



Numerical Relay MELPRO™-S Series

MODEL

CBV2 - A02S1



COC4 - A02S1


OPERATION MANUAL

- Safety precautions -


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 “Danger” and “Caution.”


	Danger	The case where a dangerous situation can arise and there is the possibility that death or seriously injury can occur if the equipment is handled incorrectly.
	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.

[Transportation]

 Caution
<ul style="list-style-type: none"> ● 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.

[Storage]

 Caution
<ul style="list-style-type: none"> ● The storage environment shall comply with the following conditions. Otherwise, there is a risk of reducing the performance and life of the product. <ul style="list-style-type: none"> - Ambient temperature -25 to +70°C The state where dew condensation or freezing does not occur. • Frequency variation Within ±5% of the rated frequency - Altitude 2000 m 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 vapour, excessive dust or fine powder, explosive gas or fine powder, wind & rain.

[Installation, wiring work]



Danger

- 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.
- 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.



Caution

- Ensure that the equipment is mounted and connected correctly. Otherwise, there are risks of failure, burning, or mal-operation.
- Securely tighten the terminal connection screws. Otherwise, there are risks of failure and burning.
- Ensure that the equipment is connected correctly in accordance with the details shown on the connection terminals. Otherwise, there is the risk of failure, burning, malfunction, or maloperation.
- Ensure that the equipment is connected correctly in accordance with the phase sequence details shown on the connection terminals. Otherwise, there is the risk of failure, burning, malfunction, or maloperation.
- All power supplies to the equipment must be of suitable capacity and rated load to avoid the risk of malfunction and maloperation.
- The appropriate connectors must be used to ensure compatibility with the connector terminals to avoid the risks of failure or fire.

[Operating and Setting the equipment]



Danger

- 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.



Caution

- 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 control power supply voltage Within -15% to $+10\%$ of the rated voltage
 - Frequency variation Within $\pm 5\%$ of the rated frequency
 - Ambient temperature -10 to $+55^{\circ}\text{C}$
(-10 to 50°C is allowable temporarily within few hours a day, but use under the state where dew condensation or freezing does not occur.)
 - Altitude 2000 m 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.
- While energized, do not tamper with or remove any components other than those which have been designated. Otherwise, there is a risk of 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.

[Maintenance and Inspection]



- 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.
- Do not touch any live parts, such as terminals, etc. Otherwise, there is a risk of electric shock.



- 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.
- 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°C |
| • Relative humidity | 90% or less |
| • External magnetic field | 80 A/m or less |
| • Atmospheric pressure | 86 to 106 × 10 ³ Pa |
| • Mounting angle | Regular direction ±2° |
| • Frequency | Rated frequency ±1% |
| • Waveform (in the case of AC) | Distortion factor 2% or less |
| | 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 |
| | Ripple factor = $\frac{\text{Max. value} - \text{Min. value}}{\text{Average value of DC}} \times 100 (\%)$ |
| • Control power supply voltage | Rated voltage ±2% |

- Do not exceed the overload capacity for voltage and current. Otherwise, equipment failure or fire could occur.
- Do not clean the equipment while energised. When the cover needs to be cleaned, make use of a damp cloth.

[Repair and modification]



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

[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 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

(1) The 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.

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

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

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

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

(4) The 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.

(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 un-correct 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 (seven) years after production of the product is discontinued. (However, please consider the replacement of products after 15 years have been passed from ex-work of products.)

(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 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.

- Introduction -

Thank for your purchasing MITSUBISHI ELECTRIC **MELPRO™** – S Series Digital Protection Relay.
Please read this instruction manual carefully to be familiar with the functions and performances enough to use the product properly.

It is necessary to forward this instruction manual to end users and a person in charge of maintenance.

This “OPERATION MANUAL” explains front panel operation (human machine interface, HMI) and how to use it. The MELPRO-S series main function –such as protection function overview, operation method– should be read each relay device instruction manual.

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1. Features

Flexible and reliable protection functions

- Fine setting step of protection elements enables flexible use for various applications.
- 16 kinds of operation time characteristics and wide setting range of time multiplier is available for overcurrent protection element.
- Fault record function (10 records at a maximum) is provided for fault analysis.
- Modbus interface using RS-485 is provided for remote communication.
- Password-protected human-machine interface enables secured operation.

Highly Accurate Digital Computation

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

Self-diagnosis

- The continuously monitoring of electronic circuits from input to output can detect internal failure before the failure causes damage on the power system.

Compact size

- The compact relay designed for space-saving is suitable for replacement of existing ones.

Energy saving

- Low power consumption of the relay is effective in miniaturization of CT and VT as well as energy saving.



Fig. 1-1 Front view of MELPRO-S Series

2. Relay Specification

In this section, the relay specification such as the rating and relay element is explained.

2.1. General specification (CBV2-A02S1)

Table 2-1 General specification (CBV2-A02S1)

Name		Over/Undervoltage Relay	
Relay Model		CBV2-A02S1	
Style		563PQB	
Elements	Protection		Undervoltage element (27)
			Overvoltage (59)
Rating	Frequency		50Hz / 60Hz (selectable)
	Voltage		AC110V
	Aux. power supply	Voltage	AC100V – 110 V DC100V – 125 V *1
		Operative range	AC: 85–126.5 V DC: 85-143 V *1
Setting	Undervoltage element	Operation value	LOCK – 60~120 V (1 V step) *2
		Operation time	INST - 0.1~ 5.0 s (0.1 s step)
		TEST MODE	OFF – AB – BC – CA
	Overvoltage element	Operation value	LOCK – 120~165 V (1 V step) *2
Operation time		INST - 0.1~ 5.0 s (0.1 s step)	
Forced operation	Trip and control (annunciator) contacts can be forced to operate.		
Operation indication	Operation indicator LED comes on when the relay element operates. LED indication: Undervoltage element, Overvoltage element, AB-Phase, BC-Phase, CA-Phase		
Display	RUN LED (green)		Indicate the result of automatic self-diagnosis. This LED is turned on for normal and turned off for abnormal.
	ALARM LED (red)		Indicate the result of automatic self-diagnosis. This LED is turned off for normal and turned on for abnormal.
Self-diagnosis (ALARM)	An electronic circuit and a built-in power supply are always supervised, and it outputs to the RUN/ALARM LED and an ALARM contact.		
Burden	Phase Circuit		0.5 VA or less (with rated current)
	Auxiliary supply		For 110 VDC: approx. 1.6W For 110 VAC: approx. 1.9VA
Output Contact	Configuration	For trip	Normally open contact
		For control	Normally open contact (for 27 and 59)
		For alarm	Normally close contact
	Capacity	For trip	Make: 110 VDC, 15 A, 0.5 s (L/R=0 s) 220 VDC, 10 A, 0.5 s (L/R=0 s) Brake: 110 VDC, 0.3 A (L/R ≤ 40 ms) 220 VDC, 0.15 A (L/R ≤ 40 ms) Continuation: 1.5 A
For control and alarm		Make: 10 VA (cos φ = 0.4) 10 W (L/R = 0.007 s)	
Case/Cover	Color: N1.5		
Mass	approx. 1.2 kg		

*1: When DC125 V is used, please note that the maximum voltage of operation range is still 143V.
(A maximum is not 125 V x 30 %.)

*2: If it sets to LOCK, the protection element will be in a lock state of operation.

2.2. General specification (COC4-A02S1)

Table 2-2 General specification (COC4-A02S1)

Name		Overcurrent Relay	
Relay Model		COC4-A02S1	
Style		562PQB	
Elements	Protection	IDMT overcurrent (51)	
		Instantaneous overcurrent (50)	
		IDMT ground overcurrent (51N)	
		Instantaneous ground overcurrent (50N)	
Rating	Frequency		50Hz / 60Hz (selectable)
	Voltage		AC5A
	Aux. power supply	Voltage	AC100V – 110V DC100V – 125V *1
		Operative range	AC: 85–126.5 V DC: 85-143 V *1
Setting	IDMT-OC (51)	Operation value	LOCK – 1.0 ~ 12.0 A (0.1 A step) *2
		Time Multiplier	0.25 – 0.5 ~ 50.0 (0.5 step)
		IDMT curve	NI01-VI01-EI01-LI01-DT01-DT(Inst.) -NI11-EI11 -EI12-NI21-VI21-LI21-MI31-NI31-VI31-EI31 * DT(Inst.): less than or equal to 50 ms * In front LED, quantified value are indicated.
	Inst.-OC (50)	Operation value	LOCK – 10.0 ~ 80.0 A (0.5 A step) *2
		Operation time	INST (less than or equal to 40 ms)
	Ground IDMT OC (51N)	Operation value	LOCK – 0.25 ~ 4.00 A (0.05 A step) *2
		Time Multiplier	0.25 – 0.5 ~ 50.0 (0.5 step)
	Ground inst. OC (50N)	IDMT curve	NI01-VI01-EI01-LI01-DT01-DT(Inst.) -NI11-EI11 -EI12-NI21-VI21-LI21-MI31-NI31-VI31-EI31 * DT(Inst.): less than or equal to 50 ms
		Operation value	LOCK – 2.0 ~ 20.0 A (0.5 A step) *2
		Operation time	INST (less than or equal to 40 ms)
Forced operation	Trip and control (annunciator) contacts can be forced to operate.		
Operation indication	Operation indicator LED comes on when the relay element operates. LED indication: A-Phase, B-Phase, C-Phase, Zero-sequence, Instantaneous overcurrent element.		
Display	RUN LED (green)		Indicate the result of automatic self-diagnosis. This LED is turned on for normal and turned off for abnormal.
	ALARM LED (red)		Indicate the result of automatic self-diagnosis. This LED is turned off for normal and turned on for abnormal.
Self-diagnosis (ALARM)	An electronic circuit and a built-in power supply are always supervised, and it outputs to the RUN/ALARM LED and an ALARM contact.		
Burden	Voltage Circuit		0.5VA or less (with 110VAC) 1.0VA or less (with 220VAC)
	Auxiliary supply		For 110VDC : approx. 1.6W For 110VAC : approx. 1.9VA
Output Contact	Configuration	For trip	Normally open contact
		For control	Normally open contact (for IDMT-OC, Inst.-OC and Ground-OC)
		For alarm	Normally close contact
	Capacity	For trip	Make: 110 VDC, 15 A, 0.5 s (L/R=0 s) 220 VDC, 10 A, 0.5 s (L/R=0 s) Break: 110 VDC, 0.3 A (L/R ≤ 40 ms) 220 VDC, 0.15 A (L/R ≤ 40 ms) Continuation: 1.5 A

Name		Overcurrent Relay	
Relay Model		COC4-A02S1	
Style		562PQB	
		For control and alarm	Make: 10 VA ($\cos \phi = 0.4$) 10 W (L/R = 0.007 s)
Case/Cover	Color : N1.5		
Mass	approx. 1.2kg		

*1: When DC125V is used, please note that the maximum voltage of operation range is still 143V.
(A maximum is not 125V x 30%.)

*2: If it sets to LOCK, the protection element will be in a lock state of operation.

3. Selection Items

3.1. Rotary Switch Assign

On this protection relay, four (4) rotary switch is mounted.
The switch name and position is shown in Fig. 3-1 and Fig. 3-2.

When each rotary switch set no assigned position, the 7-seg. LED is turned off.

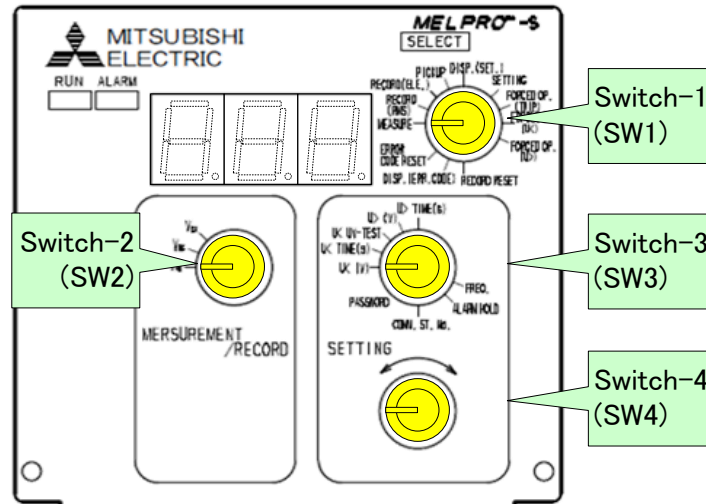


Fig. 3-1 Rotary switch assign (switch 1 ~ 4)

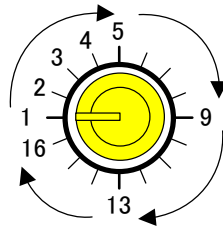


Fig. 3-2 Rotary switch position (number 1 ~ 16 are clockwise)

3.2. Switch-1: Select Item Switch

There is “Select Item Switch” which is assigned by following tables.

The “Protectable items by password” column means that the password input is required for operating if password function is activated.

Table 3-1 Select items of Switch-1 (CBV2)

Rotary position of Switch-1	CBV2-A02S1	Description	Related chapters	Protectable items by password
1	MEASURE	Real-Time Measurement	Clause 4.1	-
2	RECORD(RMS)	Fault Record – Measurement Value	Clause 4.2	-
3	RECORD (ELE.)	Fault Record – Relay Element	Clause 4.3	-
4	PICK UP	Relay Element Detection before Trip	Clause 4.4	-
5	DISP. (SET.)	Display Relay Element Setting	Clause 4.5	-
6	-	No assigned		
7	SETTING	Change Relay Element Setting	Clause 4.6	○
8	FORCED OP.(TRIP)	Forced Operation for Trip Digital Output	Clause 4.7	○
9	FORCED OP.($U<$)	Forced Operation for Relay Element (Undervoltage)	Clause 4.8	○
10	FORCED OP.($U>$)	Forced Operation for Relay Element (Overvoltage)	Clause 4.8	○
11	-	No assigned		
12	-	No assigned		
13	RECORD RESET	Clear Fault Record Data	Clause 4.9	○
14	DISP.(ERR.CODE)	Display Error Code by Self-Diagnosis	Clause 4.10	-
15	ERR.CODE RESET	Clear Error Code	Clause 4.11	○
16	-	No assigned		

Table 3-2 Select items of Switch-1 (COC4)

Rotary position of Switch-1	COC4-A02S1	Description	Related chapters	Protectable items by password
1	MEASURE	Real-Time Measurement	Clause 4.1	-
2	RECORD(RMS)	Fault Record – Measurement Value	Clause 4.2	-
3	RECORD (ELE.)	Fault Record – Relay Element	Clause 4.3	-
4	LAPSE	Relay Element Detection before Trip	Clause 4.4	-
5	DISP. (SET.)	Display Relay Element Setting	Clause 4.5	-
6	-	No assigned		
7	SETTING	Change Relay Element Setting	Clause 4.6	○
8	FORCED OP.(TRIP)	Forced Operation for Trip Digital Output	Clause 4.7	○
9	FORCED OP.($I_{\Sigma}>$)	Forced Operation for Relay Element (Time Overcurrent, 51)	Clause 4.8	○
10	FORCED OP.($I>>$)	Forced Operation for Relay Element (Instantaneous Overcurrent, 50)	Clause 4.8	○
11	FORCED OP.($I_{\pm}>$)	Forced Operation for Relay Element (Ground Overcurrent, 50N, 51N)	Clause 4.8	○
12	-	No assigned		
13	RECORD RESET	Clear Fault Record Data	Clause 4.9	○
14	DISP.(ERR.CODE)	Display Error Code by Self-Diagnosis	Clause 4.10	-
15	ERR.CODE RESET	Clear Error Code	Clause 4.11	○
16	-	No assigned		

3.3. Switch-2: Measurement Item Switch

There is "Measurement Item Switch" which is assigned by following tables.
By this rotary switch, the value or condition of selected phase are displayed.

Table 3-3 Measurement items of Switch-2 (CBV2)

Rotary position of Switch-2	CBV2-A02S1	Description	Related chapters
1	V_{AB}	RMS value of phase-to-phase voltage	Clause 4.1, 4.2, 4.3
2	V_{BC}		
3	V_{CA}		

Table 3-4 Measurement items of Switch-2 (COC4)

Rotary position of Switch-2	COC4-A02S1	Description	Related chapters
1	I_A	RMS value of phase current	Clause 4.1, 4.2, 4.3
2	I_B		
3	I_C		
4	I_0	RMS value of zero-sequence current	

3.4. Switch-3: Setting Item Switch

There is “Setting Item Switch” which is assigned by following tables. These values are enabled when Switch-1 is set “DISP. (SET.)” or “SETTING”.

Table 3-5 Setting Item of Switch-3 (CBV2)

Rotary position of Switch-3	CBV2-A02S1	Description	Related chapters
1	$U < (V)$	Undervoltage operating value	Clause 4.5, 4.6
2	$U < \text{TIME (s)}$	Undervoltage operating time	
3	$U < \text{UV-TEST}$	Undervoltage test mode	
4	$U > (V)$	Overvoltage operating value	
5	$U > \text{TIME (s)}$	Overvoltage operating time	
6	–		
7	–		
8	–		
9	–		
10	FREQ.	Frequency setting	
11	ALARM HOLD	Digital output condition of alarm contact by self-diagnosis (hold / un-hold)	
12	–		
13	COMM. ST. No.	Slave address of Modbus	
14	–		
15	PASSWORD	Set password Even though Switch-1 set “DISP. (SET.)”, current password doesn’t displayed.	
16	–		

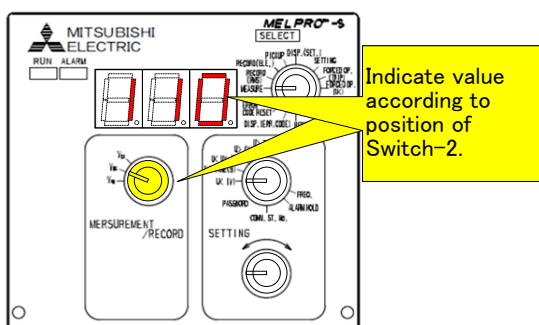
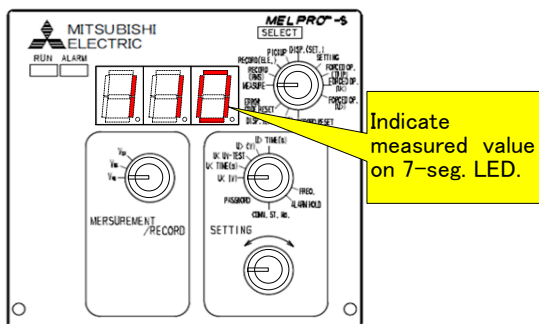
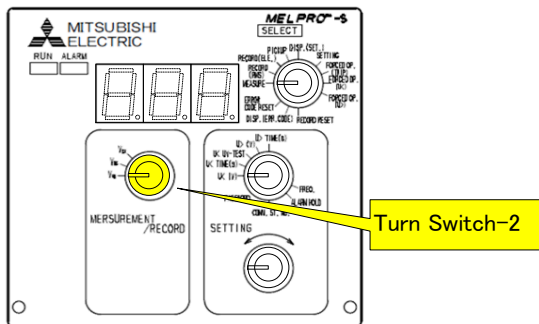
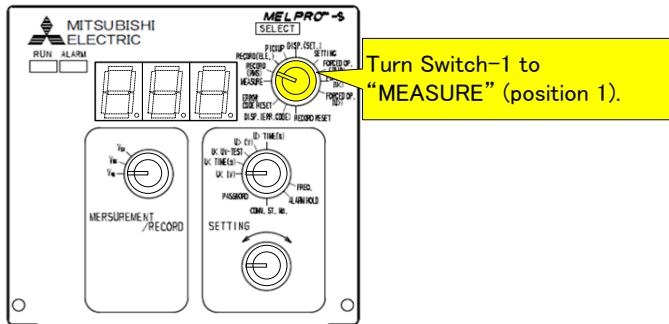
Table 3-6 Setting Item of Switch-3 (COC4)

Rotary position of Switch-3	COC4-A02S1	Description	Related chapters
1	$I_{>} (A)$	IDMT overcurrent operating value (51)	Clause 4.5, 4.6
2	$I_{>} \text{TM}$	IDMT overcurrent time multiplier (51)	
3	$I_{>} \text{CURVE}$	IDMT characteristic curve (51)	
4	$I_{>>} (A)$	Instantaneous overcurrent operating value (50)	
5	$I_{\pm} (A)$	Ground overcurrent operating value (51N)	
6	$I_{\pm} \text{TM}$	IDMT ground overcurrent time multiplier (51N)	
7	$I_{\pm} \text{CURVE}$	IDMT characteristic curve (51N)	
8	$I_{\pm}>> (A)$	Instantaneous ground overcurrent operating value (50N)	
9	–		
10	FREQ.	Frequency setting	
11	ALARM HOLD	Digital output condition of alarm contact by self-diagnosis (hold / un-hold)	
12	–		
13	COMM. ST. No.	Slave address of Modbus	
14	–		
15	PASSWORD	Set password Even though Switch-1 set “DISP. (SET.)”, current password doesn’t displayed.	
16	–		

4. Front Panel Operation

4.1. Real-Time Measurement [MEASURE]

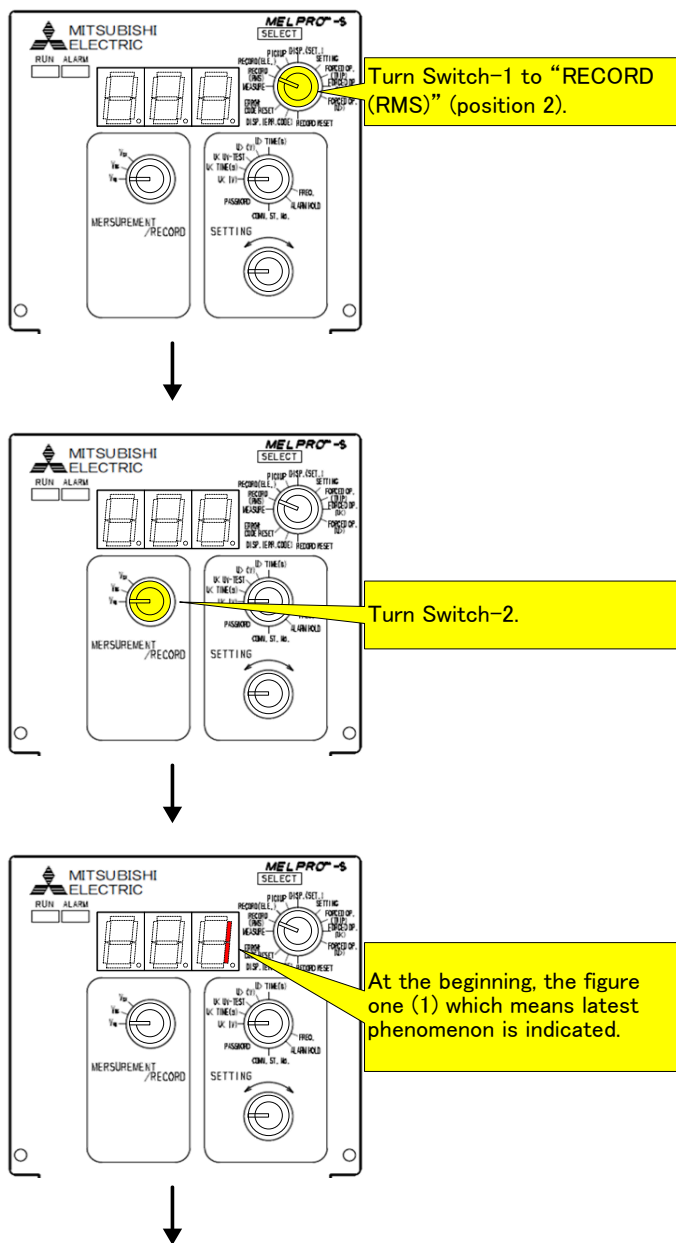
The real-time measurement value such as voltage value or current value is shown by “MEASURE” function. In this measured value, the harmonic elements are eliminated by the protection relay’s filters. The different value would be appeared between this measured value from protection relay and an electrical indicators (e.g. voltage meter or current meter).

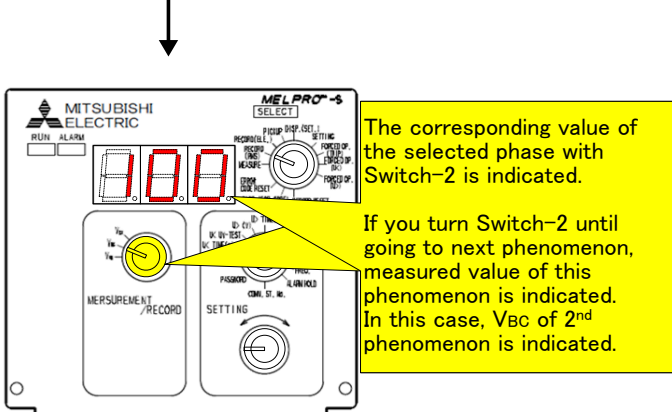
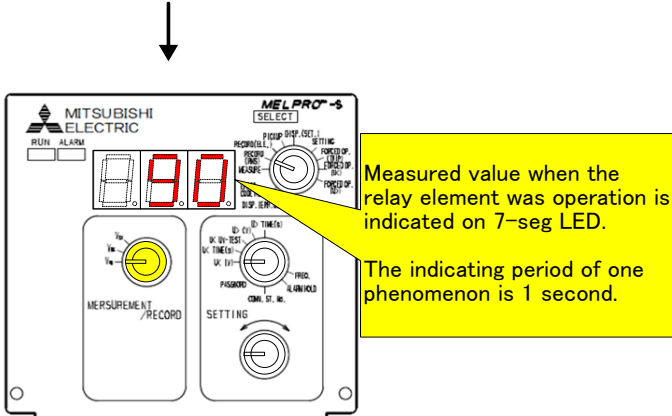
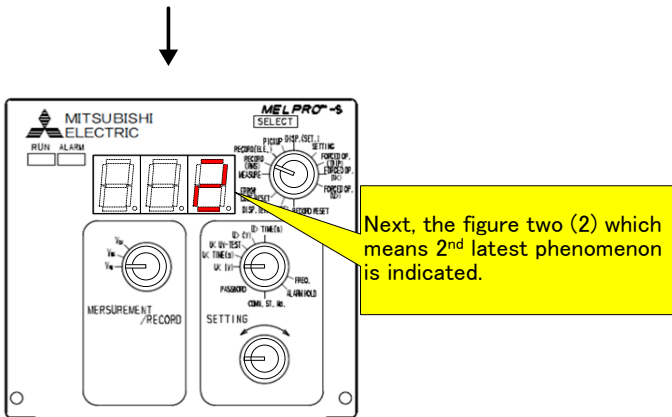
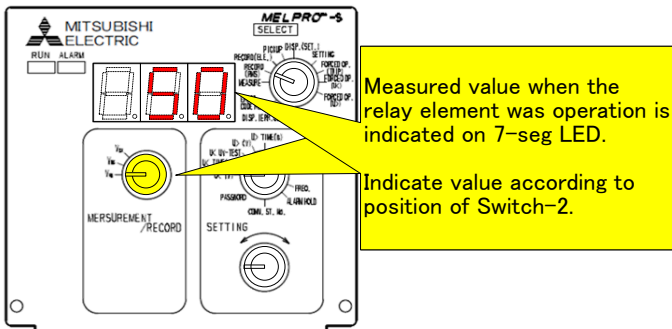


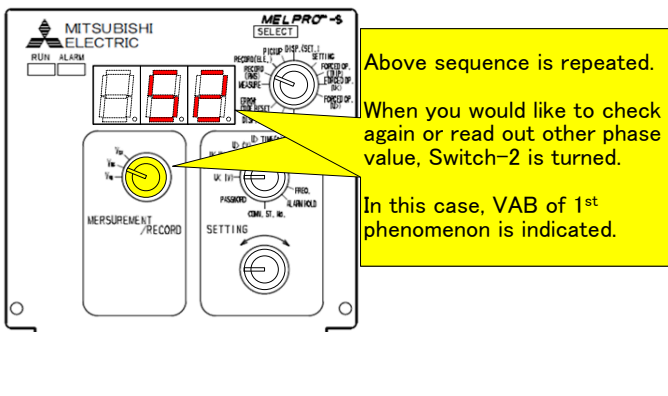
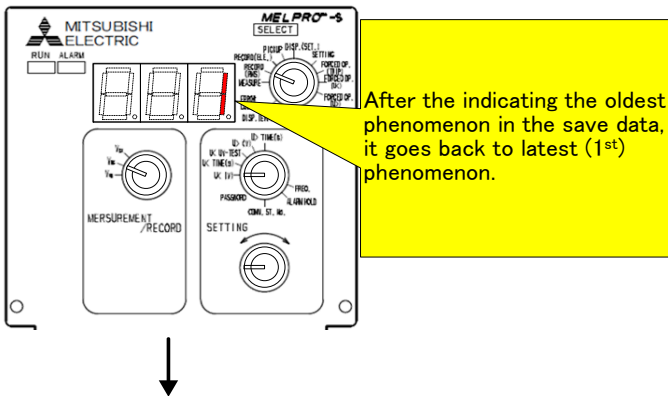
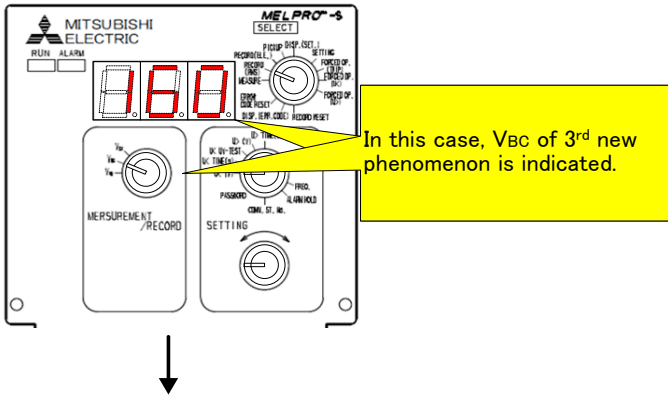
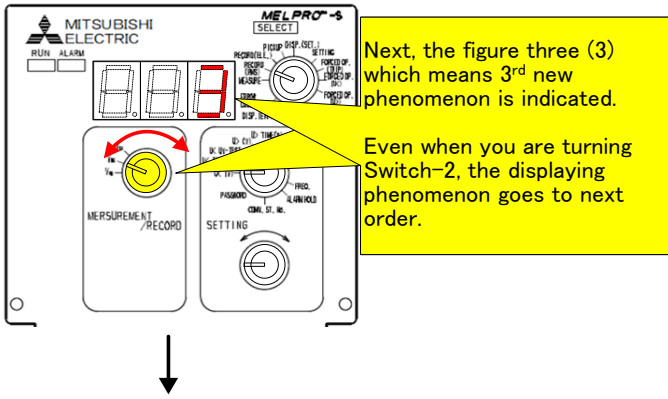
4.2. Fault Record – Measurement Value [RECORD (RMS)]

The measurement value when the relay element was operating is shown by “RECORD (RMS)” function. This protection relay can store ten (10) fault phenomena. The saved fault phenomena are displayed with rotating in order. The indicating period of one phenomenon is 1 second. The measured value which the phase is selected by Switch-2 is displayed.

In this measured value, the harmonic elements are eliminated by the protection relay’s filters. The different value would be appeared between this measured value from protection relay and an electrical indicators (e.g. voltage meter or current meter).



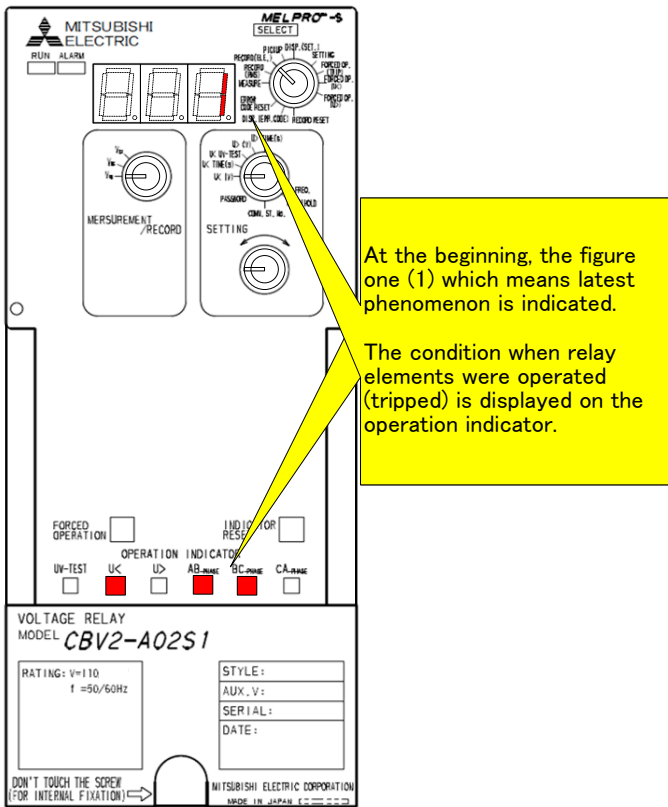
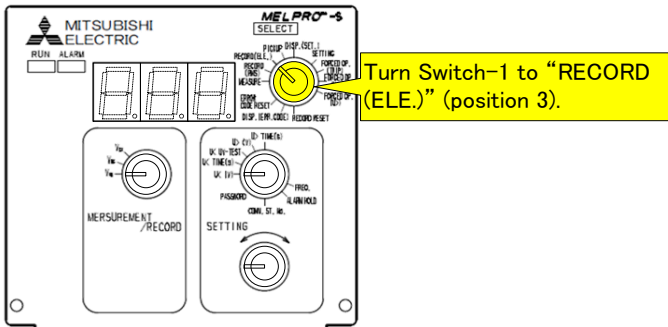


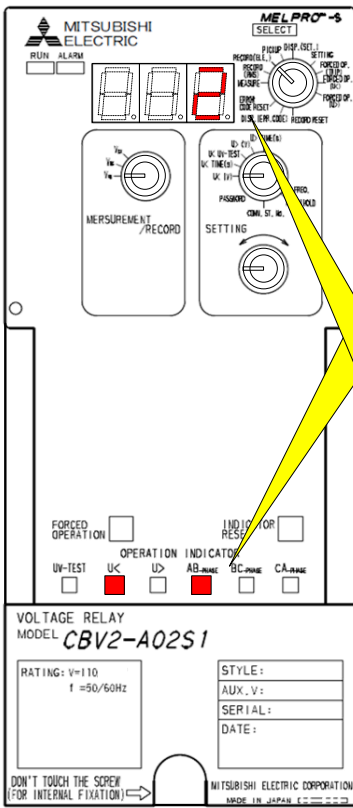


4.3. Fault Record – Relay Element [RECORD (ELE.)]

The lighting operation indicator when the relay element was operation (trip) can be read out by “RECORD (ELE.)” function.

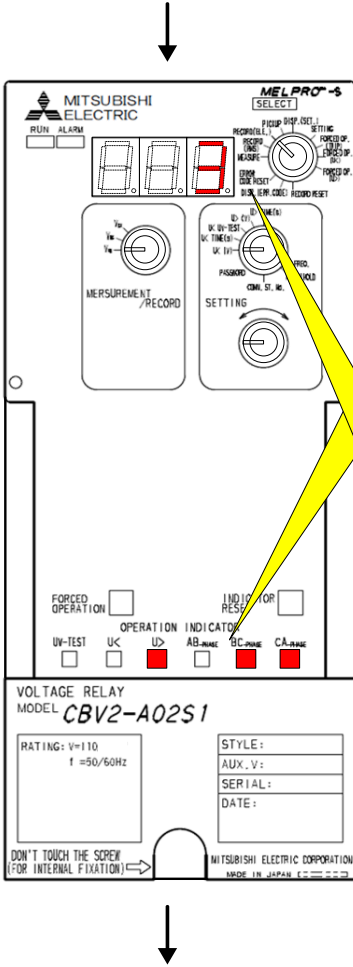
This protection relay can store ten (10) fault phenomenon. The saved fault phenomenon are displayed with rotating in order. The indicating period of one phenomenon is 1 second.





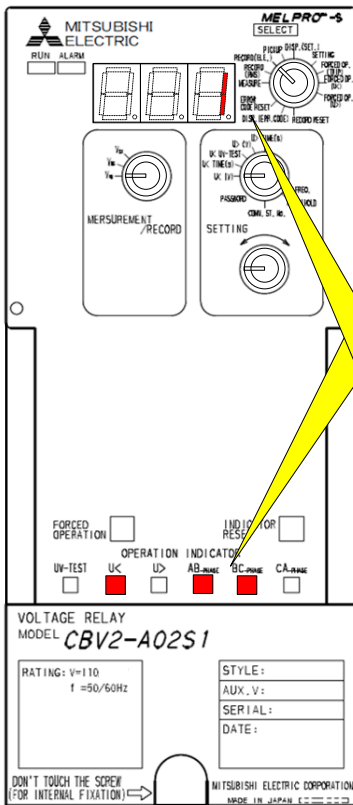
Next, the figure two (2) which means 2nd latest phenomenon is indicated.

The condition when relay elements were operated (tripped) is displayed on the operation indicator.



Next, the figure three (3) which means 3rd latest phenomenon is indicated.

The condition when relay elements were operated (tripped) is displayed on the operation indicator.



After the indicating the oldest phenomenon in the save data, it goes back to latest (1st) phenomenon.

<NOTE>

- Before checking fault records of operated relay element, please push “INDICATOR RESET” button and turn off LEDs.
If current LED remains glowing, the LED indication of fault records is glowed with overwrapping. Because of this, it would be difficult to distinguish the indication of fault records and the indication of current condition. To avoid this situation, please push “INDICATOR RESET” button and turn off current LED glowing.
- In case of occurring fault evolution, the first tripped condition is saved as latest fault record.
For example it is considered that a fault evolution from V_{AB} to V_{BC} . It is assumed that the V_{BC} fault occurs after few seconds from V_{AB} fault.
In the beginning, the “OPERATION INDICATOR” of V_{AB} is glowed and this condition is saved as a latest fault record. Next, when V_{BC} fault is occurred during V_{AB} fault, the LED of V_{BC} is also glowed but new fault record is not created.
If V_{BC} fault is occurred after cleared V_{AB} fault, LED of V_{BC} is glowed and new fault record is created.

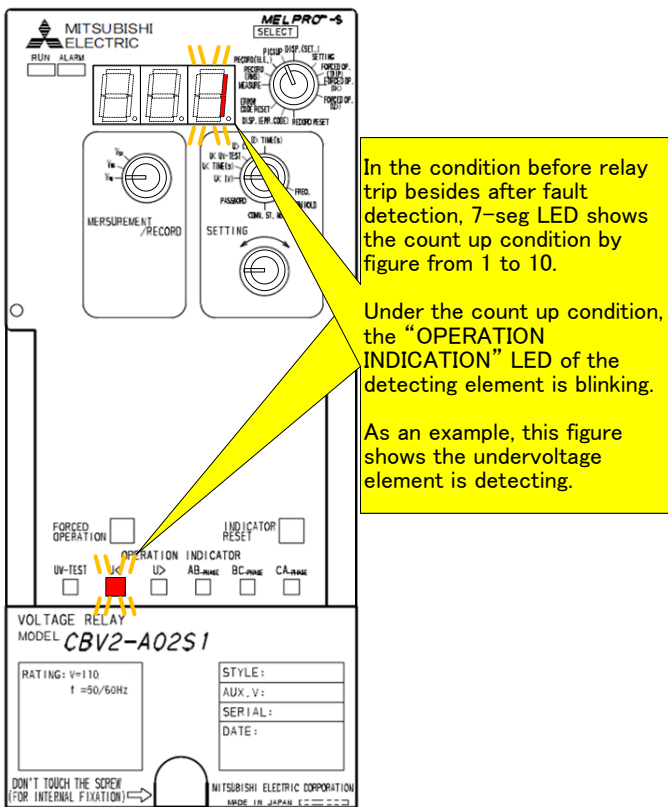
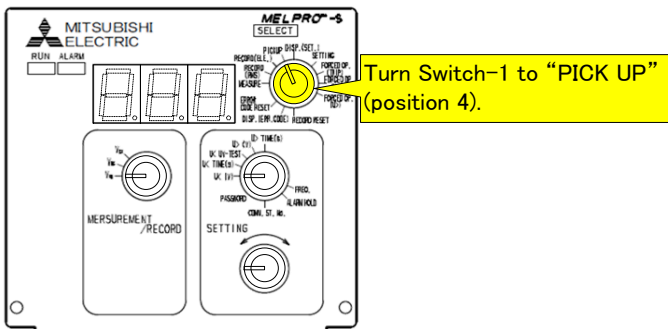
4.4. Relay Element Detection before Trip [PICK UP]

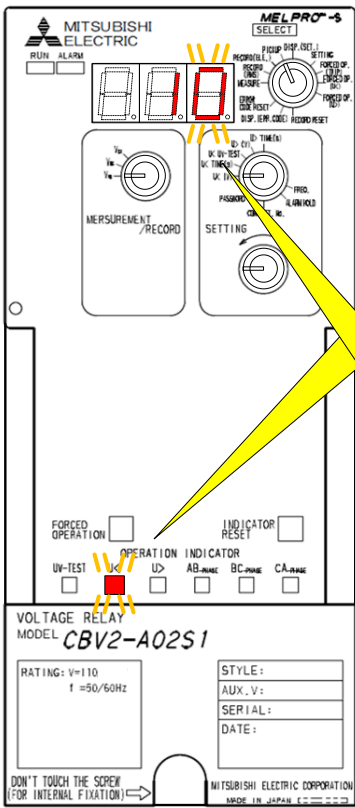
The count up status of the relay element is indicated by “PICK UP” function.
 This count up status means 2 conditions.

- First, it shows the condition from the detection to tripping.
- Second, it shows the condition after tripping.

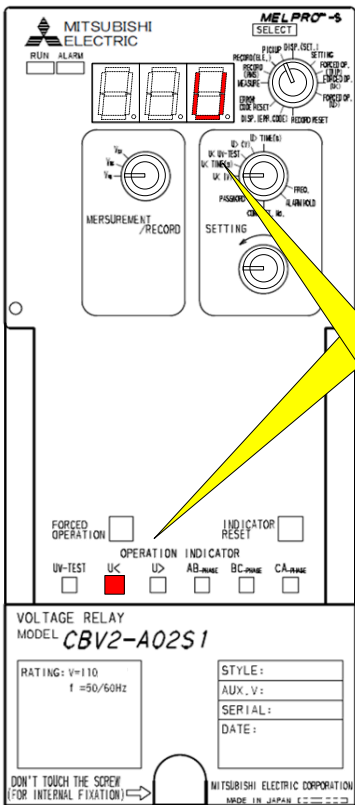
In the condition before relay trip besides after fault detection, 7-seg LED shows the count up condition by figure from 1 to 10. When this count up reaches to 10, the protection relay trips and digital output (DO) is closed. After relay tripping, 7-seg LED indicates “U” in this “PICK UP” function.

If instantaneous operation element, you would be difficult to read out the count up figures because count up condition is completed immediately.





The count up condition is continued until reaching 10.



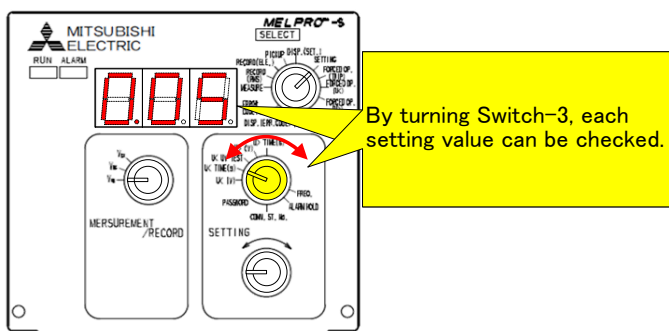
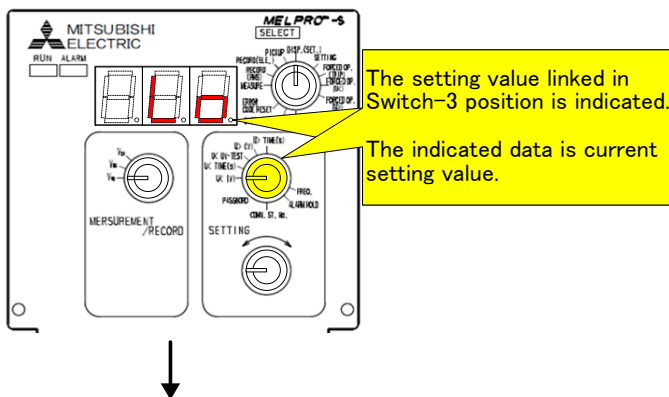
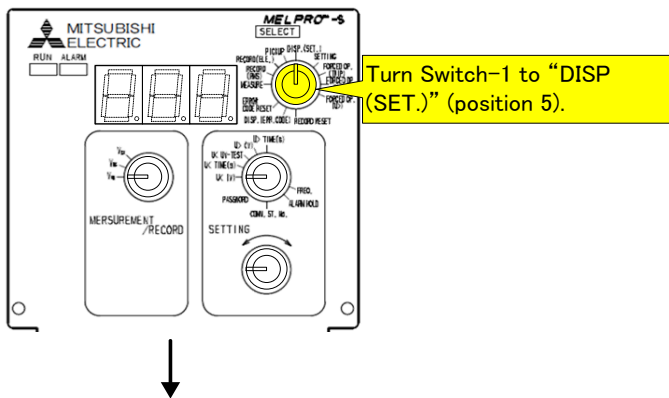
When this count up reaches to 10, the protection relay trips and digital output (DO) is closed and 7-seg LED indicates "U". The blink of LED is stopped.

4.5. Display Relay Element Setting [DISP. (SET.)]

The current setting of the relay element can be read out by “DISP. (SET.)”.

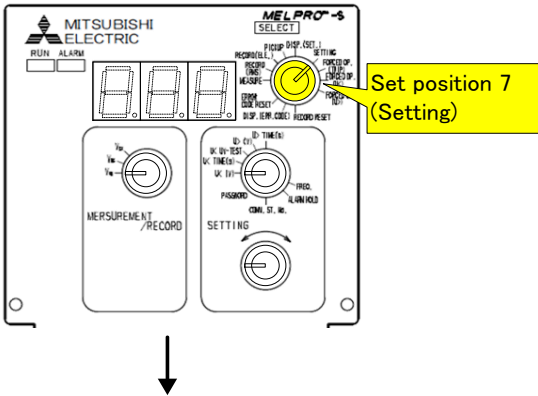
By turning Switch-3, each setting value can be read out.

Even though the Switch-3 set to “PASSWORD” (position 15), the current password does not be indicated.



4.6. Change Relay Element Setting [SETTING]

The new setting of the relay element can be changed by "SETTING" function.



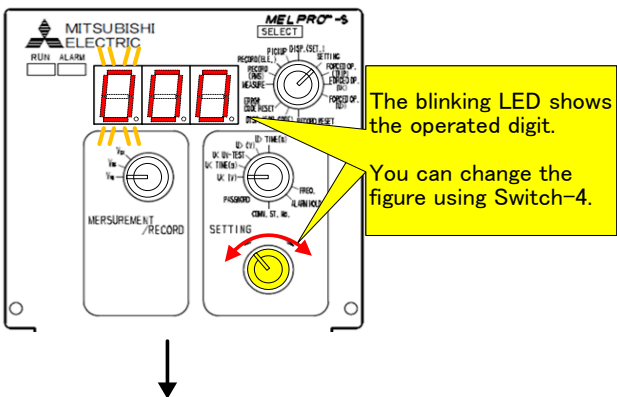
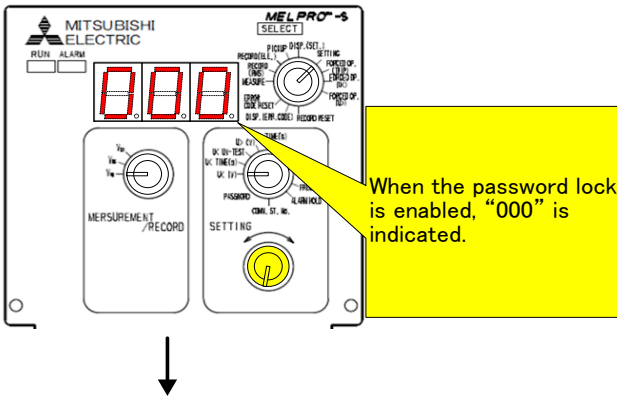
When the password is set, input the password to enter the setting mode. Go to clause 4.6.1.

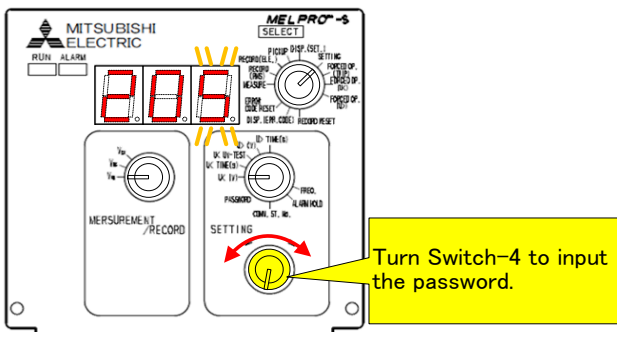
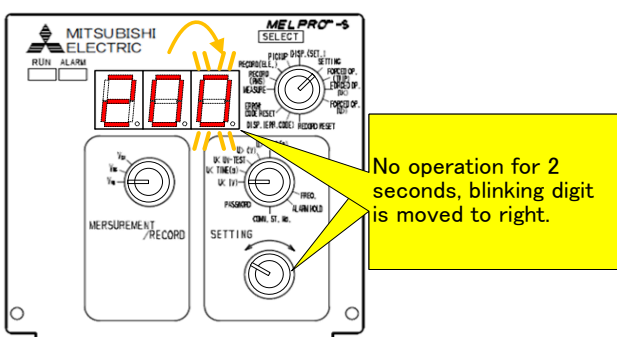
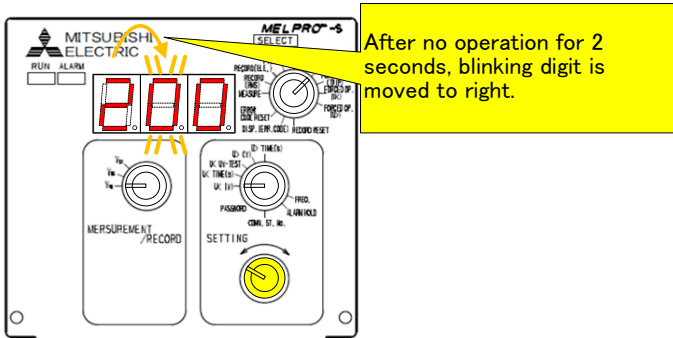
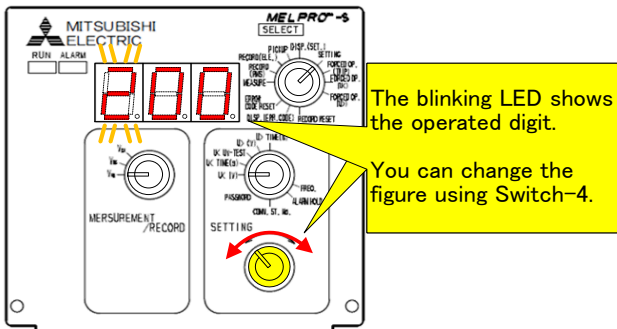
When the password isn't set, go to clause 4.6.2 ~ 4.6.8.

4.6.1. Under Protection by Password

When the password is set, input the password to enter the setting mode. If using no password, following operation can be passed. How to set password shows sub-clause 4.6.8.

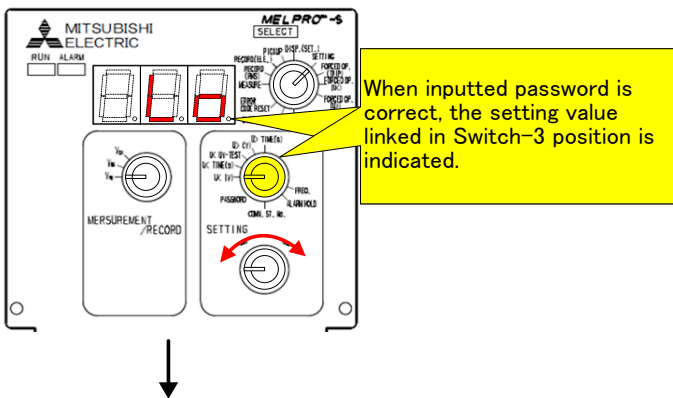
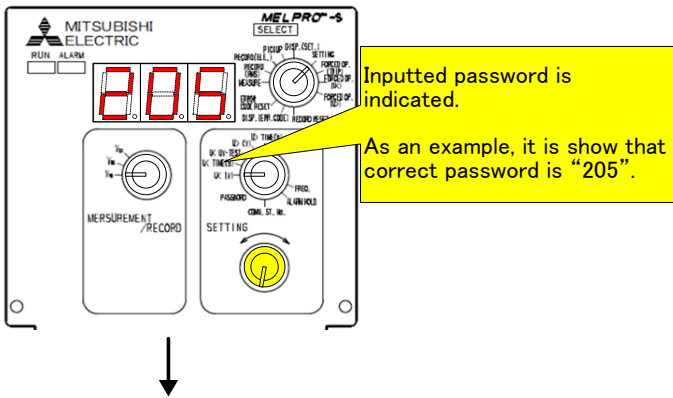
(1) Input Password





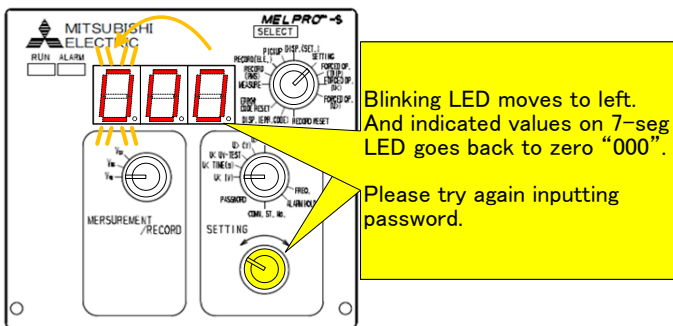
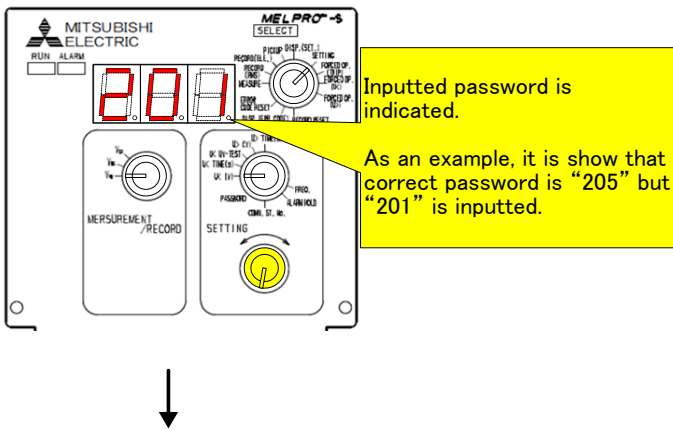
Go to sub-clause 4.6.1(2) or 4.6.1(3).

(2) If Correct Password

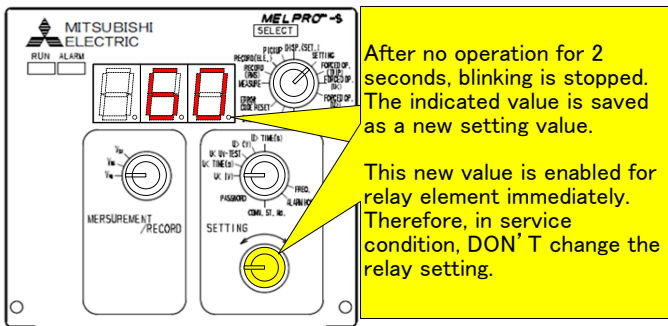
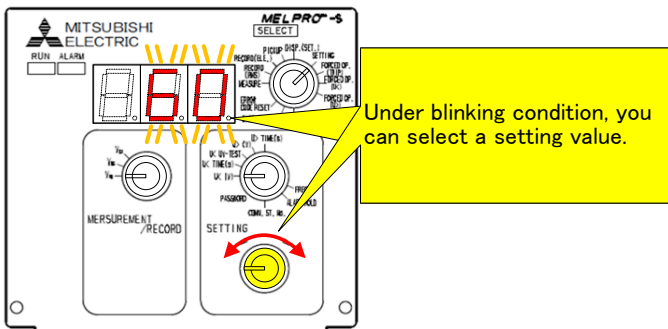
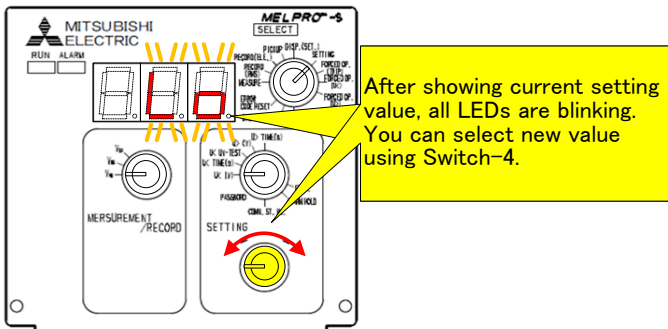
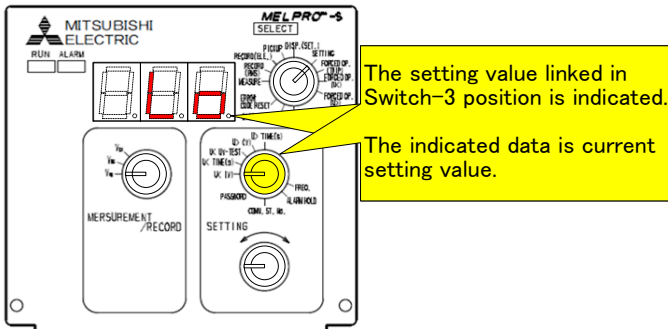


Go to sub-clause 4.6.2 ~ 4.6.8.

(3) If Wrong Password



4.6.2. Set Numerical Values



4.6.3. Set UV-TEST Mode (for CBV2)

The UV-TEST is use for the relay characteristic test.

In the CBV2, under/overvoltage elements are tripped when one of the phases is operated. In other words, under/overvoltage elements operate as an OR sequence of AB-phase, BC-phase and CA-phase. However this OR sequence interferes with a testing for the relay characteristic. It is because that an amplifier would output a single phase under testing. For undervoltage element, other phases which not related to the testing are interfered with the under testing phase.

This UV-TEST mode inactivates this OR sequence of each phase and enable a single-phase operation. Table 4-1 shows the setting items of the UV-TEST.

Table 4-1 LED indication for test mode (CBV2)

LED Indication	Detail
	This value means "OFF" setting of the Test Mode in the over/under voltage element.
	This value means "AB-phase" setting of the Test Mode in the over/under voltage element.
	This value means "BC-phase" setting of the Test Mode in the over/under voltage element.
	This value means "CA-phase" setting of the Test Mode in the over/under voltage element.

For example, in case of setting "AB-phase", this protection relay focuses on "AB-phase". Even though BC-phase and CA-phase are zero voltage, the undervoltage element doesn't operate when AB-phase is injected beyond the setting value.

<ATTENTION>

DON'T forget the setting back to off before in-service condition.

Under the UV-TEST mode, the yellow LED of "UV-TEST" is turned on. The position of "UV-TEST" LED is shown in Fig. 4-1

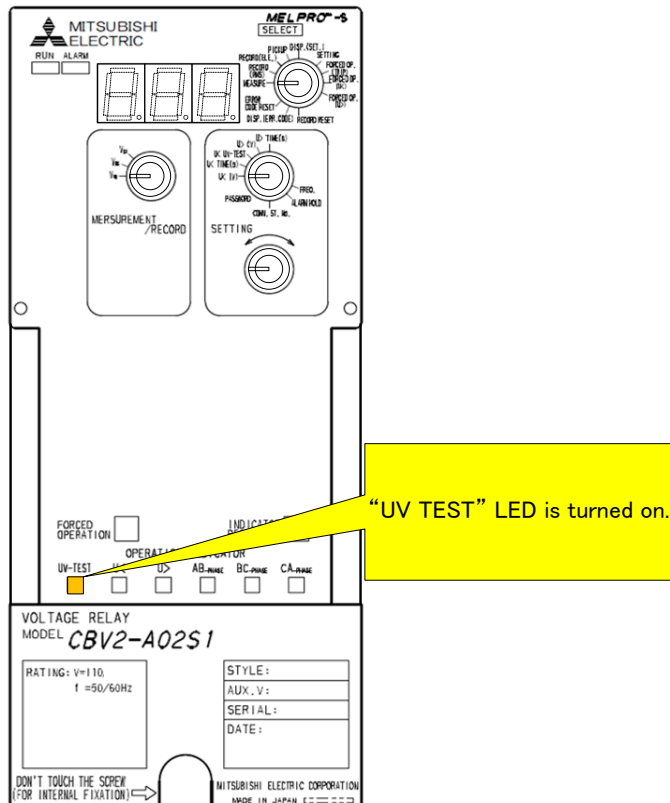


Fig. 4-1 Position of "UV-TEST" LED

4.6.4. Set IDMT Characteristic Curve (for COC4)

In the COC4-A02S1, IDMT curves can be select from 16 types. Please refer to clause 2.2. In front LED, quantified value are indicated. The correspondence table between LED indication number and curve characteristic are shown in Table 4-2. The equations of IDMT characteristic are shown in equation (4-1) to (4-3).

Table 4-2 LED indication for IDMT characteristic curve (COC4)

LED Indication	Abbreviated Name	Details
0	NI01	IEC Normal Inverse In equation (4-1), k=0.14, α=0.02, c=0.
1	VI01	IEC Very Inverse In equation (4-1), k=13.5, α=1, c=0.
2	EI01	IEC Extremely Inverse In equation (4-1), k=80, α=2, c=0.
3	LI01	Long Inverse In equation (4-1), k=54, α=1, c=0.
4	DT01	Definite Time Refer to equation (4-2)
5	DT(INST)	Instantaneous operation
6	NI11	Normal Inverse (IEEE Moderately Inverse) In equation (4-1), k=0.0515, α=0.02, c=0.114.
7	EI11	Extremely Inverse (IEEE Very Inverse) In equation (4-1), k=19.61, α=2, c=0.491.
8	EI12	Extremely Inverse (IEEE Extremely Inverse) In equation (4-1), k=28.2, α=2, c=0.1217.
9	NI21	Normal Inverse In equation (4-1), k=2.4, α=0.4, c=1.2.
10	VI21	Very Inverse In equation (4-1), k=16, α=1, c=0.4.
11	LI21	Long Inverse In equation (4-1), k=60, α=1, c=0.
12	MI31	Moderately Inverse In equation (4-3), A=0.1735, B=0.6791, C=0.8, D=-0.08, E=0.1271.
13	NI31	Normal Inverse In equation (4-3), A=0.0274, B=2.2614, C=0.3, D=-4.1899, E=9.1272.
14	VI31	Very Inverse In equation (4-3), A=0.0615, B=0.7989, C=0.34, D=-0.284, E=4.0505.
15	EI31	Extremely Inverse In equation (4-3), A=0.0399, B=0.2294, C=0.5, D=3.0094, E=0.7222.

$$t = \left(\frac{k}{(I)^\alpha - 1} + c \right) \cdot \frac{M}{10} \dots\dots\dots (4-1)$$

$$t = 2 \cdot \frac{M}{10} \dots\dots\dots (4-2)$$

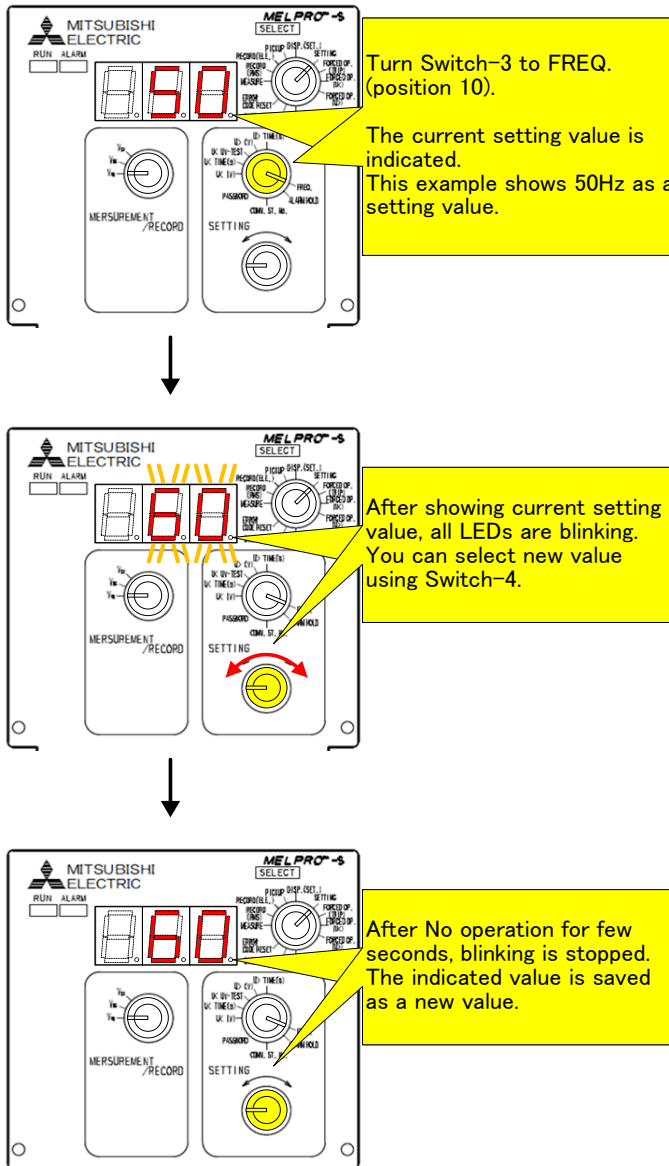
$$t = M \cdot \left(A + \frac{B}{I-C} + \frac{D}{(1-C)^2} + \frac{E}{(1-C)^3} \right) \dots\dots\dots (4-3)$$

4.6.5. Set FREQ.

There is FREQ. setting for the selecting 50 Hz or 60 Hz.

<NOTE>

Check setting power system frequency before in-service condition.



4.6.6. Set ALARM HOLD

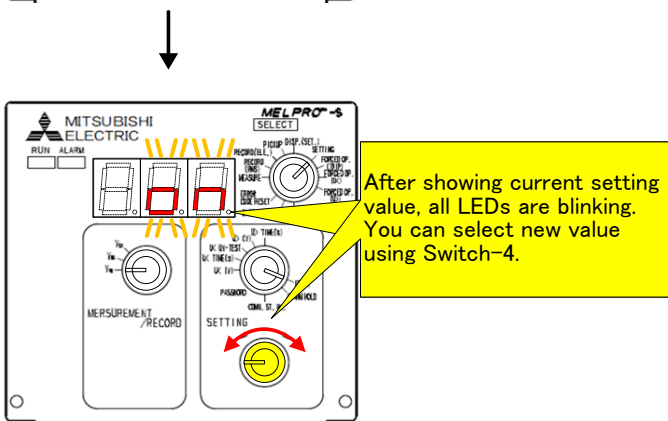
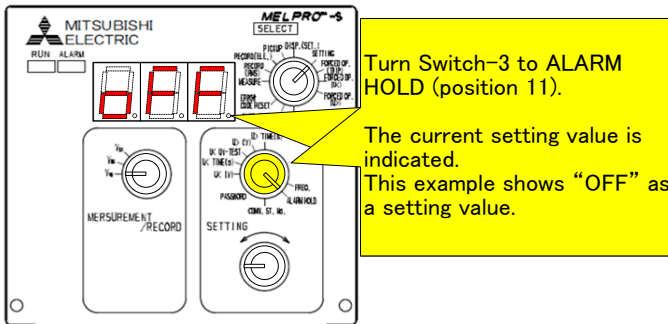
There is ALARM HOLD setting for the self-diagnosis function.

When the self-diagnosis function detects some error, the protection relay goes to error condition. The behavior under the error condition is shown in Table 4-3.

In case of ALARM HOLD = OFF, the protection relay try to recover. However the behavior of the Error condition is continued when the error cannot cleared.

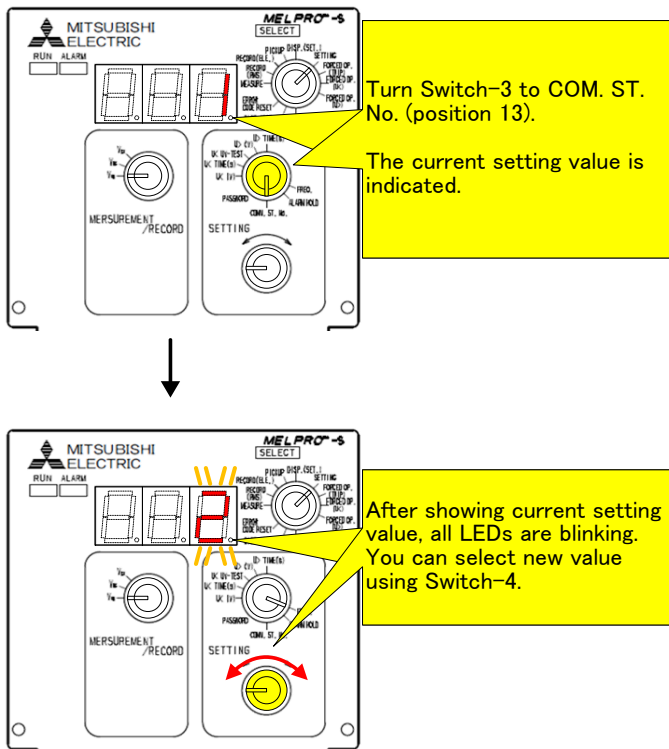
Table 4-3 Protection relay behavior in alarm condition

Items	RUN LED (green)	ALARM LED (red)	Alarm Contact Output	Protection element	Others
Normal condition	ON	OFF	OFF	Enable	-
Error condition	OFF	ON	ON	Lock (disable)	Save error code (Refer to clause 4.10.)
After recovering from error with ALARM HOLD = OFF	ON	OFF	OFF	Enable	If the intermittently or temporarily fault conditions is occurred, the protection relay could recover after the error cleared. If the error cannot cleared, the behavior of the Error condition is continued.
After recovering from error with ALARM HOLD = ON	OFF	ON	ON	Lock (disable)	Regardless of the cause of errors the relay holds (keeps) the condition at that time of the error detection. To recover from the error condition, please try push "INDICATOR RESET" button or restart the protection relay by auxiliary power off.



4.6.7. Set COMM. ST. No.

There is COMM. ST. No. setting for the setting the slave address in MODBUS.
More details please refer to “MELPRO-S series MODBUS Communication Instruction Manual”.



4.6.8. Set PASSWORD

There is PASSWORD function for the changing password.

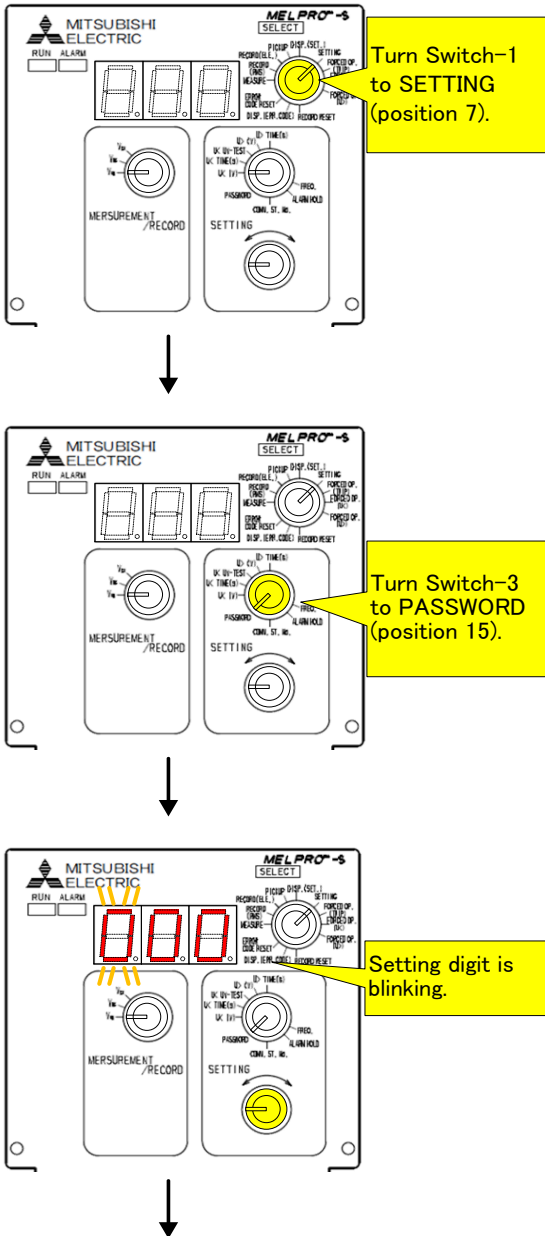
If password is set "000", the password function is disable. Default password is "000" (= disable).

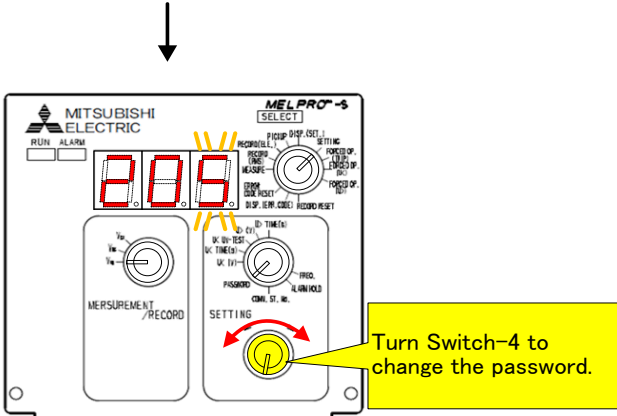
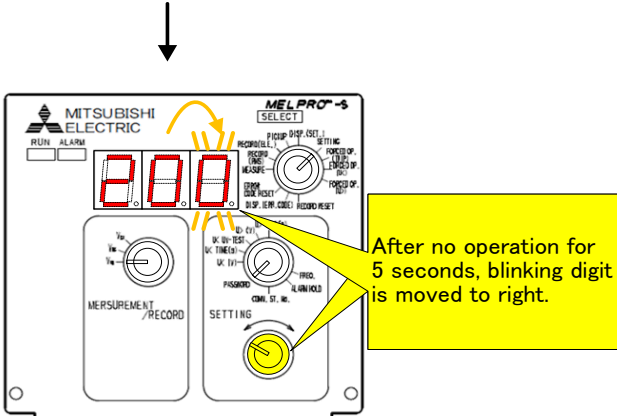
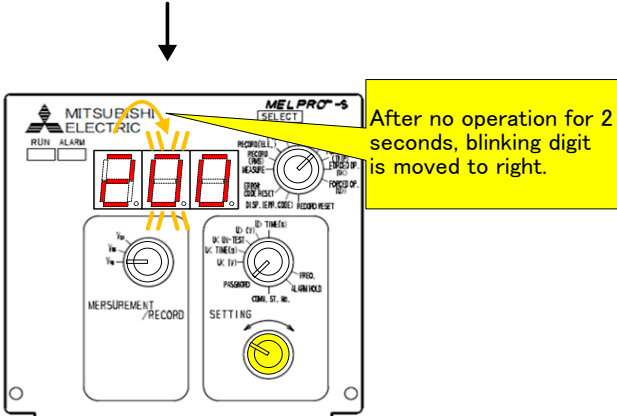
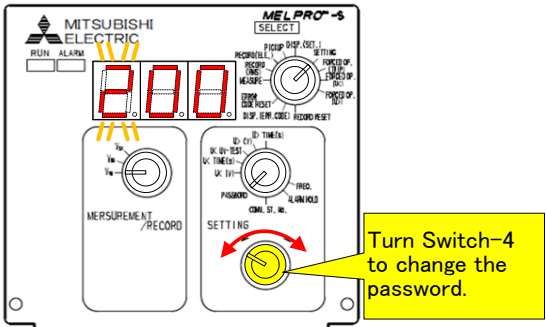
After setting password, the entering password is needed for some items. More details, please refer to section 3.2.

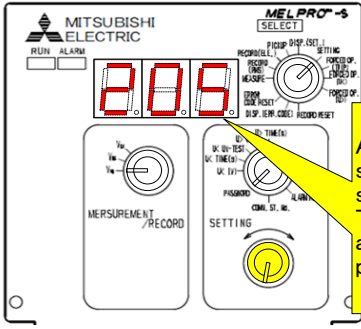
By this password, some operation items of Switch-1 are protected.

The protected items are shown in Table 3-1 and Table 3-2.

How to input the password, refer to clause 4.6.1.







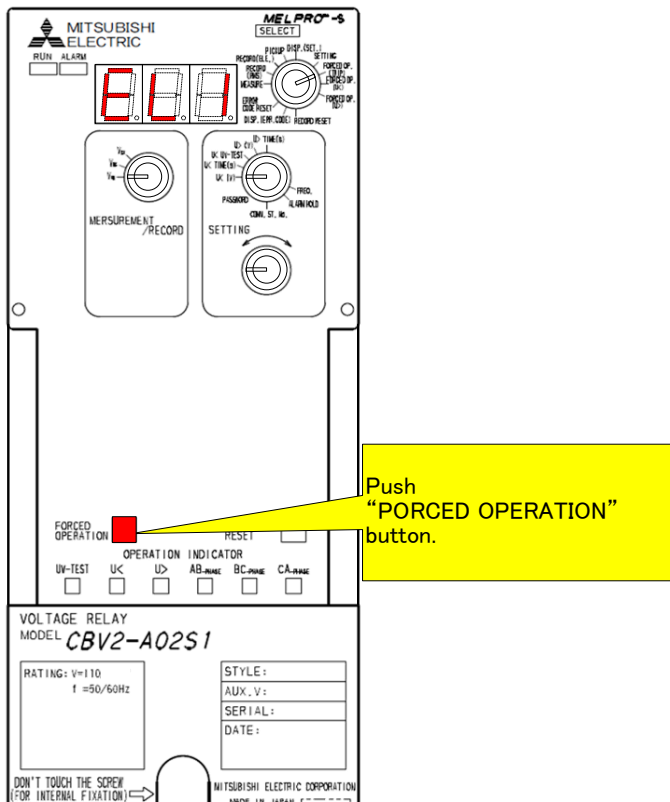
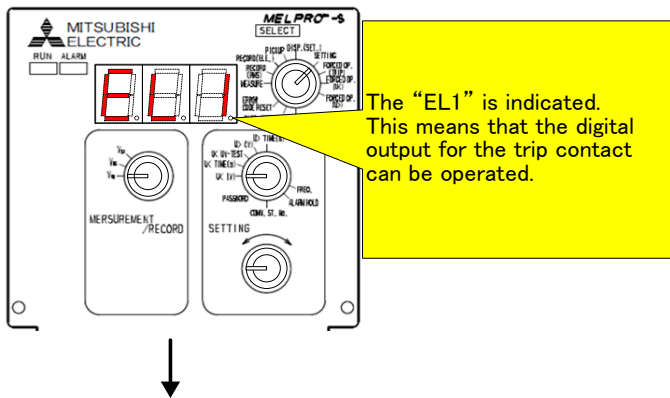
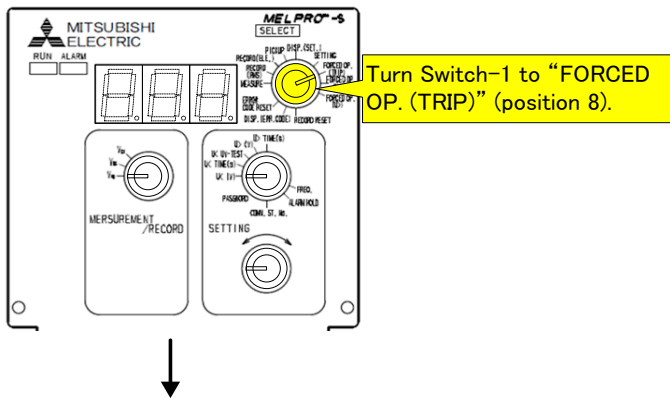
After no operation for 2 seconds, blinking is stopped. These indicated values are saved as new password.

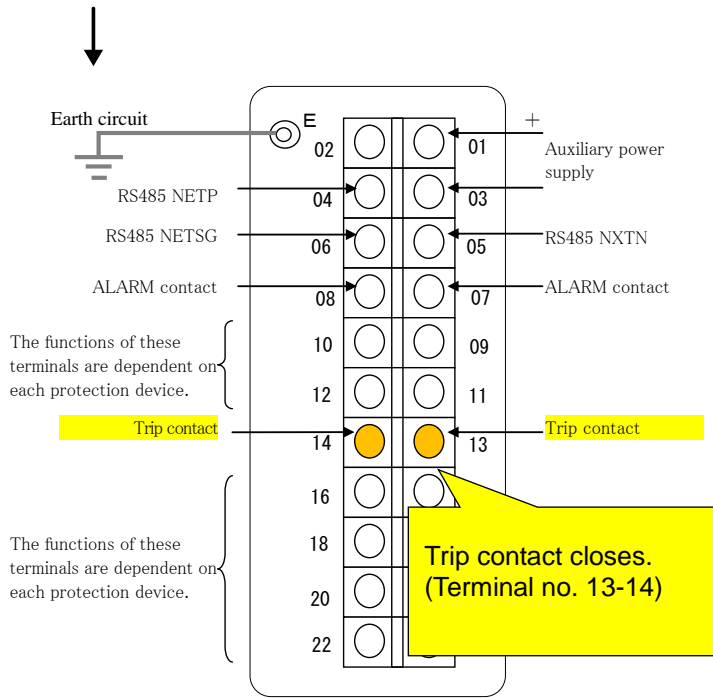
4.7. Forced Operation for Trip Digital Output [FORCED OP. (TRIP)]

The "FORCED OP. (TRIP)" function offers operating a digital output of the trip contact.

If password function is enabled, please refer to clause 4.6.1. Following operation steps shows the condition after inputting correct password.

If password function is not used, the condition directly goes to following steps.





4.8. Forced Operation for Relay Element [FORCED OP. *]

The “FORCED OP. (*)” function offers operating a digital output of each relay element. The asterisk suggests each relay elements depending on the relay model.

This forces operation for the relay element function is assigned position 9 to 11 in Switch-1. More details, please refer to clause 3.2.

If password function is enabled, please refer to clause 4.6.1. Following operation steps shows the condition after inputting correct password.

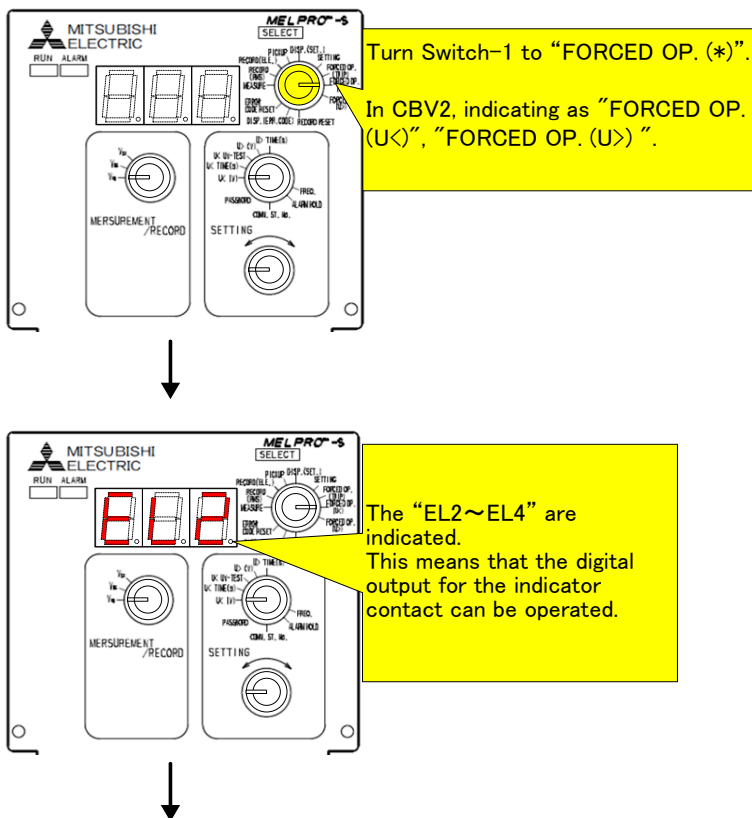
If password function is not used, the condition directly goes to following steps.

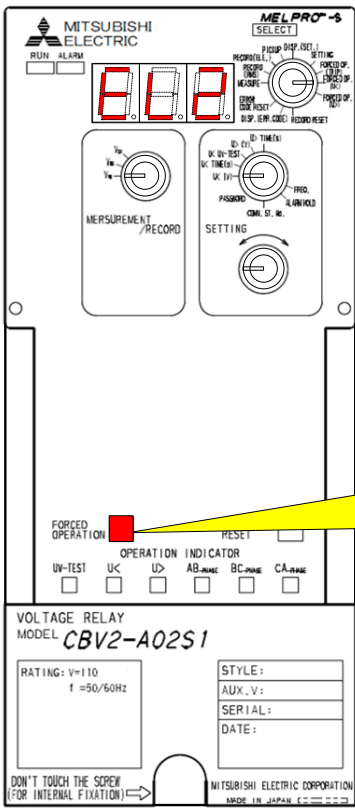
The relationship between the rotary position of Switch-1 and the displayed value in 7-seg LED are shown in Table 4-4.

Table 4-4 Relationship between Switch-1 position and the 7-seg LED

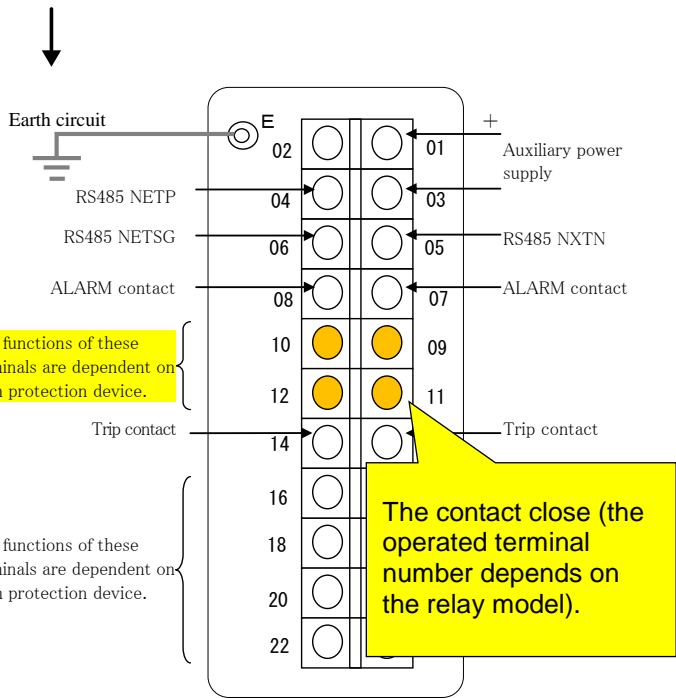
Rotary position of Switch-1	Displayed value in 7-seg. LED	COC4	CBV2
9	EL2	○	○
10	EL3	○	○
11	EL4	○	—

Note: EL4 items is available corresponding to each relay model. More detail,





Push "FORCED OPERATION" button.

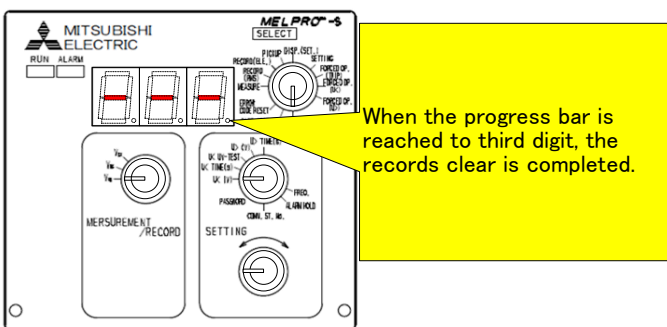
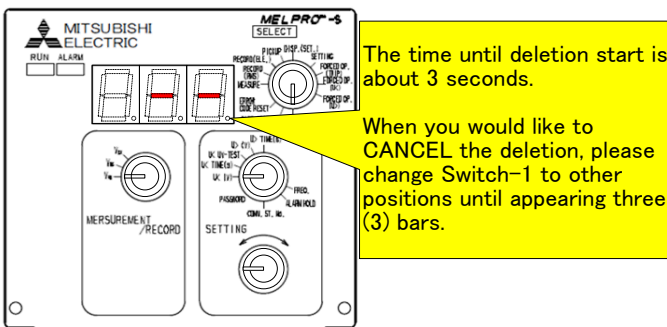
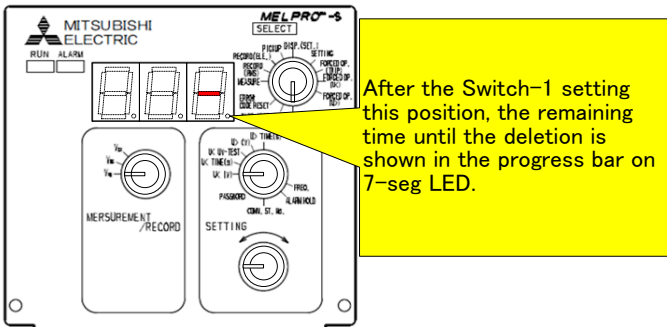
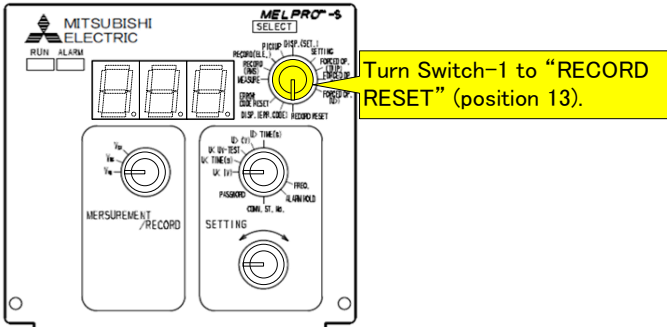


4.9. Clear Fault Record Data [RECORD RESET]

By the "RECORD RESET", all record data (such as operated elements, fault measured values) are deleted. The records are deleted 3 seconds after the Switch-1 set this position.

If password function is enabled, please refer to clause 4.6.1. Following operation steps shows the condition after inputting correct password.

If password function is not used, the condition directly goes to following steps.

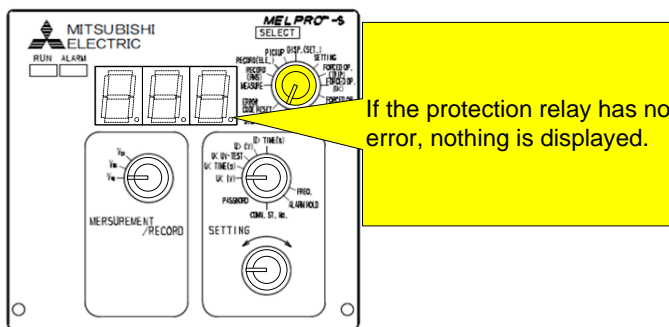
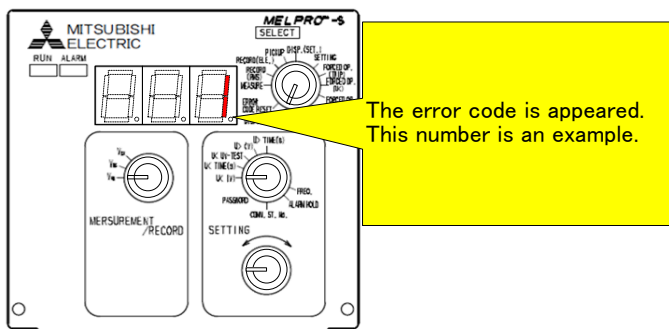
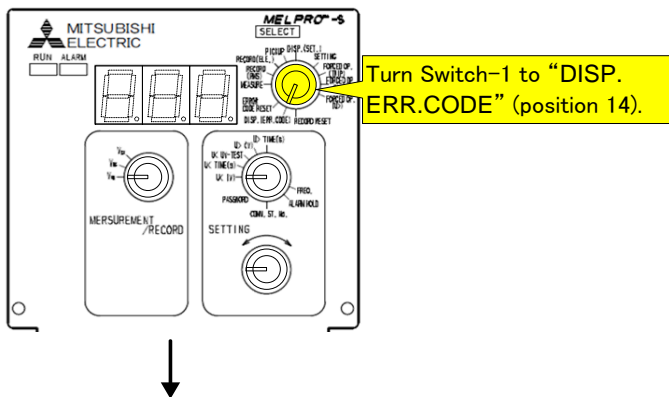


4.10. Display Error Code by Self-Diagnosis [DISP. ERR.CODE]

When the self-diagnosis function detects something to error, the error code relating a cause are saved. More detail of the error code, please refer to instruction manual of each the relay model. If the protection relay has no error, nothing is displayed.

Table 4-5 Description of error code

Error code	Details
01	ROM check
02	RAM check
03	Analog input (A/I) check
04	A/D operating check
05	Digital output (D/O) condition check
06	Digital output (D/O) operation check
07	Analogue filter check
10	Watch dog timer (WDT) check
12	A/D accuracy check

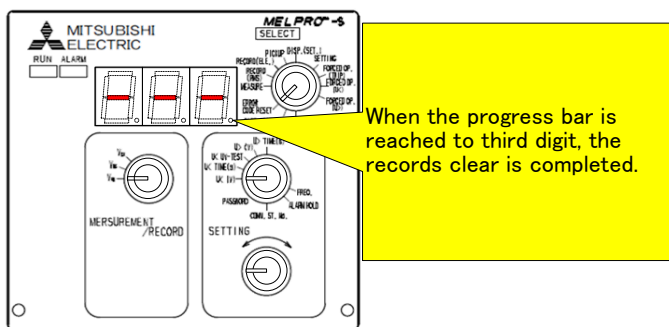
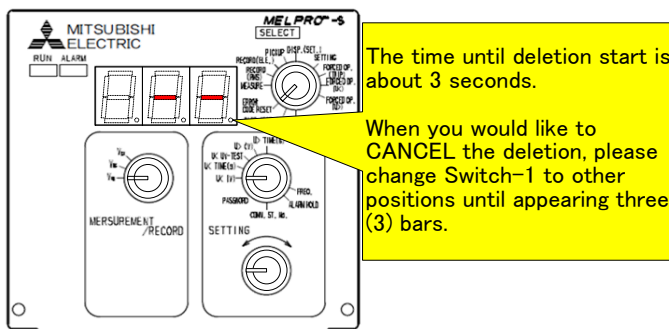
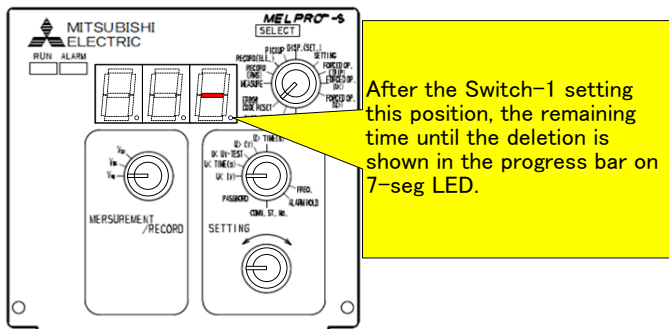
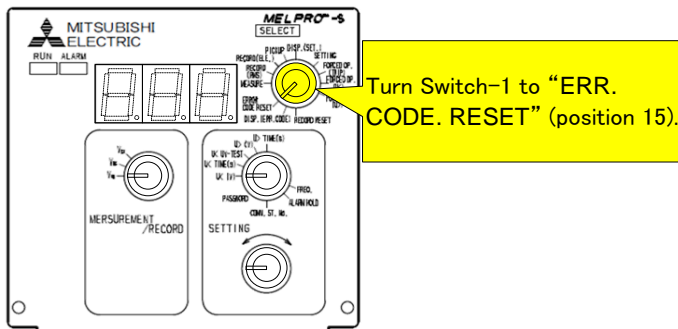


4.11. Clear Error Code [ERR. CODE. RESET]

By the "ERR. CODE. RESET", the saved error code (refer to clause 4.10) are deleted.
The records are deleted 3 seconds after the Switch-1 set this position.

If password function is enabled, please refer to clause 4.6.1. Following operation steps shows the condition after inputting correct password.

If password function is not used, the condition directly goes to following steps.



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