_2 and Y_2 with 2mm^2 cable when sub-unit is drew out.
- Do not connect the "I" terminal of MZT type ZCT to ground please.
- If ZVT is of a type MPD-2, provide DS or PCS at the primary side of ZVT please.

图 3-4 External Connection Diagram

8. Setting and Operation conditions setting

8.1 Setting

Normally, the operating values are set as follow, but these values should be set with due consideration given to various conditions of the systems, such as residual voltage and current, and protection coordination.

<Sample setting of MDG relay>

• Power receiving point :

$$I_0=0.2\sim0.4A \text{ (※)}$$

$$V_0=5\sim10\% \text{ (※)} \quad T=0.2\sim0.3s \text{ (※)}$$

• Branch feeder :

$$I_0=\text{equivalent to power receiving point or smaller}$$

$$V_0=5\sim10\% \text{ (※)} \quad T=\text{Instantaneous (Approx. 75ms)}$$

※ about the setting, please discussion with electric power company and then set it.

In addition, when take V_0 setting, can set it more than V_0 measured value in order to avoid unwanted operation.

8.2 Operating conditions setting

All of operating condition switch is set OFF position at time of shipment. Set it according to operating conditions when beginning use please.

(1) Frequency

When use 50Hz, set SW-No.1 to ON position (up side). And when use 60Hz, set SW-No.1 to OFF position (down side) please.

(2) Max. sensitivity angle

For a reactor-grounding system, set SW-No.2 to ON position (up side). And for a isolated system, set SW-No.2 to OFF position (down side).

(3) Combined ZVT

When combined with zero-phase voltage detector MPD-2 type, set SW-No.3 to ON position (up side). And when combined with zero-phase voltage detector MPD-2 type, set SW-No.2 to OFF position (down side). In addition, when combined with zero-phase voltage detector MPD-1 type, also set SW-No.3 to ON position (up side).

(4) Output contacts

If you want to set output contacts self-holding, please set SW-No.4 to ON position (up side). And if you want to set output contacts auto-reset, please set SW-No.4 to OFF position (down side).

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.

(If short circuit, relay does not operate.)

(2) Wiring material

Since the MDG-A1 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/white) to connect ZCT with terminals (Z1, Z2, Y1, Y2, M, N) of relay, and connect the shield with relay terminal "E" .

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 ZVT

with relay.

(Refer to the external connection diagram)

Grounding point is also important. Please pay attention to.

(4) ZVT position

The position of ZVT is not related to CB power supply and load side in characteristics and protection.

(5) ZVT protection :

For MPD-2 type ZVT, insert a fuse (MITSUBISHI PL-G type 7.2/3.6KV T1A) or cut-out into each phase at the high voltage side.

For MPD-3 type ZVT, DS is not required.

(6) Power cable shield earth

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

(7) Power cable handing

Take care in handing 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.

(8) ZVT grounding

Provide Class A grounding for MPD-2 type ZVT“E”terminal and case. For MPD-3 type , provide Class A grounding for terminal “E” .

(9) MDG-A1V relay grounding

Since terminals Z_2 - Y_2 are short-circuited inside the MDG-A1V relay, ground only Y_2 terminal of MPD-2/MPD-3 type ZVT or MDG-A1V type relay. It is better to ground Y_2 terminal of ZVT.

When V_0 expansion terminal is used, ground only N terminal of the MDG-A1V relay.

<Withstand voltage test>

(1) 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 ZVT secondary side (or ZCT secondary side) and VT secondary side grounding is provided.

When V_0 expansion terminal is used, make sure that to ground N terminal of the MDG-A1V relay.

(2) For the test between low-voltage circuit and earth, make sure that to remove the ZVT secondary side (or ZCT secondary side) and VT secondary side from earth. When V_0 expansion terminal is used, make sure that to remove N terminal of the MDG-A1V relay from earth.

10. Handling Method

10.1 Panel assemble

- ①Do connect the relay terminal “E” to earth at Class D please.
- ②Type MDG-A1V-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

- ①Before in-service, the setting suitable for the operating conditions (frequency, phase characteristics, combined ZVT and output contact reset system) is required for operation by the operating condition setting switch.
- ②Avoid 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.
- ③To 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.
- ④The 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.
- ⑤The position of the display selector switch is not specified in particular, but if it is normally set to 0| V_0 Measure(%). The input zero phase voltage value can be measured conveniently.
- ⑥Since the RUN indicator LED is lighting during the normal operation, check it in routine checking, for example. When it is OFF, check VT secondary input voltage value, and if it is still OFF even OFF at approx. 85v or more, contact our local agent and branch office since the relay may fail.

11. Test

This equipment (relay, ZCT) is factory tested sufficiently before shipment. In the following cases, however, it is recommended that the test be carried out.

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

11.1 Testing

- ① For voltage and current input waveforms, use a sine wave without distortion please.
- ② To select the switch for each setting with hand or use a small regular screwdriver.
- ③ 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.
- ④ 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.

- a. Do not input voltage to Z₁-Z₂ circuit please.
- b. 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	
(Y1) (Z1) (P1) (M) (a11) (a12)	(E)
(Y2) (Z2) (P2) (N) (a21) (a22)	

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

Terminals Voltage Applied	
(P1) (P2)	(a11) (a12) (a21) (a22)
(Y1) (Y2)	(a11) (a12) (a21) (a22)
(Z1) (Z2)	(a11) (a12) (a21) (a22)
(M) (N)	(a11) (a12) (a21) (a22)
(P1) (P2)	(Y1) (Y2)
(P1) (P2)	(Z1) (Z2)
(P1) (P2)	(M) (N)
(Y1) (Y2)	(M) (N)
(Z1) (Z2)	(M) (N)

Note) Do not apply test voltage between (Y1) (Y2) ~ (Z1) (Z2).

11.3 Operation Characteristic Test

[Combined with MDG+ZCT+ZVT]

- ① For job-site test, it is necessary to check the wiring, that is, the directivity is necessary to be checked. For this check, voltage is applied from the primary side (high-voltage side) of zero-phase voltage detector. There are two test methods. One is that to combine every equipment to form a test circuit (refer to Fig. 3-5). And the other is that to use a relay tester (refer to Fig. 3-6).
- ② When this test is carried out, be sure that the main circuit is turned OFF.
- ③ 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.
- ④ 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

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 to

U.		
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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	±25% of setting value
Phase Characteristics	Minimum	Minimum	0.2s	V ₀ =150% of setting value I ₀ =1000% of setting value	Maximum sensitivity angle = 45° (For isolated system) Lag : 25~65° Lead : 115~155° Maximum sensitivity angle = 10° (For PC grounding) Lag : 50~85° Lead : 90~130°
Operation Time Characteristics	Minimum	All settings	Instantaneous	V ₀ =150% of setting value I ₀ =130% of setting value Applied at the same time	50~100ms ※
			0.2s	at maximum sensitivity angle	0.1~0.3s
			Other than the above		±20% of setting value

※ The operation time is 50 to 110 ms when this relay is combined with MPD-2 type ZVT.

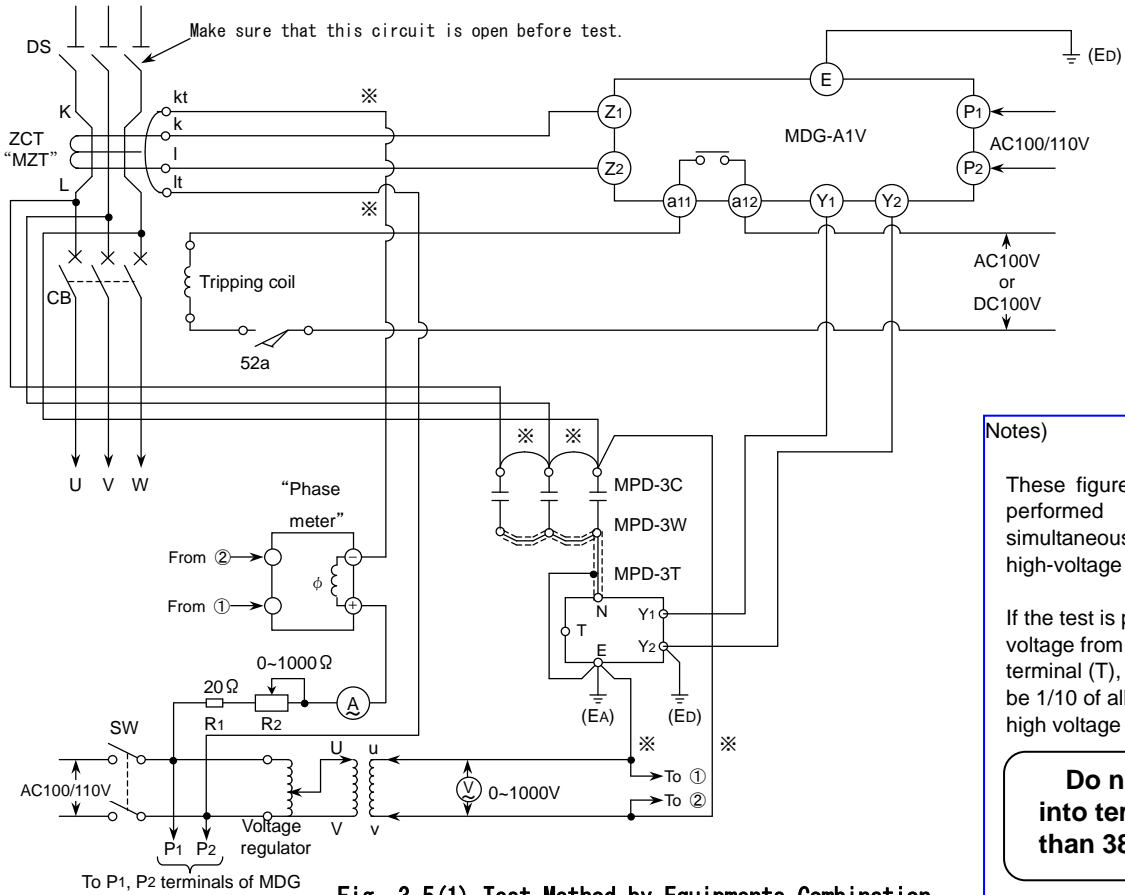


Fig. 3-5(1) Test Method by Equipments Combination

Notes)

These figures show that the test is performed by applying voltage simultaneously in 3-phase to the high-voltage side of MPD-3.MPD-3C.

If the test is performed by applying voltage from MPD-3T test terminal (T), the voltage value should be 1/10 of all 3-phase input at the high voltage side.

Do not apply voltage into terminal "T" more than 380V !

- At the case of that there are not terminals of kt and lt on ZCT, Please pass the red clip of current element cord through ZCT thru-hole for short circuit with the black clip and turn power on.
- For the relay of MDG-A1V, the ⊕ input polarity is that: Z1 with I₀ input and Y2 with V₀ input.
- Do not forget to remove the wires marked by "※" in the figures after test.
- When test using the test terminal "T", the wires marked by "※" in the figures are not required.

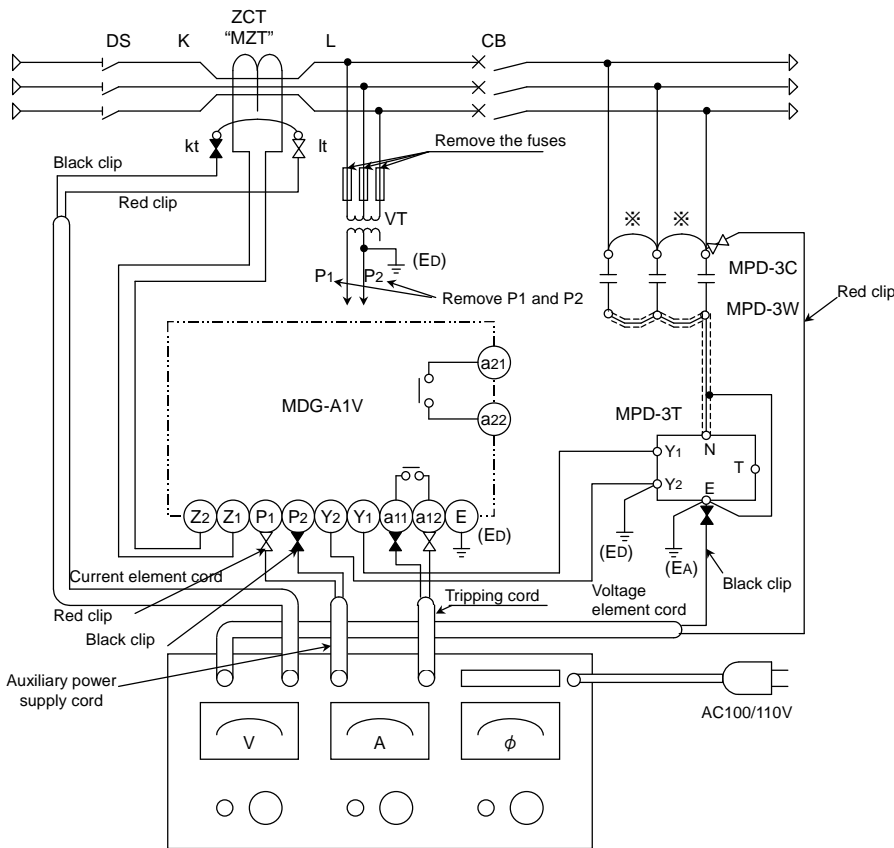


Fig. 3-6(1) Test Method Using Relay Tester

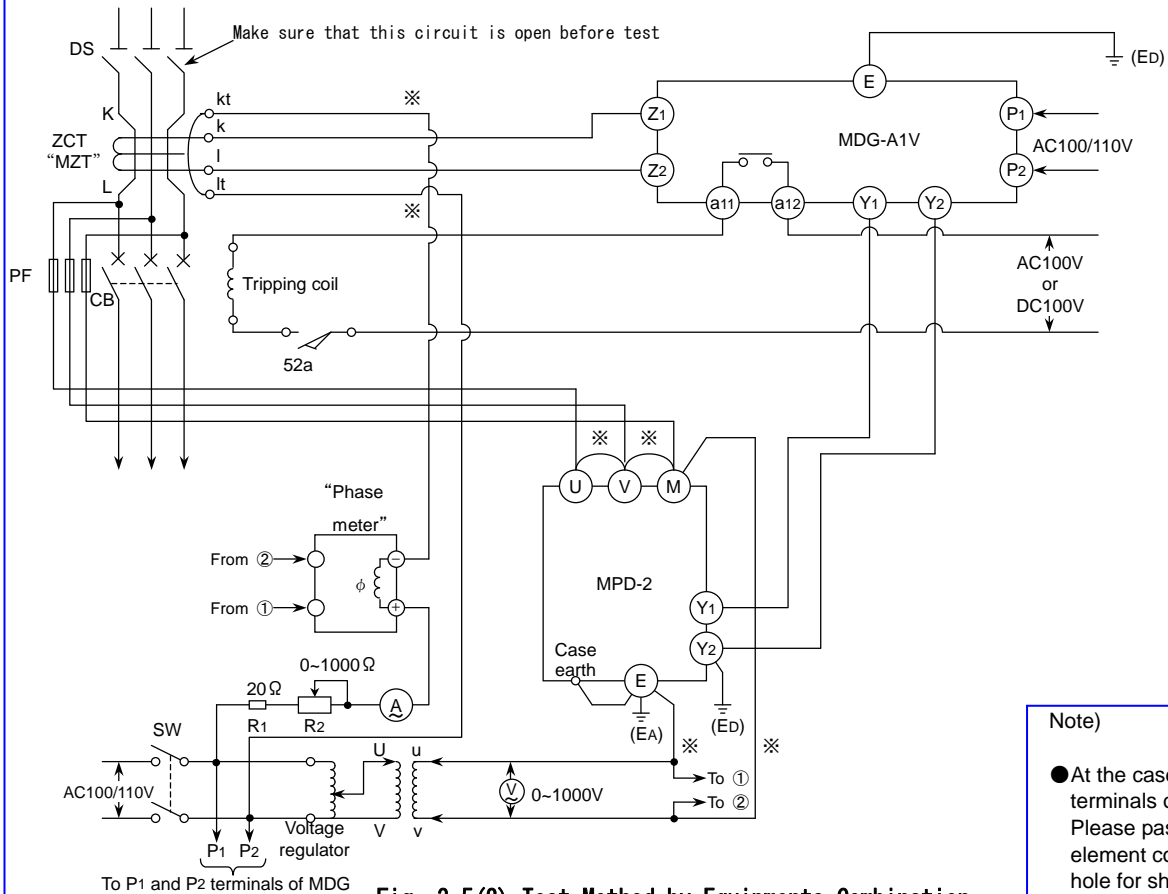


Fig. 3-5(2) Test Method by Equipments Combination

Note)

- At the case of that there are not terminals of kt and lt on ZCT, Please pass the red clip of current element cord through ZCT thru-hole for short circuit with the black clip and turn power on.
- For the relay of MDG-A1V, the ⊕ input polarity is that: Z1 with I_o input and Y2 with V_o input.
- Do not forget to remove the wires marked by "※" in the figures after test.

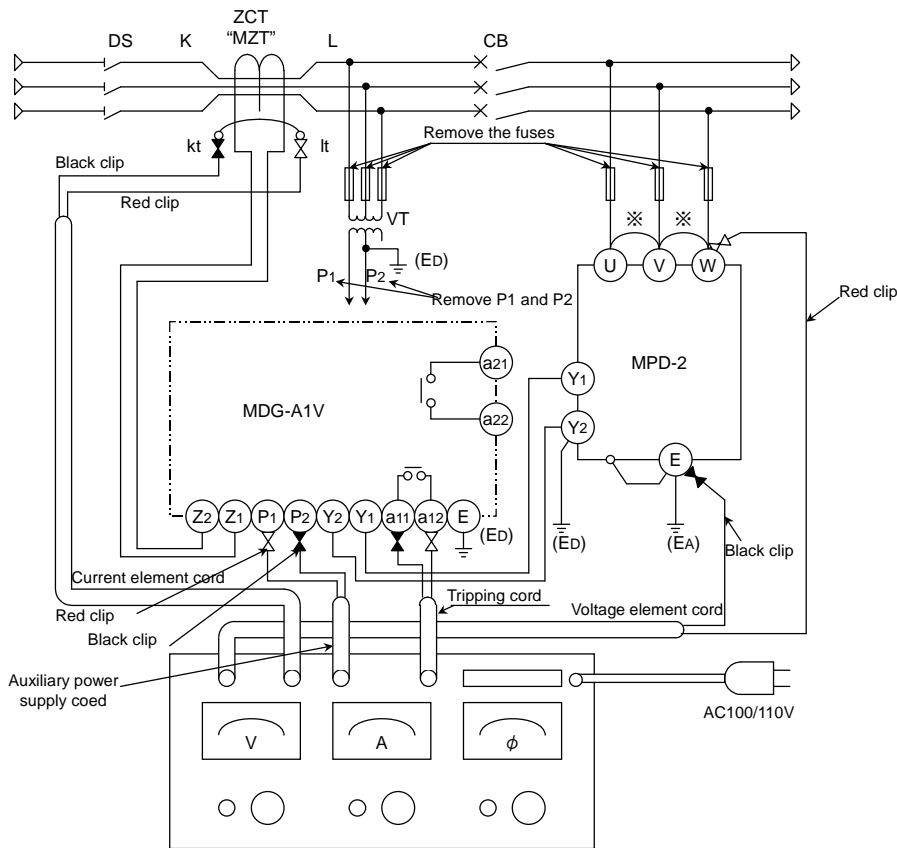


Fig. 3-6(2) Test Method Using Relay Tester

12. Terminal Layout

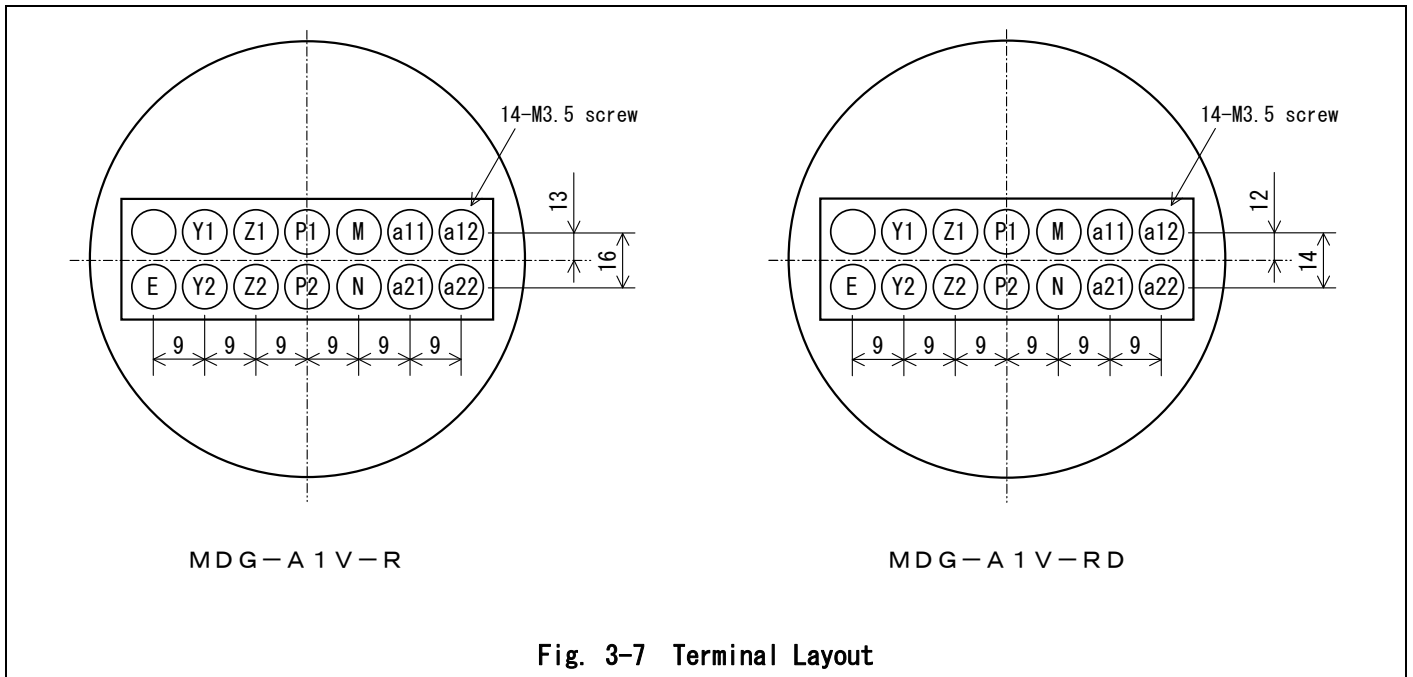


Fig. 3-7 Terminal Layout

● 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.

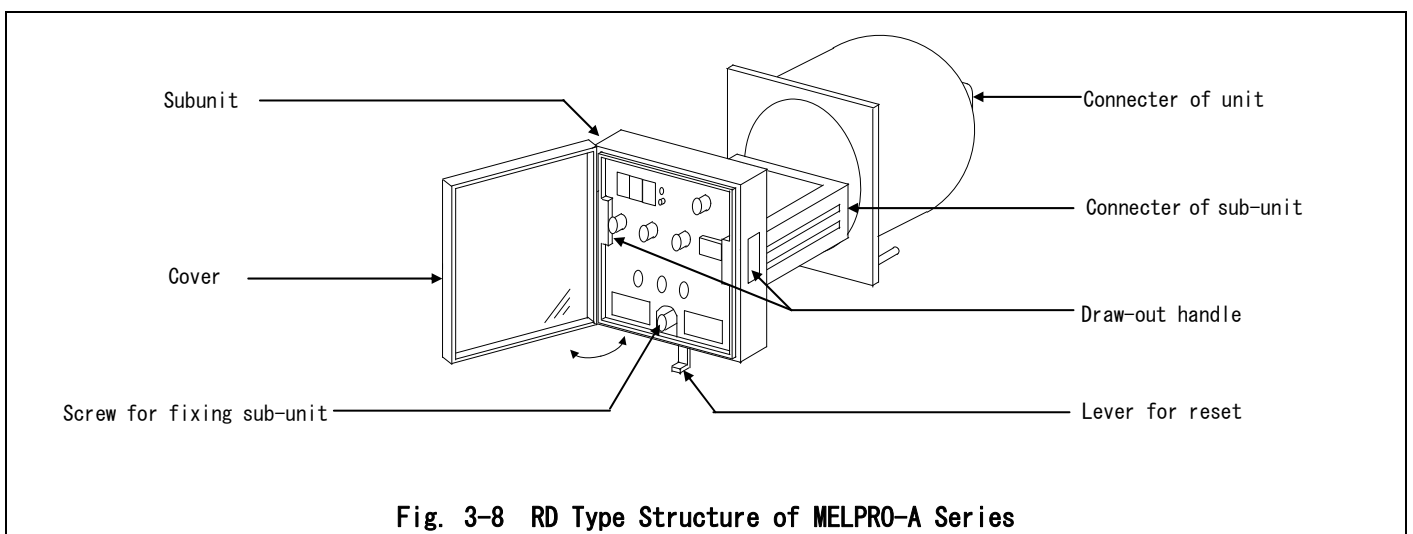
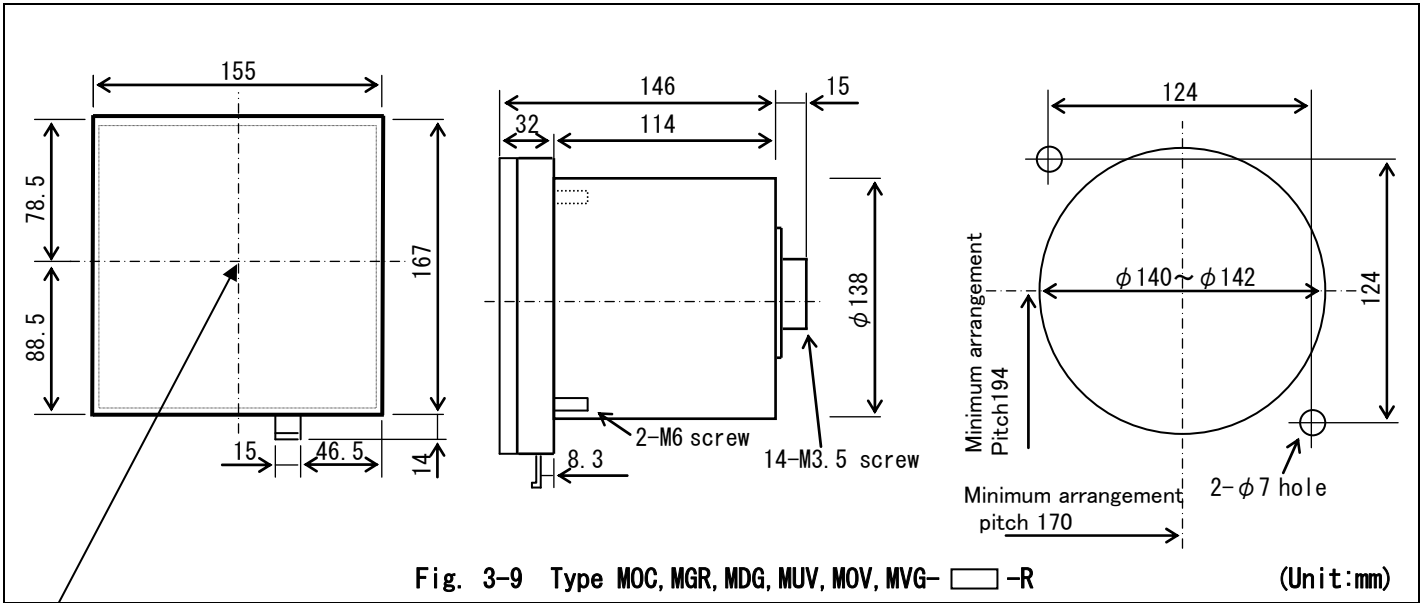
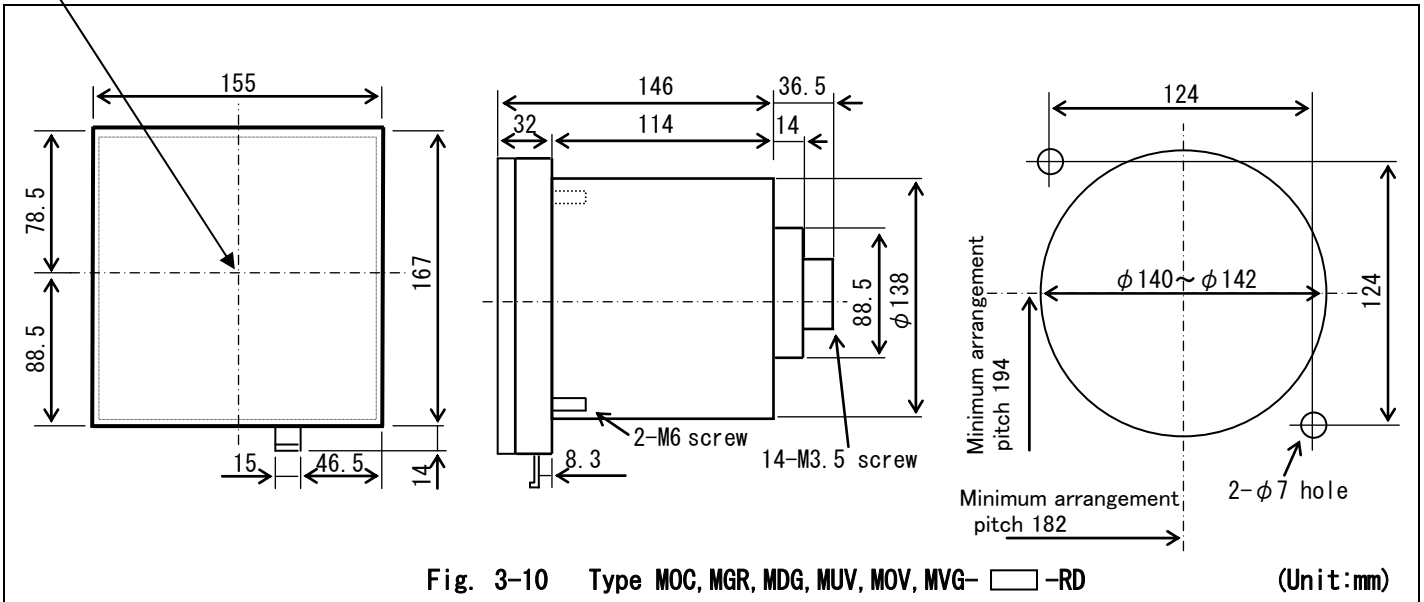


Fig. 3-8 RD Type Structure of MELPRO-A Series

13. Mounting and Dimensions

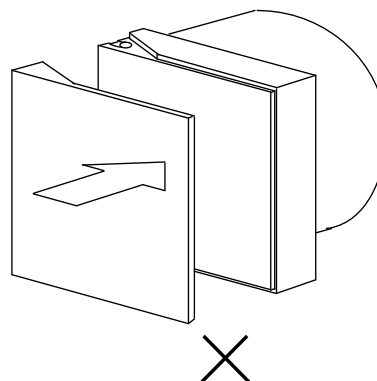
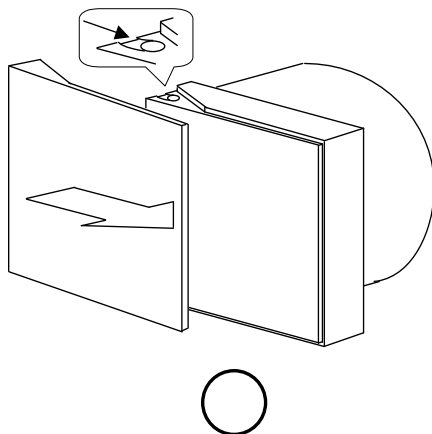
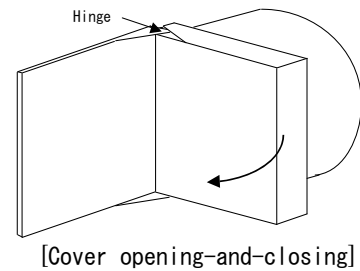


Same as the center lines of φ140~142 hole



● 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.)



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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