MITSUBISHI ELECTRIC

Numerical Protection Relay

MELPRO™-D Series

TRANSFORMER PROTECTION RELAY

MODEL

CAC1-A41D1

INSTRUCTION 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 canl 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

- 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

- The storage environment shall comply with the following conditions. Otherwise, there is a risk of reducing the performance and life of the product.
  - Ambient temperature –40 to +85°C
    The state where dew condensation or freezing does not occur.
  - Relative humidity 5 to 95% on daily average
  - 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 vapor, 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.
- For tightening torque of screws, refer to the following Table.

Place of use	Nominal dia.	Standard value of torque (steel screw)	Allowable range
Terminal block	M3.5	1.10 N•m (11.2 kgf•cm)	0.932 to 1.27 N•m (9.5 to 12.9 kgf•cm)
Panel mounting	M5.0	3.24 N•m (33 kgf•cm)	2.75 to 3.63 N•m (28 to 37 kgf•cm)

- 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 mal-operation.
- 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 mal-operation.
- All power supplies to the equipment must be of suitable capacity and rated load to avoid the risk of malfunction and mal-operation.
- 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 mal-operation.
- 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 mal-operation.

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 ±5% of the rated frequency
  - Ambient temperature: –40 to +60°C
    The state where dew condensation or freezing does not occur
  - Relative humidity: 5 to 95% on daily average
  - 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.
- While energized, do not draw out the internal unit (subunit). Otherwise, there is a risk of electric shock, injury, failure, malfunction, or maloperation.
- When changing the setting value during the energized state, ensure that all trip circuits are locked in order not to operate. Otherwise, there is a risk of malfunction.

[Maintenance and Inspection]

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

Caution

- 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

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

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

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

- 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]

Caution

- 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]

Caution

- Disposal must take place in accordance with the applicable legislation

– 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.

Index

1. Structure

1.1. Dimensions of relay and Cut-Out dimensions of panel

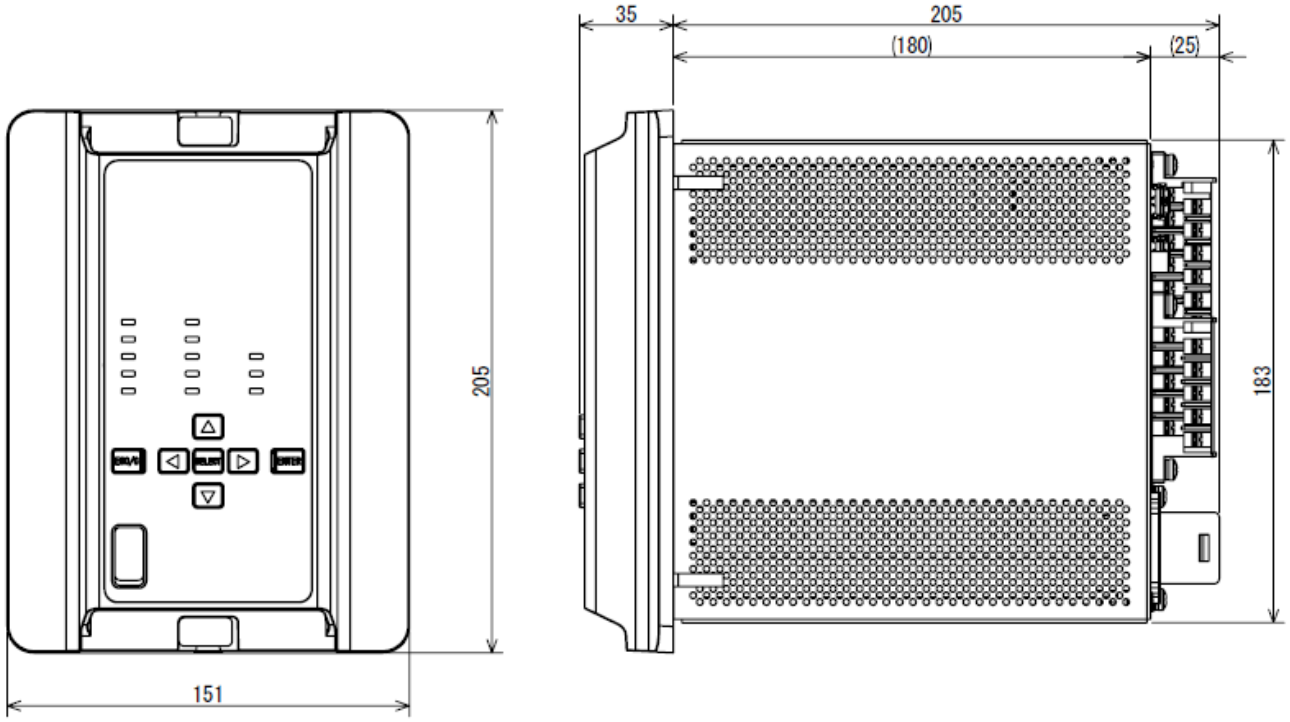


Fig. 1-1 Dimensions of relay

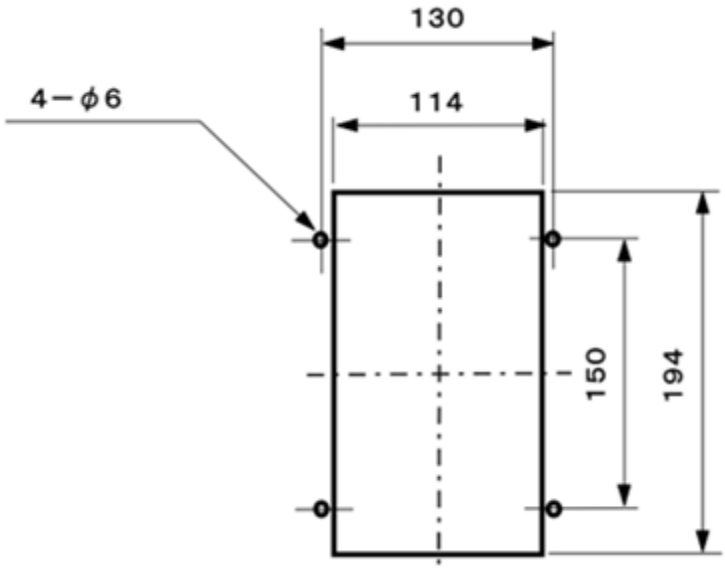


Fig. 1-2 Cut Out dimensions of panel

1.2. Front view of relay

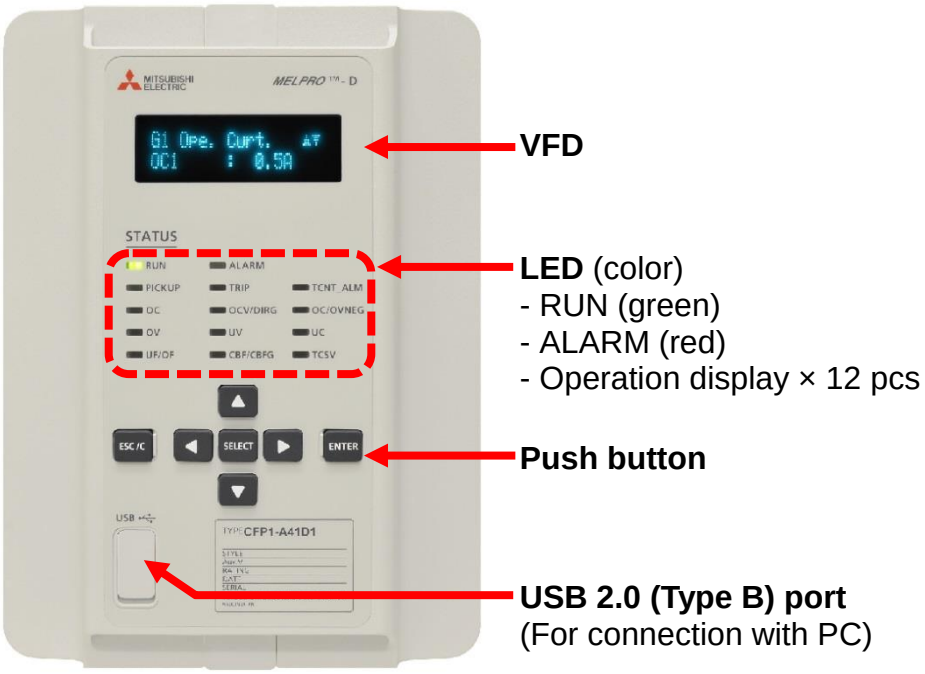


Fig. 1-3 Front view of relay

1.3. Terminal layout on the back plane of relay

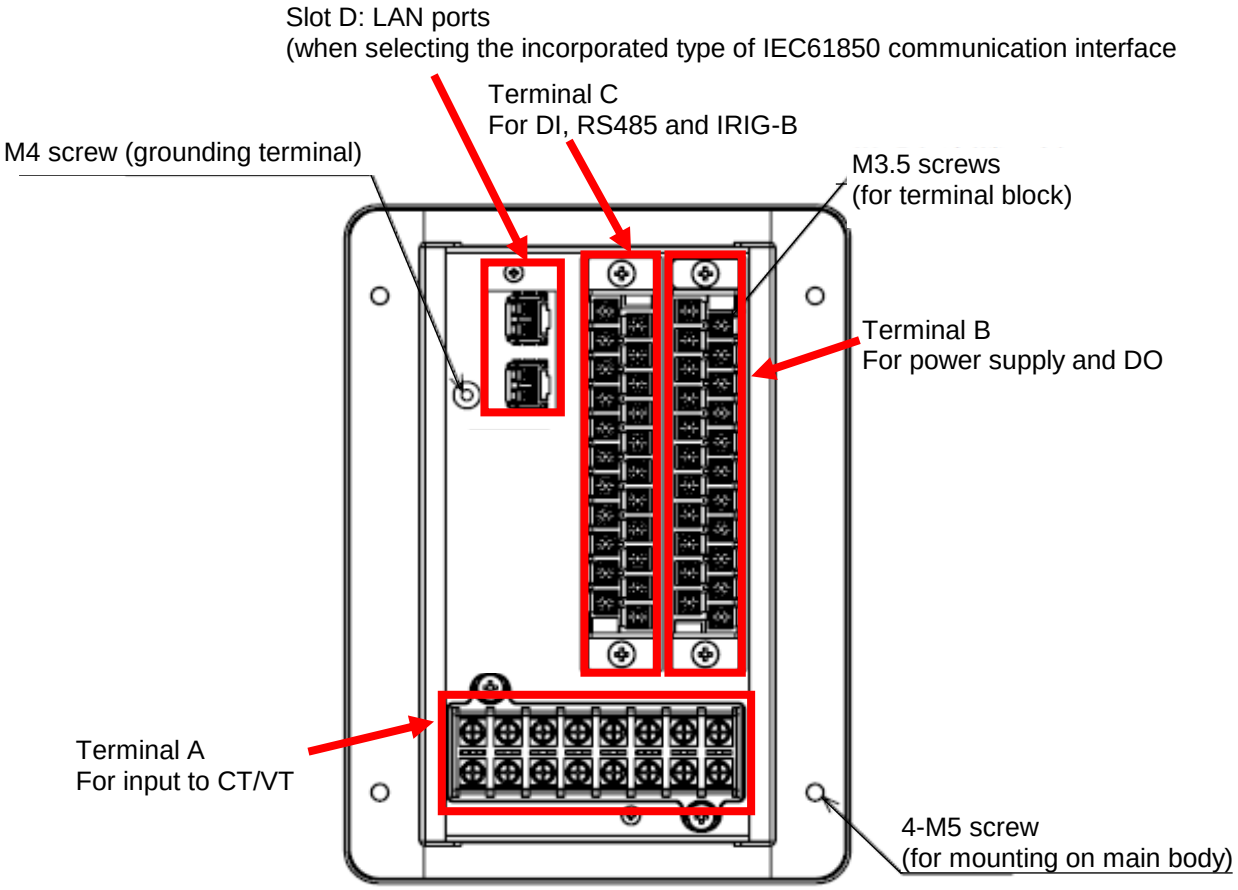


Fig. 1-4 Terminal layout on the back terminals of relay

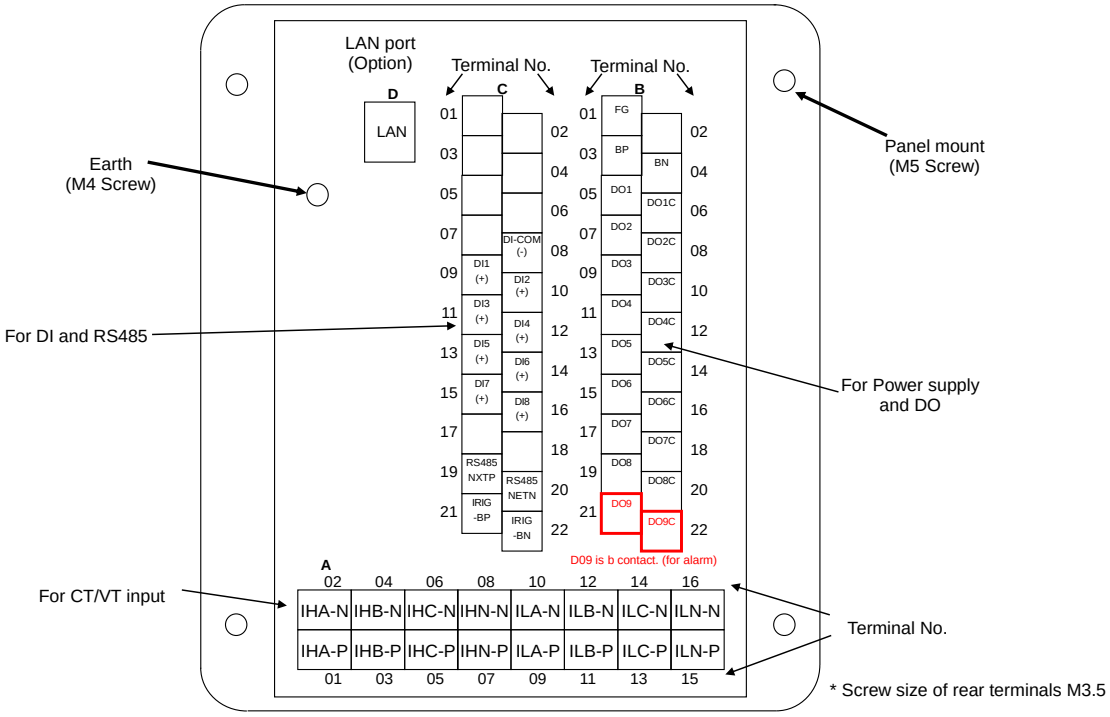


Fig. 1-5 Terminal number on the back plane of relay

1.4. External view of relay

The relay is of draw-out construction to facilitate inspection and testing. Therefore, it is possible to draw out the sub-unit without disconnecting the external wiring
When drawing out the subunit, be sure to take the following steps to avoid the unwanted operation of primary equipment:

- Isolate the relay supplies
- Take care that the appropriate circuit is isolated
- Separate / bridge the CT circuit
- Lock out the operation of circuit breakers etc
- Disconnect the control circuits

As an additional precaution, the CT circuit is provided with an automatic short-circuiting mechanism. This will ensure that the CT secondary circuit is not opened when the sub-unit is removed even if the CT circuits have not been separately bridged.

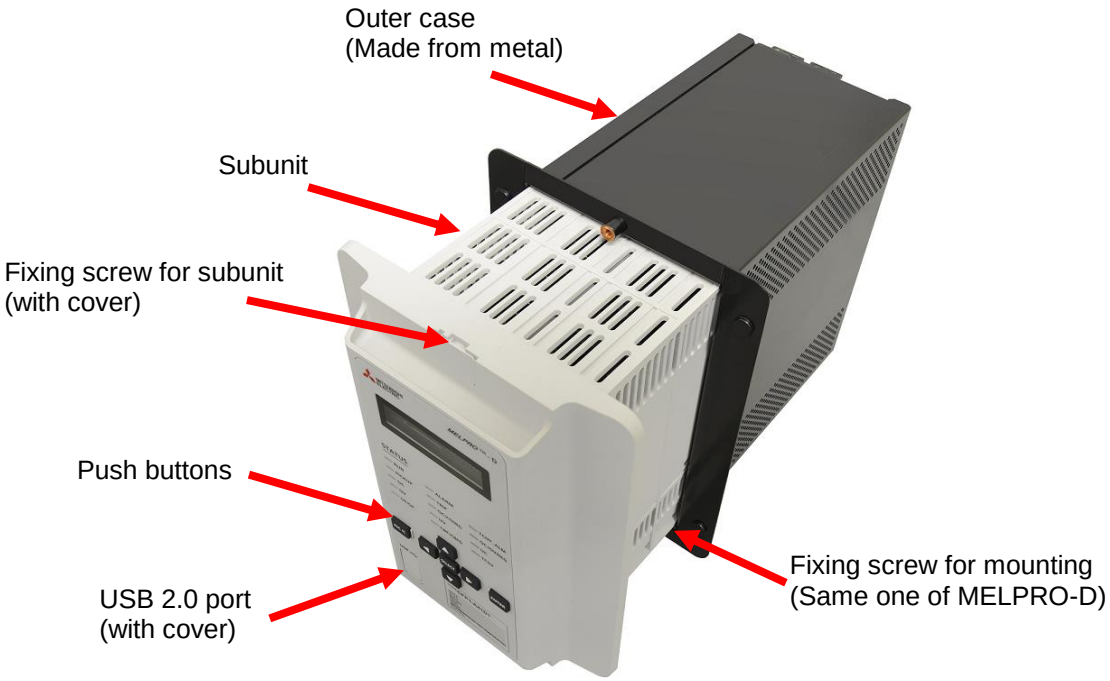


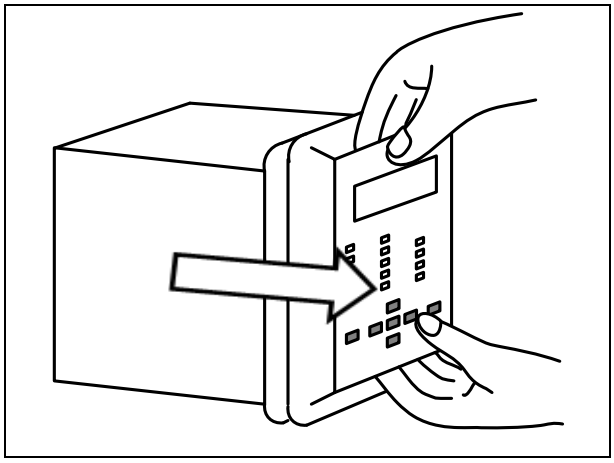
Fig. 1-6 External view of relay

1.4.1. Procedures for draw out the subunit

(1) Removing screws

To draw out the subunit from the case, remove upper & lower screws at the front side of the subunit.

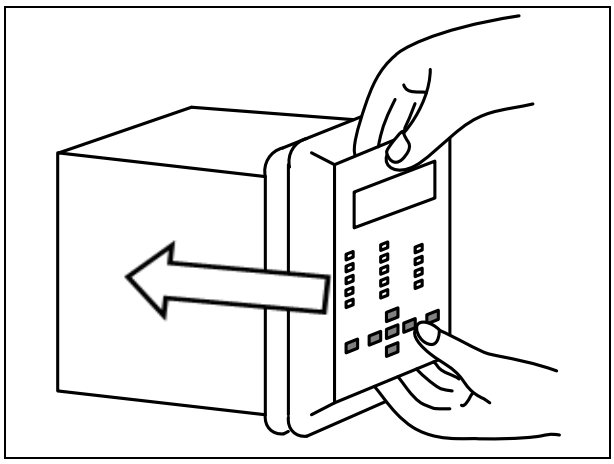
(2) Draw out the subunit



Then, draw out the subunit using fingers on the upper & lower grooves of it.

1.4.2. Procedures for insert the subunit

(1) Insert the subunit



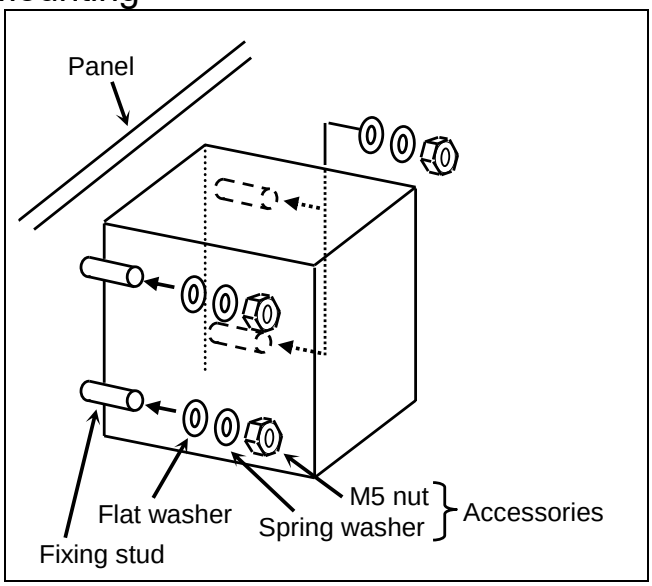
To insert the subunit into the case, using fingers on the upper & lower grooves of it.

Ensure that there is no gap between front side of the subunit and outer case.

(2) Fixing screws

Then, fix upper & lower screws at the front side of the subunit.

1.5. Mounting



When inserting this relay into control panel, take care in order not to damage it.
After inserting, fix this relay with washers and nuts which are supplied with the product.

2. Rating, Specification

2.1. Features

(1) Multi-function
- The relay incorporates a variety of protection functions which are required for transformer protection. Therefore, it is possible to protect the transformer with the use of a single relay.
- The relay has two Group settings sets. Therefore, it can be used for different purposes, such as operation/test, or quickly adapted to meet load conditions.
- Control of a circuit breaker is possible via the font panel, PC-HMI, or remote communication (option).

(2) High-precision measuring functions
- Measurement functions are enhanced.
  Current, voltage, electric power, quantity of electricity, frequency, can be viewed via the front panel display on the relay or using interface software on a PC.
- Fault / Disturbance Recording
  The relay stores up to 5 fault / disturbance records which can be used for fault investigations.
  Fault record function is the record of analog input values (as RMS) at the time when relay elements are operated. Disturbance record function is the record of waveform data for the prescribed period before and after occurrence of fault at sampling rate of 24 samples/cycle.

(3) Selection of communication networks
- Modbus (RS485)
  Modbus communication function is incorporated as standard.
- IEC61850 (Ethernet Station Bus)
  An optional communication card will enable communication based on IEC61850 with GOOSE messaging.
  A two-port optical connector or a single port electrical connector is provided. If the optical two-port connector is selected, HSR (High-availability Seamless Redundancy) and PRP (Parallel Redundancy Protocol) can be configured to improve the reliability of communication.

(4) Programmable Output Contacts provide flexibility
The configuration of output contact is possible by PLC (Programmable Logic Controller), which enables to apply the relay to various systems.

(5) Advanced constant monitoring function improves reliability
The relay continuously monitors the electronic circuits and can detect internal component failure, which enables to improve reliability.
The relay's behavior is as follows:
- In normal conditions: RUN LED lights.
- In abnormal conditions: ALARM LED lights.
  During serious abnormal conditions, the protection elements are locked to prevent an unnecessary output, and the relay fail alarm is issued.

(6) The draw-out Subunit improves maintainability
The provision of an automatic CT shorting mechanism at the time of drawing out the unit makes it very easy to maintain the relay.
Remarks: This mechanism is installed only in the input terminals of relay devices with connected to current transformer.

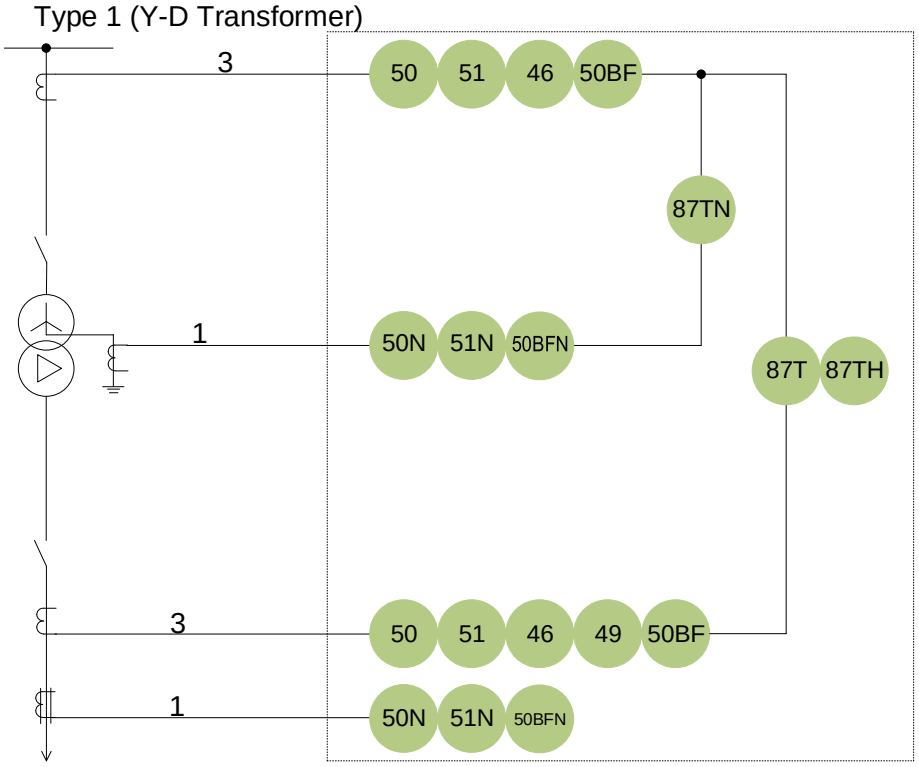
2.2. Standard Ratings

Item			Contents
Rating	Current		5A type
	Zero-phase current		5A type (neutral or residual current)
	Frequency		60Hz / 50Hz
	Power Supply	Voltage	DC110 ~ 250 V, AC100 ~ 240 V
		Variation range	DC88 ~ 300 V, AC85 ~ 264 V
Communication function (*Note)	Modbus		Option
	IEC61850		Option (Optical 2 ch)
Time synchronization function	IRIG-B		Standard equipment
	SNTP		Provided in the case where the IEC61850 communication card is mounted.

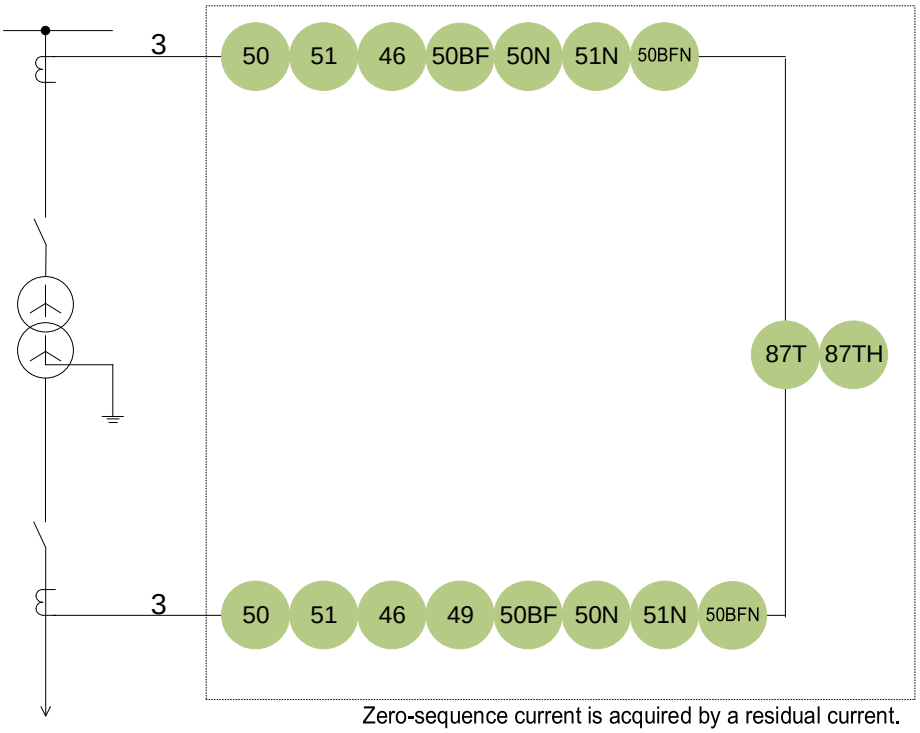
*Note: When IEC61850 is used, Modbus cannot be used and vice-versa. (Only one communications protocol can be selected at a time)

2.3. Protection elements

Type 1 (Y-D Transformer)



Type 1 (Y-Y Transformer) without neutral CT



Zero-sequence current is acquired by a residual current.

Device No.	Protection element (Abbreviated name)	Operating value	Operating time	Other settings
87T	Ratio Differential Current	20 ~ 100%	0.0 ~ 110.0s	
87TH	Differential Current	5 ~ 12	0.0 ~ 110.0s	
87TN	Restricted Earth Fault (Zero-sequence Differential Current)	10 ~ 200%	0.0 ~ 1600.0s	
50P	Instantaneous Overcurrent element (OC1~3)	5A type: 0.5 ~ 1100.0A	0.0 ~ 110.0s	
51P	Definite time or IDMT overcurrent element (OC4)	5 A type: 0.5 ~ 100.0 A	—	14 types of operating time characteristics, 3 types of reset time characteristics
50N • 50G	Instantaneous ground (earth) fault overcurrent element (by residual current or neutral current) (OCN1~3 / OCG1~3)	I0 = 5 A type: 0.1 ~ 100.0 A	0.0 ~ 110.0s	
51N • 51G	Definite time or IDMT ground (earth) fault overcurrent element (by residual current or neutral current) (OCN4 / OCG4)	I0 = 5 A type: 0.1 ~ 100.0 A	—	14 types of operating time characteristics, 3 types of reset time characteristics
46	Negative sequence overcurrent element (OCNEG1~2)	5 A type: 0.25 ~ 5.00 A	0.0 ~ 110.0s	
50BF	CB failure protection(CBF)	5 A type: 0.15 ~ 10.00 A	0.0 ~ 110.0s	
50BFN • 50BFG	Ground (Earth) fault CB failure protection (CBFG)	5 A type: 0.15 ~ 10.00 A	0.0 ~ 110.0s	
49	Thermal Overload	5A type: 1.0 ~ 110.0A	—	

*As the factory settings, a default of “Non-use” for the products with ‘Use/Non-use setting’ is set. If the setting items don’t have ‘Use/Non-use setting’, the minimum setting value is set.

* For details, refer to Chapter 3.

* As factory default, protection element is disabled, i.e., set to “OFF”, for “*** EN” setting if the element is selectable from enabled and disabled. For protection elements which have no such settings, the minimum value is set as the operating value.

2.4. Measuring element

Contents displayed		Range	Measured value		Accident record	Waveform record
Name of symbol	Item	(Secondary value/Primary value)	Primary	Secondary	Primary only	Common
IHa	HV side A-phase current	5A type: 0.00 ~ 10.00A(0.01 A step)/ 0 ~ 60 000 A (1A step)	○	○	○	○
IHb	HV side B-phase current		○	○	○	○
IHc	HV side C-phase current		○	○	○	○
IHN	HV side Zero-phase current		○	○	○	○
ILa	LV side A-phase current		○	○	○	○
ILb	LV side B-phase current		○	○	○	○
ILc	LV side C-phase current		○	○	○	○
ILN	LV side Zero-phase current		○	○	○	○
3IH0	HV side Zero-phase current (S/W calculation)		○	○	○	×
IH1	HV side positive-phase-sequence current (S/W calculation)		○	○	○	×
IH2	HV side negative-equence current (S/W calculation)		○	○	○	×
3IL0	LV side Zero-sequence current (S/W calculation)		○	○	○	×
IL1	LV side positive-sequence current (S/W calculation)		○	○	○	×
IL2	LV side negative-sequence current (S/W calculation)		○	○	○	×
Ida	A-phase differential current	0 ~ 20 000% (1% step)/ 0 ~ 20 000% (1% step)	○	○	○	×
Idb	B-phase differential current		○	○	○	×
Idc	C-phase differential current		○	○	○	×
IHdN	HV side differential current (phase to zero-phase)		○	○	○	×
ILdN	LV side differential current (phase to zero-phase)		○	○	○	×

2.5. List of functions

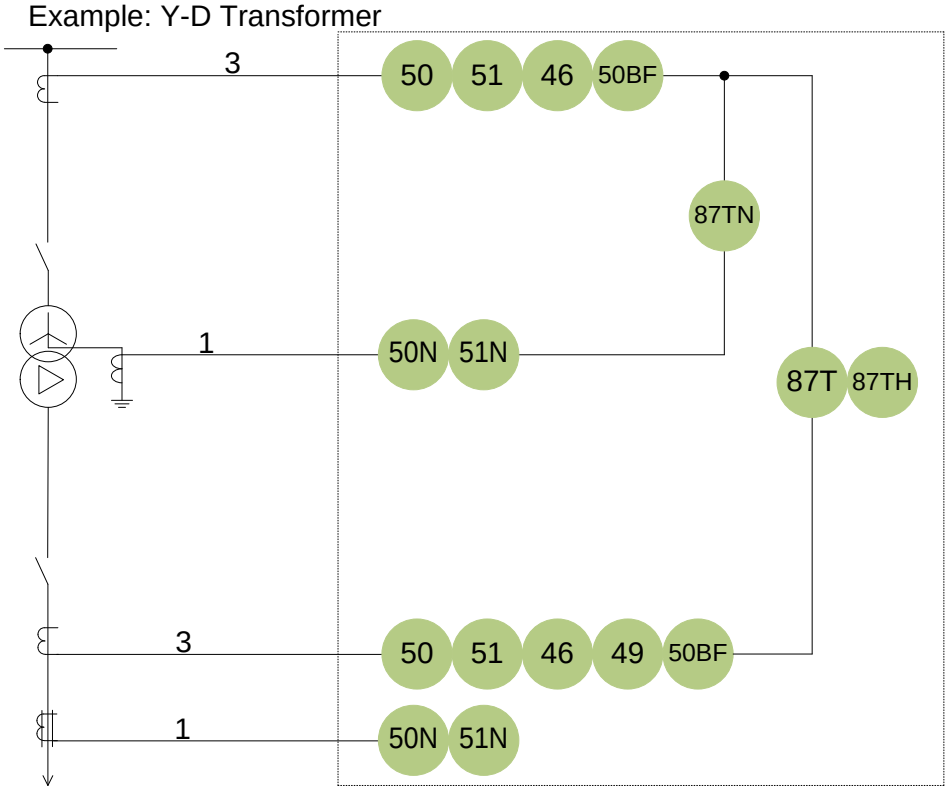
Menu	Item	Operation system		
		Front panel	PC-HMI	Communication
Record (RECORD)	Waveform analysis (WAVEFORM ANALYSIS)	×	○ 11.7.1	×
	Disturbance record (DISTURBANCE RECORD)	×	○ 11.10.1	○
	Fault record (FAULT RECORD)	○ 4.3.2.2.1	×	○
	Event record (EVENT RECORD)	○ 4.3.2.2.2	○ 11.10.3	○
	Access record (ACCESS RECORD)	○ 4.3.2.2.3	○ 11.10.4	○
	Alarm record (ALARM RECORD)	○ 4.3.2.2.4	○ 11.10.2	○
Clear record (CLEAR RECORD)	Clear fault record (FAULT REC CLEAR)	○ 4.3.4.5.1	○ 11.10.5	○
	Clear alarm record (ALARM REC CLEAR)	○ 4.3.4.5.2	○ 11.10.5	○
	Clear event record (EVENT REC CLEAR)	○ 4.3.4.5.3	○ 11.10.5	○
Status (STATUS)	Clock (CLOCK)	○ 4.3.2.1.1	×	○
	Measured value (METERING)	○ 4.3.2.1.2	○ 11.11.1	○
	DI/DO status (DIGITAL I/O)	○ 4.3.2.1.3	○ 11.11.2	○
	Trip counter (TRIP COUNTER)	○ 4.3.2.1.4	×	○
	Device name (DEVICE NAME)	○ 4.3.2.1.5	○ 11.14.1	×
Setting (SETTING)	Active group (ACTIVE WG)	○ 4.3.4.1.1	○ 11.12.2	○
	Group 1 setting (G1)	○ 4.3.4.1.2	○ 11.12.1	○
	Group 2 setting (G2)	○ 4.3.4.1.2	○ 11.12.1	○
	Programable logic (PLC)	×	○ 11.12.4	
Control (CONTROL)	Control setting (CTRL MODE)	○ 4.3.4.2.1	○ 11.13.1	○
	Circuit breaker control (CB CONTROL)	○ 4.3.4.2.2	○ 11.13.2	○
Configuration (CONFIG)	Communication setting (COMMUNICATION)	○ 4.3.4.3.1	×	×

	Clock adjustment (CLOCK ADJUST)	○ 4.3.4.3.2	○ 11.14.2	○
	Measured analog value (METERING)	○ 4.3.4.3.3	○ 11.14.3	○
	Trip counter (TRIP COUNTER)	○ 4.3.4.3.4	○ 11.14.9	○
	Disturbance record (DISTURBANCE)	○ 4.3.4.3.5	○ 11.14.6	○
	DI detection voltage value (DI VOLTAGE)	○ 4.3.4.3.6	○ 11.14.5	○
	Password use/unused (PASSWORD USE)	○ 4.3.4.3.7	×	×
	Password registration (PASSWORD REGIST)	○ 4.3.4.3.8	×	×
Test (TEST)	Forced control of DO (CONTACT TEST)	○ 4.3.4.4.1	○ 11.15.1	○
	Test mode (MODE)	○ 4.3.4.4.2	○ 11.15.2	○
	LED/VFD lighting test (LED/VFD TEST)	○ 4.3.4.4.3	○ 11.15.3	○

3. Protection Function

The CAC1-A41D1 Relay incorporates protective elements which are necessary and sufficient for the protection of the double wounded transformer.
In this chapter, the protection elements incorporated in CAC1-A41D1 are explained.

Example: Y-D Transformer



3.1. Differential Current Element

The CAC1-A41D1 Relay incorporates 4 types of differential current element, listed in the table below, which achieve a quick detection of the transformer fault. The relay features a software-based phase and amplitude adjustments to be applicable with various transformer winding configuration. And then, it is not necessary to provide an auxiliary CT installed externally for this purpose. Further, the relay has a 2nd and 5th harmonic blocking function built into its DIFF element, which prevents unnecessary relay operation for a transformer excitation inrush current or over-excitation.

Device No.	Display name	Protective function
87T	DIFF	Current ratio differential element with a 2nd and 5th harmonic blocking function
87TH	DIFFH	Differential overcurrent element
87TN	RGFH	Zero-sequence current ratio differential element at high-voltage side
	RGFL	Zero-sequence current ratio differential element at low-voltage side

3.1.1. DIFF Element (Current Ratio Differential Element)

DIFF is a ratio differential current element with a 2nd and 5th harmonic blocking function.
The internal function block diagram is shown in Fig. 3-1.

DIFF element takes in input currents on both high- and low-voltage sides of the transformer and compensates both phase difference of both sides' current at load current and zero phase current at each side which generate at external earth fault due to the transformer's winding configuration. The element provides the phase configuration setting and CT ratio-matching setting to active the no- differential current at through fault current, and calculates differential current and restraint current. The element extracts 2nd and 5th harmonics from the differential current to detect the transformer inrush current or transformer over-exciting current for blocking the element's unnecessary operation.

DIFF outputs the trip signal after the lapse of an operation timer (Ope. Time) if the relation of differential and restraint current is in the set ratio-differential characteristics shown in Fig. 3-2 under no detection of 2nd/5th harmonics blocking function.

An off-delay timer of 200-ms is added on the reset side of DIFF to prevent chattering on the contact.
In addition, this element outputs an operating signal only when its enable/disable setting (DIFF EN) is set ON. If this protective element is not necessary, switch the setting to OFF. 'DIFF EN =OFF' setting prevents the unnecessary operation of the element.

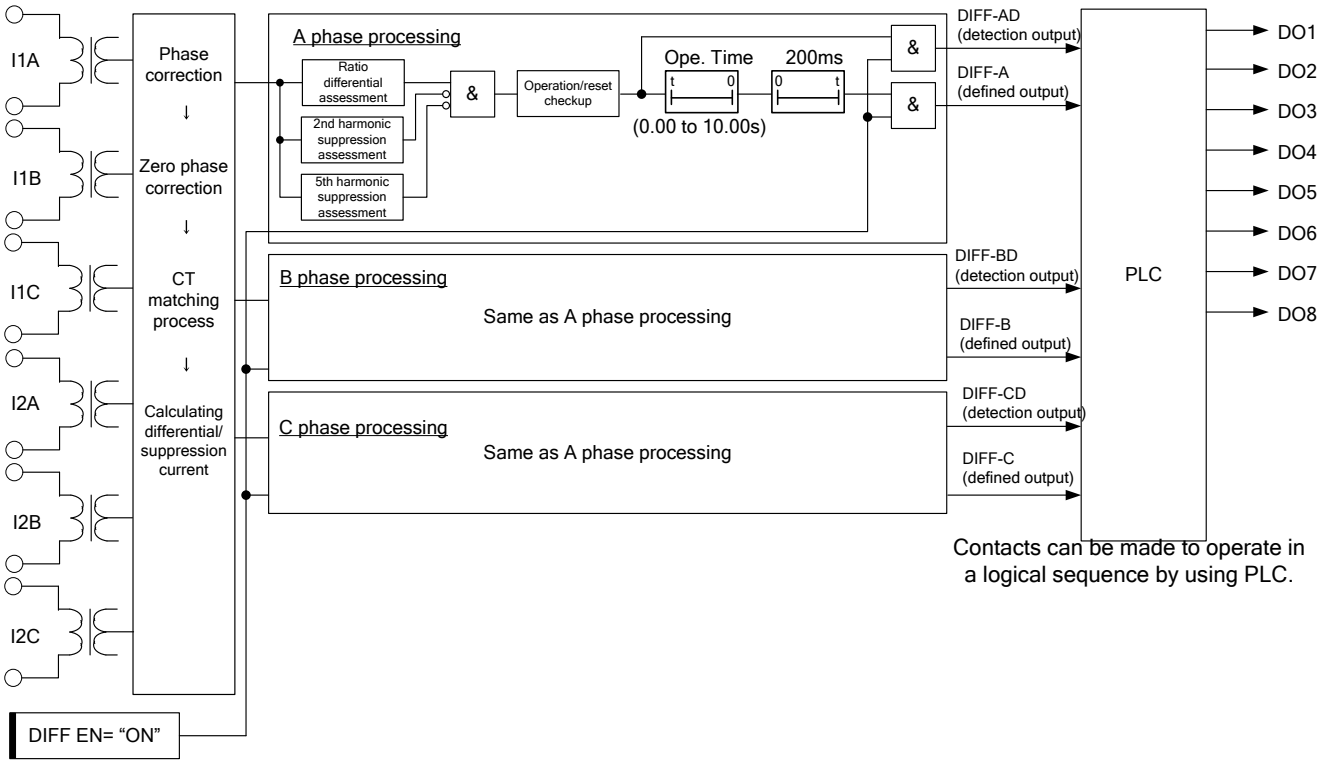


Fig. 3-1 Ratio Differential Current Element (DIFF) – internal function block diagram

* [ ] shows setting value.

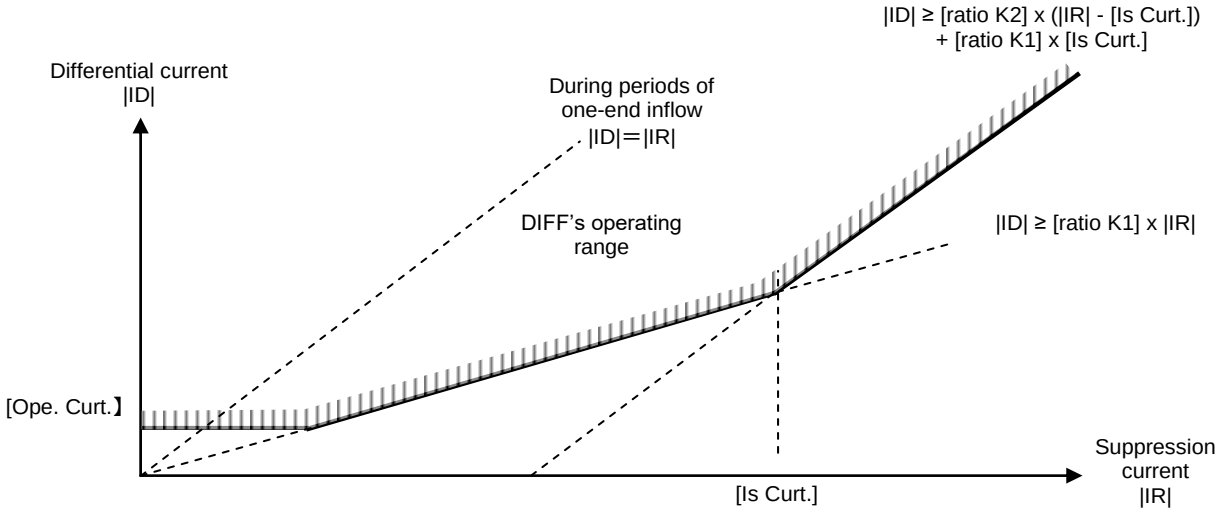


Fig. 3-2 Operating characteristics of Current Ratio Differential Element (DIFF)

3.1.1.1. Phase / Zero-Sequence Compensation

When a transformer winding configuration is such that phases differ between its high-voltage side and low-voltage side, phase compensation shall be required in accordance with Table 3-1 to calculate a correct differential current. And since there may be an unnecessary differential current at external earth fault due to a zero phase current even if the correct phase/gain matching settings are set, the additional zero-phase compensation is provided.
Table 3-2 shows a correspondence between a typical transformer winding configuration and setting values for phase /zero-sequence compensation.

These phase / zero-sequence compensation mean calculating phase rotation. Generally, how to compensation is selected from 2 way – first way is conducted by CT connection and second way is conducted by relay setting. When the phase compensation or zero-sequence compensation are carried out by the CT connection (such as Fig. 7-1 ~ Fig. 7-4 is adopted), please set “0” for setting “TRH Con.”, “TRH Zero”, “TRL Con.” And “TRL Zero”. Following shows examples of adopting each method.

e.g. Transformer: Yd1
Condition of CT connection
Delta (D) connection of CT is adopted for High side winding.
Star (Y) connection of CT is adopted for Low side winding.
Relay Settings
TRH Con. = 0, TRH Zero = 0, TRL Con. = 0, TRL Zero = 0.

e.g. Transformer: Yd1
Condition of CT connection
Star (Y) connection of CT is adopted for High side winding.
Star (Y) connection of CT is adopted for Low side winding.
Relay Settings
TRH Con. = 1, TRH Zero = 0, TRL Con. = 0, TRL Zero = 0.
More detail of these relay setting, please refer to Table 3-2.

Table 3-1 Phase compensation setting

(1) Phase compensation setting TRH Con. and TRL Con.

TRH (L) Con.	Conversion table			Remark
	A phase	B phase	C phase	
0	Ia	Ib	Ic	No conversion
1	(Ia-Ic)/ $\sqrt{3}$	(Ib-Ia)/ $\sqrt{3}$	(Ic-Ib)/ $\sqrt{3}$	Δ conversion, -30°phase shift
2	(Ia-Ib)/ $\sqrt{3}$	(Ib-Ic)/ $\sqrt{3}$	(Ic-Ia)/ $\sqrt{3}$	Δ conversion, +30°phase shift
3	(Ib-Ia)/ $\sqrt{3}$	(Ic-Ib)/ $\sqrt{3}$	(Ia-Ic)/ $\sqrt{3}$	Δ conversion, -150°phase shift
4	(Ib-Ic)/ $\sqrt{3}$	(Ic-Ia)/ $\sqrt{3}$	(Ia-Ib)/ $\sqrt{3}$	Δ conversion, -90°phase shift
5	(Ic-Ib)/ $\sqrt{3}$	(Ia-Ic)/ $\sqrt{3}$	(Ib-Ia)/ $\sqrt{3}$	Δ conversion, +90°phase shift
6	(Ic-Ia)/ $\sqrt{3}$	(Ia-Ib)/ $\sqrt{3}$	(Ib-Ic)/ $\sqrt{3}$	Δ conversion, +150°phase shift
7	- Ia	- Ib	- Ic	-180°phase shift
8	Ib	Ic	Ia	-120°phase shift
9	- Ib	- Ic	- Ia	+60°phase shift
10	Ic	Ia	Ib	+120°phase shift
11	- Ic	- Ia	- Ib	-60°phase shift

(2) Zero-sequence compensation setting TRH Zero and TRL Zero

TRH Zero and TRL Zero = '0': No I0 compensation after conversions of TRH Con. and TRL Con.
TRH Zero and TRL Zero = '1': I0 compensation (with (Ia + Ib + Ic) / 3 being subtracted) after conversions to TRH Con. and TRL Con.

Note: I0 compensation is performed on a terminal current-by-terminal current basis.

TRH(L) Zero	Conversion table		Remark
	HV-side	LV-side	
0	-	-	No I0 correction
1	-(I1a+I1b+I1c)/3/ITH	-(I2a+I2b+I2c)/3/ITL	(Ia + Ib + Ic) / 3 being subtracted from phase differential current

Table 3-2 Correspondence table for transformer winding types (IEC60076-1) and phase/zero-phase compensation settings

Transformer winding	HV-side (TRH)		LV-side (TRL)		Description	
	Con.	Zero	Con.	Zero	HV-side	LV-side
Yy0	1	0	1	0	Δ conversion, -30°phase shift	Δ conversion, -30°phase shift
	0	1	0	1	- I0	- I0
	2	0	2	0	Δ conversion, +30°phase shift	Δ conversion, +30°phase shift
Dd0	0	0	0	0	-	-
Dz0	0	0	0	1	-	- I0
Yd1	1	0	0	0	Δ conversion, -30°phase shift	-
Dy1	0	0	2	0	-	Δ conversion, +30°phase shift
Yz1	1	0	0	1	Δ conversion, -30°phase shift	- I0
Yd5	1	0	10	0	Δ conversion, -30°phase shift	+120°phase shift
	2	0	7	0	Δ conversion, +30°phase shift	-180°phase shift
Dy5	0	0	6	0	-	Δ conversion, +150°phase shift
Yz5	1	0	10	1	Δ conversion, -30°phase shift	- I0, +120°phase shift
	2	0	7	1	Δ conversion, +30°phase shift	- I0, -180deg shift
Yd6	0	1	7	0	- I0	-180°phase shift
Dd6	0	0	7	0	-	-180°phase shift
Dz6	0	0	7	1	-	- I0, -180°phase shift
Yd11	1	0	11	0	Δ conversion, -30°phase shift	-60°phase shift
	2	0	0	0	Δ conversion, +30°phase shift	-
Dy11	0	0	1	0	-	Δ conversion, -30°phase shift
Yz11	1	0	11	1	Δ conversion, -30°phase shift	- I0, -60°phase shift
	2	0	0	1	Δ conversion, +30°phase shift	- I0
Dd2	0	0	9	0	-	+60°phase shift
Dz2	0	0	9	1	-	- I0, +60°phase shift
Dd4	0	0	10	0	-	+120°phase shift
Dz4	0	0	10	1	-	- I0, +120°phase shift
Yd7	1	0	7	0	Δ conversion, -30°phase shift	-180°phase shift
Dy7	0	0	3	0	-	Δ conversion, -150°phase shift
Yz7	1	0	7	1	Δ conversion, -30°phase shift	- I0, -180°phase shift
Dd8	0	0	8	0	-	-120°phase shift
Dz8	0	0	8	1	-	- I0, -120°phase shift
Dd10	0	0	11	0	-	-60°phase shift
Dz10	0	0	11	1	-	- I0, -60°phase shift

3.1.1.2. CT Matching Tap

After the phase/zero-phase compensation step, a current amplitude matching according to the transformer ratio and CT ratios on the transformer's high-voltage side and low-voltage side shall be set so that no differential current can be calculated at load current and external fault by the following equation.

$$I1\square_{CT} = I1 / ITH$$
$$I1N_{CT} = I1N / ITNH$$
$$I2\square_{CT} = I2 / ITL$$
$$I2N_{CT} = I2N / ITNL \quad (3\text{-}1)$$

* $I1\square_{CT}$: HV-side current value after CT matching
I1: CT secondary current of HV-side
ITH: Relay setting of HV-side CT matching

$I1N_{CT}$: HV-side zero-sequence current value after CT matching
I1N: CT secondary current of HV-side zero-sequence
ITNH: Relay setting of HV-side zero-sequence CT matching

$I2\square_{CT}$: LV-side current value after CT matching
I2: CT secondary current of LV-side
ITL: Relay setting of LV-side CT matching

$I2N_{CT}$: LV-side zero-sequence current value after CT matching
I2N: CT secondary current of LV-side zero-sequence
ITNL: Relay setting of LV-side zero- sequence CT matching
□: Phase indication (A, B, C)

3.1.1.3. Calculation of the differential and restraint current

(1) Calculation of the differential current

(1.1) For A phase (same as for B phase and C phase)
A phase differential current $IdA = I1A_{CT} + I2A_{CT}$

(1.2) For zero phase
HV-side zero-phase differential current I1d0 = I1ACT + I1BCT + I1CCT + I1NCT
LV-side zero-phase differential current I2d0 = I2ACT + I2BCT + I2CCT + I2NCT

(2) Calculation of the restraint current

(2.1) Restraint current of DIFF
The restraint current can be selected by setting as follows;.
The following applies to A phase (same as to B phase and C phase).

(a) 'Ires Meth. = Max'
The restraint current is calculated by a maximum (rms) current of high or low voltage side.
Restraint current IR = MAX of (I1ACT, I2ACT)

(b) 'Ires Meth. = SUM'
The restraint current is calculated by a half of scalar (rms) sum of high or low voltage side.
Restraint current IR = (I1ACT + I2ACT) /2

(2.2) Restraint current of RGFH and RGFL
Restraint current is calculated by a maximum value of all input current
Restraint current of RGFH (HV-side) IR10 = MAX ($3I10_{CT}$, $I1N_{CT}$)
$3I10_{CT}$: $I1A_{CT} + I1B_{CT} + I1C_{CT}$
Restraint current of RGFL (LV-side) IR20 = MAX ($3I20_{CT}$, $I2N_{CT}$)
$3I20_{CT}$: $I2A_{CT} + I2B_{CT} + I2C_{CT}$

3.1.1.4. 2nd harmonic blocking function (for DIFF element)

DIFF element incorporates a 2nd harmonic blocking function to block DIFF element from the unnecessary operation by the transformer (excitation) inrush current.
The internal function block diagram is shown in Fig. 3-3.

Since the content ratio of 2nd harmonic (2f) component compared with fundamental (1f) component under inrush current is much larger than that under fault current generally, 2nd harmonic component in differential current is used to distinguish the inrush current and fault current.

1f component and 2f component of differential current are individually extracted and the detection is effective when the 1f component is greater than minimum operation setting value (1f-Min. Ope.) and the 2f component compared with 1f component is greater than the content-ratio setting value (2f-lock ratio). Also, in order to be stable detection, 2nd harmonic detection circuit has latch circuit, 'set' needs continuous 1cycle detection and 'reset' needs continuous 1.5 cycles no-detection.

(*1) One cycle is calculated from the following equation:
One cycle (in seconds) = 1 / system frequency ···· (16.7ms at 60Hz, 20ms at 50Hz)

The CAC1-A41D1 Relay also incorporates 4 types of 2f lock methods as shown in following;

2f lock method	Contents
ANY 1 PH	When one or more phase(s) of 2nd harmonic is (are) detected, it blocks all phases.
	Upon the detection of DIF2f-AD, DIFF-A, DIFF-B and DIFF-C elements are locked.
ANY 2 PH	When two or three phases of 2nd harmonic are detected, it blocks all phases.
	Upon the detection of DIF2f-AD and DIF2f-BD, DIFF-A, DIFF-B and DIFF-C Elements are locked.
EACH PH	When one or more phase(s) of 2nd harmonic is (are) detected, it blocks only the detected phase(s).
	Upon the detection of DIF2f-AD, DIFF-A Element is locked.
3-PH AVG	When the three-phase average of 2nd harmonic is greater than 2f-lock ratio, it blocks all phases.
	The detection level of DIF2f-AD is $\{ (ID_{2fA} + ID_{2fB} + ID_{2fC}) / 3 \} / ID_{1fA}$ > setting value. Once detected, DIFF-A, DIFF-B and DIFF-C Elements are locked.

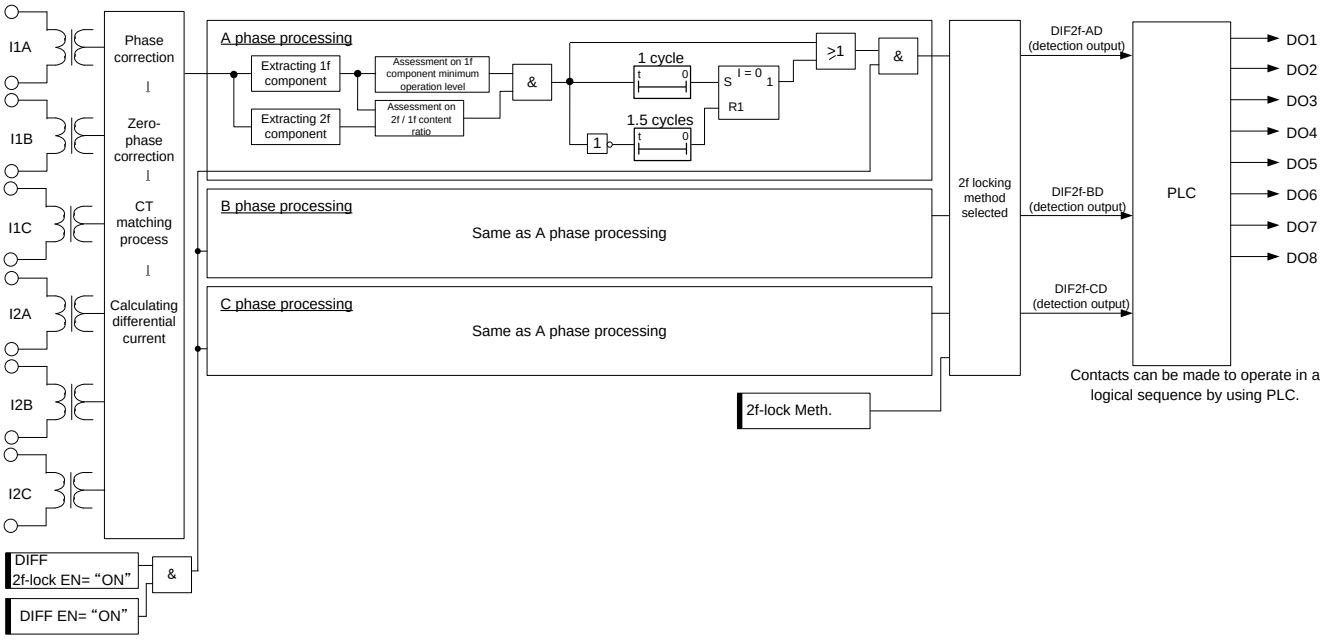


Fig. 3-3 2nd harmonic blocking function –internal function block diagram

Table 3-3 2nd harmonic detection element (differential current) - setting items

Display name	Setting value name	Setting		Description
		Setting range	step	
DIFF 2F	2f-lock ratio	5 ~ 40%	-	2f/1f content ratio
	1f-Min. Ope.	5A type: 0.4 ~ 2.5A	5A type: 0.1A	1f component minimum operation value on 2f/1f content ratio

3.1.1.5. 5thHarmonic blocking Function (for DIFF element)

DIFF incorporates a 5th harmonic blocking function to protect DIFF element from unnecessary operation by transformer over-excitation.
The internal function block diagram is shown in Fig. 3-4.

Since 5th harmonic is much contained in transformer over-excitation current which generates under the overvoltage on the transformer, 1f component and 5f component of differential current are individually extracted and the detection is effective when the 1f component is greater than minimum operation setting value (1f-Min. Ope.) and the 5f component ratio compared with 1f component is greater than the content-ratio setting value (5f-lock ratio). Also, in order to be stable detection, 5th harmonic detection circuit has latch circuit, 'set' needs continuous 1cycle detection and 'reset' needs continuous 1.5 cycles no-detection.

(*1) One cycle is calculated from the following equation:
One cycle (in seconds) = 1 / system frequency ···· (16.7ms at 60Hz, 20ms at 50Hz)

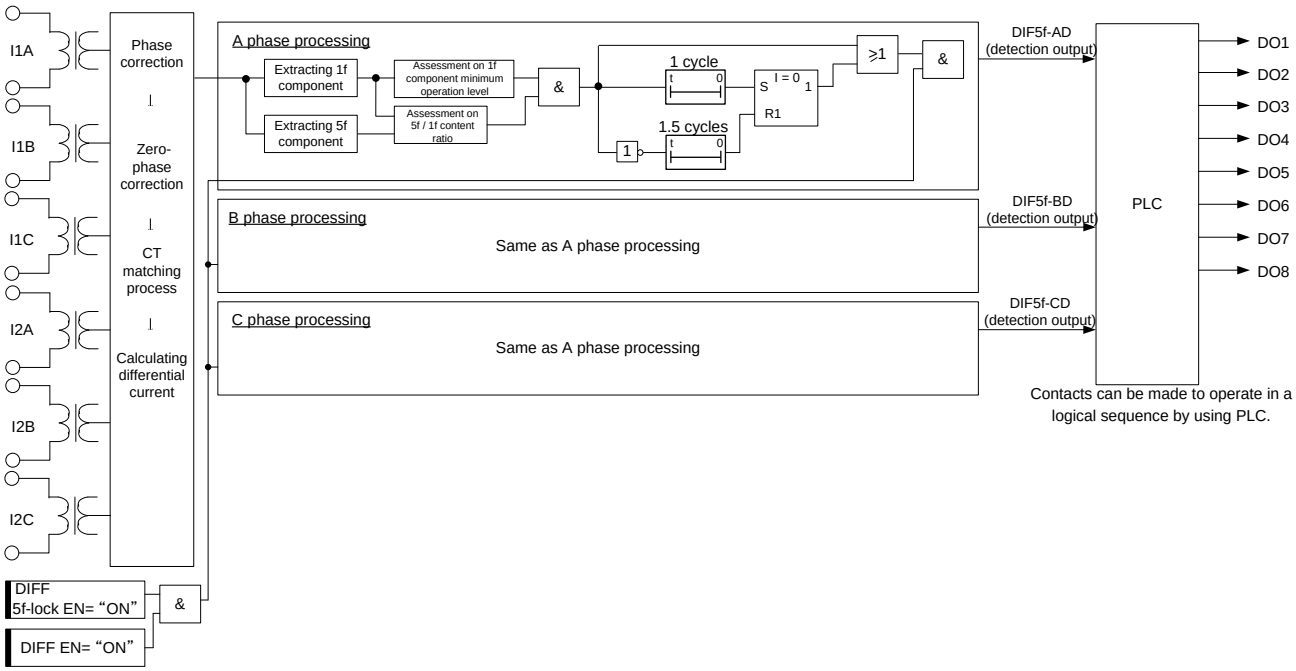


Fig. 3-4 5th Harmonic Suppression Function (Differential Current) – internal function block diagram

Table 3-4 5th harmonic detection element (differential current) - setting items

Display name	Setting value name	Setting		Description
		Setting range	step	
DIFF 5F	5f-lock ratio	30 ~ 50%	-	5f/1f content ratio
	1f-Min. Ope.	5A type: 0.4 ~ 2.5A	5A type: 0.1A	1f component minimum operation value on 5f/1f content ratio

3.1.2. DIFSV Element (Ratio Differential Current Supervision Element)

This element is used to detect abnormal differential current, such as incorrect wiring, wrong setting or any failure at transformer, CT or the relay's current input circuits.
The internal function block diagram is shown in Fig. 3-5.

DIFSV Element is a ratio differential characteristics using the same differential and restraint current as DIFF Element. It outputs a detection signal when the differential and restraint current remains within the operating area shown in Fig. 3-6 for 20 seconds or more.

Also, this element outputs an operating signal only when its enable/disable setting (SV EN) is set ON. Therefore, if this element is not necessary, set the setting to OFF. SV_EN = OFF prevents the unnecessary detection.

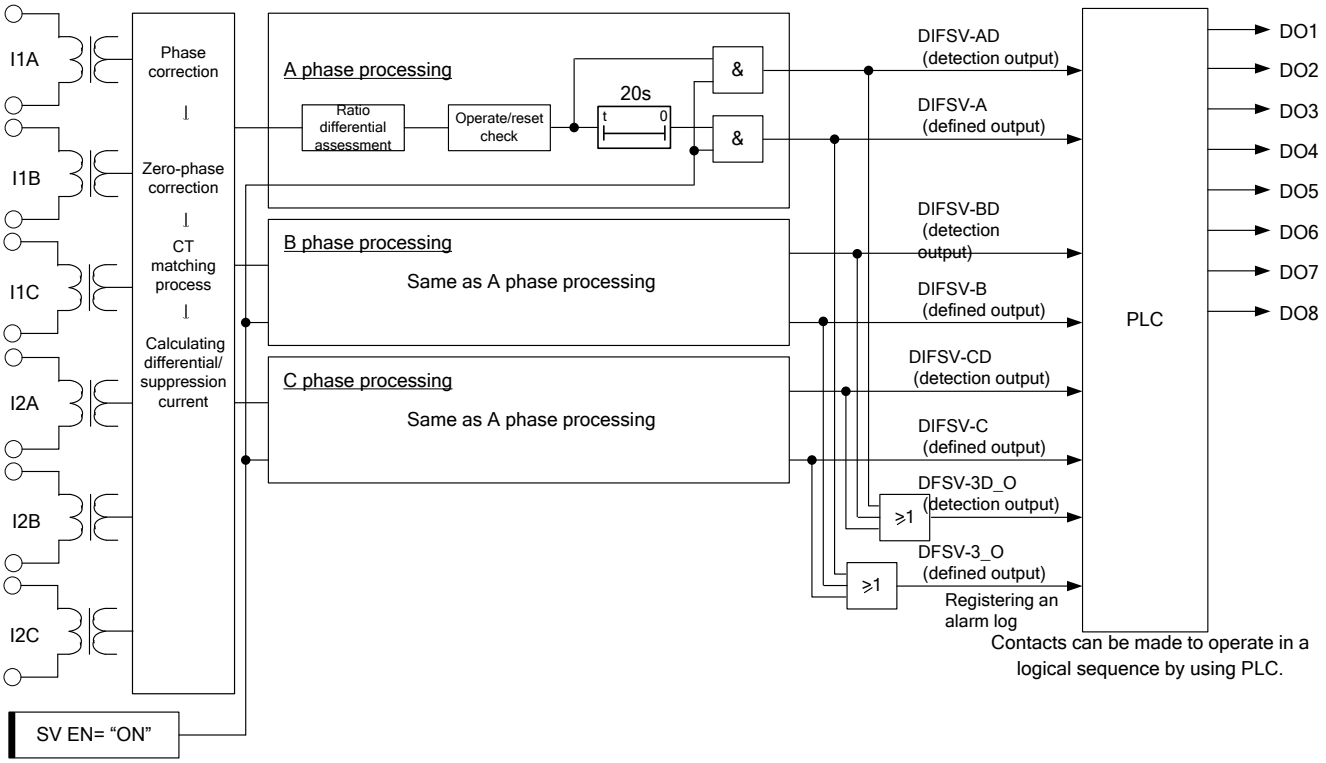


Fig. 3-5 Current Ratio Differential Supervision Element (DIFSV) – internal function block diagram

* [ ] shows setting value.

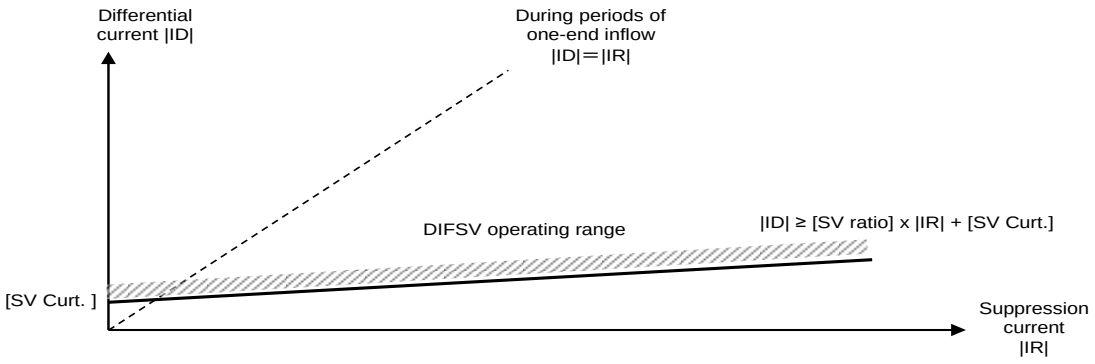


Fig. 3-6 Operating characteristics of Current Ratio Differential Supervision Element (DIFSV)

3.1.3. DIFFH Element (Differential Overcurrent Element)

DIFFH element is a differential current element without a 2nd/5th harmonic blocking function. It provides a fast operation for a large fault current.
The internal function block diagram is shown in Fig. 3-7.

DIFFH element uses the same differential current as DIFF element. It outputs a detection signal after the lapse of an operation timer period (Ope. Time) if differential current is greater than operating value (Ope. Curt.). A 200-ms reset timer is added on the reset side to prevent chattering on the contact.
In addition, it outputs an operating signal only when its enable/disable setting (DIFFH EN) is set ON. If this element is not necessary, set the setting to OFF. DIFFH EN= OFF setting prevents the unnecessary detection.

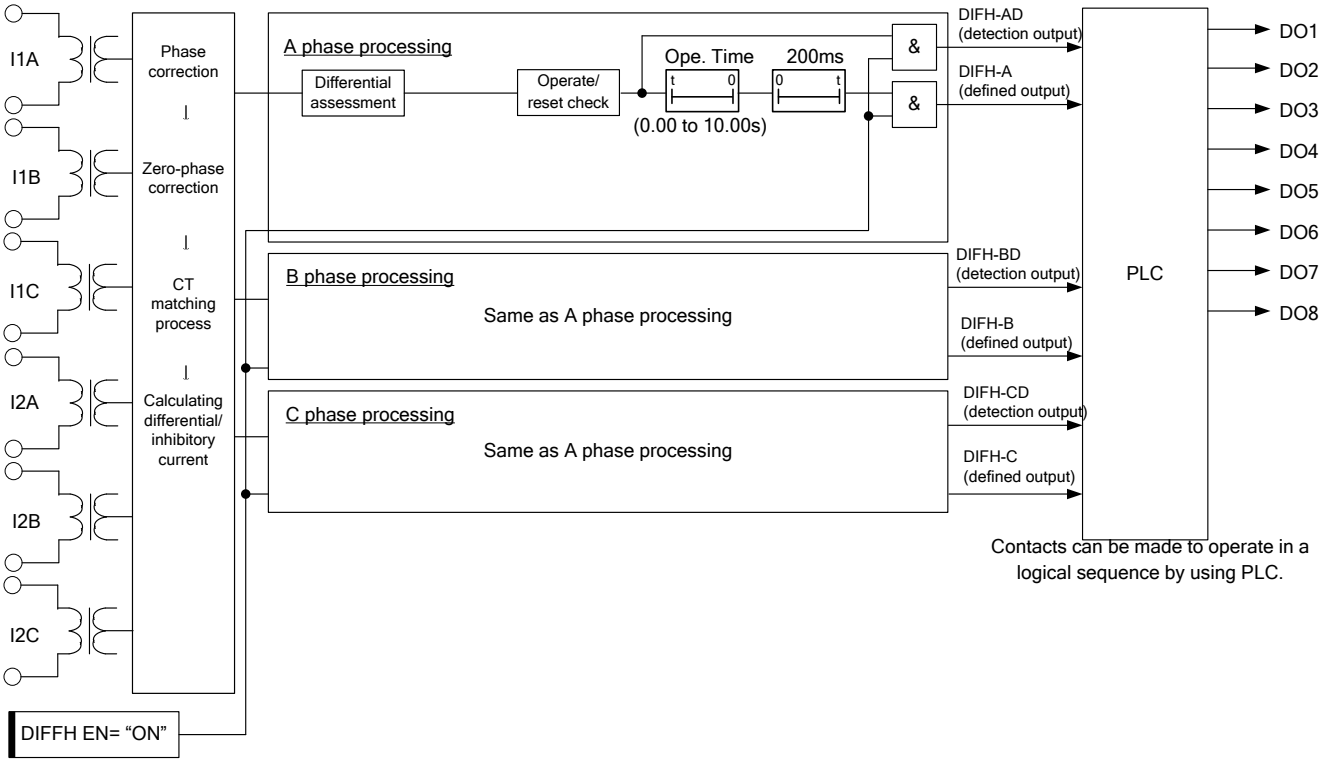


Fig. 3-7 Differential Overcurrent Element (DIFFH) – internal function block diagram

Table 3-5 Differential Current Elements (DIFF, DIFSV, DIFFH) – setting items

Display name	Name of setting value	Setting		Description
		Setting range	Step	
TR	TRH Con.	0 ~ 11	1	HV-side phase compensation
	TRH Zero	0 ~ 1	1	HV-side zero-phase compensation
	TRL Con.	0 ~ 11	1	LV-side phase compensation
	TRL Zero	0 ~ 1	1	LV-side zero-phase compensation
MT	ITH	5A type: 2.2 ~ 12.5A	5A type:0.1A	HV-side positive phase matching tap
	ITL	5A type: 2.2 ~ 12.5A	5A type:0.1A	LV-side positive phase matching tap
	ITNH	5A type: 2.2 ~ 12.5A	5A type:0.1A	HV-side zero-phase matching tap
	ITNL	5A type: 2.2 ~ 12.5A	5A type:0.1A	LV-side zero-phase matching tap
DIFF	DIFF EN	OFF, ON	-	OFF: disable, ON: enable DIFF element is effective at ON.
	Ires Meth.	MAX, SUM	-	Configuration of restraint current (MAX – maximum value, SUM - scalar sum)
	Ope. Curt.	20 ~ 100%	1%	Minimum operating current
	Ratio K1	15 ~ 100%	1%	Ratio K1 for small current region
	Ratio K2	15 ~ 100%	1%	Ratio K2 for large current region
	Is Curt.	100 ~ 1000%	1%	Break point of ratio differential characteristics
	Ope. Time	0.00 ~ 10.00s	0.01s	Operating time (INST ≤ 50 ms)
	SV EN	OFF, ON	-	OFF: disable, ON: enable DIFSV element is effective at ON
	SV Curt.	5 ~ 100%	1%	Min. operating current of DIFSV element
	SV ratio	0 ~ 20%	1%	Ratio setting of DIFSV element
	2f-lock EN	OFF, ON	-	OFF: disable, ON: enable 2nd Harmonic blocking is effective at ON.
	2f-lock Meth.	ANY 1 PH, ANY 2 PH, EACH PH, 3-PH AVG	-	Lock method of 2nd harmonic blocking logic ・ ANY 1 PH: When one or more phase(s) of 2nd harmonic is (are) detected, it blocks all phases. ・ ANY 2 PH: When two or three phases of 2nd harmonic are detected, it blocks all phases. ・ EACH PH: When one or more phase(s) of 2nd harmonic is (are) detected, it blocks only the detected phase(s). ・ 3-PH AVG: When the three-phase average of 2nd harmonic is greater than 2f-lock ratio, it blocks all phases.
	5f-lock EN	OFF, ON	-	OFF: disable, ON: enable 5th harmonic blocking is effective at ON.
DIFFH	DIFFH EN	OFF, ON	-	OFF: disable, ON: enable DIFFH element is effective at ON.
	Ope. Curt.	5 ~ 12	1	Operating current setting This Ope. Curt. setting means multiplayer. Please use following equation when convert this setting Ope.Curt. into ampere. Operating value for high side [A] = (ITH [A]) × (DIFFH.Ope.Curt.) Operating value for low side [A] = (ITL [A]) × (DIFFH.Ope.Curt.)
	Ope. Time	0.00 ~ 10.00s	0.01s	Operating time (INST ≤ 30 ms)

3.1.4. Setting guidance for differential element

3.1.4.1. Relationship between setting ‘ratio K1’ and ‘ratio K2’

This section shows the recommend setting of ‘ratio K1’ and ‘ratio K2’.
Normally, the characteristic slope by Eq. (3) is set as Fig. 3-8. In this case, ‘ratio K2’ set bigger than the ‘ratio K1’ (ratio K1 < ratio K2). It is because, the slope of Eq. (3) avoids unwanted trip by abnormal conditions (e.g. CT saturation).

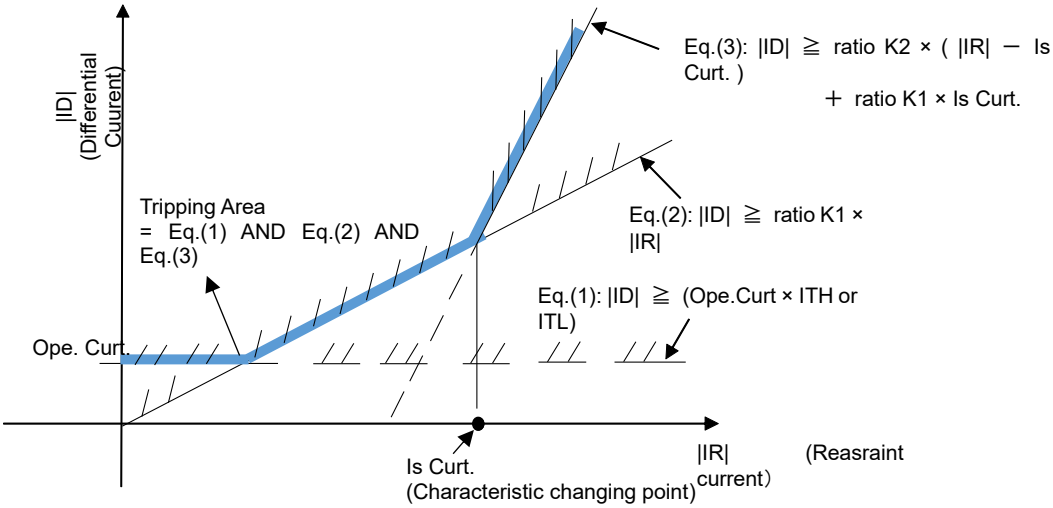


Fig. 3-8 Tripping characteristic of differential element (ratio K1 < ratio K2)

Fig. 3-9 shows when ‘ratio K1’ set same as ‘ratio K2’. If you select the CT which considered not to saturate even in the maximum fault current, the differential element would be set like this.

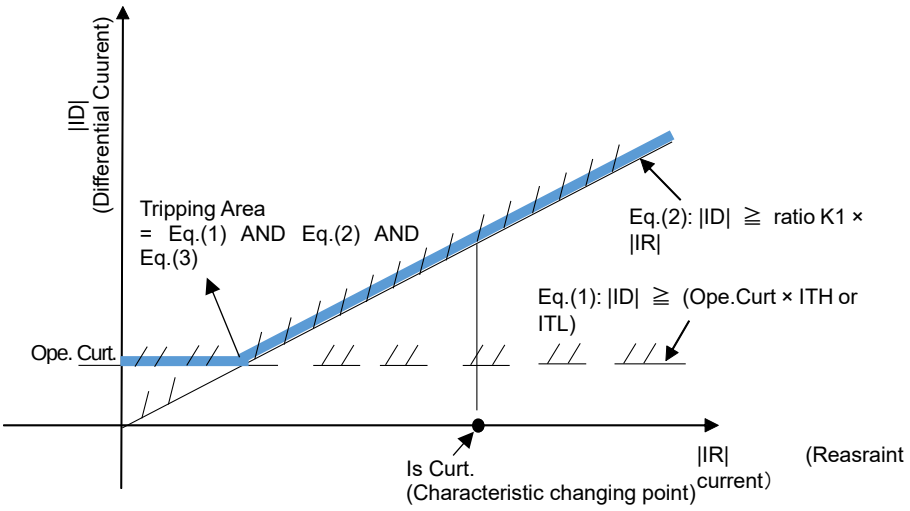


Fig. 3-9 Tripping characteristic of differential element (ratio K1 = ratio K2)

We don’t recommend that ‘ratio K1’ set bigger than the ‘ratio K2’ (ratio K1 > ratio K2) as shown in Fig. 3-10. In this case, the setting ‘Ope. Curt.’ cannot work in the region of small restraint current.

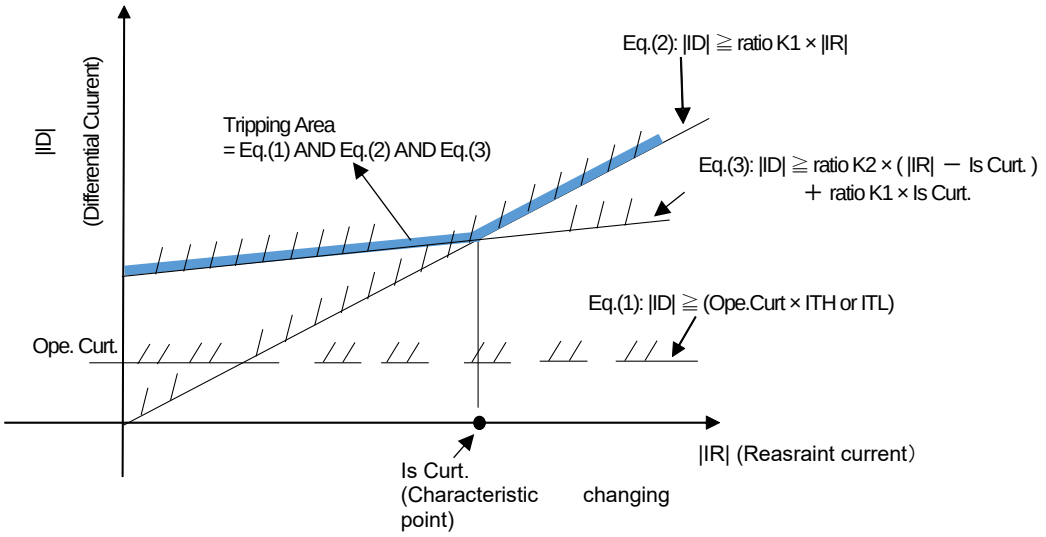


Fig. 3-10 Tripping characteristic of differencial element (ratio K1 > ratio K2)

3.1.4.2. Calculation procedure of CT matching tap setting

3.1.4.2.1. Power system parameters

To obtain the setting value of CT matching tap, following parameters are used.
- The rated apparent power of the power transformer (S [kVA]).
- The rated line-line voltage of high winding side (V_H [kV]) and low winding side (V_L [kV]).
- The CT turn ratio of high winding side (CTR_H) and low winding side (CTR_L).
- The CT secondary winding impedance at 25°C (R_{CT} [ohm]).
- The CT connection (star or delta).
- The CT excitation characteristics such as hysteresis (but not essential values).

3.1.4.2.2. Define of parameters

- I_{PH}: Rated current of CT primary side (at high winding side).
- I_{PL}: Rated current of CT primary side (at low winding side).
- I_{RH}: Rated current of relay input (CT secondary side at high winding side).
- I_{RL}: Rated current of relay input (CT secondary side at low winding side).
- ITH: Relay setting value of matching tap (at high winding side).
- ITL: Relay setting value of matching tap (at low winding side).
- Z_{Total}: Total impedance of CT secondary.

3.1.4.2.3. Calculation process

(1) Selection of CT turn ratio

Selecting CT turn ratio, please consider that the CT secondary current value is greater than or equal to minimum relay setting of ITH or ITL. To check setting range and minimum value of matching tap of ITH and ITL, please refer to Table 3-5 (p. 36).

(2) CT turn ratio compensation (Matching Tap setting)

To eliminate the differential current by the CT turn ratio on both ends, the CT ratio should be compensated. This protection relay has a can set a compensation value by 'Matching Tap Setting'.
The matching tap setting is obtained by following formula.

$$Matching\ Tap\ Setting\,[A] = \frac{Rated\ Current[A]}{CT\ Turn\ Ratio} \quad \cdots\cdots \quad (3\text{-}2)$$

The calculation of matching tap setting both high winding and low winding is necessary.

$$\begin{cases} Setting\ ITH[A] = \dfrac{I_{PH}[A]}{CTR_H} \\ Setting\ ITL[A] = \dfrac{I_{PL}[A]}{CTR_L} \end{cases} \quad \cdots\cdots \quad (3\text{-}3)$$

where the variable names are defined in sub-clause 3.1.4.2.1 and 3.1.4.2.2.
When you use a transformer with tap changer, the rated current (I_{PH} and I_{PL}) i is calculated using the center position of the tap.

(3) Confirm the percentage of mismatching ratio after matching tap setting

However, due to the setting range or setting step, the CT ratio compensation sometimes would not be match perfectly. In this situation, please confirm the percentage of mismatching ratio.
The percentage of mismatching ratio is obtained by following equation.

$$\text{Percentage of Mismatching Ratio}[\%] = \frac{\dfrac{I_{RH}[A]}{I_{RL}[A]} - \dfrac{setting\ ITH[A]}{setting\ ITL[A]}}{\min\left(\dfrac{I_{RH}[A]}{I_{RL}[A]}, \dfrac{setting\ ITH[A]}{setting\ ITL[A]}\right)} \times 100 \quad \cdots\cdots \quad (3\text{-}4)$$

where the variable names are defined in sub-clause 3.1.4.2.1 and 3.1.4.2.2.

In above equation, the denominator means that the smaller value is selected from $\dfrac{I_{RH}}{I_{RL}}$ and $\dfrac{ITH}{ITL}$.

When you use a transformer with tap changer, please consider the percentage of mismatching ratio including a tap position.
Please confirm that the percentage of mismatching ratio does not exceed 15%.

(4) Considering the CT excitation characteristic

To consider the influence for a differential element by a CT error, the CT secondary voltage is needed. The CT secondary voltage is able to be calculated from a CT secondary impedance (Z_{Total}) and following shows as example.

$$\begin{aligned} Z_{Total} &= 1.13 \times \text{CT Secondary Winding Impedance} + \text{Relay Burden} \\ &= 1.13 \times R_{CT} + \text{Relay Burden} \end{aligned} \quad \cdots\cdots \quad (3\text{-}5)$$

where the variable names are defined in sub-clause 3.1.4.2.1 and 3.1.4.2.2.
In this equation, we assume the coefficient of R_{CT} is set as 1.13. This value means the temperature rise increases these impedance during a fault current flowing.
Above equation are in case of a CT star-connection. If a CT is connected as a delta, the CT secondary impedance (Z_{Total}) becomes 3 times higher than star-connection. It is because, in delta-connection, all winding impedance is summed.

Therefore you can obtain the CT secondary voltage in fault condition using a theoretical fault current of CT secondary winding and the total impedance of CT secondary winding (Z_{Total}). Normally a theoretical fault current of CT secondary winding is calculated by the CT primary current and the CT turn ratio.
From the CT secondary voltage, an actual assumed CT secondary current (CT excitation current) can be obtained by the CT exciting curve. The difference between an actual CT secondary current and a theoretical CT secondary current is called a CT composite error.
In other words, the worst case of the CT error is assumed by the composite error. E.g. using 5P10 as a CT accuracy class, the CT error keeps within 5% until 10 times of a rated current.
The total error is summation of a CT composite error and a percentage of mismatching ratio (eq.(3-4)).

Last, please confirm that this total error should not exceed a setting ‘ratio K1’ value of the differential element.

3.1.4.3. Example calculation to obtain CT matching tap setting

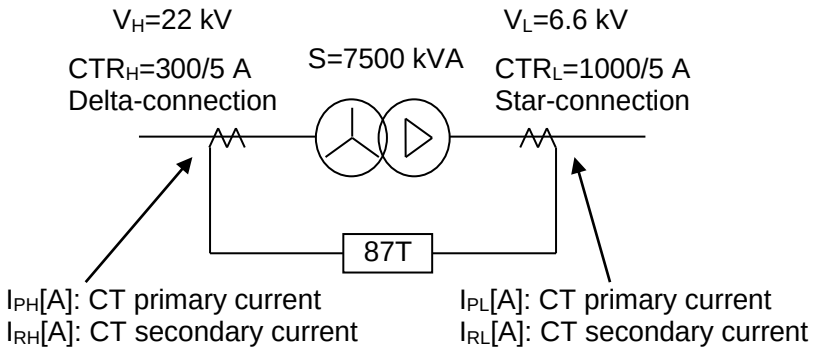


Fig. 3-11 Example circuit parameters

Table 3-6 Power system parameters

	High Winding Side	Low Winding Side
Rated Voltage	V_H = 22 kV	V_L = 6.6 kV
Rated Capacity	7500 kVA	7500 kVA
Transformer Winding	Star-winding	Delta-winding
CT Turn Ratio	300 A / 5 A → CTR_H = 60	1000A / 5A → CTR_L = 200
CT Connection	Delta-connection	Star-connection

(1) Calculate rated current

The rated current of CT primary side at high winding side (I_{PH}) and low winding side (I_{PL}) are calculated by following equation.

$$I_{PH}[A] = \frac{S[kVA]}{V_H \times \sqrt{3}} = \frac{7500[kVA]}{22[kVA] \times \sqrt{3}} = 196.8[A] \quad \cdots\cdots \text{(3-6)}$$

$$I_{PL}[A] = \frac{S[kVA]}{V_L \times \sqrt{3}} = \frac{7500[kVA]}{6.6[kVA] \times \sqrt{3}} = 656.1[A] \quad \cdots\cdots \text{(3-7)}$$

(2) Calculate CT turn ratio

The CT turn ratios were calculated in Table 3-6.

$$CTR_H = 300[A]/5[A] = 60 \quad \cdots\cdots \text{(3-8)}$$

$$CTR_L = 1000[A]/5[A] = 200 \quad \cdots\cdots \text{(3-9)}$$

(3) Calculate rated current of relay input

The rated current of relay inputs (I_{RH}, I_{RL}) are calculated by following equation.

$$I_{RH} = \frac{Rated\ Current}{CT\ Turn\ Ratio} = \frac{I_{PH}[A]}{CTR_H} = \frac{196.8[A]}{60} \times \sqrt{3} = 5.68[A] \quad \cdots\cdots \text{(3-10)}$$

$$I_{RL} = \frac{Rated\ Current}{CT\ Turn\ Ratio} = \frac{I_{PL}[A]}{CTR_L} = \frac{656.1[A]}{200} = 3.28[A] \quad \cdots\cdots \text{(3-11)}$$

The sqrt (3) is multiplied because the CT is set a delta-connection in a high side. (Eq. (3-10))

(4) Decide matching tap

By Eq. (3-10) and (3-11), the rated current of relay inputs ware got.
If these values are fitted to the matching tap setting (ITH, ITL), you can set setting 'ITH' = I_{RH} and setting 'ITL' = I_{RL}.
However, in this case, above calculations already rounded to 2 decimal places. The CAC1-A41D1 supports a 1 decimal place as a matching tap setting. Therefore, to get matching tap setting, please round to 1 decimal

place from Eq. (3-10) and (3-11).

$$I_{RH} = 5.68[A]$$
$$\Rightarrow ITH \approx 5.7[A] \quad \cdots\cdots (3\text{-}12)$$

$$I_{RL} = 3.28[A]$$
$$\Rightarrow ITL \approx 3.3[A] \quad \cdots\cdots (3\text{-}13)$$

(5) Confirm the percentage of mismatching ratio

Using Eq. (3-4), the percentage of mismatching ratio is calculated.

$$\text{Percentage of Mismatching Ratio}[\%] = \frac{\frac{I_{RH}[A]}{I_{RL}[A]} - \frac{setting\ ITH[A]}{setting\ ITL[A]}}{\min\left(\frac{I_{RH}[A]}{I_{RL}[A]}, \frac{setting\ ITH[A]}{setting\ ITL[A]}\right)} \times 100$$

Next, substitute the values of this example for above equation.

$$\text{Percentage of Mismatching Ratio}[\%] = \frac{\frac{5.68[A]}{3.28[A]} - \frac{5.7[A]}{3.3[A]}}{\min\left(\frac{5.68[A]}{3.28[A]}, \frac{5.7[A]}{3.3[A]}\right)} \times 100$$

When we focus on denominator, I_{RH}/I_{RL} = 5.68 [A] / 3.28 [A] ≒ 1.7317. And we similarly check next member: setting ITH / setting ITL = 5.7 [A] / 3.3 [A] ≒ 1.7272. Therefore, setting ITH / setting ITL value is selected which is smaller than I_{RH}/I_{RL} (min function).

$$\text{Percentage of Mismatching Ratio}[\%] = \frac{\frac{5.68[A]}{3.28[A]} - \frac{5.7[A]}{3.3[A]}}{\frac{5.7[A]}{3.3[A]}} \times 100 = 0.2567\%$$

The percentage of Mismatching Ratio = 0.2567% is smaller than 15% and this matching tap is available.

(6) Recalculate matching tap when the I_{RH} and I_{RL} is beyond the setting range

In this situation (Eq. (3-12) and (3-13)), these values are within setting range (ITH, ITL = 2.2 A ~ 12.5 A). However, when the rated current of relay inputs (I_{RH}, I_{RL}) is exceed the setting value, please recalculate and start from matching tap value.

In case of I_{RH} = 2A, the 2.2A which is minimum value of the matching tap setting is selected as a new setting of 'ITH'. And recalculation is started from new setting '$ITH_{NewSetting}$' = 2.2A.
The new setting '$ITL_{NewSetting}$' is obtained by following equation.

$$ITL_{NewSetting} = ITL_{OldSetting} \times \frac{ITH_{NewSetting}}{ITH_{OldSetting}} \quad \cdots\cdots (3\text{-}14)$$
$$= 3.3[A] \times \frac{2.2[A]}{2[A]} = 3.63[A]$$

where, $ITL_{OldSetting}$ = 3.3 A by Eq. (3-13),
$ITH_{NewSetting}$ = 2.2 A by this assumed new condition,
$ITH_{OldSetting}$ = 2 A by this assumed old condition

Therefore, by above recalculated values, setting 'ITH' = 2.2 [A] and setting 'ITL' = 3.6 [A] should be set as new setting values.

3.1.5. RGFH Element (Zero-sequence Current Ratio Differential Element)

RGFH element is a zero-sequence current ratio differential element for protecting earth fault on the high-voltage side of the transformer.
The internal function block diagram shown in Fig. 3-12explains how the RGFH element detects.

RGFH element takes in 3 phase terminal-current and neutral current of the neutral earth line of the high-voltage winding of the transformer to obtain the zero phase differential current. Then, it requires a CT on the neutral earth line of the high-voltage winding of the transformer. It provides a CT matching function to compensate the difference between CT ratio of the high-voltage terminal side of the transformer and CT ratio of the neutral line of the HV-winding using a CT matching tap for calculating zero-phase differential current and zero-phase restraint current.
Since it calculates the zero phase current by summing 3 phase terminal current and zero phase current on earth line, it incorporates overcurrent blocking function for preventing an unnecessary operation due to the large error caused by the CT error, CT saturation error and etc. of large fault current. The overcurrent blocking function is effective at 'RGFH I0 EN = ON' and the overcurrent setting is 'Ope. Curt'. And also RGFH element provides the CT saturation countermeasure function, which increasing the collation time for operation when detecting the external fault at fault initiating state before starting CT saturation. This CT saturation countermeasure can be set ineffective by setting "CT Sat. Meas." to OFF.

If the calculated zero-phase differential current and restraint current remains within an operating area shown in Fig. 3-13 and no detection of overcurrent blocking function, RGFH outputs a detection signal after the lapse of the operating timer period (Ope. Time).
A 200-ms resetting timer is incorporated to prevent chattering on the contact.
In addition, this element outputs an operating signal only when its enable/disable setting (RGFH EN) is set ON. By setting it OFF, it prevents the unnecessary operation of the element.

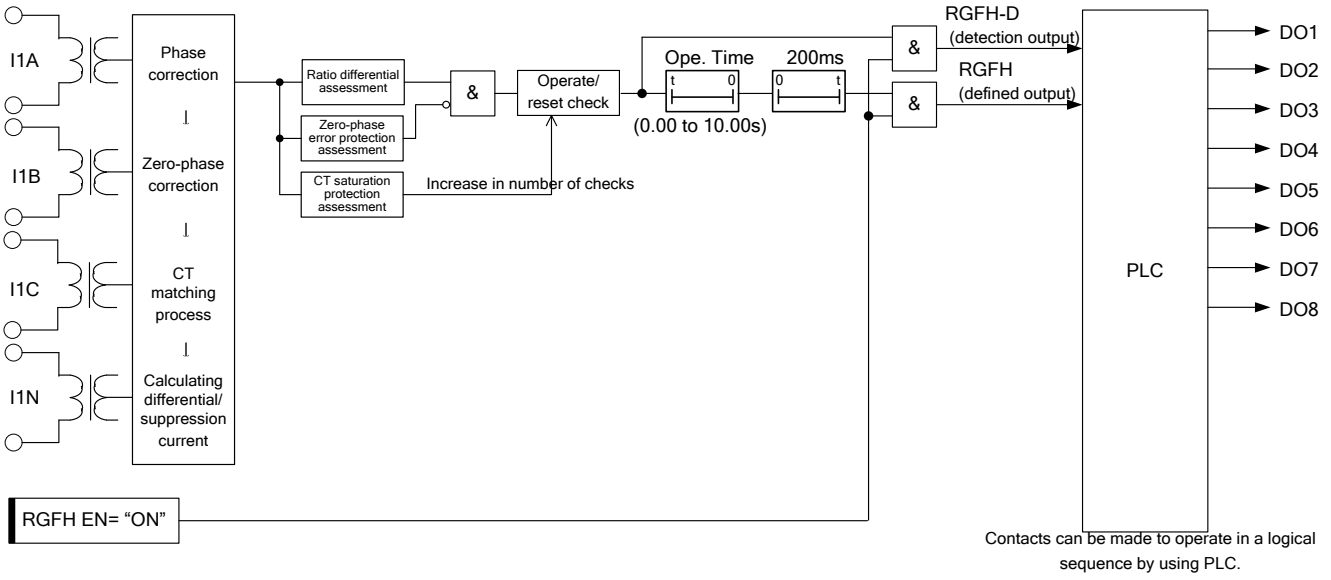


Fig. 3-12 Zero-sequence Current Ratio Differential Element (RGFH) – internal function block diagram

* [ ] shows setting value.

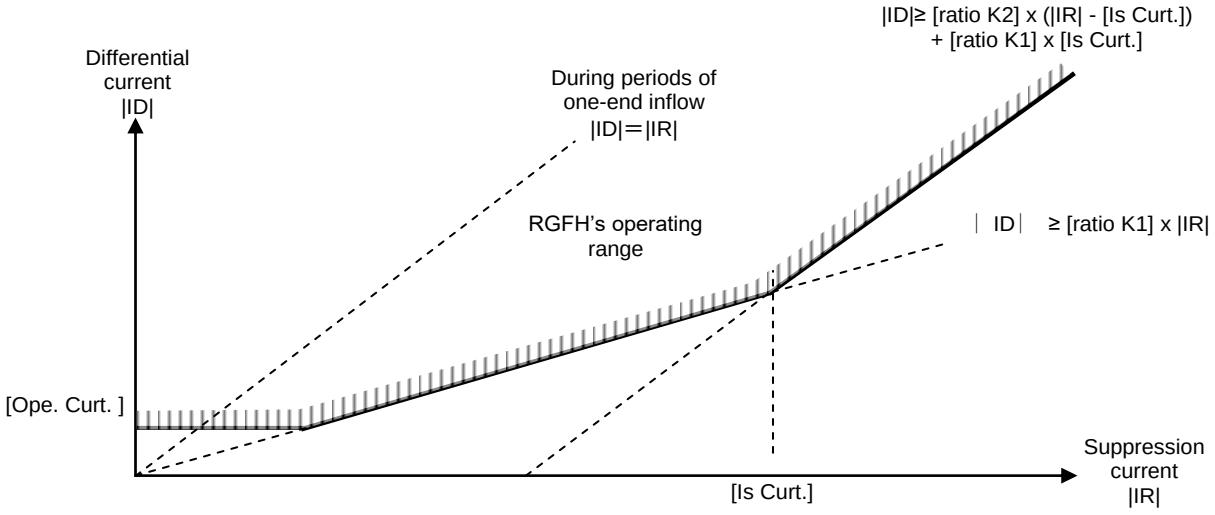


Fig. 3-13 Operating characteristics of Zero-sequence Current Ratio Differential Element (RGFH)

3.1.6. RGFL Element (Zero-sequence Current Ratio Differential Element)

RGFL element is a zero-sequence current ratio differential element for protecting earth fault on the low-voltage side of the transformer.
RGFL has the same operating characteristics as RGFH element.
For more information about the element's internal function block diagram and how it works, see Section 3.1.5.

Table 3-7 Zero-sequence Current Ratio Differential Elements (RGFH, RGFL) – setting items

Display name	Setting value name	Setting		Description
		Setting range	Step	
TR	TRH Con.	0 - 11	1	HV-side phase correction
	TRH Zero	0 - 1	1	HV-side zero-phase correction
	TRL Con.	0 - 11	1	LV-side phase correction
	TRL Zero	0 - 1	1	LV-side zero-phase correction
MT	ITH	2.2 - 12.5A	0.1A	HV-side positive phase matching tap
	ITL	2.2 - 12.5A	0.1A	LV-side positive phase matching tap
	ITNH	2.2 - 12.5A	0.1A	HV-side zero-phase matching tap
	ITNL	2.2 - 12.5A	0.1A	LV-side zero-phase matching tap
RGFH	RGFH EN	OFF, ON	-	OFF: disable, ON: enable RGFH element is effective at ON.
	Ope. Curt.	10 - 200%	1%	Minimum operating current
	ratio K1	10 - 100%	1%	Ratio K1
	ratio K2	10 - 100%	1%	Ratio K2
	Is Curt.	100 - 1000%	1%	Ratio breaking point
	Ope. Time	0.0 - 600.0s	0.1s	Operating time (INST ≤ 30 ms)
	CT Sat. Meas.	OFF, ON	-	OFF: disable, ON: enable CT saturation countermeasure is effective at ON.
	RGFH I0 EN	OFF, ON	-	OFF: disable, ON: enable Overcurrent blocking function is effective at ON.
	I0 Ope. Curt.	5.0 - 50.0A	0.1A	Operating current of Overcurrent blocking function
RGFL	RGFL EN	OFF, ON	-	OFF: disable, ON: enable RGFL element is effective at ON.
	Ope. Curt.	10 - 200%	1%	Minimum operating current
	ratio K1	10 - 100%	1%	Ratio K1
	ratio K2	10 - 100%	1%	Ratio K2
	Is Curt.	100 - 1000%	1%	Ratio breaking point
	Ope. Time	0.0 - 600.0s	0.1s	Operating time (INST ≤ 30 ms)
	CT Sat. Meas.	OFF, ON	-	OFF: disable, ON: enable CT saturation countermeasure is effective at ON.
	RGFL I0 EN	OFF, ON	-	OFF: disable, ON: enable Overcurrent blocking function is effective at ON.
	I0 Ope. Curt.	5.0 - 50.0A	0.1A	Operating current of Overcurrent blocking function

3.2. Overcurrent Element

The CAC1-A41D1 Relay provides 8 ground (earth) overcurrent elements listed in the table below, which permit a quick detection of accident within the transformer. It contains a wide variety of operation/reset time characteristics, as well, which facilitate time coordination as shown in Fig. 3-14 and thus assure applicability to the protection of diverse systems. Further, the relay has a built-in 2nd harmonic suppression function, providing a protection against unnecessary actuation resulting from an excitation in-rush current.

Device No.	Display name	Protective function
50P	OC1H	HV-side overcurrent instantaneous element
	OC1L	LV-side overcurrent instantaneous element
	OC2H, OC3H	HV-side overcurrent instantaneous element with a 2nd harmonic suppression function (2 stages)
	OC2L, OC3L	LV-side overcurrent instantaneous element with a 2nd harmonic suppression function (2 stages)
51P	OC4H	HV-side overcurrent time-delay element with a 2nd harmonic suppression function ・ 14 types of operating time characteristics ・ 3 types of resetting time characteristics
	OC4L	LV-side overcurrent time-delay element with a 2nd harmonic suppression function ・ 14 types of operating time characteristics ・ 3 types of resetting time characteristics

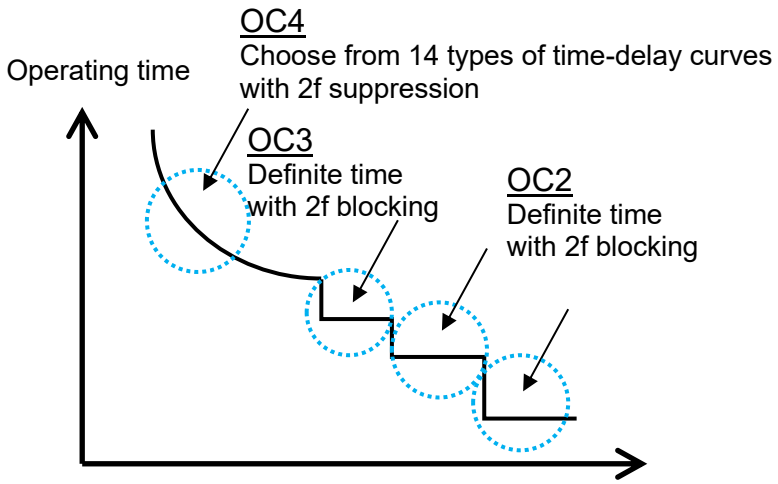


Fig. 3-14 An example of Overcurrent Element's operating time-limit coordination curve

3.2.1. OC1H Element (Overcurrent Instantaneous Element)

OC1H element is an overcurrent instantaneous element for detecting the fault current from the CT on the high-voltage side of the transformer.
Since this element is the operation without a 2nd harmonic blocking, it can provide a fast operation at large fault current.

Since the internal function block diagram shown in Fig. 3-15 explains how OC1H Element works.
OC1H Element outputs a detection signal after the lapse of the operating timer period (Ope. Time) in case the current is greater than operation setting value (Ope. Curt.).
A 200-ms resetting timer is incorporated on the resetting side to prevent chattering on the contact.
In addition, this element outputs an operating signal only when its enable/disable setting (OC1H EN) is set ON. If the setting of 'OC1H EN=OFF' is set OFF, it prevents the unnecessary operation of the element.

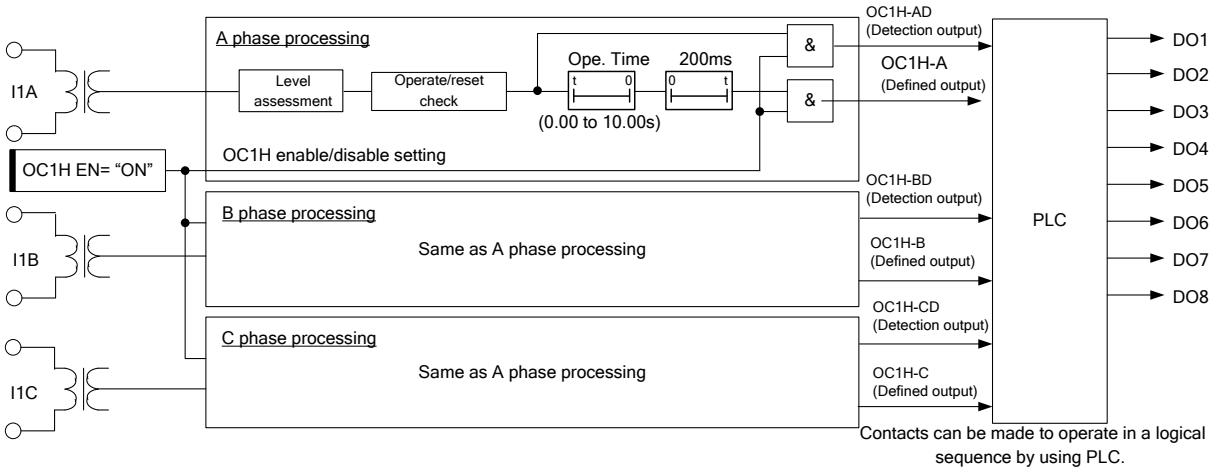


Fig. 3-15 Overcurrent Instantaneous Element (OC1H) – internal function block diagram

Table 3-8 Overcurrent Instantaneous Element (OC1H) – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OC1H	OC1H EN	OFF, ON	-	OFF: disable, ON: enable OC1H element is effective at ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current
	Ope. Time	0.00 - 10.00s	0.01s	Operating time (INST ≤ 30 ms)

3.2.2. OC1L Element (Overcurrent Instantaneous Element)

OC1L is an overcurrent instantaneous element for detecting the fault current from the CT on the low-voltage side of the transformer.
OC1L Element has the same operating characteristics as OC1H Element.
For more information about the element's internal function block diagram and how it works, see Section 3.2.1.

Table 3-9 Overcurrent Instantaneous Element (OC1L) – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OC1L	OC1L EN	OFF, ON	-	OFF: disable, ON: enable OC1L element is effective at ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current
	Ope. Time	0.00 - 10.00s	0.01s	Operating time (INST ≤ 30 ms)

3.2.3. OC2H Elemrnt (Overcurrent Instantaneous Element with a 2nd Harmonic Blocking Function)

OC2H is an overcurrent instantaneous element with a 2nd harmonic blocking function for detecting the fault current from the CT on the high-voltage side of the transformer.
Since this element provides 2nd harmonic blocking function, it prevents unnecessary operation from a transformer excitation in-rush current.
The internal function block diagram shown in Fig. 3-16 explains how OC2H Element works.

OC2H outputs a detection signal after the lapse of the operating timer period (Ope. Time) if input current is greater than the operating setting value (Ope. Curt.) without 2nd harmonic detection.
When 2nd harmonic blocking function is “disabled” (2f-lock ON=OFF), 2nd harmonic blocking signal is not blocked the operation of the OC2 Element.
A 200-ms reset timer is incorporated on the reset side to prevent chattering on the contact.
In addition, this element outputs an operating signal only when its enable/disable setting (OC2H EN) is set ON. ‘OC2H EN= OFF’ setting prevents the unnecessary operation of the element.

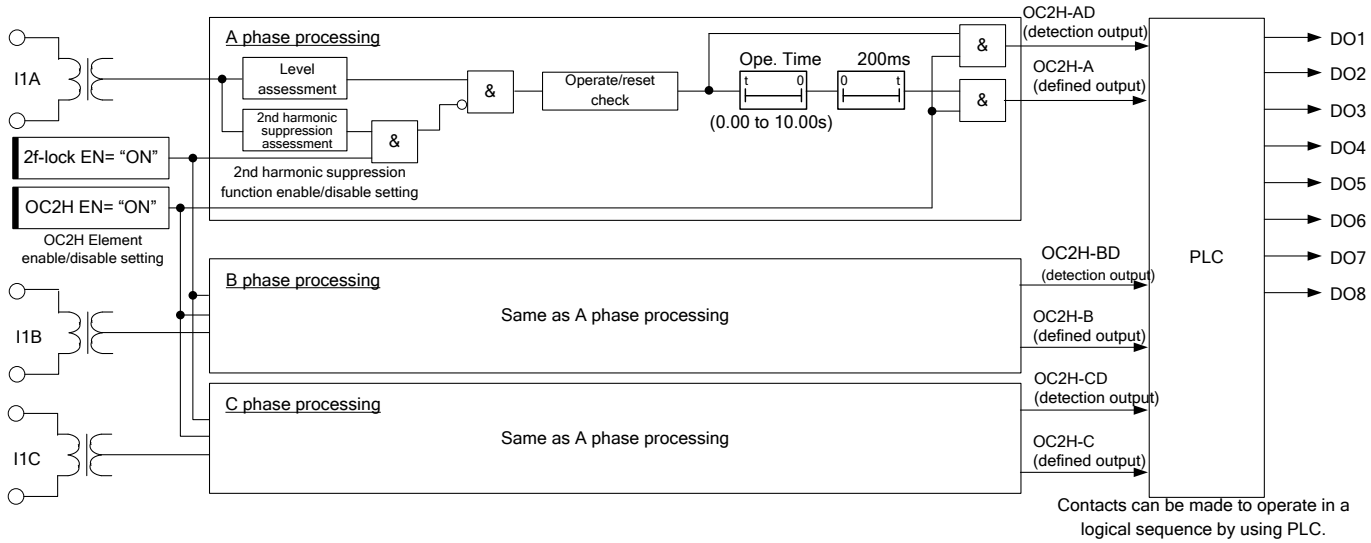


Fig. 3-16 OC2H Element – internal function block diagram

Table 3-10 OC2H Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OC2H	OC2H EN	OFF, ON	-	OFF: disable, ON: enable OC2H element is effective at ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current
	Ope. Time	0.00 - 10.00s	0.01s	Operating time (INST ≤ 40 ms at 2f-lock EN=ON)
	2f-lock EN	OFF, ON	-	OFF: disable, ON: enable 2f blocking function is effective at ON.

3.2.3.1. 2nd Harmonic Blocking Function

The CAC1-A41D1 Relay incorporates 2nd harmonic blocking function to provide a protection against unnecessary operation due to transformer excitation inrush current.
The internal function block diagram shown in Fig. 3-17 explain how the 2nd harmonic blocking function works.

Since 2nd harmonic is much contained in an excitation in-rush current compared with the normal fault current, it extracts 1f component and 2f component of input current individually and detects when the 1f component is greater than minimum operation setting value (1f-Min. Ope.) and the ratio of 2f component compeared with 1f component is greater than content-ratio setting value (2f-lock ratio). Also, in order to be stable detection, 2nd harmonic detection circuit has latch circuit,'set' needs continuos 1cycle detection and 'reset' needs continuous 1.5 cycles no-detection.

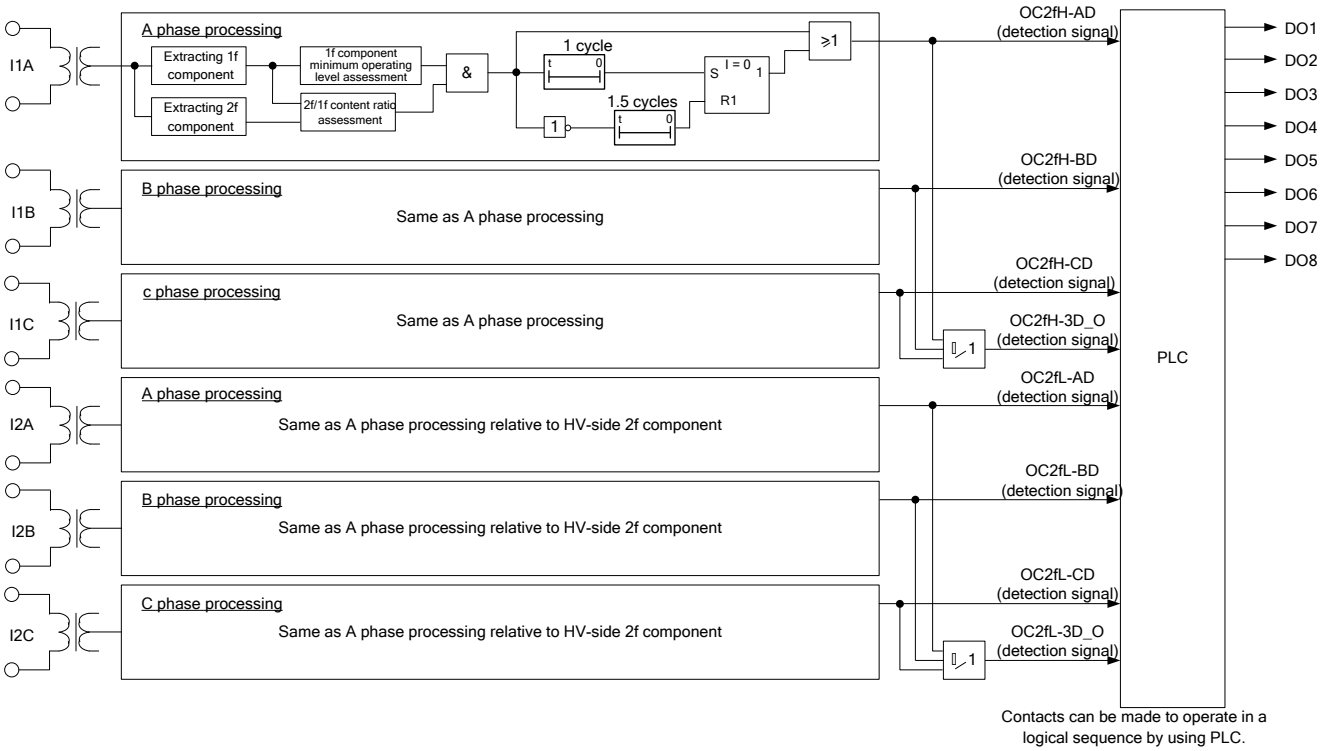


Fig. 3-17 2nd Harmonic Suppression Function – internal function block diagram

Table 3-11 2nd Harmonic Detection Element - setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OC 2F	2f-lock ratio	10 - 30%	1%	2f/1f content ratio
	1f-Min. Ope.	0.4 - 2.5A	0.1A	1f component minimum operating value

3.2.4. OC2L Element (Overcurrent Instantaneous Element with a 2nd Harmonic Blocking Function)

OC2L is an overcurrent instantaneous element with a 2nd harmonic blocking function for the fault current from the CT on the low-voltage side of the transformer.
OC2L has the same operating characteristics as OC2H Element.
For more information about the element's internal function block diagram and how the element works, see Section 3.2.3.

Table 3-12 OC2L Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OC2L	OC2L EN	OFF, ON	-	OFF: disable, ON: enable OC2L is effective at ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current
	Ope. Time	0.00 - 10.00s	0.01s	Operating time (INST ≤ 40 ms at 2f-lock EN = ON)
	2f-lock EN	OFF, ON	-	OFF: disable, ON: enable 2f blocking function is effective at ON.

3.2.5. OC3H Element (Overcurrent Instantaneous Element with a 2nd Harmonic Blocking Function)

OC3H is an overcurrent instantaneous element with a 2nd harmonic blocking function for the fault current from the CT on the high-voltage side of the transformer.
OC3H has the same operating characteristics as OC2H Element.
For more information about the element's internal function block diagram and how the element works, see Section 3.2.3.

Table 3-13 OC3H Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OC3H	OC3H EN	OFF, ON	-	OFF: disable, ON: enable OC3H is effective at ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current
	Ope. Time	0.00 - 10.00s	0.01s	Operating time (INST ≤ 40 ms at 2f-lock EN = ON)
	2f-lock EN	OFF, ON	-	OFF: disable, ON: enable 2f blocking function is effective at ON.

3.2.6. OC3L Element (Overcurrent Instantaneous Element with a 2nd harmonic Blocking Function)

OC3L is an overcurrent instantaneous element with a 2nd harmonic blocking function for the fault current from the CT on the low-voltage side of the transformer.
OC3L has the same operating characteristics as OC2L Element.
For more information about the element's internal function block diagram and how the element works, see Section 3.2.3.1.

Table 3-14 OC3L Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OC3L	OC3L EN	OFF, ON	-	OFF: disable, ON: enable OC3L is effective at ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current
	Ope. Time	0.00 - 10.00s	0.01s	Operating time (INST ≤ 40 ms at 2f-lock EN = ON)
	2f-lock EN	OFF, ON	-	OFF: disable, ON: enable 2f blocking function is effective at ON.

3.2.7. OC4H element (Overcurrent Element with dependent time characteristic and 2nd harmonic blocking function)

OC4H is an overcurrent element with dependent time characteristic and 2nd harmonic blocking function for the fault current from the CT on the high-voltage side of the transformer.

This element incorporates 14 types of dependent time characteristics and 3 types of reset time characteristics. The internal function block diagram shown in Fig. 3-18 explains how OC4H Element works.

The OC4H element outputs a detection signal at setting “enabled”.

And it outputs the detection signal when input current is greater than the detection current setting which is selected by ‘Ope. Curt.’ setting (IEC Chr. EN = OFF) or ‘Ope. Curt.’ x 1.15 (IEC Chr.EN = ON) without 2nd harmonic detection. The selection of ‘Ope. Curt.’ x 1.15 is provided to meat with the time characteristic of IEC60255-151.

The time-limit timer counts up in accordance with the dependent time characteristic (Ope. Chr.) when input current is greater than operation setting value (Ope. Curt.) without 2nd harmonic detection.

Note that the 2nd harmonic blocking function can be disabled by setting ‘2f-lock EN = OFF’.

The reset time characteristic of internal time-limit timer is settable by the setting ‘Rst. Chr’.

If the reset time characteristic setting is IDMT (inverse time) or DT (definite time), the output signal has 200-ms reset timer for preventing the contact chattering besides the reduction of internal time-limit timer counter of the rest time characteristic.

The instantaneous reset of the contact can be set by ‘Rst. Chr. to INST (instantaneous)’.

This element outputs an operating signal only when its “enable/disable” setting (OC4H EN) is set ON. The setting ‘OC4H EN= OFF’ prevents the unnecessary operation.

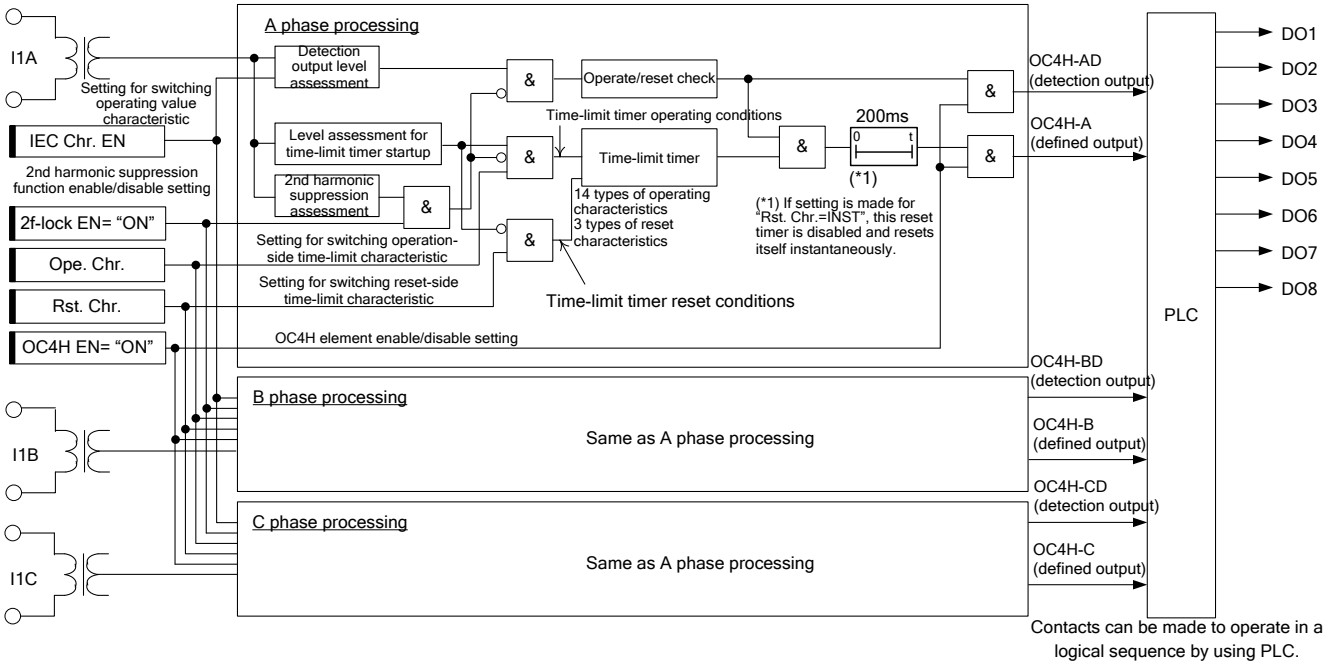


Fig. 3-18 OC4H Element – internal function block diagram

Table 3-15 OC4H Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OC4H	OC4H EN	OFF, ON	-	OFF: disable, ON: enable OC4H EN element is effective at ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current setting
	Ope. TM	0.25 - 50.00	0.01	Operating time multiplier setting The value “TM” is the time multiplier setting of the characteristic equation in Section 3.2.8.3.
	Ope. Chr.	NI01, VI01, EI01, LI01, LI02, DT01, NI11, EI11, EI12, NI21, VI21, LI21, NI31, VI31	-	Inverse definite minimum time characteristics For more information, refer to Section 3.2.8.3.
	Rst. Chr.	IDMT,DT,INST	-	Reset time counter characteristics of internal timer IDMT: Inverse-time reset DT: Definite time (fixed at 200 ms) INST: Instantaneous (less than 50 ms) Refer to Section3.2.8.3.
	2f-lock EN	OFF, ON	-	OFF: disable, ON: enable 2nd harmonic blocking function is effective at ON.
	IEC Chr. EN	OFF, ON	-	OFF: detection current = Ope.Curt ON: detection current = Ope.Curt x 1.15 It shall be set ON to meat with the dependent time characteristic of IEC60255 151 operating characteristics. Refer to Section3.2.8.1.

3.2.8. OC4L element (Overcurrent Element with dependent time characteristic and 2nd Harmonic blocking Function)

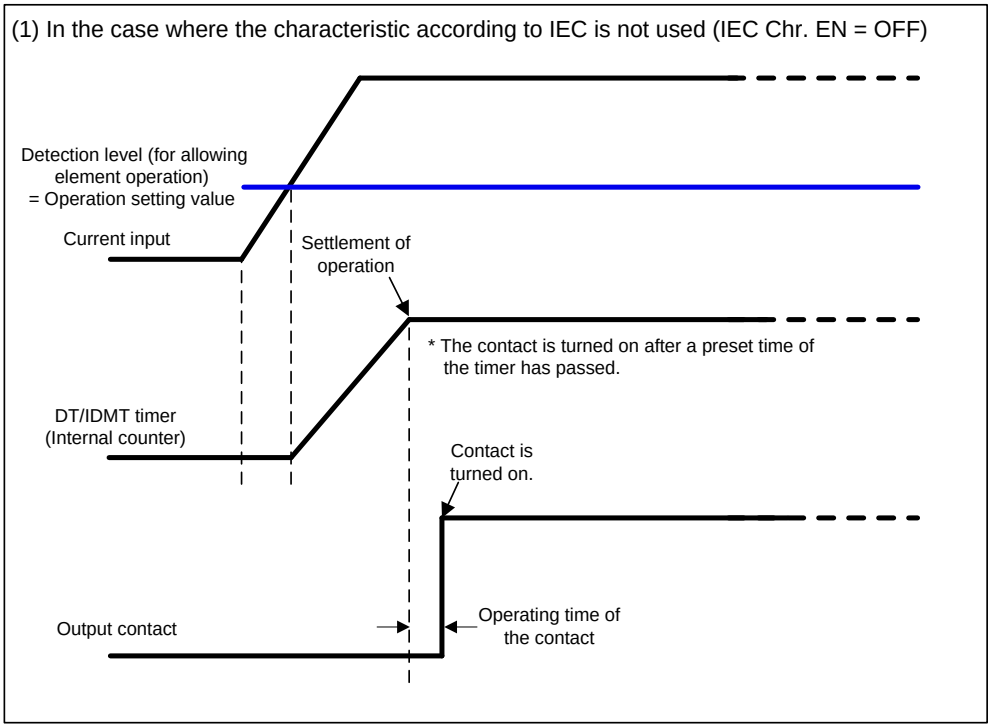
OC4L is the overcurrent with dependent time characteristic and 2nd harmonic blocking function for the fault current from the CT on the low-voltage side of the transformer.
OC4L has the same operating characteristics as OC4H Element.
Refer to Section 3.2.7 for the internal function block diagram.

Table 3-16 OC4L Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OC4L	OC4L EN	OFF, ON	-	OFF: disable, ON: enable OC4L element is effective at ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current setting
	Ope. TM	0.25 - 50.00	0.01	Operating time multiplier setting The value “TM” is the time multiplier setting of the characteristic equation in Section3.2.8.3.
	Ope. Chr.	NI01, VI01, EI01, LI01, LI02, DT01, NI11, EI11, EI12, NI21, VI21, LI21, NI31, VI31	-	Inverse definite minimum time lag characteristic For more information, refer to Section3.2.8.3.
	Rst. Chr.	IDMT,DT,INST	-	Reset time counter characteristics of internal timer IDMT: Inverse-time reset DT: Definite time (fixed at 200 ms) INST: Instantaneous (less than 50 ms) Refer to Section3.2.8.3.
	2f-lock EN	OFF, ON	-	OFF: disable, ON: enable 2nd harmonic blocking function is effective at ON.
	IEC Chr. EN	OFF, ON	-	OFF: detection current = Ope.Curt ON: detection current = Ope.Curt x 1.15 It shall be set ON to meat with the dependent time characteristic of IEC60255 151 operating characteristics. Refer to Section 3.2.8.1.

3.2.8.1. Operating Time Characteristics

The dependent time characteristic of OC4H and OC4L elements comply with the characteristic specified by IEC60255-151. The operating time characteristic is settable by 'IEC Chr. EN' setting.
Fig. 3-19 shows the operation of the element.



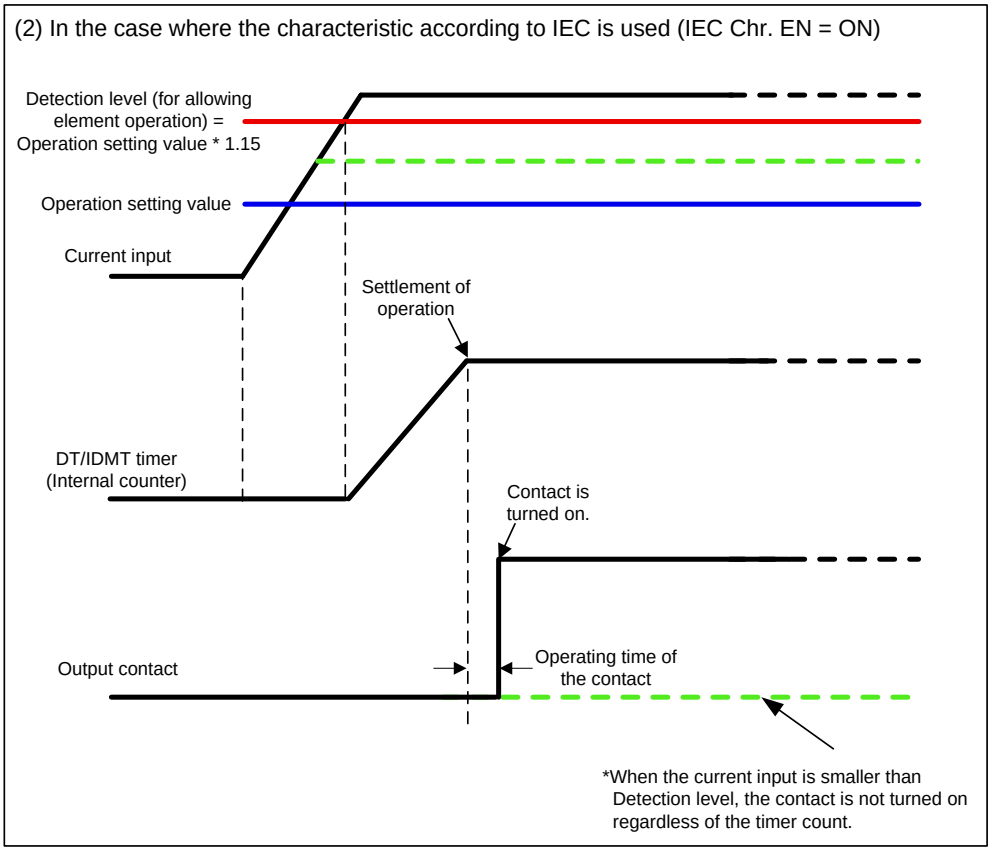


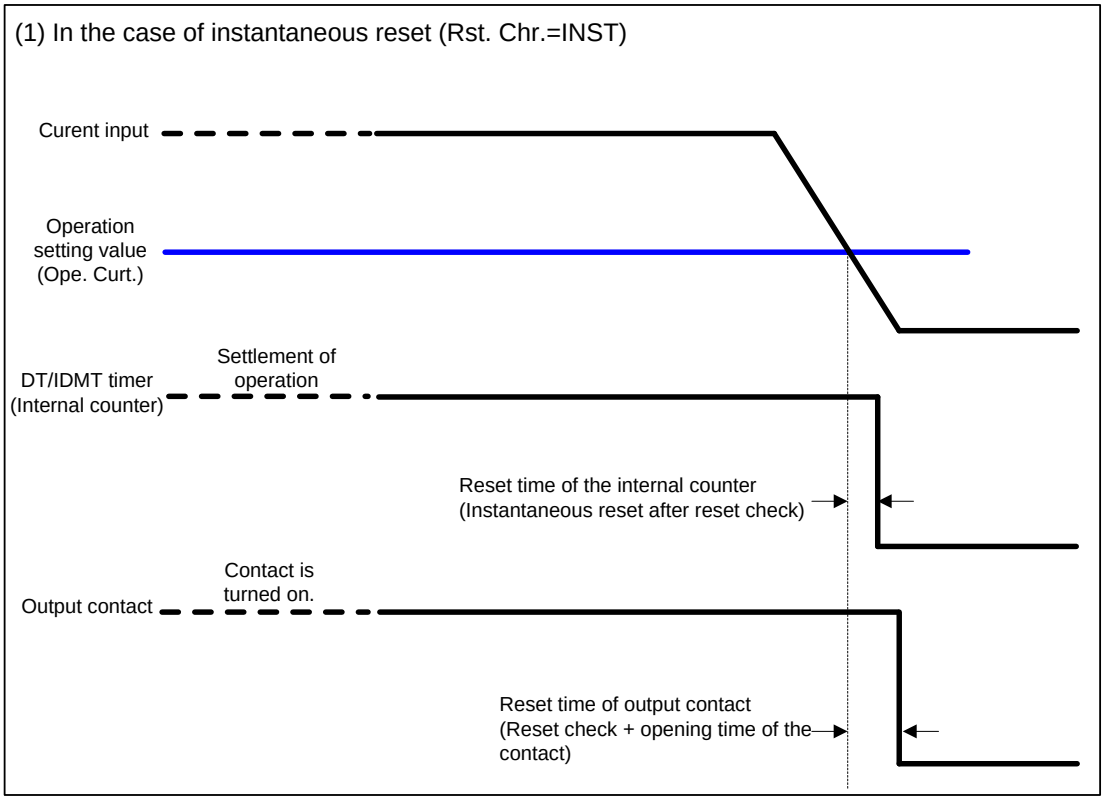
Fig. 3-19 Comparison of the operation between IEC Chr. EN = ON and IEC Chr. EN = OFF

3.2.8.2. Reset Time counter Characteristic

There are 3 types of resetting time characteristics associated with the OC4 element which can be selected.

- Instantaneous reset
- Definite time reset
- IDMT (Inverse definite minimum time) reset

These resetting characteristics are illustrated in Fig. 3-20 and Fig. 3-21 and to be selected in accordance with the customer's requirements.



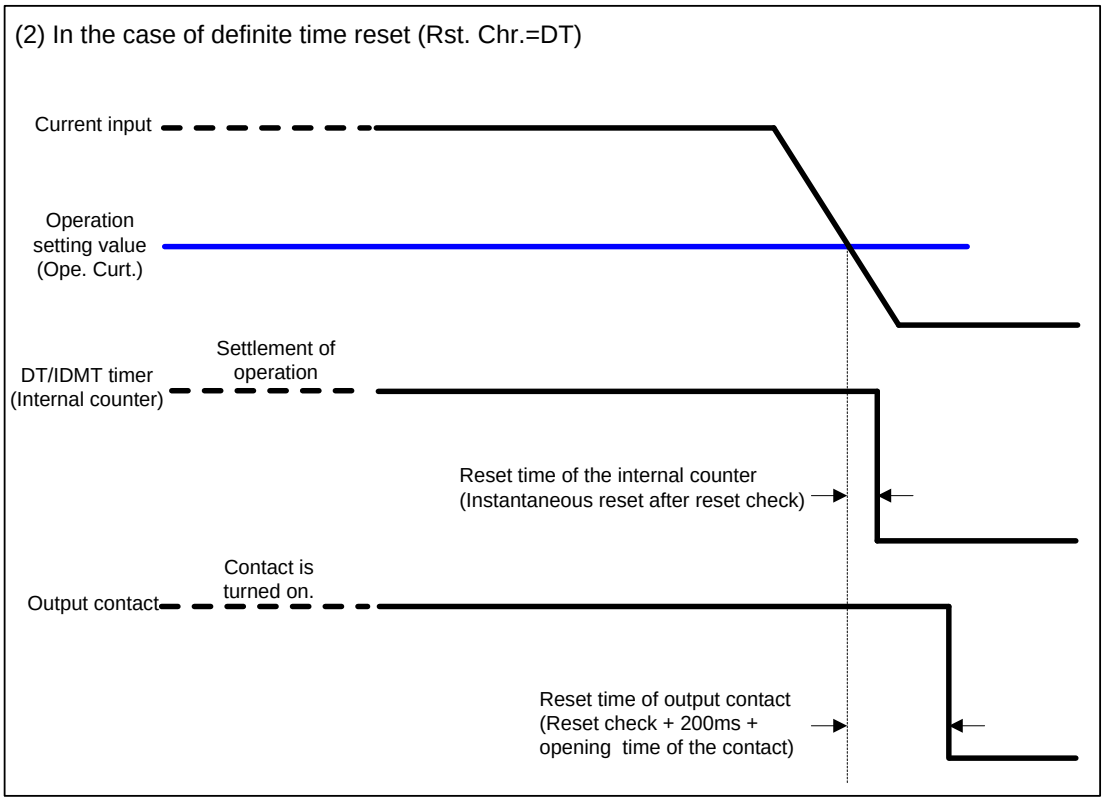


Fig. 3-20 Reset time characteristic (1)

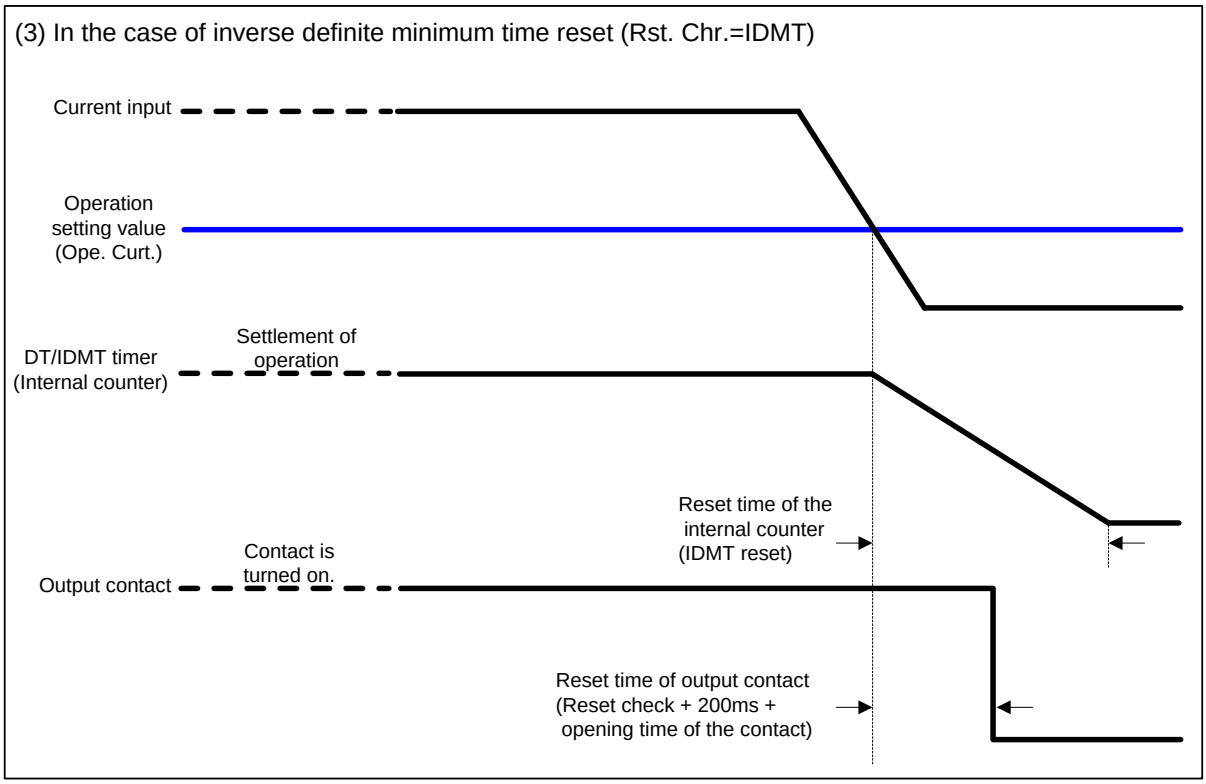


Fig. 3-21 Reset time characteristic (2)

3.2.8.3. Inverse definite minimum time lag Characteristics

OC4H and OC4L Elements provides settable 14 types of operation time characteristic and 3 types of reset time counter characteristic.

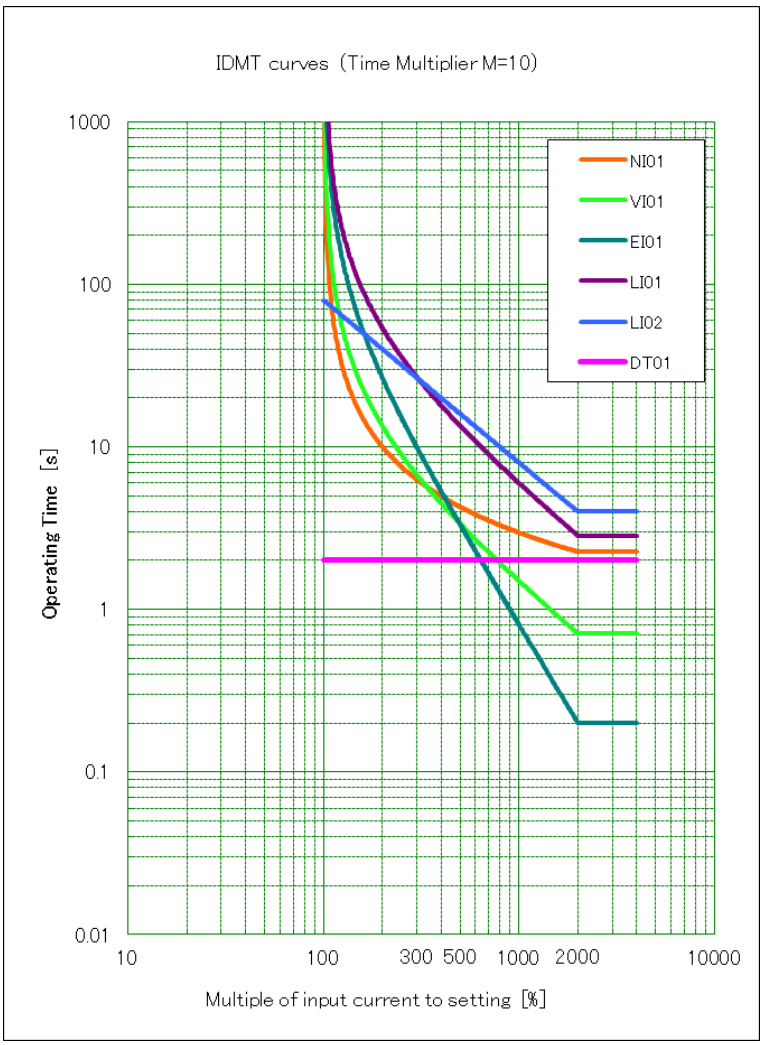


Fig. 3-22 Operating Time Characteristics (1)

[1] IEC Normal nverse (NI01)

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

[2] IEC Very inverse (VI01)

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

[3] IEC Extremely inverse (EI01)

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

[4] Long Time inverse (LI01)

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

[5] Long Time inverse (LI02)

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

[6] Definite time (DT01)

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

t: Operating time (s)
I: Multiple of input current relative to setting value
(n times)
M: Operating time multiplier setting (n times)

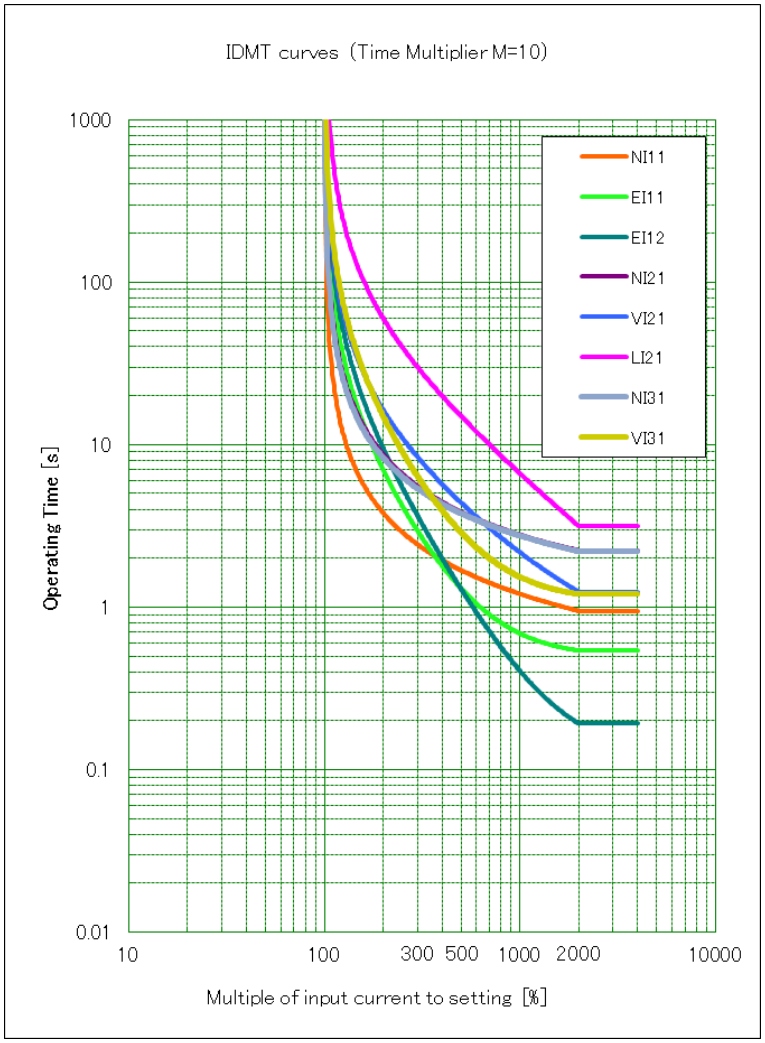


Fig. 3-23 Operating Time Characteristics (2)

[7] IEEE Moderate Inverse (NI11)

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

[8] IEEE Very inverse (EI11)

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

[9] IEEE Extremely inverse (EI12)

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

[10] Normal inverse (NI21)

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

[11] Very inverse (VI21)

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

[12] Long Time inverse (LI21)

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

[13] Korean Normal inverse (NI31)

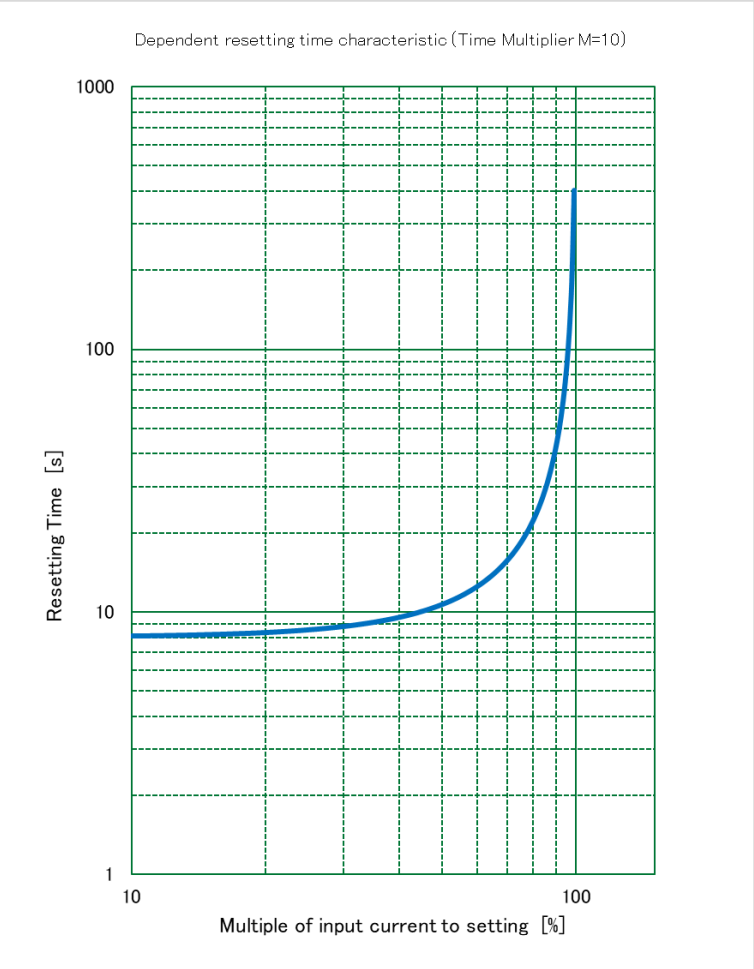
$$t = \left(\frac{0.11}{I^{0.02} - 1} + 0.42 \right) \times \frac{M}{10} (s)$$

[14] Korean Very inverse (VI31)

$$t = \left(\frac{39.85}{I^{1.95} - 1} + 1.084 \right) \times \frac{M}{10} (s)$$

t: Operating time (s)
I: Multiple of input current relative to setting value (times)
M: Operating time multiplier setting (times)

Fig. 3-24 shows the dependent resetting time characteristic of the internal counter when the setting of OC4-Rst.Chr. = IDMT is selected.



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

tr: Reset time (s)
I: Multiple of input current relative to setting value (n times)
M: Magnification of operating time (n times)

Fig. 3-24 Dependent Reset Time Characteristics

*Note for the IDMT reset characteristic

Although the output contact resets at the definite time (0.2 s) after the input current is smaller than the pickup current, the internal operation counter will be decreased by the IDMT characteristic which is similar characteristic of the reset characteristic of an induction disk type electromechanical overcurrent relay. This reset characteristic may be useful for intermittent overload detection at motor start-up and etc. For details, refer to Section 3.2.8.2.

Table 3-17 IEC Normal Inverse (NI01) operating time accuracy table

Unit: s

Input value	300%		500%		1000%	
Operating time multiplier setting (M)	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range
0.25	±0.100 (s)	0.158 0.058 ～ 0.258	±0.100 (s)	0.107 * 0.050 ～ 0.207	±0.100 (s)	0.074 * 0.050 ～ 0.174
0.5	±0.100 (s)	0.315 0.215 ～ 0.415	±0.100 (s)	0.214 0.114 ～ 0.314	±0.100 (s)	0.149 0.049 ～ 0.249
1	±0.100 (s)	0.630 0.530 ～ 0.730	±0.100 (s)	0.428 0.328 ～ 0.528	±0.100 (s)	0.297 0.197 ～ 0.397
1.5	±12.00 (%)	0.945 0.832 ～ 1.058	±0.100 (s)	0.642 0.542 ～ 0.742	±0.100 (s)	0.446 0.346 ～ 0.546
2	±12.00 (%)	1.260 1.109 ～ 1.411	±0.100 (s)	0.856 0.756 ～ 0.956	±0.100 (s)	0.594 0.494 ～ 0.694
2.5	±12.00 (%)	1.575 1.386 ～ 1.764	±0.100 (s)	1.070 0.970 ～ 1.170	±0.100 (s)	0.743 0.643 ～ 0.843
3	±12.00 (%)	1.891 1.665 ～ 2.117	±0.100 (s)	1.284 1.184 ～ 1.384	±0.100 (s)	0.891 0.791 ～ 0.991
3.5	±12.00 (%)	2.206 1.942 ～ 2.470	±7.00 (%)	1.498 1.394 ～ 1.602	±0.100 (s)	1.040 0.940 ～ 1.140
4	±12.00 (%)	2.521 2.219 ～ 2.823	±7.00 (%)	1.712 1.593 ～ 1.831	±0.100 (s)	1.188 1.088 ～ 1.288
4.5	±12.00 (%)	2.836 2.496 ～ 3.176	±7.00 (%)	1.926 1.792 ～ 2.060	±0.100 (s)	1.337 1.237 ～ 1.437
5	±12.00 (%)	3.151 2.773 ～ 3.529	±7.00 (%)	2.140 1.991 ～ 2.289	±0.100 (s)	1.485 1.385 ～ 1.585
6	±12.00 (%)	3.781 3.328 ～ 4.234	±7.00 (%)	2.568 2.389 ～ 2.747	±0.100 (s)	1.782 1.682 ～ 1.882
7	±12.00 (%)	4.411 3.882 ～ 4.940	±7.00 (%)	2.996 2.787 ～ 3.205	±5.00 (%)	2.079 1.976 ～ 2.182
8	±12.00 (%)	5.042 4.437 ～ 5.647	±7.00 (%)	3.424 3.185 ～ 3.663	±5.00 (%)	2.376 2.258 ～ 2.494
9	±12.00 (%)	5.672 4.992 ～ 6.352	±7.00 (%)	3.852 3.583 ～ 4.121	±5.00 (%)	2.674 2.541 ～ 2.807
10	±12.00 (%)	6.302 5.546 ～ 7.058	±7.00 (%)	4.280 3.981 ～ 4.579	±5.00 (%)	2.971 2.823 ～ 3.119
15	±12.00 (%)	9.453 8.319 ～ 10.587	±7.00 (%)	6.420 5.971 ～ 6.869	±5.00 (%)	4.456 4.234 ～ 4.678
20	±12.00 (%)	12.604 11.092 ～ 14.116	±7.00 (%)	8.559 7.960 ～ 9.158	±5.00 (%)	5.941 5.644 ～ 6.238
30	±12.00 (%)	18.906 16.638 ～ 21.174	±7.00 (%)	12.839 11.941 ～ 13.737	±5.00 (%)	8.912 8.467 ～ 9.357
40	±12.00 (%)	25.208 22.184 ～ 28.232	±7.00 (%)	17.119 15.921 ～ 18.317	±5.00 (%)	11.882 11.288 ～ 12.476
50	±12.00 (%)	31.510 27.729 ～ 35.291	±7.00 (%)	21.399 19.902 ～ 22.896	±5.00 (%)	14.853 14.111 ～ 15.595

Table 3-18 IEC Very inverse (VI01) Operating time accuracy table

Unit: s

Input value	300%		500%		1000%	
Operating time multiplier setting (M)	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range
0.25	±0.100 (s)	0.169 0.069 ～ 0.269	±0.100 (s)	0.084 * 0.050 ～ 0.184	±0.100 (s)	0.038 * 0.050 ～ 0.138
0.5	±0.100 (s)	0.338 0.238 ～ 0.438	±0.100 (s)	0.169 0.069 ～ 0.269	±0.100 (s)	0.075 * 0.050 ～ 0.175
1	±0.100 (s)	0.675 0.575 ～ 0.775	±0.100 (s)	0.338 0.238 ～ 0.438	±0.100 (s)	0.150 0.050 ～ 0.250
1.5	±12.00 (%)	1.013 0.892 ～ 1.134	±0.100 (s)	0.506 0.406 ～ 0.606	±0.100 (s)	0.225 0.125 ～ 0.325
2	±12.00 (%)	1.350 1.188 ～ 1.512	±0.100 (s)	0.675 0.575 ～ 0.775	±0.100 (s)	0.300 0.200 ～ 0.400
2.5	±12.00 (%)	1.688 1.486 ～ 1.890	±0.100 (s)	0.844 0.744 ～ 0.944	±0.100 (s)	0.375 0.275 ～ 0.475
3	±12.00 (%)	2.025 1.782 ～ 2.268	±0.100 (s)	1.013 0.913 ～ 1.113	±0.100 (s)	0.450 0.350 ～ 0.550
3.5	±12.00 (%)	2.363 2.080 ～ 2.646	±0.100 (s)	1.181 1.081 ～ 1.281	±0.100 (s)	0.525 0.425 ～ 0.625
4	±12.00 (%)	2.700 2.376 ～ 3.024	±0.100 (s)	1.350 1.250 ～ 1.450	±0.100 (s)	0.600 0.500 ～ 0.700
4.5	±12.00 (%)	3.038 2.674 ～ 3.402	±7.00 (%)	1.519 1.413 ～ 1.625	±0.100 (s)	0.675 0.575 ～ 0.775
5	±12.00 (%)	3.375 2.970 ～ 3.780	±7.00 (%)	1.688 1.570 ～ 1.806	±0.100 (s)	0.750 0.650 ～ 0.850
6	±12.00 (%)	4.050 3.564 ～ 4.536	±7.00 (%)	2.025 1.884 ～ 2.166	±0.100 (s)	0.900 0.800 ～ 1.000
7	±12.00 (%)	4.725 4.158 ～ 5.292	±7.00 (%)	2.363 2.198 ～ 2.528	±0.100 (s)	1.050 0.950 ～ 1.150
8	±12.00 (%)	5.400 4.752 ～ 6.048	±7.00 (%)	2.700 2.511 ～ 2.889	±0.100 (s)	1.200 1.100 ～ 1.300
9	±12.00 (%)	6.075 5.346 ～ 6.804	±7.00 (%)	3.038 2.826 ～ 3.250	±0.100 (s)	1.350 1.250 ～ 1.450
10	±12.00 (%)	6.750 5.940 ～ 7.560	±7.00 (%)	3.375 3.139 ～ 3.611	±0.100 (s)	1.500 1.400 ～ 1.600
15	±12.00 (%)	10.125 8.910 ～ 11.340	±7.00 (%)	5.063 4.709 ～ 5.417	±5.00 (%)	2.250 2.138 ～ 2.362
20	±12.00 (%)	13.500 11.880 ～ 15.120	±7.00 (%)	6.750 6.278 ～ 7.222	±5.00 (%)	3.000 2.850 ～ 3.150
30	±12.00 (%)	20.250 17.820 ～ 22.680	±7.00 (%)	10.125 9.417 ～ 10.833	±5.00 (%)	4.500 4.275 ～ 4.725
40	±12.00 (%)	27.000 23.760 ～ 30.240	±7.00 (%)	13.500 12.555 ～ 14.445	±5.00 (%)	6.000 5.700 ～ 6.300
50	±12.00 (%)	33.750 29.700 ～ 37.800	±7.00 (%)	16.875 15.694 ～ 18.056	±5.00 (%)	7.500 7.125 ～ 7.875

Table 3-19 IEC Extremely inverse (EI01) Operating time accuracy table

Unit: s

Input value	300%		500%		1000%	
Operating time multiplier setting (M)	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range
0.25	±0.100 (s)	0.250 0.150 ～ 0.350	±0.100 (s)	0.083 * 0.050 ～ 0.183	±0.100 (s)	0.020 * 0.050 ～ 0.120
0.5	±0.100 (s)	0.500 0.400 ～ 0.600	±0.100 (s)	0.167 0.067 ～ 0.267	±0.100 (s)	0.040 * 0.050 ～ 0.140
1	±12.00 (%)	1.000 0.880 ～ 1.120	±0.100 (s)	0.333 0.233 ～ 0.433	±0.100 (s)	0.081 * 0.050 ～ 0.181
1.5	±12.00 (%)	1.500 1.320 ～ 1.680	±0.100 (s)	0.500 0.400 ～ 0.600	±0.100 (s)	0.121 * 0.050 ～ 0.221
2	±12.00 (%)	2.000 1.760 ～ 2.240	±0.100 (s)	0.667 0.567 ～ 0.767	±0.100 (s)	0.162 0.062 ～ 0.262
2.5	±12.00 (%)	2.500 2.200 ～ 2.800	±0.100 (s)	0.833 0.733 ～ 0.933	±0.100 (s)	0.202 0.102 ～ 0.302
3	±12.00 (%)	3.000 2.640 ～ 3.360	±0.100 (s)	1.000 0.900 ～ 1.100	±0.100 (s)	0.242 0.142 ～ 0.342
3.5	±12.00 (%)	3.500 3.080 ～ 3.920	±0.100 (s)	1.167 1.067 ～ 1.267	±0.100 (s)	0.283 0.183 ～ 0.383
4	±12.00 (%)	4.000 3.520 ～ 4.480	±0.100 (s)	1.333 1.233 ～ 1.433	±0.100 (s)	0.323 0.223 ～ 0.423
4.5	±12.00 (%)	4.500 3.960 ～ 5.040	±7.00 (%)	1.500 1.395 ～ 1.605	±0.100 (s)	0.364 0.264 ～ 0.464
5	±12.00 (%)	5.000 4.400 ～ 5.600	±7.00 (%)	1.667 1.551 ～ 1.783	±0.100 (s)	0.404 0.304 ～ 0.504
6	±12.00 (%)	6.000 5.280 ～ 6.720	±7.00 (%)	2.000 1.860 ～ 2.140	±0.100 (s)	0.485 0.385 ～ 0.585
7	±12.00 (%)	7.000 6.160 ～ 7.840	±7.00 (%)	2.333 2.170 ～ 2.496	±0.100 (s)	0.566 0.466 ～ 0.666
8	±12.00 (%)	8.000 7.040 ～ 8.960	±7.00 (%)	2.667 2.481 ～ 2.853	±0.100 (s)	0.646 0.546 ～ 0.746
9	±12.00 (%)	9.000 7.920 ～ 10.080	±7.00 (%)	3.000 2.790 ～ 3.210	±0.100 (s)	0.727 0.627 ～ 0.827
10	±12.00 (%)	10.000 8.800 ～ 11.200	±7.00 (%)	3.333 3.100 ～ 3.566	±0.100 (s)	0.808 0.708 ～ 0.908
15	±12.00 (%)	15.000 13.200 ～ 16.800	±7.00 (%)	5.000 4.650 ～ 5.350	±0.100 (s)	1.212 1.112 ～ 1.312
20	±12.00 (%)	20.000 17.600 ～ 22.400	±7.00 (%)	6.667 6.201 ～ 7.133	±0.100 (s)	1.616 1.516 ～ 1.716
30	±12.00 (%)	30.000 26.400 ～ 33.600	±7.00 (%)	10.000 9.300 ～ 10.700	±5.00 (%)	2.424 2.303 ～ 2.545
40	±12.00 (%)	40.000 35.200 ～ 44.800	±7.00 (%)	13.333 12.400 ～ 14.266	±5.00 (%)	3.232 3.071 ～ 3.393
50	±12.00 (%)	50.000 44.000 ～ 56.000	±7.00 (%)	16.667 15.501 ～ 17.833	±5.00 (%)	4.040 3.838 ～ 4.242

Table 3-20 Long inverse (LI01) Operating time accuracy table

Unit: s

Input value	300%		500%		1000%	
Operating time multiplier setting (M)	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range
0.25	±0.100 (s)	0.675 0.575 ～ 0.775	±0.100 (s)	0.338 0.238 ～ 0.438	±0.100 (s)	0.150 0.050 ～ 0.250
0.5	±12.00 (%)	1.350 1.188 ～ 1.512	±0.100 (s)	0.675 0.575 ～ 0.775	±0.100 (s)	0.300 0.200 ～ 0.400
1	±12.00 (%)	2.700 2.376 ～ 3.024	±0.100 (s)	1.350 1.250 ～ 1.450	±0.100 (s)	0.600 0.500 ～ 0.700
1.5	±12.00 (%)	4.050 3.564 ～ 4.536	±7.00 (%)	2.025 1.884 ～ 2.166	±0.100 (s)	0.900 0.800 ～ 1.000
2	±12.00 (%)	5.400 4.752 ～ 6.048	±7.00 (%)	2.700 2.511 ～ 2.889	±0.100 (s)	1.200 1.100 ～ 1.300
2.5	±12.00 (%)	6.750 5.940 ～ 7.560	±7.00 (%)	3.375 3.139 ～ 3.611	±0.100 (s)	1.500 1.400 ～ 1.600
3	±12.00 (%)	8.100 7.128 ～ 9.072	±7.00 (%)	4.050 3.767 ～ 4.333	±0.100 (s)	1.800 1.700 ～ 1.900
3.5	±12.00 (%)	9.450 8.316 ～ 10.584	±7.00 (%)	4.725 4.395 ～ 5.055	±5.00 (%)	2.100 1.995 ～ 2.205
4	±12.00 (%)	10.800 9.504 ～ 12.096	±7.00 (%)	5.400 5.022 ～ 5.778	±5.00 (%)	2.400 2.280 ～ 2.520
4.5	±12.00 (%)	12.150 10.692 ～ 13.608	±7.00 (%)	6.075 5.650 ～ 6.500	±5.00 (%)	2.700 2.565 ～ 2.835
5	±12.00 (%)	13.500 11.880 ～ 15.120	±7.00 (%)	6.750 6.278 ～ 7.222	±5.00 (%)	3.000 2.850 ～ 3.150
6	±12.00 (%)	16.200 14.256 ～ 18.144	±7.00 (%)	8.100 7.533 ～ 8.667	±5.00 (%)	3.600 3.420 ～ 3.780
7	±12.00 (%)	18.900 16.632 ～ 21.168	±7.00 (%)	9.450 8.789 ～ 10.111	±5.00 (%)	4.200 3.990 ～ 4.410
8	±12.00 (%)	21.600 19.008 ～ 24.192	±7.00 (%)	10.800 10.044 ～ 11.556	±5.00 (%)	4.800 4.560 ～ 5.040
9	±12.00 (%)	24.300 21.384 ～ 27.216	±7.00 (%)	12.150 11.300 ～ 13.000	±5.00 (%)	5.400 5.130 ～ 5.670
10	±12.00 (%)	27.000 23.760 ～ 30.240	±7.00 (%)	13.500 12.555 ～ 14.445	±5.00 (%)	6.000 5.700 ～ 6.300
15	±12.00 (%)	40.500 35.640 ～ 45.360	±7.00 (%)	20.250 18.833 ～ 21.667	±5.00 (%)	9.000 8.550 ～ 9.450
20	±12.00 (%)	54.000 47.520 ～ 60.480	±7.00 (%)	27.000 25.110 ～ 28.890	±5.00 (%)	12.000 11.400 ～ 12.600
30	±12.00 (%)	81.000 71.280 ～ 90.720	±7.00 (%)	40.500 37.665 ～ 43.335	±5.00 (%)	18.000 17.100 ～ 18.900
40	±12.00 (%)	108.000 95.040 ～ 120.960	±7.00 (%)	54.000 50.220 ～ 57.780	±5.00 (%)	24.000 22.800 ～ 25.200
50	±12.00 (%)	135.000 118.800 ～ 151.200	±7.00 (%)	67.500 62.775 ～ 72.225	±5.00 (%)	30.000 28.500 ～ 31.500

Table 3-21 Long inverse (LI02) Operating time accuracy table

Unit: s

Input value	300%		500%		1000%	
Operating time multiplier setting (M)	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range
0.25	±0.100 (s)	0.667 0.567 ～ 0.767	±0.100 (s)	0.400 0.300 ～ 0.500	±0.100 (s)	0.200 0.100 ～ 0.300
0.5	±12.00 (%)	1.333 1.174 ～ 1.492	±0.100 (s)	0.800 0.700 ～ 0.900	±0.100 (s)	0.400 0.300 ～ 0.500
1	±12.00 (%)	2.667 2.347 ～ 2.987	±7.00 (%)	1.600 1.488 ～ 1.712	±0.100 (s)	0.800 0.700 ～ 0.900
1.5	±12.00 (%)	4.000 3.520 ～ 4.480	±7.00 (%)	2.400 2.232 ～ 2.568	±0.100 (s)	1.200 1.100 ～ 1.300
2	±12.00 (%)	5.333 4.694 ～ 5.972	±7.00 (%)	3.200 2.976 ～ 3.424	±0.100 (s)	1.600 1.500 ～ 1.700
2.5	±12.00 (%)	6.667 5.867 ～ 7.467	±7.00 (%)	4.000 3.720 ～ 4.280	±0.100 (s)	2.000 1.900 ～ 2.100
3	±12.00 (%)	8.000 7.040 ～ 8.960	±7.00 (%)	4.800 4.464 ～ 5.136	±5.00 (%)	2.400 2.280 ～ 2.520
3.5	±12.00 (%)	9.333 8.214 ～ 10.452	±7.00 (%)	5.600 5.208 ～ 5.992	±5.00 (%)	2.800 2.660 ～ 2.940
4	±12.00 (%)	10.667 9.387 ～ 11.947	±7.00 (%)	6.400 5.952 ～ 6.848	±5.00 (%)	3.200 3.040 ～ 3.360
4.5	±12.00 (%)	12.000 10.560 ～ 13.440	±7.00 (%)	7.200 6.696 ～ 7.704	±5.00 (%)	3.600 3.420 ～ 3.780
5	±12.00 (%)	13.333 11.734 ～ 14.932	±7.00 (%)	8.000 7.440 ～ 8.560	±5.00 (%)	4.000 3.800 ～ 4.200
6	±12.00 (%)	16.000 14.080 ～ 17.920	±7.00 (%)	9.600 8.928 ～ 10.272	±5.00 (%)	4.800 4.560 ～ 5.040
7	±12.00 (%)	18.667 16.427 ～ 20.907	±7.00 (%)	11.200 10.416 ～ 11.984	±5.00 (%)	5.600 5.320 ～ 5.880
8	±12.00 (%)	21.333 18.774 ～ 23.892	±7.00 (%)	12.800 11.904 ～ 13.696	±5.00 (%)	6.400 6.080 ～ 6.720
9	±12.00 (%)	24.000 21.120 ～ 26.880	±7.00 (%)	14.400 13.392 ～ 15.408	±5.00 (%)	7.200 6.840 ～ 7.560
10	±12.00 (%)	26.667 23.467 ～ 29.867	±7.00 (%)	16.000 14.880 ～ 17.120	±5.00 (%)	8.000 7.600 ～ 8.400
15	±12.00 (%)	40.000 35.200 ～ 44.800	±7.00 (%)	24.000 22.320 ～ 25.680	±5.00 (%)	12.000 11.400 ～ 12.600
20	±12.00 (%)	53.333 46.934 ～ 59.732	±7.00 (%)	32.000 29.760 ～ 34.240	±5.00 (%)	16.000 15.200 ～ 16.800
30	±12.00 (%)	80.000 70.400 ～ 89.600	±7.00 (%)	48.000 44.640 ～ 51.360	±5.00 (%)	24.000 22.800 ～ 25.200
40	±12.00 (%)	106.667 93.867 ～ 119.467	±7.00 (%)	64.000 59.520 ～ 68.480	±5.00 (%)	32.000 30.400 ～ 33.600
50	±12.00 (%)	133.333 117.334 ～ 149.332	±7.00 (%)	80.000 74.400 ～ 85.600	±5.00 (%)	40.000 38.000 ～ 42.000

Table 3-22 Definite time (DT01) Operating time accuracy table

Unit: s

Input value	300%		500%		1000%	
Operating time multiplier setting (M)	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range
0.25	±0.050 (s)	0.050 * 0.050 ～ 0.100	±0.050 (s)	0.050 * 0.050 ～ 0.100	±0.050 (s)	0.050 * 0.050 ～ 0.100
0.5	±0.050 (s)	0.100 0.050 ～ 0.150	±0.050 (s)	0.100 0.050 ～ 0.150	±0.050 (s)	0.100 0.050 ～ 0.150
1	±0.050 (s)	0.200 0.150 ～ 0.250	±0.050 (s)	0.200 0.150 ～ 0.250	±0.050 (s)	0.200 0.150 ～ 0.250
1.5	±0.050 (s)	0.300 0.250 ～ 0.350	±0.050 (s)	0.300 0.250 ～ 0.350	±0.050 (s)	0.300 0.250 ～ 0.350
2	±0.050 (s)	0.400 0.350 ～ 0.450	±0.050 (s)	0.400 0.350 ～ 0.450	±0.050 (s)	0.400 0.350 ～ 0.450
2.5	±0.050 (s)	0.500 0.450 ～ 0.550	±0.050 (s)	0.500 0.450 ～ 0.550	±0.050 (s)	0.500 0.450 ～ 0.550
3	±0.050 (s)	0.600 0.550 ～ 0.650	±0.050 (s)	0.600 0.550 ～ 0.650	±0.050 (s)	0.600 0.550 ～ 0.650
3.5	±0.050 (s)	0.700 0.650 ～ 0.750	±0.050 (s)	0.700 0.650 ～ 0.750	±0.050 (s)	0.700 0.650 ～ 0.750
4	±0.050 (s)	0.800 0.750 ～ 0.850	±0.050 (s)	0.800 0.750 ～ 0.850	±0.050 (s)	0.800 0.750 ～ 0.850
4.5	±0.050 (s)	0.900 0.850 ～ 0.950	±0.050 (s)	0.900 0.850 ～ 0.950	±0.050 (s)	0.900 0.850 ～ 0.950
5	±5.00 (%)	1.000 0.950 ～ 1.050	±5.00 (%)	1.000 0.950 ～ 1.050	±5.00 (%)	1.000 0.950 ～ 1.050
6	±5.00 (%)	1.200 1.140 ～ 1.260	±5.00 (%)	1.200 1.140 ～ 1.260	±5.00 (%)	1.200 1.140 ～ 1.260
7	±5.00 (%)	1.400 1.330 ～ 1.470	±5.00 (%)	1.400 1.330 ～ 1.470	±5.00 (%)	1.400 1.330 ～ 1.470
8	±5.00 (%)	1.600 1.520 ～ 1.680	±5.00 (%)	1.600 1.520 ～ 1.680	±5.00 (%)	1.600 1.520 ～ 1.680
9	±5.00 (%)	1.800 1.710 ～ 1.890	±5.00 (%)	1.800 1.710 ～ 1.890	±5.00 (%)	1.800 1.710 ～ 1.890
10	±5.00 (%)	2.000 1.900 ～ 2.100	±5.00 (%)	2.000 1.900 ～ 2.100	±5.00 (%)	2.000 1.900 ～ 2.100
15	±5.00 (%)	3.000 2.850 ～ 3.150	±5.00 (%)	3.000 2.850 ～ 3.150	±5.00 (%)	3.000 2.850 ～ 3.150
20	±5.00 (%)	4.000 3.800 ～ 4.200	±5.00 (%)	4.000 3.800 ～ 4.200	±5.00 (%)	4.000 3.800 ～ 4.200
30	±5.00 (%)	6.000 5.700 ～ 6.300	±5.00 (%)	6.000 5.700 ～ 6.300	±5.00 (%)	6.000 5.700 ～ 6.300
40	±5.00 (%)	8.000 7.600 ～ 8.400	±5.00 (%)	8.000 7.600 ～ 8.400	±5.00 (%)	8.000 7.600 ～ 8.400
50	±5.00 (%)	10.000 9.500 ～ 10.500	±5.00 (%)	10.000 9.500 ～ 10.500	±5.00 (%)	10.000 9.500 ～ 10.500

Table 3-23 IEEE Moderate inverse (NI11) Operating time accuracy table

Unit: s

Input value	300%		500%		1000%	
Operating time multiplier setting (M)	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range
0.25	±0.100 (s)	0.061 * 0.050 ～ 0.161	±0.100 (s)	0.042 * 0.050 ～ 0.142	±0.100 (s)	0.030 * 0.050 ～ 0.130
0.5	±0.100 (s)	0.122 * 0.050 ～ 0.222	±0.100 (s)	0.084 * 0.050 ～ 0.184	±0.100 (s)	0.060 * 0.050 ～ 0.160
1	±0.100 (s)	0.243 0.143 ～ 0.343	±0.100 (s)	0.169 0.069 ～ 0.269	±0.100 (s)	0.121 * 0.050 ～ 0.221
1.5	±0.100 (s)	0.365 0.265 ～ 0.465	±0.100 (s)	0.253 0.153 ～ 0.353	±0.100 (s)	0.181 0.081 ～ 0.281
2	±0.100 (s)	0.486 0.386 ～ 0.586	±0.100 (s)	0.338 0.238 ～ 0.438	±0.100 (s)	0.241 0.141 ～ 0.341
2.5	±0.100 (s)	0.608 0.508 ～ 0.708	±0.100 (s)	0.422 0.322 ～ 0.522	±0.100 (s)	0.302 0.202 ～ 0.402
3	±0.100 (s)	0.730 0.630 ～ 0.830	±0.100 (s)	0.506 0.406 ～ 0.606	±0.100 (s)	0.362 0.262 ～ 0.462
3.5	±12.00 (%)	0.851 0.749 ～ 0.953	±0.100 (s)	0.591 0.491 ～ 0.691	±0.100 (s)	0.422 0.322 ～ 0.522
4	±12.00 (%)	0.973 0.857 ～ 1.089	±0.100 (s)	0.675 0.575 ～ 0.775	±0.100 (s)	0.483 0.383 ～ 0.583
4.5	±12.00 (%)	1.094 0.963 ～ 1.225	±0.100 (s)	0.760 0.660 ～ 0.860	±0.100 (s)	0.543 0.443 ～ 0.643
5	±12.00 (%)	1.216 1.071 ～ 1.361	±0.100 (s)	0.844 0.744 ～ 0.944	±0.100 (s)	0.603 0.503 ～ 0.703
6	±12.00 (%)	1.459 1.284 ～ 1.634	±0.100 (s)	1.013 0.913 ～ 1.113	±0.100 (s)	0.724 0.624 ～ 0.824
7	±12.00 (%)	1.703 1.499 ～ 1.907	±0.100 (s)	1.182 1.082 ～ 1.282	±0.100 (s)	0.845 0.745 ～ 0.945
8	±12.00 (%)	1.946 1.713 ～ 2.179	±0.100 (s)	1.351 1.251 ～ 1.451	±0.100 (s)	0.965 0.865 ～ 1.065
9	±12.00 (%)	2.189 1.927 ～ 2.451	±7.00 (%)	1.519 1.413 ～ 1.625	±0.100 (s)	1.086 0.986 ～ 1.186
10	±12.00 (%)	2.432 2.141 ～ 2.723	±7.00 (%)	1.688 1.570 ～ 1.806	±0.100 (s)	1.207 1.107 ～ 1.307
15	±12.00 (%)	3.648 3.211 ～ 4.085	±7.00 (%)	2.532 2.355 ～ 2.709	±0.100 (s)	1.810 1.710 ～ 1.910
20	±12.00 (%)	4.864 4.281 ～ 5.447	±7.00 (%)	3.377 3.141 ～ 3.613	±5.00 (%)	2.414 2.294 ～ 2.534
30	±12.00 (%)	7.297 6.422 ～ 8.172	±7.00 (%)	5.065 4.711 ～ 5.419	±5.00 (%)	3.620 3.439 ～ 3.801
40	±12.00 (%)	9.729 8.562 ～ 10.896	±7.00 (%)	6.753 6.281 ～ 7.225	±5.00 (%)	4.827 4.586 ～ 5.068
50	±12.00 (%)	12.161 10.702 ～ 13.620	±7.00 (%)	8.442 7.852 ～ 9.032	±5.00 (%)	6.034 5.733 ～ 6.335

Table 3-24 IEEE Very inverse (EI11) Operating time accuracy table

Unit: s

Input value	300%		500%		1000%	
Operating time multiplier setting (M)	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range
0.25	±0.100 (s)	0.074 * 0.050 ～ 0.174	±0.100 (s)	0.033 * 0.050 ～ 0.133	±0.100 (s)	0.017 * 0.050 ～ 0.117
0.5	±0.100 (s)	0.147 0.047 ～ 0.247	±0.100 (s)	0.065 * 0.050 ～ 0.165	±0.100 (s)	0.034 * 0.050 ～ 0.134
1	±0.100 (s)	0.294 0.194 ～ 0.394	±0.100 (s)	0.131 * 0.050 ～ 0.231	±0.100 (s)	0.069 * 0.050 ～ 0.169
1.5	±0.100 (s)	0.441 0.341 ～ 0.541	±0.100 (s)	0.196 0.096 ～ 0.296	±0.100 (s)	0.103 * 0.050 ～ 0.203
2	±0.100 (s)	0.588 0.488 ～ 0.688	±0.100 (s)	0.262 0.162 ～ 0.362	±0.100 (s)	0.138 * 0.050 ～ 0.238
2.5	±0.100 (s)	0.736 0.636 ～ 0.836	±0.100 (s)	0.327 0.227 ～ 0.427	±0.100 (s)	0.172 0.072 ～ 0.272
3	±12.00 (%)	0.883 0.778 ～ 0.988	±0.100 (s)	0.392 0.292 ～ 0.492	±0.100 (s)	0.207 0.107 ～ 0.307
3.5	±12.00 (%)	1.030 0.907 ～ 1.153	±0.100 (s)	0.458 0.358 ～ 0.558	±0.100 (s)	0.241 0.141 ～ 0.341
4	±12.00 (%)	1.177 1.036 ～ 1.318	±0.100 (s)	0.523 0.423 ～ 0.623	±0.100 (s)	0.276 0.176 ～ 0.376
4.5	±12.00 (%)	1.324 1.166 ～ 1.482	±0.100 (s)	0.589 0.489 ～ 0.689	±0.100 (s)	0.310 0.210 ～ 0.410
5	±12.00 (%)	1.471 1.295 ～ 1.647	±0.100 (s)	0.654 0.554 ～ 0.754	±0.100 (s)	0.345 0.245 ～ 0.445
6	±12.00 (%)	1.765 1.554 ～ 1.976	±0.100 (s)	0.785 0.685 ～ 0.885	±0.100 (s)	0.413 0.313 ～ 0.513
7	±12.00 (%)	2.060 1.813 ～ 2.307	±0.100 (s)	0.916 0.816 ～ 1.016	±0.100 (s)	0.482 0.382 ～ 0.582
8	±12.00 (%)	2.354 2.072 ～ 2.636	±0.100 (s)	1.046 0.946 ～ 1.146	±0.100 (s)	0.551 0.451 ～ 0.651
9	±12.00 (%)	2.648 2.331 ～ 2.965	±0.100 (s)	1.177 1.077 ～ 1.277	±0.100 (s)	0.620 0.520 ～ 0.720
10	±12.00 (%)	2.942 2.589 ～ 3.295	±0.100 (s)	1.308 1.208 ～ 1.408	±0.100 (s)	0.689 0.589 ～ 0.789
15	±12.00 (%)	4.413 3.884 ～ 4.942	±7.00 (%)	1.962 1.825 ～ 2.099	±0.100 (s)	1.034 0.934 ～ 1.134
20	±12.00 (%)	5.885 5.179 ～ 6.591	±7.00 (%)	2.616 2.433 ～ 2.799	±0.100 (s)	1.378 1.278 ～ 1.478
30	±12.00 (%)	8.827 7.768 ～ 9.886	±7.00 (%)	3.924 3.650 ～ 4.198	±5.00 (%)	2.067 1.964 ～ 2.170
40	±12.00 (%)	11.769 10.357 ～ 13.181	±7.00 (%)	5.232 4.866 ～ 5.598	±5.00 (%)	2.756 2.619 ～ 2.893
50	±12.00 (%)	14.711 12.946 ～ 16.476	±7.00 (%)	6.540 6.083 ～ 6.997	±5.00 (%)	3.445 3.273 ～ 3.617

Table 3-25 IEEE Extremely inverse (EI12) Operating time accuracy table

Unit: s

Input value	300%		500%		1000%	
Operating time multiplier setting (M)	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range
0.25	±0.100 (s)	0.091 * 0.050 ～ 0.191	±0.100 (s)	0.032 * 0.050 ～ 0.132	±0.100 (s)	0.010 * 0.050 ～ 0.110
0.5	±0.100 (s)	0.182 0.082 ～ 0.282	±0.100 (s)	0.065 * 0.050 ～ 0.165	±0.100 (s)	0.020 * 0.050 ～ 0.120
1	±0.100 (s)	0.365 0.265 ～ 0.465	±0.100 (s)	0.130 * 0.050 ～ 0.230	±0.100 (s)	0.041 * 0.050 ～ 0.141
1.5	±0.100 (s)	0.547 0.447 ～ 0.647	±0.100 (s)	0.195 0.095 ～ 0.295	±0.100 (s)	0.061 * 0.050 ～ 0.161
2	±0.100 (s)	0.729 0.629 ～ 0.829	±0.100 (s)	0.259 0.159 ～ 0.359	±0.100 (s)	0.081 * 0.050 ～ 0.181
2.5	±12.00 (%)	0.912 0.803 ～ 1.021	±0.100 (s)	0.324 0.224 ～ 0.424	±0.100 (s)	0.102 * 0.050 ～ 0.202
3	±12.00 (%)	1.094 0.963 ～ 1.225	±0.100 (s)	0.389 0.289 ～ 0.489	±0.100 (s)	0.122 * 0.050 ～ 0.222
3.5	±12.00 (%)	1.276 1.123 ～ 1.429	±0.100 (s)	0.454 0.354 ～ 0.554	±0.100 (s)	0.142 0.042 ～ 0.242
4	±12.00 (%)	1.459 1.284 ～ 1.634	±0.100 (s)	0.519 0.419 ～ 0.619	±0.100 (s)	0.163 0.063 ～ 0.263
4.5	±12.00 (%)	1.641 1.445 ～ 1.837	±0.100 (s)	0.584 0.484 ～ 0.684	±0.100 (s)	0.183 0.083 ～ 0.283
5	±12.00 (%)	1.823 1.605 ～ 2.041	±0.100 (s)	0.648 0.548 ～ 0.748	±0.100 (s)	0.203 0.103 ～ 0.303
6	±12.00 (%)	2.188 1.926 ～ 2.450	±0.100 (s)	0.778 0.678 ～ 0.878	±0.100 (s)	0.244 0.144 ～ 0.344
7	±12.00 (%)	2.553 2.247 ～ 2.859	±0.100 (s)	0.908 0.808 ～ 1.008	±0.100 (s)	0.285 0.185 ～ 0.385
8	±12.00 (%)	2.917 2.567 ～ 3.267	±0.100 (s)	1.037 0.937 ～ 1.137	±0.100 (s)	0.325 0.225 ～ 0.425
9	±12.00 (%)	3.282 2.889 ～ 3.675	±0.100 (s)	1.167 1.067 ～ 1.267	±0.100 (s)	0.366 0.266 ～ 0.466
10	±12.00 (%)	3.647 3.210 ～ 4.084	±0.100 (s)	1.297 1.197 ～ 1.397	±0.100 (s)	0.407 0.307 ～ 0.507
15	±12.00 (%)	5.470 4.814 ～ 6.126	±7.00 (%)	1.945 1.809 ～ 2.081	±0.100 (s)	0.610 0.510 ～ 0.710
20	±12.00 (%)	7.293 6.418 ～ 8.168	±7.00 (%)	2.593 2.412 ～ 2.774	±0.100 (s)	0.813 0.713 ～ 0.913
30	±12.00 (%)	10.940 9.628 ～ 12.252	±7.00 (%)	3.890 3.618 ～ 4.162	±0.100 (s)	1.220 1.120 ～ 1.320
40	±12.00 (%)	14.587 12.837 ～ 16.337	±7.00 (%)	5.187 4.824 ～ 5.550	±0.100 (s)	1.626 1.526 ～ 1.726
50	±12.00 (%)	18.234 16.046 ～ 20.422	±7.00 (%)	6.484 6.031 ～ 6.937	±5.00 (%)	2.033 1.932 ～ 2.134

Table 3-26 Normal inverse (NI21) Operating time accuracy table

Unit: s

Input value	300%		500%		1000%	
Operating time multiplier setting (M)	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range
0.25	±0.100 (s)	0.139 * 0.050 ～ 0.239	±0.100 (s)	0.096 * 0.050 ～ 0.196	±0.100 (s)	0.070 * 0.050 ～ 0.170
0.5	±0.100 (s)	0.277 0.177 ～ 0.377	±0.100 (s)	0.193 0.093 ～ 0.293	±0.100 (s)	0.139 * 0.050 ～ 0.239
1	±0.100 (s)	0.555 0.455 ～ 0.655	±0.100 (s)	0.386 0.286 ～ 0.486	±0.100 (s)	0.279 0.179 ～ 0.379
1.5	±0.100 (s)	0.832 0.732 ～ 0.932	±0.100 (s)	0.578 0.478 ～ 0.678	±0.100 (s)	0.418 0.318 ～ 0.518
2	±12.00 (%)	1.110 0.977 ～ 1.243	±0.100 (s)	0.771 0.671 ～ 0.871	±0.100 (s)	0.557 0.457 ～ 0.657
2.5	±12.00 (%)	1.387 1.221 ～ 1.553	±0.100 (s)	0.964 0.864 ～ 1.064	±0.100 (s)	0.697 0.597 ～ 0.797
3	±12.00 (%)	1.665 1.466 ～ 1.864	±0.100 (s)	1.157 1.057 ～ 1.257	±0.100 (s)	0.836 0.736 ～ 0.936
3.5	±12.00 (%)	1.942 1.709 ～ 2.175	±0.100 (s)	1.350 1.250 ～ 1.450	±0.100 (s)	0.976 0.876 ～ 1.076
4	±12.00 (%)	2.220 1.954 ～ 2.486	±7.00 (%)	1.542 1.435 ～ 1.649	±0.100 (s)	1.115 1.015 ～ 1.215
4.5	±12.00 (%)	2.497 2.198 ～ 2.796	±7.00 (%)	1.735 1.614 ～ 1.856	±0.100 (s)	1.254 1.154 ～ 1.354
5	±12.00 (%)	2.775 2.442 ～ 3.108	±7.00 (%)	1.928 1.794 ～ 2.062	±0.100 (s)	1.394 1.294 ～ 1.494
6	±12.00 (%)	3.329 2.930 ～ 3.728	±7.00 (%)	2.314 2.153 ～ 2.475	±0.100 (s)	1.672 1.572 ～ 1.772
7	±12.00 (%)	3.884 3.418 ～ 4.350	±7.00 (%)	2.699 2.511 ～ 2.887	±0.100 (s)	1.951 1.851 ～ 2.051
8	±12.00 (%)	4.439 3.907 ～ 4.971	±7.00 (%)	3.085 2.870 ～ 3.300	±5.00 (%)	2.230 2.119 ～ 2.341
9	±12.00 (%)	4.994 4.395 ～ 5.593	±7.00 (%)	3.470 3.228 ～ 3.712	±5.00 (%)	2.509 2.384 ～ 2.634
10	±12.00 (%)	5.549 4.884 ～ 6.214	±7.00 (%)	3.856 3.587 ～ 4.125	±5.00 (%)	2.787 2.648 ～ 2.926
15	±12.00 (%)	8.324 7.326 ～ 9.322	±7.00 (%)	5.784 5.380 ～ 6.188	±5.00 (%)	4.181 3.972 ～ 4.390
20	±12.00 (%)	11.098 9.767 ～ 12.429	±7.00 (%)	7.712 7.173 ～ 8.251	±5.00 (%)	5.575 5.297 ～ 5.853
30	±12.00 (%)	16.647 14.650 ～ 18.644	±7.00 (%)	11.568 10.759 ～ 12.377	±5.00 (%)	8.362 7.944 ～ 8.780
40	±12.00 (%)	22.196 19.533 ～ 24.859	±7.00 (%)	15.424 14.345 ～ 16.503	±5.00 (%)	11.150 10.593 ～ 11.707
50	±12.00 (%)	27.745 24.416 ～ 31.074	±7.00 (%)	19.279 17.930 ～ 20.628	±5.00 (%)	13.937 13.241 ～ 14.633

Table 3-27 Very inverse (VI21) Operating time accuracy table

Unit: s

Input value	300%		500%		1000%	
Operating time multiplier setting (M)	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range
0.25	±0.100 (s)	0.210 0.110 ～ 0.310	±0.100 (s)	0.110 * 0.050 ～ 0.210	±0.100 (s)	0.054 * 0.050 ～ 0.154
0.5	±0.100 (s)	0.420 0.320 ～ 0.520	±0.100 (s)	0.220 0.120 ～ 0.320	±0.100 (s)	0.109 * 0.050 ～ 0.209
1	±0.100 (s)	0.840 0.740 ～ 0.940	±0.100 (s)	0.440 0.340 ～ 0.540	±0.100 (s)	0.218 0.118 ～ 0.318
1.5	±12.00 (%)	1.260 1.109 ～ 1.411	±0.100 (s)	0.660 0.560 ～ 0.760	±0.100 (s)	0.327 0.227 ～ 0.427
2	±12.00 (%)	1.680 1.479 ～ 1.881	±0.100 (s)	0.880 0.780 ～ 0.980	±0.100 (s)	0.436 0.336 ～ 0.536
2.5	±12.00 (%)	2.100 1.848 ～ 2.352	±0.100 (s)	1.100 1.000 ～ 1.200	±0.100 (s)	0.544 0.444 ～ 0.644
3	±12.00 (%)	2.520 2.218 ～ 2.822	±0.100 (s)	1.320 1.220 ～ 1.420	±0.100 (s)	0.653 0.553 ～ 0.753
3.5	±12.00 (%)	2.940 2.588 ～ 3.292	±7.00 (%)	1.540 1.433 ～ 1.647	±0.100 (s)	0.762 0.662 ～ 0.862
4	±12.00 (%)	3.360 2.957 ～ 3.763	±7.00 (%)	1.760 1.637 ～ 1.883	±0.100 (s)	0.871 0.771 ～ 0.971
4.5	±12.00 (%)	3.780 3.327 ～ 4.233	±7.00 (%)	1.980 1.842 ～ 2.118	±0.100 (s)	0.980 0.880 ～ 1.080
5	±12.00 (%)	4.200 3.696 ～ 4.704	±7.00 (%)	2.200 2.046 ～ 2.354	±0.100 (s)	1.089 0.989 ～ 1.189
6	±12.00 (%)	5.040 4.436 ～ 5.644	±7.00 (%)	2.640 2.456 ～ 2.824	±0.100 (s)	1.307 1.207 ～ 1.407
7	±12.00 (%)	5.880 5.175 ～ 6.585	±7.00 (%)	3.080 2.865 ～ 3.295	±0.100 (s)	1.524 1.424 ～ 1.624
8	±12.00 (%)	6.720 5.914 ～ 7.526	±7.00 (%)	3.520 3.274 ～ 3.766	±0.100 (s)	1.742 1.642 ～ 1.842
9	±12.00 (%)	7.560 6.653 ～ 8.467	±7.00 (%)	3.960 3.683 ～ 4.237	±0.100 (s)	1.960 1.860 ～ 2.060
10	±12.00 (%)	8.400 7.392 ～ 9.408	±7.00 (%)	4.400 4.092 ～ 4.708	±5.00 (%)	2.178 2.070 ～ 2.286
15	±12.00 (%)	12.600 11.088 ～ 14.112	±7.00 (%)	6.600 6.138 ～ 7.062	±5.00 (%)	3.267 3.104 ～ 3.430
20	±12.00 (%)	16.800 14.784 ～ 18.816	±7.00 (%)	8.800 8.184 ～ 9.416	±5.00 (%)	4.356 4.139 ～ 4.573
30	±12.00 (%)	25.200 22.176 ～ 28.224	±7.00 (%)	13.200 12.276 ～ 14.124	±5.00 (%)	6.533 6.207 ～ 6.859
40	±12.00 (%)	33.600 29.568 ～ 37.632	±7.00 (%)	17.600 16.368 ～ 18.832	±5.00 (%)	8.711 8.276 ～ 9.146
50	±12.00 (%)	42.000 36.960 ～ 47.040	±7.00 (%)	22.000 20.460 ～ 23.540	±5.00 (%)	10.889 10.345 ～ 11.433

Table 3-28 Long inverse (LI21) Operating time accuracy table

Unit: s

Input value	300%		500%		1000%	
Operating time multiplier setting (M)	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range
0.25	±0.100 (s)	0.750 0.650 ～ 0.850	±0.100 (s)	0.375 0.275 ～ 0.475	±0.100 (s)	0.167 0.067 ～ 0.267
0.5	±12.00 (%)	1.500 1.320 ～ 1.680	±0.100 (s)	0.750 0.650 ～ 0.850	±0.100 (s)	0.333 0.233 ～ 0.433
1	±12.00 (%)	3.000 2.640 ～ 3.360	±7.00 (%)	1.500 1.395 ～ 1.605	±0.100 (s)	0.667 0.567 ～ 0.767
1.5	±12.00 (%)	4.500 3.960 ～ 5.040	±7.00 (%)	2.250 2.093 ～ 2.407	±0.100 (s)	1.000 0.900 ～ 1.100
2	±12.00 (%)	6.000 5.280 ～ 6.720	±7.00 (%)	3.000 2.790 ～ 3.210	±0.100 (s)	1.333 1.233 ～ 1.433
2.5	±12.00 (%)	7.500 6.600 ～ 8.400	±7.00 (%)	3.750 3.488 ～ 4.012	±0.100 (s)	1.667 1.567 ～ 1.767
3	±12.00 (%)	9.000 7.920 ～ 10.080	±7.00 (%)	4.500 4.185 ～ 4.815	±0.100 (s)	2.000 1.900 ～ 2.100
3.5	±12.00 (%)	10.500 9.240 ～ 11.760	±7.00 (%)	5.250 4.883 ～ 5.617	±5.00 (%)	2.333 2.217 ～ 2.449
4	±12.00 (%)	12.000 10.560 ～ 13.440	±7.00 (%)	6.000 5.580 ～ 6.420	±5.00 (%)	2.667 2.534 ～ 2.800
4.5	±12.00 (%)	13.500 11.880 ～ 15.120	±7.00 (%)	6.750 6.278 ～ 7.222	±5.00 (%)	3.000 2.850 ～ 3.150
5	±12.00 (%)	15.000 13.200 ～ 16.800	±7.00 (%)	7.500 6.975 ～ 8.025	±5.00 (%)	3.333 3.167 ～ 3.499
6	±12.00 (%)	18.000 15.840 ～ 20.160	±7.00 (%)	9.000 8.370 ～ 9.630	±5.00 (%)	4.000 3.800 ～ 4.200
7	±12.00 (%)	21.000 18.480 ～ 23.520	±7.00 (%)	10.500 9.765 ～ 11.235	±5.00 (%)	4.667 4.434 ～ 4.900
8	±12.00 (%)	24.000 21.120 ～ 26.880	±7.00 (%)	12.000 11.160 ～ 12.840	±5.00 (%)	5.333 5.067 ～ 5.599
9	±12.00 (%)	27.000 23.760 ～ 30.240	±7.00 (%)	13.500 12.555 ～ 14.445	±5.00 (%)	6.000 5.700 ～ 6.300
10	±12.00 (%)	30.000 26.400 ～ 33.600	±7.00 (%)	15.000 13.950 ～ 16.050	±5.00 (%)	6.667 6.334 ～ 7.000
15	±12.00 (%)	45.000 39.600 ～ 50.400	±7.00 (%)	22.500 20.925 ～ 24.075	±5.00 (%)	10.000 9.500 ～ 10.500
20	±12.00 (%)	60.000 52.800 ～ 67.200	±7.00 (%)	30.000 27.900 ～ 32.100	±5.00 (%)	13.333 12.667 ～ 13.999
30	±12.00 (%)	90.000 79.200 ～ 100.800	±7.00 (%)	45.000 41.850 ～ 48.150	±5.00 (%)	20.000 19.000 ～ 21.000
40	±12.00 (%)	120.000 105.600 ～ 134.400	±7.00 (%)	60.000 55.800 ～ 64.200	±5.00 (%)	26.667 25.334 ～ 28.000
50	±12.00 (%)	150.000 132.000 ～ 168.000	±7.00 (%)	75.000 69.750 ～ 80.250	±5.00 (%)	33.333 31.667 ～ 34.999

Table 3-29 Korean Normal inverse (NI31) Operating time accuracy table

Unit: s

Input value	300%		500%		1000%	
Operating time multiplier setting (M)	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range
0.25	±0.100 (s)	0.134 * 0.050 ~ 0.234	±0.100 (s)	0.095 * 0.050 ~ 0.195	±0.100 (s)	0.069 * 0.050 ~ 0.169
0.5	±0.100 (s)	0.269 0.169 ~ 0.369	±0.100 (s)	0.189 0.089 ~ 0.289	±0.100 (s)	0.138 * 0.050 ~ 0.238
1	±0.100 (s)	0.537 0.437 ~ 0.637	±0.100 (s)	0.378 0.278 ~ 0.478	±0.100 (s)	0.275 0.175 ~ 0.375
1.5	±0.100 (s)	0.806 0.706 ~ 0.906	±0.100 (s)	0.567 0.467 ~ 0.667	±0.100 (s)	0.413 0.313 ~ 0.513
2	±12.00 (%)	1.074 0.946 ~ 1.202	±0.100 (s)	0.757 0.657 ~ 0.857	±0.100 (s)	0.551 0.451 ~ 0.651
2.5	±12.00 (%)	1.343 1.182 ~ 1.504	±0.100 (s)	0.946 0.846 ~ 1.046	±0.100 (s)	0.689 0.589 ~ 0.789
3	±12.00 (%)	1.611 1.418 ~ 1.804	±0.100 (s)	1.135 1.035 ~ 1.235	±0.100 (s)	0.826 0.726 ~ 0.926
3.5	±12.00 (%)	1.880 1.655 ~ 2.105	±0.100 (s)	1.324 1.224 ~ 1.424	±0.100 (s)	0.964 0.864 ~ 1.064
4	±12.00 (%)	2.149 1.892 ~ 2.406	±7.00 (%)	1.513 1.408 ~ 1.618	±0.100 (s)	1.102 1.002 ~ 1.202
4.5	±12.00 (%)	2.417 2.127 ~ 2.707	±7.00 (%)	1.702 1.583 ~ 1.821	±0.100 (s)	1.239 1.139 ~ 1.339
5	±12.00 (%)	2.686 2.364 ~ 3.008	±7.00 (%)	1.891 1.759 ~ 2.023	±0.100 (s)	1.377 1.277 ~ 1.477
6	±12.00 (%)	3.223 2.837 ~ 3.609	±7.00 (%)	2.270 2.112 ~ 2.428	±0.100 (s)	1.652 1.552 ~ 1.752
7	±12.00 (%)	3.760 3.309 ~ 4.211	±7.00 (%)	2.648 2.463 ~ 2.833	±0.100 (s)	1.928 1.828 ~ 2.028
8	±12.00 (%)	4.297 3.782 ~ 4.812	±7.00 (%)	3.026 2.815 ~ 3.237	±5.00 (%)	2.203 2.093 ~ 2.313
9	±12.00 (%)	4.834 4.254 ~ 5.414	±7.00 (%)	3.404 3.166 ~ 3.642	±5.00 (%)	2.479 2.356 ~ 2.602
10	±12.00 (%)	5.372 4.728 ~ 6.016	±7.00 (%)	3.783 3.519 ~ 4.047	±5.00 (%)	2.754 2.617 ~ 2.891
15	±12.00 (%)	8.057 7.091 ~ 9.023	±7.00 (%)	5.674 5.277 ~ 6.071	±5.00 (%)	4.131 3.925 ~ 4.337
20	±12.00 (%)	10.743 9.454 ~ 12.032	±7.00 (%)	7.565 7.036 ~ 8.094	±5.00 (%)	5.508 5.233 ~ 5.783
30	±12.00 (%)	16.115 14.182 ~ 18.048	±7.00 (%)	11.348 10.554 ~ 12.142	±5.00 (%)	8.262 7.849 ~ 8.675
40	±12.00 (%)	21.486 18.908 ~ 24.064	±7.00 (%)	15.131 14.072 ~ 16.190	±5.00 (%)	11.016 10.466 ~ 11.566
50	±12.00 (%)	26.858 23.636 ~ 30.080	±7.00 (%)	18.913 17.590 ~ 20.236	±5.00 (%)	13.770 13.082 ~ 14.458

Table 3-30 Korean Very inverse (VI31) Operating time accuracy table

Unit: s

Input value	300%		500%		1000%	
Operating time multiplier setting (M)	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range	Accuracy (ε)	Theoretical operating time Operating time range
0.25	±0.100 (s)	0.160 0.060 ~ 0.260	±0.100 (s)	0.072 * 0.050 ~ 0.172	±0.100 (s)	0.038 * 0.050 ~ 0.138
0.5	±0.100 (s)	0.319 0.219 ~ 0.419	±0.100 (s)	0.144 0.044 ~ 0.244	±0.100 (s)	0.077 * 0.050 ~ 0.177
1	±0.100 (s)	0.638 0.538 ~ 0.738	±0.100 (s)	0.289 0.189 ~ 0.389	±0.100 (s)	0.154 0.054 ~ 0.254
1.5	±12.00 (%)	0.958 0.844 ~ 1.072	±0.100 (s)	0.433 0.333 ~ 0.533	±0.100 (s)	0.230 0.130 ~ 0.330
2	±12.00 (%)	1.277 1.124 ~ 1.430	±0.100 (s)	0.578 0.478 ~ 0.678	±0.100 (s)	0.307 0.207 ~ 0.407
2.5	±12.00 (%)	1.596 1.405 ~ 1.787	±0.100 (s)	0.722 0.622 ~ 0.822	±0.100 (s)	0.384 0.284 ~ 0.484
3	±12.00 (%)	1.915 1.686 ~ 2.144	±0.100 (s)	0.867 0.767 ~ 0.967	±0.100 (s)	0.461 0.361 ~ 0.561
3.5	±12.00 (%)	2.234 1.966 ~ 2.502	±0.100 (s)	1.011 0.911 ~ 1.111	±0.100 (s)	0.538 0.438 ~ 0.638
4	±12.00 (%)	2.554 2.248 ~ 2.860	±0.100 (s)	1.156 1.056 ~ 1.256	±0.100 (s)	0.614 0.514 ~ 0.714
4.5	±12.00 (%)	2.873 2.529 ~ 3.217	±0.100 (s)	1.300 1.200 ~ 1.400	±0.100 (s)	0.691 0.591 ~ 0.791
5	±12.00 (%)	3.192 2.809 ~ 3.575	±7.00 (%)	1.445 1.344 ~ 1.546	±0.100 (s)	0.768 0.668 ~ 0.868
6	±12.00 (%)	3.830 3.371 ~ 4.289	±7.00 (%)	1.734 1.613 ~ 1.855	±0.100 (s)	0.922 0.822 ~ 1.022
7	±12.00 (%)	4.469 3.933 ~ 5.005	±7.00 (%)	2.023 1.882 ~ 2.164	±0.100 (s)	1.075 0.975 ~ 1.175
8	±12.00 (%)	5.107 4.495 ~ 5.719	±7.00 (%)	2.312 2.151 ~ 2.473	±0.100 (s)	1.229 1.129 ~ 1.329
9	±12.00 (%)	5.746 5.057 ~ 6.435	±7.00 (%)	2.601 2.419 ~ 2.783	±0.100 (s)	1.383 1.283 ~ 1.483
10	±12.00 (%)	6.384 5.618 ~ 7.150	±7.00 (%)	2.890 2.688 ~ 3.092	±0.100 (s)	1.536 1.436 ~ 1.636
15	±12.00 (%)	9.576 8.427 ~ 10.725	±7.00 (%)	4.335 4.032 ~ 4.638	±5.00 (%)	2.304 2.189 ~ 2.419
20	±12.00 (%)	12.768 11.236 ~ 14.300	±7.00 (%)	5.780 5.376 ~ 6.184	±5.00 (%)	3.072 2.919 ~ 3.225
30	±12.00 (%)	19.152 16.854 ~ 21.450	±7.00 (%)	8.670 8.064 ~ 9.276	±5.00 (%)	4.609 4.379 ~ 4.839
40	±12.00 (%)	25.536 22.472 ~ 28.600	±7.00 (%)	11.559 10.750 ~ 12.368	±5.00 (%)	6.145 5.838 ~ 6.452
50	±12.00 (%)	31.920 28.090 ~ 35.750	±7.00 (%)	14.449 13.438 ~ 15.460	±5.00 (%)	7.681 7.297 ~ 8.065

Table 3-31 Reset Time Characteristics

Input: setting value x 300% → 0

Reset time setting (Rst. Chr.)	Output contact	Reset time of internal timer counter
IDMT: Definite time (200 ms)	200 ms ± 25 ms	Instant
DT: Definite time	200 ms ± 25 ms	About 8 s
INST: Instant (50 ms)	50 ms or less	Instant

◆How to read the operating time accuracy table

* "300%, 500%, and 1000%" which are listed in the table are a multiple to be applied to the current setting value, respectively.
* The upper row shows the theoretical operating time, and the lower row shows the operating time range with accuracy added (The operating time range can be calculated from the below equation).

Operating time range
$\varepsilon = \dfrac{T_M - \frac{M}{10} \times T_{10}}{\frac{M}{10} \times T_{10}}$

Where,

T_{10} : Nominal operating time at reference operating time setting (M=10)
T_M : Operating time range at the operating time multiplier setting M
ε : Accuracy (%)
M : Operating time multiplier setting

Note: that if the operating time range which has been calculated from the above equation is smaller than the lower limits of ±100ms, accuracy are taken as ±100ms. However, in case of definite time characteristic (DT01), the accuracy lower limit is set to ±50ms.

* The underlined 50 ms marked with * in the tables is a fixed time, as the minimum operating time.

3.3. Ground (Earth) Fault Overcurrent Element

The Relay incorporates the 4 stages of ground (earth) fault overcurrent element which enable rapid detection of ground-faults. And it provides a variety of operations & reset time characteristics as same as the overcurrent elements in Fig. 3-14. Therefore, the relay can be applied to protect various systems. Second harmonic restraint is included and this can prevent unnecessary operation due to transformer magnetizing inrush current.

Device No.	Display name	Protective function
50N	OCN1H	Instantaneous ground fault overcurrent element. (HV-side)
	OCN1L	Instantaneous ground fault overcurrent element. (LV-side)
	OCN2H, OCN3H	Instantaneous ground fault overcurrent element (two-stage) with 2nd harmonic restraint. (HV-side)
	OCN2L, OCN3L	Instantaneous ground fault overcurrent element (two-stage) with 2nd harmonic restraint. (LV-side)
51N	OCN4H	Definite time or IDMT ground fault overcurrent element with second harmonic restraint. (HV-side) ・ Selection of 14 operating time characteristics ・ Selection of 3 reset characteristics
	OCN4L	Definite time or IDMT ground fault overcurrent element with second harmonic restraint. (LV-side) ・ Selection of 14 operating time characteristics ・ Selection of 3 reset characteristics

3.3.1. OCN1H Element (Ground Fault Overcurrent Element)

As this element has no 2nd harmonic restraint function on high-voltage side of the transformer, it is possible to achieve high-speed operation for large fault currents.

Fig. 3-25 shows the internal function blocks of the element.
The OCN1H element outputs a definitive signal after a preset time of the operation timer (Ope. Time) has passed, when zero-sequence current is greater than or equal to the operation setting value (Ope. Curt.).
An off-delay timer of 200 ms is added in order to prevent chattering of the output contacts.
Furthermore, this element outputs the definitive signal only when the Use/Non-use setting of OCN1H element (OCN1H EN) is ON. Therefore, when this element is not used, unnecessary operation can be prevented by setting to OFF. It is not necessary to adjust any other settings with regard to the OCN1H element.

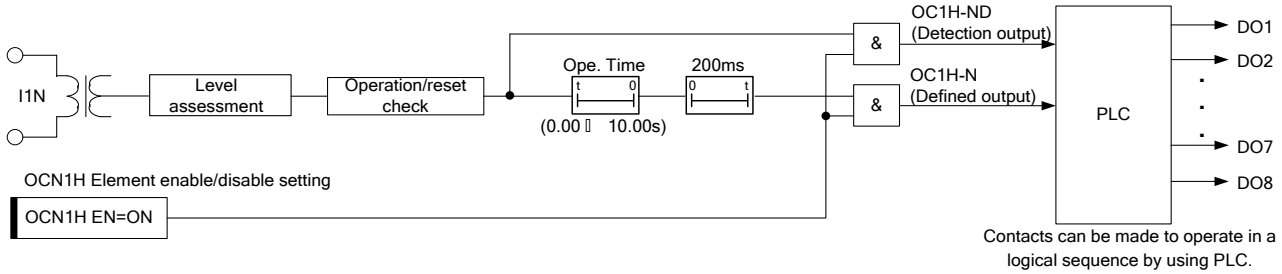


Fig. 3-25 OCN1H Element – internal function block diagram

Table 3-32 OCN1H Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OCN1H	OCN1H EN	OFF, ON	-	OFF: disable, ON: enable OCN1H element is effective at ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current
	Ope. Time	0.00 - 10.00s	0.01s	Operating time (INST ≤ 30 ms)

3.3.2. OCN1L Element (Ground Fault Overcurrent Element)

As this element has no 2nd harmonic restraint function on high-voltage side of the transformer, it is possible to achieve high-speed operation for large fault currents.
The OCN1L Element has the same operating characteristics as OCN1H Element.
For more information about the element's internal function block diagram, refer to Section 3.3.1.

Table 3-33 OCN1L Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OCN1L	OCN1L EN	OFF, ON	-	OFF: disable, ON: enable If you want to use this element, set it ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current
	Ope. Time	0.00 - 10.00s	0.01s	Operating time INST ≤ 30 ms

3.3.3. OCN2H Element (Ground Fault Overcurrent Element with 2nd harmonic restraint)

This is the definite time ground-fault element on the high-voltage side of the transformer with selectable second harmonic restraint.
Second harmonic restraint function can prevent unnecessary operation due to transformer magnetizing inrush current.
Fig. 3-26 shows the internal function blocks of the element.

The OCN2H element outputs a definitive signal after a preset time of the operation timer (Ope. Time) has passed, when the zero-sequence current is greater than or equal to the operation setting value (Ope. Curt.), and when 2nd harmonic restraint is not operated.
When the 2nd harmonic restraint function is not used (2f-lock EN=OFF), it is not linked to the operation of the OCN2H element.
An off-delay timer of 200 ms is added in order to prevent chattering of the output contacts.
This element outputs the definitive signal only when the setting of Use/Non-use of OCN2H element (OCN2H EN) is ON. Therefore, when this element is not used, unnecessary operation can be prevented by setting it to OFF. It is not necessary to adjust any other settings with regard to the OCN2H element.

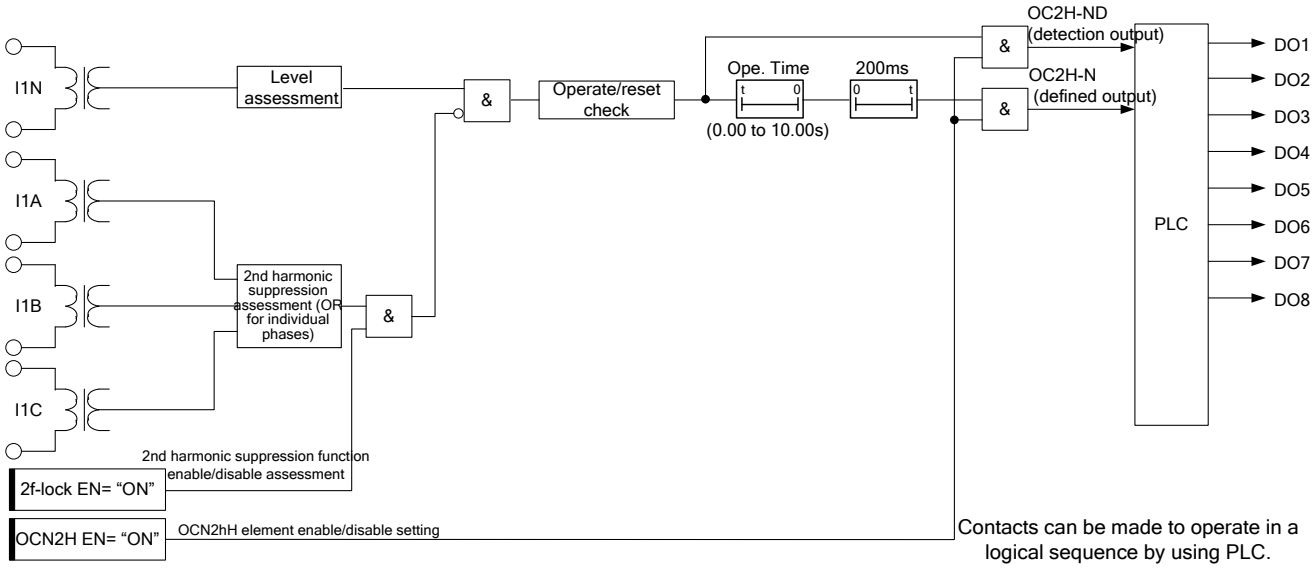


Fig. 3-26 OCN2H Element – internal function block diagram

Table 3-34 OCN2H Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OCN2H	OCN2H EN	OFF, ON	-	OFF: disable, ON: enable OCN2H element is effective at ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current
	Ope. Time	0.00 - 10.00s	0.01s	Operating time (INST ≤ 40 ms at 2f-lock EN=ON)
	2f-lock EN	OFF, ON	-	OFF: disable, ON: enable When 2nd harmonic restraint function is used, set to ON.

3.3.4. OCN2L Element (Ground Fault Overcurrent Element with 2nd harmonic restraint)

This is the definite time ground-fault element on the low-voltage side of the transformer with selectable 2nd harmonic restraint.
The OCN2L Element has the same operating characteristics as OCN2H Element.
For more information, refer to Section 3.3.3.

Table 3-35 OCN2L Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OCN2L	OCN2L EN	OFF, ON	-	OFF: disable, ON: enable OCN2L element is effective at ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current
	Ope. Time	0.00 - 10.00s	0.01s	Operating time (INST ≤ 40 ms at 2f-lock EN=ON)
	2f-lock EN	OFF, ON	-	OFF: disable, ON: enable When 2nd harmonic restraint function is used, set to ON.

3.3.5. OCN3H Element (Ground Fault Overcurrent Element with 2nd harmonic restraint)

This is the definite time ground-fault element on the high-voltage side of the transformer with selectable second harmonic restraint.
The OCN3H Element has the same operating characteristics as OCN2H Element.
For more information, refer to Section 3.3.3.

Table 3-36 OCN3H Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OCN3H	OCN3H EN	OFF, ON	-	OFF: disable, ON: enable OCN3H element is effective at ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current
	Ope. Time	0.00 - 10.00s	0.01s	Operating time (INST ≤ 40 ms at 2f-lock EN=ON)
	2f-lock EN	OFF, ON	-	OFF: disable, ON: enable 2nd harmonic blocking function is effective at ON.

3.3.6. OCN3L Element (Ground Fault Overcurrent Element with 2nd harmonic restraint)

This is the definite time ground-fault element on the low-voltage side of the transformer with selectable second harmonic restraint.
The OCN3L Element has the same operating characteristics as OCN2L Element.
For more information, refer to Section 3.3.4.

Table 3-37 OCN3L Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OCN3L	OCN3L EN	OFF, ON	-	OFF: disable, ON: enable OCN3L element is effective at ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current
	Ope. Time	0.00 - 10.00s	0.01s	Operating time (INST ≤ 40 ms at 2f-lock EN=ON)
	2f-lock EN	OFF, ON	-	OFF: disable, ON: enable 2nd harmonic blocking function is effective at ON.

3.3.7. OCN4H Element (Definite time or IDMT ground fault Overcurrent Element with second harmonic restraint)

This is the definite time or IDMT ground fault element on the high-voltage side of the transformer with selectable 2nd harmonic restraint. Second harmonic restraint can prevent unnecessary operation due to transformer magnetizing inrush current.
Furthermore, 14 types of operating time characteristics and 3 types of reset time characteristics are incorporated.
Fig. 3-27 shows the internal function blocks of the element.

The OCN4H element outputs a definitive signal when detection signal operates for longer than a definite time setting.
The detection signal is issued when zero-sequence current is greater than or equal to the operation setting value (Ope. Curt. or Ope. Curt.×1.15 is to be selected by setting of IEC Chr. EN), and when 2nd harmonic restraint is not operated.

The DT or IDMT timer counts up in accordance with the operating time characteristic (Ope. Chr.), when zero-sequence current is greater than or equal to the operation setting value (Ope. Curt.), and when 2nd harmonic restraint is not operated.
Furthermore, when the 2nd harmonic restraint function is not used (2f-lock EN=OFF), it is not linked to the operation of the OCN4H element.

The reset time characteristic can be selected by setting (Rst. Chr.).
When set to IDMT (inverse definite minimum time) or DT (definite time), it is included an off-delay timer of 200 ms to prevent chattering of the contacts.
When instantaneous reset of the contact is required, the setting (Rst. Chr.) should be set to INST (instantaneous).

Furthermore, this element operates only when the setting of Use/Non-use of OCN4H element (OCN4H EN) is ON. Therefore, when this element is not used, unnecessary operation can be prevented by setting to OFF. It is not necessary to adjust any other settings with regard to the OCN4H element.

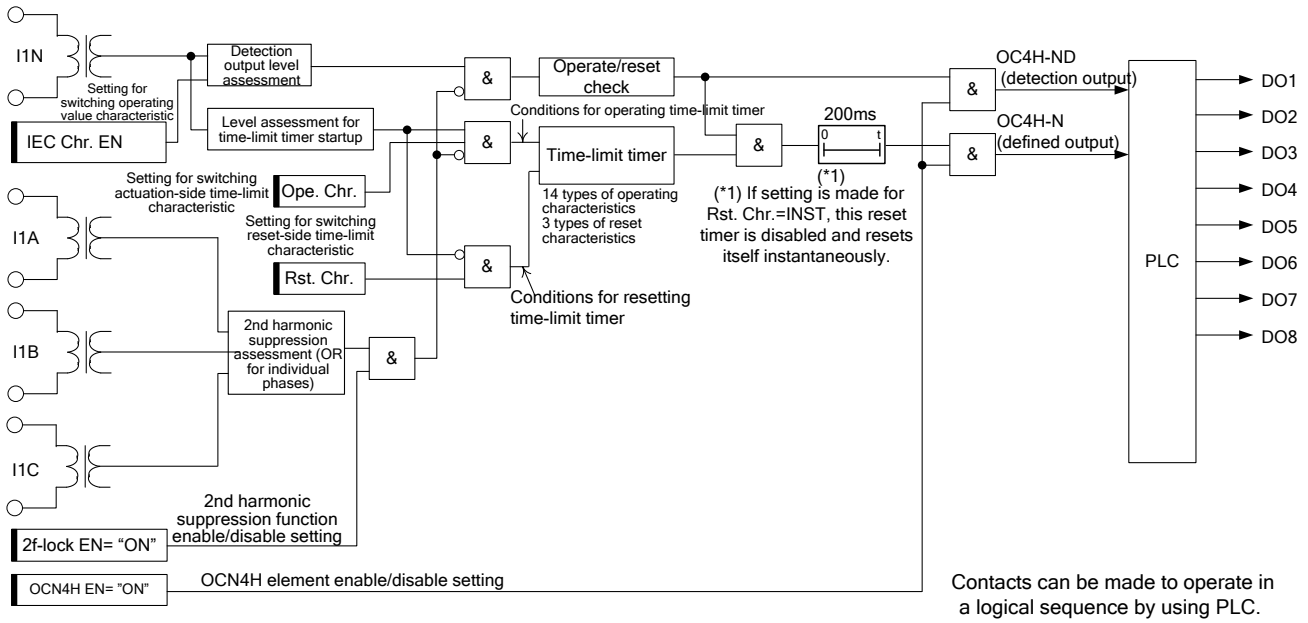


Fig. 3-27 OCN4H Element – internal function block diagram

Table 3-38 OCN4H Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OCN4H	OCN4H EN	OFF, ON	-	OFF: disable, ON: enable OCN4H element is effective at ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current
	Ope. TM	0.25 - 50.00	0.01	Operating time multiplier. This is indicated as “M” in the characteristic formula shown in sub-clause 3.2.8.3.
	Ope. Chr.	NI01, VI01, EI01, LI01, LI02, DT01, NI11, EI11, EI12, NI21, VI21, LI21, NI31, VI31	-	Choice of DT and IDMT operating characteristics. (Refer to IDMT characteristic formula in sub-clause 3.2.8.3.)
	Rst. Chr.	IDMT,DT,INST	-	Reset time characteristic. IDMT: Inverse definite minimum time DT: Definite time (fixed to 200 ms) INST: Instantenious (50 ms or less) (Refer to IDMT characteristic formula in sub-clause 3.2.8.3.
	2f-lock EN	OFF, ON	-	OFF: disable, ON: enable When 2nd harmonic restraint is used, set to ON.
	IEC Chr. EN	OFF, ON	-	OFF: Normal characteristic, ON: Characteristic according to IEC When this element is used with the operating characteristic compliant with IEC60255-151, set this parameter to ON. By setting this parameter to ON, the operating value for detection becomes 1.15 times the ‘Ope. Curt.’ as shown in sub-clause3.2.8.1.

3.3.8. OCN4L Element (Definite time or IDMT ground fault Overcurrent Element with second harmonic restraint)

This is the definite time or IDMT ground fault element on the low-voltage side of the transformer with selectable 2nd harmonic restraint. Second harmonic restraint can prevent unnecessary operation due to transformer magnetizing inrush current.
The OCN4L Element has the same operating characteristics as OCN4H Element.
For more information about the element's internal function block diagram, refer to Section 3.3.7.

Table 3-39 OCN4L Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OCN4L	OCN4L EN	OFF, ON	-	OFF: disable, ON: enable OCN4L element is effective at ON.
	Ope. Curt.	0.5 - 100.0A	0.1A	Operating current
	Ope. TM	0.25 - 50.00	0.01	Operating time multiplier. This is indicated as "M" in the characteristic formula shown in sub-clause 3.2.8.3.
	Ope. Chr.	NI01, VI01, EI01, LI01, LI02, DT01, NI11, EI11, EI12, NI21, VI21, LI21, NI31, VI31	-	Choice of DT and IDMT operating characteristics. (Refer to IDMT characteristic formula in sub-clause 3.2.8.3.)
	Rst. Chr.	IDMT,DT,INST	-	Reset time characteristic. IDMT: Inverse definite minimum time DT: Definite time (fixed to 200 ms) INST: Instantenious (50 ms or less) (Refer to IDMT characteristic formula in sub-clause 3.2.8.3.)
	2f-lock EN	OFF, ON	-	OFF: disable, ON: enable When 2nd harmonic restraint is used, set to ON.
	IEC Chr. EN	OFF, ON	-	OFF: Normal characteristic, ON: Characteristic according to IEC When this element is used with the operating characteristic compliant with IEC60255-151, set this parameter to ON. By setting this parameter to ON, the operating value for detection becomes 1.15 times the Ope. Curt., as shown in sub-clause 3.2.8.1.

3.4. Thermal Overload Element

This relay incorporates 2 overload elements for the current on HV side and LV side. Both element have 2 user-selectable operating time characteristics.

Device No.	Display name	Protective function
49	THOLH	Thermal Overload element on HV-side ・ 2 types of operating time characteristic.
	THOLL	Thermal Overload element on LV-side ・ 2 types of operating time characteristic.

3.4.1. THOLH Element (Thermal Overload Element)

This is an overload detection element for the current on the high-voltage side of the transformer.
There are two types of operating time characteristics, COLD and HOT.
Fig. 3-28 shows the internal function blocks of the element.

THOLH Element calculates positive and negative-sequence current from a 3-phase current and makes the combined current according to the equation 2. The 'Neg.K' value is the negative-phase heating-magnification factor. This element outputs a detection signal after the lapse of a time interval calculated from the characteristic equation for operate/reset time characteristic setting (THOLH Sel.) when the combined current is larger than the operation setting value (Ope. Curt.).

$$Iop = \sqrt{I_1^{\,2} + \left(Neg.K\right) \times I_2^{\,2}} \qquad \text{(Equation 2)}$$

Where,

Iop: Operating value of THOL element

I_1: Positive sequence current

I_2: Negative sequence current

Neg. K: Negative sequence heat-generation multiplier

An off-delay timer which corresponds to the COLD/HOT characteristic is added in order to prevent chattering of the output contacts.
Furthermore, this element outputs the definitive signal only when the Use/Non-use setting of THOLH element (THOLH EN) is ON. Therefore, when this element is not used, unnecessary operation can be prevented by setting to OFF. It is not necessary to set other setting items with regard to THOLH element.

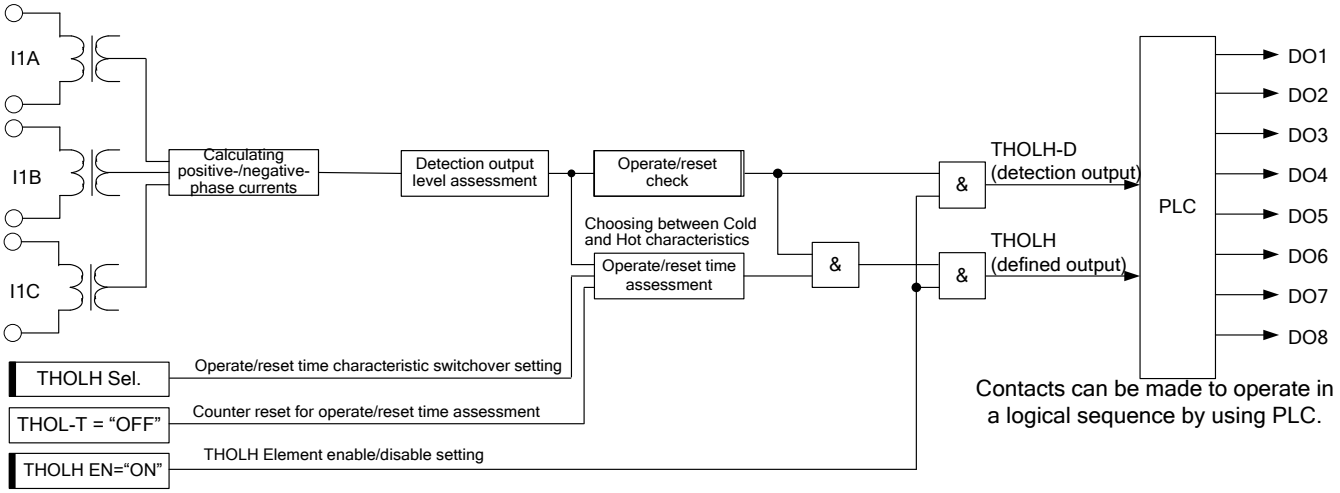


Fig. 3-28 THOLH Element – internal function block diagram

Table 3-40 THOLH Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
THOLH	THOLH EN	OFF, ON	-	OFF: Non-use, ON: Use When this element is used, set to ON.
	THOLH Sel.	COLD, HOT	-	Operate/reset time characteristics For more information, refer to Section 3.4.2.1.
	Ope. Curt.	1.0 - 10.0A	0.1A	Operating current
	Ope. Kth	8 - 240	1	Operating time multiplier setting The value “Kth” in the operating time characteristic equation is in Section 3.4.2.1.
	Neg. K	1 - 10	1	Negative sequence heat generation multiplier

3.4.2. THOLL Element (Thermal Overload Element)

This is an overload detecting element for the current on the low-voltage side of the transformer.
THOLL Element has the same characteristics as THOLH Element.
For more information about the element's internal function block, see Section 3.4.1.

Table 3-41 THOLL Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
THOLL	THOLL EN	OFF, ON	-	OFF: Non-use, ON: Use When this element is used, set to ON.
	THOLL Sel.	COLD, HOT	-	Operate/reset time characteristics For more information, refer to Section 3.4.2.1.
	Ope. Curt.	1.0 - 10.0A	0.1A	Operating current
	Ope. Kth	8 - 240	1	Operating time multiplier setting The value "Kth" in the operating time characteristic equation is in Section 3.4.2.1.
	Neg. K	1 - 10	1	Negative sequence heat generation multiplier

3.4.2.1. Operate/Reset Time Characteristics

The operate/reset time characteristics of the THOLH and THOLL Elements are expressed by the following equation:

$$OperatingTime[s] = 8.49 \times Kth \times \ln \frac{(I_1^{\,2} + Neg.K \times I_2^{\,2}) - (I_{P1}^{\,2} + Neg.K \times I_{P2}^{\,2})}{(I_1^{\,2} + Neg.K \times I_2^{\,2}) - 1}$$

$$K = \frac{\text{Heating effect by negative phase current}}{\text{Heating effect by positive phase current}}$$

Where,

I_{P1} = initial positive-phase current (I_{P1} =0 at COLD characteristic)

I_{P2} = initial negative-phase current (I_{P1} =0 at COLD characteristic)

I_1 = positive-phase sequence current

I_2 = negative-phase sequence current

- COLD characteristic
  The COLD characteristic starts computations from when input has exceeded an operating current setting.
  When the input has reduced below the operating current setting after the operation of element's output, the element resets itself in 200 ms and resets its computations.
  On the other hand, if the input has reduced below the operating current setting on the way to the element's output-operation by larger current than the operating current setting, the internal computation value reduces according to the equation.

- HOT characteristic
  The HOT characteristic always performs heat-accumulation computations even if input remains below an operating current setting.

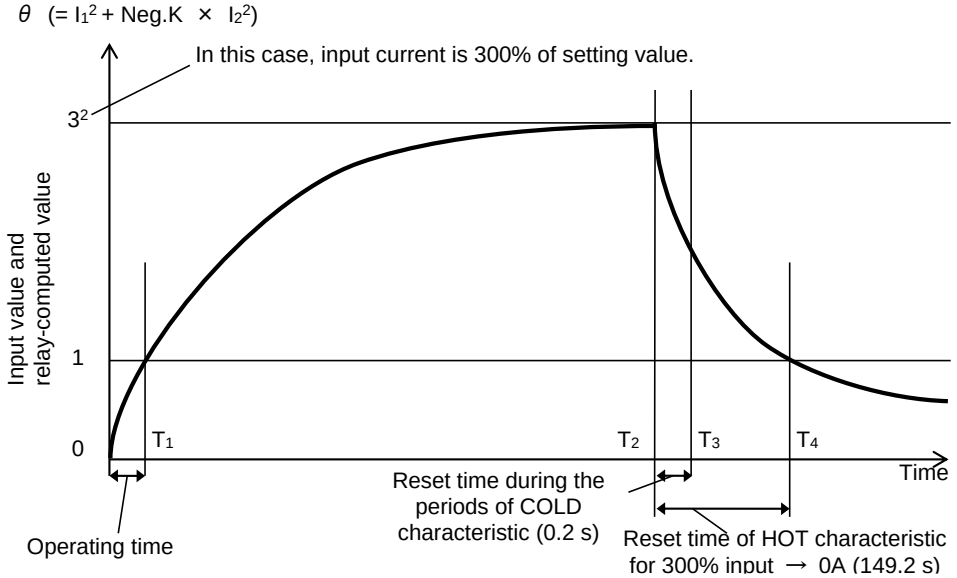


Fig. 3-29 An example of operating time and reset time

0 - T_1: Operating time with input change of 0 → 300%
T_1 - T_3: Output relay contact operation time at COLD characteristic
T_1 - T_4: Output relay contact operation time at HOT characteristic
T_2 - T_3: Output relay reset time at COLD characteristic
T_2 - T_4: Output relay reset time at HOT characteristic for the current change of 300% → 0 input
T_1: Time at relay-computed value (θn) ≧ 1
T_2: Time at relay input change from 300% to 0
T_4: Time at relay-computed value (θn) < 1

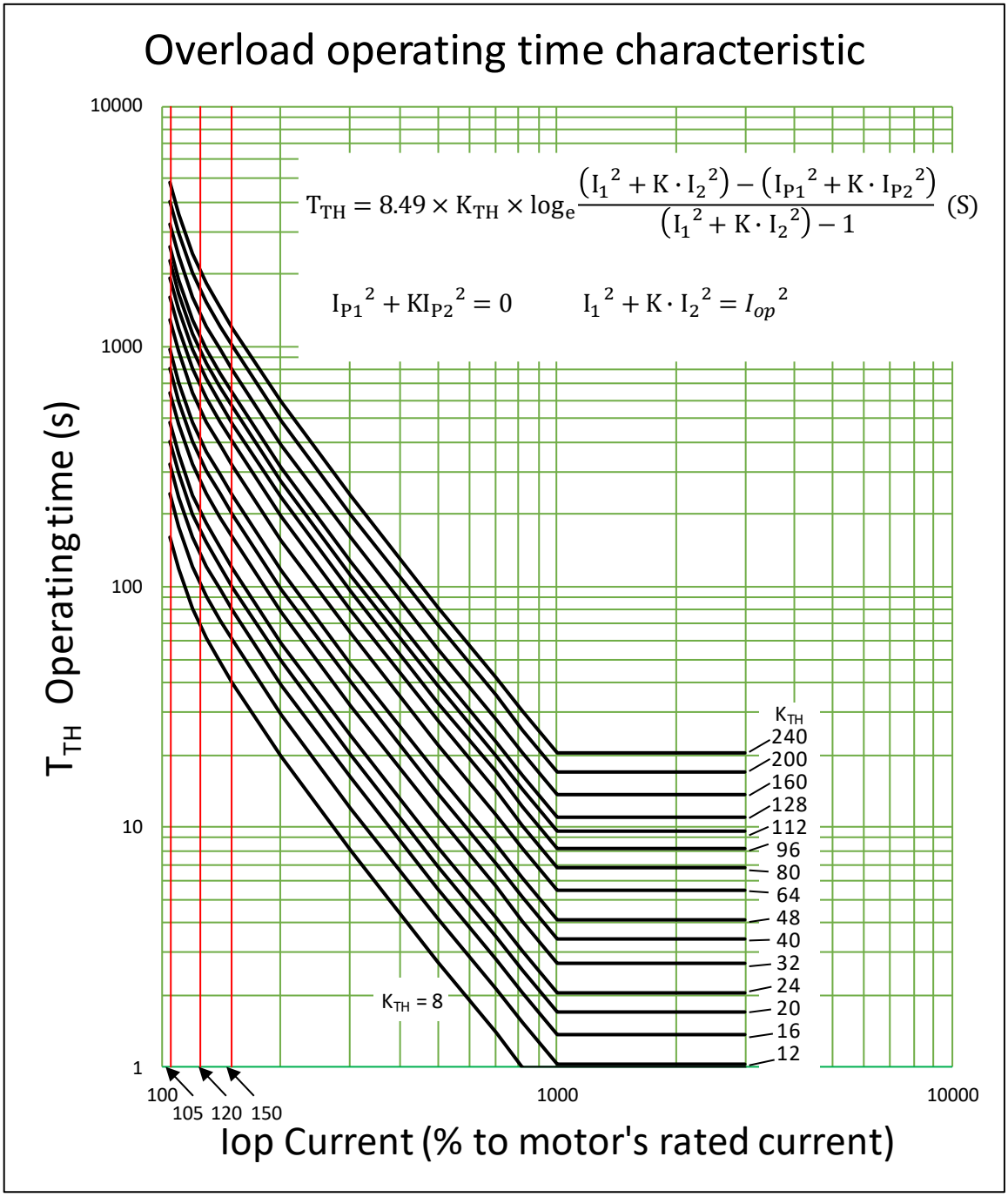


Fig. 3-30 Operating time characteristic of overload element

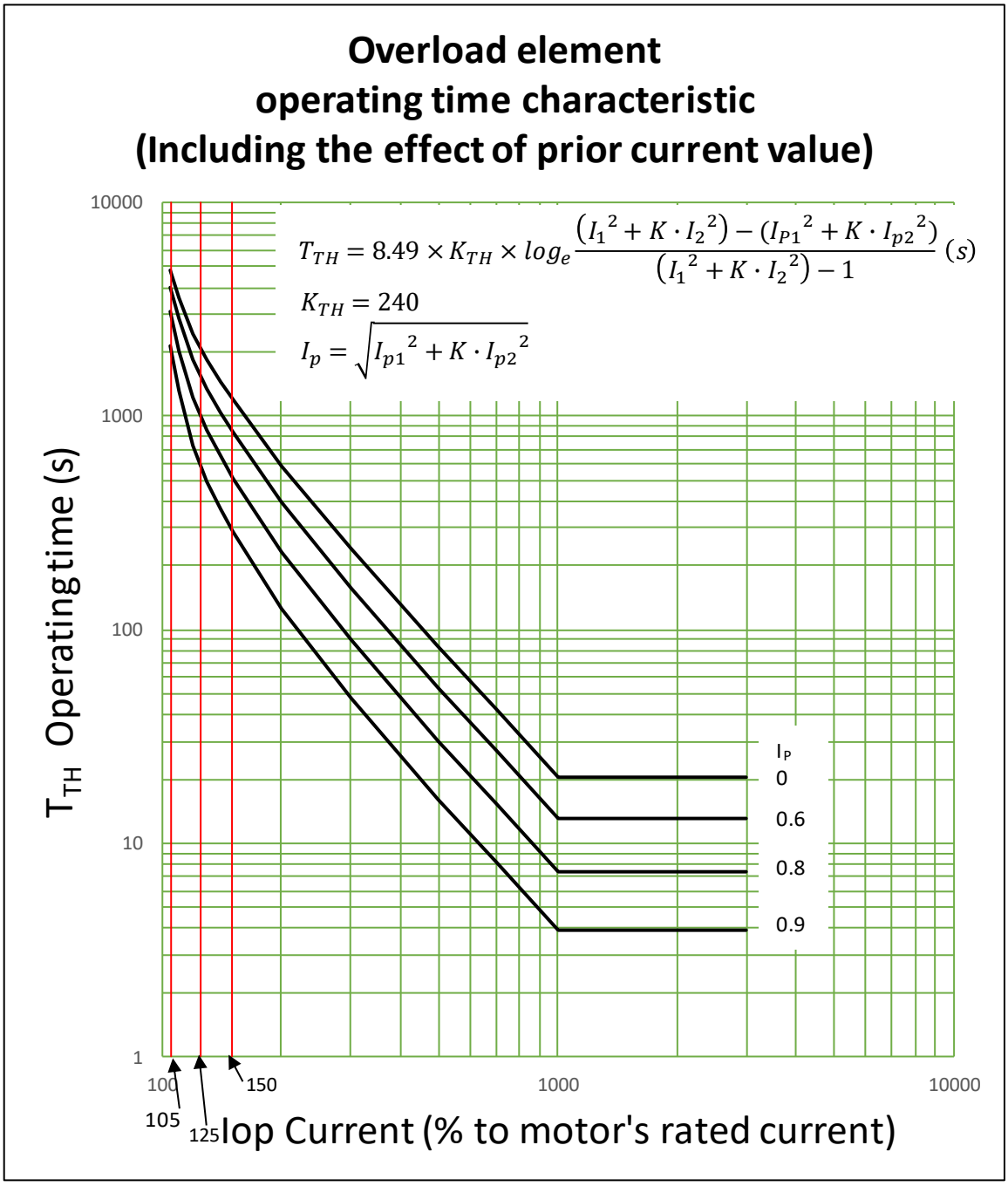


Fig. 3-31 Operating time characteristic of overload element
(Variation dependent on prior current value in HOT characteristic)

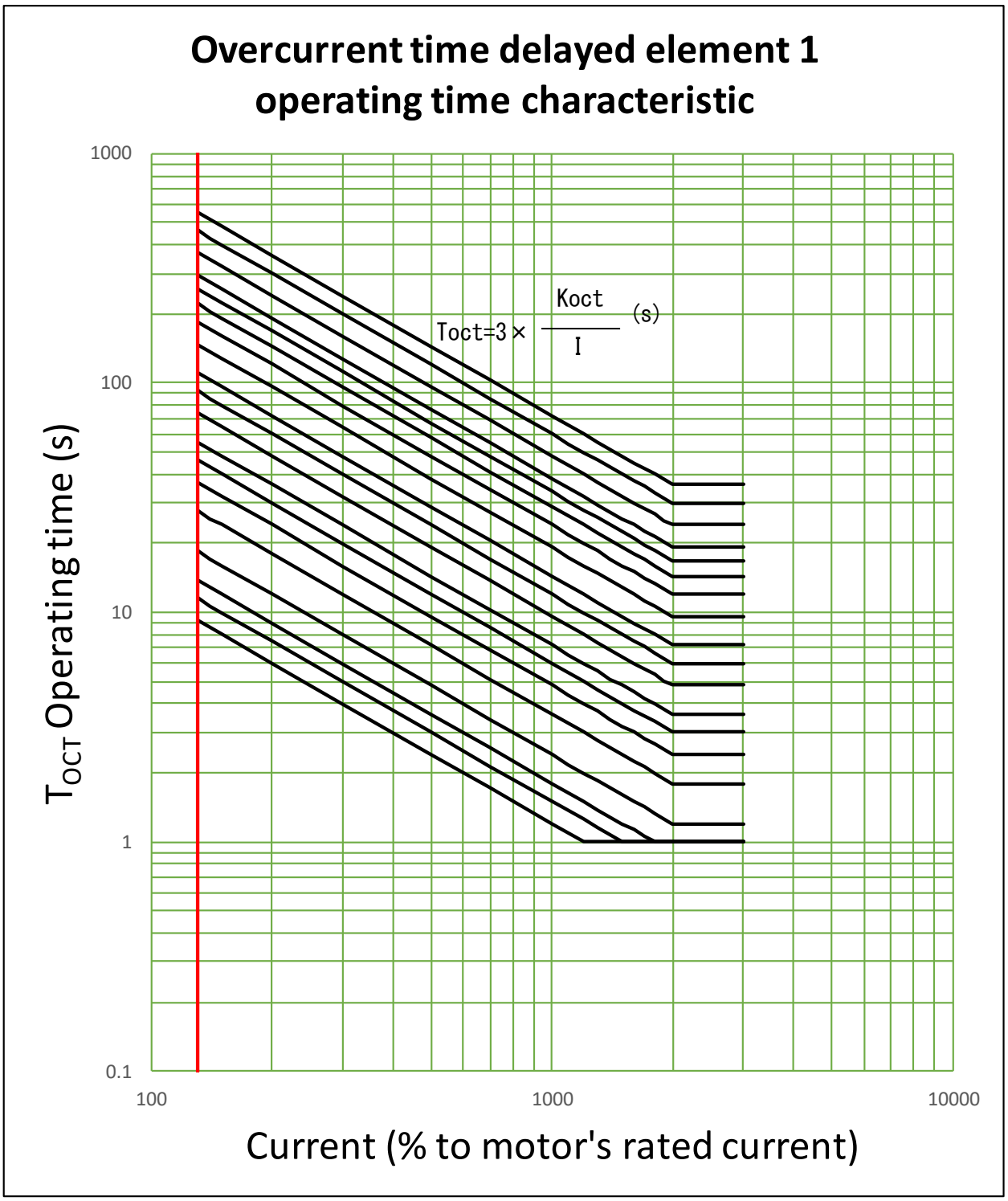


Fig. 3-32 Operating time characteristic of IDMT overcurrent element

3.5. Negative-phase Overcurrent Element

The negative sequence overcurrent elements with 2 stages for high-voltage side and low-voltage side are incorporated in the CAC1-A41D1. As the negative sequence current is obtained from 3-phase current, it is possible to detect unbalance current owing to external wiring errors, open phase condition, etc.

Component number	Display name	Protective function
46	OCNEG1H, OCNEG2H	Negative sequence overcurrent element (HV-side)
	OCNEG1L, OCNEG2L	Negative sequence overcurrent element (LV-side)

3.5.1. OCNEG1H Element (Negative sequence overcurrent element)

This is a negative-sequence overcurrent instantaneous element on the low-voltage side of the transformer Fig. 3-33 shows the internal function blocks of OCNEG1 element.

The OCNEG1H Element calculates a negative-sequence current from 3-phase input current, and compares it with the operation setting value (Ope. Curt.). It outputs a definitive signal after a preset time of the operation timer (Ope. Time) has passed, when the current is greater than or equal to the setting value.

An off-delay timer of 200 ms is added in order to prevent chattering of the contacts.
Furthermore, this element operates only when the setting of Use/Non-use of OCNEG1H element (OCNEG1H EN) is ON. Therefore, when this element is not used, unnecessary operation can be prevented by setting it to OFF. It is not necessary to adjust any other settings with regard to the OCNEG1H element.
The relationship between the operation equation and the setting value is following.

$$I_2 = \frac{1}{3}\left(Ia + a^2 \times Ib + a \times Ic\right) \geq (OCNEG\ Ope.Curt.)$$

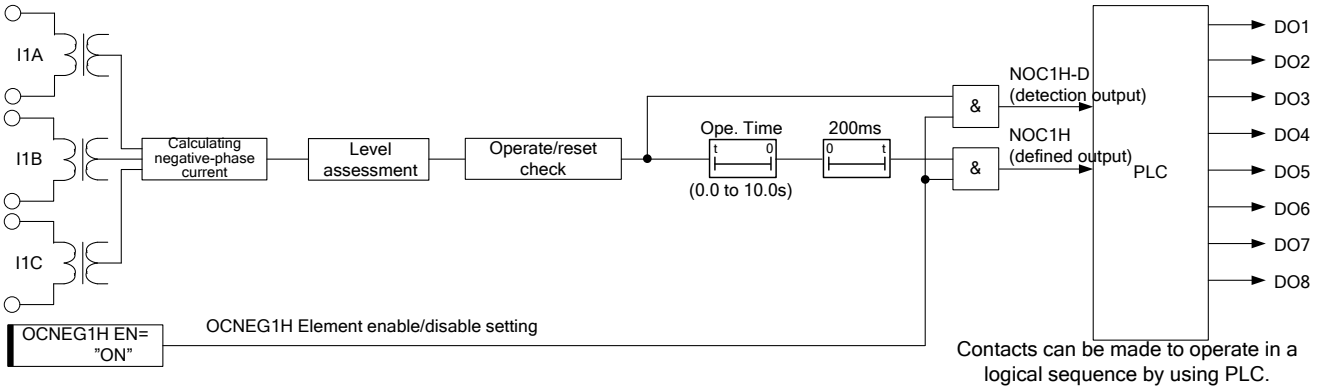


Fig. 3-33 OCNEG1H Element – internal function block diagram

Table 3-42 OCNEG1H Element – setting items

Display name	Setting parameter	Setting		Description
		Setting range	Step	
OCNEG1H	OCNEG1H EN	OFF, ON	-	OFF: disable, ON: enable OCNEG1H element is effective at ON.
	Ope. Curt.	0.25 - 5.00A	0.01A	Operating current Please input the triple negative-sequence current ($3I_2$) as this set value. The I_2 means a negative-sequence current.
	Ope. Time	0.0 - 10.0s	0.1s	Operating time (INST ≤ 50 ms)

3.5.2. OCNEG1L Element (Negative sequence overcurrent element)

This is a negative-sequence overcurrent instantaneous element on the low-voltage side of the transformer.

The OCNEG1L Element has the same characteristics as OCNEG1H Element.
For more information about the element's internal function block diagram, refer to Section3.5.1.

Table 3-43 OCNEG1L Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OCNEG1L	OCNEG1L EN	OFF, ON	-	OFF: disable, ON: enable OCNEG1L element is effective at ON.
	Ope. Curt.	0.25 - 5.00A	0.01A	Operating current Please input the triple negative-sequence current ($3I_2$) as this set value. The I_2 means a negative-sequence current.
	Ope. Time	0.0 - 10.0s	0.1s	Operating time (INST ≤ 50 ms)

3.5.3. OCNEG2H Element (Negative sequence overcurrent element)

This is a negative-sequence overcurrent instantaneous element for the current on the high-voltage side of the transformer.
The OCNEG2H Element has the same characteristics as the OCNEG1H Element.
For more information about the element's internal function block diagram, refer to Section 3.5.1.

Table 3-44 OCNEG2H Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OCNEG2H	OCNEG2H EN	OFF, ON	-	OFF: disable, ON: enable OCNEG2H element is effective at ON.
	Ope. Curt.	0.25 - 5.00A	0.01A	Operating current
	Ope. Time	0.0 - 10.0s	0.1s	Operating time (INST ≤ 50 ms)

3.5.4. OCNEG2L Element (Negative sequence overcurrent element)

This is a negative-sequence overcurrent instantaneous element for the current on the low-voltage side of the transformer.
OCNEG2L Element has the same characteristics as the OCNEG1H Element.
For more information about the element's internal function block diagram and how it works, see Section 3.5.1.

Table 3-45 OCNEG2L Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
OCNEG2L	OCNEG2L EN	OFF, ON	-	OFF: disable, ON: enable OCNEG2L element is effective at ON.
	Ope. Curt.	0.25 - 5.00A	0.01A	Operating current
	Ope. Time	0.0 - 10.0s	0.1s	Operating time (INST ≤ 50 ms)

3.6. CBF Function

The circuit breaker failure (CBF) elements for high-voltage side and low-voltage side are incorporated in the CAC1-A41D1.

Component number	Display name	Protective function
50BF	CBFH, CBFNH	HV-side CBF detecting element
	CBFL, CBFNL	LV-side CBF detecting element

3.6.1. CBFH Element

CBFH element is the CB failure detection element for using the current on the high-voltage side of the transformer.
The internal function block diagram is shown in Fig. 3-34.

CBFH Element outputs a detection signal after the lapse of an operation timer period (Ope. Time) if each phase or zero-phase current of the transformer's HV-side is greater than the operation setting value (CBFH Curt. and CBFNH Curt.) and a CB trip signal is received from the external relays.
In other words, when it receives the CB trip signal of other external relay(s) on the occurrence of a power network fault and the current continuous detection for more than a certain set time, it judges that there is a faulty condition in the breaker and outputs the CB failure signal. For the CB trip signal of other external relay(s), D/I (DI 8) terminal is assigned.

[Note] If an optional IEC61850 communication card is installed, it is possible to receive a CB trip signal from other relays via the GOOSE message on communication route. In this case, set a Goose receive setting so that the trip signal may be received by G_TRIP1, G_TRIP2, or G_TRIP3.
In addition, this element is effective only when its enable/disable setting (CBFH EN and CBFNH EN) is set ON. The setting of both CBFH EN and CBFNH EN to OFF prevent the unnecessary operation of the element.

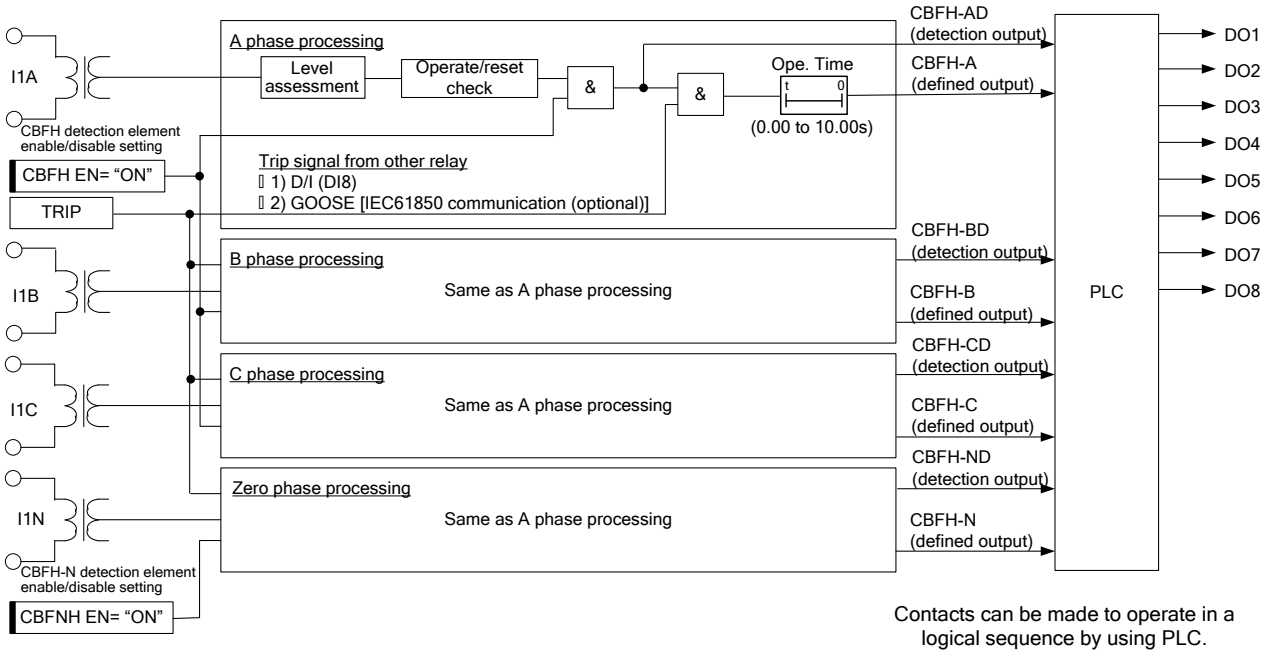


Fig. 3-34 CBFH Element – internal function block diagram

Table 3-46 CBFH Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
CBFH	CBFH EN	OFF, ON	-	OFF – disabled, ON – enabled CBFH element is effective at ON.
	CBFNH EN	OFF, ON	-	OFF: disable, ON: enable CBFNH element is effective at ON.
	CBFH Curt.	0.15 - 10.00A	0.01A	Operating time (for each phase)
	CBFNH Curt.	0.15 - 10.00A	0.01A	Operating time (for zero phase)
	Ope. Time	0.00 - 10.00s	0.01s	Operating time (INST ≤ 30 ms)

3.6.2. CBFL Element

CBFL element is the CB failure detection element using the current on the low-voltage side of the transformer. The internal function block diagram is shown in Fig. 3-35.

CBFL Element outputs a detection signal after the lapse of an operation timer period (Ope. Time) if each phase or zero-phase current of the transformer's HV-side is greater than the operation setting value (CBFL Curt. and CBFNL Curt.) and a CB trip signal is received from the external relays.

In other words, when it receives the CB trip signal of other external relay(s) on the occurrence of a power network fault and the current continuous detection for more than a certain set time, it judges that there is a faulty condition in the breaker and outputs the CB failure signal. For the CB trip signal of other external relay(s), D/I (DI 7) terminal is assigned.

[Note] If an optional IEC61850 communication card is installed, it is possible to receive a CB trip signal from other relays via the GOOSE message on communication route. In this case, set a Goose receive setting so that the trip signal may be received by G_TRIP1, G_TRIP2, or G_TRIP3.
In addition, this element is effective only when its enable/disable setting (CBFL EN and CBFNL EN) is set ON. The setting of both CBFL EN and CBFNL EN to OFF prevent the unnecessary operation of the element.

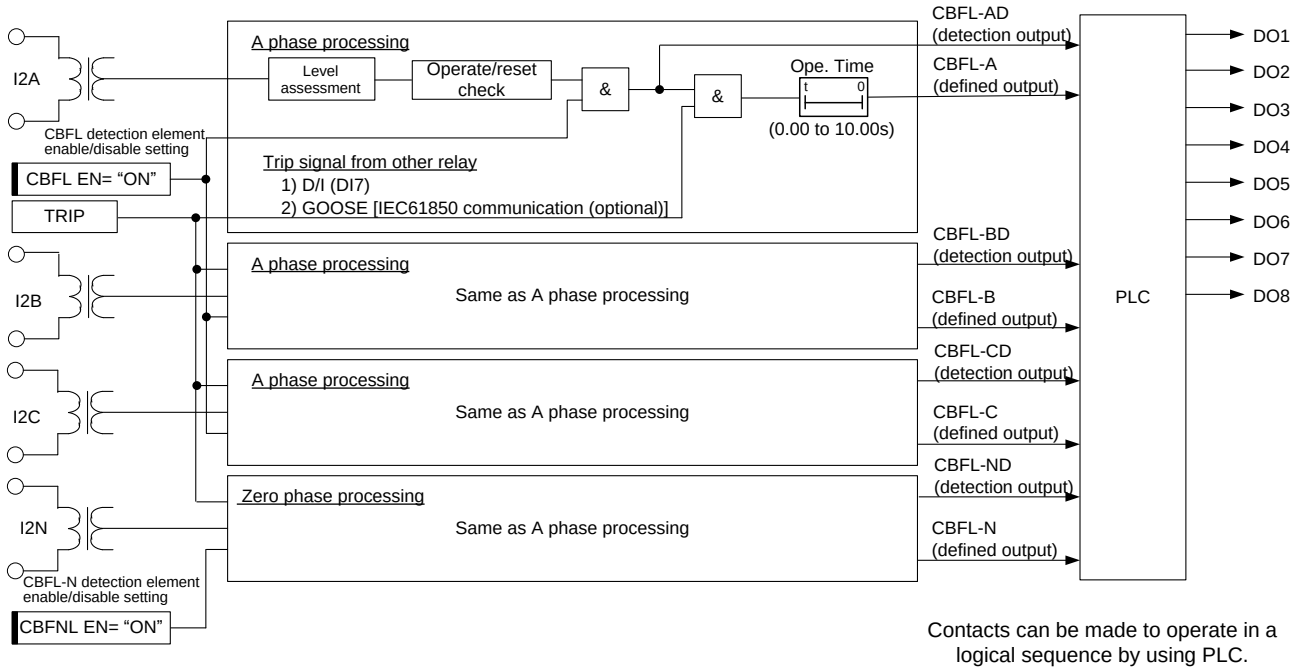


Fig. 3-35 CBFL Element – internal function block diagram

Table 3-47 CBFL Element – setting items

Display name	Setting name	Setting		Description
		Setting range	Step	
CBFL	CBFL EN	OFF, ON	-	OFF – disabled, ON – enabled CBFL element is effective at ON.
	CBFNL EN	OFF, ON	-	OFF: disable, ON: enable CBFNL element is effective at ON.
	CBFL Curt.	0.15 - 10.00A	0.01A	Operating time (for each phase)
	CBFNL Curt.	0.15 - 10.00A	0.01A	Operating time (for zero phase)
	Ope. Time	0.00 - 10.00s	0.01s	Operating time (INST ≤ 30 ms)

4. Human machine interface

There are two ways to set and operate the relay:
(1) Operation from the front panel
(2) Operation from a locally connected PC

This chapter describes about “(1) Operation from the front panel” by pushbuttons and the indication display. The operation method (2) will be described in Chapter **11**.

4.1. Pushbutton switches and indication display

This section describes the pushbutton switches and indication display on the front panel by using Fig. 4-1 and Table 4-1.

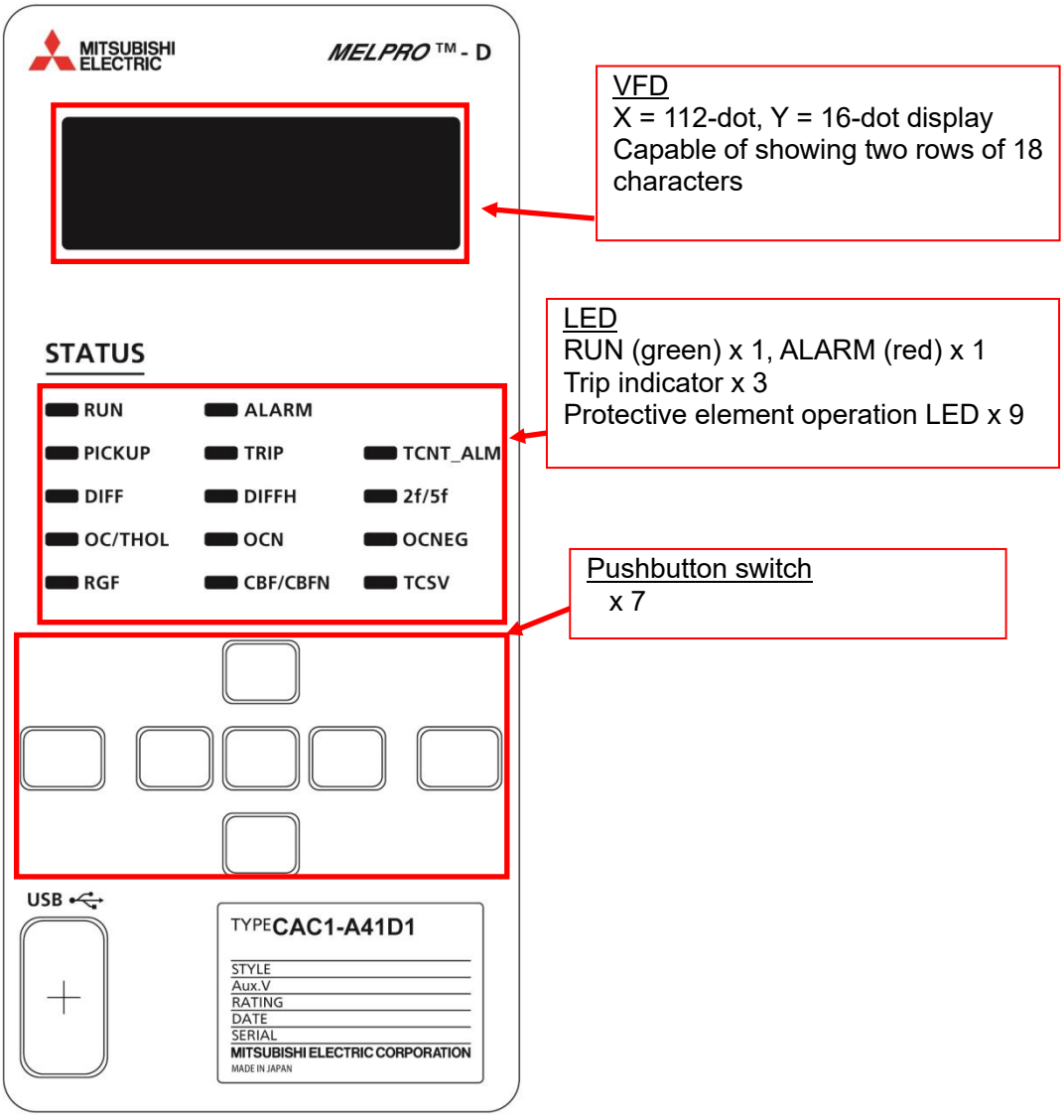


Fig. 4-1 Front panel section description

Table 4-1 Front panel section description

Name			Description
VFD			Shows various menus of the DISPLAY/SETTING mode.
LED	RUN	Green	Shows the result of constant supervision. Illuminated for a normal condition.
	ALARM	Red	Shows the result of constant supervision. Illuminated for an abnormal condition.
	PICKUP	Yellow	Illuminated for detection of PICKUP (OR of all elements).
	TRIP	Red	Illuminated for detection of TRIP (OR of all elements).
	TCNT_ALM	Red	Illuminated for activation of trip counter ALARM.
	DIFF	Red	Illuminated for activation of DIFF.
	DIFFH	Red	Illuminated for activation of DIFFH.
	2f/5f	Red	Illuminated for activation of 2f/5f.
	OC/THOL	Red	Illuminated for activation of OC/THOL.
	OCN	Red	Illuminated for activation of OCN.
	OCNEG	Red	Illuminated for activation of OCNEG.
	RGF	Red	Illuminated for activation of RGF.
	CBF/CBFG	Red	Illuminated for activation of CBF/CBFG.
	-	-	-
Pushbutton switch	SELECT		• Moves to lower level menu • Confirms selection of input item • Confirms input value • Reconfirms after pressing ENTER in SETTING mode
	ENTER		• Starts operation in SETTING mode
	ESC/C		• Turns off VFD • Turns off operation indicator LEDs by holding down (for 3s or longer)
	◀		• Moves to the menu one level higher • Moves to digit on the left in the value input screen • Discards the input value in the input screen and moves to the menu one level higher
	▶		• Moves to digit on the right in the value input screen
	▲ ▼		• Moves to the menu above/below • Increments/decrements the input value in the value input screen

4.2. List of menus

The operation mode includes the DISPLAY and SETTING modes, which respectively have different menus available.
Table 4-2 lists the menus available in the respective modes.

Table 4-2 List of menus

○: DISPLAY only ⊙: DISPLAY and SETTING -: Not shown

Menu		Operation mode	
		DISPLAY	SETTING
RECORD (RECORD)	Fault record (FAULT RECORD)	○	-
	Event record (EVENT RECORD)	○	-
	Access record (ACCESS RECORD)	○	-
	Alarm record (ALARM RECORD)	○	-
Clear record (CLEAR RECORD)	Clear fault record (FAULT REC CLEAR)	-	⊙
	Clear event record (EVENT REC CLEAR)	-	⊙
	Clear alarm record (ALARM REC CLEAR)	-	⊙
Status (STATUS)	Clock (CLOCK)	○	-
	Measured value (METERING)	○	-
	DI/DO status (DIGITAL I/O)	○	-
	Trip counter (TRIP COUNTER)	○	-
	Device name (DEVICE NAME)	○	-
Setting (SETTING)	Active group (ACTIVE WG)	○	⊙
	Group 1 setting (G1)	○	⊙
	Group 2 setting (G2)	○	⊙
Control (CONTROL)	Control mode (CTRL MODE)	○	⊙
	Circuit breaker control (CB CONTROL)	-	⊙
Configuration (CONFIG)	Communication setting (COMMUNICATION)	○	⊙
	Clock adjustment (CLOCK ADJUST)	-	⊙
	Measured analog value (METERING)	○	⊙
	Electric energy (ENERGY)	○	⊙
	Trip counter (TRIP COUNTER)	○	⊙
	Disturbance record (DISTURBANCE)	○	⊙
	DI detection voltage value (DI VOLTAGE)	○	⊙
	Password use/non-use (PASSWORD USE)	-	⊙
	Password registration (PASSWORD REGIST)	-	⊙
Test (TEST)	DO contact test (CONTACT TEST)	-	⊙
	Test mode (MODE)	-	⊙
	LED/VFD lighting test (LED/VFD TEST)	-	⊙

4.3. Operation method

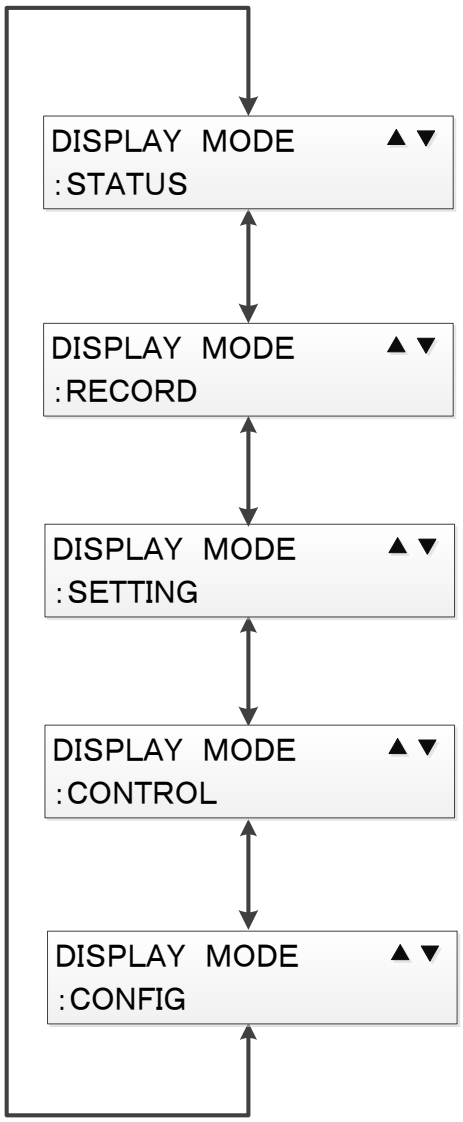
This section describes the operations for mode selection and various menus.

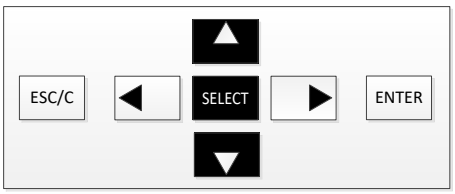
4.3.1. DISPLAY/SETTING mode selection

Press a key except for ESC/C when VFD is OFF to show the DISPLAY/SETTING mode selection screen.
The DISPLAY and SETTING modes offer different sets of menus available.
For the details about the menus available in the respective modes, see Table 4-2.

4.3.2. DISPLAY mode menu operations

This subsection describes the menu operations in the DISPLAY mode.
The menu screen has following selectable items. Use the Up and Down keys to select the item and press SELECT.
For the details about the menus available in the DISPLAY mode, see Table 4-2.

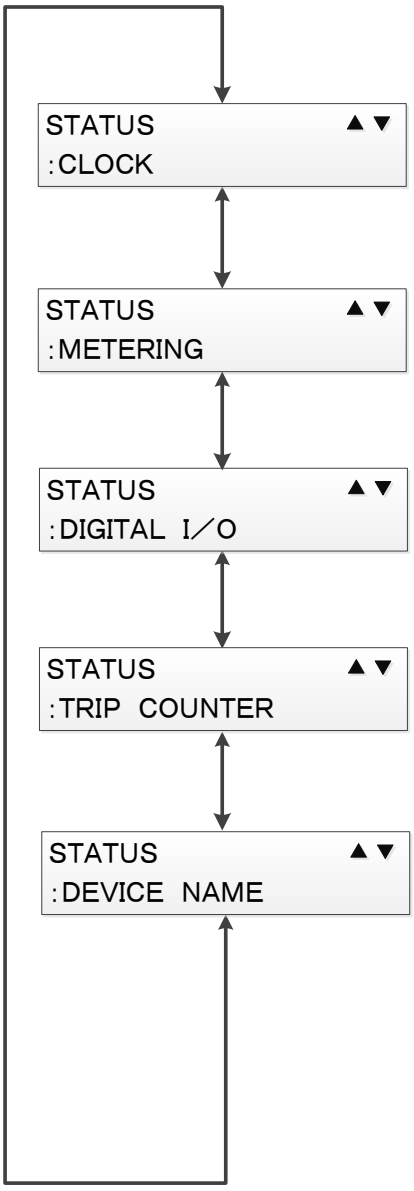


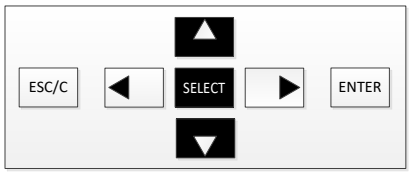


Use ▲ and ▼ to switch between items and press SELECT to select an item

4.3.2.1. Status (STATUS) menu

This subsection describes the Status (STATUS) menu.
The Status menu allows viewing of the current time, measured value, DI/DO status, trip counter and device name.





Use ▲ and ▼ to switch between items and press SELECT to select an item

4.3.2.1.1. Clock (CLOCK)

[Operation path] DISPLAY MODE > STATUS > CLOCK

The Show clock (CLOCK) menu allows viewing of the current time and synchronization type.

The text in the upper right part of the screen indicates the synchronization type for the time shown. (Part showing “LOCAL” in figure above)

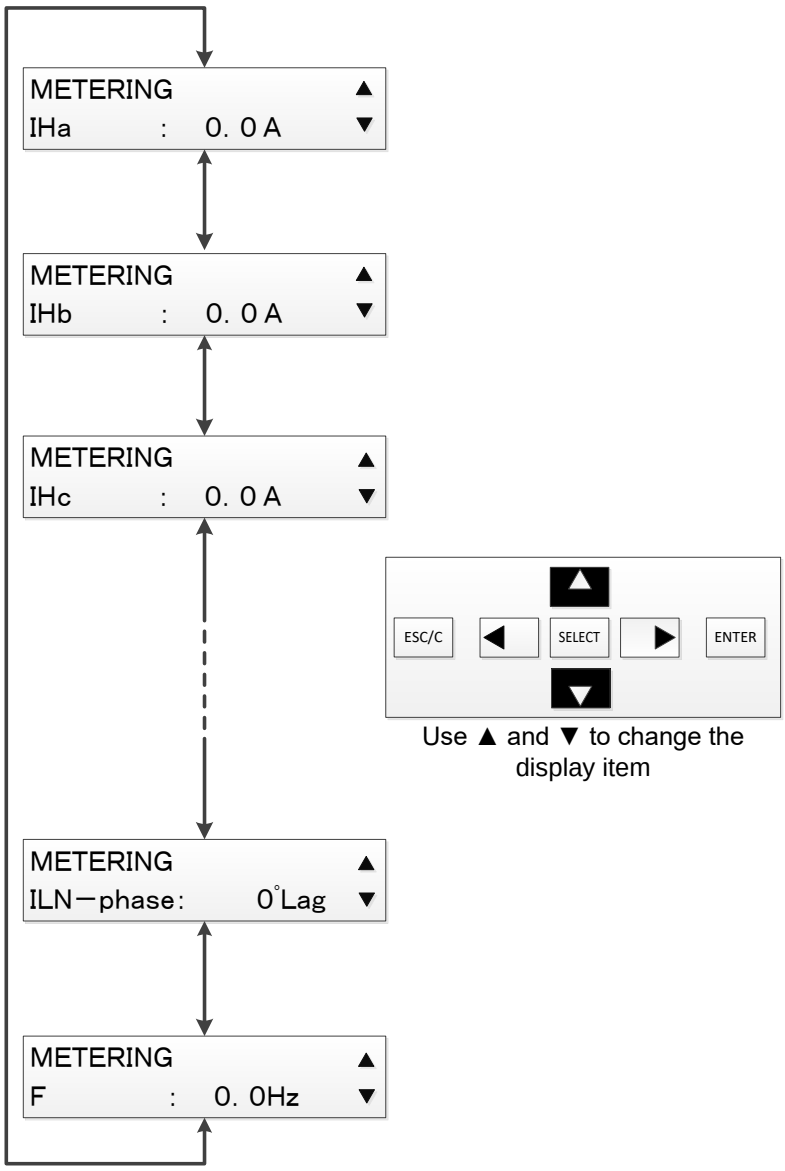
Table 4-3 Clock synchronization type indication

Synchronization type	Description
SNTP	Synchronizing with SNTP
DI	Synchronizing with the synchronization request signal from DI
ERR	When RTC (real time clock) error reached at maximum time, the time management is disabled.
GPS	Synchronizing with IRIG-B
LOCAL	Relay’s internal clock

4.3.2.1.2. Measured value (METERING) menu

[Operation path] DISPLAY MODE > STATUS > METERING

The Measured value (METERING) menu allows viewing of the current measured value.
The Configuration menu can specify the measured value of the primary or secondary value of CT.
For the setting procedure, see sub-clause **4.3.4.3.3**.



The list of measuring vales is shown in Table 4-4.

Table 4-4 Measured value display items (for 5 A type)

No.	Signal name	Range (primary/secondary)	remarks
1	IHa	0 ~ 60 000 A / 0.00 ~ 10.00 A	—
2	IHb	0 ~ 60 000 A / 0.00 ~ 10.00 A	—
3	IHc	0 ~ 60 000 A / 0.00 ~ 10.00 A	—
4	IHN	0 ~ 60 000 A / 0.00 ~ 10.00 A	—
5	ILa	0 ~ 60 000 A / 0.00 ~ 10.00 A	—
6	ILb	0 ~ 60 000 A / 0.00 ~ 10.00 A	—
7	ILc	0 ~ 60 000 A / 0.00 ~ 10.00 A	—
8	ILN	0 ~ 60 000 A / 0.00 ~ 10.00 A	—
9	3IH0	0 ~ 60 000 A / 0.00 ~ 10.00 A	—
10	IH1	0 ~ 60 000 A / 0.00 ~ 10.00 A	—
11	IH2	0 ~ 60 000 A / 0.00 ~ 10.00 A	—
12	3IL0	0 ~ 60 000 A / 0.00 ~ 10.00 A	—
13	IL1	0 ~ 60 000 A / 0.00 ~ 10.00 A	—
14	IL2	0 ~ 60 000 A / 0.00 ~ 10.00 A	—
15	Ida	0 ~ 20 000% / 0 ~ 20 000%	In this item, 100% means relay rated current / matching tap. (e.g. 5A / ITH or 5A / ITL)
16	Idb	0 ~ 20 000% / 0 ~ 20 000%	Ditto
17	Idc	0 ~ 20 000% / 0 ~ 20 000%	Ditto
18	IHdN	0 ~ 20 000% / 0 ~ 20 000%	Ditto
19	ILdN	0 ~ 20 000% / 0 ~ 20 000%	Ditto

No.	Signal name	Range (primary/secondary)	remarks
20	IHa-ph	0.0 ~ 359.9° / 0.0 ~ 359.9°	—
21	IHb-ph	0.0 ~ 359.9° / 0.0 ~ 359.9°	—
22	IHc-ph	0.0 ~ 359.9° / 0.0 ~ 359.9°	—
23	IHN-ph	0.0 ~ 359.9° / 0.0 ~ 359.9°	—
24	ILa-ph	0.0 ~ 359.9° / 0.0 ~ 359.9°	—
25	ILb-ph	0.0 ~ 359.9° / 0.0 ~ 359.9°	—
26	ILc-ph	0.0 ~ 359.9° / 0.0 ~ 359.9°	—
27	ILN-ph	0.0 ~ 359.9° / 0.0 ~ 359.9°	—

4.3.2.1.3. DI/DO status (DIGITAL I/O) menu

[Operation path] DISPLAY MODE > STATUS > DIGITAL I/O

The Show DI/DO status (DIGITAL I/O) menu allows viewing of the current DI/DO.
The following describes the operation procedure for showing DI/DO.

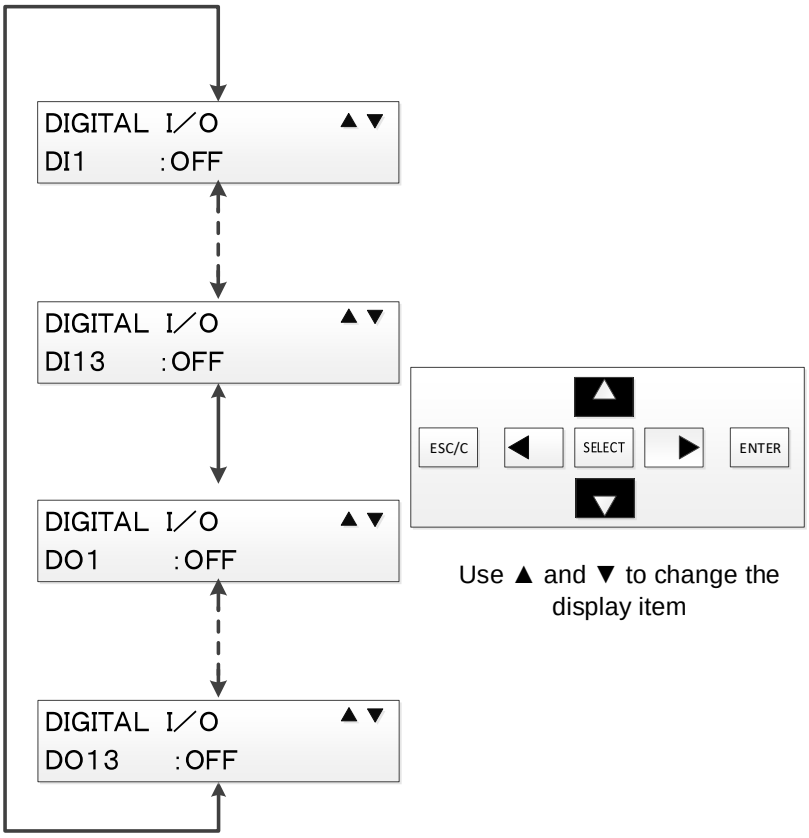


Table 4-5 Show DI/DO status Display items

No.	Signal name	No.	Signal name
1	DI1	14	DO1
2	DI2	15	DO2
3	DI3	16	DO3
4	DI4	17	DO4
5	DI5	18	DO5
6	DI6	19	DO6
7	DI7	20	DO7
8	DI8	21	DO8
9	DI9	22	DO9
10	DI10	23	DO10
11	DI11	24	DO11
12	DI12	25	DO12
13	DI13	26	DO13

4.3.2.1.4. Trip counter (TRIP COUNTER) menu

[Operation path] DISPLAY MODE > STATUS > TRIP COUNTER

The Trip counter (TRIP COUNTER) menu allows viewing of the number of trips.

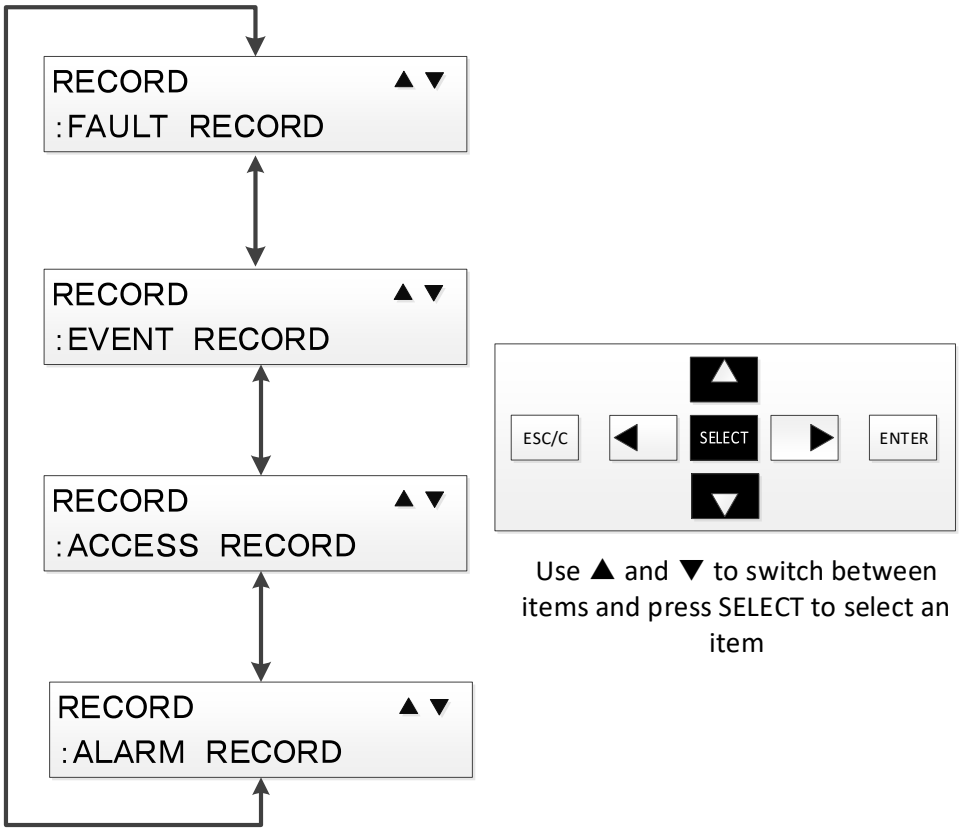
4.3.2.1.5. Device name (DEVICE NAME) menu

[Operation path] DISPLAY MODE > STATUS > DEVICE NAME

The Device name (DEVICE NAME) menu allows viewing of the device name.

4.3.2.2. Record (RECORD) menu

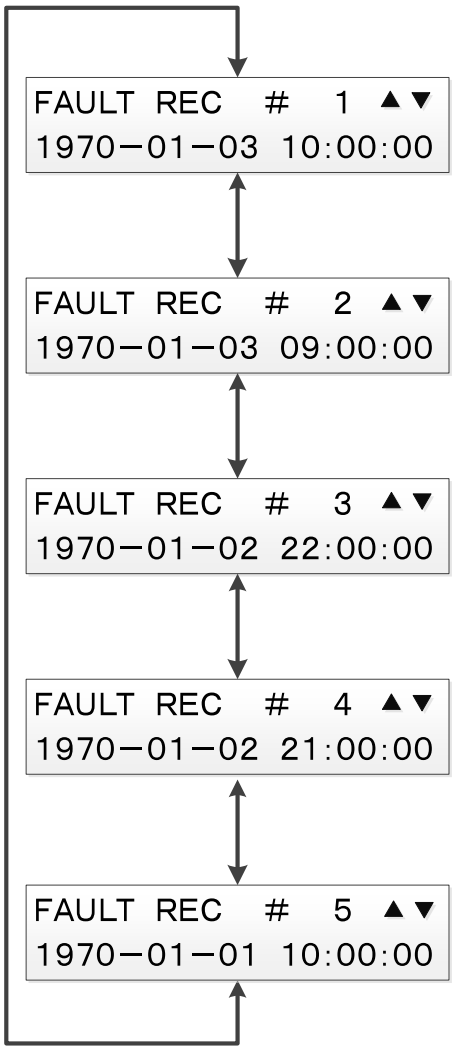
This subsection describes the operation logs in for the Record (RECORD) menu.
The Record menu allows viewing four types of log data.
(Fault record, event record, access record and alarm record)

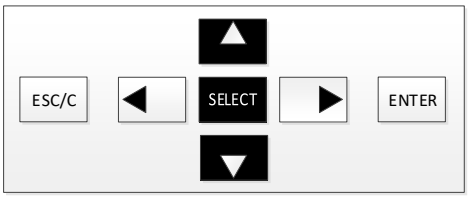


4.3.2.2.1. Fault record (FAULT RECORD) menu

[Operation path] DISPLAY MODE > RECORD > FAULT RECORD

The Fault record (FAULT RECORD) menu allows viewing of the time, operating values and operating elements when the fault is detected. Fault records of up to five phenomena are stored and the respective fault record can be viewed. For selecting record for display, use the Up and Down keys to select the date of the fault record and press SELECT.





Use ▲ and ▼ to switch between items and press SELECT to select an item

After a fault record is selected, use the Up and Down keys to view the trip factors and measured values.

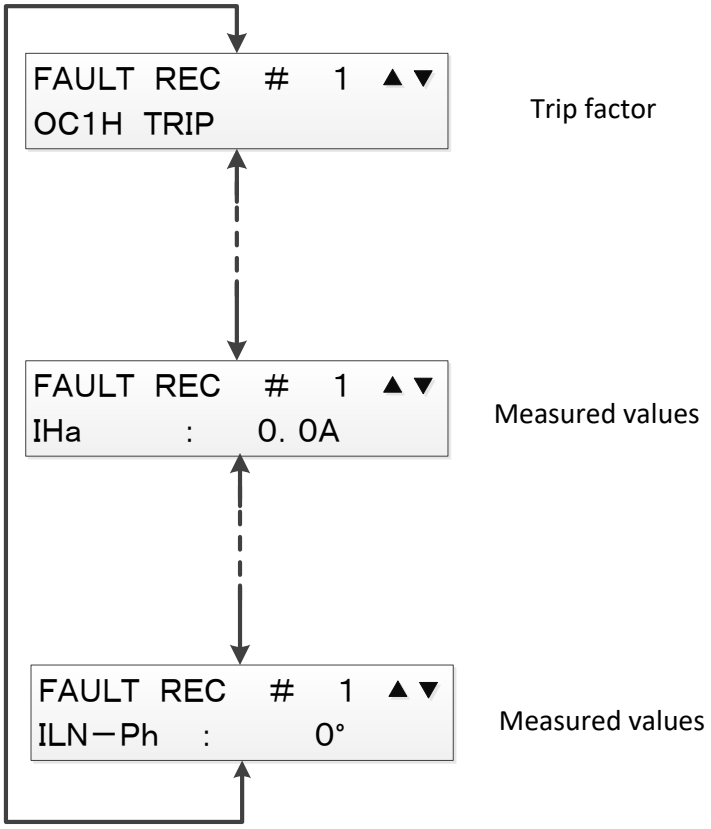


Table 4-6 Fault record trip factors

Element name displayed	Element name displayed
DIFF Trip	OC4H Trip
DIFFH Trip	OCN4H Trip
RGFH Trip	OC4L Trip
RGFL Trip	OCN4L Trip
OC1H Trip	THOLH Trip
OCN1H Trip	THOLL Trip
OC1L Trip	OCNEG1H Trip
OCN1L Trip	OCNEG1L Trip
OC2H Trip	OCNEG2H Trip
OCN2H Trip	OCNEG2L Trip
OC2L Trip	CBFH Trip
OCN2L Trip	CBFNH Trip
OC3H Trip	CBFL Trip
OCN3H Trip	CBFNL Trip
OC3L Trip	
OCN3L Trip	

Table 4-7 Fault record measured values displayed

No.	Item	Range (primary only)	No.	Signal name	Range (primary only)
1	IHa	0 ~ 60 000 A	15	Ida	0 ~ 20 000%
2	IHb	0 ~ 60 000 A	16	Idb	0 ~ 20 000%
3	IHc	0 ~ 60 000 A	17	Idc	0 ~ 20 000%
4	IHN	0 ~ 60 000 A	18	IHdN	0 ~ 20 000%
5	ILa	0 ~ 60 000 A	19	ILdN	0 ~ 20 000%
6	ILb	0 ~ 60 000 A	20	IHa-ph	0.0 ~ 359.9°
7	ILc	0 ~ 60 000 A	21	IHb-ph	0.0 ~ 359.9°
8	ILN	0 ~ 60 000 A	22	IHc-ph	0.0 ~ 359.9°
9	3IH0	0 ~ 60 000 A	23	IHN-ph	0.0 ~ 359.9°
10	IH1	0 ~ 60 000 A	24	ILa-ph	0.0 ~ 359.9°
11	IH2	0 ~ 60 000 A	25	ILb-ph	0.0 ~ 359.9°
12	3IL0	0 ~ 60 000 A	26	ILc-ph	0.0 ~ 359.9°
13	IL1	0 ~ 60 000 A	27	ILN-ph	0.0 ~ 359.9°
14	IL2	0 ~ 60 000 A			

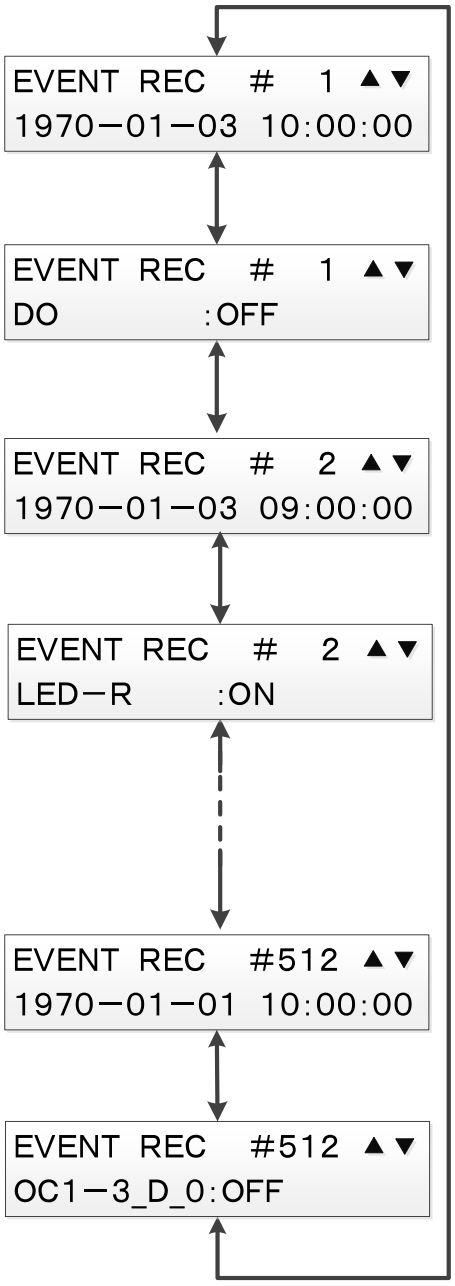
4.3.2.2.2. Event record (EVENT RECORD) menu

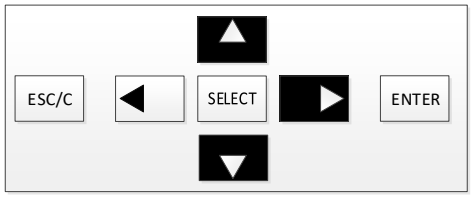
[Operation path] DISPLAY MODE > RECORD > EVENT RECORD

The Event records (EVENT RECORD) menu allows viewing of event records saved.
Event records of up to 512 events are stored and the respective event record can be viewed.
Press the Up and Down keys to switch the indication on the screen as below.

Date of occurrence > Record description > Date of occurrence...

Press the Right key to display from the current event record to the past 10th record.





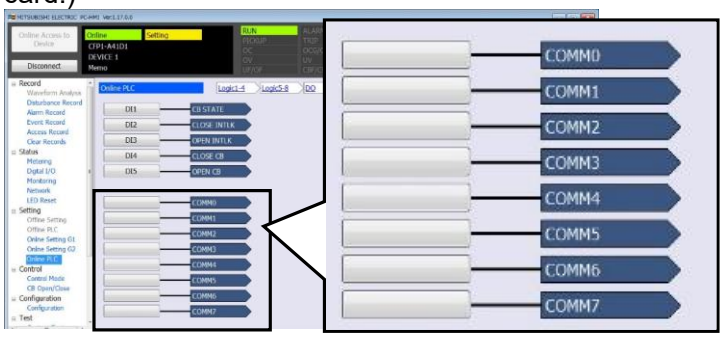
Use ▲ and ▼ to change the display item
Use ▸ to move from the record currently shown to the date of the tenth record into past

Table 4-8 Event record List of events

No.	Signal name	Description
1	DI1	Status of DI1 (This signal is available only in the relay unit with a DI card in SLOT-C.)
2	DI2	Status of DI2 (This signal is available only in the relay unit with a DI card in SLOT-C.)
3	DI3	Status of DI3 (This signal is available only in the relay unit with a DI card in SLOT-C.)
4	DI4	Status of DI4 (This signal is available only in the relay unit with a DI card in SLOT-C.)
5	DI5	Status of DI5 (This signal is available only in the relay unit with a DI card in SLOT-C.)
6	DI6	Status of DI6 (This signal is available only in the relay unit with a DI card in SLOT-C.)
7	DI7	Status of DI7 (This signal is available only in the relay unit with a DI card in SLOT-C.)
8	DI8	Status of DI8 (This signal is available only in the relay unit with a DI card in SLOT-C.)
9	DO1	Status of DO1
10	DO2	Status of DO2
11	DO3	Status of DO3
12	DO4	Status of DO4
13	DO5	Status of DO5
14	DO6	Status of DO6
15	DO7	Status of DO7
16	DO8	Status of DO8
17	TCNT_ALM	Alarm of trip counter
18	DIFSV-A	Definitive signal of supervision of differential current element. More detail, please refer to sub-clause 3.1, ‘Differential current element (87)’.
19	DIFSV-B	Definitive signal of supervision of differential current element. More detail, please refer to sub-clause 3.1, ‘Differential current element (87)’.
20	DIFSV-C	Definitive signal of supervision of differential current element. More detail, please refer to sub-clause 3.1, ‘Differential current element (87)’.
21	CBa1	Status of circuit breaker
22	INT_LK_OP	OPEN signal of INTERLOCK
23	INT_LK_CL	CLOSE signal of INTERLOCK
24	CTL_OP_OK	Condition signal for CB open control. This signal is ON when all conditions are met to control the CB.
25	CTL_CL_OK	Condition signal for CB close control. This signal is ON when all conditions are met to control the CB.
26	CB_CTL_OK	Confirmation signal of CB operation success.
27	CB_CTL_NG	Confirmation signal of CB operation failure.
28	OP_TS	CB open control via local operation.
29	CL_TS	CB close control via local operation.
30	MANU_CLS	Operation signal to close a circuit breaker (This signal is available only in the relay unit with a DI card in SLOT-C.)
31	MANU_OPN	Operation signal to open a circuit breaker (This signal is available only in the relay unit with a DI card in SLOT-C.)
32	CB_LR	CB operating authority status signal. (Local / Remote) The “CB_LR” = ON means that Local control is authorized.
33	CTL_BLOP1	Setting condition signal (Use/Non-use) for blocking CB open status. The “CTL_BLOP1” = ON (=Use) means that the CB open operations is blocked. (This signal is available only in the relay unit with IEC 61850 communication card.)

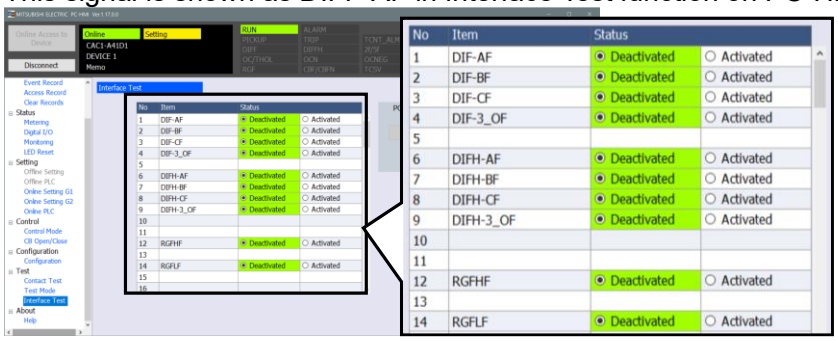
No.	Signal name	Description
34	CTL_BLCL1	Setting condition signal (Use/Non-use) for blocking CB close status. The “CTL_BLCL1” = ON (=Use) means that the CB close operations is blocked. (This signal is available only in the relay unit with IEC 61850 communication card.)
35	43INT_FLG	Setting condition signal (Use/Non-use) for CB control interlock. (This signal is available only in the relay unit with IEC 61850 communication card.)
36	VL4000000	Operation failure or setting failure status signal. This “VL4000000” signal = ON when any following conditions. ・ The interlock condition doesn't meet. ・ The CB control doesn't be authorized. ・ The CB control direction is same as current condition. (This signal is available only in the relay unit with IEC 61850 communication card.)
37	RES_STS00	Confirmation signal of CB operation success. This “RES_STS00” signal is same as “CB_CTL_OK” signal. (This signal is available only in the relay unit with IEC 61850 communication card.)
38	RES_STS02	Status signal of CB operation failure and cause. This “RES_STS02” signal is ON when any following conditions. ・ The CB control doesn't be authorized. ・ The CB control blocking conditions are met. (This signal is available only in the relay unit with IEC 61850 communication card.)
39	RES_STS05	Status signal of CB operation failure and cause. This “RES_STS05” signal is ON when following condition. ・ The CB control direction is same as current condition. (This signal is available only in the relay unit with IEC 61850 communication card.)
40	RES_STS0A	Status signal of CB operation failure and cause. This “RES_STS0A” signal is ON when following condition. ・ The interlock condition doesn't meet. (This signal is available only in the relay unit with IEC 61850 communication card.)
41	RES_STS10	Status signal of CB operation failure and cause. This “RES_STS10” signal is ON when following condition. ・ The time passes over the timeout setting value (10 sec). (This signal is available only in the relay unit with IEC 61850 communication card.)
42	CL_DI	CB close operation signal. This signal express the condition of “CLOSE CB” on PC-HMI.  Fig. 4-2 CB control signal description on PC-HMI and internal signal name.
43	OP_DI	CB open operation signal. This signal express the condition of “OPEN CB” on PC-HMI. Please refer to Fig. 4-2.

No.	Signal name	Description
44	P_INT_LK1	CB close interlock signal. This signal express the condition of “CLOSE INTLK” on PC-HMI. Please refer to Fig. 4-2.
45	P_INT_LK2	CB open interlock signal. This signal express the condition of “OPEN INTLK” on PC-HMI. Please refer to Fig. 4-2.
46	CB_DI_CTL	Real-time DI status signal for CB control. The “CB_DI_CTL” = ON when the “CL_DI” =ON or the “OP_DI” =ON. The relationship between CB_DI_CTL, CL_DI and OP_DI is following. CB_DI_CTL = OR(CL_DI, OP_DI)
47	RGFH-D	Detection signal of zero sequence differential current (87TN) element (High winding side)
48	RGFL-D	Detection signal of zero sequence differential current (87TN) element (Low winding side)
49	OC1H-ND	Detection signal of 1st stage instantaneous overcurrent (50) element on zero sequence current (High winding side)
50	OC1L-ND	Detection signal of 1st stage instantaneous overcurrent (50) element on zero sequence current (Low winding side)
51	OC2H-ND	Detection signal of 2nd stage instantaneous overcurrent (50) element on zero sequence current (High winding side)
52	OC2L-ND	Detection signal of 2nd stage instantaneous overcurrent (50) element on zero sequence current (Low winding side)
53	OC3H-ND	Detection signal of 3rd stage instantaneous overcurrent (50) element on zero sequence current (High winding side)
54	OC3L-ND	Detection signal of 3rd instantaneous overcurrent (50) element on zero sequence current (Low winding side)
55	OC4H-ND	Detection signal of definite time or IDMT overcurrent (51) element on zero sequence current (High winding side)
56	OC4L-ND	Detection signal of definite time or IDMT overcurrent (51) element on zero sequence current (Low winding side)
57	THOLH-D	Detection signal of overload (49) element (High winding side)
58	THOLL-D	Detection signal of overload (49) element (Low winding side)
59	NOC1H-D	Detection signal of 1st stage negative sequence overcurrent (46) element (High winding side)
60	NOC1L-D	Detection signal of 1st stage negative sequence overcurrent (46) element (Low winding side)
61	NOC2H-D	Detection signal of 2nd stage negative sequence overcurrent (46) element (High winding side)
62	NOC2L-D	Detection signal of 2nd stage negative sequence overcurrent (46) element (Low winding side)
63	CBFH-ND	Detection signal of overcurrent element for the detection of CBF (50BF) on zero sequence current (High winding side) (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
64	CBFL-ND	Detection signal of overcurrent element for the detection of CBF (50BF) on zero sequence current (Low winding side) (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
65	ALARM	Abnormal condition of constant supervision (heavy alarm)
66	ALARM-L	Abnormal condition of constant supervision (light alarm)
67	RY-LOCK	Locking of relay
68	SV-LK	The operation lock signal for monitoring function such as a DIFSV function. The ON/OFF of this signal is changed via TEST mode.
69	TCNT-LK	The operation lock signal for a trip counter function (TCNT). The ON/OFF of this signal is changed via TEST mode.
70	THOL-T	Testing of THOL (49) element.

No.	Signal name	Description
71	COMM0	Assignment to IEC 61850 transmitted signals. This “COMM0” signal is assigned Ind1 of GGIO4 in IEC 61850 model. (This signal is available only in the relay unit with IEC 61850 communication card.)  Fig. 4-3 COMM signal description on PC-HMI.
72	COMM1	Assignment to IEC 61850 transmitted signals. This “COMM1” signal is assigned Ind2 of GGIO4 in IEC 61850 model. (This signal is available only in the relay unit with IEC 61850 communication card.) Please refer to Fig. 4-3.
73	COMM2	Assignment to IEC 61850 transmitted signals. This “COMM2” signal is assigned Ind3 of GGIO4 in IEC 61850 model. (This signal is available only in the relay unit with IEC 61850 communication card.) Please refer to Fig. 4-3.
74	COMM3	Assignment to IEC 61850 transmitted signals. This “COMM3” signal is assigned Ind4 of GGIO4 in IEC 61850 model. (This signal is available only in the relay unit with IEC 61850 communication card.) Please refer to Fig. 4-3.
75	COMM4	Assignment to IEC 61850 transmitted signals. This “COMM4” signal is assigned Ind5 of GGIO4 in IEC 61850 model. (This signal is available only in the relay unit with IEC 61850 communication card.) Please refer to Fig. 4-3.
76	COMM5	Assignment to IEC 61850 transmitted signals. This “COMM5” signal is assigned Ind6 of GGIO4 in IEC 61850 model. (This signal is available only in the relay unit with IEC 61850 communication card.) Please refer to Fig. 4-3.
77	COMM6	Assignment to IEC 61850 transmitted signals. This “COMM6” signal is assigned Ind7 of GGIO4 in IEC 61850 model. (This signal is available only in the relay unit with IEC 61850 communication card.) Please refer to Fig. 4-3.
78	COMM7	Assignment to IEC 61850 transmitted signals. This “COMM7” signal is assigned Ind8 of GGIO4 in IEC 61850 model. (This signal is available only in the relay unit with IEC 61850 communication card.) Please refer to Fig. 4-3.
79	DIF-3D_O	Detection signal of any DIFF of A, B, and C phase
80	DIFH-3D_O	Detection signal of any DIFFH of A, B, and C phase

No.	Signal name	Description
81	OC1H-3D_O	Detection signal of any OC1H of A, B, and C phase
82	OC1L-3D_O	Detection signal of any OC1L of A, B, and C phase
83	OC2H-3D_O	Detection signal of any OC2H of A, B, and C phase
84	OC2L-3D_O	Detection signal of any OC2L of A, B, and C phase
85	OC3H-3D_O	Detection signal of any OC3H of A, B, and C phase
86	OC3L-3D_O	Detection signal of any OC3L of A, B, and C phase
87	OC4H-3D_O	Detection signal of any OC4H of A, B, and C phase
88	OC4L-3D_O	Detection signal of any OC4L of A, B, and C phase
89	CBFH-3D_O	Detection signal of any CBFH of A, B, and C phase
90	CBFL-3D_O	Detection signal of any CBFL of A, B, and C phase
91	DF2f-3D_O	Detection signal of any DIFF2f of A, B, and C phase
92	DF5f-3D_O	Detection signal of any DIFF5f of A, B, and C phase
93	C2fH-3D_O	Detection signal of any OC2fH of A, B, and C phase
94	C2fL-3D_O	Detection signal of any OC2fL of A, B, and C phase
95	DFSV-3D_O	Detection signal of any DIFFSV of A, B, and C phase
96	DFSV-3_O	Definitive signal of any DIFFSV of A, B, and C phase
97	ALLEL-O	Definitive signal of any of all elements. (OR of all definitive signals)
98	DS_TRIG	Operating status signal of the disturbance recorder (data save function) –which is also called a data save function. While this "DS_TRIG" signal is ON, the waveform data and binary data are captured and saved.
99	GOOSE1	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
100	GOOSE2	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
101	GOOSE3	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
102	GOOSE4	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
103	GOOSE5	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
104	GOOSE6	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
105	GOOSE7	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
106	GOOSE8	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
107	GOOSE9	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
108	GOOSE10	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)

No.	Signal name	Description
109	GOOSE11	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
110	GOOSE12	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
111	GOOSE13	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
112	GOOSE14	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
113	GOOSE15	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
114	GOOSE16	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
115	GOOSE17	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
116	GOOSE18	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
117	GOOSE19	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
118	GOOSE20	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
119	GOOSE21	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
120	GOOSE22	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
121	GOOSE23	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
122	GOOSE24	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
123	GOOSE25	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
124	GOOSE26	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
125	GOOSE27	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
126	GOOSE28	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
127	GOOSE29	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
128	GOOSE30	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)

No.	Signal name	Description
129	GOOSE31	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
130	GOOSE32	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
131	GOOSE33	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
132	GOOSE34	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
133	GOOSE35	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
134	GOOSE36	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
135	GOOSE37	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
136	G_TRIP1	Operating condition of CBF/CBFN element (Trip signal from other relay) (This signal is available only in the relay unit with IEC61850 communication card.)
137	G_TRIP2	Operating condition of CBF/CBFN element (Trip signal from other relay) (This signal is available only in the relay unit with IEC61850 communication card.)
138	G_TRIP3	Operating condition of CBF/CBFN element (Trip signal from other relay) (This signal is available only in the relay unit with IEC61850 communication card.)
139	DIF-A	Definitive signal of DIFF A-phase or forced operation from PC-HMI. This signal is shown as DIFF-AF in Interface Test function on PC-HMI.  Fig. 4-4 Signal description of the forced operation and interface test on PC-HMI.
140	DIF-B	Definitive signal of DIFF B-phase or forced operation from PC-HMI. This signal is shown as DIFF-BF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
141	DIF-C	Definitive signal of DIFF C-phase or forced operation from PC-HMI. This signal is shown as DIFF-CF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
142	DIF-3_O	Definitive signal of any DIFF of A, B, and C phase or forced operation from PC-HMI. This signal is shown as DIFF-3_OF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.

No.	Signal name	Description
143	DIFH-A	Definitive signal of DIFFH A-phase or forced operation from PC-HMI. This signal is shown as DIFFH-AF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
144	DIFH-B	Definitive signal of DIFFH B-phase or forced operation from PC-HMI. This signal is shown as DIFFH-BF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
145	DIFH-C	Definitive signal of DIFFH C-phase or forced operation from PC-HMI. This signal is shown as DIFFH-CF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
146	DIFH-3_O	Definitive signal of any DIFFH of A, B, and C phase or forced operation from PC-HMI. This signal is shown as DIFFH-3_OF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
147	RGFH	Definitive signal of RGFH or forced operation from PC-HMI. This signal is shown as RGFHF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
148	RGFL	Definitive signal of RGFL or forced operation from PC-HMI. This signal is shown as RGFLF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
149	OC1H-A	Definitive signal of OC1H A-phase or forced operation from PC-HMI. This signal is shown as OC1H-AF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
150	OC1H-B	Definitive signal of OC1H B-phase or forced operation from PC-HMI. This signal is shown as OC1H-BF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
151	OC1H-C	Definitive signal of OC1H C-phase or forced operation from PC-HMI. This signal is shown as OC1H-CF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
152	OC1H-3_O	Definitive signal of any OC1H of A, B, and C phase or forced operation from PC-HMI. This signal is shown as OC1H-3_OF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
153	OC1H-N	Definitive signal of OC1H zero-phase or forced operation from PC-HMI. This signal is shown as OC1H-NF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
154	OC1L-A	Definitive signal of OC1L A-phase or forced operation from PC-HMI. This signal is shown as OC1L-AF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
155	OC1L-B	Definitive signal of OC1L B-phase or forced operation from PC-HMI. This signal is shown as OC1L-BF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
156	OC1L-C	Definitive signal of OC1L C-phase or forced operation from PC-HMI. This signal is shown as OC1L-CF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.

No.	Signal name	Description
157	OC1L-3_O	Definitive signal of any OC1L of A, B, and C phase or forced operation from PC-HMI. This signal is shown as OC1L-3_OF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
158	OC1L-N	Definitive signal of OC1L zero-phase or forced operation from PC-HMI. This signal is shown as OC1L-NF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
159	OC2H-A	Definitive signal of OC2H A-phase or forced operation from PC-HMI. This signal is shown as OC2H-AF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
160	OC2H-B	Definitive signal of OC2H B-phase or forced operation from PC-HMI. This signal is shown as OC2H-BF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
161	OC2H-C	Definitive signal of OC2H C-phase or forced operation from PC-HMI. This signal is shown as OC2H-CF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
162	OC2H-3_O	Definitive signal of any OC2H of A, B, and C phase or forced operation from PC-HMI. This signal is shown as OC2H-3_OF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
163	OC2H-N	Definitive signal of OC2H zero-phase or forced operation from PC-HMI. This signal is shown as OC2H-NF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
164	OC2L-A	Definitive signal of OC2L A-phase or forced operation from PC-HMI. This signal is shown as OC2L-AF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
165	OC2L-B	Definitive signal of OC2L B-phase or forced operation from PC-HMI. This signal is shown as OC2L-BF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
166	OC2L-C	Definitive signal of OC2L C-phase or forced operation from PC-HMI. This signal is shown as OC2L-CF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
167	OC2L-3_O	Definitive signal of any OC2L of A, B, and C phase or forced operation from PC-HMI. This signal is shown as OC2L-3_OF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
168	OC2L-N	Definitive signal of OC2L zero-phase or forced operation from PC-HMI. This signal is shown as OC2L-NF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
169	OC3H-A	Definitive signal of OC3H A-phase or forced operation from PC-HMI. This signal is shown as OC3H-AF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
170	OC3H-B	Definitive signal of OC3H B-phase or forced operation from PC-HMI. This signal is shown as OC3H-BF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.

No.	Signal name	Description
171	OC3H-C	Definitive signal of OC3H C-phase or forced operation from PC-HMI. This signal is shown as OC3H-CF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
172	OC3H-3_O	Definitive signal of any OC3H of A, B, and C phase or forced operation from PC-HMI. This signal is shown as OC3H-3_OF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
173	OC3H-N	Definitive signal of OC3H zero-phase or forced operation from PC-HMI. This signal is shown as OC3H-NF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
174	OC3L-A	Definitive signal of OC3L A-phase or forced operation from PC-HMI. This signal is shown as OC3L-AF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
175	OC3L-B	Definitive signal of OC3L B-phase or forced operation from PC-HMI. This signal is shown as OC3L-BF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
176	OC3L-C	Definitive signal of OC3L C-phase or forced operation from PC-HMI. This signal is shown as OC3L-CF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
177	OC3L-3_O	Definitive signal of any OC3L of A, B, and C phase or forced operation from PC-HMI. This signal is shown as OC3L-3_OF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
178	OC3L-N	Definitive signal of OC3L zero-phase or forced operation from PC-HMI. This signal is shown as OC3L-NF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
179	OC4H-A	Definitive signal of OC4H A-phase or forced operation from PC-HMI. This signal is shown as OC4H-AF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
180	OC4H-B	Definitive signal of OC4H B-phase or forced operation from PC-HMI. This signal is shown as OC4H-BF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
181	OC4H-C	Definitive signal of OC4H C-phase or forced operation from PC-HMI. This signal is shown as OC4H-CF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
182	OC4H-3_O	Definitive signal of any OC4H of A, B, and C phase or forced operation from PC-HMI. This signal is shown as OC4H-3_OF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
183	OC4H-N	Definitive signal of OC4H zero-phase or forced operation from PC-HMI. This signal is shown as OC4H-NF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
184	OC4L-A	Definitive signal of OC4L A-phase or forced operation from PC-HMI. This signal is shown as OC4L-AF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.

No.	Signal name	Description
185	OC4L-B	Definitive signal of OC4L B-phase or forced operation from PC-HMI. This signal is shown as OC4L-BF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
186	OC4L-C	Definitive signal of OC4L C-phase or forced operation from PC-HMI. This signal is shown as OC4L-CF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
187	OC4L-3_O	Definitive signal of any OC4L of A, B, and C phase or forced operation from PC-HMI. This signal is shown as OC4L-3_OF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
188	OC4L-N	Definitive signal of OC4L zero-phase or forced operation from PC-HMI. This signal is shown as OC4L-NF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
189	THOLH	Definitive signal of THOLH or forced operation from PC-HMI. This signal is shown as THOLHF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
190	THOLL	Definitive signal of THOLL or forced operation from PC-HMI. This signal is shown as THOLLF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
191	NOC1H	Definitive signal of OCNEG1H or forced operation from PC-HMI. This signal is shown as OCNEG1HF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
192	NOC1L	Definitive signal of OCNEG1L or forced operation from PC-HMI. This signal is shown as OCNEG1LF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
193	NOC2H	Definitive signal of OCNEG2H or forced operation from PC-HMI. This signal is shown as OCNEG2HF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
194	NOC2L	Definitive signal of OCNEG2L or forced operation from PC-HMI. This signal is shown as OCNEG2LF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
195	CBFH-A	Definitive signal of CBFH A-phase or forced operation from PC-HMI. This signal is shown as CBFH-AF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
196	CBFH-B	Definitive signal of CBFH B-phase or forced operation from PC-HMI. This signal is shown as CBFH-BF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
197	CBFH-C	Definitive signal of CBFH C-phase or forced operation from PC-HMI. This signal is shown as CBFH-CF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
198	CBFH-3_O	Definitive signal of any CBFH of A, B, and C phase or forced operation from PC-HMI. This signal is shown as CBFH-3_OF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.

No.	Signal name	Description
199	CBFH-N	Definitive signal of CBFH N-phase or forced operation from PC-HMI. This signal is shown as CBFH-NF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
200	CBFL-A	Definitive signal of CBFL A-phase or forced operation from PC-HMI. This signal is shown as CBFL-AF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
201	CBFL-B	Definitive signal of CBFL B-phase or forced operation from PC-HMI. This signal is shown as CBFL-BF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
202	CBFL-C	Definitive signal of CBFL C-phase or forced operation from PC-HMI. This signal is shown as CBFL-CF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
203	CBFL-3_O	Definitive signal of any CBFL of A, B, and C phase or forced operation from PC-HMI. This signal is shown as CBFL-3_OF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.
204	CBFL-N	Definitive signal of CBFL N-phase or forced operation from PC-HMI. This signal is shown as CBFL-NF in Interface Test function on PC-HMI. Please refer to Fig. 4-4.

Table 4-9 Event record List of events (just name table)

Event name			
DI1	INT_LK_CL	OC2H-ND	OC2L-3D_O
DI2	CTL_OP_OK	OC2L-ND	OC3H-3D_O
DI3	CTL_CL_OK	OC3H-ND	OC3L-3D_O
DI4	CB_CTL_OK	OC3L-ND	OC4H-3D_O
DI5	CB_CTL_NG	OC4H-ND	OC4L-3D_O
DI6	OP_TS	OC4L-ND	CBFH-3D_O
DI7	CL_TS	THOLH-D	CBFL-3D_O
DI8	MANU_CLS	THOLL-D	DF2f-3D_O
RESRV8	MANU_OPN	NOC1H-D	DF5f-3D_O
RESRV9	CB_LR	NOC1L-D	C2fH-3D_O
RESRV10	DIFSV-C	NOC2H-D	C2fL-3D_O
RESRV11	THOL-T	NOC2L-D	ALLEL-O
RESRV12	DFSV-3D_O	CBFH-ND	DS_TRIG
DO1	CTL_BLOP1	CBFL-ND	GOOSE1
DO2	CTL_BLCL1	ALARM	GOOSE2
DO3	43INT_FLG	ALARM-L	GOOSE3
DO4	VL4000000	RY-LOCK	GOOSE4
DO5	RES_STS00	SV-LK	GOOSE5
DO6	RES_STS02	TCNT-LK	GOOSE6
DO7	RES_STS05	COMM0	GOOSE7
DO8	RES_STS0A	COMM1	GOOSE8
RESRV1	RES_STS10	COMM2	GOOSE9
RESRV2	CL_DI	COMM3	GOOSE10
RESRV3	OP_DI	COMM4	GOOSE11
RESRV4	P_INT_LK1	COMM5	GOOSE12
RESRV5	P_INT_LK2	COMM6	GOOSE13
TCNT_ALM	CB_DI_CTL	COMM7	GOOSE14
RESRV15	DFSV-3_O	DIF-3D_O	GOOSE15
DIFSV-A	RGFH-D	DIFH-3D_O	GOOSE16
DIFSV-B	RGFL-D	OC1H-3D_O	GOOSE17
CBa1	OC1H-ND	OC1L-3D_O	GOOSE18
INT_LK_OP	OC1L-ND	OC2H-3D_O	GOOSE19

Event name			
GOOSE20	OC1H-B	OC4H-3_O	
GOOSE21	OC1H-C	OC4H-N	
GOOSE22	OC1H-3_O	OC4L-A	
GOOSE23	OC1H-N	OC4L-B	
GOOSE24	OC1L-A	OC4L-C	
GOOSE25	OC1L-B	OC4L-3_O	
GOOSE26	OC1L-C	OC4L-N	
GOOSE27	OC1L-3_O	THOLH	
GOOSE28	OC1L-N	THOLL	
GOOSE29	OC2H-A	NOC1H	
GOOSE30	OC2H-B	NOC1L	
GOOSE31	OC2H-C	NOC2H	
GOOSE32	OC2H-3_O	NOC2L	
GOOSE33	OC2H-N	CBFH-A	
GOOSE34	OC2L-A	CBFH-B	
GOOSE35	OC2L-B	CBFH-C	
GOOSE36	OC2L-C	CBFH-3_O	
GOOSE37	OC2L-3_O	CBFH-N	
G_TRIP1	OC2L-N	CBFL-A	
G_TRIP2	OC3H-A	CBFL-B	
G_TRIP3	OC3H-B	CBFL-C	
DIF-A	OC3H-C	CBFL-3_O	
DIF-B	OC3H-3_O	CBFL-N	
DIF-C	OC3H-N	RESRV13	
DIF-3_O	OC3L-A	RESRV14	
DIFH-A	OC3L-B		
DIFH-B	OC3L-C		
DIFH-C	OC3L-3_O		
DIFH-3_O	OC3L-N		
RGFH	OC4H-A		
RGFL	OC4H-B		
OC1H-A	OC4H-C		

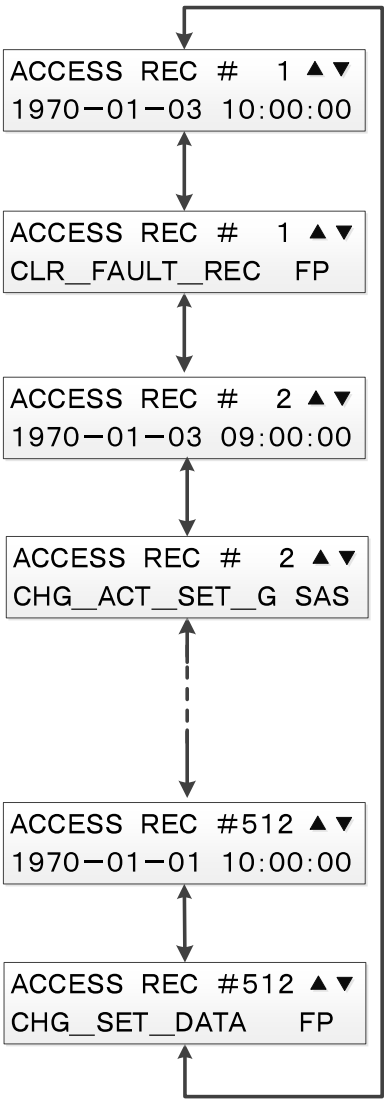
4.3.2.2.3. Access record (ACCESS RECORD) menu

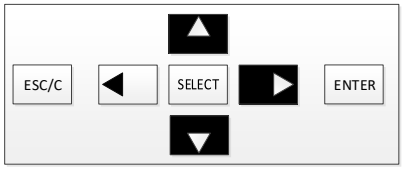
[Operation path] DISPLAY MODE > RECORD > ACCESS RECORD

The Access record (ACCESS RECORD) menu allows viewing of the saved access records.
Access records of up to 512 accesses are stored and the records for the respective accesses can be viewed.
Press the Up and Down keys to switch the indication on the screen as below.

Date of occurrence > Record description > Date of occurrence...

Press the Right key to display from the current access record to the past 10th record.





Use ▲ and ▼ to change the display item
Use ▸ to move from the record currently shown to the date of the tenth record into past

Table 4-10 Access record description registered (operator)

Display item	Operation description
FP	Front panel
PC	PC-HMI
MOD	Modbus
SAS	IEC61850
AUT	Automatic cancelation on device

Table 4-11 Access record description registered (operation description)

Display item	Operation description
CHG_ACT_SET_G	Change of active setting group
CHG_FREQ	Change of rated frequency
CHG_DI_VOLTAGE	Change of DI detection voltage value
CHG_DIST_REC_T	Change of configuration of disturbance record
CHG_USE_PASSWD	Change of password use setting
CHG_PASSWD	Change of password
CHG_USB_CONN	Change of USB connection channel
CHG_VFD_BRIGHT	Change of VFD brightness
CHG_TRIP_CNTR	Change of trip counter
CHG_MOTOR_TIME	Change of motor operating time
CHG_CFG_MODBUS	Change of configuration of Modbus
CHG_CFG_CCLINK	Change of configuration of CC-Link
CHG_IEC61850	Change of configuration of IEC61850
CHG_DEV_NAME	Change of device name
CHG_CFG_METER	Change of configuration of analog measurement status display
CHG_CFG_ENERGY	Change of configuration of electric energy
CHG_TIMEMANAGE	Change of configuration of time management
CHG_CTRL_MODE	Change of CB control mode
CHG_CONTACT_T	Change of configuration of DO contact test
CHG_PLC_DATA	Change of PLC data
CHG_SET_DATA	Change of relay setting
CLR_FAULT_REC	Clearing of fault/disturbance record
CLR_ALARM_REC	Clearing of alarm record
CLR_EVENT_REC	Clearing of event record
CLR_ACCESS_REC	Clearing of access record
ADJ_CLOCK	Adjustment of system clock
ACT_TST_MODE	Activation of test mode
DEACT_TST_MODE	Deactivation of test mode
RESET_LED	LED reset
STA_CONTACTTST	Start of DO contact test
STP_CONTACTTST	Stop of DO contact test
LOCK_SV	Locking of supervision
UNLOCK_SV	Unlocking of supervision
OPERATE_CB	Operation to open/close CB

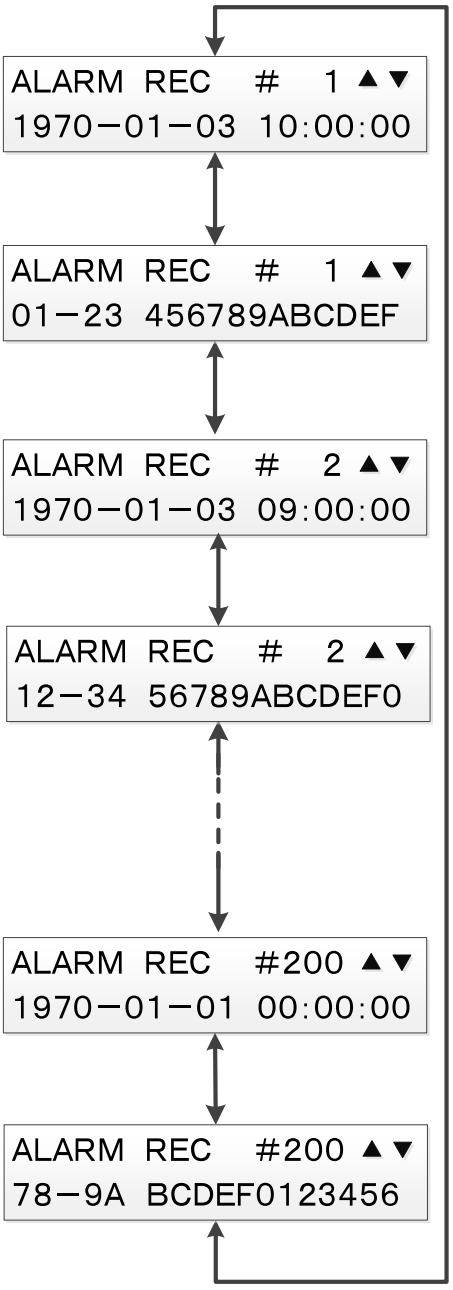
4.3.2.2.4. Alarm record (ALARM RECORD) menu

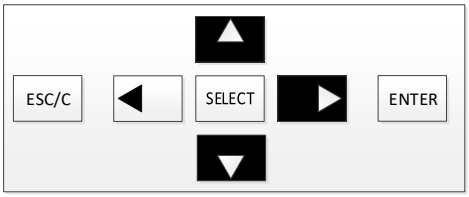
[Operation path] DISPLAY MODE > RECORD > ALARM RECORD

The ALARM RECORD menu allows viewing of the saved alarm records.
Alarm records of up to 200 alarms are stored and the records for the respective alarms can be viewed.
Press the Up and Down keys to switch the indication on the screen as below.

Date of occurrence > Record description > Date of occurrence...

Press the Right key to display from the current alarm record to the past 10th record.





Use ▲ and ▼ to change the display item
Use ▸ to move from the record currently shown to the date of the tenth record into past

4.3.2.3. Setting (SETTING) menu

The Setting menu can be selected in either DISPLAY or SETTING mode, but the DISPLAY mode only allows viewing of the setting values.
The setting values can be changed only in the SETTING mode.

For operations for the Setting menu, see 4.3.4.1.

4.3.2.4. Control (CONTROL) menu

The Control menu can be selected in either DISPLAY or SETTING mode. But the DISPLAY mode only allows viewing of the control mode (CTRL MODE) settings.
The SETTING mode allows viewing and setting of the Control mode and Circuit breaker control (CB CONTROL).

For operations for the Control mode menu, see 4.3.4.2.

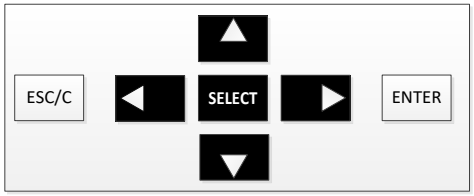
4.3.2.5. Configuration (CONFIG) menu

The Configuration menu can be selected in either DISPLAY or SETTING mode. Clock adjustment (CLOCK ADJUST), Password use/unused (PASSWORD USE) and Password registration (PASSWORD REGIST) can be selected only in the SETTING mode.
For other settings, the DISPLAY mode allows only viewing of the setting values.
The setting values can be changed only in the SETTING mode.

For operations for the Configuration menu, see 4.3.4.3.

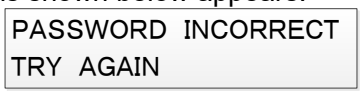
4.3.3. Password input screen

If the password use/no-use setting is “USE,” a four-digit password is requested when the SETTING mode is selected.
* For the password use/no-use setting, see **4.3.4.3.7**.
For how to set the password to input, see **4.3.4.3.8**.

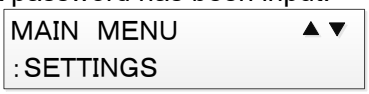


Use ◄ and ► to select the digit to enter a value for the password and ▲ and ▼ to change the value of the digit selected
When the password has been entered, press SELECT

If the password input is wrong, a screen as shown below appears.

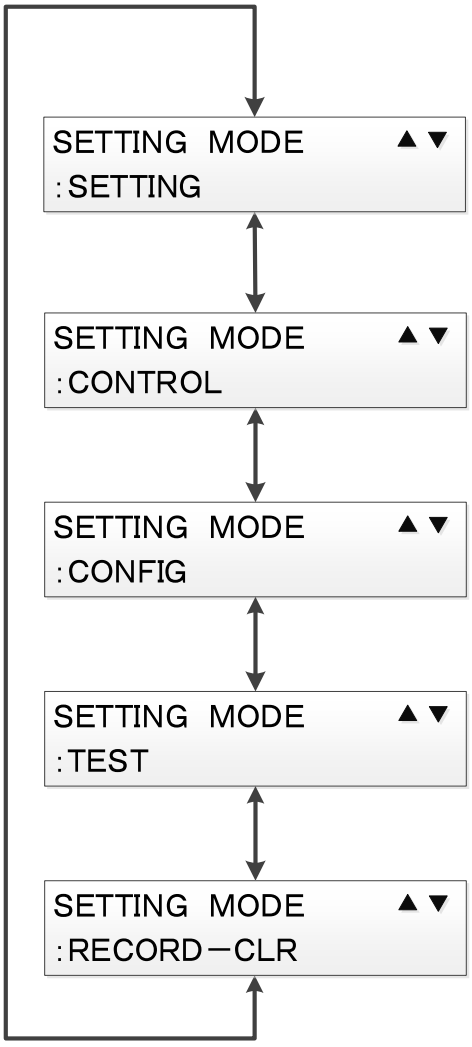


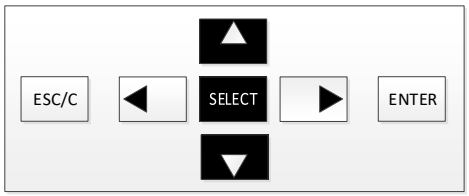
The main menu appears when the correct password has been input.



4.3.4. SETTING mode menu operations

This subsection describes the SETTING mode menu.
The menu screen has five selectable items. Use the Up and Down keys to select the item and press SELECT.
For the details about the menus available in the SETTING mode, see Table 4-2.

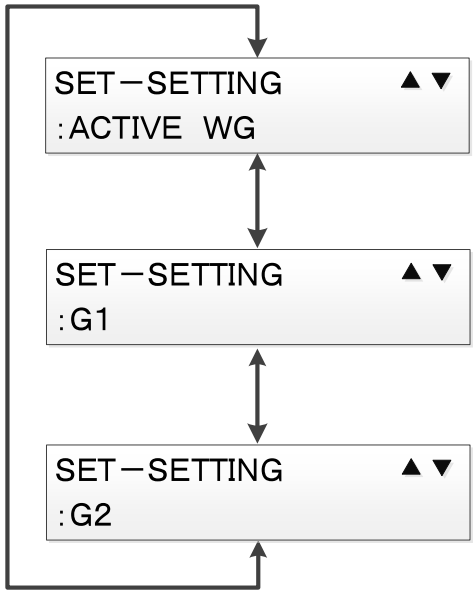


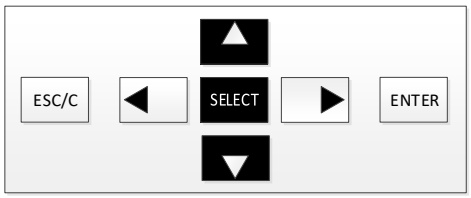


Use ▲ and ▼ to switch between items and press SELECT to select an item

4.3.4.1. Setting (SETTING) menu

The Setting (SETTING) menu allows viewing/changing of the active setting group and viewing/changing of the group setting values.
The Setting menu can be selected in either DISPLAY or SETTING mode but the setting values can be changed only in the SETTING mode.
(The DISPLAY mode allows only viewing of the setting values.)





Use ▲ and ▼ to switch between items and press SELECT to select an item

4.3.4.1.1. Active group (ACTIVE WG) menu

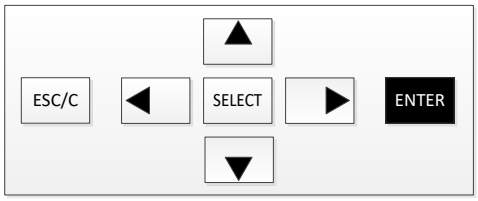
[Operation path] SETTING MODE > SETTING > ACTIVE WG

The Active group (ACTIVE WG) menu allows changing of the active group numbers setting.
(Active group numbers can be changed only in the SETTING mode.
The DISPLAY mode allows only viewing of the current group numbers.)

To change the active group number, in the Active group menu, press SELECT.
A cursor appears, which allows the selection of a group number with the Up and Down keys.
Select the group number to change and press SELECT to confirm the change.

Use ▲ and ▼ to switch between group Nos. and press SELECT to confirm the change

Press ENTER to show the confirmation screen below. Press SELECT to initiate the change to the group number selected.
When the new active group setting is not required, press the Left key to return the display back.



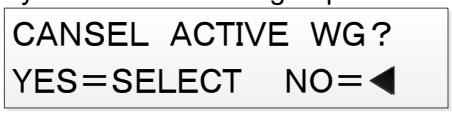
Press ENTER to show the screen on the left.

The next message shows the Successful or Unsuccessful change of active group number.
Pressing SELECT brings the display back to the Setting menu.

Message for a successful change of the active group.

Message for an unsuccessful change of the active group.

The cancel message will appear by pressing the Left key in the Active group menu.
Pressing SELECT exits the Active group menu without changing the active group and brings the display back to the Setting menu.
Pressing the Left key brings the display back to the Active group menu.



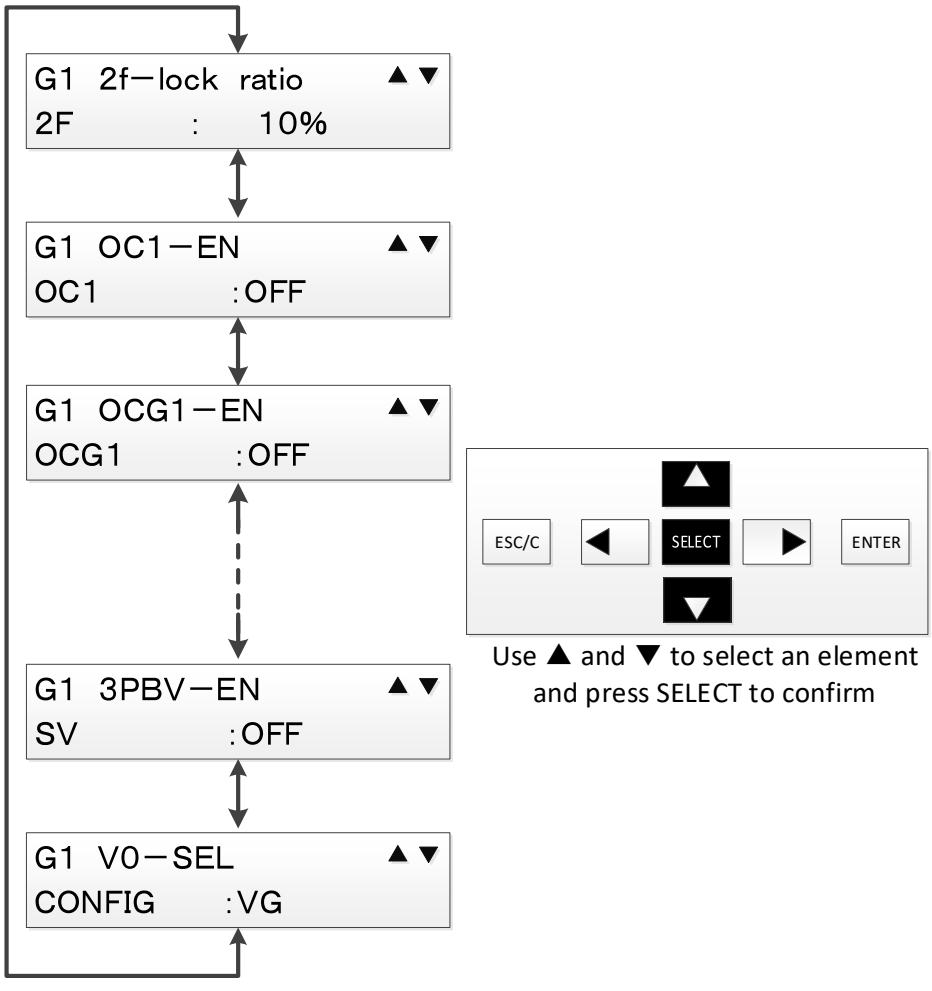
4.3.4.1.2. Group 1 setting (G1) and Group 2 setting (G2) menus

[Operation path] SETTING MODE > SETTING > G1(G2)

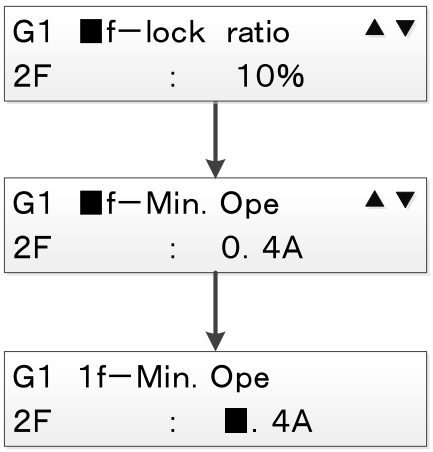
The Group 1 setting (G1) and Group 2 setting (G2) menus allow viewing and changing of the setting values for the respective group settings.
(Setting values can be changed only in the SETTING mode. The DISPLAY mode allows only viewing of the setting values)
The operation procedure for changing group settings is explained by changing G1 (for example).

1. First, select the setting value group in the Setting menu to change and press SELECT.

2. The Group setting menu appears.
Select the protective element to change with pressing the Up and Down key, and press SELECT.



3. The cursor moves to the setting parameter indication.
Use the Up and Down keys to select the setting parameter to be changed and press SELECT. The cursor moves to the setting value indication.



Cursor moves to the setting parameter indication.

Select the setting parameter to change and press SELECT.

Cursor moves to the setting value indication.

4. Use the Left and Right keys to select the digit to change and use the Up and Down keys to set the value.

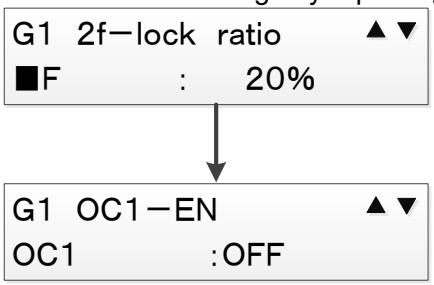
For setting a value as shown on the left, use ◂ and ▸ to select the digit to change, and ▲ and ▼ to set the value
Press SELECT to confirm the change

5. When the value has been changed, press SELECT to move the cursor to the setting item parameter.

Cursor moves to the setting parameter indication

6. Complete setting of all parameters in the element to change by repeating steps 2 to 5 above.

7. Press the Left key to return the cursor back to the protective element indication.
Complete setting of any other protective elements to change by repeating steps 1 to 6 above.



8. When the all necessary change of the setting values has been completed, press ENTER.
A confirmation message of the setting value changes appears as shown in the figure below. After confirmation of correct settings, press SELECT. If discarding the setting value changes, press the Left key.

Press SELECT to change the setting.
Press ◄ to discard the change.

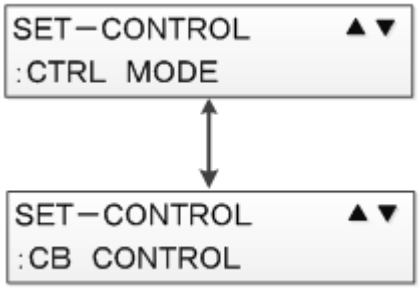
The following messages are shown respectively to check the successful or unsuccessful setting change,
The display returns back to the Setting menu by pressing SELECT while either of the messages below.

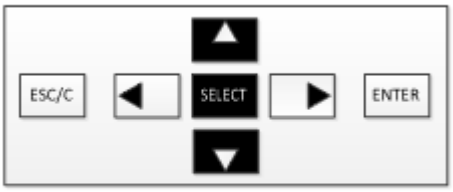
Message for successful setting value changes

Message for unsuccessful setting value changes

4.3.4.2. CONTROL menu

The Control (CONTROL) menu allows viewing and setting of the Control mode (CTRL MODE) and Circuit breaker control (CB CONTROL).
The Control menu can be selected in either DISPLAY or SETTING mode. In the DISPLAY mode, only viewing of the Control mode settings is possible.
The SETTING mode allows viewing and setting of the Control mode and Circuit breaker control.





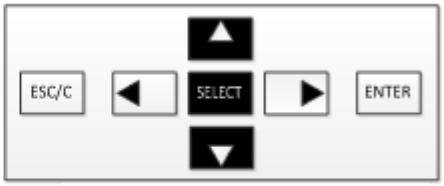
Use ▲ and ▼ to switch between items and press SELECT to select an item

4.3.4.2.1. Control mode (CTRL MODE) menu

[Operation path] SETTING MODE > CONTROL > CTRL MODE

The Control mode (CTRL MODE) menu allows the setting of the Local/remote control, Interlock selection and Circuit breaker operation inhibit.
(Note that they can be set only in the SETTING mode. The DISPLAY mode only allows viewing of the settings)

1. Use the Up and Down keys to show the control mode item to change and press SELECT for selection.



Use ▲ and ▼ to switch between items and press SELECT to select an item

2. The cursor moves to the setting value. Use the Up and Down keys to change the setting value.
(The setting value below shows a selection setting. For a value setting, use the Left and Right key to change the digit for setting)

3. Press SELECT to change the setting value.

4. Complete all settings to be changed by repeating steps 1 to 3.

5. Press ENTER and the confirmation message of the applied control mode appears as shown in the figure below.
Press SELECT to apply the changed control mode settings by steps 1 to 4 and complete the Control mode setting.
Press the Left key to return the setting menu in (1) above without applying the setting changes.

Table 4-12 Setting items of Control mode

No	Setting item	Description	Setting value
1	LOCAL/REMOTE	Local/remote setting	R / L
2	INTERLOCK	Interlock no-use/use selection setting	UNUSE / USE
3	CB OPEN	Open side block setting	UNBLK / BLK
4	CB CLOSE	Close side block setting	UNBLK / BLK
5	ON TIMER	Control waiting time	Value setting (unit: s)

4.3.4.2.2. Circuit breaker control (CB CONTROL) menu

[Operation path] SETTING MODE > CONTROL > CB CONTROL

The Circuit breaker control (CB CONTROL) menu allows CB OPEN control/CB CLOSE control. This item can be selected for implementing CB control only in the SETTING mode.

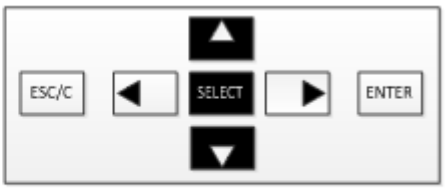
For CB control, the Control mode settings must be as shown in the table below.
For the details about operation for the Control mode, see 4.3.4.2.1.

Table 4-13 Control mode settings of circuit breaker control

Setting item	Description	Setting value
LOCAL/REMOTE	Local/remote setting	L
INTERLOCK	Interlock no-use/use selection setting	No-USE
CB OPEN	Open side block setting	For enabling CB open control: UNBLK
CB CLOSE	Close side block setting	For enabling CB close control: UNBLK

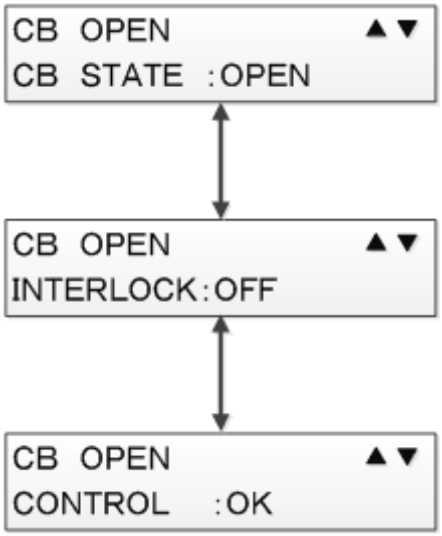
If the Control mode settings do not allow the circuit breaker control, an error message for control condition failure appears.
(The figure below shows the control condition failure that appears for CB open control)

1. Use the Up and Down keys to show the control mode item to change and press SELECT.
   * Select CB OPEN for CB open control and CB CLOSE for CB close control.



Use ▲ and ▼ to switch between items and press SELECT to select an item

2. The display switches to CB status indication.
   Press the Up and Down keys to select the display of CB status indication.
   * The figure below shows screens that appear when CB OPEN is selected.



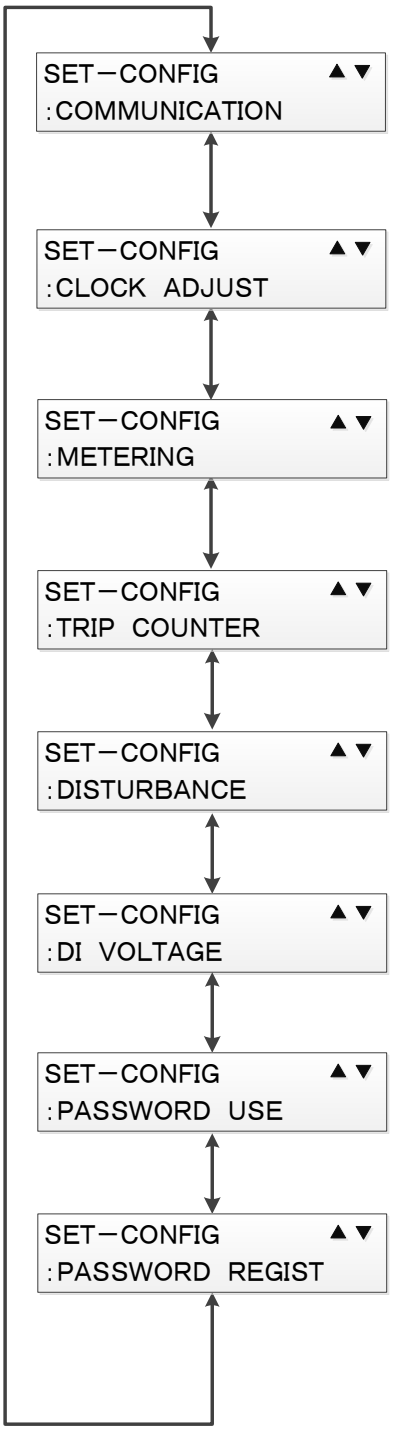
3. At pressing ENTER while the CB status indication screen is shown, it displays a CB control instruction.
   When CB control has been successful, a control succeed message appears.

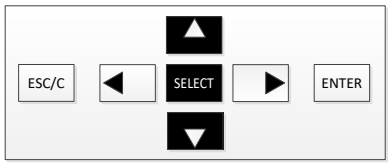
   When CB control has been unsuccessful, a control failed message appears.

   At pressing SELECT while either of the control succeed or failed messages, it brings the display of Setting menu.

4.3.4.3. Configuration (CONFIG) menu

This subsection describes the operations for the Configuration (CONFIG) menu.
The Configuration menu can be selected in either DISPLAY or SETTING mode. Clock adjustment (CLOCK ADJUST), Password use/no-use (PASSWORD USE) and Password registration (PASSWORD REGIST) can be selected only in the SETTING mode.
The other settings can be changed in the SETTING mode only.
(The DISPLAY mode only allows viewing of the setting values)





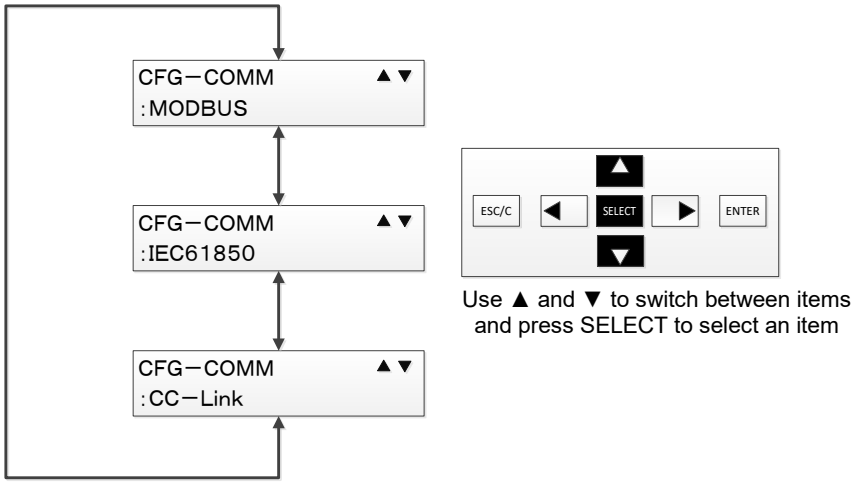
Use ▲ and ▼ to switch between items
and press SELECT to select an item

4.3.4.3.1. Communication setting (COMMUNICATION) menu

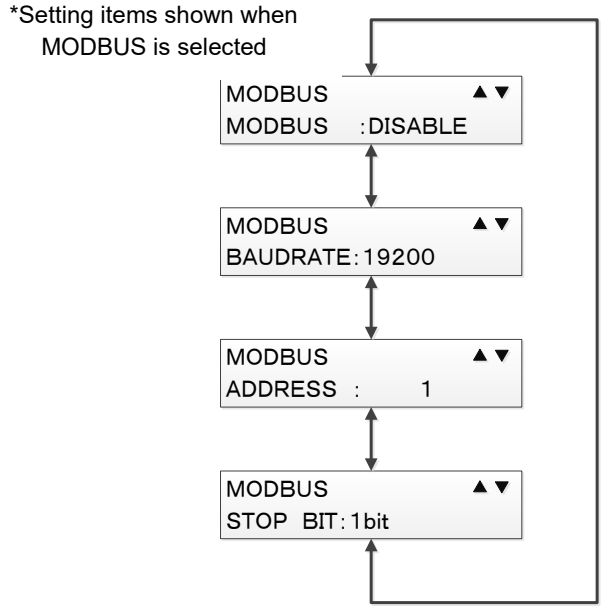
[Operation path] SETTING MODE > CONFIG > COMMUNICATION

The Communication setting (COMMUNICATION) menu allows viewing and setting of the Modbus, Station bus of IEC61850 and CC-Link configurations.
(The DISPLAY mode only allows viewing of the setting values)
The following describes the operation procedure for showing and changing communication settings.

1. Use the Up and Down keys to select the communication type and press SELECT.



2. The setting items according to the selected communication type are shown.
Use the Up and Down keys to select the item to change and press SELECT.



3. The cursor moves to the setting value. Use the Up and Down keys to change the setting value.

4. Press SELECT to change the setting value.

5. Complete all settings to be changed by repeating steps 2 to 4.

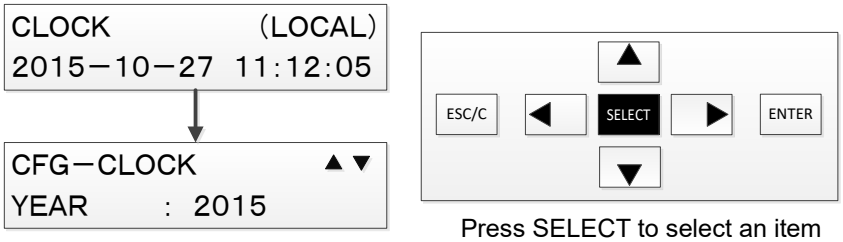
6. Press ENTER and the confirmation message of the selected communication type appears as shown in the figure below.
   Press SELECT to apply the communication settings changed by steps 2. to 5. and complete the communication setting.
   Press the Left key to return the Setting item menu in 2. above without applying the setting changes.

4.3.4.3.2. Clock adjustment (CLOCK ADJUST) menu

[Operation path] SETTING MODE > CONFIG > CLOCK ADJUST

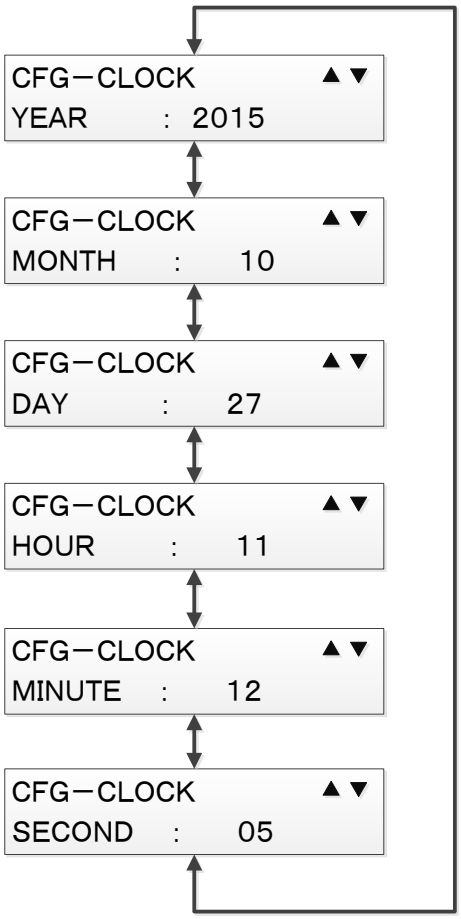
The Clock adjustment (CLOCK ADJUST) menu allows time setting.
This item can be selected only in the SETTING mode.

1. When the Clock adjustment menu is selected, the current time is indicated as shown below.
Pressing SELECT while this screen is shown allows changing of the year, month, day, hour, minute and second settings.

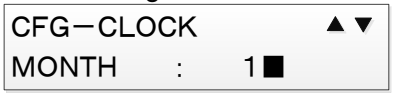


Press SELECT to select an item

2. Pressing the Up and Down keys cycles through the year, month, day, hour, minute and second selection items.Select the item to change and press SELECT.



3. The cursor moves to the setting value. Use the Up and Down keys to select the value and the Left and Right keys to select the digit to make the change.



4. Press SELECT to change the setting value.

5. Complete setting of all other items to change by repeating steps 1. to 3..

6. Press ENTER and the confirmation message of the time setting appears.
   Press SELECT to apply the time setting changed by steps 1. to 4. and complete the Clock adjustment setting.
   Press the Left key to go back to the Clock adjustment menu without applying the setting changes.

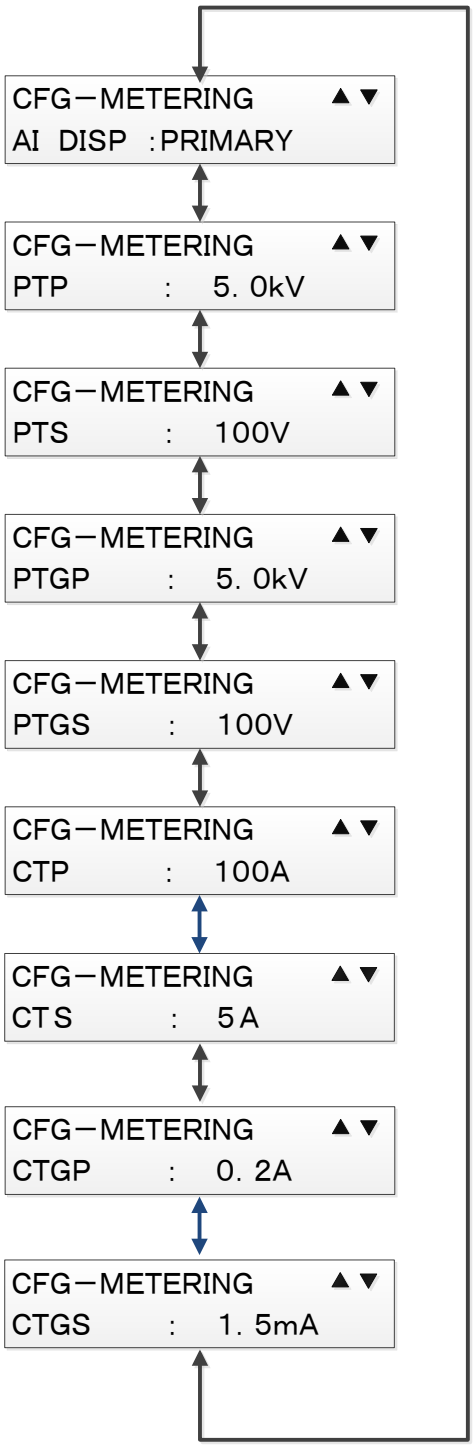
4.3.4.3.3. Measured analog value (METERING) menu

[Operation path] SETTING MODE > CONFIG > METERING

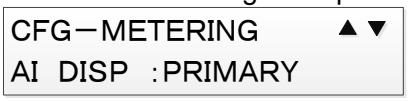
The Analog value measurement switching (METERING) menu allows configuration of the following settings.

(1) Set the indication type from the primary or secondary side of CT/VT
(2) Set the rating of CT/VT.
(The DISPLAY mode only allows viewing of the setting values)

The following describes the operation procedure for viewing and changing the settings for the Measurement value display switching menu.



1. Use the Up and Down keys to select the item to change and press SELECT for selection.



2. The cursor moves to the setting value. Use the Up and Down keys to select the value and the Left and Right keys to select the digit to make the change.

3. Press SELECT to change the setting value.

4. Complete setting of all other items to change by repeating steps 1. to 3..

5. Press ENTER and the confirmation message of the new measurement settings appears as shown in the figure below.
   Press SELECT to apply the measurement value settings changed by steps 1. to 4. and complete the setting.
   Press the Left key to go back to the Analog value display switching menu without applying the setting changes.

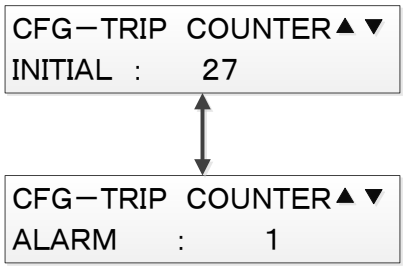
Table 4-14 Setting items of analog value display

No.	Item	Setting description	Setting range	Unit
1	AI DISP	AI display primary value/ secondary value selection	PRIMARY / SECONDARY	-
2	CTHP	HVside CT primary side rating	1 ~ 30000	A
3	CTHS	HVside CT secondary side rating	1, 5	A
4	CTNHP	HVside CTG primary side rating	1 ~ 30000	A
5	CTNHS	HVside CTG secondary side rating	1, 5	A
6	CTLP	LVside CT primary side rating	1 ~ 30000	A
7	CTLS	LVside CT secondary side rating	1, 5	A
8	CTNLP	LVside CTG primary side rating	1 ~ 30000	A
9	CTNLS	LVside CTG secondary side rating	1, 5	A

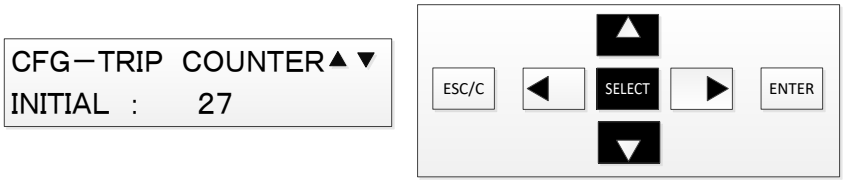
4.3.4.3.4. Trip counter (TRIP COUNTER) menu

[Operation path] SETTING MODE > CONFIG > TRIP COUNTER

The Trip counter (TRIP COUNTER) menu allows setting of the initial counter and alarm counter values. The trip counter will count the number of trip times.



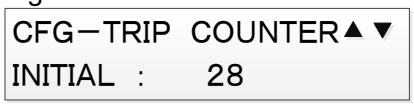
1. The trip counter setting menu appears. Use the Up and Down keys to select the item to change and press SELECT.



Use ▲ and ▼ to switch between items and press SELECT to select an item

2. The cursor moves to the setting value. Use the Up and Down keys to select the value and the Left and Right keys to select the digit to make the change.

3. Press SELECT to change the setting value.



4. Complete setting of all other items to change by repeating steps 1. to 3..

5. Press ENTER and the confirmation message of the trip counter settings appears.
   Press SELECT to apply the trip counter settings changed by steps 1. to 4. and complete the setting.
   Press the Left key to go back to the setting menu in step 1. above without applying the setting changes.

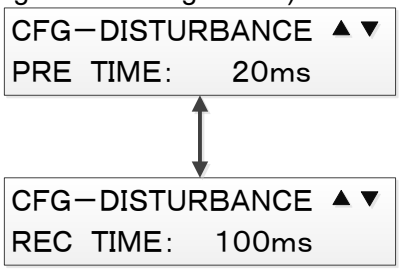
Table 4-15 Setting items of trip counter

No.	Item	Setting description	Setting range	Unit
1	INITIAL	Initial value of trip counter	0~10000	Times
2	ALARM	Alarm value of trip counter	1~10000	Times

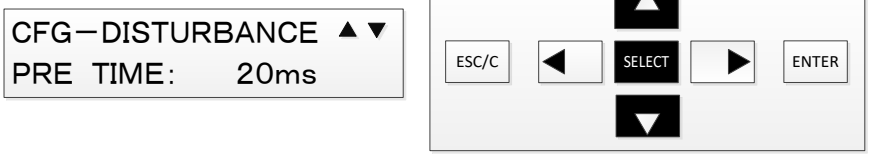
4.3.4.3.5. Disturbance record (DISTURBANCE) menu

[Operation path] SETTING MODE > CONFIG > DISTURBANCE

The Disturbance record (DISTURBANCE) menu allows setting of maximum recording time and pre-fault recording time of each disturbance (fault) record.
(The DISPLAY mode only allows viewing of the setting values)

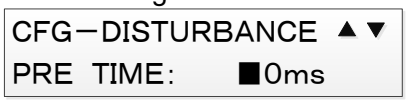


1. Use the Up and Down keys to select the item to change and press SELECT.

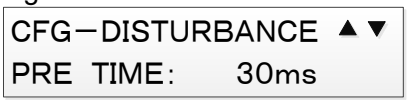


Use ▲ and ▼ to switch between items
and press SELECT to select an item

2. The cursor moves to the setting value. Use the Up and Down keys to select the value and the Left and Right keys to select the digit to make the change.



3. Press SELECT to change the setting value.



4. Complete setting of all other items to change by repeating steps 1. to 3..

5. Press ENTER and the message to confirm application of the disturbance record time settings appears. Press SELECT to apply the disturbance record time settings changed by steps 1. to 4. and complete the setting.
Press the Left key to go back to the setting menu in step 1. above without applying the setting changes.

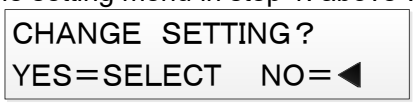


Table 4-16 Disturbance record pre-fault time width setting items

No.	Item	Setting description	Setting range	Unit
1	PRE TIME	Save time of pre-fault waveform data	20~4500	ms
2	REC TIME	Save time of waveform data	100~5000	ms

Note: The save time of “PRE TIME” is included in that of “REC TIME”.

In other words, the setting value of “REC TIME” must be larger than that of “PRE TIME”.

4.3.4.3.6. DI detection voltage value (DI VOLTAGE) menu

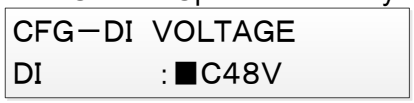
[Operation path] SETTING MODE > CONFIG > DI VOLTAGE

DI detection voltage value (DI VOLTAGE) menu allows setting of the DI rated voltage.
(The DISPLAY mode only allows viewing of the setting values)

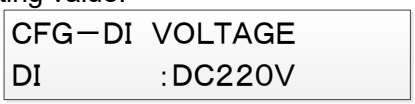
1. In the DI detection voltage value setting menu, show item “DI” and press SELECT.
*The DI detection voltage value setting menu only has one item: “DI.”

Press SELECT to select an item

2. The cursor moves to the setting value. Use the Up and Down keys to select the setting to be changed.



3. Press SELECT to change the setting value.



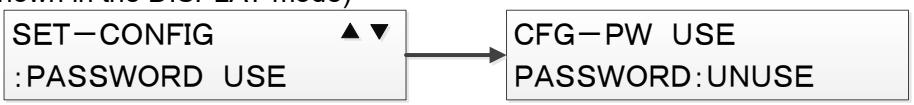
4. Press ENTER and the confirmation message of the DI detection voltage value setting appears.
Press SELECT to apply the DI detection voltage value setting and complete the setting.
Press the Left key to go back to the setting menu in step 1. above without applying the setting changes.

Table 4-17 Setting items of DI detection voltage value

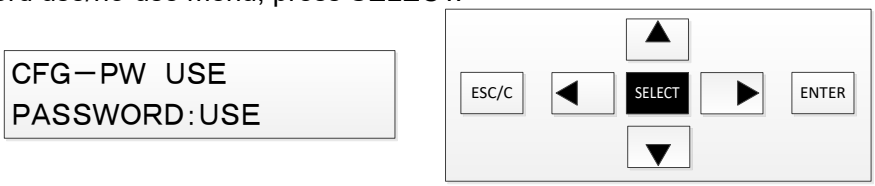
No.	Item	Setting description	Setting
1	DI	DI detection voltage value setting	24/48/110/220 VDC

4.3.4.3.7. Password use/unuse (PASSWORD USE) menu

The Password use/no-use (PASSWORD USE) menu specifies whether to use or not use a password input when the SETTING mode is selected.
(This item is not shown in the DISPLAY mode)

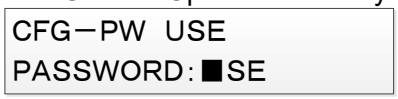


1. In the Password use/no-use menu, press SELECT.



Press SELECT to select an item

2. The cursor moves to the setting value. Use the Up and Down keys to select the setting to be changed.



3. Press SELECT to change the setting value.

4. Press ENTER and the confirmation message of the password use/no-use setting changed appears as shown in the figure below.
   Press SELECT to apply the password use/no-use setting and complete the setting.
   Press the Left key to go back to the setting menu in step 1. above without applying the setting changes.

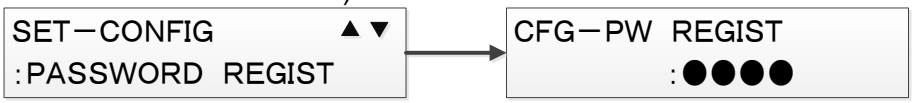
Table 4-18 Setting item of Password use/no-use

No.	Item	Setting description	Setting
1	PASSWORD	Password use/nonuse setting	USE / UNUSE

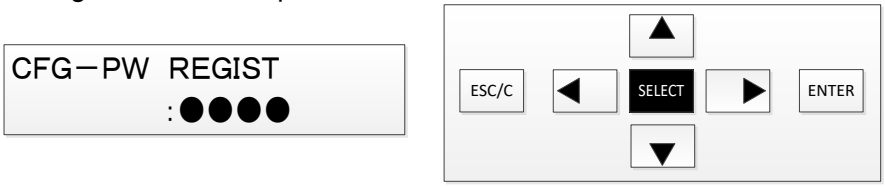
4.3.4.3.8. Password registration (PASSWORD REGIST) menu

[Operation path] SETTING MODE > CONFIG > PASSWORD REGIST

Password registration (PASSWORD REGIST) menu allows the setting of the password input when the SETTING mode is selected.
(This item is not shown in the DISPLAY mode)



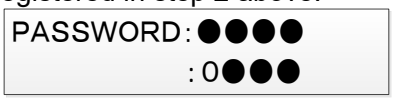
1. In the Password registration menu, press SELECT.



Press SELECT to select an item

2. The Password registration screen appears.
   For registering a password, press SELECT after each digit is entered.
   Pressing SELECT confirms the value for the digit entered and moves the cursor to the digit on the right.
   It is not possible to return to the previous digit by using the Left key.
   Use the Up and Down keys to select a value out of 0 to 9 for each digit.

3. When the four digits have been entered, password input is requested again.
   Enter the same password as that registered in step 2 above.

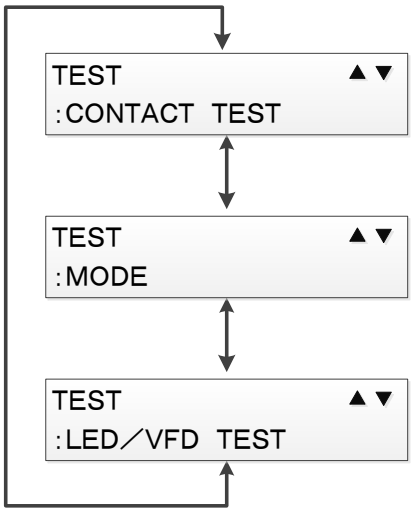


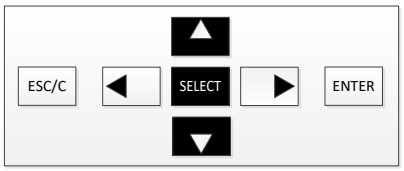
4. If the above two password-inputs in steps 2 and 3 are same, the screen shown in step 1 appears.
   Press ENTER and the confirmation message of the password registration appears.
   Press SELECT to apply the password registration and complete the setting.
   Press the Left key to go back to the setting menu in step 1. above without applying the setting changes.

If the two password-inputs in steps 2 and 3 are not same, an error message as shown below appears.

4.3.4.4. TEST menu

This subsection describes the operations for the Test menu.
The Test menu can be selected only in the SETTING mode.





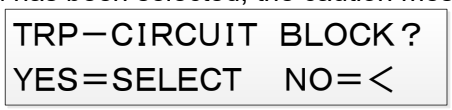
Use ▲ and ▼ to switch between items
and press SELECT to select an item

4.3.4.4.1. DO contact test (CONTACT TEST) menu

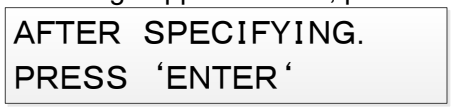
[Operation path] SETTING MODE > TEST > CONTACT TEST

The DO contact test (CONTACT TEST) menu allows contact testing of DO signals (DO1 to DO13).

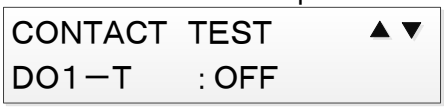
1. When the DO contact test menu has been selected, the caution message appears.



When pressing SELECT, the next message appears. Then, press “SELECT” again.

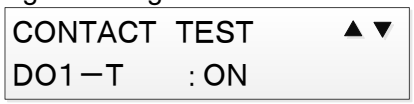


2. The setting screen for the DO contact test appears.
Use the Up and Down keys to select the item to set and press SELECT.



3. The cursor moves to the setting of the selected item.
   Use the Up and Down keys to switch the setting.
   Select ON to conduct a contact test on the selected DO. If not, select OFF.

4. Press SELECT to change the setting and bring the cursor back to the item name.



5. Complete settings of all the items to change by repeating steps 2. to 4. above.

6. After the settings are completed, press ENTER while the setting item selection screen in step 4 is shown in order to operate DO contact test.
   *The selected DO contact(s) is(are) operated while ENTER is held down. The operation of the respective DO contact corresponds to the settings in steps (2) to (5) above.

   To exit the DO contact test setting screen, press the Left key.

Table 4-19 Setting items of DO contact test

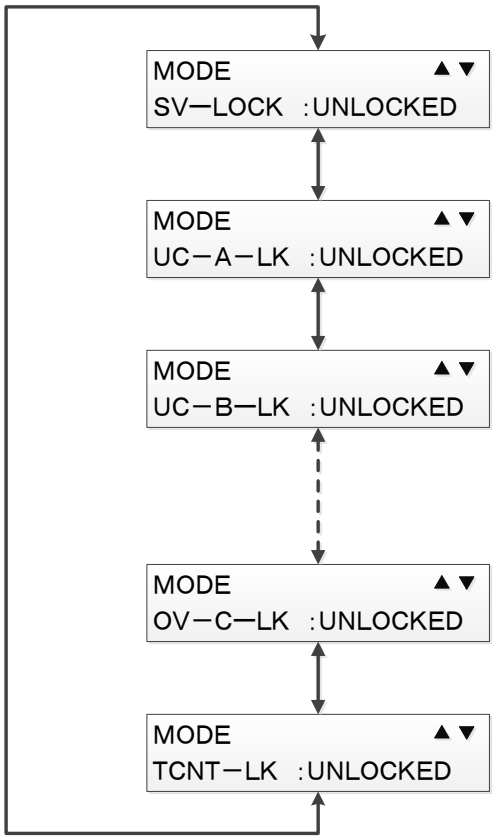
No.	Item
1	DO1-T
2	DO2-T
3	DO3-T
4	DO4-T
5	DO5-T
6	DO6-T
7	DO7-T
8	DO8-T
9	DO9-T
10	DO10-T
11	DO11-T
12	DO12-T
13	DO13-T

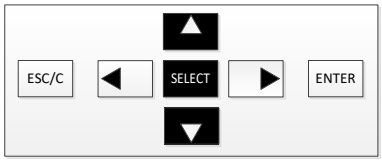
4.3.4.4.2. Test mode (MODE) menu

[Operation path] SETTING MODE > TEST > MODE

The Test mode (MODE) menu allows setting of the test mode.

1. Use the Up and Down keys to select the item to set and press SELECT.





Use ▲ and ▼ to switch between items
and press SELECT to select an item

2. The cursor moves to the setting of the selected item. Use the Up and Down keys to switch the setting.

3. Press SELECT to change the setting.

4. Complete setting of all other items to change by repeating steps 1. to 3. above.

5. Press ENTER to be enable the test mode as set in steps 1. to 4. above.
The RUN LED flashes during the test mode.

Caution

During the test mode, use of the Left or ESC key to exit the SETTING mode is disabled.
(Operations implemented in the SETTING mode are enabled)
When turning off the VFD screen or moving to the DISPLAY mode, it exits the test mode.

4.3.4.4.3. LED/VFD lighting test (LED/VFD TEST) menu

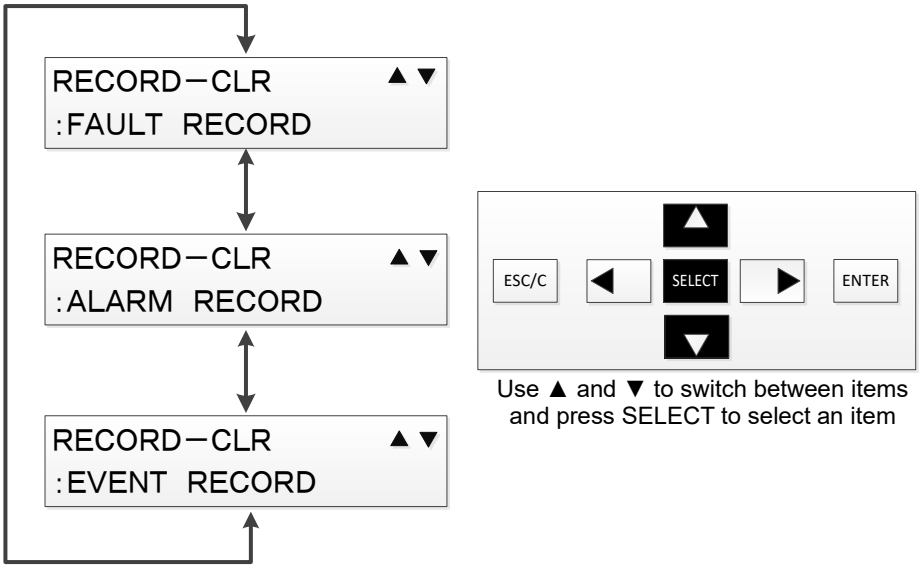
[Operation path] SETTING MODE > TEST > LED/VFD TEST

The LED/VFD lighting test (LED/VFD TEST) menu allows lighting of all LEDs/VFDs.

When LED/VFD TEST is selected in the Test menu, a screen as shown below appears.
Pressing ENTER and all LEDs and VFDs are lighting while the key is held down.
It can be checked the LED/VFD indication visually.

4.3.4.5. Clear record (RECORD-CLR) menu

The Clear record (RECORD-CLR) menu allows clearing three types of log data: fault, event and alarm records.
*Access record log data cannot be cleared.



4.3.4.5.1. Clear fault record (FAULT REC CLEAR) menu

[Operation path] SETTING MODE > RECORD-CLR > FAULT RECORD

The Clear fault record (FAULT REC CLEAR) menu allows clearing of fault records.
In the Clear record menu, select FAULT RECORD and press ENTER. Then, the next screen appears.
Press SELECT to clear the fault records.
When pressing the Left key, the display returns to the selection screen of Clear record menu without clearing the fault records.

When clearing of the fault records are completed, the display returns to the Clear record menu.
If the clearing is unsuccessful, a message screen as shown below appears.
Pressing SELECT while the message below is shown brings the display back to the Clear record menu selection screen.

4.3.4.5.2. Clear alarm record (ALARM REC CLEAR) menu

[Operation path] SETTING MODE > RECORD-CLR > ALARM RECORD

The Clear alarm record (ALARM REC CLEAR) menu allows clearing of alarm records.
In the Clear record menu, select ALARM RECORD and press ENTER. Then, the next screen appears.
Press SELECT to clear the alarm records.
When pressing the Left key, the display returns to the selection screen of Clear record menu without clearing the alarm records.

When clearing of the alarm records are completed, the display returns to the Clear record menu.
If the clearing is unsuccessful, a message screen as shown below appears.
Pressing SELECT while the message below is shown brings the display back to the Clear record menu selection screen.

4.3.4.5.3. Clear event record (EVENT REC CLEAR) menu

[Operation path] SETTING MODE > RECORD-CLR > EVENT RECORD

The Clear event record (EVENT REC CLEAR) menu allows clearing of event records.
In the Clear record menu, select EVENT RECORD and press ENTER. Then, the next screen appears.
Press SELECT to clear the event records.
When pressing the Left key, the display returns to the selection screen of Clear record menu without clearing the event records.

When clearing of the event records are completed, the display returns to the Clear record menu.
If the clearing is unsuccessful, a message screen as shown below appears.
Pressing SELECT while the message below is shown brings the display back to the Clear record menu selection screen.

5. Internal Signals for Programmable Logic Controller (PLC) on PC-HMI

Table 5-1 PLC signals of CAC1-A41D1

	Signal name	Description
1	DI1	Status of DI1 (This signal is available only in the relay unit with a DI card in SLOT-C.)
2	DI2	Status of DI2 (This signal is available only in the relay unit with a DI card in SLOT-C.)
3	DI3	Status of DI3 (This signal is available only in the relay unit with a DI card in SLOT-C.)
4	DI4	Status of DI4 (This signal is available only in the relay unit with a DI card in SLOT-C.)
5	DI5	Status of DI5 (This signal is available only in the relay unit with a DI card in SLOT-C.)
6	DI6	Status of DI6 (This signal is available only in the relay unit with a DI card in SLOT-C.)
7	DI7	Status of DI7 (This signal is available only in the relay unit with a DI card in SLOT-C.)
8	DI8	Status of DI8 (This signal is available only in the relay unit with a DI card in SLOT-C.)
9	DIF-A/	Definitive signal of current ratio differential (87T) element on A phase
10	DIF-B/	Definitive signal of current ratio differential (87T) element on B phase
11	DIF-C/	Definitive signal of current ratio differential (87T) element on C phase
12	DIFH-A/	Definitive signal of differential overcurrent (87TH) element on A phase
13	DIFH-B/	Definitive signal of differential overcurrent (87TH) element on B phase
14	DIFH-C/	Definitive signal of differential overcurrent (87TH) element on C phase
15	RGFH/	Definitive signal of zero-sequence current ratio differential (87TN) element for high-voltage side
16	RGFL/	Definitive signal of zero-sequence current ratio differential (87TN) element for low-voltage side
17	OC1H-A/	Definitive signal of 1st instantaneous overcurrent (50) element for high-voltage side on A phase
18	OC1H-B/	Definitive signal of 1st instantaneous overcurrent (50) element for high-voltage side on B phase
19	OC1H-C/	Definitive signal of 1st instantaneous overcurrent (50) element for high-voltage side on C phase
20	OC1H-N/	Definitive signal of 1st instantaneous overcurrent (50) element for high-voltage side on zero phase
21	OC1L-A/	Definitive signal of 1st instantaneous overcurrent (50) element for low-voltage side on A phase
22	OC1L-B/	Definitive signal of 1st instantaneous overcurrent (50) element for low-voltage side on B phase
23	OC1L-C/	Definitive signal of 1st instantaneous overcurrent (50) element for low-voltage side on C phase
24	OC1L-N/	Definitive signal of 1st instantaneous overcurrent (50) element for low-voltage side on zero phase
25	OC2H-A/	Definitive signal of 2nd instantaneous overcurrent (50) element for high-voltage side on A phase
26	OC2H-B/	Definitive signal of 2nd instantaneous overcurrent (50) element for high-voltage side on B phase
27	OC2H-C/	Definitive signal of 2nd instantaneous overcurrent (50) element for high-voltage side on C phase
28	OC2H-N/	Definitive signal of 2nd instantaneous overcurrent (50) element for high-voltage side on zero phase
29	OC2L-A/	Definitive signal of 2nd instantaneous overcurrent (50) element for low-voltage side on A phase
30	OC2L-B/	Definitive signal of 2nd instantaneous overcurrent (50) element for low-voltage side on B phase

	Signal name	Description
31	OC2L-C/	Definitive signal of 2nd instantaneous overcurrent (50) element for low-voltage side on C phase
32	OC2L-N/	Definitive signal of 2nd instantaneous overcurrent (50) element for low-voltage side on zero phase
33	OC3H-A/	Definitive signal of 3rd instantaneous overcurrent (50) element for high-voltage side on A phase
34	OC3H-B/	Definitive signal of 3rd instantaneous overcurrent (50) element for high-voltage side on B phase
35	OC3H-C/	Definitive signal of 3rd instantaneous overcurrent (50) element for high-voltage side on C phase
36	OC3H-N/	Definitive signal of 3rd instantaneous overcurrent (50) element for high-voltage side on zero phase
37	OC3L-A/	Definitive signal of 3rd instantaneous overcurrent (50) element for low-voltage side on A phase
38	OC3L-B/	Definitive signal of 3rd instantaneous overcurrent (50) element for low-voltage side on B phase
39	OC3L-C/	Definitive signal of 3rd instantaneous overcurrent (50) element for low-voltage side on C phase
40	OC3L-N/	Definitive signal of 3rd instantaneous overcurrent (50) element for low-voltage side on zero phase
41	OC4H-A/	Definitive signal of definite time or IDMT overcurrent (51) element for high-voltage side on A phase
42	OC4H-B/	Definitive signal of definite time or IDMT overcurrent (51) element for high-voltage side on B phase
43	OC4H-C/	Definitive signal of definite time or IDMT overcurrent (51) element for high-voltage side on C phase
44	OC4H-N/	Definitive signal of definite time or IDMT overcurrent (51) element for high-voltage side on zero phase
45	OC4L-A/	Definitive signal of definite time or IDMT overcurrent (51) element for low-voltage side on A phase
46	OC4L-B/	Definitive signal of definite time or IDMT overcurrent (51) element for low-voltage side on B phase
47	OC4L-C/	Definitive signal of definite time or IDMT overcurrent (51) element for low-voltage side on C phase
48	OC4L-N/	Definitive signal of definite time or IDMT overcurrent (51) element for low-voltage side on zero phase
49	THOLH/	Definitive signal of overload (49) element for high-voltage side
50	THOLL/	Definitive signal of overload (49) element for low-voltage side
51	NOC1H/	Definitive signal of 1st negative sequence overcurrent (46) element for high-voltage side
52	NOC1L/	Definitive signal of 1st negative sequence overcurrent (46) element for low-voltage side
53	NOC2H/	Definitive signal of 2nd negative sequence overcurrent (46) element for high-voltage side
54	NOC2L/	Definitive signal of 2nd negative sequence overcurrent (46) element for low-voltage side
55	CBFH-A/	Definitive signal of overcurrent element for the detection of CBF (50BF) for high-voltage side on A phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
56	CBFH-B/	Definitive signal of overcurrent element for the detection of CBF (50BF) for high-voltage side on B phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
57	CBFH-C/	Definitive signal of overcurrent element for the detection of CBF (50BF) for high-voltage side on C phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
58	CBFH-N/	Definitive signal of overcurrent element for the detection of CBF (50BF) for high-voltage side on zero phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
59	CBFL-A/	Definitive signal of overcurrent element for the detection of CBF (50BF) for low-voltage side on A phase

	Signal name	Description
		(This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
60	CBFL-B/	Definitive signal of overcurrent element for the detection of CBF (50BF) for low-voltage side on B phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
61	CBFL-C/	Definitive signal of overcurrent element for the detection of CBF (50BF) for low-voltage side on C phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
62	CBFL-N/	Definitive signal of overcurrent element for the detection of CBF (50BF) for low-voltage side on zero phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
63	TCNT_ALM	Alarm of trip counter
64	DIFSV-A	Definitive signal of supervision of differential current on A-phase
65	DIFSV-B	Definitive signal of supervision of differential current on B-phase
66	DIFSV-C	Definitive signal of supervision of differential current on C-phase
67	MANU_CLS	Operation signal to close a circuit breaker (This signal is available only in the relay unit with a DI card in SLOT-C.)
68	MANU_OPN	Operation signal to open a circuit breaker (This signal is available only in the relay unit with a DI card in SLOT-C.)
69	DIF-AD	Detection signal of current ratio differential (87T) element on A phase
70	DIF-BD	Detection signal of current ratio differential (87T) element on B phase
71	DIF-CD	Detection signal of current ratio differential (87T) element on C phase
72	DIFH-AD	Detection signal of differential overcurrent (87TH) element on A phase
73	DIFH-BD	Detection signal of differential overcurrent (87TH) element on B phase
74	DIFH-CD	Detection signal of differential overcurrent (87TH) element on C phase
75	RGFH-D	Detection signal of zero-sequence current ratio differential (87TN) element for high-voltage side
76	RGFL-D	Detection signal of zero-sequence current ratio differential (87TN) element for low-voltage side
77	OC1H-AD	Detection signal of 1st instantaneous overcurrent (50) element for high-voltage side on A phase
78	OC1H-BD	Detection signal of 1st instantaneous overcurrent (50) element for high-voltage side on B phase
79	OC1H-CD	Detection signal of 1st instantaneous overcurrent (50) element for high-voltage side on C phase
80	OC1H-ND	Detection signal of 1st instantaneous overcurrent (50) element for high-voltage side on zero phase
81	OC1L-AD	Detection signal of 1st instantaneous overcurrent (50) element for low-voltage side on A phase
82	OC1L-BD	Detection signal of 1st instantaneous overcurrent (50) element for low-voltage side on B phase
83	OC1L-CD	Detection signal of 1st instantaneous overcurrent (50) element for low-voltage side on C phase
84	OC1L-ND	Detection signal of 1st instantaneous overcurrent (50) element for low-voltage side on zero phase
85	OC2H-AD	Detection signal of 2nd instantaneous overcurrent (50) element for high-voltage side on A phase
86	OC2H-BD	Detection signal of 2nd instantaneous overcurrent (50) element for high-voltage side on B phase
87	OC2H-CD	Detection signal of 2nd instantaneous overcurrent (50) element for high-voltage side on C phase
88	OC2H-ND	Detection signal of 2nd instantaneous overcurrent (50) element for high-voltage side on zero phase
89	OC2L-AD	Detection signal of 2nd instantaneous overcurrent (50) element for low-voltage side on A phase
90	OC2L-BD	Detection signal of 2nd instantaneous overcurrent (50) element for low-voltage side on B phase
91	OC2L-CD	Detection signal of 2nd instantaneous overcurrent (50) element for low-voltage side on C phase

	Signal name	Description
92	OC2L-ND	Detection signal of 2nd instantaneous overcurrent (50) element for low-voltage side on zero phase
93	OC3H-AD	Detection signal of 3rd instantaneous overcurrent (50) element for high-voltage side on A phase
94	OC3H-BD	Detection signal of 3rd instantaneous overcurrent (50) element for high-voltage side on B phase
95	OC3H-CD	Detection signal of 3rd instantaneous overcurrent (50) element for high-voltage side on C phase
96	OC3H-ND	Detection signal of 3rd instantaneous overcurrent (50) element for high-voltage side on zero phase
97	OC3L-AD	Detection signal of 3rd instantaneous overcurrent (50) element for low-voltage side on A phase
98	OC3L-BD	Detection signal of 3rd instantaneous overcurrent (50) element for low-voltage side on B phase
99	OC3L-CD	Detection signal of 3rd instantaneous overcurrent (50) element for low-voltage side on C phase
100	OC3L-ND	Detection signal of 3rd instantaneous overcurrent (50) element for low-voltage side on zero phase
101	OC4H-AD	Detection signal of definite time or IDMT overcurrent (51) element for high-voltage side on A phase
102	OC4H-BD	Detection signal of definite time or IDMT overcurrent (51) element for high-voltage side on B phase
103	OC4H-CD	Detection signal of definite time or IDMT overcurrent (51) element for high-voltage side on C phase
104	OC4H-ND	Detection signal of definite time or IDMT overcurrent (51) element for high-voltage side on zero phase
105	OC4L-AD	Detection signal of definite time or IDMT overcurrent (51) element for low-voltage side on A phase
106	OC4L-BD	Detection signal of definite time or IDMT overcurrent (51) element for low-voltage side on B phase
107	OC4L-CD	Detection signal of definite time or IDMT overcurrent (51) element for low-voltage side on C phase
108	OC4L-ND	Detection signal of definite time or IDMT overcurrent (51) element for low-voltage side on zero phase
109	THOLH-D	Detection signal of overload (49) element for high-voltage side
110	THOLL-D	Detection signal of overload (49) element for low-voltage side
111	NOC1H-D	Detection signal of 1st negative sequence overcurrent (46) element for high-voltage side
112	NOC1L-D	Detection signal of 1st negative sequence overcurrent (46) element for low-voltage side
113	NOC2H-D	Detection signal of 2nd negative sequence overcurrent (46) element for high-voltage side
114	NOC2L-D	Detection signal of 2nd negative sequence overcurrent (46) element for low-voltage side
115	CBFH-AD	Detection signal of overcurrent element for the detection of CBF (50BF) for high-voltage side on A phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
116	CBFH-BD	Detection signal of overcurrent element for the detection of CBF (50BF) for high-voltage side on B phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
117	CBFH-CD	Detection signal of overcurrent element for the detection of CBF (50BF) for high-voltage side on C phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
118	CBFH-ND	Detection signal of overcurrent element for the detection of CBF (50BF) for high-voltage side on zero phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
119	CBFL-AD	Detection signal of overcurrent element for the detection of CBF (50BF) for low-voltage side on A phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)

	Signal name	Description
120	CBFL-BD	Detection signal of overcurrent element for the detection of CBF (50BF) for low-voltage side on B phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
121	CBFL-CD	Detection signal of overcurrent element for the detection of CBF (50BF) for low-voltage side on C phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
122	CBFL-ND	Detection signal of overcurrent element for the detection of CBF (50BF) for low-voltage side on zero phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
123	DIF2f-AD	Detection signal of 2f for current ratio differential element on A-phase
124	DIF2f-BD	Detection signal of 2f for current ratio differential element on B-phase
125	DIF2f-CD	Detection signal of 2f for current ratio differential element on C-phase
126	DIF5f-AD	Detection signal of 5f for current ratio differential element on A-phase
127	DIF5f-BD	Detection signal of 5f for current ratio differential element on B-phase
128	DIF5f-CD	Detection signal of 5f for current ratio differential element on C-phase
129	OC2fH-AD	Detection signal of 2f for high-voltage side overcurrent element on A-phase
130	OC2fH-BD	Detection signal of 2f for high-voltage side overcurrent element on B-phase
131	OC2fH-CD	Detection signal of 2f for high-voltage side overcurrent element on C-phase
132	OC2fL-AD	Detection signal of 2f for low-voltage side overcurrent element on A-phase
133	OC2fL-BD	Detection signal of 2f for low-voltage side overcurrent element on B-phase
134	OC2fL-CD	Detection signal of 2f for low-voltage side overcurrent element on C-phase
135	DIFSV-AD	Detection signal of supervision of differential current on A-phase
136	DIFSV-BD	Detection signal of supervision of differential current on B-phase
137	DIFSV-CD	Detection signal of supervision of differential current on C-phase
138	ALARM	Abnormal condition of constant supervision (heavy alarm)
139	ALARM-L	Abnormal condition of constant supervision (light alarm)
140	RY-LOCK	Locking of relay
141	RESET	LED reset signal (activated by pushing the “ESC/C” button on the front panel for more than 3 seconds)
142	INTER1	1st intermediate output signal of PLC
143	INTER2	2nd intermediate output signal of PLC
144	INTER3	3rd intermediate output signal of PLC
145	INTER4	4th intermediate output signal of PLC
146	INTER5	5th intermediate output signal of PLC
147	INTER6	6th intermediate output signal of PLC
148	INTER7	7th intermediate output signal of PLC
149	INTER8	8th intermediate output signal of PLC
150	DIF-3D_O	Detection signal of any DIFF of A, B, and C phase
151	DIFH-3D_O	Detection signal of any DIFFH of A, B, and C phase
152	OC1H-3D_O	Detection signal of any OC1H of A, B, and C phase
153	OC1H-D_O	Detection signal of any OC1H of A, B, C, and zero phase
154	OC1L-3D_O	Detection signal of any OC1L of A, B, and C phase
155	OC1L-D_O	Detection signal of any OC1L of A, B, C, and zero phase
156	OC2H-3D_O	Detection signal of any OC2H of A, B, and C phase
157	OC2H-D_O	Detection signal of any OC2H of A, B, C, and zero phase
158	OC2L-3D_O	Detection signal of any OC2L of A, B, and C phase
159	OC2L-D_O	Detection signal of any OC2L of A, B, C, and zero phase
160	OC3H-3D_O	Detection signal of any OC3H of A, B, and C phase
161	OC3H-D_O	Detection signal of any OC3H of A, B, C, and zero phase
162	OC3L-3D_O	Detection signal of any OC3L of A, B, and C phase
163	OC3L-D_O	Detection signal of any OC3L of A, B, C, and zero phase
164	OC4H-3D_O	Detection signal of any OC4H of A, B, and C phase
165	OC4H-D_O	Detection signal of any OC4H of A, B, C, and zero phase
166	OC4L-3D_O	Detection signal of any OC4L of A, B, and C phase

	Signal name	Description
167	OC4L-D_O	Detection signal of any OC4L of A, B, C, and zero phase
168	CBFH-3D_O	Detection signal of any CBFH of A, B, and C phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
169	CBFH-D_O	Detection signal of any CBFH of A, B, C, and zero phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
170	CBFL-3D_O	Detection signal of any CBFL of A, B, and C phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
171	CBFL-D_O	Detection signal of any CBFL of A, B, C, and zero phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
172	DF2f-3D_O	Detection signal of any DIFF2f of A, B, and C phase
173	DF5f-3D_O	Detection signal of any DIFF5f of A, B, and C phase
174	C2fH-3D_O	Detection signal of any OC2fH of A, B, and C phase
175	C2fL-3D_O	Detection signal of any OC2fL of A, B, and C phase
176	DFSV-3D_O	Detection signal of any DIFFSV of A, B, and C phase
177	OCH-3D_O	Detection signal of any of overcurrent elements on A, B, and C phase for high-voltage side
178	OCH-D_O	Detection signal of any of overcurrent elements on A, B, C, and zero phase for high-voltage side
179	OCL-3D_O	Detection signal of any of overcurrent elements on A, B, and C phase for low-voltage side
180	OCL-D_O	Detection signal of any of overcurrent elements on A, B, C, and zero phase for low-voltage side
181	OC-3D_O	Detection signal of any of overcurrent elements on A, B, and C phase for both high and low voltage side
182	OC-D_O	Detection signal of any of overcurrent elements on A, B, C, and zero phase for both high and low voltage side
183	THOL-D_O	Detection signal of any of overload (THOL) elements
184	NOCH-D_O	Detection signal of any of negative sequence overcurrent (OCNEG) elements for high-voltage side
185	NOCL-D_O	Detection signal of any of negative sequence overcurrent (OCNEG) elements for low-voltage side
186	NOC-D_O	Detection signal of any of negative sequence overcurrent (OCNEG) elements for both high and low voltage side
187	CBF-3D_O	Detection signal of any CBF (CBFH/CBFL) of A, B, and C phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
188	CBF-D_O	Detection signal of any CBF (CBFH/CBFL) of A, B, C, and zero phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
189	DIF/RGF-D	Detection signal of any of DIF, RGFH, and RGFL elements
190	ALLEL-D_O	Detection signal of any of all elements (OR of all detection signals)
191	DIF-3_O/	Definitive signal of any DIFF of A, B, and C phase
192	DIFH-3_O/	Definitive signal of any DIFFH of A, B, and C phase
193	OC1H-3_O/	Definitive signal of any OC1H of A, B, and C phase
194	OC1H-O	Definitive signal of any OC1H of A, B, C, and zero phase
195	OC1L-3_O/	Definitive signal of any OC1L of A, B, and C phase
196	OC1L-O	Definitive signal of any OC1L of A, B, C, and zero phase
197	OC2H-3_O/	Definitive signal of any OC2H of A, B, and C phase
198	OC2H-O	Definitive signal of any OC2H of A, B, C, and zero phase
199	OC2L-3_O/	Definitive signal of any OC2L of A, B, and C phase
200	OC2L-O	Definitive signal of any OC2L of A, B, C, and zero phase
201	OC3H-3_O/	Definitive signal of any OC3H of A, B, and C phase
202	OC3H-O	Definitive signal of any OC3H of A, B, C, and zero phase
203	OC3L-3_O/	Definitive signal of any OC3L of A, B, and C phase
204	OC3L-O	Definitive signal of any OC3L of A, B, C, and zero phase
205	OC4H-3_O/	Definitive signal of any OC4H of A, B, and C phase
206	OC4H-O	Definitive signal of any OC4H of A, B, C, and zero phase

	Signal name	Description
207	OC4L-3_O/	Definitive signal of any OC4L of A, B, and C phase
208	OC4L-O	Definitive signal of any OC4L of A, B, C, and zero phase
209	CBFH-3_O/	Definitive signal of any CBFH of A, B, and C phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
210	CBFH-O	Definitive signal of any CBFH of A, B, C, and zero phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
211	CBFL-3_O/	Definitive signal of any CBFL of A, B, and C phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
212	CBFL-O	Definitive signal of any CBFL of A, B, C, and zero phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
213	DFSV-3_O	Definitive signal of any DIFFSV of A, B, and C phase
214	OCH-3_O	Definitive signal of any of overcurrent elements on A, B, and C phase for high-voltage side
215	OCH-O	Definitive signal of any of overcurrent elements on A, B, C, and zero phase for high-voltage side
216	OCL-3_O	Definitive signal of any of overcurrent elements on A, B, and C phase for low-voltage side
217	OCL-O	Definitive signal of any of overcurrent elements on A, B, C, and zero phase for low-voltage side
218	OC-3_O	Definitive signal of any of overcurrent elements on A, B, and C phase for both high and low voltage side
219	OC-O	Definitive signal of any of overcurrent elements on A, B, C, and zero phase for both high and low voltage side
220	THOL-O	Definitive signal of any of overload (THOL) elements
221	NOCH-O	Definitive signal of any of negative sequence overcurrent (OCNEG) elements for high-voltage side
222	NOCL-O	Definitive signal of any of negative sequence overcurrent (OCNEG) elements for low-voltage side
223	NOC-O	Definitive signal of any of negative sequence overcurrent (OCNEG) elements for both high and low voltage side
224	CBF-3_O	Definitive signal of any CBF (CBFH/CBFL) of A, B, and C phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
225	CBF-O	Definitive signal of any CBF (CBFH/CBFL) of A, B, C, and zero phase (This signal is available only in the relay unit with a DI card or IEC61850 GOOSE.)
226	DIF/RGF	Definitive signal of any of DIF, RGFH, and RGFL elements
227	ALLEL-O	Definitive signal of any of all elements (OR of all definitive signals)
228	GOOSE1	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
229	GOOSE2	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
230	GOOSE3	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
231	GOOSE4	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
232	GOOSE5	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
233	GOOSE6	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
234	GOOSE7	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
235	GOOSE8	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
236	GOOSE9	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
237	GOOSE10	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
238	GOOSE11	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)

	Signal name	Description
239	GOOSE12	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
240	GOOSE13	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
241	GOOSE14	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
242	GOOSE15	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
243	GOOSE16	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
244	GOOSE17	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
245	GOOSE18	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
246	GOOSE19	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
247	GOOSE20	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
248	GOOSE21	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
249	GOOSE22	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
250	GOOSE23	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
251	GOOSE24	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
252	GOOSE25	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
253	GOOSE26	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
254	GOOSE27	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
255	GOOSE28	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
256	GOOSE29	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
257	GOOSE30	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
258	GOOSE31	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
259	GOOSE32	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
260	GOOSE33	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
261	GOOSE34	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
262	GOOSE35	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
263	GOOSE36	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
264	GOOSE37	Assignment of GOOSE received signals (This signal is available only in the relay unit with IEC61850 communication card.)
265	G_TRIP1	Operating condition of CBF/CBFG element (Trip signal from other relay) (This signal is available only in the relay unit with IEC61850 communication card.)
266	G_TRIP2	Operating condition of CBF/CBFG element (Trip signal from other relay) (This signal is available only in the relay unit with IEC61850 communication card.)
267	G_TRIP3	Operating condition of CBF/CBFG element (Trip signal from other relay) (This signal is available only in the relay unit with IEC61850 communication card.)
268	DIF-A	Definitive signal of DIFF A-phase or forced operation from PC-HMI
269	DIF-B	Definitive signal of DIFF B-phase or forced operation from PC-HMI

	Signal name	Description
270	DIF-C	Definitive signal of DIFF C-phase or forced operation from PC-HMI
271	DIF-3_O	Definitive signal of any DIFF of A, B, and C phase or forced operation from PC-HMI
272	DIFH-A	Definitive signal of DIFFH A-phase or forced operation from PC-HMI
273	DIFH-B	Definitive signal of DIFFH B-phase or forced operation from PC-HMI
274	DIFH-C	Definitive signal of DIFFH C-phase or forced operation from PC-HMI
275	DIFH-3_O	Definitive signal of any DIFFH of A, B, and C phase or forced operation from PC-HMI
276	RGFH	Definitive signal of RGFH or forced operation from PC-HMI
277	RGFL	Definitive signal of RGFL or forced operation from PC-HMI
278	OC1H-A	Definitive signal of OC1H A-phase or forced operation from PC-HMI
279	OC1H-B	Definitive signal of OC1H B-phase or forced operation from PC-HMI
280	OC1H-C	Definitive signal of OC1H C-phase or forced operation from PC-HMI
281	OC1H-3_O	Definitive signal of any OC1H of A, B, and C phase or forced operation from PC-HMI
282	OC1H-N	Definitive signal of OC1H zero-phase or forced operation from PC-HMI
283	OC1L-A	Definitive signal of OC1L A-phase or forced operation from PC-HMI
284	OC1L-B	Definitive signal of OC1L B-phase or forced operation from PC-HMI
285	OC1L-C	Definitive signal of OC1L C-phase or forced operation from PC-HMI
286	OC1L-3_O	Definitive signal of any OC1L of A, B, and C phase or forced operation from PC-HMI
287	OC1L-N	Definitive signal of OC1L zero-phase or forced operation from PC-HMI
288	OC2H-A	Definitive signal of OC2H A-phase or forced operation from PC-HMI
289	OC2H-B	Definitive signal of OC2H B-phase or forced operation from PC-HMI
290	OC2H-C	Definitive signal of OC2H C-phase or forced operation from PC-HMI
291	OC2H-3_O	Definitive signal of any OC2H of A, B, and C phase or forced operation from PC-HMI
292	OC2H-N	Definitive signal of OC2H zero-phase or forced operation from PC-HMI
293	OC2L-A	Definitive signal of OC2L A-phase or forced operation from PC-HMI
294	OC2L-B	Definitive signal of OC2L B-phase or forced operation from PC-HMI
295	OC2L-C	Definitive signal of OC2L C-phase or forced operation from PC-HMI
296	OC2L-3_O	Definitive signal of any OC2L of A, B, and C phase or forced operation from PC-HMI
297	OC2L-N	Definitive signal of OC2L zero-phase or forced operation from PC-HMI
298	OC3H-A	Definitive signal of OC3H A-phase or forced operation from PC-HMI
299	OC3H-B	Definitive signal of OC3H B-phase or forced operation from PC-HMI
300	OC3H-C	Definitive signal of OC3H C-phase or forced operation from PC-HMI
301	OC3H-3_O	Definitive signal of any OC3H of A, B, and C phase or forced operation from PC-HMI
302	OC3H-N	Definitive signal of OC3H zero-phase or forced operation from PC-HMI
303	OC3L-A	Definitive signal of OC3L A-phase or forced operation from PC-HMI
304	OC3L-B	Definitive signal of OC3L B-phase or forced operation from PC-HMI
305	OC3L-C	Definitive signal of OC3L C-phase or forced operation from PC-HMI
306	OC3L-3_O	Definitive signal of any OC3L of A, B, and C phase or forced operation from PC-HMI
307	OC3L-N	Definitive signal of OC3L zero-phase or forced operation from PC-HMI
308	OC4H-A	Definitive signal of OC4H A-phase or forced operation from PC-HMI
309	OC4H-B	Definitive signal of OC4H B-phase or forced operation from PC-HMI
310	OC4H-C	Definitive signal of OC4H C-phase or forced operation from PC-HMI
311	OC4H-3_O	Definitive signal of any OC4H of A, B, and C phase or forced operation from PC-HMI
312	OC4H-N	Definitive signal of OC4H zero-phase or forced operation from PC-HMI
313	OC4L-A	Definitive signal of OC4L A-phase or forced operation from PC-HMI
314	OC4L-B	Definitive signal of OC4L B-phase or forced operation from PC-HMI
315	OC4L-C	Definitive signal of OC4L C-phase or forced operation from PC-HMI
316	OC4L-3_O	Definitive signal of any OC4L of A, B, and C phase or forced operation from PC-HMI
317	OC4L-N	Definitive signal of OC4L zero-phase or forced operation from PC-HMI
318	THOLH	Definitive signal of THOLH or forced operation from PC-HMI
319	THOLL	Definitive signal of THOLL or forced operation from PC-HMI
320	NOC1H	Definitive signal of OCNEG1H or forced operation from PC-HMI
321	NOC1L	Definitive signal of OCNEG1L or forced operation from PC-HMI
322	NOC2H	Definitive signal of OCNEG2H or forced operation from PC-HMI

	Signal name	Description
323	NOC2L	Definitive signal of OCNEG2L or forced operation from PC-HMI
324	CBFH-A	Definitive signal of CBFH A-phase or forced operation from PC-HMI
325	CBFH-B	Definitive signal of CBFH B-phase or forced operation from PC-HMI
326	CBFH-C	Definitive signal of CBFH C-phase or forced operation from PC-HMI
327	CBFH-3_O	Definitive signal of any CBFH of A, B, and C phase or forced operation from PC-HMI
328	CBFH-N	Definitive signal of CBFH zero-phase or forced operation from PC-HMI
329	CBFL-A	Definitive signal of CBFL A-phase or forced operation from PC-HMI
330	CBFL-B	Definitive signal of CBFL B-phase or forced operation from PC-HMI
331	CBFL-C	Definitive signal of CBFL C-phase or forced operation from PC-HMI
332	CBFL-3_O	Definitive signal of any CBFL of A, B, and C phase or forced operation from PC-HMI
333	CBFL-N	Definitive signal of CBFL zero-phase or forced operation from PC-HMI

6. Standard (Technical data)

Guaranteed performance

Common conditions	Frequency: Rated frequency Control power supply voltage: Rated voltage Ambient temperature: 20°C Humidity: 5-95%	Unless otherwise indicated, the common conditions shall be as described in the left column.

6.1. Relay characteristic data

Item	Test condition		Standard
Operating value	All elements	1) Current setting value	1) Setting value ±5%
Return value	All elements	1) Current setting value	2) Current operation value × 95% or more
Inertial characteristic	Time-limit element of overcurrent (51) Time-limit element of ground-fault overcurrent (51N)	Setting value: Current setting value = Minimum Operating time magnification = Minimum Operating characteristics = All characteristics Current input: Current = 0 → Current setting value × 1000% Energizing time: Theoretical value of operating time × 90%	The relay shall not operate.
Operating time	Overcurrent element (50) Ground-fault overcurrent element (50N) Negative-phase-sequence overcurrent element (46)	Setting value: Current setting value = Minimum Input: Current = 0 → Current setting value × 200% (a) Ope.Time : 0.00 s (b) Ope.Time: 0.01 ~ 1.00 s (c) Ope.Time: 1.00 ~ 10 s	(a) Within 30 ms (b) Ope.Time ± within 50 ms (c) Ope.Time ± within 5%
	Time-limit element of overcurrent (51) Time-limit element of ground-fault overcurrent (51N)	Setting value: Current setting value = Minimum Input: Current = (a) 0→Ope.Curt.×300% (b) 0→Ope.Curt.×500% (c) 0→Ope.Curt.×1000%	▪ Other than DT01 (a) Operating time characteristic ± within 12% (b) Operating time characteristic ± within 7% (c) Either one of the followings, having a larger error Operating time characteristic ± within 5% Operating time characteristic ± within 100 ms ▪ DT01 Either one of the followings, having a larger error Operating time characteristic ± within 5% Operating time characteristic ± within 50 ms

	Thermal Overload Element (49)	Setting value: Current setting value = 1.0A Operating time magnification = 8 Negative-phase heat generation Magnification = 1 Input: Current = (a) 0→Ope.Curt.×300% (b) 0→Ope.Curt.×500% (b) 0→Ope.Curt.×1000%	(a) 8.000s ± within 12% (b) 2.773s ± within 7% (c) 1.000s ± within 5%
	CBF detection	Setting value: Current setting value = Minimum Input: Current = 0 → Current setting value × 200% (a) Ope.Time : 0.00 s (b) Ope.Time: 0.01 ~ 1.0 s (c) Ope.Time: 1.0 ~ 10 s	(a) Within 50 ms (b) Ope.Time ± within 50 ms (c) Ope.Time ± within 5%
	Current Ratio Differential Element (87)	Setting value: TRH Con. : 0 TRH Zero : 0 TRL Con : 0 TRL Zero : 0 ITH : 2.2A ITL : 2.2A 2f lock ratio : 5% 2f-Min. Ope. : 0.4A 5f lock ratio : 5% 5f-Min. Ope. : 0.4A Ires Meth : MAX Opr.Curt. : 20% ratio K1 : 15% ratio K2 : 15% Is Curt. : 100% SV EN : ON SV Curt. : 5% SV ratio : 0% 2f lock EN : ON 2f-lock Meth. : 1P LOCK 5f lock EN : ON Input: Current = 0→Ope.Curt.×200% (a) Ope.Time : 0.00 s (b) Ope.Time: 0.01 ~ 1.0 s (c) Ope.Time: 1.0 ~ 10 s	(a) Within 40 ms (b) Ope.Time ± within 50 ms (c) Ope.Time ± within 5%
	Differential Overcurrent Element(87TH)	Setting value: TRH Con. : 0 TRH Zero : 0 TRL Con : 0 TRL Zero : 0 ITH : 2.2A ITL : 2.2A Ope.Curt. : 5 Input: Current = 0→Ope.Curt.×200% (a) Ope.Time : 0.00 s (b) Ope.Time: 0.01 ~ 1.0 s (c) Ope.Time: 1.0 ~ 10 s	(a) Within 30 ms (b) Ope.Time ± within 50 ms (c) Ope.Time ± within 5%
	Zero-phase Current Ratio Differential Element(87TN)	Setting value: ITH : 2.2A ITL : 2.2A Ope.Curt. : 10.0%	(a) Within 30 ms (b) Ope.Time ± within 50 ms (c) Ope.Time ± within 5%

		Ratio K1 : 10%, Ratio K2 : 10% Is Curt. : 100% CT Sat. Meas. : ON RGFH(L) I0 EN : ON I0 Ope.Curt. : 5.0A Input: Current = 0→Ope.Curt.×200% (a) Ope.Time : 0.00 s (b) Ope.Time: 0.01 ~ 1.0 s (c) Ope.Time: 1.0 ~ 10 s	
Reset time	Overcurrent element (50) Ground-fault overcurrent element (50N) Negative-phase-sequence overcurrent element (46)	Setting value: Current setting value = Minimum Input: Current = Current setting value × 200% → 0	200 ms ± within 25 ms
	Time-limit element of overcurrent (51) Time-limit element of ground-fault overcurrent (51N)	Setting value: Current setting value = Minimum (a) Rst. Chr.=DT (b) Rst. Chr.=IDMT (c) Rst. Chr.=INST Input: Current setting value × 300% → 0	(a) 200 ms ± within 25 ms (b) 200 ms ± within 25 ms (c) 50 ms or less
	Thermal Overload element (49)	Setting value: Current setting value = 1.0A Operating time magnification = 8 Negative-phase heat generation Magnification = 1 Input: Current = Ope.Curt.×300% → 0	HOT characteristic (300% input is applied for 5 minutes or more and then input is turned to zero.) 149.2 s ± 5 % COLD characteristic 200 ms ± within 25 ms
	CBF detection	Setting value: Current setting value = Minimum Input: Current = Current setting value × 200% → 0	200 ms ± within 25 ms
	Current Ratio Differential Element (87)	Setting value: TRH Con. : 0 TRH Zero : 0 TRL Con : 0 TRL Zero : 0 ITH : 2.2A ITL : 2.2A 2f lock ratio : 5% 2f-Min. Ope. : 0.4A 5f lock ratio : 5% 5f-Min. Ope. : 0.4A Ires Meth : MAX Opr.Curt. : 20% ratio K1 : 15% ratio K2 : 15% Is Curt. : 100% SV EN : ON SV Curt. : 5% SV ratio : 0% 2f lock EN : ON 2f-lock Meth. : 1P LOCK 5f lock EN : ON Input: Current = Ope.Curt.×200%→0	200 ms ± within 25 ms
	Differential Overcurrent Element(87TH)	Setting value: TRH Con. : 0 TRH Zero : 0 TRL Con : 0 TRL Zero : 0 ITH : 2.2A ITL : 2.2A Ope.Curt. : 5	200 ms ± within 25 ms

		Input: Current = Ope.Curt.×200%→0	
	Zero-phase Current Ratio Differential Element(87TN)	Setting value: ITH : 2.2A ITL : 2.2A Ope.Curt. : 10.0% Ratio K1 : 10%, Ratio K2 : 10% Is Curt. : 100% CT Sat. Meas. : ON RGFH(L) I0 EN : ON I0 Ope.Curt. : 5.0A Input: Current = Ope.Curt.×200%→0	200 ms ± within 25 ms
Temperature characteristics	Time-limit element of overcurrent, Time-limit element of ground-fault overcurrent (51, 51N)	Setting value: Current setting value = Minimum Ope. Chr.= Other than DT01 Input: Current = (a) 0→Ope.Curt.×300% (b) 0→Ope.Curt.×500% (c) 0→Ope.Curt.×1000%	The error relates to the operating value & operating time when ambient temperature is 20°C. ● When ambient temperature is 0, 40°C: Operating value ± within 5% (a) Operating time ± within 12% (b) Operating time ± within 7% (c) Operating time ± within 5% ● When ambient temperature is -10, 50°C: Operating value ± within 10% (a) Operating time ± within 24% (b) Operating time ± within 14% (c) Operating time ± within 10% ● When ambient temperature is -40, 60°C: Operating value ± within 20% (a) Operating time ± within 48% (b) Operating time ± within 28% (c) Operating time ± within 20%
	Other elements	(a) 0, 40°C (b) -10, 50°C (c) -40, 60°C	The error relates to the operating value & operating time when ambient temperature is 20°C. (a) Operating value ± within 5% Operating time ± within 5% (b) Operating value ± within 10% Operating time ± 10% (c) Operating value ± within 20% Operating time ± 20%
DC power supply voltage characteristics	All elements	Variation range of control power supply =DC88, DC300 V, AC85, AC264 V	Within ± 5% to the measured value at DC rated voltage
Distorted wave characteristics	Other elements	Third harmonic: Distortion rate 30% superposition	Operating value when only 1f is inputted ± within 10%
		Fifth harmonic: Distortion rate 30% superposition	
		Seventh harmonic: Distortion rate 30% superposition	

6.2. General specification data

<table>
<tr><th>Item</th><th colspan="4">Test condition</th><th>Standard</th></tr>
<tr><td rowspan="4">Contact capacity</td><td colspan="2" rowspan="2">Contact for tripping</td><td colspan="2">Closed circuit capacity</td><td>DC250 V:30 A
0.2s L/R=0</td></tr>
<tr><td colspan="2">Open-circuit capacity</td><td>DC250 V:0.2 A
L/R=40 ms</td></tr>
<tr><td colspan="2" rowspan="2">Contact for control, emergency monitoring</td><td colspan="2">Closed circuit capacity</td><td>DC250 V:0.2 A
L/R=7 ms</td></tr>
<tr><td colspan="2">Open-circuit capacity</td><td>DC250 V:0.2 A
L/R=7 ms</td></tr>
<tr><td rowspan="2">Overload capacity</td><td>Current circuit</td><td colspan="3">Rated current × 3 times Continuous
Rated current × 40 times 2 s, twice, 1 min interval
Rated current × 100 times 1 s</td><td rowspan="2">Unfavorable reactions such as erroneous operation, faulty indication, etc., as well as trouble of performance must not be generated.</td></tr>
<tr><td>Voltage circuit</td><td colspan="3">Rated voltage × 1.15 times, 3 hr</td></tr>
<tr><td>Insulation resistance</td><td colspan="4">DC500 V megohmmeter is used.
(1) Between collective electric circuit and ground (However, the serial communication circuit is excluded.)
(2) Between mutual circuits, between contact poles (However, the serial communication circuit is excluded.)</td><td>(1) 10 MΩ or more
(2) 5 MΩ or more</td></tr>
<tr><td>Withstand voltage at commercial frequency</td><td colspan="4">IEC60255-5
(1) Between collective electric circuit and ground: AC2000 V, 1 min
(2) Between mutual circuits, between contact poles: AC2000 V, 1 min (However, the serial communication circuit is excluded.)
(3) Between contact terminals (between poles): AC1000 V, 1 min</td><td>Unfavorable reactions such as erroneous operation, faulty indication, etc., as well as trouble of performance must not be generated.</td></tr>
<tr><td rowspan="2">Withstand voltage against lightning impulse</td><td colspan="4">IEC60255-5</td><td rowspan="2">Unfavorable reactions such as erroneous operation, faulty indication, etc., as well as trouble of performance must not be generated.</td></tr>
<tr><td>Standard shock voltage waveform (1.2/50 μs)
Application for each 3 times by positive or negative pole</td><td>5 kV</td><td>・Between collective electric circuit and ground
・Between mutual transformer circuits for measuring instruments
・Between the transformer circuit for measuring instrument and the control circuit
(However, the serial communication circuit is excluded.)</td><td></td></tr>
<tr><td></td><td>5 kV</td><td>・Between terminals of transformer circuit for measuring instrument
・Between terminals of control power supply circuit
(However, the serial communication circuit is excluded.)</td><td></td></tr>
<tr><td>Trouble of control power supply</td><td colspan="4">IEC60255-11
IEC61000-4-11
Confirm that faulty indication and erroneous operation do not exist at the occasion of turning on/off control power supply, instantaneous interruption of the control power supply, and slow variation of the control power supply.</td><td>Unfavorable reactions such as erroneous operation, faulty indication, etc. must not exist.</td></tr>
<tr><td></td><td colspan="4">Go to next page</td><td></td></tr>
</table>

Item	Test condition	Standard
Immunity against electrostatic discharge	IEC60255-22-2 class4 8 kV: Contact discharge 15 kV: Aerial discharge	Unfavorable reactions such as erroneous operation, faulty indication, etc., as well as trouble of performance must not be generated.
Immunity against commercial frequency	IEC60255-22-7 Applied point: Between line and ground Test voltage: 300 V, Test time: 10 s Applied point: Between lines Test voltage: 150 V, Test time: 10 s	Unfavorable reactions such as erroneous operation, faulty indication, etc., as well as trouble of performance must not be generated.
Immunity against damped oscillatory wave	IEC60255-22-1 ・ Peak value of 1st wave: 2.5 kV ・ Vibration frequency: 1 MHz±10% ・ Damping time to 1/2: 3 ~ 6 cycles ・ Frequency of repetition: 6 ~ 10 times/ 1 cycle of commercial frequency (asynchronous) ・ Output impedance of test circuit: 200 Ω±10% Applied point: Between collective transformer circuit and ground Between collective control power supply circuit and ground Between terminals of control power supply circuit	Unfavorable reactions such as erroneous operation, faulty indication, etc., as well as trouble of performance must not be generated.
Electric fast transient/Burst immunity	IEC60255-22-4 Applied voltage: ±4.0 kV (Class A) Repetition frequency: 5.0 KHz, 100 kHz Applied place: Between collective control power supply circuit and ground Applied voltage: ±2.0 kV (Class B) Repetition frequency: 5.0 KHz, 100 kHz Applied place: Between collective transformer circuit for measuring instrument and ground Between collective control input circuit and ground	Unfavorable reactions such as erroneous operation, faulty indication, etc., as well as trouble of performance must not be generated.
Surge immunity	IEC60255-22-5 Application time: 1.2/50 (8/20)μs TR/TS voltage (current) Effective output impedance: 2 Ω ・ Applied place: Between terminals of control power supply circuit Applied voltage: 0.5, 1 kV (0 Ω, 18 μF) ・ Applied place: Between collective control power supply circuit and ground Applied voltage: 0.5, 1, 2 kV (10 Ω, 9 μF) ・ Applied place: Between collective control input/output (communication) circuit and ground Applied voltage: 0.5, 1 kV (0 Ω, 0 μF) ・ Applied place: Between terminals of collective control input/output circuit Applied voltage: 0.5, 1 kV (40 Ω, 0.5 μF) ・ Applied place: Between collective control input/output circuit and ground Applied voltage: 0.5, 1, 2 kV (40 Ω, 0.5 μF) ・ Applied place: Between terminals of transformer circuit for measuring instrument	Unfavorable reactions such as erroneous operation, faulty indication, etc., as well as trouble of performance must not be generated.

Item	Test condition	Standard
	Applied voltage: 0.5, 1 kV (40 Ω, 0.5 μF) ▪ Applied place: Between transformer circuit for measuring instrument and ground Applied voltage: 0.5, 1, 2 kV (40 Ω, 0.5 μF)	
Immunity against commercial frequency magnetic field	IEC60255-26 IEC61000-4-8 level5 Magnetic field intensity: 100 A/m continuous 1000 A/m 1 s ~ 3 s * Setting value of the I0 circuit for ZCT input shall be implemented at 5 mA or more.	Unfavorable reactions such as erroneous operation, faulty indication, etc., as well as trouble of performance must not be generated.
Immunity against conducted interference of radio frequency magnetic field (RF)	IEC60255-22-6 Frequency range: 150 kHz ~ 80 MHz 27, 68 MHz Voltage level: 10 V Amplitude modulation: 1 kHz, ±80%	Unfavorable reactions such as erroneous operation, faulty indication, etc., as well as trouble of performance must not be generated.
Immunity against radiant radio frequency magnetic field	IEC60255-22-3 Frequency range: 80 MHz ~ 1 GHz 1.4 GHz ~ 2.7 GHz 80, 160, 450, 900, 1890, 2150 MHz Electric field intensity: 10 V/m Amplitude modulation: 1 KHz, ±80%	Unfavorable reactions such as erroneous operation, faulty indication, etc., as well as trouble of performance must not be generated.
Conductive emission	IEC60255-25 Perform measurement by using the receiver for measuring average value and the receiver for measuring quasipeak value.	0.15 ~ 0.5 MHz: Quasipeak value 79 dBμs Average value 66 dBμs 0.5 ~ 30 MHz: Quasipeak value 73 dBμs Average value 60 dBμs
Radiant emission	IEC60255-25 [1] CE specification (EMC Directive) (CISPR22-A) [2] FCC specification (FCC-part15-A) Regarding the both of above-mentioned 2 specifications, perform measurement by using the receiver for measuring quasipeak value.	[1] CE specification 30 ~ 230 MHz: Quasipeak value 40 dBμs 230 ~ 1000 MHz: Quasipeak value 47 dBμs [2] FCC specification 30 ~ 88 MHz: Quasipeak value 39.1 dBμs 88 ~ 216 MHz: Quasipeak value 43.5 dBμs 216 ~ 1000 MHz: Quasipeak value 46.4 dBμs
Vibration	IEC60255-21-1 class1 [1] Response speed ▪ Frequency range: 10 ~ 150 Hz ▪ Sweep speed: 1 octave/min ▪ Crossover frequency: 58 ~ 60 Hz	Unfavorable reactions such as erroneous operation, faulty indication, etc., as well as trouble of performance must not be generated.

Item	Test condition	Standard
	・ Test time: 8 min × 1 ・ Number of tests: Each direction: Once [2] Endurance test ・ Frequency range: 10 ~ 150 Hz ・ Sweep speed: 1 octave/min ・ Double amplitude: 5 ~ 0.022 mm ・ Test time: 8 min × 20 times ・ Acceleration: 9.8 m/s^2 * Power supply and input are zero.	
Impact	IEC60255-21-2 class1 [1] Response test ・ Impact acceleration: 5 G (49 m/s^2), pulse application range: 11 ms ・ Direction of impact application: Respective 3 directions in back and forth, right and left, up and down (3 times/bidirection) ・ Direction of impact application: 18 times ・ Status of Power ON [2] Impact resistance test ・ Impact acceleration: 15 G (147 m/s^2), pulse application range: 11 ms ・ Direction of impact application: Respective 3 directions in back and forth, right and left, up and down (1000 times/bidirection) ・ Direction of impact application: 18 times ・ Status of Power OFF [3] Bump test ・ Impact acceleration: 10 G (98 m/s^2), pulse application range: 16 ms ・ Direction of impact application: Respective 3 directions in back and forth, right and left, up and down (1000 times/bidirection) ・ Direction of impact application: 6000 times	Unfavorable reactions such as erroneous operation, faulty indication, etc., as well as trouble of performance must not be generated.
Earthquake	IEC60255-21-3 class2 • Frequency range: 1 ~ 35 Hz fc (in the case where crossover frequency is 8 Hz) amplitude 1 ~ 5 Hz X: 7.5 mm, Y: 3.5 mm 5 ~ 8 Hz X: 7.5 mm, Y: 3.5 mm 8 ~ 35 Hz X: 2.0 G (19.6 m/s^2), Y: 1.0 G (9.8 m/s^2) ・ Sweep speed: 1 octave/min → 1 sweep time (about 10 min) ・ Direction of impact application: Respective 3 directions in back and forth, right and left, up and down (sweep of 1 time) ・ Direction of impact application: Sweep of 3 times	During excitation, unfavorable reactions such as erroneous operation, faulty indication, etc. must not exist. After excitation, measure the operating value, operating time, and confirm that no problem exists by comparing with the value before the excitation.
Dry heat	IEC60068-2-2 Operating temperature: 60°C, 16 hours Storage temperature: 85°C, 16 hours	Any anomaly such as fissure, crack, or deformation, etc. shall not exist on external appearance & structure. No anomaly shall exist on indication, etc. Measure the operating values of respective elements before & after the test, and the values shall be within the standard.
Low temperature	IEC60068-2-1 Operating temperature: -40°C, 16 hours Storage temperature: -40°C, 16 hours	Any anomaly such as fissure, crack, or deformation, etc. shall not exist on external appearance & structure. No anomaly shall exist on indication, etc. Measure the operating values of respective elements before & after the test, and the values

Item	Test condition	Standard
		shall be within the standard.
Temperature & humidity cycle test	To be based on IEC60068-2-30 (JIS-C60068-2-30 variant 2) Perform cyclic change of temperature & humidity between 40°C/95%RH and 25°C/95%RH. 1 cycle: 24 hours Number of cycles: 56 cycles	Any anomaly such as fissure, crack, or deformation, etc. shall not exist on external appearance & structure. Measure the operating values of respective elements before & after the test, and confirm that the values are within the standard.
Temperature and humidity combination (cyclic) test	IEC 60068-2-38 Perform cyclic change of temperature & humidity among 65°C/93%RH, 25°C/93%RH, and -10°C/80%RH. 1 cycle: 24 hours Number of cycles: 5 Control power supply circuit: Rated voltage	Any anomaly such as fissure, crack, or deformation, etc. shall not exist on external appearance & structure. Measure the operating values of respective elements before & after the test, and confirm that the values are within the standard.
Damp heat test	IEC 60068-2-78(3) Temperature/humidity: 40°C/93%RH Number of cycles: 56 days	Any anomaly such as fissure, crack, or deformation, etc. shall not exist on external appearance & structure. Measure the operating values of respective elements before & after the test, and confirm that the values are within the standard.
Load	(1) Current circuit (2) Voltage circuit (3) Zero-phase voltage circuit (4) Control power supply	(1) At the rating of 5 A: 0.6 VA or less (2) 0.1 VA or less (3) 0.1 VA or less (4) 20 W or less
Mass		4 kg or less

7. Connection
7.1. External Connection

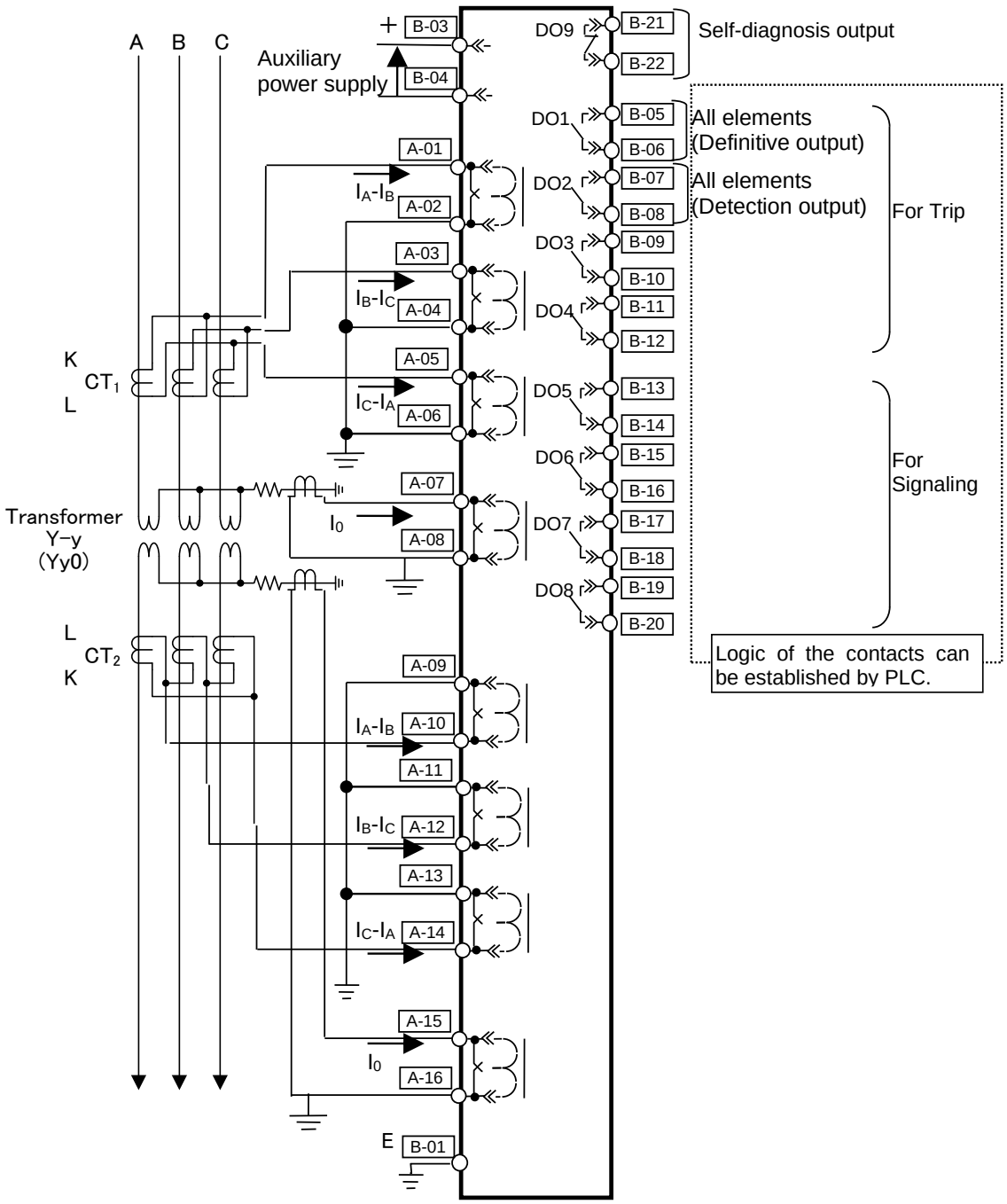


Fig. 7-1 Example connection for Star-Star transformer (Yy0)

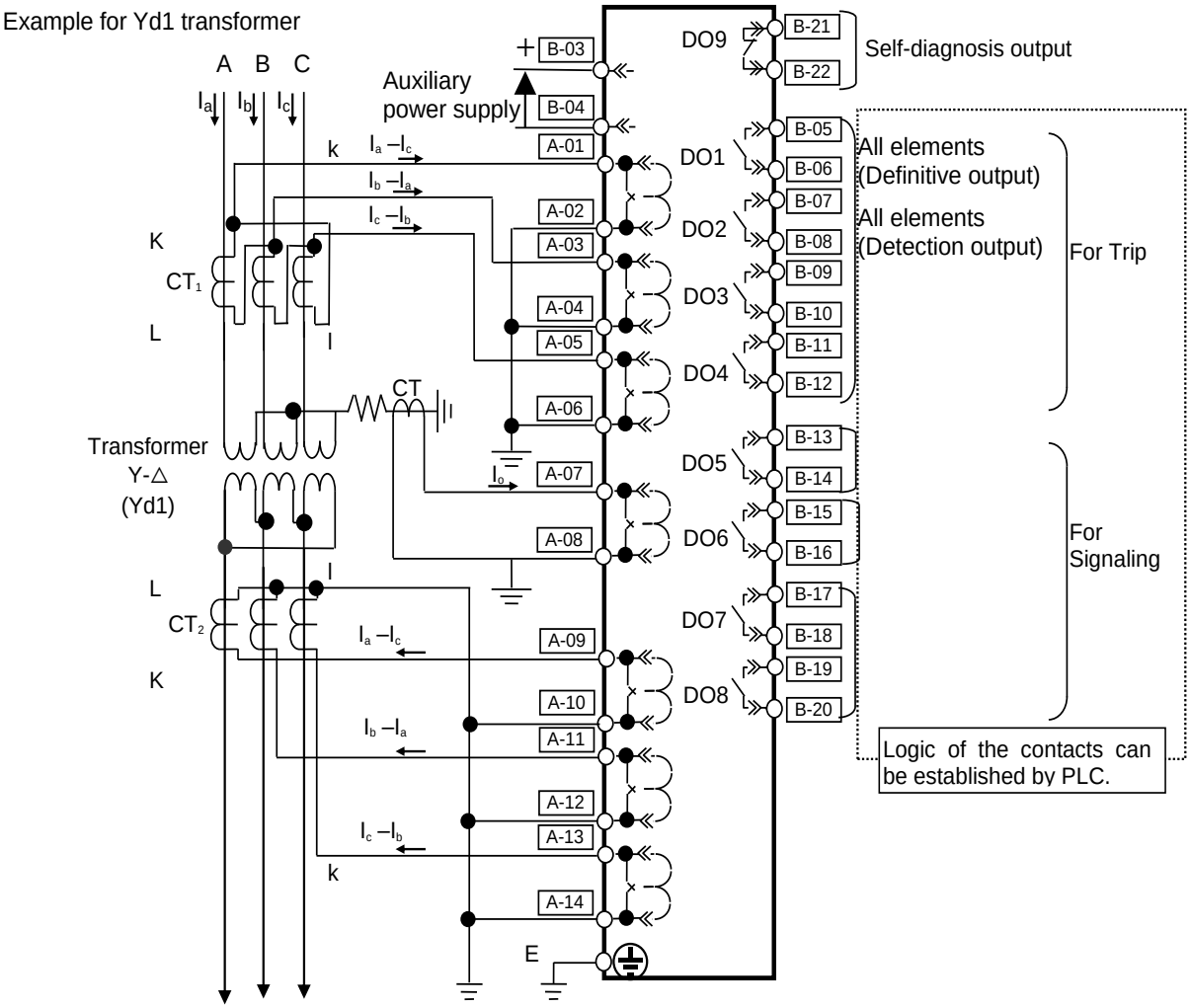


Fig. 7-2 Example connection for Star-Delta transformer (Yd1)

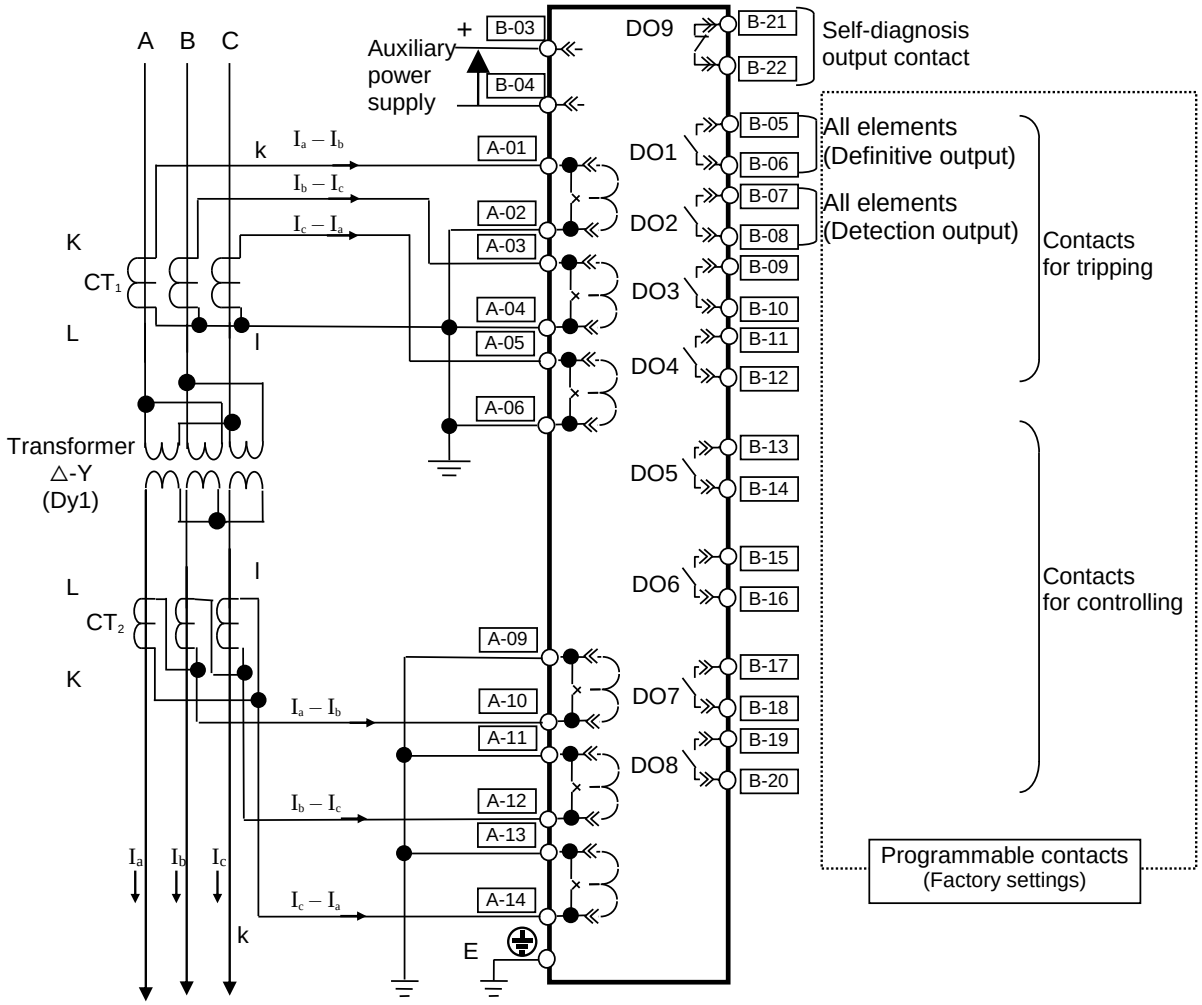


Fig. 7-3 Example connection for Delta-Star transformer (Dy1)

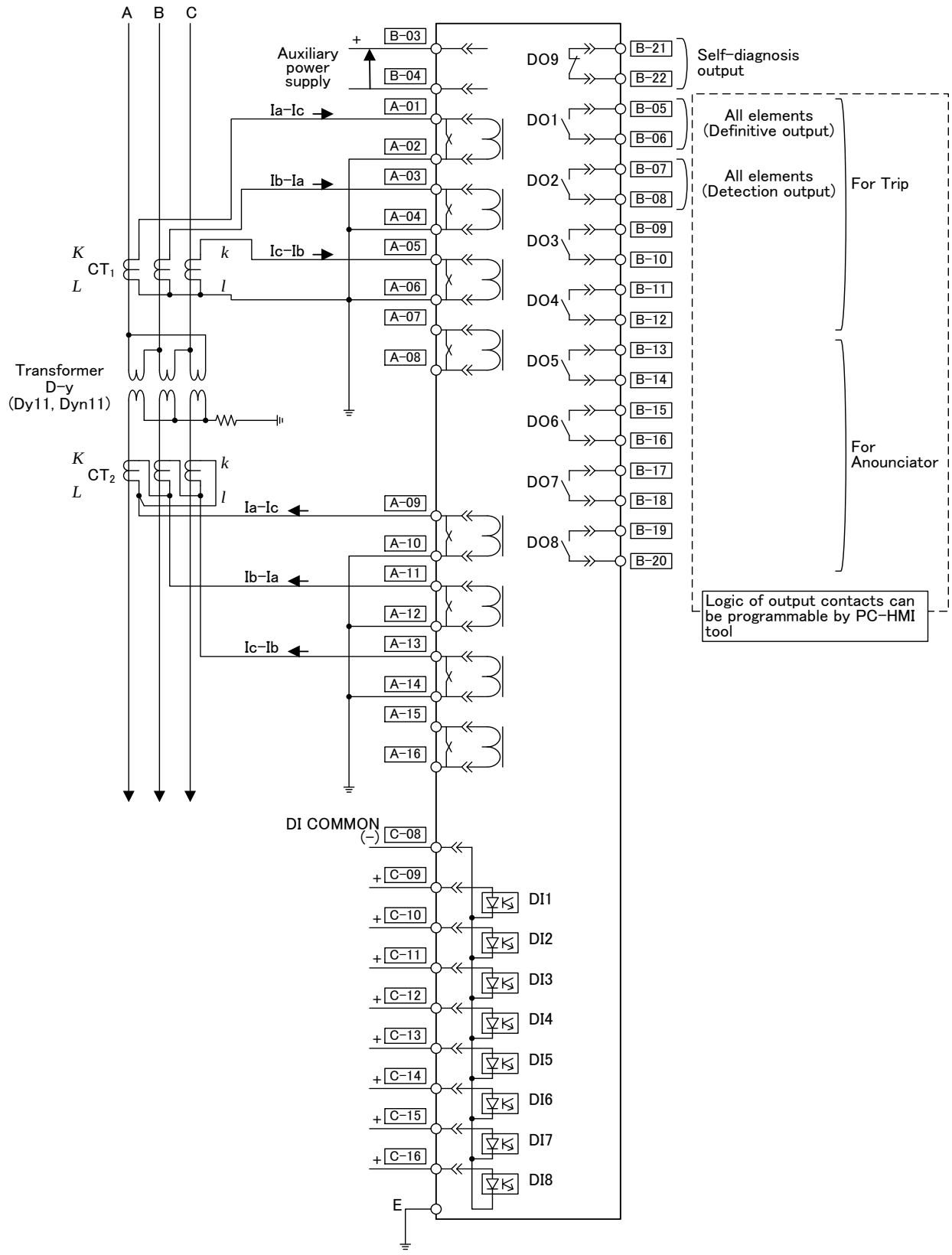


Fig. 7-4 Example connection for Delta-Star transformer (Dy11)

8. Test

Although all necessary functional tests are implemented for this relay before shipment from the factory, it is recommendable to perform the tests with reference to the following items, before use.

8.1. Visual inspection

Perform the visual inspection check with reference to the following items.

Inspection item	Contents of inspection
Unit (working part)	(1) No deformation (2) Operational check of the operation key switches (3) Neither discoloration nor deformation of the front name plate (4) No damage at the terminal connectors
Case	No damage including the terminal connectors
Others	No foreign substances, such as dust, iron pieces, etc.

8.2. Characteristic test

8.2.1. Notes related to the tests

(1) Recommended test condition

Regarding the ambient conditions, following conditions shall be complied with, as far as possible.
If the test is performed at the condition which is significantly different from the next condition, the correct test results may not be obtained.

- Ambient temperature: 20°C ± 10°C
- Rated frequency: ±1%
- Waveform (AC): Distortion factor 2% or less
- Control voltage: Rated voltage ±2%

(2) Functional control points

Refer to Chapter 6.
The functional control point (standard point) of each relay's element shall be checked by the relay alone. Therefore, when the combined test with external devices such as CT, ZCT, etc. is performed, it shall be considered the error factor of external devices.
Furthermore, if user-defined control point is specified (e.g. accracy of relay characteristic is controlled at service conditions), execute the test at the manufacturer-defined control point (mentioned in Section 6.1) before in-service operation and then check accuracy of the relay.
After that, execute the test at the user-defined control point, and set this data to the subsequent standards.

(3) Setting change

Refer to 4.3.4.1 for the setting change.

(4) Judgment of operation

Basically, the measurement of the operating value, operating time, etc. shall be done by open/close of the output relay contact of each element.

(5) Communication card

Regardless of equipping or not of the communication card, the test voltage input to the serial communication circuit shall be avoided at the dielectric test and the impulse voltage test.

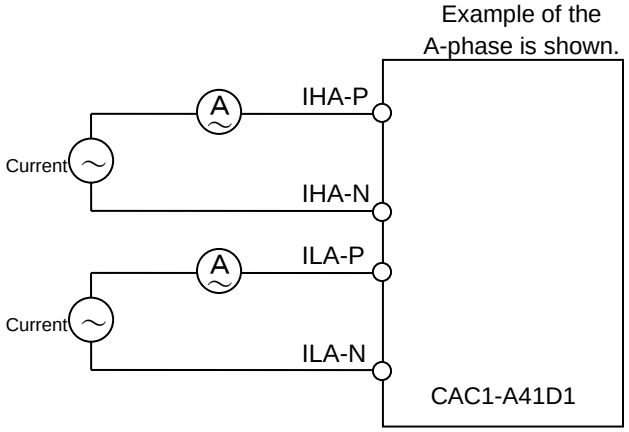
Furthermore, when the communication card is equipped with, it is not necessary to disconnect the communication card at the test.

8.2.2. Characteristic test

8.2.2.1. Test circuit

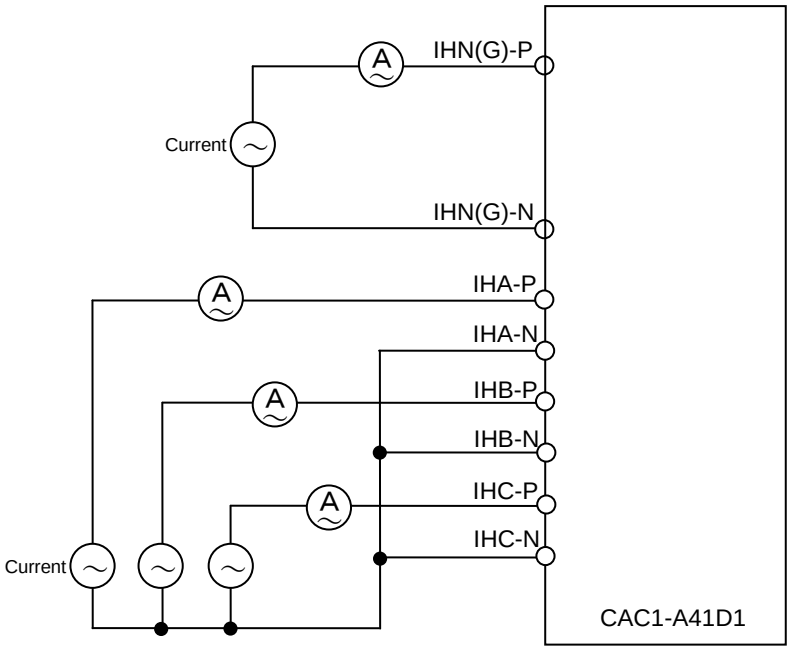
The external connection of AC input circuit is as shown below as a reference.
Refer to Fig. 1-5 on Chapter 1 for the terminal arrangement.

[1] Current ratio differential element, Differential overcurrent element



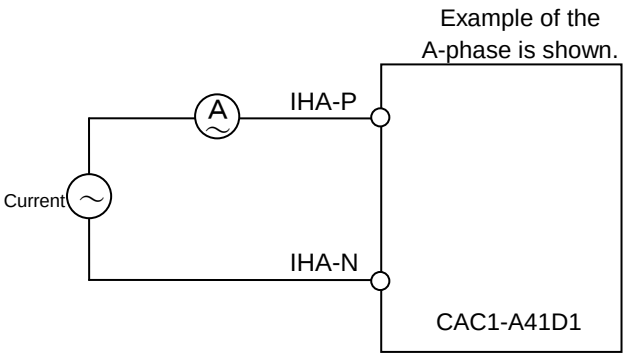
Test phase	Terminal No.	
A-phase	IHA-P～IHA-N	ILA-P～ILA-N
B-phase	IHB-P～IHB-N	ILB-P～ILB-N
C-phase	IHC-P～IHC-N	ILC-P～ILC-N

[2] Zero-phase differential current element, CBF detection element



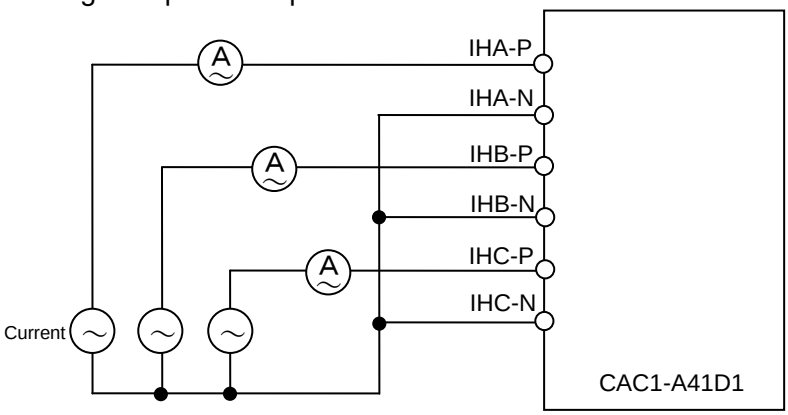
Test phase	Terminal No.
HV side	IHA-P～IHA-N, IHB-P～IHB-N IHC-P～IHC-N, IHN(G)-P～I HN(G)-N
LV side	ILA-P～ILA-N, ILB-P～ILB-N ILC-P～ILC-N, ILN(G)-P～ILN(G)-N

[3] Overcurrent element



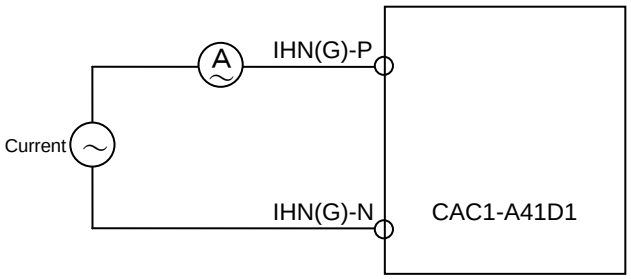
Test phase	Terminal No.
A-phase	IHA-P～IHA-N
	ILA-P～ILA-N
B-phase	IHB-P～IHB-N
	ILB-P～ILB-N
C-phase	IHC-P～IHC-N
	ILC-P～ILC-N

[4] Negative-phase-sequence overcurrent element



Test phase	Terminal No.
HV side	IHA-P～IHA-N, IHB-P～IHB-N IHC-P～IHC-N
LV side	ILA-P～ILA-N, ILB-P～ILB-N ILC-P～ILC-N

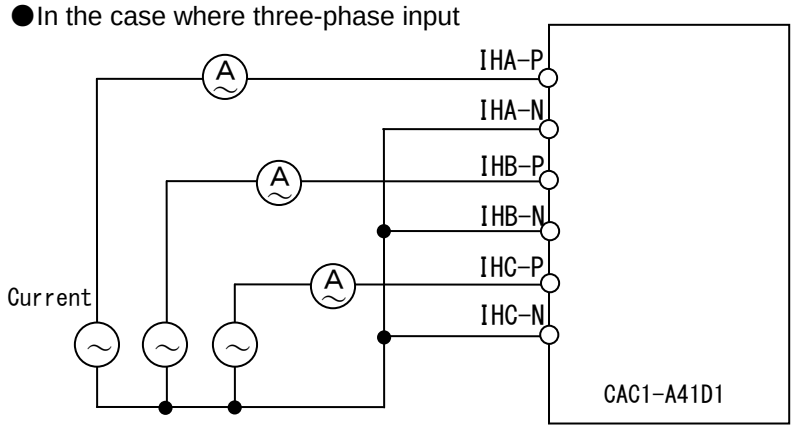
[5] Ground-fault current element



Test phase	Terminal No.
HV side	IHN(G)-P～IHN(G)-N
LV side	ILN(G)-P～ILN(G)-N

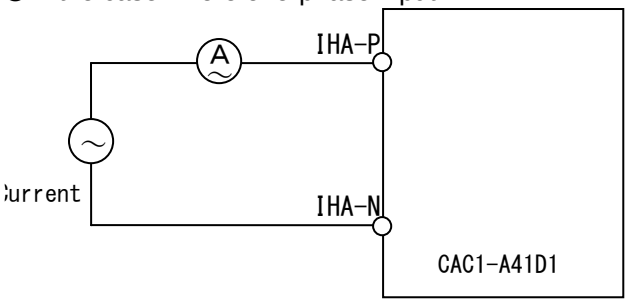
[6] Thermal Overload Element

●In the case where three-phase input



Test phase	Terminal No.
HV side	IHA-P～IHA-N, IHB-P～IHB-N IHC-P～IHC-N
LV side	ILA-P～ILA-N, ILB-P～ILB-N ILC-P～ILC-N

●In the case where one-phase input



Test phase	Terminal No.
A-phese	IHA-P～IHA-N
	ILA-P～ILA-N
B-phese	IHB-P～IHB-N
	ILB-P～ILB-N
C-phese	IHC-P～IHC-N
	ILC-P～ILC-N

8.2.2.2. Test items and functional control points

[1] Test setting

Before staring test, it is recommended to to use ‘Test setting’ function in order to lock the operation of un-tested phases and elements for easy testing.

Ex.) When carrying out the test of undervoltage A-phase element, lock the operaion of undervoltage B-phase and C-phase.

As for the method of test setting, refer to 4.3.4.4.2 in Chapter 4.

Furthermore, as for the list of test setting items, refer to the Table shown below.

List of test setting items

No.	Name of items	Contents of setting	Setting
1	SV-LK	Lock of monitoring	UNLOCKED / LOCKED
	TCNT-LK	Lock of trip counter	UNLOCKED / LOCKED

[2] Forced operation test

Refer to 4.3.4.4.1 in Chapter 4.

[3] Operating value test

Refer to the “Operating value” and “Return value” in Section 6.1.

[4] Operating time test

Refer to the “Operating time” in Section 6.1.

[5] Resetting time test

Refer to the “Recovery time” in Section 6.1.

[6] Phase test

Refer to the “Phase characteristic” in Section 6.1.

[7] LED/VFD full lighting test

Refer to 4.3.4.4.3 in Chapter 4.

9. Maintenance and self diagnosis

9.1. Maintenance

9.1.1. Daily inspection

It is recommended to check the following items daily;

- No dust (such as iron powder, etc) is in/on the relay case
- No abnormal noise is generated
- ‘RUN’ LED is lighting

9.1.2. Periodic inspection

It is recommended to test the following items periodically. The recommended perdic cycle is 5 to 7 years.

- Visual inspection check, referring to Section 8.1.
- Characteristic test using current and voltage input, referring to Section 8.2.

9.2. Self diagnosis

Monitoring of the electronic circuit as well as the incorporated power supply is performed, and if any trouble is generated, fault display by LED and output by alarm DO (b contact) are executed.

9.2.1. Alarm indication

The relay alarm, which would be appeared at relay failure, is divided two types, light alarm and heavy alarm.

Light alarm ----- This alarm may appear by detecting the abnormal current or voltage input, or abnormality of the circuits which would not affect the relay unnecessary trip operation directly.

Heavy alarm --- This alarm may appear by detecting abnormality of the important circuits which would affect the relay unnecessary trip operation directly.

The operation of LED display and alarm DO output are shown in next table.

Table 9-1 LED display, Alarm DO

Equipment status	Alarm DO	RUN LED	ALARM LED
Light alarm	OFF	ON	ON
Heavy alarm	ON	OFF	ON

Furthermore, since the indication of ‘ALARM LED’ at fault detection is latched, it is necessary to press ‘ESC’ key for 3 sec or more after removing the cause of trouble.

9.2.2. Handling of Alarm indication

When any trouble is generated, please collect the necessary information as shown below which would be useful for finding the cause of trouble.

[1] Confirm the state of LED display and the contact of alarm DO.
Refer to Fig. 9-1, Fig. 9-2 for LED display and alarm DO.

[2] Confirm the error code in monitoring
Refer to 4.3.2.2.4 in Chapter 4 for the confirmation method of the error code,

[3] Please inquire of our company (the nearest Mitsubishi Electric’s branch or sales office).
The inquiry destination is described at the end of the document.

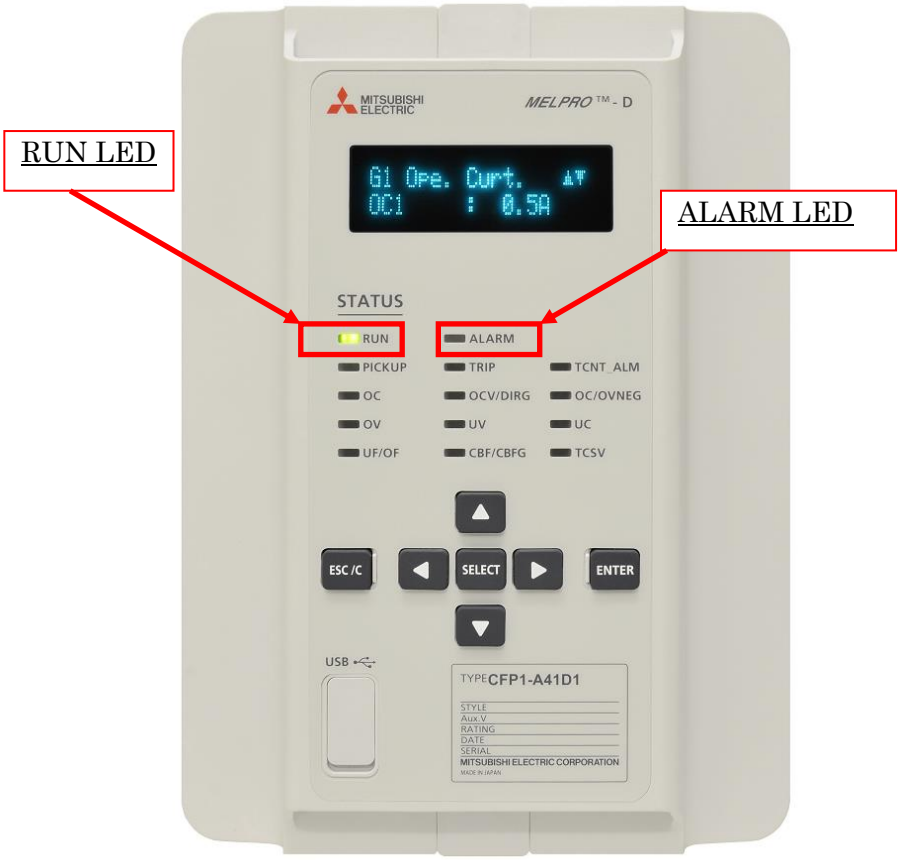


Fig. 9-1 Position of RUN LED, ALARM LED

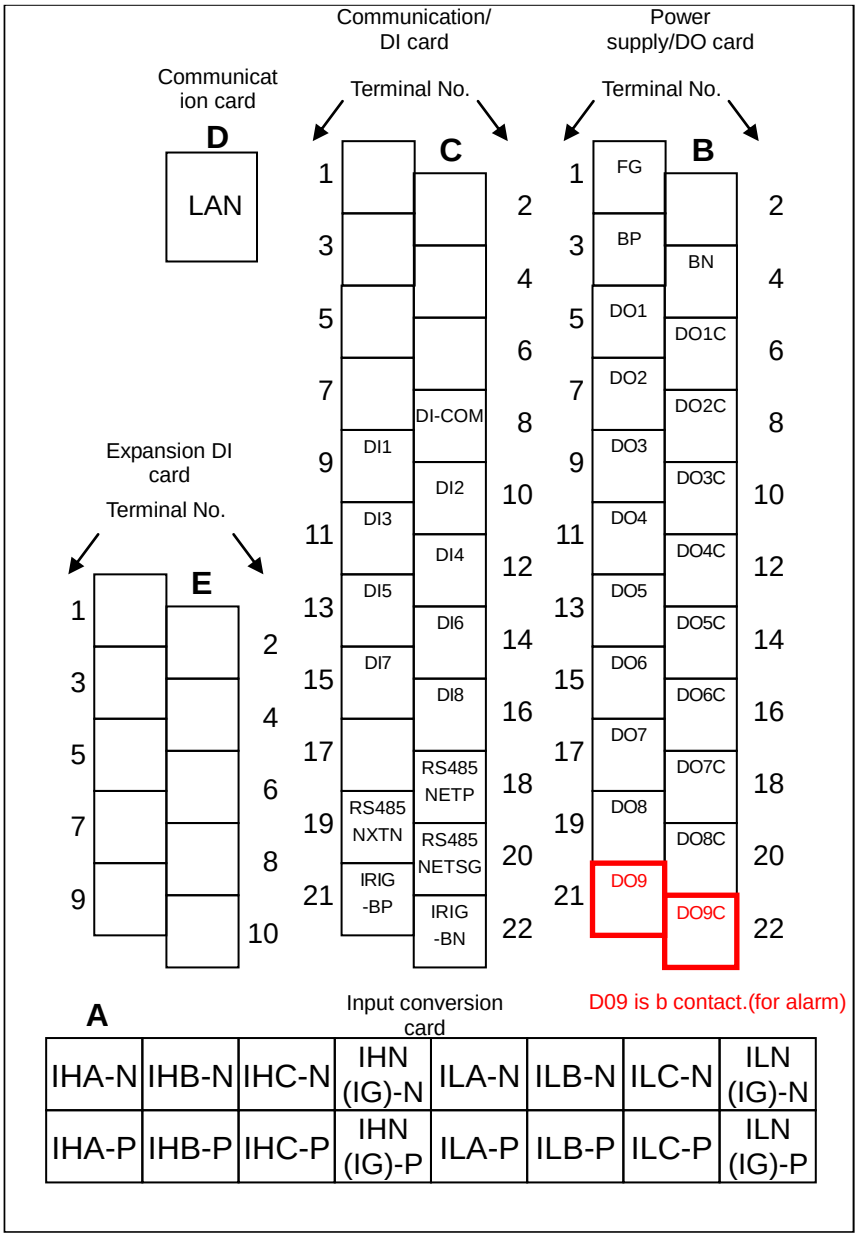


Fig. 9-2 Position of alarm DO

9.2.3. Error code and self diagnosis items

The self-diagnosis items and error codes are shown on Table 9-2. The error code can be confirmed from ALARM RECORD menu via front panel (refer to chapter 4) or PC-HMI (refer to chapter 11).

Table 9-2 Detail of error code on EVENT RECORD function

Error code	Detail	Behavior of the protection relay (Severe cases are as follows)			
		RUN LED	ALARM LED	Alarm DO	Relay calculation
00 ~ 07, 0A, 0F, 20	CPU failure	OFF	ON	Close	Lock
10, 11	RAM check failure	OFF	ON	Close	Lock
12	ROM check failure	OFF	ON	Close	Lock
13	CPU calculation failure	OFF	ON	Close	Lock
15	Communication failure	OFF	ON	Close	Lock
18	Flash memory failure	OFF	ON	Close	Lock
19, 1A, 30	Internal data table failure (information about analog input)	OFF	ON	Close	Lock
23, 48	DO circuit failure	OFF	ON	Close	Lock
25	A/D accuracy failure	OFF	ON	Close	Lock
33	Analog input circuit failure	ON	ON	Open	Run
34	DC offset value of analog circuit failure	ON	ON	Open	Run
35	Setting data table failure	OFF	ON	Close	Lock
37	Configuration setting failure of disturbance recorder (data save function)	ON	ON	Open	Run
38	Internal data failure	ON	ON	Open	Run
42, 43	Supervision function.	ON	OFF	Close	Run
N/A	AUX circuit failure	OFF	OFF	Close	Lock
N/A	CPU stop	OFF	ON	Close	Lock
N/A	Normal condition	ON	OFF	Open	Run

Note: Error code in ALARM RECORD menu is indicated as following

AA BB CCCCCCCCCCCC

- AA: Error code (the numbers are shown in above table.)
- BB: Sub error code. (for Mitsubishi Electric analysis.)
- CCCCCCCCCCCC: Detail code (for Mitsubishi Electric analysis.)

10. Default setting or configuration value

10.1. Setting (Rated current is 5 A, order code E*H55 type)

Table 10-1 Setting values

Category	Element	Item name of setting parameters	Range	Step	Default value	Description
DIFF/ DIFFH/ RGF	TR	TRH Connection	0 ～ 11	1	0	
		TRH Zero	0 ～ 1	1	0	
		TRL Connection	0 ～ 11	1	0	
		TRL Zero	0 ～ 1	1	0	
	MT	Matching Tap ITH	2.2 ～ 12.5A	0.1A	2.2A	
		Matching Tap ITL	2.2 ～ 12.5A	0.1A	2.2A	
		Matching Tap ITNH	2.2 ～ 12.5A	0.1A	2.2A	
		Matching Tap ITNL	2.2 ～ 12.5A	0.1A	2.2A	
	DIFF 2F	DIFF 2f-lock ratio	5 ～ 40%	1%	5%	
		DIFF 1f-Min. Ope.	0.4 ～ 2.5A	0.1A	0.4A	
	DIFF 5F	DIFF 5f-lock ratio	30 ～ 50%	1%	30%	
		DIFF 1f-Min. Ope.	0.4 ～ 2.5A	0.1A	0.4A	
	DIFF	DIFF EN	OFF, ON		OFF	
		DIFF Ires Meth.	MAX, SUM		MAX	
		DIFF Ope. Curt.	20 ～ 100%	1%	20%	
		DIFF ratio K1	15 ～ 100%	1%	15%	
		DIFF ratio K2	15 ～ 100%	1%	15%	
		DIFF Is Curt.	100～1000%	1%	100%	
		DIFF Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	
		DIFF SV EN	OFF, ON		OFF	
		DIFF SV Curt.	5 ～ 100%	1%	5%	
		DIFF SV ratio	0 ～ 20%	1%	0%	
		DIFF 2f-lock EN	OFF, ON		OFF	
		DIFF 2f-lock Meth.	ANY 1 PH, ANY 2 PH, EACH PH, 3-PH AVG		ANY 1 PH	
		DIFF 5f-lock EN	OFF, ON		OFF	
	DIFFH	DIFFH EN	OFF, ON		OFF	
		DIFFH Ope. Curt.	5 ～ 12	1	5	
		DIFFH Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	
	RGFH	RGFH EN	OFF, ON		OFF	
		RGFH Ope. Curt.	10 ～ 200%	1%	10%	
		RGFH ratio K1	10 ～ 100%	1%	10%	
		RGFH ratio K2	10 ～ 100%	1%	10%	
		RGFH Is Curt.	100 ～ 1000%	1%	100%	
		RGFH Ope. Time	0.0 ～ 600.0s	0.1s	0.0s	

Category	Element	Item name of setting parameters	Range	Step	Default value	Description
		RGFH CT Sat. Meas.	OFF, ON		OFF	
		RGFH I0 EN	OFF, ON		OFF	
		RGFH I0 Ope. Curt.	5.0 ～ 50.0A	0.1A	5.0A	
	RGFL	RGFL EN	OFF, ON		OFF	
		RGFL Ope. Curt.	10 ～ 200%	1%	10%	
		RGFL ratio K1	10 ～ 100%	1%	10%	
		RGFL ratio K2	10 ～ 100%	1%	10%	
		RGFL Is Curt.	100 ～ 1000%	1%	100%	
		RGFL Ope. Time	0.0 ～ 600.0s	0.1s	0.0s	
		RGFL CT Sat. Meas.	OFF, ON		OFF	
		RGFL I0 EN	OFF, ON		OFF	
		RGFL I0 Ope. Curt.	5.0 ～ 50.0A	0.1A	5.0A	
OC/OCN	OC 2F	OC 2f-lock ratio	10 ～ 30%	1%	10%	
		OC 1f-Min.Ope.	0.4 ～ 2.5A	0.1A	0.4A	
	OC1H	OC1H EN	OFF, ON		OFF	
		OC1H Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OC1H Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	
	OC1L	OC1L EN	OFF, ON		OFF	
		OC1L Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OC1L Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	
	OCN1H	OCN1H EN	OFF, ON		OFF	
		OCN1H Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OCN1H Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	
	OCN1L	OCN1L EN	OFF, ON		OFF	
		OCN1L Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OCN1L Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	
	OC2H	OC2H EN	OFF, ON		OFF	
		OC2H Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OC2H Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	
		OC2H 2f-lock EN	OFF, ON		OFF	
	OC2L	OC2L EN	OFF, ON		OFF	
		OC2L Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OC2L Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	
		OC2L 2f-lock EN	OFF, ON		OFF	
	OCN2H	OCN2H EN	OFF, ON		OFF	
		OCN2H Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OCN2H Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	
		OCN2H 2f-lock EN	OFF, ON		OFF	
	OCN2L	OCN2L EN	OFF, ON		OFF	
		OCN2L Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OCN2L Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	
		OCN2L 2f-lock EN	OFF, ON		OFF	
	OC3H	OC3H EN	OFF, ON		OFF	
		OC3H Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OC3H Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	
		OC3H 2f-lock EN	OFF, ON		OFF	
	OC3L	OC3L EN	OFF, ON		OFF	
		OC3L Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OC3L Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	
		OC3L 2f-lock EN	OFF, ON		OFF	
	OCN3H	OCN3H EN	OFF, ON		OFF	

Category	Element	Item name of setting parameters	Range	Step	Default value	Description
		OCN3H Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OCN3H Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	
		OCN3H 2f-lock EN	OFF, ON		OFF	
	OCN3L	OCN3L EN	OFF, ON		OFF	
		OCN3L Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OCN3L Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	
		OCN3L 2f-lock EN	OFF, ON		OFF	
	OC4H	OC4H EN	OFF, ON		OFF	
		OC4H Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OC4H Ope. TM	0.25 ～ 50.00	0.01	10.00	
		OC4H Ope. Chr.	NI01, VI01, EI01, LI01, LI02, DT01, NI11, EI11, EI12, NI21, VI21, LI21, NI31, VI31		NI01	
		OC4H Rst. Chr.	IDMT, DT, INST		IDMT	
		OC4H 2f-lock EN	OFF, ON		OFF	
		OC4H IEC Chr. EN	OFF, ON		OFF	
	OC4L	OC4L EN	OFF, ON		OFF	
		OC4L Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OC4L Ope. TM	0.25 ～ 50.00	0.01	10.00	
		OC4L Ope. Chr.	NI01, VI01, EI01, LI01, LI02, DT01, NI11, EI11, EI12, NI21, VI21, LI21, NI31, VI31		NI01	
		OC4L Rst. Chr.	IDMT, DT, INST		IDMT	
		OC4L 2f-lock EN	OFF, ON		OFF	
		OC4L IEC Chr. EN	OFF, ON		OFF	
	OCN4H	OCN4H EN	OFF, ON		OFF	
		OCN4H Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OCN4H Ope. TM	0.25 ～ 50.00	0.01	10.00	
		OCN4H Ope. Chr.	NI01, VI01, EI01, LI01, LI02, DT01, NI11, EI11, EI12, NI21, VI21, LI21, NI31, VI31		NI01	
		OCN4H Rst. Chr.	IDMT, DT, INST		IDMT	
		OCN4H 2f-lock EN	OFF, ON		OFF	
		OCN4H IEC Chr. EN	OFF, ON		OFF	
	OCN4L	OCN4L EN	OFF, ON		OFF	
		OCN4L Ope. Curt.	0.5 ～ 100.0A	0.1A	0.5A	
		OCN4L Ope. TM	0.25 ～ 50.00	0.01	10.00	
		OCN4L Ope. Chr.	NI01, VI01, EI01, LI01, LI02, DT01, NI11, EI11, EI12, NI21, VI21, LI21,		NI01	

Category	Element	Item name of setting parameters	Range	Step	Default value	Description
			NI31, VI31			
		OCN4L Rst. Chr.	IDMT, DT, INST		IDMT	
		OCN4L 2f-lock EN	OFF, ON		OFF	
		OCN4L IEC Chr. EN	OFF, ON		OFF	
THOL/ OCNEG/CBF THOL/ OCNEG/CBF	THOLH	THOLH EN	OFF, ON		OFF	
		THOLH Sel.	COLD, HOT		COLD	
		THOLH Ope. Curt.	1.0 ～ 10.0A	0.1A	1.0A	
		THOLH Ope. Kth	8 ～ 240	1	8	
		THOLH Neg. K	1 ～ 10	1	1	
	THOLL	THOLL EN	OFF, ON		OFF	
		THOLL Sel.	COLD, HOT		COLD	
		THOLL Ope. Curt.	1.0 ～ 10.0A	0.1A	1.0A	
		THOLL Ope. Kth	8 ～ 240	1	8	
		THOLL Neg. K	1 ～ 10	1	1	
	OCNEG1H	OCNEG1H EN	OFF, ON		OFF	
		OCNEG1H Ope.Curt.	0.25 ～ 5.00A	0.01A	0.25A	
		OCNEG1H Ope.Time	0.0 ～ 10.0s	0.1s	0.0s	
	OCNEG1L	OCNEG1L EN	OFF, ON		OFF	
		OCNEG1L Ope.Curt.	0.25 ～ 5.00A	0.01A	0.25A	
		OCNEG1L Ope.Time	0.0 ～ 10.0s	0.1s	0.0s	
	OCNEG2H	OCNEG2H EN	OFF, ON		OFF	
		OCNEG2H Ope.Curt.	0.25 ～ 5.00A	0.01A	0.25A	
		OCNEG2H Ope.Time	0.0 ～ 10.0s	0.1s	0.0s	
	OCNEG2L	OCNEG2L EN	OFF, ON		OFF	
		OCNEG2L Ope.Curt.	0.25 ～ 5.00A	0.01A	0.25A	
		OCNEG2L Ope.Time	0.0 ～ 10.0s	0.1s	0.0s	
	CBFH (This element is enabled by DI8 = ON)	CBFH EN	OFF, ON		OFF	
		CBFNH EN	OFF, ON		OFF	
		CBFH Curt.	0.15 ～ 10.00A	0.01A	0.15A	
		CBFNH Curt.	0.15 ～ 10.00A	0.01A	0.15A	
		CBFH Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	
	CBFL (This element is enabled by DI7 = ON)	CBFL EN	OFF, ON		OFF	
		CBFNL EN	OFF, ON		OFF	
		CBFL Curt.	0.15 ～ 10.00A	0.01A	0.15A	
		CBFNL Curt.	0.15 ～ 10.00A	0.01A	0.15A	
		CBFL Ope. Time	0.00 ～ 10.00s	0.01s	0.00s	

10.2. Terminal assigned

For details about the “Default signal (PLC signal)”, refer to Chapter 5.

Table 10-2 Terminal assigned for digital outputs

	Item name (PC-HMI)	Default signal (PLC signal)	Please make a note about setting.
Contacts for tripping (DO)	DO1	ALLEL-O	
	DO2	ALLEL-D_O	
	DO3	–	
	DO4	–	
Contacts for annunciator (DO)	DO5	–	
	DO6	–	
	DO7	–	
	DO8	–	

Table 10-3 Terminal assigned for digital inputs

Item name	Description
DI1	–
DI2	–
DI3	–
DI4	–
DI5	All relay elements are locked for trip lock.
DI6	–
DI7	Receiving from other relays trip signal, and CBFL element on this protection relay operates (trip).
DI8	Receiving from other relays trip signal, and CBFH element on this protection relay operates (trip).

This signals are available only in the relay unit with a DI card in SLOT-C.
The CB control signal assignments between the items and digital inputs can be changed using PC-HMI.

Table 10-4 Terminal assigned for circuit breaker control

Item name (PC-HMI)	Default signal (PLC signal)	Detail
CB STATE	DI1	The “CB STATE” shows a circuit breaker status (condition) such as open or close.
CLOSE INTLK	DI2	The “CLOSE INTLK” means an interlock for close operation of circuit breaker. Disable or enable the interlock can be set. For details, refer to 4.3.4.2 in Chapter 4.
OPEN INTLK	DI3	The “OPEN INTLK” means an interlock for open operation of circuit breaker. Disable or enable the interlock can be set. For details, refer to 4.3.4.2 in Chapter 4.
CLOSE CB	DI4	The “CLOSE CB” means a remote CB operation from other devices. Use Case We assumed that a digital output of another device is connected to digital input (in this case, DI4). This protection relay receives the control signal from remote device using DI. Next, this protection relay outputs own DO and operates a connected CB.

OPEN CB	DI5	The “OPEN CB” means a remote CB operation from other devices. Use Case We assumed that a digital output of another device is connected to digital input (in this case, DI5). This protection relay receives the control signal from remote device using DI. Next, this protection relay outputs own DO and operates a connected CB.

11. PC Software (PC-HMI)

11.1. Introduction

The MELPRO-D40 Series provides PC-HMI for implementing analog and digital signal supervision and control (DO contact test and circuit breaker control).
This chapter describes the functions of PC-HMI.

11.2. Precautions on software use

Be sure to observe the following precautions when using this software.

Precautions

1) This software and manual are warranted only against damage to the medium, defects in the product and program execution errors.
2) This manual does not give warranty of merchantability or fitness for a particular purpose for the product. No warranty is given with respect to any damage to equipment or business performance.
3) We shall not be liable for use or reliability of other software not created by us.
4) Use of this software requires one license per PC.
   When using the software on another PC, purchase a separate copy.
5) Duplicating this software for any purpose other than making a backup copy is strictly prohibited.
6) Exercise sufficient caution in handling the original medium containing this software.
7) Alteration or modification of this software is strictly prohibited.
8) Lending or taking out any part or all of this software to a third party without prior permission is prohibited.
9) This manual and medium can be used only for this software.
   Sale of this program or any of its modification to a third party is strictly prohibited.

Note) These precautions apply to all of our products.
Some of the product specifications may not apply.

11.3. Compatible models

11.3.1. PC-HMI operation terminal specifications

The recommended and minimum specifications for the operation terminal to install PC-HMI on are as shown below.

Item	Recommended specification	Minimum specification
OS	Windows7	Windows7
CPU	2.5 GHz or higher (4 CPUs or more)	1.5 GHz (2 CPU)
Memory	2 GB or larger	2 GB
Display color	32-bit (16,770,000 colors)	32-bit (16,770,000 colors)

Note) For use with the waveform analysis software (see Chapter 12), available HDD space of 100 MB or more and separate available space for saving waveform data are required.

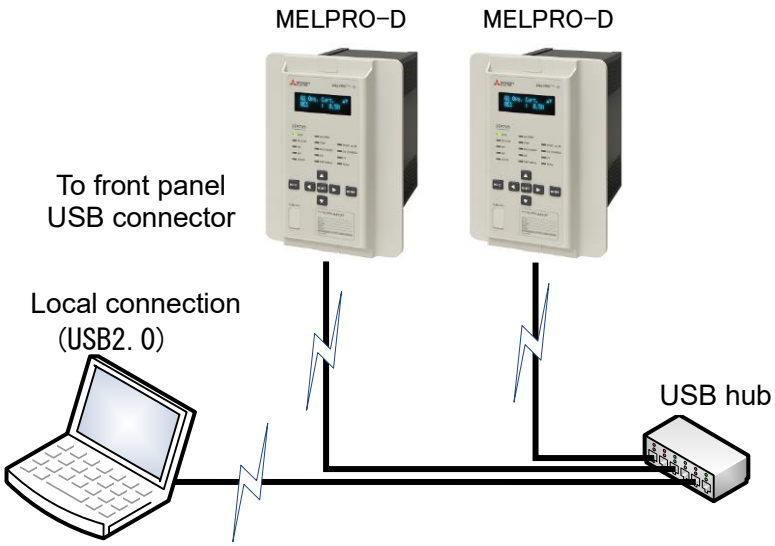
11.3.2. Display

The recommended and minimum specifications for the display for PC-HMI are as shown below.

Item	Recommended specification	Minimum specification
Screen size	15.6 in	11 in
Screen resolution	1366 x 768 WXGA	1366 x 768 WXGA
Dot pitch [mm]	0.253	0.188
Exact size [mm]	W345.598 x H194.304	W243.148 x H136.704

11.4. Basic configuration for PC-HMI

The hardware configuration for PC-HMI is as shown below.



11.5. Basics for operation of PC-HMI

This section provides the knowledge and instructions required for operation of PC-HMI.
For more information about the operation, see the instruction manual of the PC being used.

11.5.1. Mouse operation

This subsection describes the knowledge required for mouse operation.

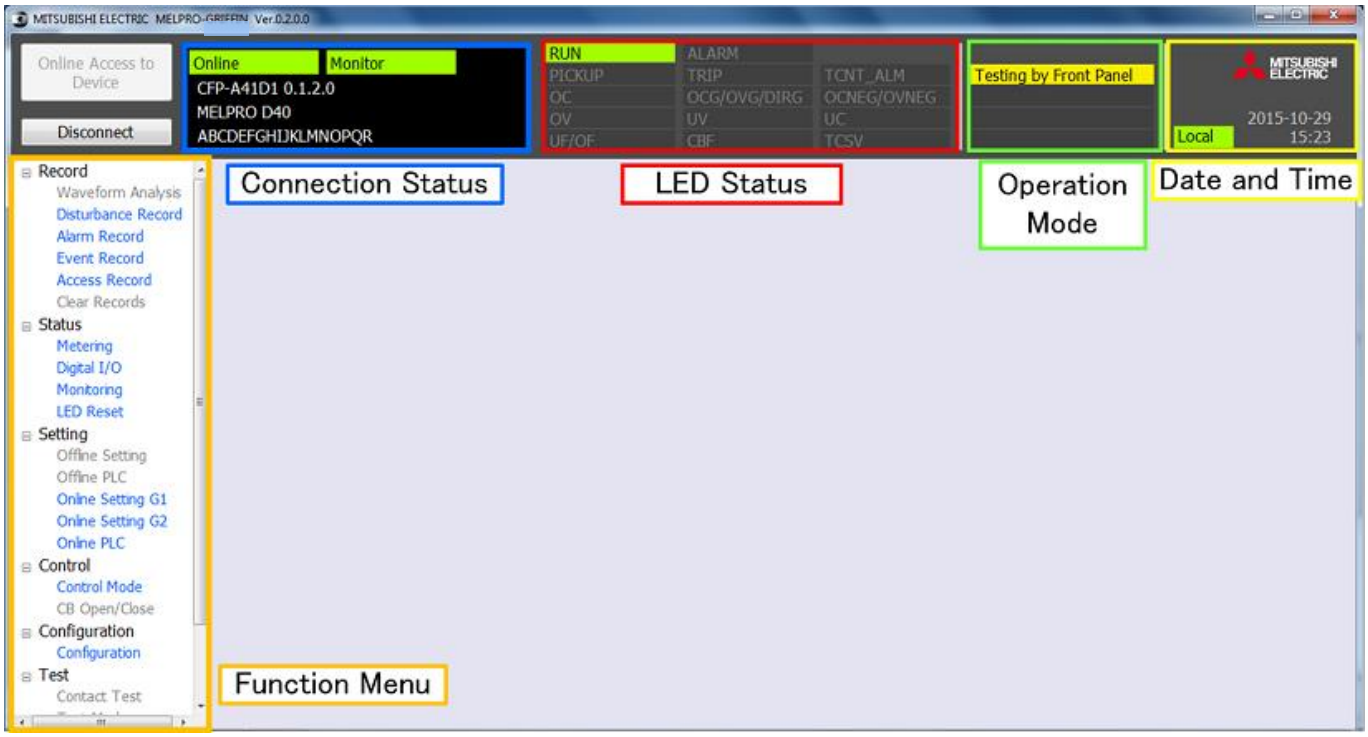
1) Click
   The action of pressing the left mouse button.

2) Double click
   Clicking of a mouse button twice successively.

3) Mouse pointer
   Moving the mouse causes the arrow on the screen to move according to the mouse movement. To select an item on the screen, move the mouse pointer onto the item and click.
   The clicked item is illuminated. When the mouse pointer is moved onto text input, the arrow turns into a cursor.

4) Drag
   Dragging refers to moving the mouse pointer while pressing the mouse button.

11.6. Screen structure of PC-HMI



*The screen shown above is different from how the actual screen looks because the individual menus are outlined with borders for ease of understanding.

The screen structure of PC-HMI is as shown below.

Function Menu	: Clicking the individual items calls the corresponding functions.
Connection Status	: Indicates the connection status and operation permission of devices.
LED Status	: Indicates the operating conditions and failure descriptions of devices.
Operation Mode	: Indicates the operation mode.
Date and Time	: Indicates the time synchronization status and date and time.

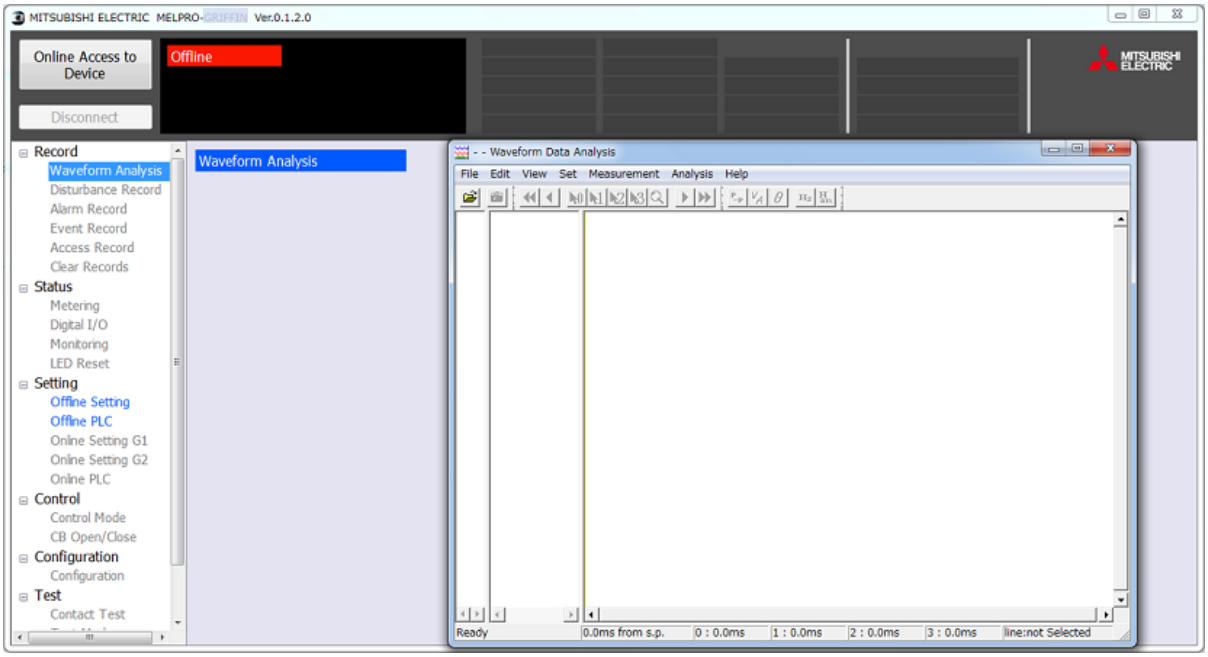
11.7. Operation in offline mode

The Function menu items available in the offline mode are as shown below.

Waveform Analysis : Launches the waveform analysis software.
Offline Setting : Reads, edits and saves setting files.
Offline PLC : Reads, edits and saves PLC configuration files.

11.7.1. Launching the waveform analysis software

1. From the Function menu, click Waveform Analysis.
2. The waveform analysis software is launched in a new window.

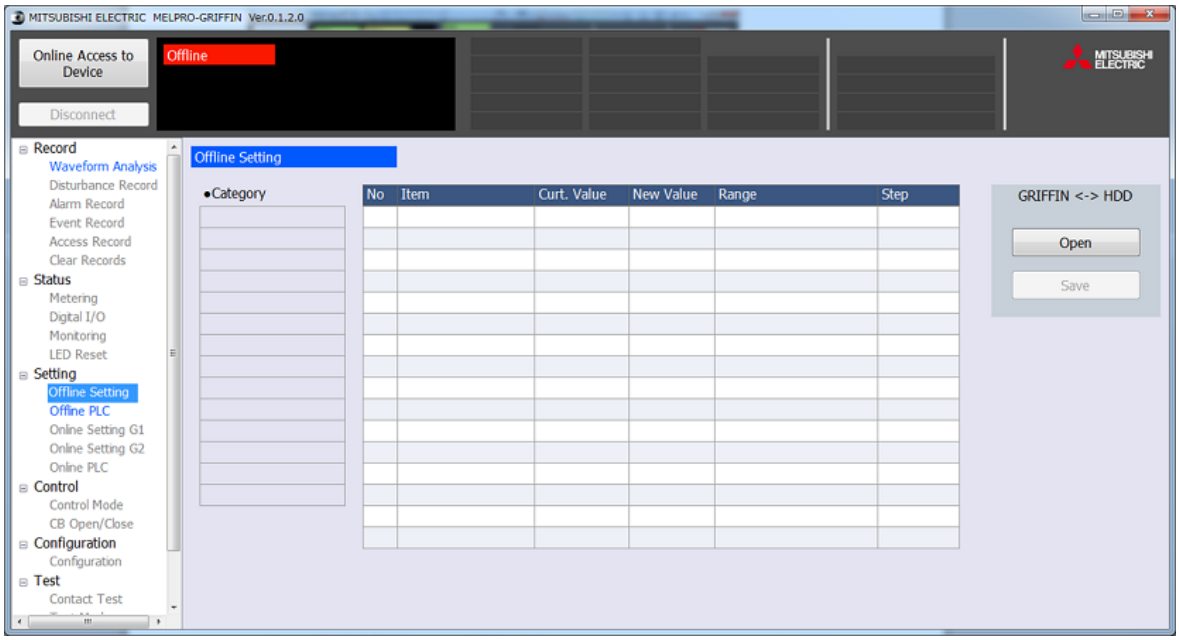


3. From the File menu of the waveform analysis software, select a waveform data file.
   (For the details about the waveform analysis software, see Chapter 12.)

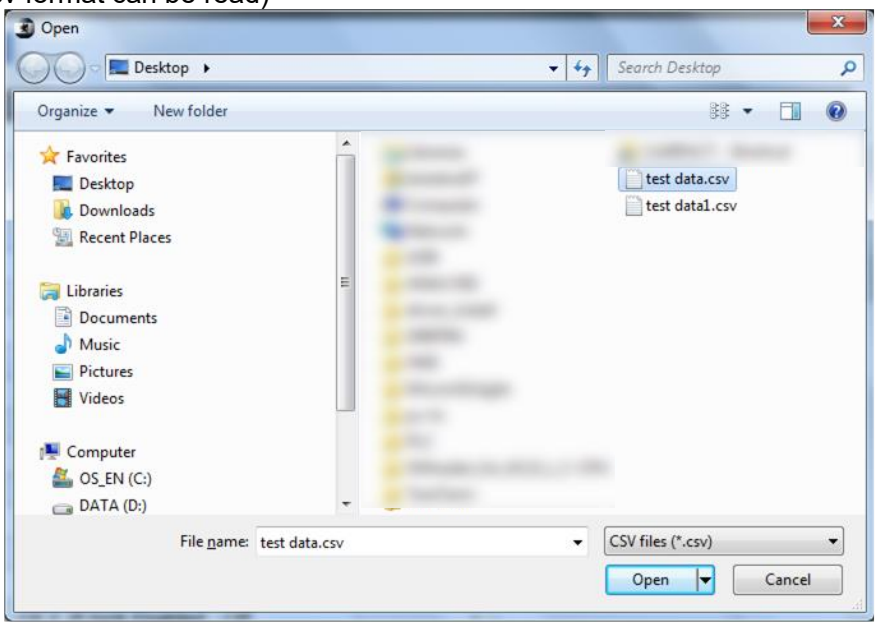
11.7.2. Reading, editing and saving setting files

[Reading setting files]

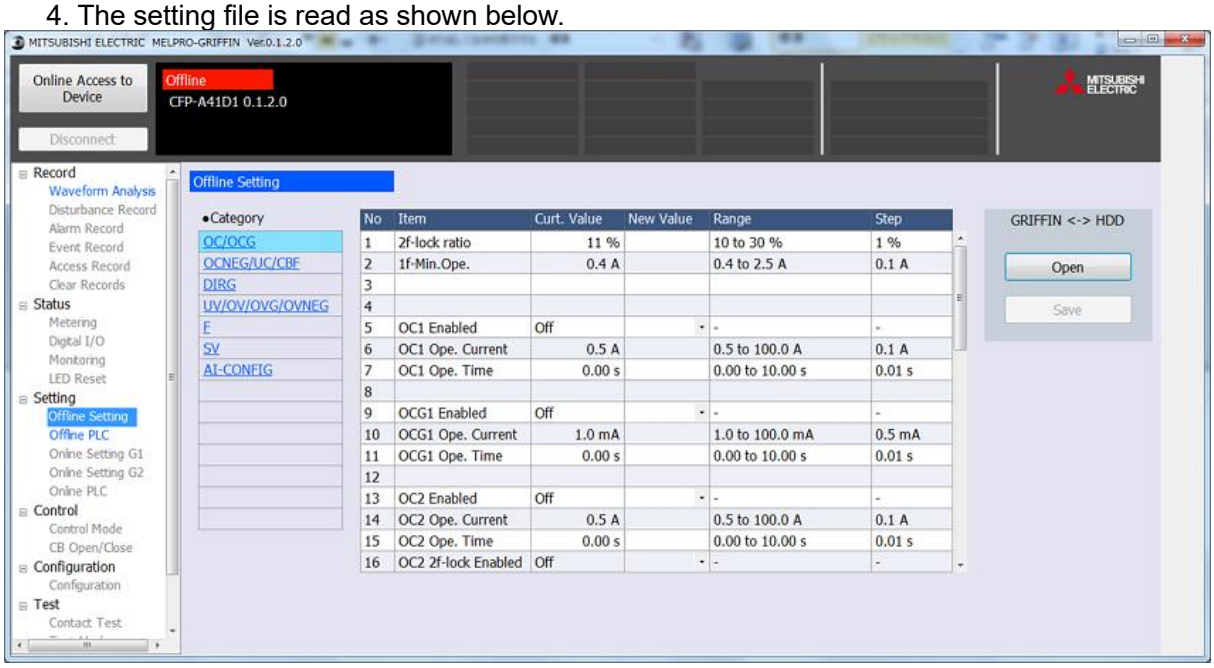
1. From the Function menu, click Offline Setting.
2. From PC-HMI <-> HDD in the upper right part of the main screen, click “Open.”



3. Select the setting file to read from the HDD.
   (Files in the .csv format can be read)

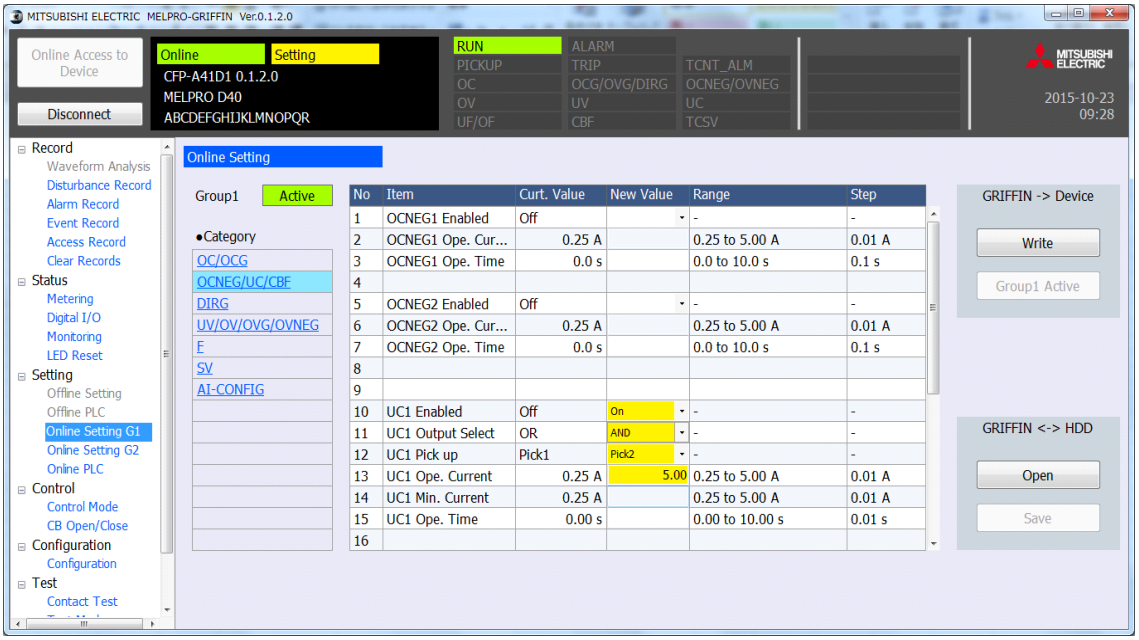


4. The setting file is read as shown below.

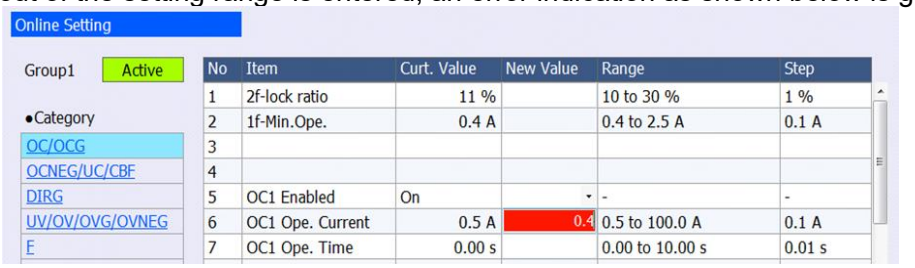


[Editing setting files]

1. Select an item to edit from Category. A list of setting values is shown under Item. Click New Value for the item to make a change.
   From the list, make a selection by clicking ▼.
   To enter a value, use the keyboard.

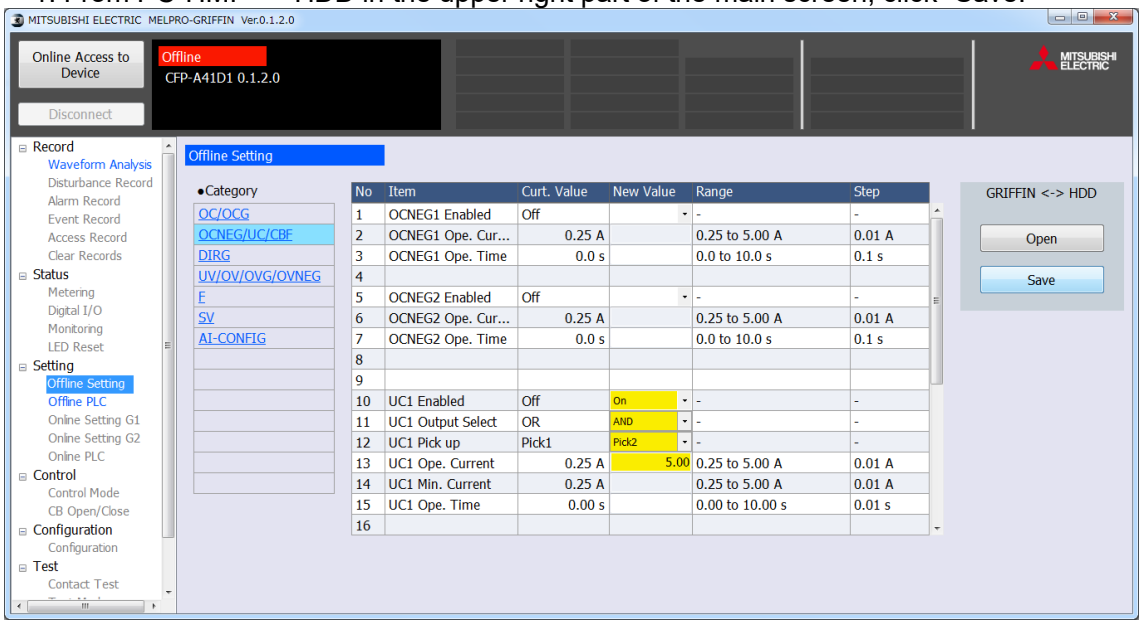


Note) If any value out of the setting range is entered, an error indication as shown below is given.

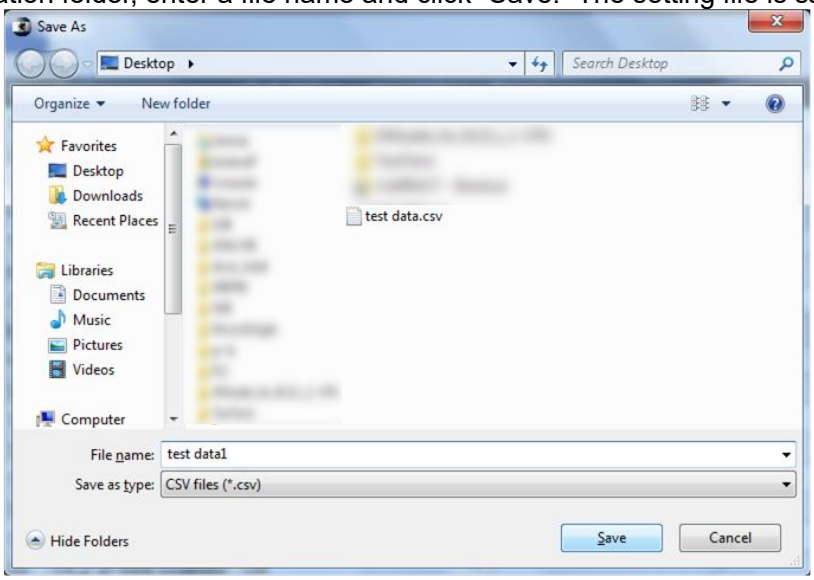


[Saving setting files]

1. From PC-HMI <-> HDD in the upper right part of the main screen, click “Save.”



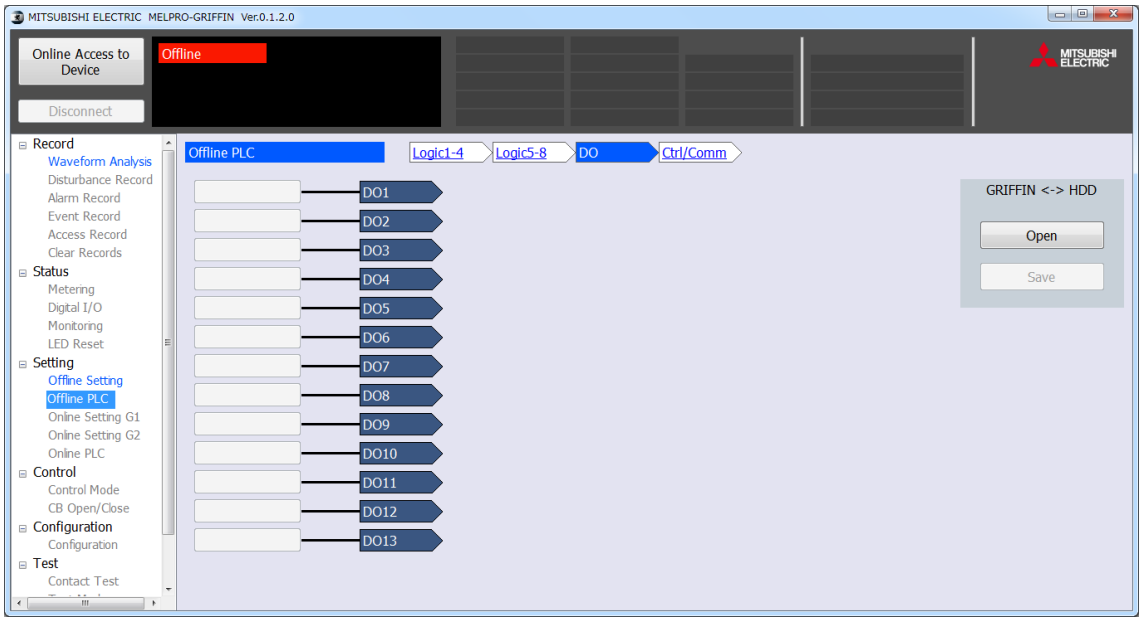
2. Select the destination folder, enter a file name and click “Save.” The setting file is saved.



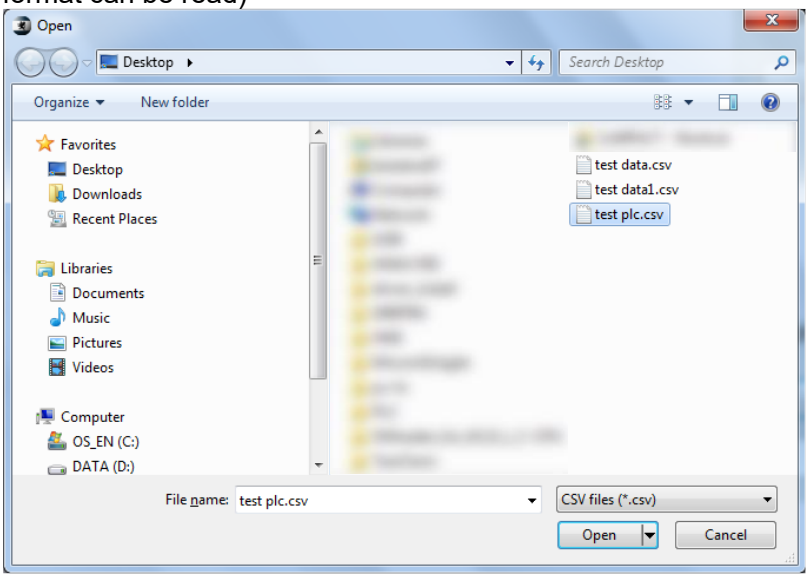
11.7.3. Reading, editing and saving PLC files

[Reading PLC files]

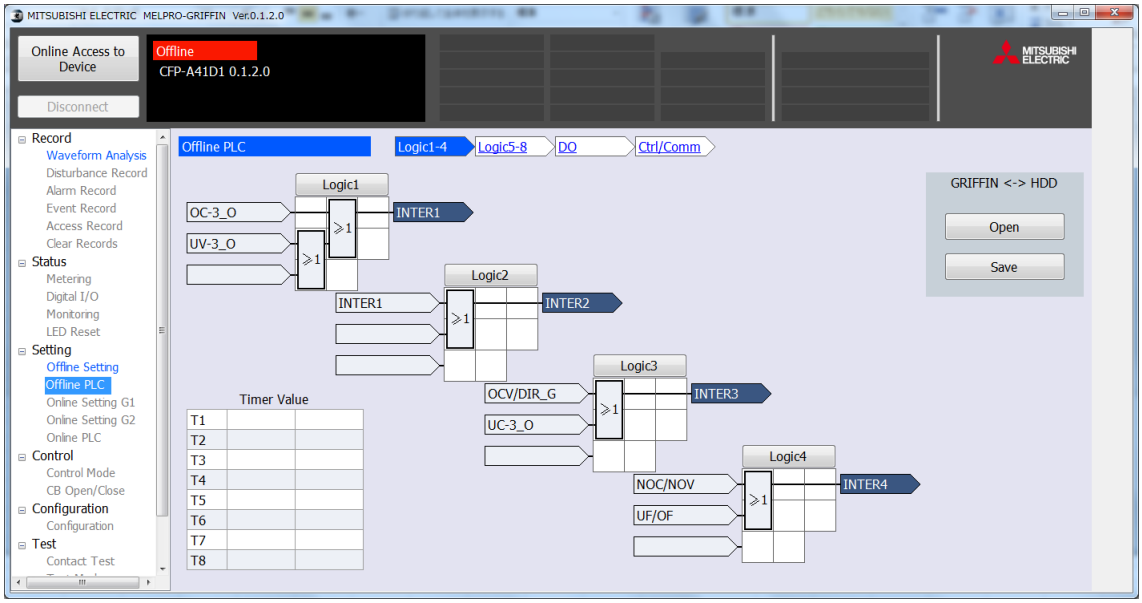
1. From the Function menu, click Offline PLC.
2. From PC-HMI <-> HDD in the upper right part of the main screen, click “Open.”



3. Select the PLC file to read from the HDD.
   (Files in the .csv format can be read)



4. The PLC file is read as shown below.

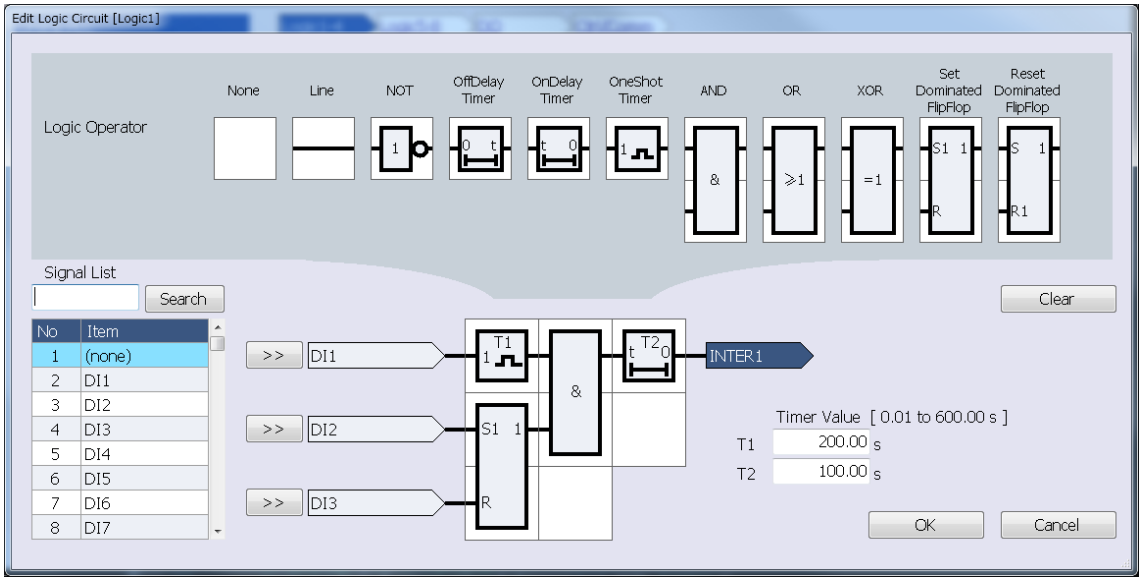


[Editing PLC files]

1. Click the Logic group and Logic to edit.

   Logic1-4 : indication and editing screen for logic circuits 1 to 4
   Logic5-8 : indication and editing screen for logic circuits 5 to 8

2. The logic circuit editing screen as shown below appears. (The screen below shows a display example)

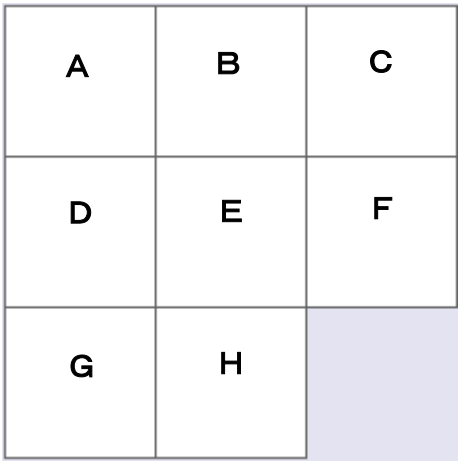


3. From the Item list, select the signal to input and click. The selected signal is shown in light blue. Click “>>” to select the input signal.

Note) The signal name can be searched by entering it on the Signal List by using the keyboard and clicking “Search.”

4. From the list of circuit components, select the logic component to place and click the logic area to place it. The logic component is placed.
   After the placement has been completed, click “OK” to go back to the previous screen.

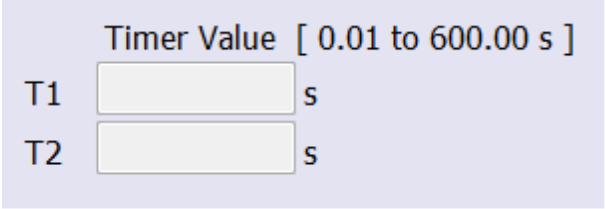
Note) Logic components that can and cannot be placed in certain areas are as shown below.



No	Component	A	B	C	D	E	F	G	H	Note
1	None	Y	Y	Y	Y	Y	Y	Y	Y	(*1)
2	Line	Y	Y	Y	Y	Y	N	Y	N	
3	Not	Y	Y	Y	Y	Y	N	Y	N	
4	OffDelay Timer	Y	Y	Y	Y	Y	N	Y	N	(*2)
5	OnDelay Timer	Y	Y	Y	Y	Y	N	Y	N	(*2)
6	OneShot Timer	Y	Y	Y	Y	Y	N	Y	N	(*2)
7	And	Y	Y	Y	Y	Y	N	N	N	
8	Or	Y	Y	Y	Y	Y	N	N	N	
9	Xor	Y	Y	Y	Y	Y	N	N	N	
10	Set FlipFlop	Y	Y	Y	Y	Y	N	N	N	
11	Reset FlipFlop	Y	Y	Y	Y	Y	N	N	N	

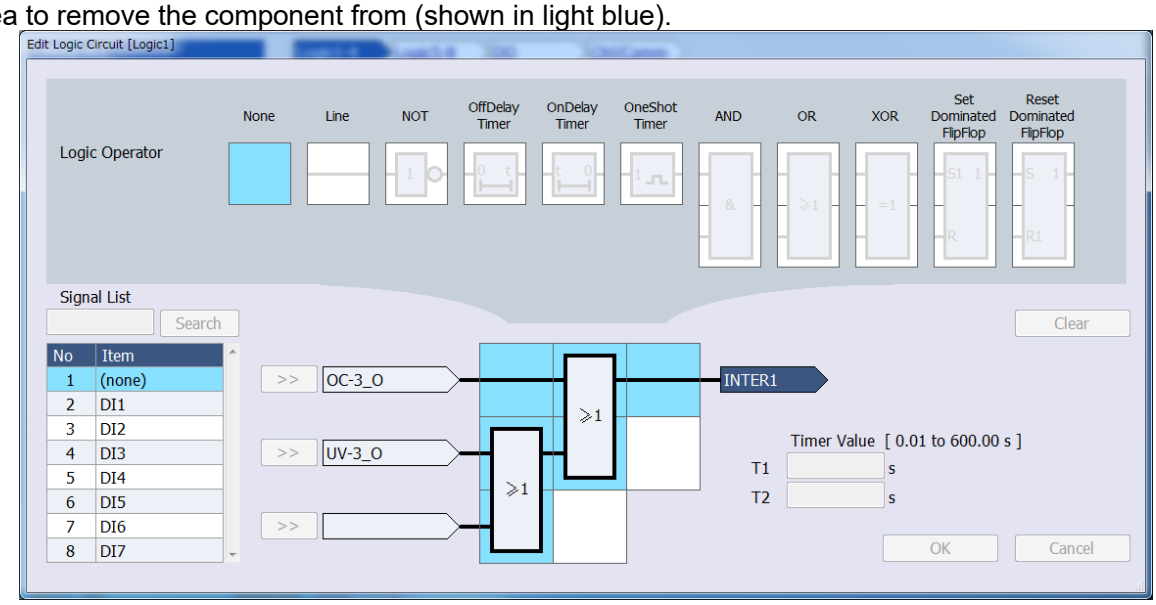
(*1): The component needs to have been placed.
(*2): Up to two timer components can be placed in a logic area.
(More than two timers cannot be placed.)

When providing any timer component, specify the time in the Timer Value field.



Note) Attempting to place a logic component that cannot be placed in a certain logic area generates the error as shown below.

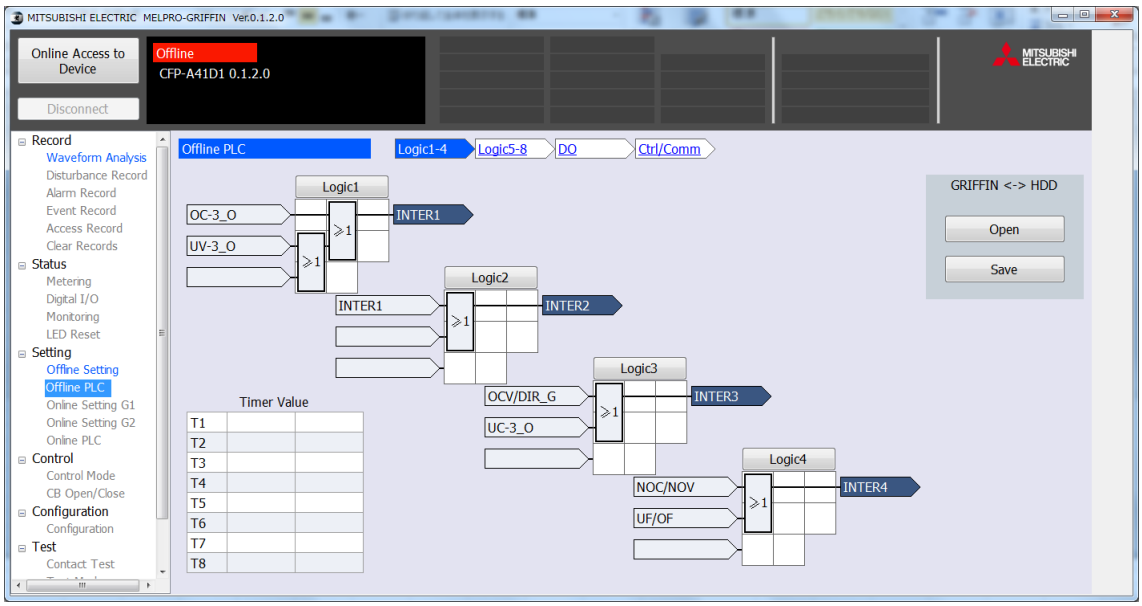
To remove any logic component that has been placed, select a None logic component and click the logic area to remove the component from (shown in light blue).



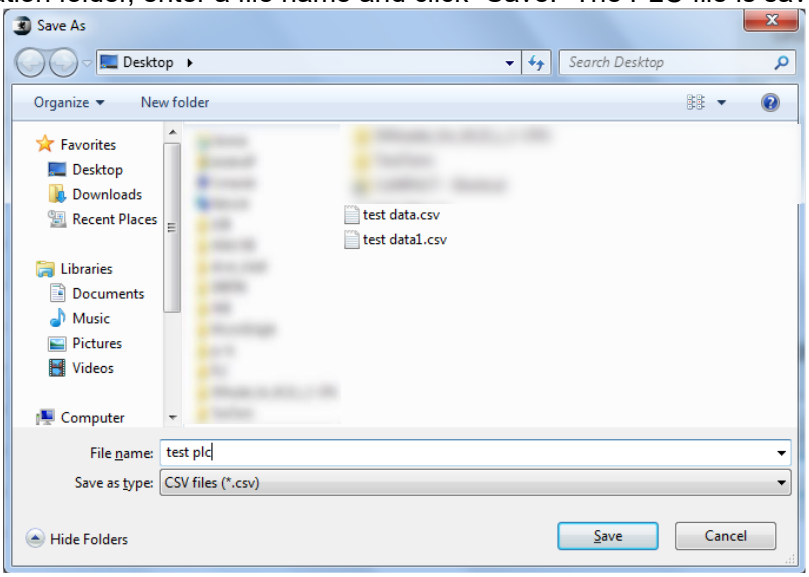
Clicking “Clear” brings back to the initial state with no input signal set, logic component placed or timer setting configured.

[Saving PLC files]

1. To save a PLC file on the HDD, from PC-HMI <-> HDD in the upper right part of the main screen, click “Save.”



2. Select the destination folder, enter a file name and click “Save.” The PLC file is saved.

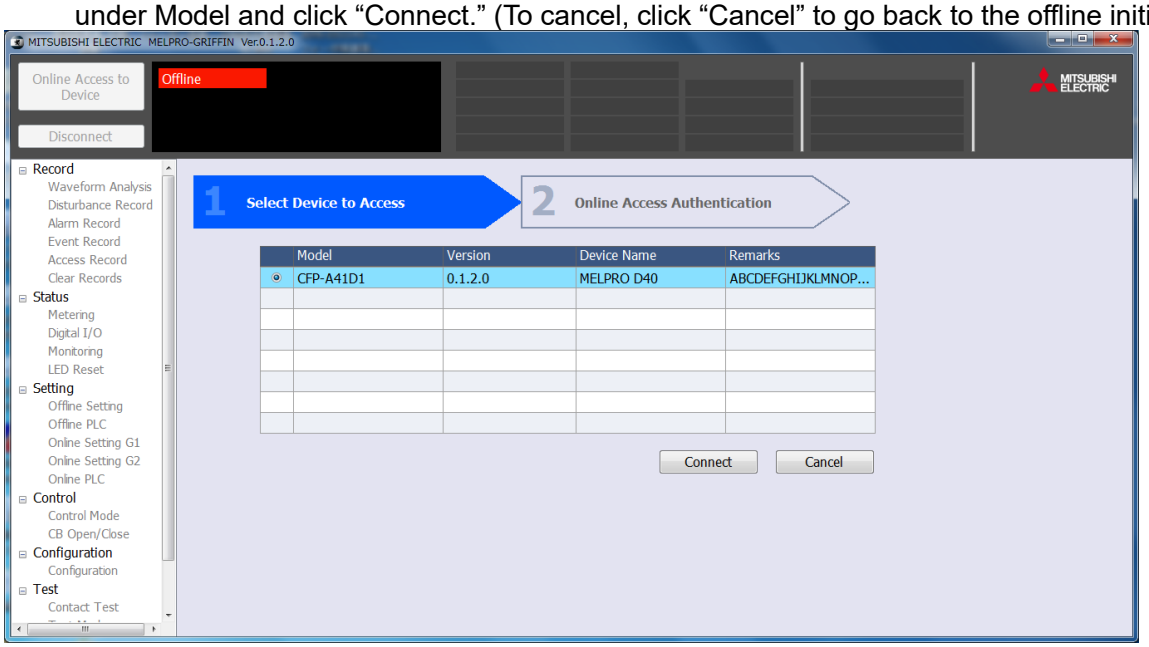


11.8. Log In (connection) and Log out (disconnection) to relay device via PC-HMI

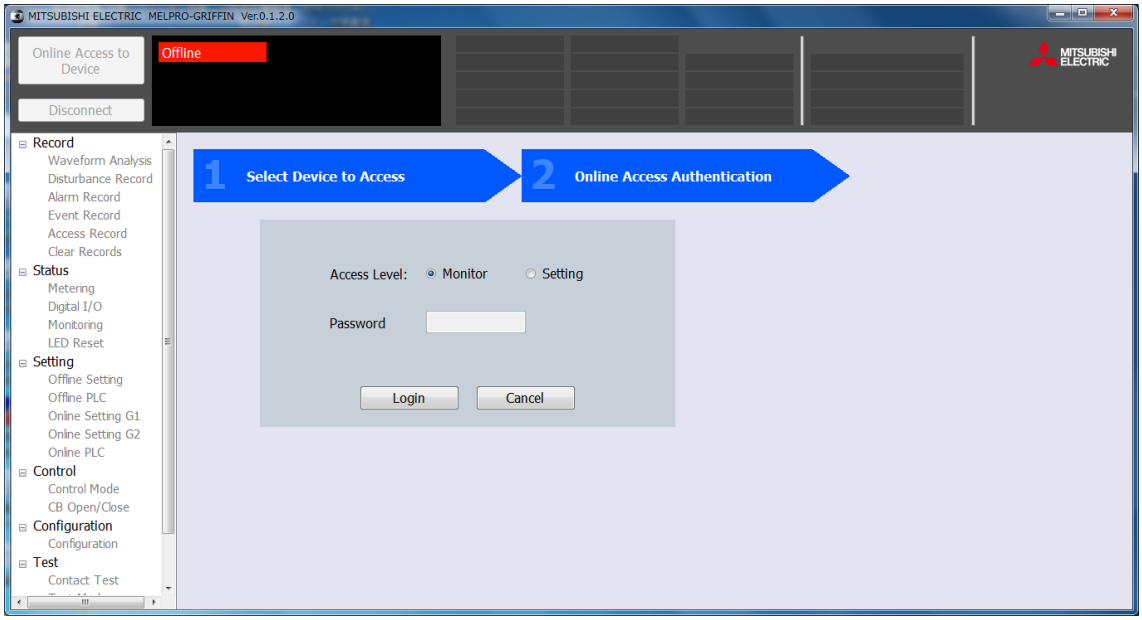
11.8.1. Log in (connection)

1. From the offline screen, click the [Online Access to Device] button. The screen for selecting the device to access appears.

2. A list of devices that can be accessed appears. Click the radio button for the desired device to access under Model and click “Connect.” (To cancel, click “Cancel” to go back to the offline initial screen.)

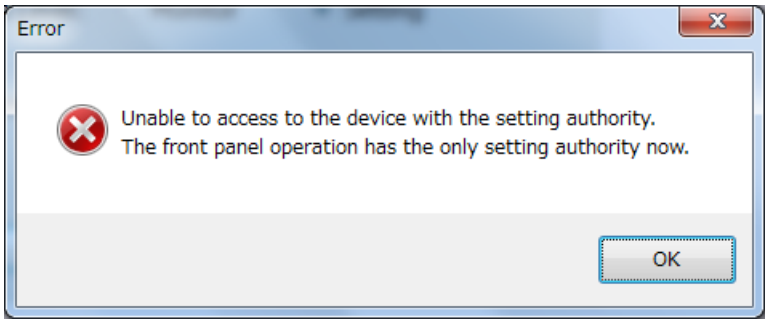


3. The access authentication screen appears. Click the radio button for the desired access level. (Monitor: view permission, Setting: write permission)



If you do not desire to log in, click “Cancel” to go back to the offline initial screen.

Note) If the Setting permission is selected from the panel, it is not possible to log in from the PC-HMI with the Setting permission. The error message as shown below appears.



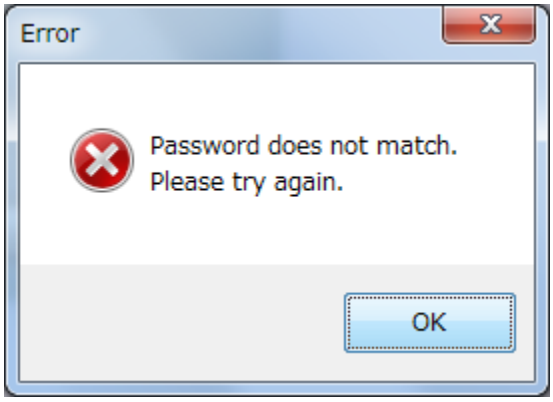
4. Enter the password (when a password is used and the device is accessed with the Setting permission).

Note) This operation is required when the device is accessed with the password use setting and Setting permission.
The password use/unuse setting can be changed by operation from the front panel.
(For how to change the password use/unuse setting, see 4.3.4.3.7 of Chapter 4.)

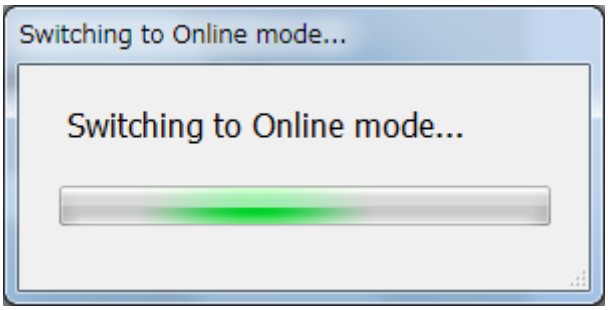
When no password is used or the device is accessed with the Monitor permission, password entry is not required.Simply click “Login” to log in.

After entering the password in the Password field, click “Login.”
Only half-width alphanumeric characters are acceptable to be included in a password.
The default password setting is “0000.”

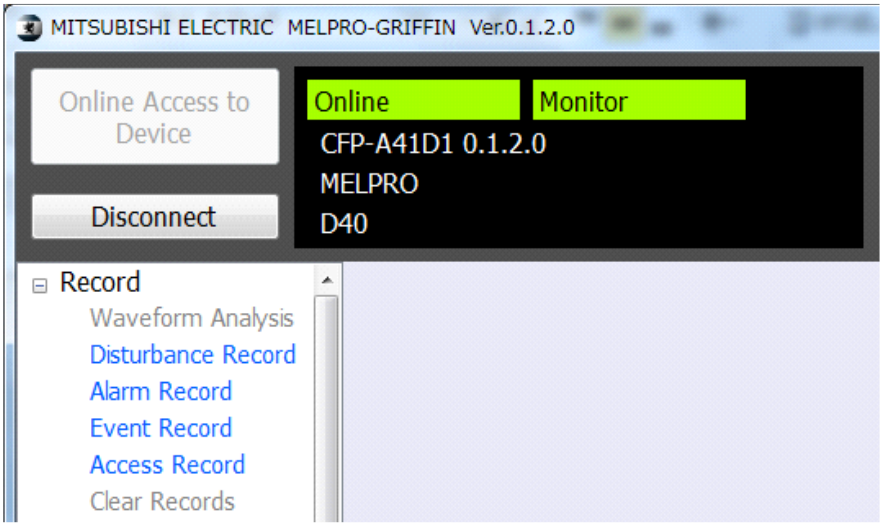
If a wrong password is given, the error message as shown below appears. Click “OK” and enter the password again.



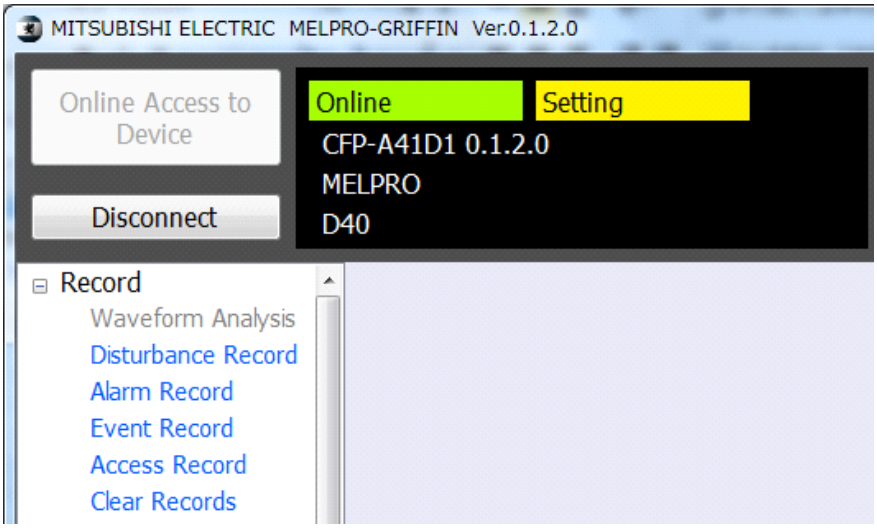
5. Successful password authentication switches the device mode from offline to online.



6. After switching to the online mode, the initial screen according to the access level appears.
   (1) Online initial screen for the view permission



   (2) Online initial screen for the write permission



Operations enabled differ depending on the access level.
   Items in blue: enabled
   Items in gray: disabled
For operations enabled/disabled depending on the access level, see the list on the next page.

List of operations enabled/disabled for the respective access levels

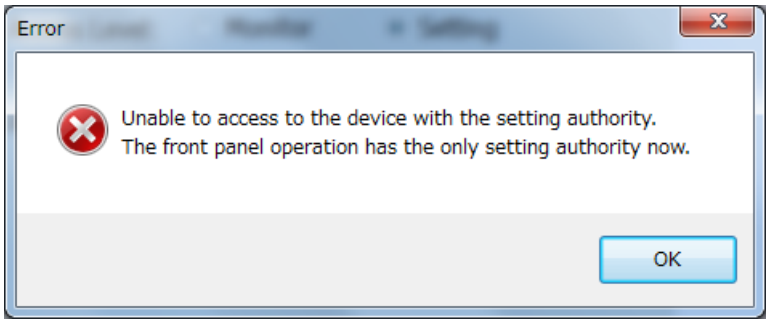
Type	Item	Offline mode	Online mode	
			View permission	Write permission
Record	Waveform Analysis	Y	N	N
	Disturbance Record	N	Y	Y
	Alarm Record	N	Y	Y
	Event Record	N	Y	Y
	Access Record	N	Y	Y
	Clear Records	N	N	Y
Status	Metering	N	Y	Y
	Digital I/O	N	Y	Y
	Monitoring	N	Y	Y
	LED Reset	N	Y	Y
Setting	Offline Setting	Y	N	N
	Offline PLC	Y	N	N
	Online Setting G1	N	Y	Y
	Online Setting G2	N	Y	Y
	Online PLC	N	Y	Y
Control	Control Mode	N	Y	Y
	CB Open/Close	N	N	Y
Configuration	Configuration	N	Y	Y
Test	Contact Test	N	N	Y
	Test Mode	N	N	Y
About	Help	Y	Y	Y

The symbols in the table above have the following meanings.

Y: The menu can be used to access a function screen.
Display of the function screen and operations other than device write are possible.

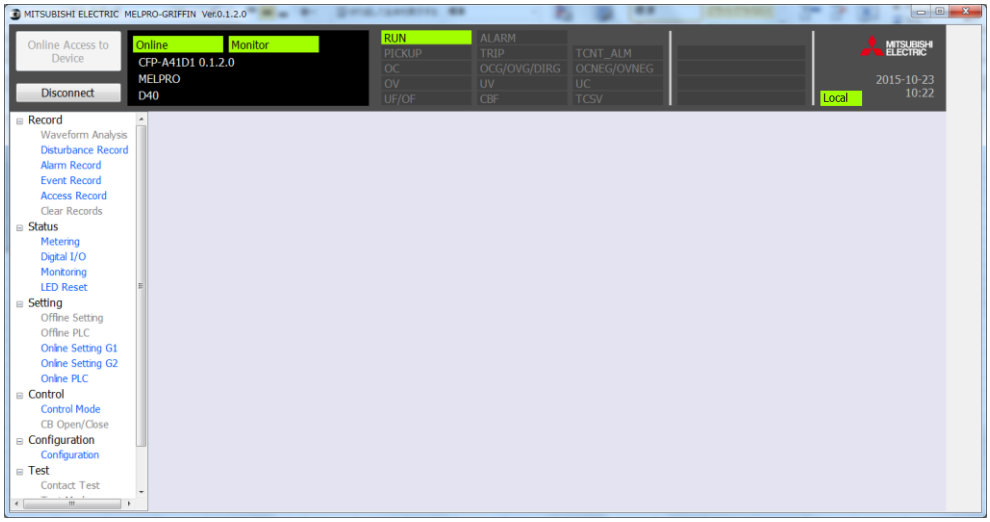
N: The menu is shown but grayed out and does not allow access to a function screen.
Neither display nor operation of the function screen is possible.

Note) Attempting an operation not permitted by the access level generates the error message as shown below.

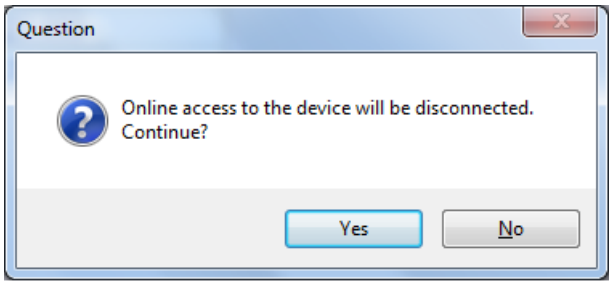


11.8.2. Log off (disconnect) from the online mode

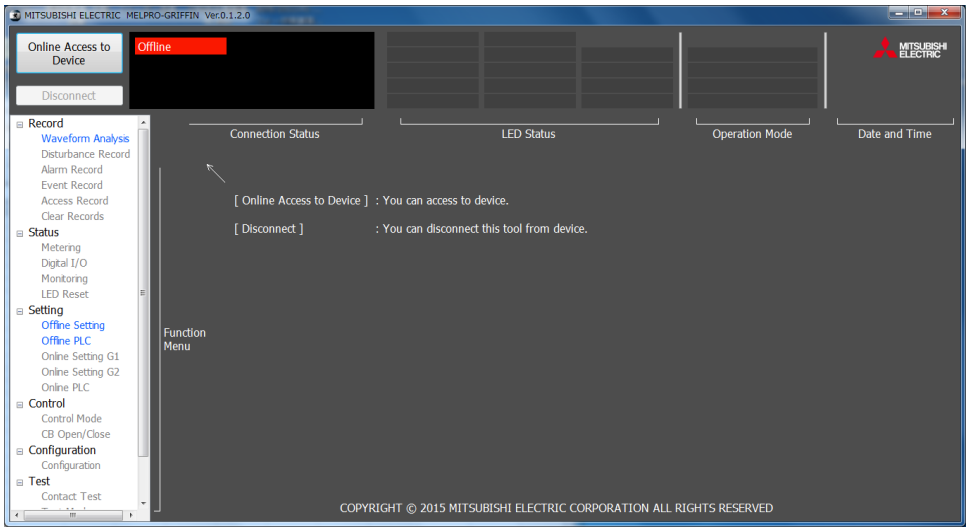
1. Click the [Disconnect] button in the upper left part of the online mode screen.



2. The dialog to confirm disconnection as shown below appears. Click “Yes.”



3. The device mode is switched to offline.



11.9. PC-HMI operation menu

PC-HMI allows access to the individual items from the list of functions on the left side of the main screen. The name and overview of each item are given in the table below.

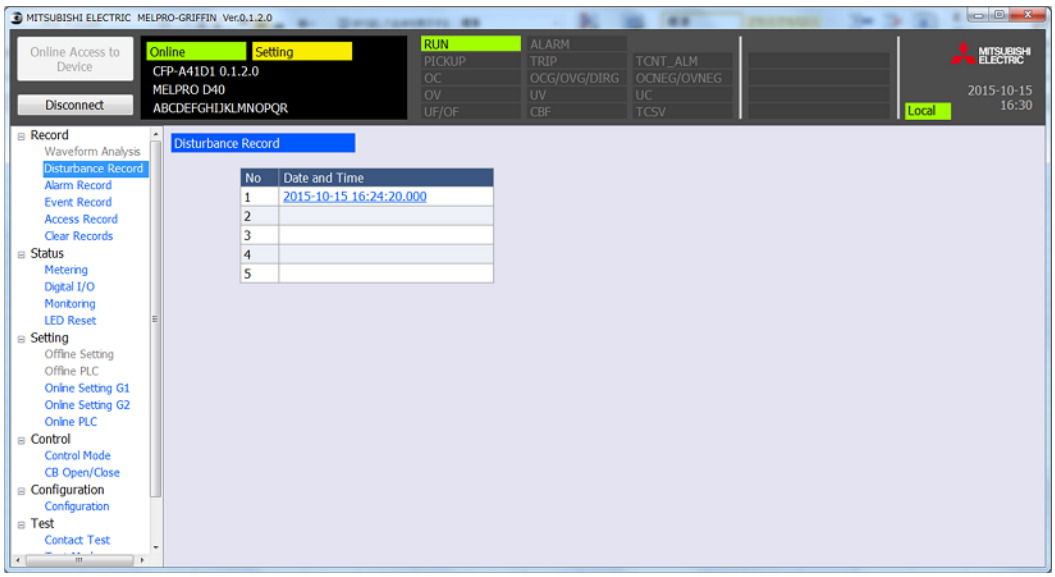
No	Type	Name	Description
1	Record	Waveform Analysis	Starts the waveform analysis tool, a separate application (*1)
2		Disturbance Record	Disturbance record screen
3		Alarm Record	Supervision alarm record screen
4		Event Record	Event record screen
5		Access Record	Access record screen
6		Clear Records	Clear record screen
7	Status	Metering	Analog measurement status display screen
8		Digital I/O	DIO status display screen
9		Monitoring	Device supervision status display screen
10		LED Reset	LED reset screen
11	Setting	Offline Setting	Offline setting screen
12		Offline PLC	Offline PLC screen
13		Online Setting G1	Online setting screen (Group 1)
14		Online Setting G2	Online setting screen (Group 2)
15		Online PLC	Online PLC screen
16	Control	Control Mode	CB control mode screen
17		CB Open/Close	CB control execution screen
18	Configuration	Configuration	Configuration screen
19	Test	Contact Test	DO contact test screen
20		Test Mode	Test mode activation screen
21	About	Help	Shows the operation manual as a PDF file in a new window (*2)

Note) Items that cannot be selected are grayed out and not enabled for selection.
(*1): Implemented by a different application and the menu only allows starting of the application.
(*2): Only allows starting of PDF. If no application is installed that is required for starting PDF, the instruction manual read error message appears.

11.10. Operate record functions

11.10.1. Disturbance record function

1. From the Function menu, select Disturbance Record.



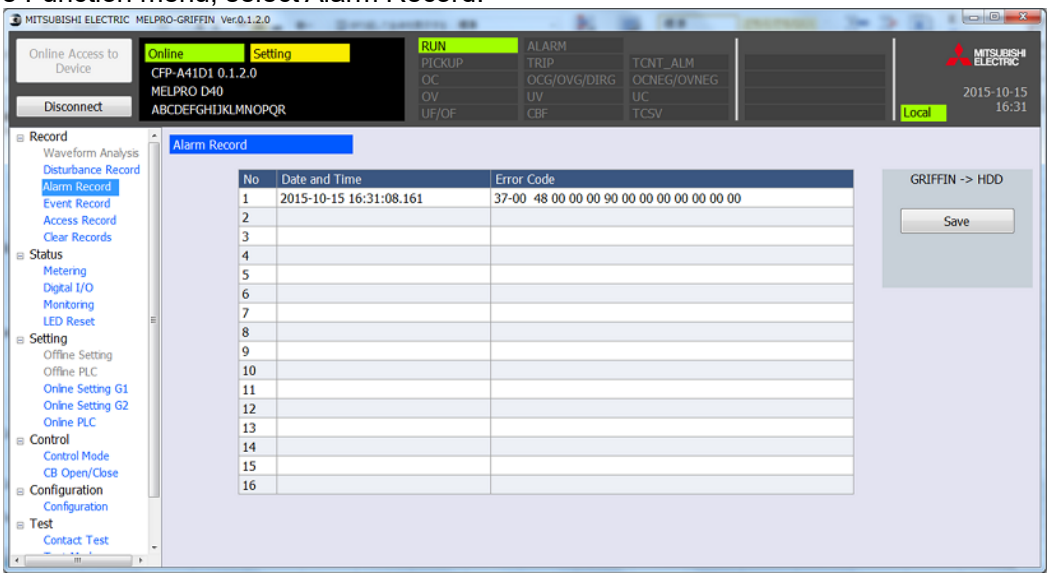
2. The dates and times of disturbance occurrences are listed in the descending order of the date and time. Select the data to retrieve.

3. Save it in an arbitrary location on the HDD.
   (The waveform analysis tool allows analysis of the waveform data saved.)

Note) The dates and times are represented as “-year-month-day- hour:-minute:-second.-millisecond.”
Note) Up to five occurrences can be shown. If the data size is large, the number may be less than five.

11.10.2. Alarm record function (by self-diagnosis function)

1. From the Function menu, select Alarm Record.



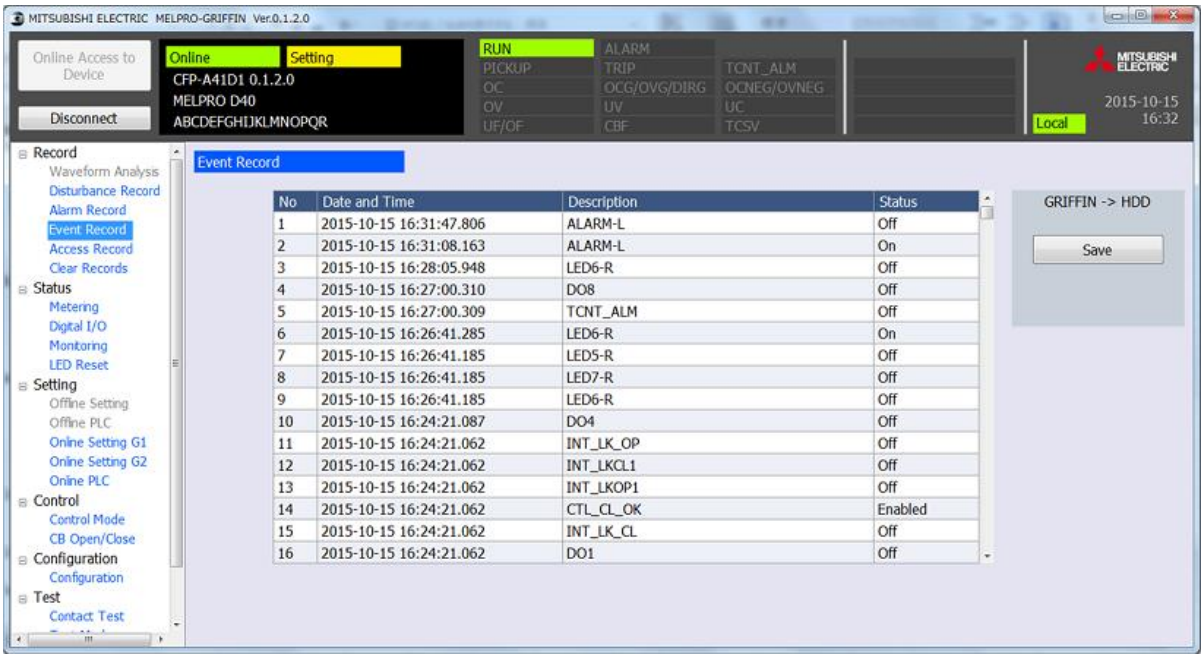
2. The supervision alarm records are listed in the descending order of the date and time. Select the data to retrieve.

3. From PC-HMI -> HDD, click “Save” to save it in an arbitrary location on the HDD.

Note) If the number of record data exceeds 16, use the scroll bar for display.
Up to 200 data can be shown. For the details of the date and time indication, see 11.10.1

11.10.3. Event record function

1. From the Function menu, select Event Record.



2. The record data relating to preregistered events are listed in the descending order of the date and time.

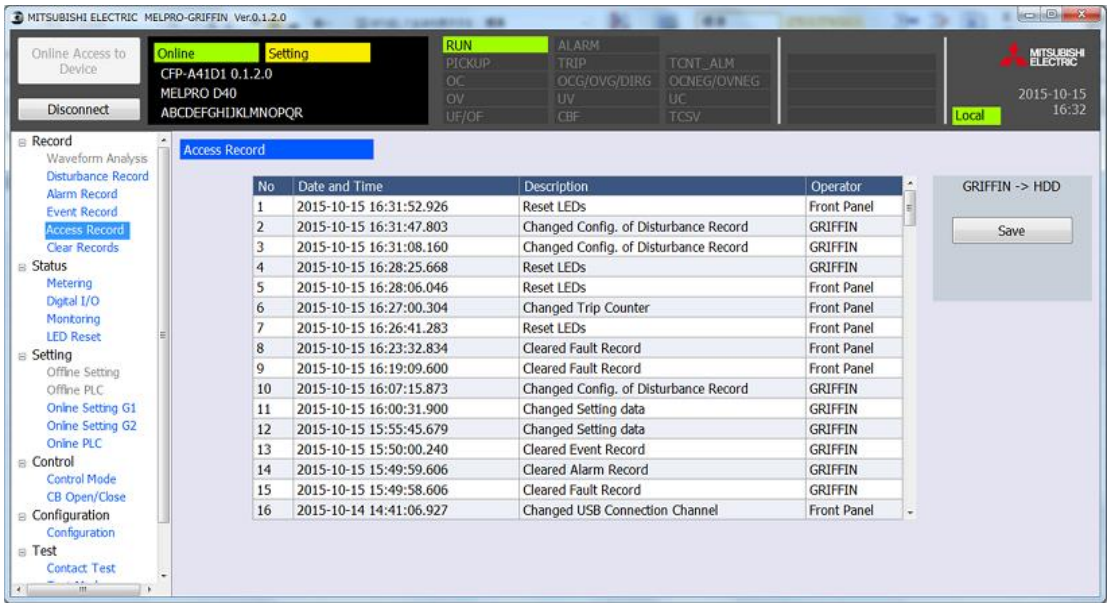
Note) For the events, see 4.3.2.2.2 of Chapter 4.

3. Select the event record to retrieve and, from PC-HMI -> HDD, click “Save” to save it in an arbitrary location on the HDD.

Note) If the number of record data exceeds 16, use the scroll bar for display.
Up to 512 data can be shown. For the details of the date and time indication, see 11.10.1.

11.10.4. Access record function

1. From the Function menu, click Access Record.



2. The record data relating to access to the preregistered device are listed in the descending order of the date and time.

3. From PC-HMI -> HDD, click “Save” to save it in an arbitrary location on the HDD.

Note) If the number of record data exceeds 16, use the scroll bar for display.
Up to 200 data can be shown. For the details of the date and time indication, see 11.10.1.

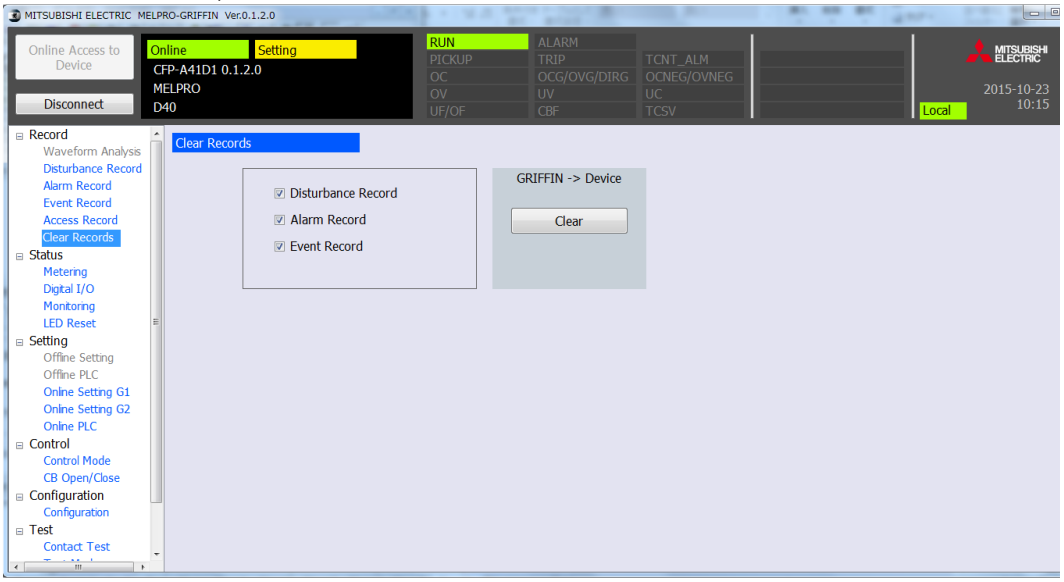
Note) For access operator and access record description, see the list below.

Access operator list (Operator)

Access operator	PC-HMI indication
Front panel	Front Panel
PC-HMI	PC-HMI
Via Modbus communication I/F	via Modbus
Via TCP/IP communication I/F	via TCP/IP
Via CC-Link communication I/F	via CC-Link
Automatic cancellation on device	Automatic
Change of active setting group	Changed Active Setting Group
Change of DI detection voltage value	Changed DI Voltage
Change of configuration of disturbance record	Changed Config. of Disturbance Record
Change of password use setting	Changed Use of Password
Change of password	Changed Password
Change of USB connection channel	Changed USB Connection Channel
Change of VFD brightness	Changed VFD Brightness
Change of trip counter	Changed Trip Counter
Change of configuration of Modbus	Changed Config. of Modbus
Change of configuration of CC-Link	Changed Config. of CC-Link
Change of configuration of IEC61850	Changed Config. of IEC61850
Change of device name	Changed Device Name
Change of configuration of analog measurement status display	Changed Config. of Metering
Change of configuration of electric energy	Changed Config. of Energy
Change of configuration of time management	Changed Config. of Time Management
Change of CB control mode	Changed CB Control Mode
Change of configuration of DO contact test	Changed Config. of Contact Test
Change of configuration of SNTP	Changed Config. of SNTP
Change of PLC data	Changed PLC data
Change of relay setting	Changed Setting data
Clearing of fault/disturbance record	Cleared Fault/Disturbance Record
Clearing of alarm record	Cleared Alarm Record
Clearing of event record	Cleared Event Record
Adjustment of system clock	Adjusted System Clock
Activation of test mode	Activated Test Mode
Deactivation of test mode	Deactivated Test Mode
LED reset	Reset LEDs
Start of DO contact test	Started Contact Test
Stop of DO contact test	Stopped Contact Test
Locking of supervision	Locked Supervision
Unlocking of supervision	Unlocked Supervision
Start of interface test	Started Interface Test
Stop of interface test	Stopped Interface Test
Operation to open/close CB	Operated to Open/Close CB

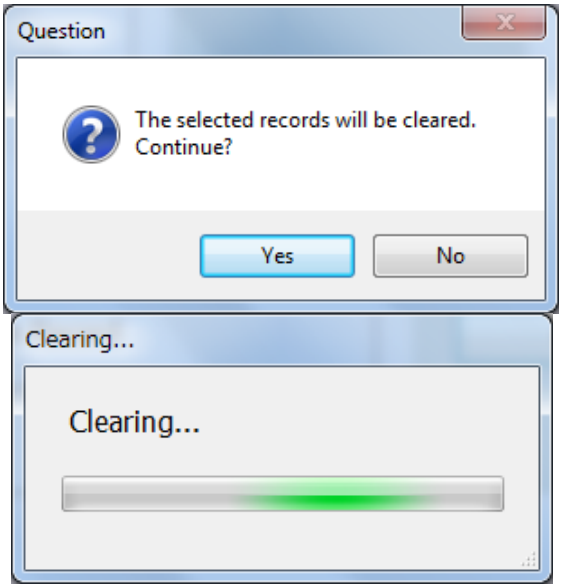
11.10.5. Clear record function

1. From the Function menu, click Clear Records.

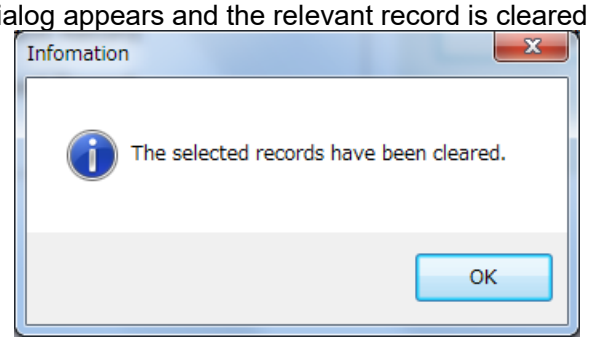


2. Check the box for the record to clear and, from PC-HMI -> Device, click “Clear.”

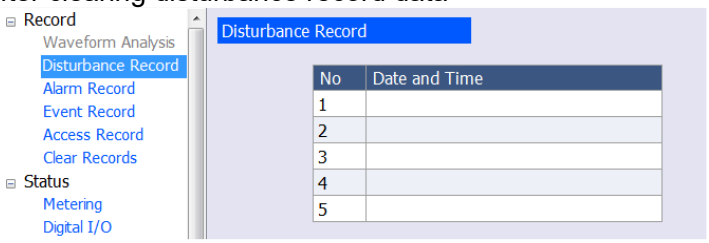
3. The confirmation dialog as shown below appears. Click “Yes” to start clearing.



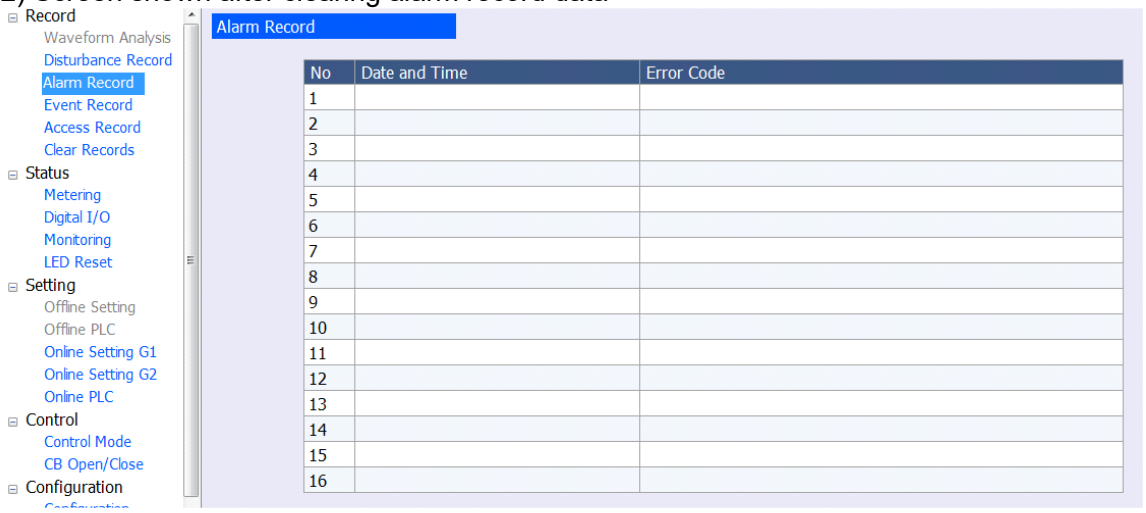
4. The clearing completion dialog appears and the relevant record is cleared.



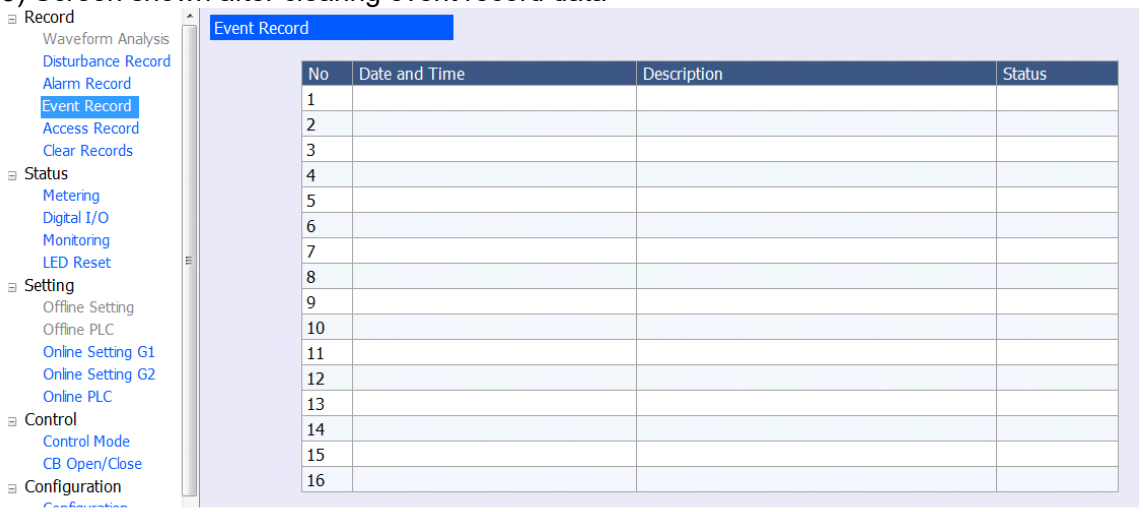
(1) Screen shown after clearing disturbance record data



(2) Screen shown after clearing alarm record data



(3) Screen shown after clearing event record data



Note) The file clearing operation erases the relevant record file
(The system does not allow clearing of access records.)

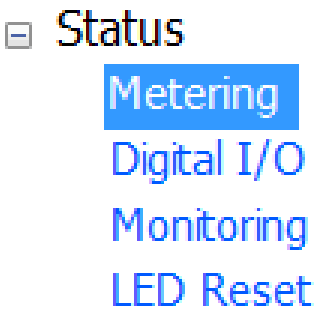
11.11. Showing statuses

11.11.1. Showing analog values measured

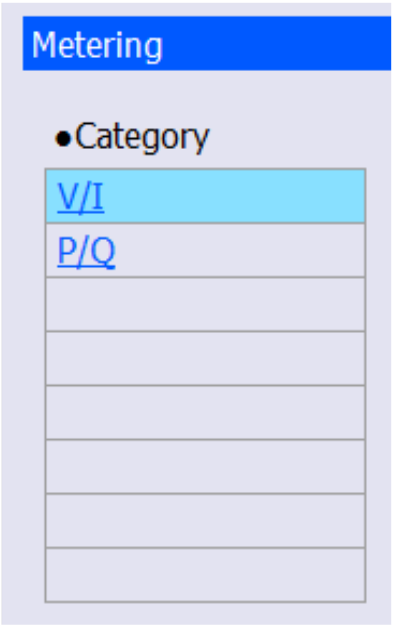
In the analog measurement status mode, the current statuses of analog values measured are listed.

11.11.1.1. Showing the current/voltage

1. From the Function menu, click Metering.

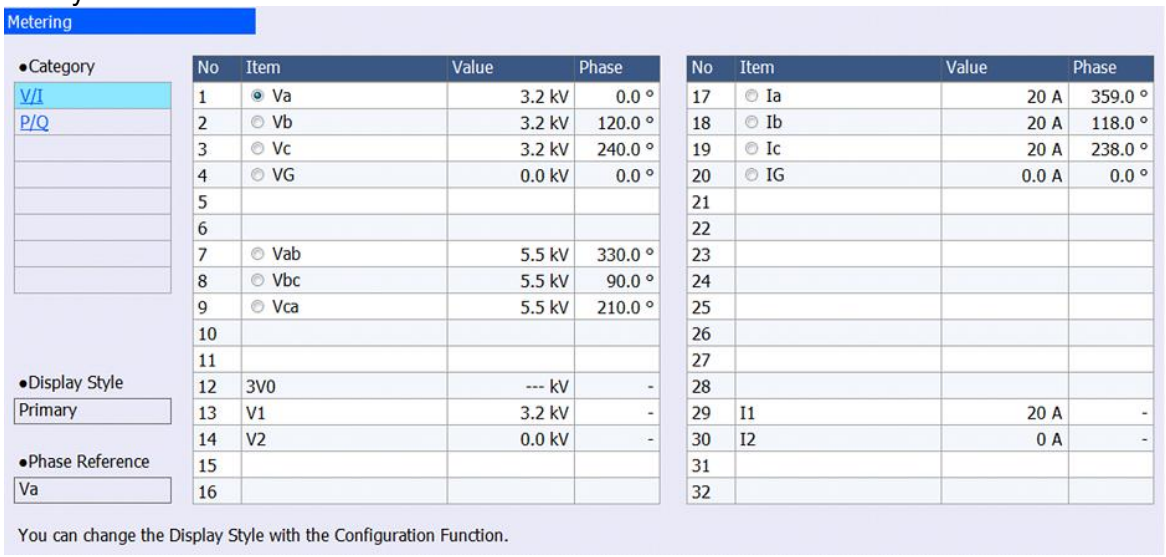


2. From Category, click V/I.



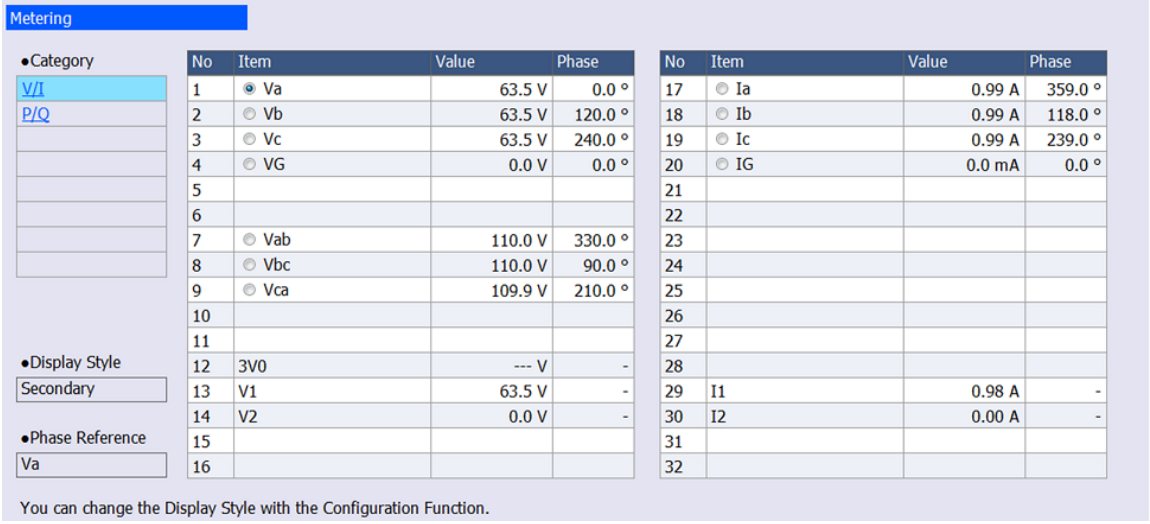
3. The V/I values for the side specified by the configuration are shown.

Primary side



No	Item	Value	Phase	No	Item	Value	Phase
1	Va	3.2 kV	0.0 °	17	Ia	20 A	359.0 °
2	Vb	3.2 kV	120.0 °	18	Ib	20 A	118.0 °
3	Vc	3.2 kV	240.0 °	19	Ic	20 A	238.0 °
4	VG	0.0 kV	0.0 °	20	IG	0.0 A	0.0 °
5				21			
6				22			
7	Vab	5.5 kV	330.0 °	23			
8	Vbc	5.5 kV	90.0 °	24			
9	Vca	5.5 kV	210.0 °	25			
10				26			
11				27			
12	3V0	--- kV	-	28			
13	V1	3.2 kV	-	29	I1	20 A	-
14	V2	0.0 kV	-	30	I2	0 A	-
15				31			
16				32			

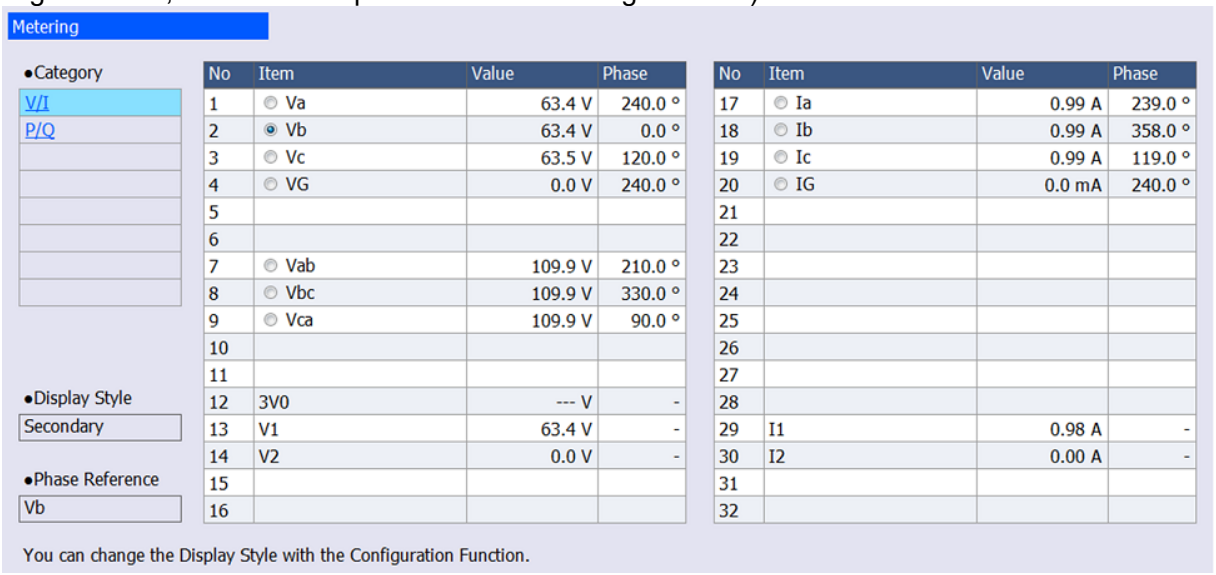
Secondary side



No	Item	Value	Phase	No	Item	Value	Phase
1	Va	63.5 V	0.0 °	17	Ia	0.99 A	359.0 °
2	Vb	63.5 V	120.0 °	18	Ib	0.99 A	118.0 °
3	Vc	63.5 V	240.0 °	19	Ic	0.99 A	239.0 °
4	VG	0.0 V	0.0 °	20	IG	0.0 mA	0.0 °
5				21			
6				22			
7	Vab	110.0 V	330.0 °	23			
8	Vbc	110.0 V	90.0 °	24			
9	Vca	109.9 V	210.0 °	25			
10				26			
11				27			
12	3V0	--- V	-	28			
13	V1	63.5 V	-	29	I1	0.98 A	-
14	V2	0.0 V	-	30	I2	0.00 A	-
15				31			
16				32			

Note) For switching between the primary and secondary indications, see **11.14.4**.

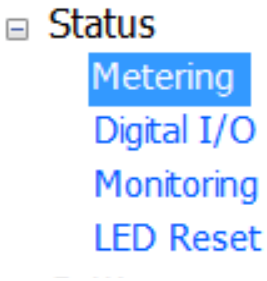
Note) Clicking an Item radio button allows change of the reference phase.
(In the figure below, the reference phase has been changed to Vb.)



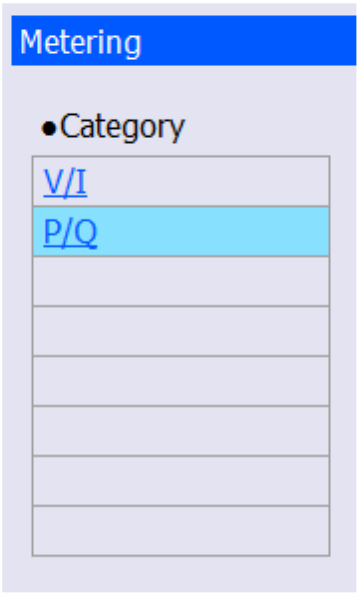
No	Item	Value	Phase	No	Item	Value	Phase
1	Va	63.4 V	240.0 °	17	Ia	0.99 A	239.0 °
2	Vb	63.4 V	0.0 °	18	Ib	0.99 A	358.0 °
3	Vc	63.5 V	120.0 °	19	Ic	0.99 A	119.0 °
4	VG	0.0 V	240.0 °	20	IG	0.0 mA	240.0 °
5				21			
6				22			
7	Vab	109.9 V	210.0 °	23			
8	Vbc	109.9 V	330.0 °	24			
9	Vca	109.9 V	90.0 °	25			
10				26			
11				27			
12	3V0	--- V	-	28			
13	V1	63.4 V	-	29	I1	0.98 A	-
14	V2	0.0 V	-	30	I2	0.00 A	-
15				31			
16				32			

11.11.1.2. Showing active/reactive power

1. From the Function menu, click Metering.

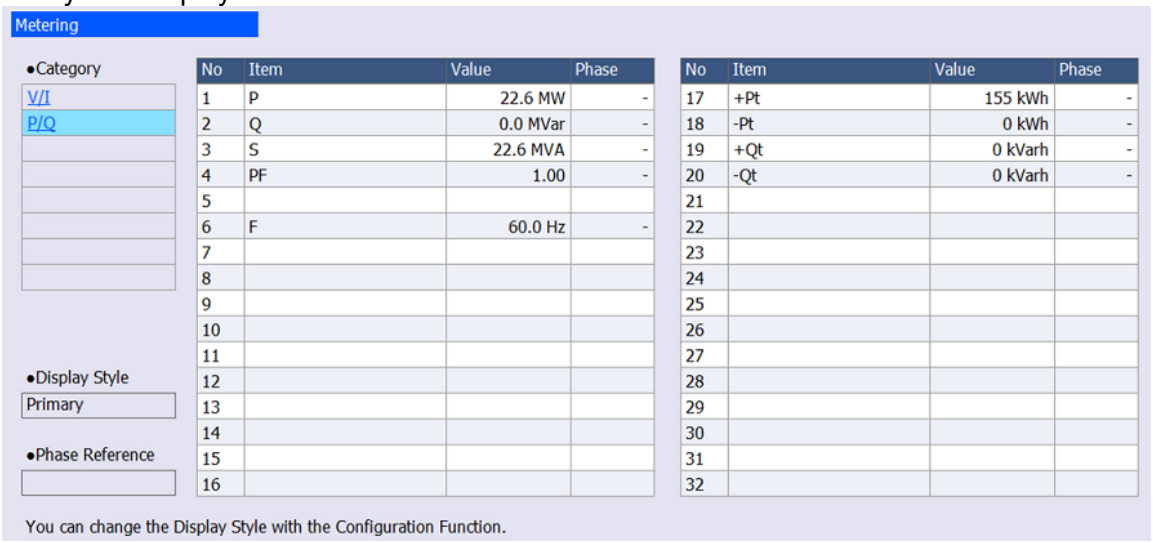


2. From Category, click P/Q.

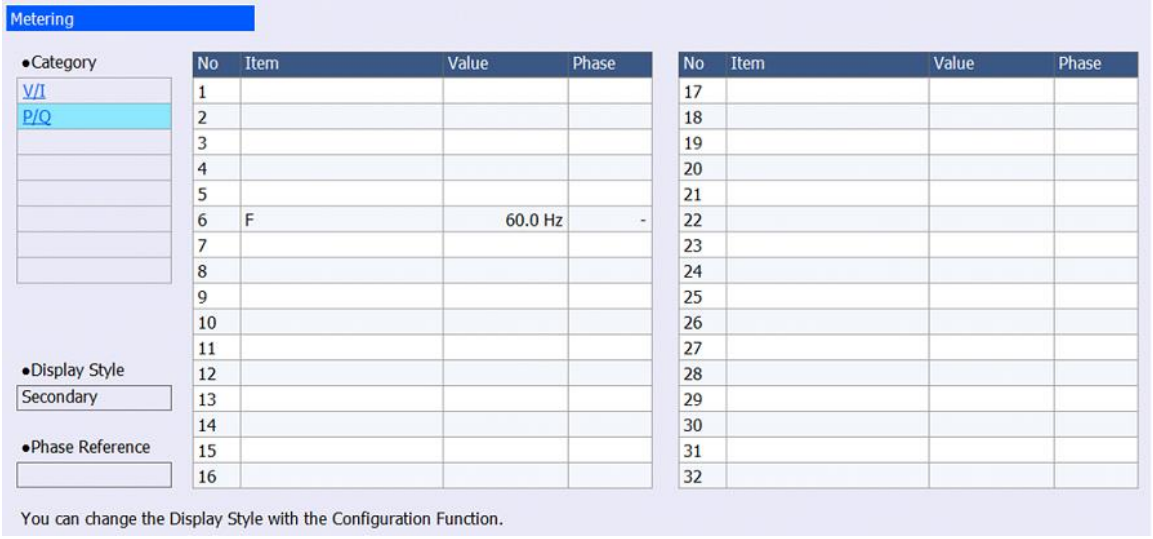


3. The active/reactive power and other values for the side specified by the configuration are shown.

Primary side display



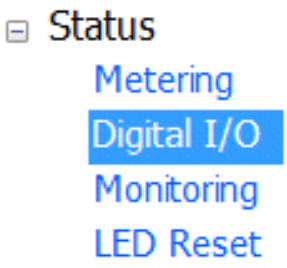
Secondary side display



Note) Power and electric energy are not shown for the secondary side.

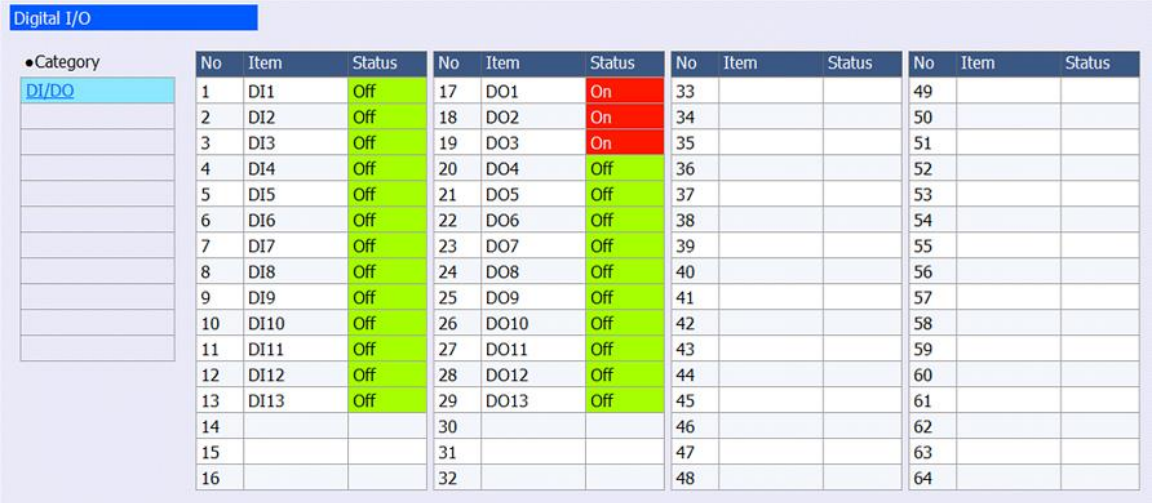
11.11.2. Showing Digital I/O

1. From the Function menu, click Digital I/O.



2. From Category, click DI/DO.

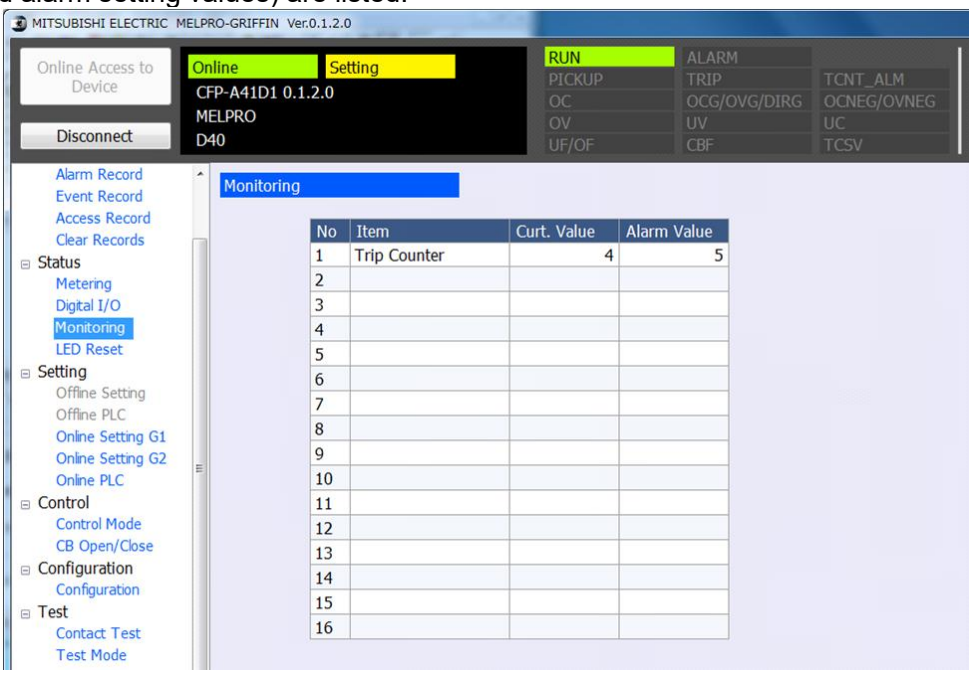
3. The current statuses of DI/DO are listed.



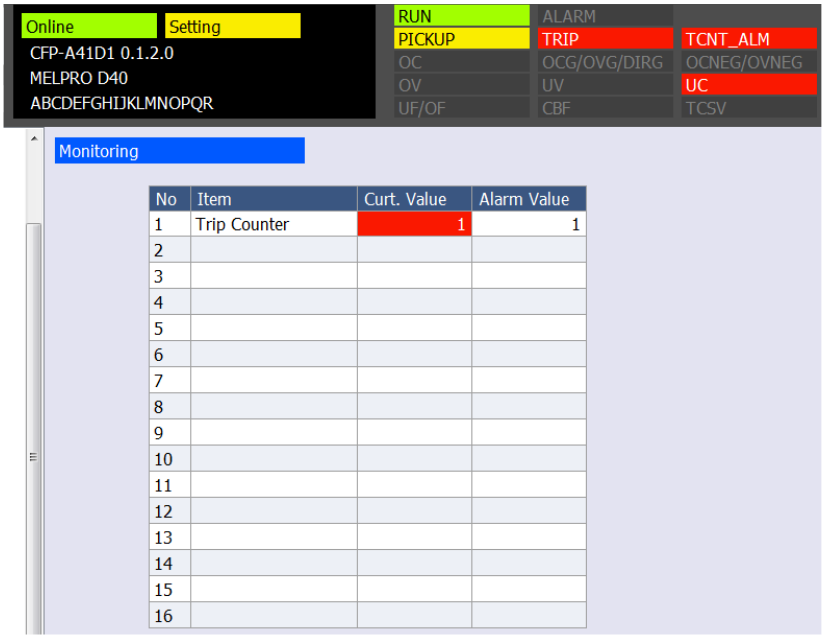
No	Item	Status	No	Item	Status	No	Item	Status	No	Item	Status
1	DI1	Off	17	DO1	On	33			49		
2	DI2	Off	18	DO2	On	34			50		
3	DI3	Off	19	DO3	On	35			51		
4	DI4	Off	20	DO4	Off	36			52		
5	DI5	Off	21	DO5	Off	37			53		
6	DI6	Off	22	DO6	Off	38			54		
7	DI7	Off	23	DO7	Off	39			55		
8	DI8	Off	24	DO8	Off	40			56		
9	DI9	Off	25	DO9	Off	41			57		
10	DI10	Off	26	DO10	Off	42			58		
11	DI11	Off	27	DO11	Off	43			59		
12	DI12	Off	28	DO12	Off	44			60		
13	DI13	Off	29	DO13	Off	45			61		
14			30			46			62		
15			31			47			63		
16			32			48			64		

11.11.3. Showing device supervision status

1. From the Function menu, click Monitoring. The device supervision status values (current and alarm setting values) are listed.



Note) If the current value is equal to or larger than the alarm setting value, an alarm indication is given as shown below.



11.11.4. Resetting LEDs

1. From the Function menu, click LED Reset.
2. From PC-HMI -> Device, click “LED Reset.”

3. The dialog as shown below appears. Click “Yes.”

4. The latched LEDs are reset.

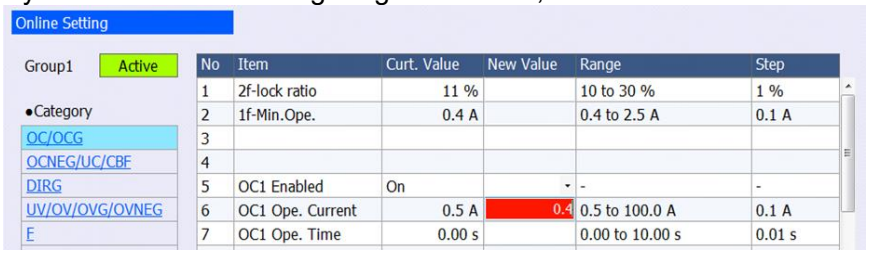
11.12. Setting mode

11.12.1. Online setting

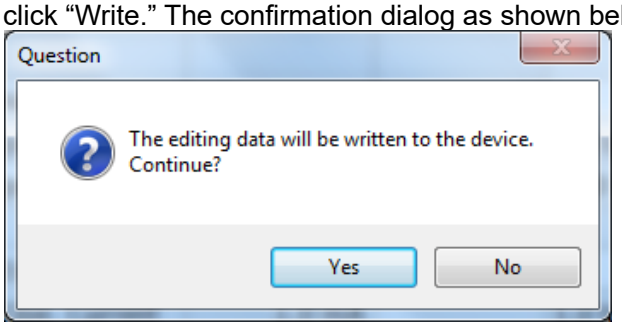
1. From the Function menu, click the group to set.
   Online Setting G1: listing and editing of Group 1
   Online Setting G2: listing and editing of Group 2

2. Click the item to set from Category. A list of setting values is shown under Item. Click New Value for the item to make a change.
   From the list, make a selection by clicking ▼.
   To enter a value, use the keyboard.

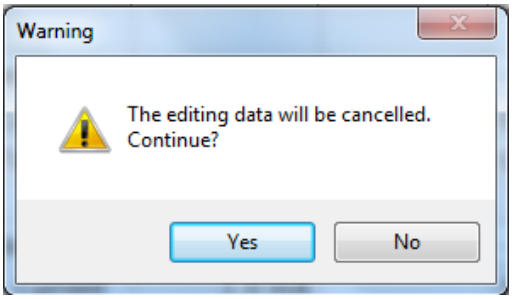
Note) If any value out of the setting range is entered, an error indication as shown below is given.



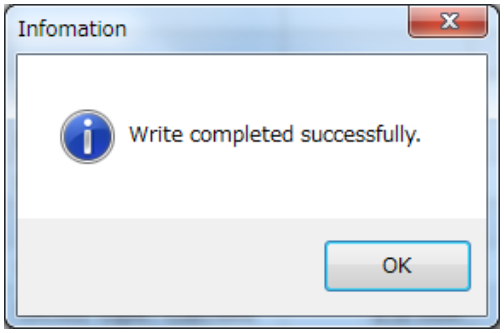
3. From PC-HMI -> Device, click “Write.” The confirmation dialog as shown below appears. Click “Yes.”



Note) To cancel writing of any setting value, click “No.” The confirmation dialog as shown below appears. Click “Yes” to cancel.



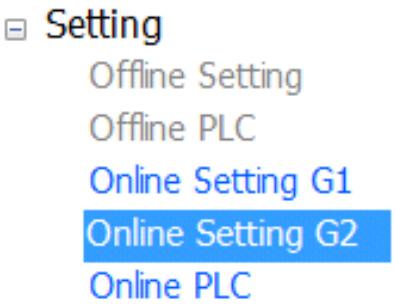
4. Writing of the setting values to the device starts. When it has been completed, the completion message as shown below appears.



11.12.2. Switching between setting groups to activate

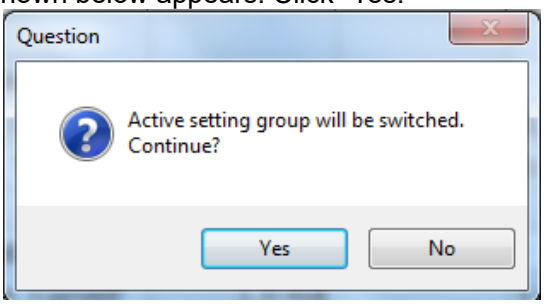
On the Online setting screen, the active group is marked as Active and the inactive group Inactive.

1. From the Function menu, click the setting group to activate.
   (In this example, the active group is switched from Group 1 to Group 2.)

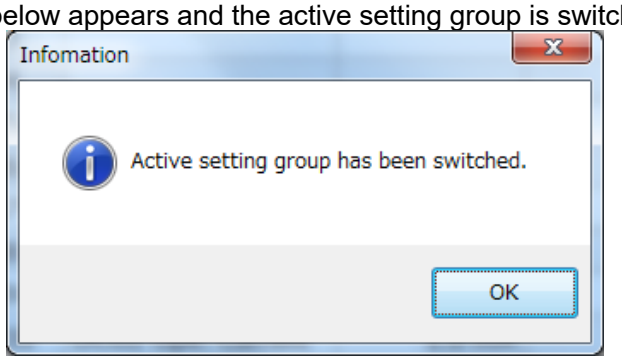


2. From PC-HMI -> Device, click “Group- Active.”

3. The confirmation dialog as shown below appears. Click “Yes.”



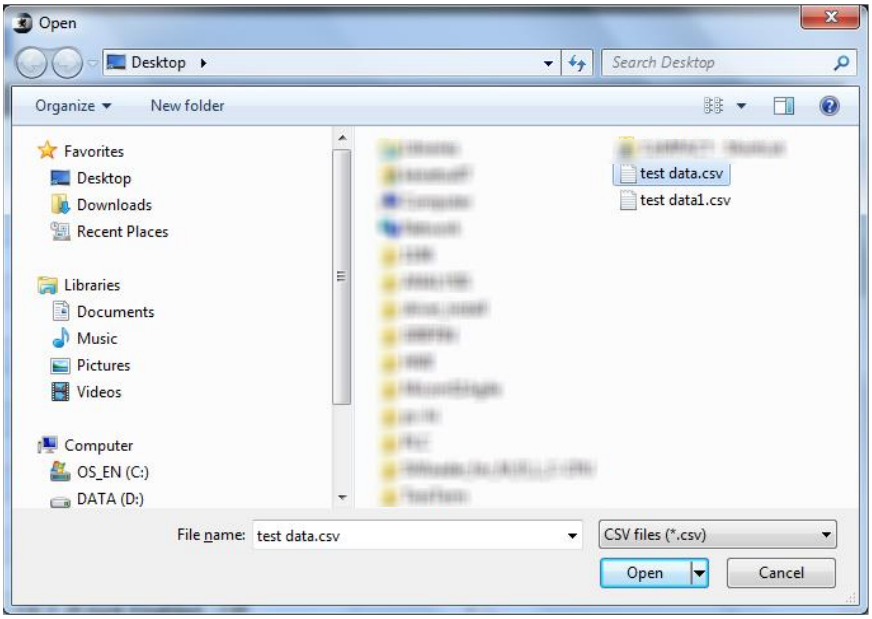
4. The message as shown below appears and the active setting group is switched.



11.12.3. Reading/saving setting files from/to the HDD

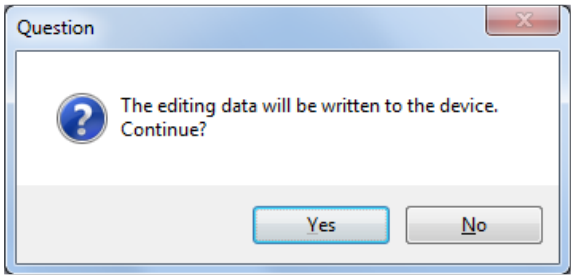
1. From the Function menu, click the group to read setting values.
2. From PC-HMI <-> HDD in the lower right part of the main screen, click “Open.”

3. Select the file to read and click “Open.”

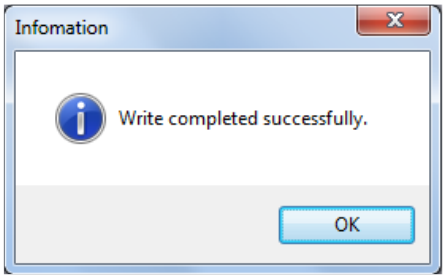


4. The read values are shown on the screen.

5. From PC-HMI -> Device in the upper right part of the main screen, click “Write.” The confirmation dialog appears.

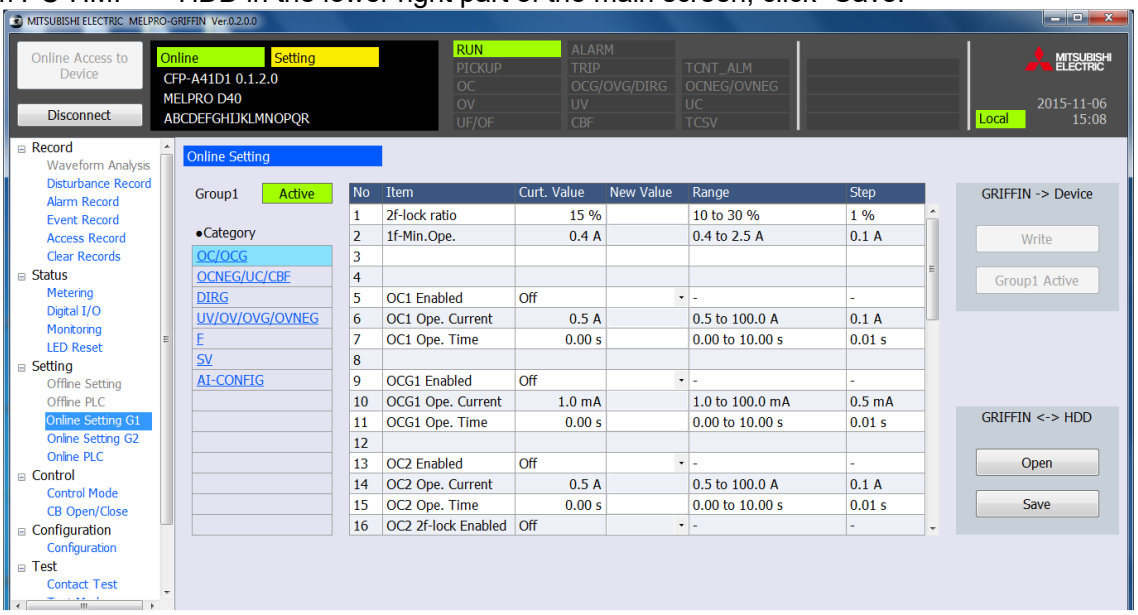


6. Click “Yes” to write the setting values to the device and activate them.

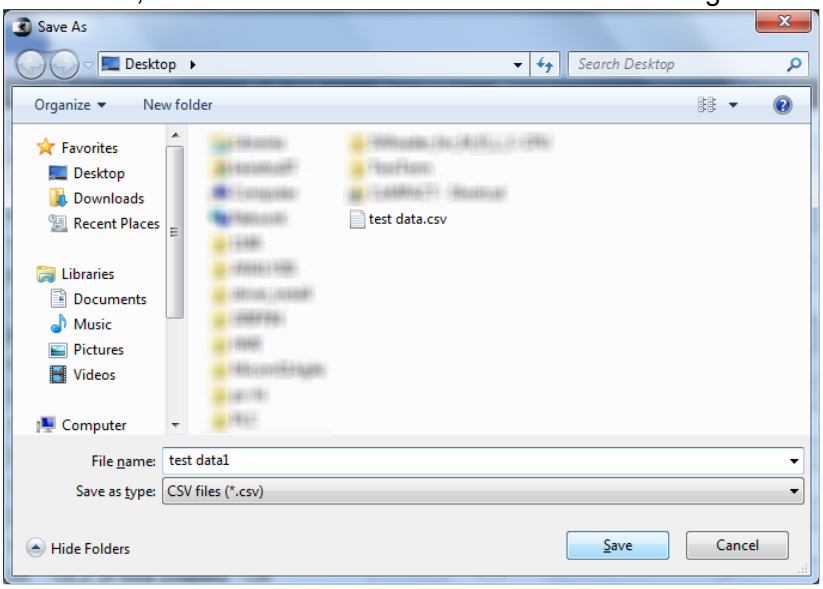


(To save setting value files)

1. From PC-HMI <-> HDD in the lower right part of the main screen, click “Save.”



2. Select the destination folder, enter a file name and click “Save.” The setting file is saved.

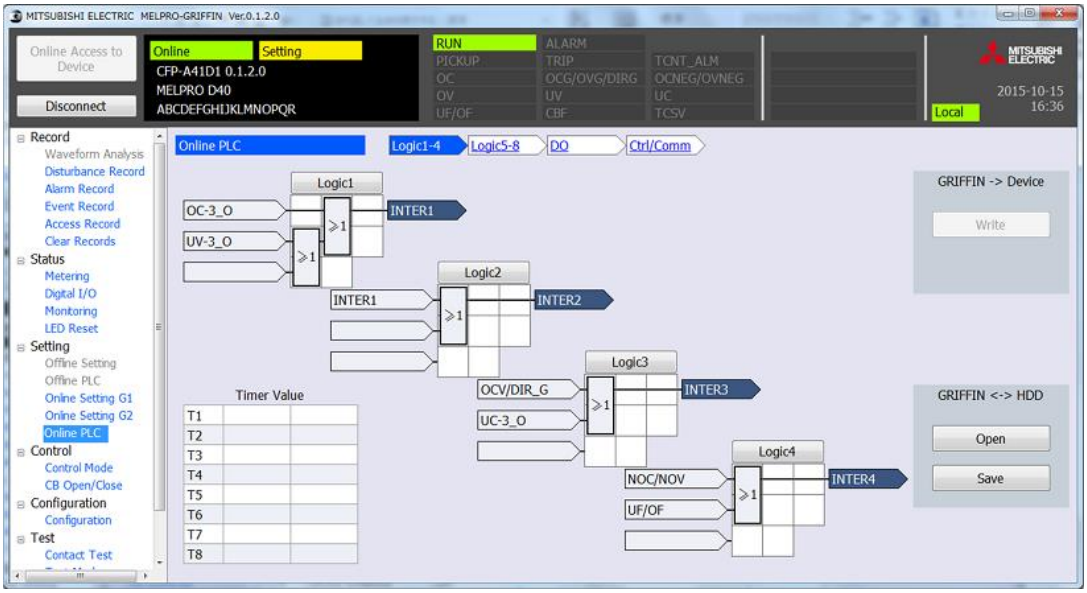


11.12.4. Online PLC

With MELPRO-D, the PLC function allows the user to configure the sequence in the relay. It is customizable according to the system by assigning the user-configured sequence outputs to contacts, for example.

11.12.4.1. Configuring online PLC (logic circuit)

A sequence can be configured for eight outputs. These sequence outputs can be assigned as DO signals described later.

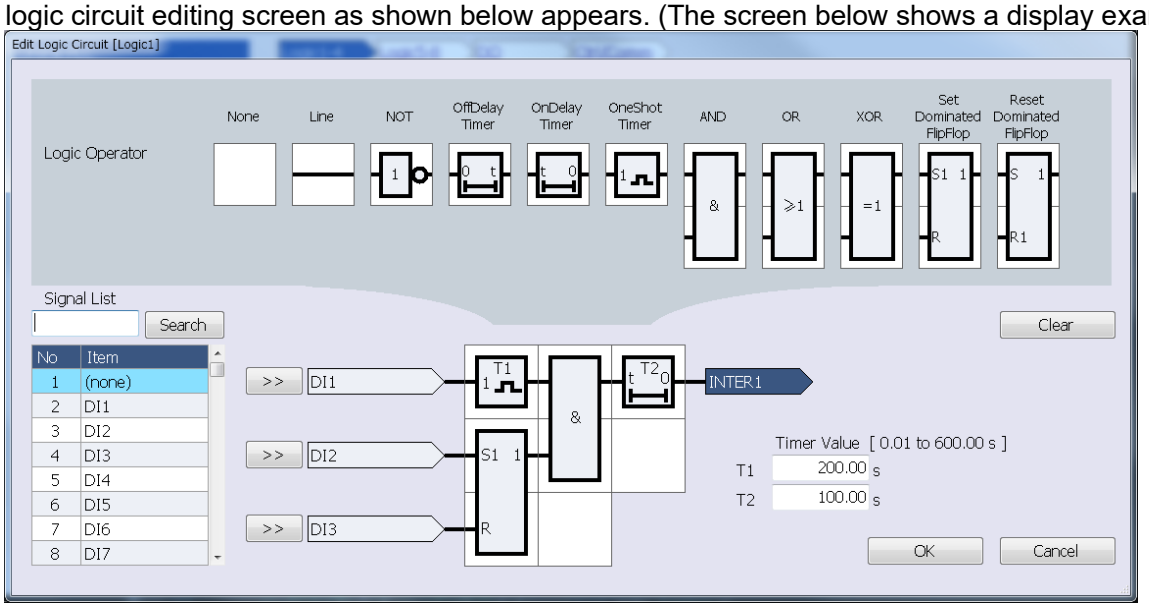


[Adding PLC configuration]

1. From the Function menu, click Online PLC.

2. Click the Logic group and Logic to edit.
   Logic1-4: indication and editing screen for logic circuits 1 to 4
   Logic5-8: indication and editing screen for logic circuits 5 to 8

3. The logic circuit editing screen as shown below appears. (The screen below shows a display example)

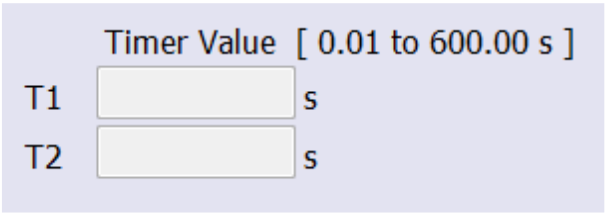


4. From the Item list on the screen above, select the signal to input and click. The selected signal is shown in light blue.
   Click “>>” to select the input signal.

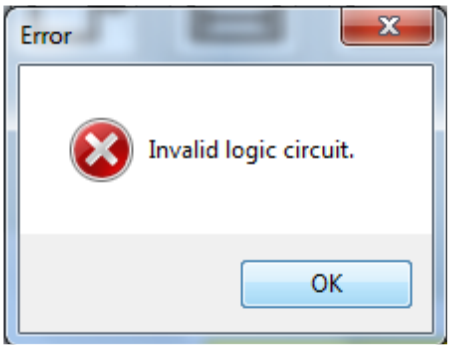
Note) The signal name can be searched by entering it on the Signal List by using the keyboard and clicking “Search.”

5. From the list of circuit components, select the logic component to place and click the logic area to place it. The logic component is placed. After the placement has been completed, click “OK” to go back to the previous screen.

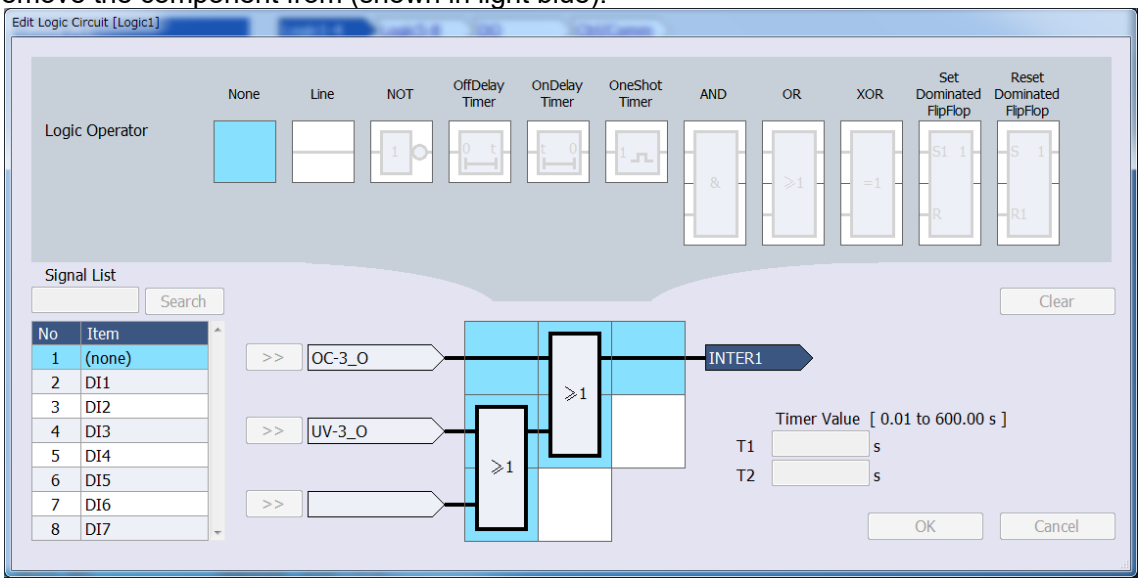
   When providing any timer component, specify the time in the Timer Value field.
   (Up to two timer components can be configured for each of Logics 1 to 8.)



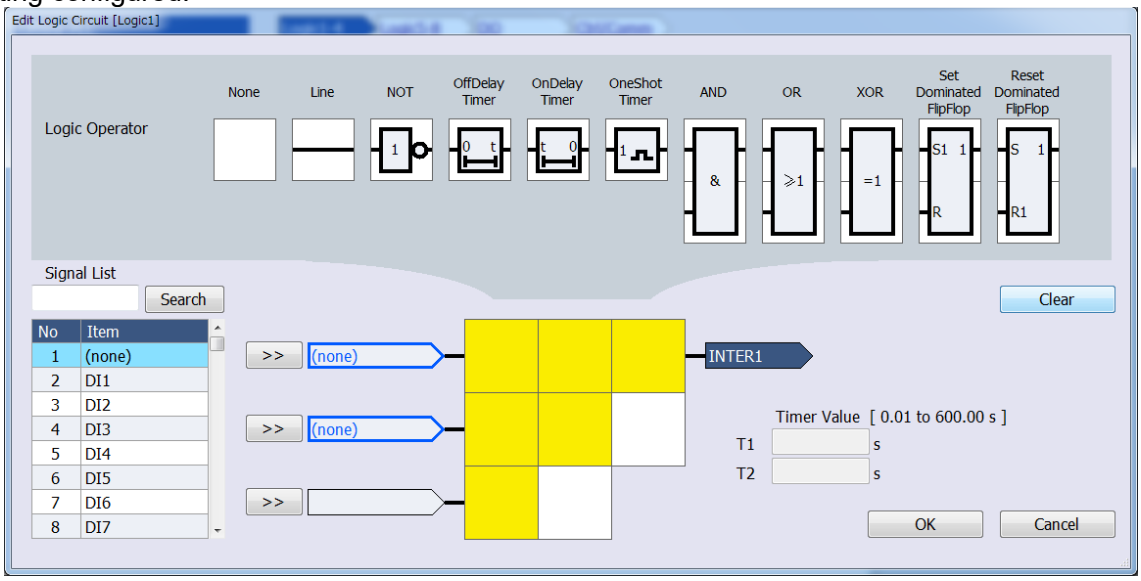
For logic components that can and cannot be placed, see 11.7.3.
Attempting to place a component in an area that does not allow placement, the error message as shown below appears.



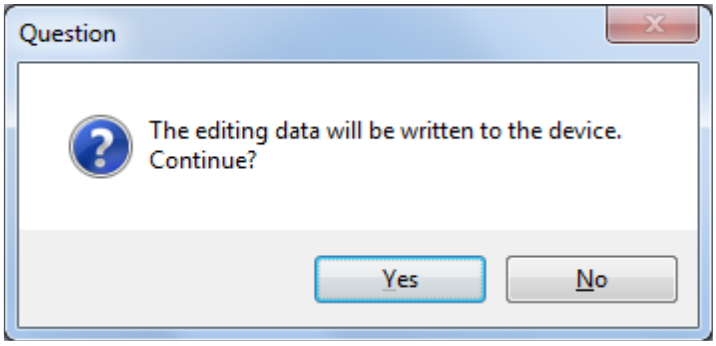
To remove any component that has been placed, select a None logic component and click the logic area to remove the component from (shown in light blue).



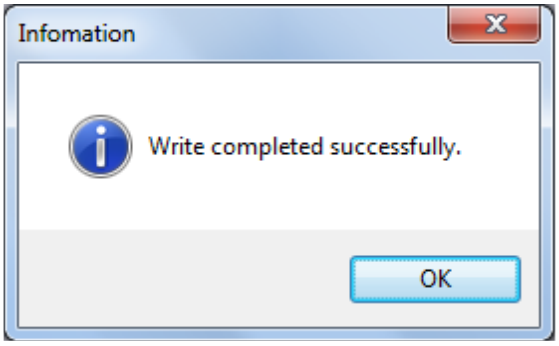
Clicking “Clear” brings back to the initial state with no input signal set, logic component placed or timer setting configured.



6. From PC-HMI -> Device in the upper right part of the main screen, click “Write.” The dialog to confirm writing to the device appears. Click “Yes” to write the setting to the device.



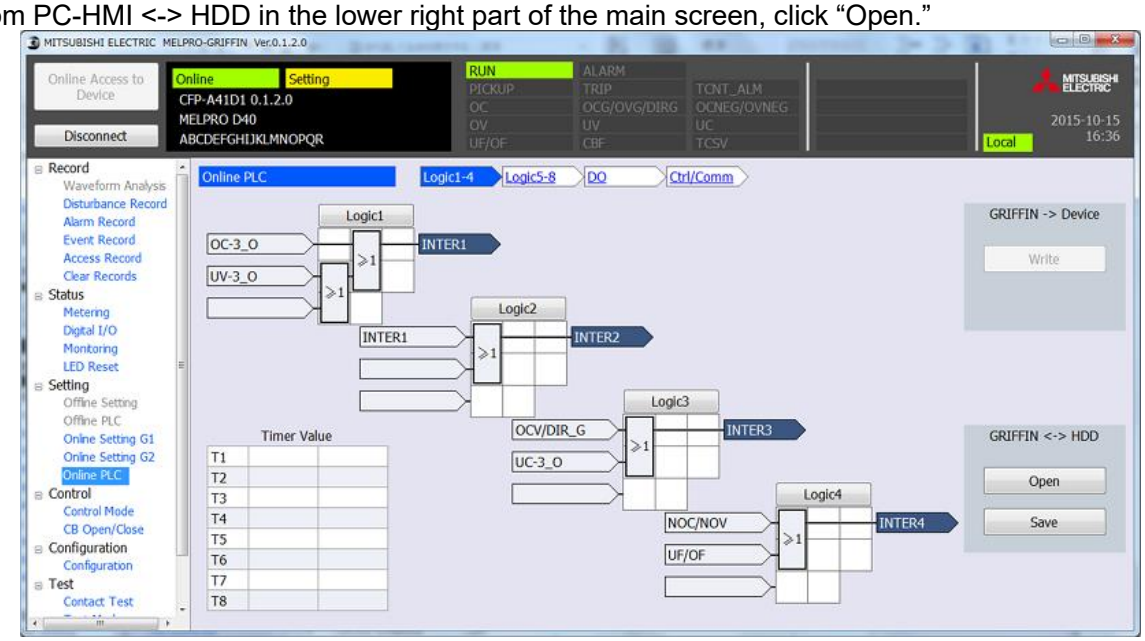
For successful writing, the dialog as shown below appears.



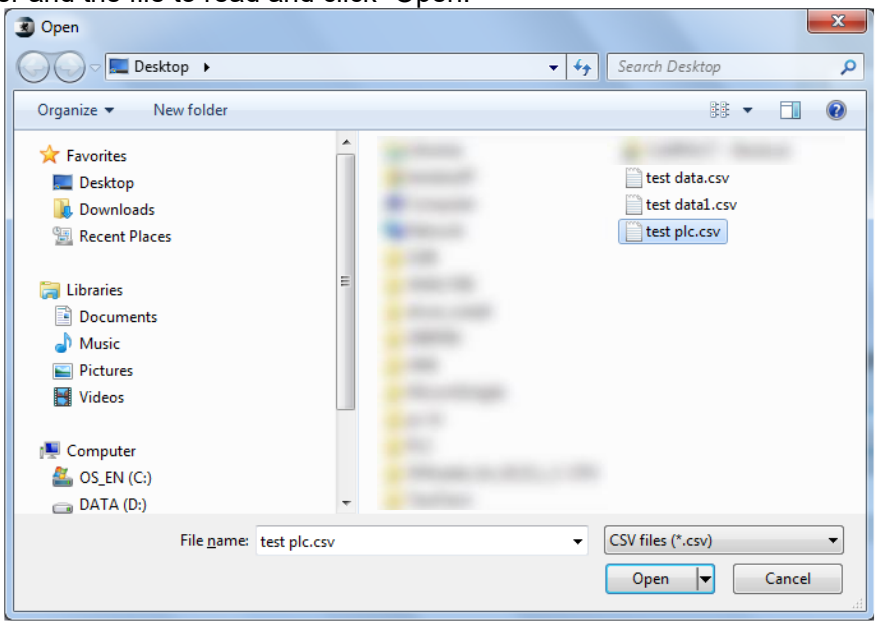
Note) For reading/writing PLC data from/to the PC, perform the following operations.

1) Reading PLC data saved in the PC

1. From PC-HMI <-> HDD in the lower right part of the main screen, click “Open.”



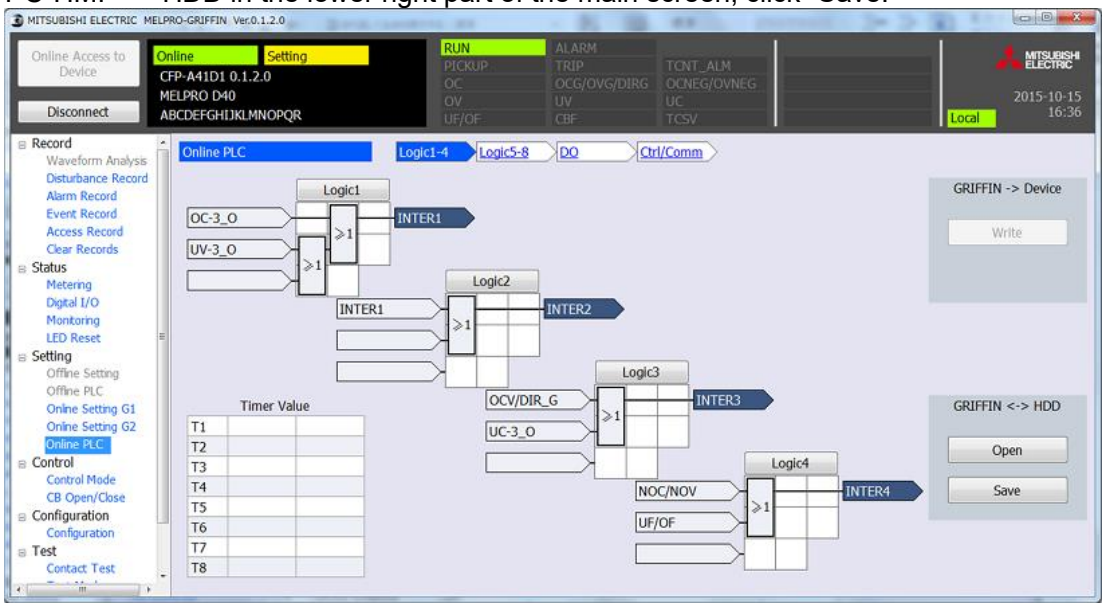
2. Select the folder and the file to read and click “Open.”



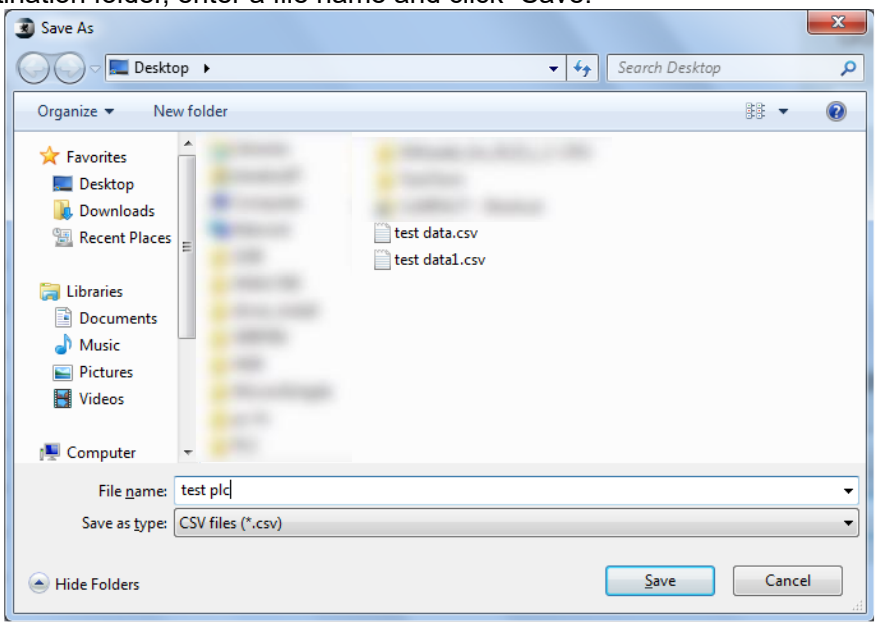
3. The specified PLC data are read to the device.

2) Saving the configured PLC data to the PC

1. From PC-HMI <-> HDD in the lower right part of the main screen, click “Save.”



2. Select the destination folder, enter a file name and click “Save.”

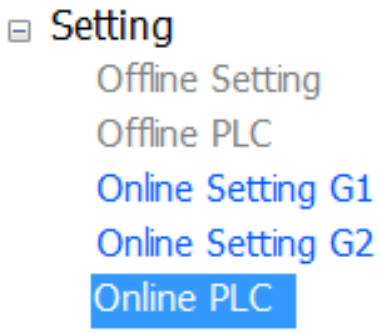


3. The configured PLC data are saved in the specified folder.

11.12.4.2. DO assignment

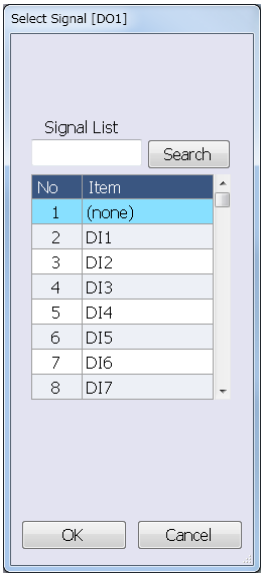
DO allows DO configuration of output assignments from the signal list.

1. From the Function menu, click Online PLC.



2. Click DO. The DO assignment circuit indication and editing screen appears. Click the button in the red frame to assign input signals.

3. Click the input signal button. The signal selection dialog as shown below appears.
From the list, select the desired signal and click “OK.” (To search for a signal, enter the signal name in the Signal List and click “Search.”)



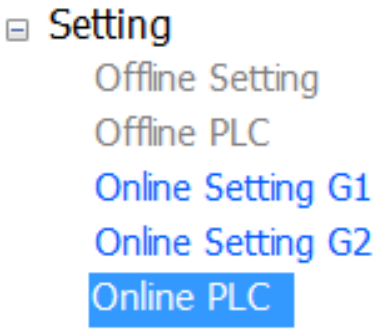
4. From PC-HMI -> Device, click “Write” to write the setting to the device.

Note) For saving/reading PLC data to/from the PC, perform the same operation as 11.12.4.1.

11.12.4.3. Assignment of CB control/communication output signals

Ctrl/Comm allows assignment of the CB control and communication output signals.
(COMM0 to COMM7 are used for assignment of communication outputs (IEC61850).)

1. From the Function menu, click Online PLC.



2. Click Ctrl/Comm. The CB control and communication output signal assignment circuit indication and editing screen appears. Click the button in the red frame to assign input signals.

3. Click the input signal button. The signal selection dialog for selecting a signal to assign appears. From the list, select the signal and click “OK” to assign the signal.
(To search for a signal, enter the signal name in the Signal List and click “Search.”)

   The signal selected from the list and clicked is shown in light blue. Click “OK” to select the signal as an output signal.

4. From PC-HMI -> Device, click “Write” to write the setting to the device.

Note) For saving/reading PLC data to/from the PC, perform the same operation as 11.12.4.1.

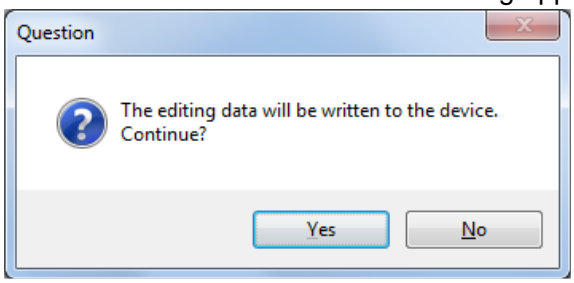
11.13. Control functions

11.13.1. Setting the CB control mode

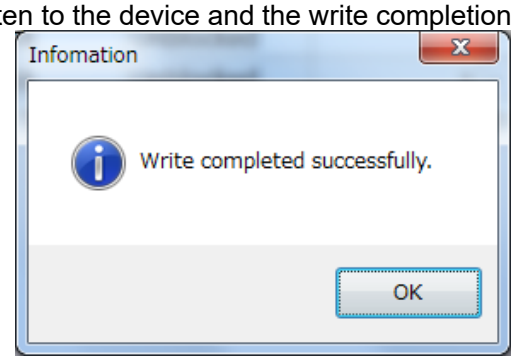
1. From the Function menu, select Control Mode.

2. The list of CB control mode items appears. Click New Value for the item to make a change.
   From the list, make a selection by clicking ▼.
   To enter a value, use the keyboard.

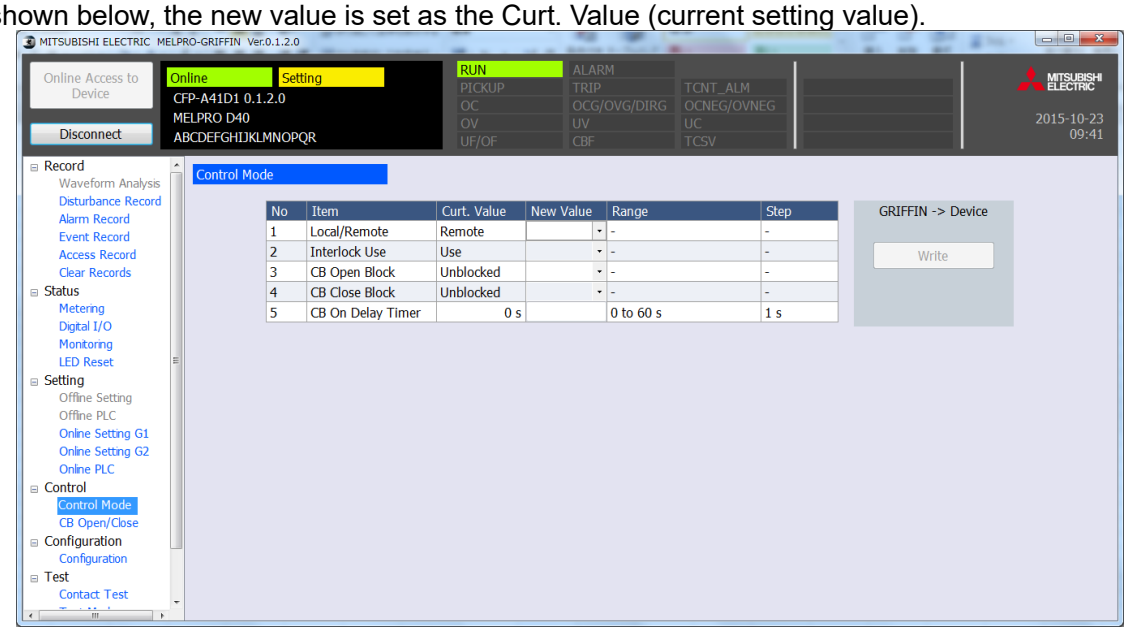
3. From PC-HMI -> Device, click “Write.” The write confirmation dialog appears. Click “Yes.”



4. The new setting value is written to the device and the write completion message appears.

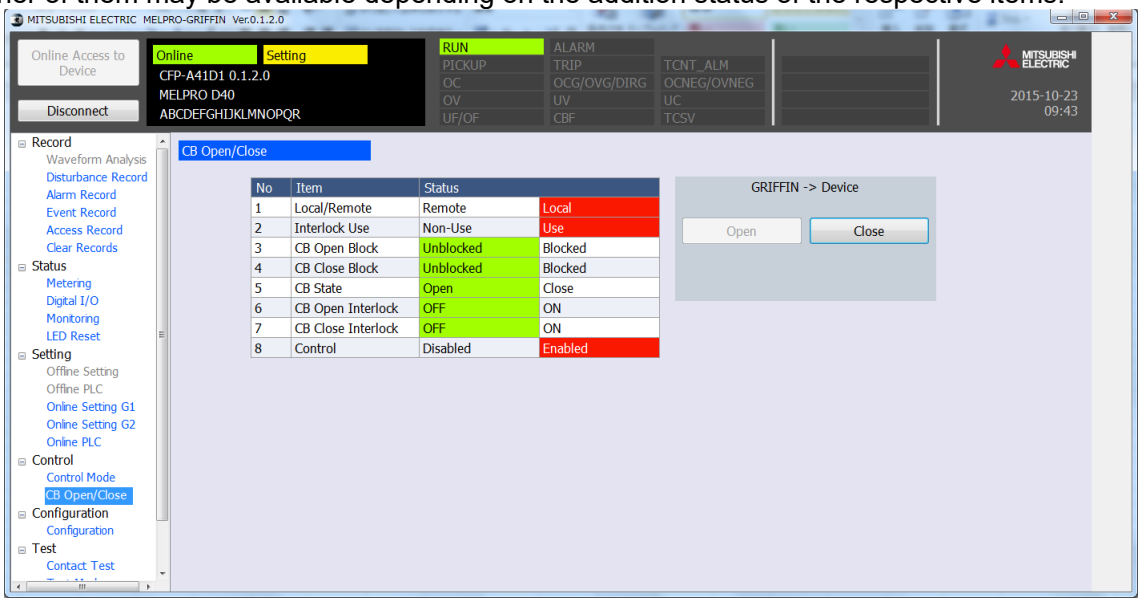


5. As shown below, the new value is set as the Curt. Value (current setting value).



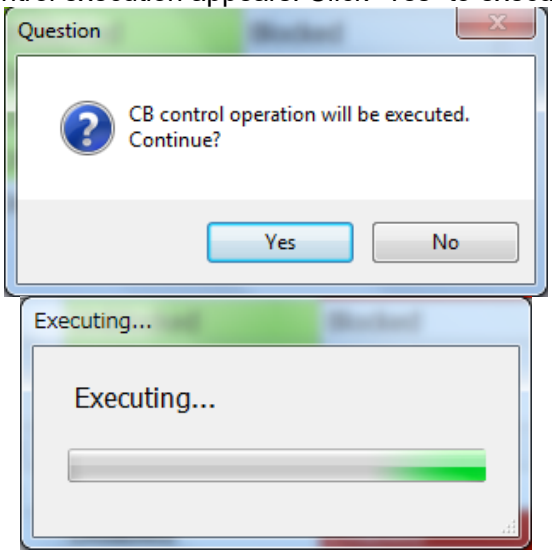
11.13.2. Executing CB control

1. From the Function menu, click CB Open/Close.
   CB control can be executed either as open control or close control and the button for the unavailable control operation is disabled.
   Neither of them may be available depending on the addition status of the respective items.

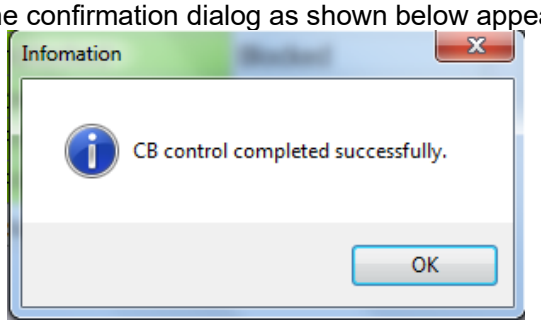


2. From PC-HMI -> Device, click “Open”/“Close.”

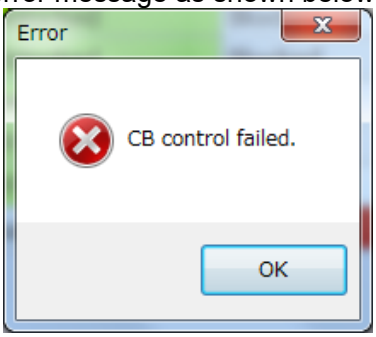
3. The dialog to confirm CB control execution appears. Click “Yes” to execute.



4. For successful CB control, the confirmation dialog as shown below appears.



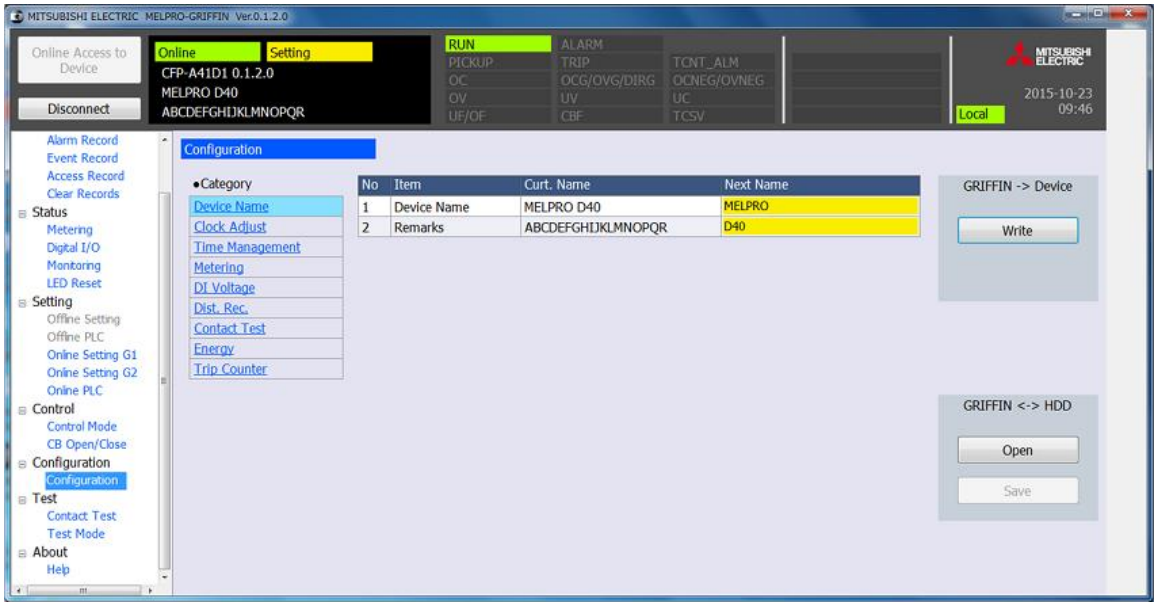
Note) If the selected control failed, the error message as shown below appears.



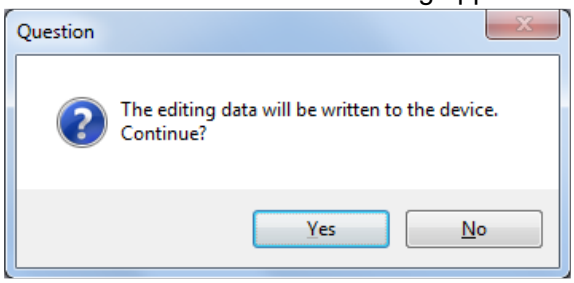
11.14. Device setting

11.14.1. Setting the device name

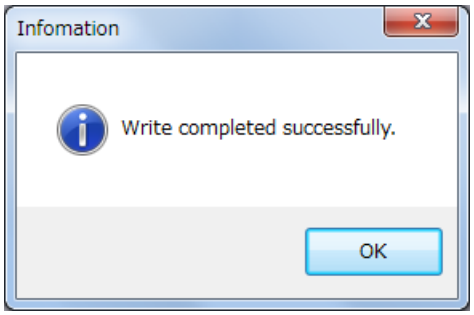
1. From the Function menu, click Configuration.
2. From Category, click Device Name.
3. Enter the new name to set in Next Name.



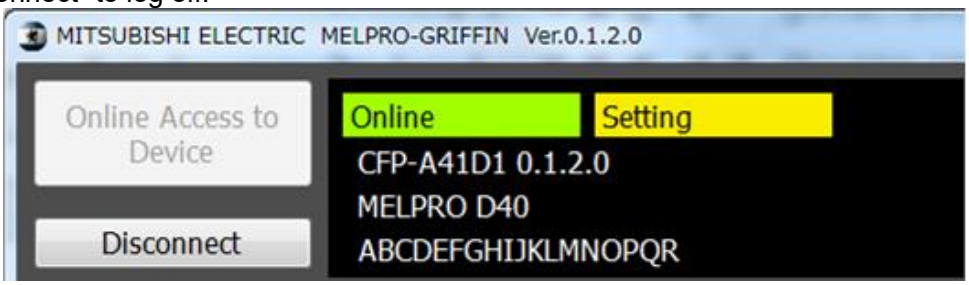
4. From PC-HMI -> Device, click “Write.” The confirmation dialog appears. Click “Yes.”



5. The setting is written to the device.



6. The indication is not updated when the setting has been written to the device.
   Click “Disconnect” to log off.

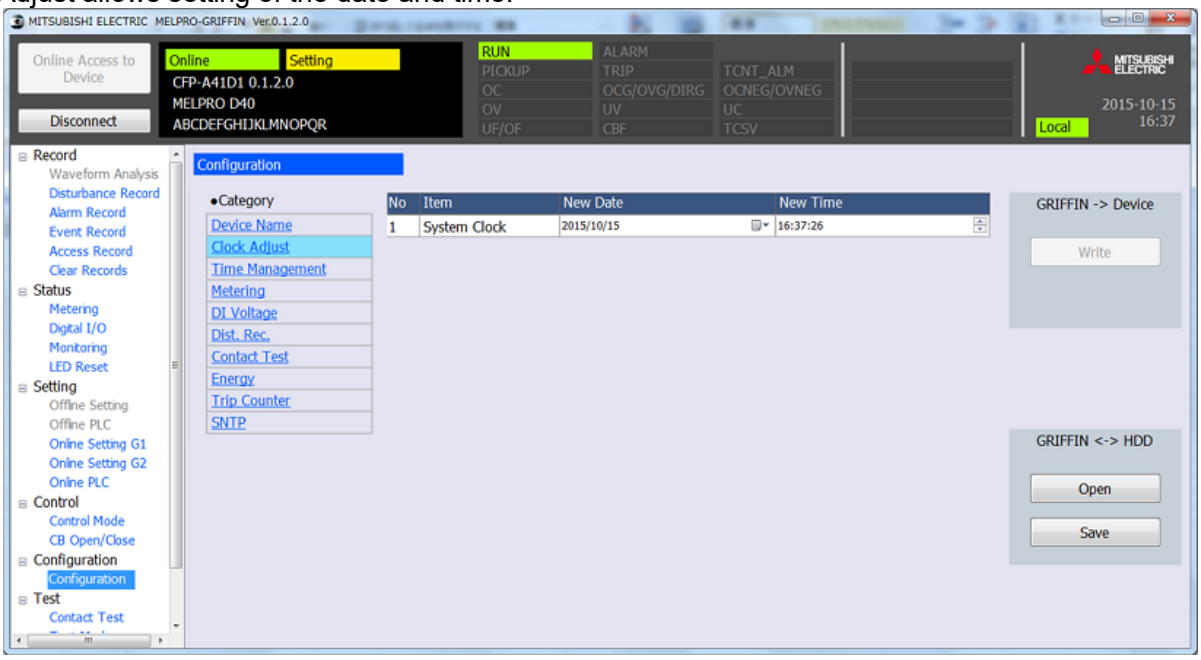


7. Click “Online Access to Device” to log in.
   (For the details about logging in, see 11.8.1.)

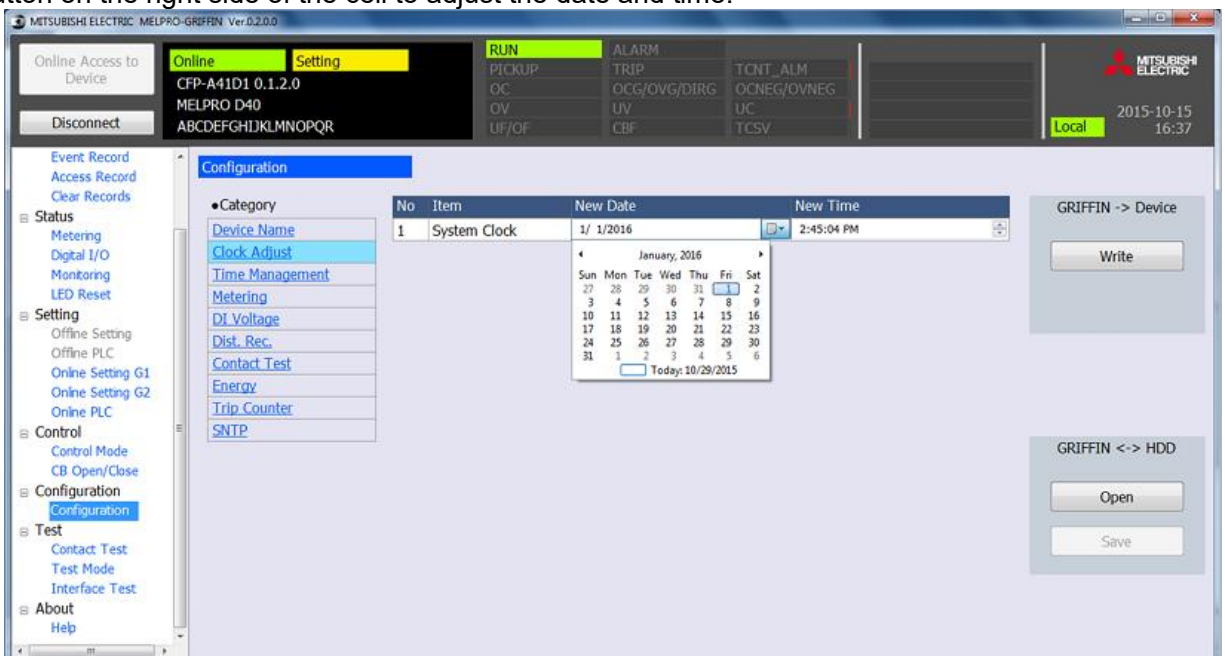
8. The device name indication is updated when the device has been logged in.

11.14.2. Clock Adjust setting

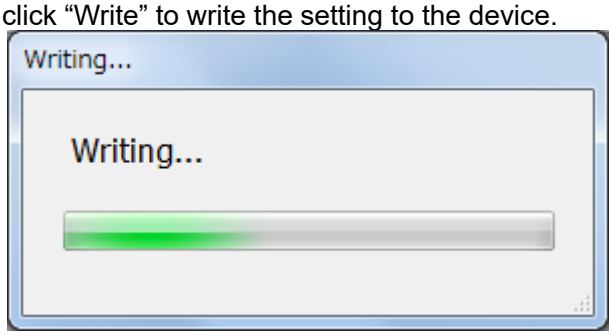
Clock Adjust allows setting of the date and time.



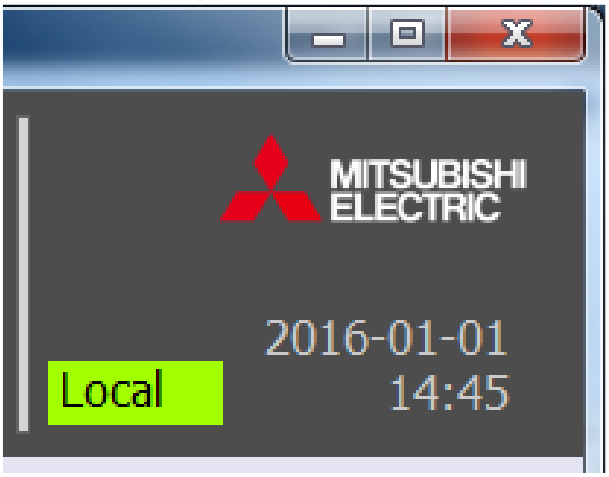
1. From the Function menu, click Configuration.
2. From Category, click Clock Adjust.
3. Select the date and/or time to adjust.
   New Date: year, month and date setting; New Time: hour, minute and second setting
   Use the mouse to bring the cursor to the setting to change and directly enter with the keyboard or click the button on the right side of the cell to adjust the date and time.



4. From PC-HMI -> Device, click “Write” to write the setting to the device.



5. When writing has been completed, the adjusted date and time take effect.



Note) The date and time setting is applied immediately.

11.14.3. Time Management setting

Time Management allows setting of the daylight saving time and time synchronization.

1. From the Function menu, click Configuration.
2. From Category, click Time Management.
3. Select the Next Value for the item to change.
   Select the item from the drop-down list.
   For an item that requires entry of a value, use the keyboard to enter directly.

Note) If any value out of the setting range is entered, an error message as shown below appears.
Click “OK” and reenter a value within the range.

4. From PC-HMI -> Device, click “Write” to write the setting to the device.

Note) To change a Time Management item, power cycling is required for updating with the new setting.

11.14.4. Metering setting

Metering allows setting of the primary and secondary values of the measurement indication.

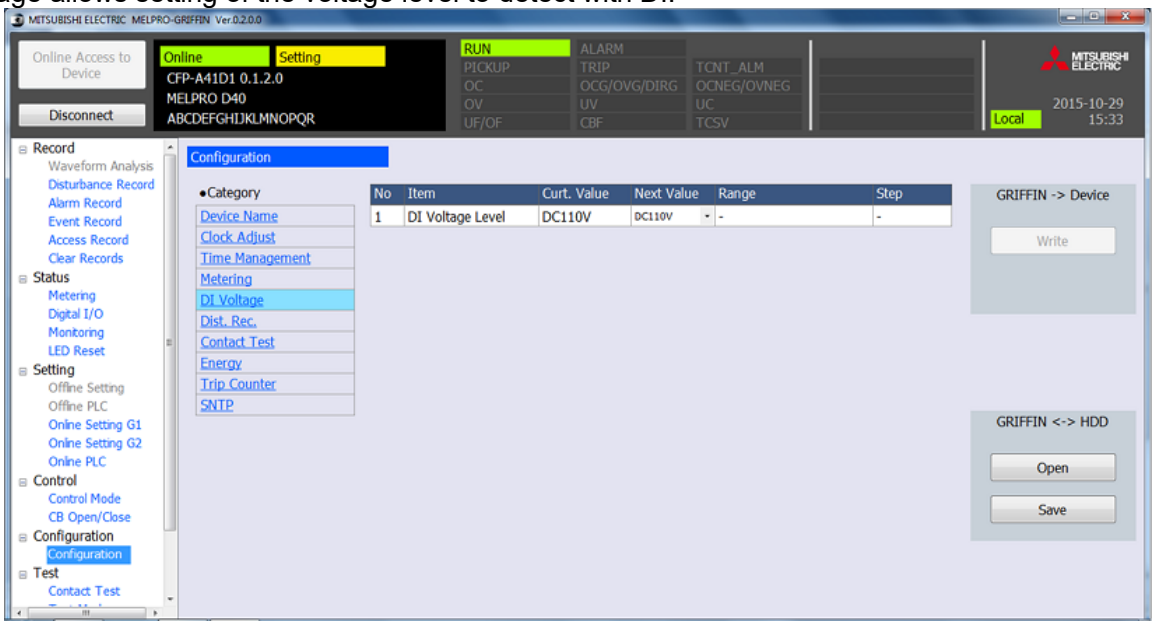
1. From the Function menu, click Configuration.
2. From Category, click Metering.
3. Select New Value for the item to change.
   Select the item from the drop-down list.
   For an item that requires entry of a value, use the keyboard to enter directly.

Note) If any value out of the setting range is entered, an error message as shown below appears.
Click “OK” and reenter a value within the range.

4. From PC-HMI -> Device, click “Write” to write the setting to the device.

11.14.5. DI Voltage setting

DI Voltage allows setting of the voltage level to detect with DI.

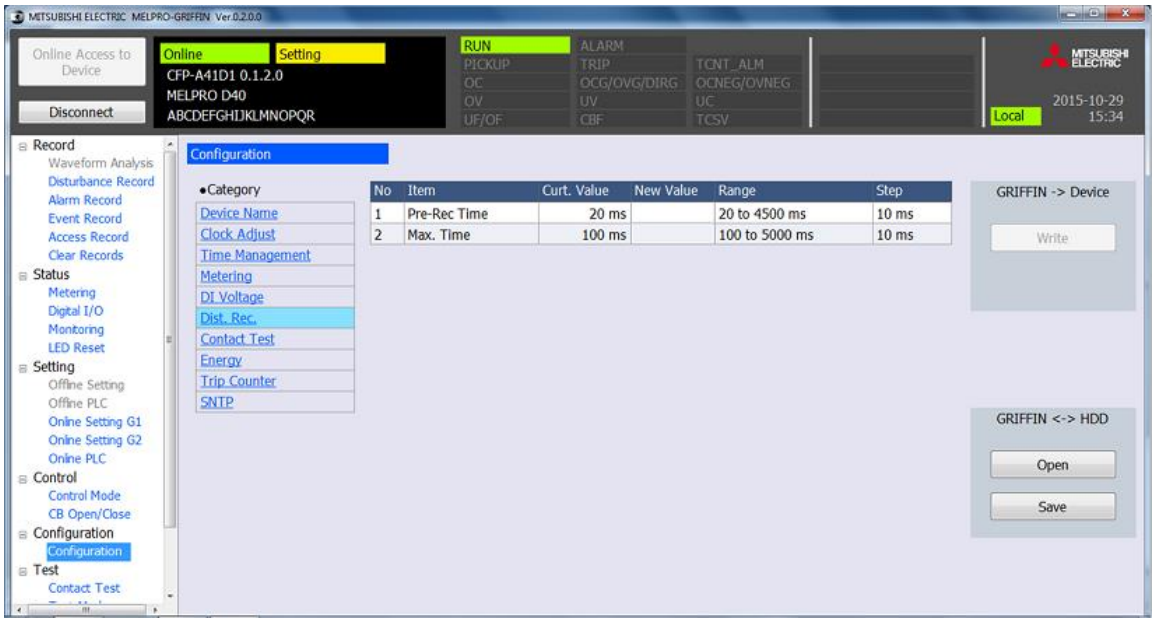


1. From the Function menu, click Configuration.
2. From Category, click DI Voltage.
3. Select a Next Value item.
   Select the value to set from the drop-down list.
4. From PC-HMI -> Device, click “Write” to write the setting to the device.

Note) To change a DI detection voltage item, power cycling is required for updating with the new setting.

11.14.6. Configuring the disturbance record

Dist. Rec. allows setting of the time before relay operation of the waveform record and the maximum time of one phenomenon.



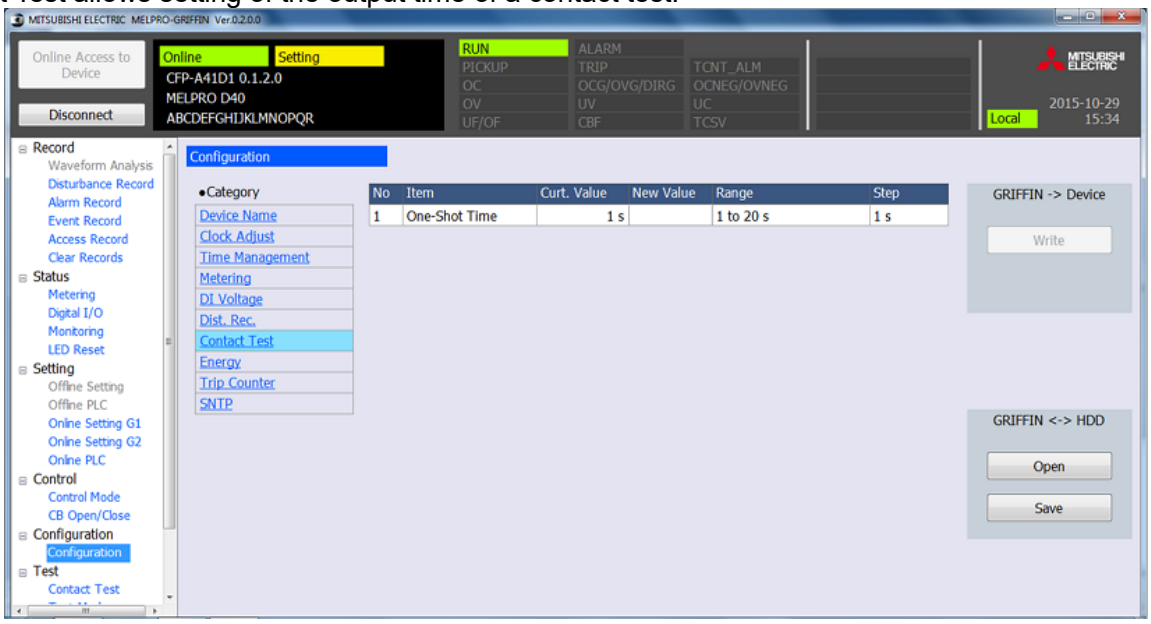
1. From the Function menu, click Configuration.
2. From Category, click Dist. Rec.
3. Select New Value for the item to change.
   For an item that requires entry of a value, use the keyboard to enter directly.

Note) If any value out of the setting range is entered, an error message as shown below appears.
Click “OK” and reenter a value within the range.

4. From PC-HMI -> Device, click “Write” to write the setting to the device.

11.14.7. DO Contact Test setting

Contact Test allows setting of the output time of a contact test.



1. From the Function menu, click Configuration.
2. From Category, click Contact Test.
3. Select a New Value item.
   Use the keyboard to directly enter the value to change.

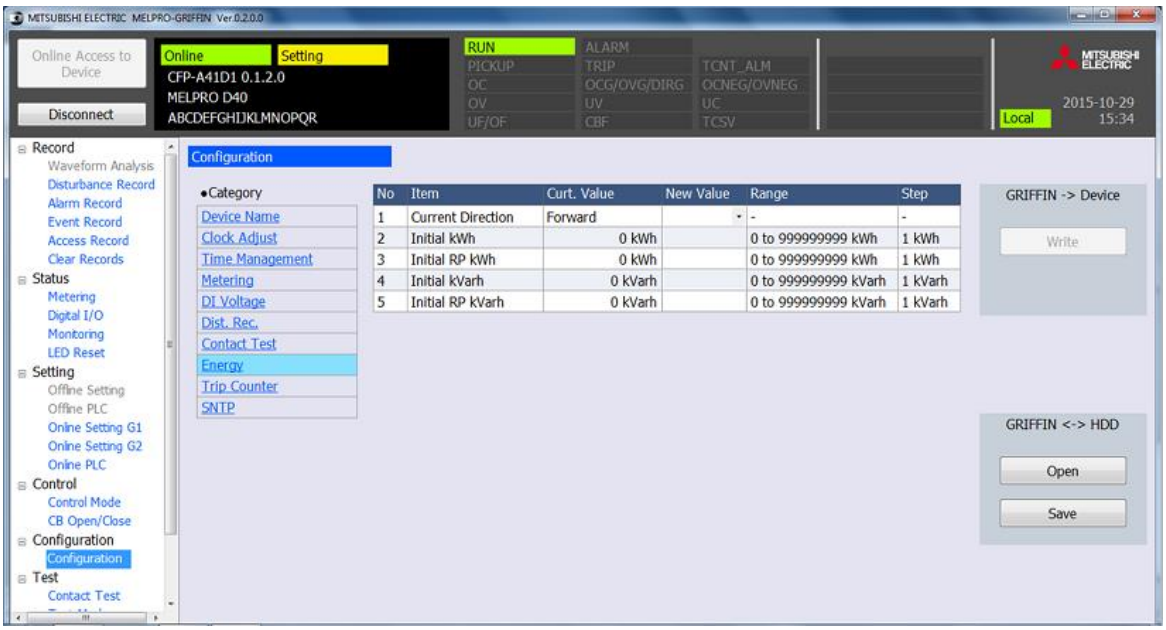
Note) If any value out of the setting range is entered, an error message as shown below appears.
Click “OK” and reenter a value within the range.

4. From PC-HMI -> Device, click “Write” to write the setting to the device.

Note) The One Shot value set is the operating time for DO contact test in 11.15.1.

11.14.8. Electric Energy setting

Energy allows setting of the power flow direction and the initial values of electric energy, reverse electric energy, reactive electric energy and reverse reactive power.



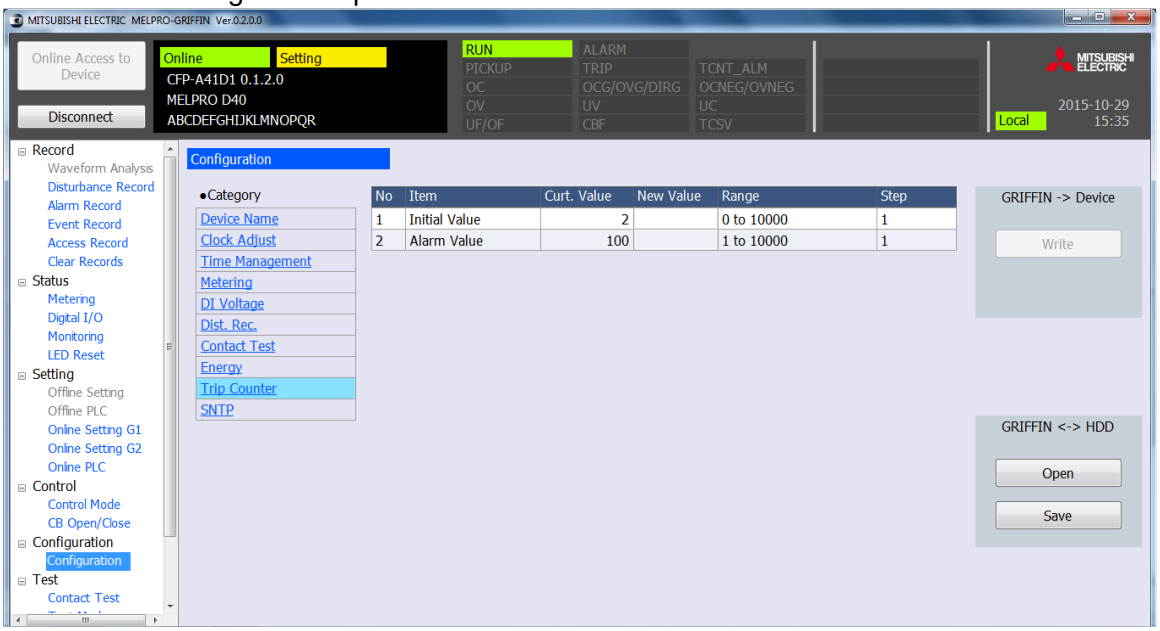
1. From the Function menu, click Configuration.
2. From Category, click Energy.
3. Select New Value for the item to change.
   Select the item from the drop-down list.
   For an item that requires entry of a value, use the keyboard to enter directly.

Note) If any value out of the setting range is entered, an error message as shown below appears.
Click “OK” and reenter a value within the range.

4. From PC-HMI -> Device, click “Write” to write the setting to the device.

11.14.9. Trip Counter setting

Trip Counter allows setting of the trip count initial value and alarm value.



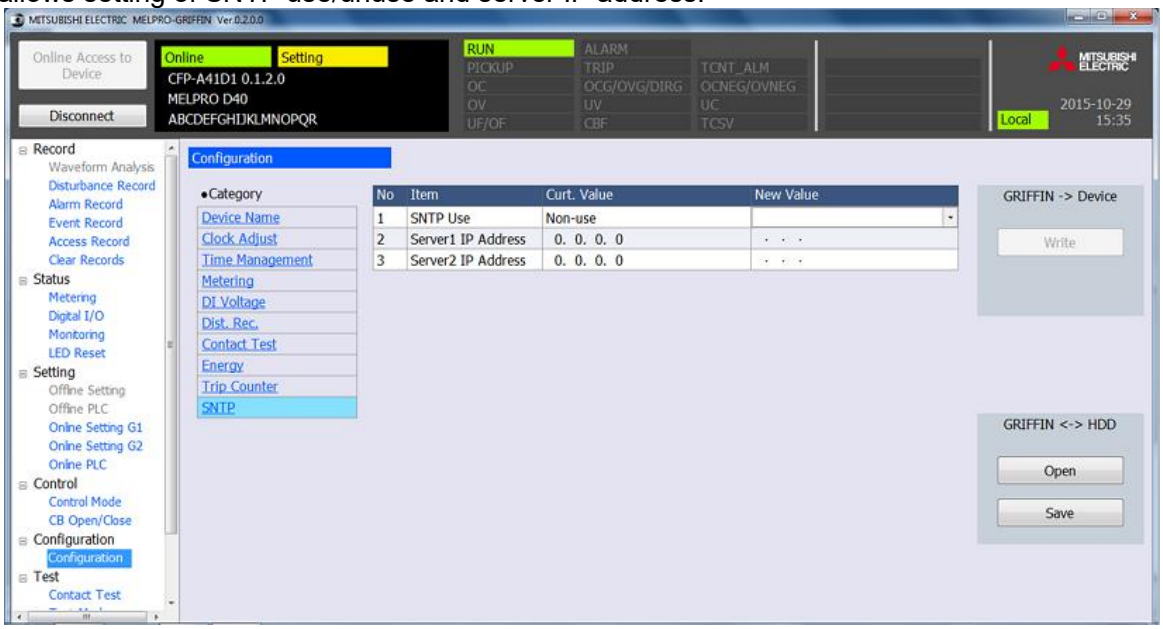
1. From the Function menu, click Configuration.
2. From Category, click Trip Counter.
3. Select New Value for the item to change.
   For an item that requires entry of a value, use the keyboard to enter directly.

Note) If any value out of the setting range is entered, an error message as shown below appears.
Click “OK” and reenter a value within the range.

4. From PC-HMI -> Device, click “Write” to write the setting to the device.

11.14.10. SNTP setting

SNTP allows setting of SNTP use/unuse and server IP address.



1. From the Function menu, click Configuration.
2. From Category, click SNTP.
3. Select New Value for the item to change.
   For an item that requires entry of a value, use the keyboard to enter directly.

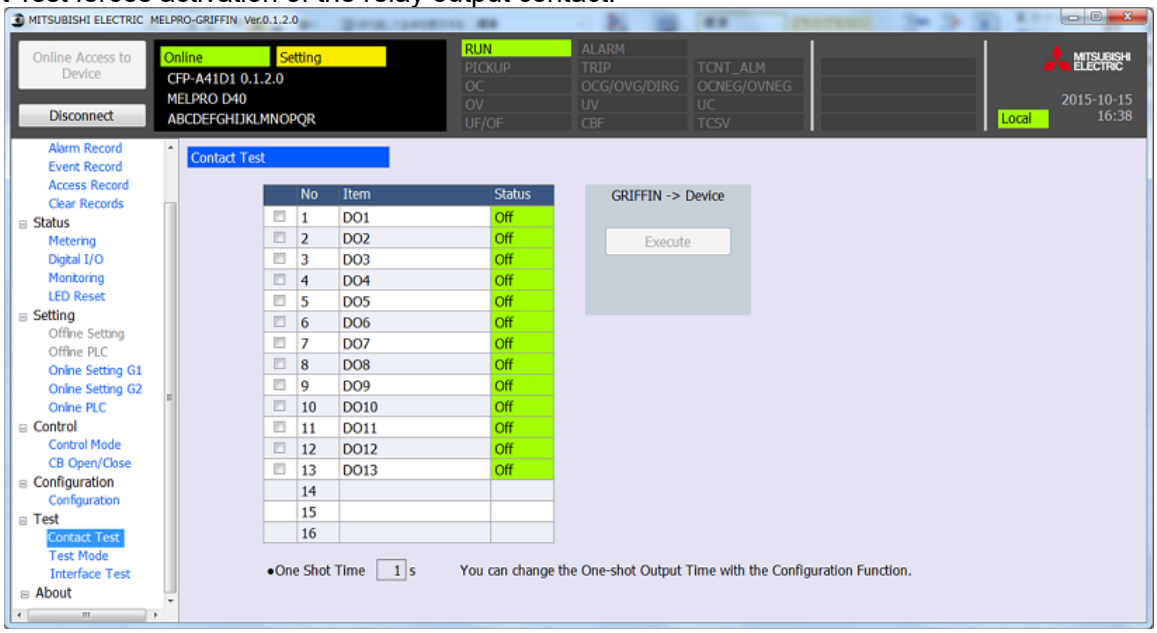
Note) If any value out of the setting range is entered, an error message as shown below appears.
Click “OK” and reenter a value within the range.

4. From PC-HMI -> Device, click “Write” to write the setting to the device.

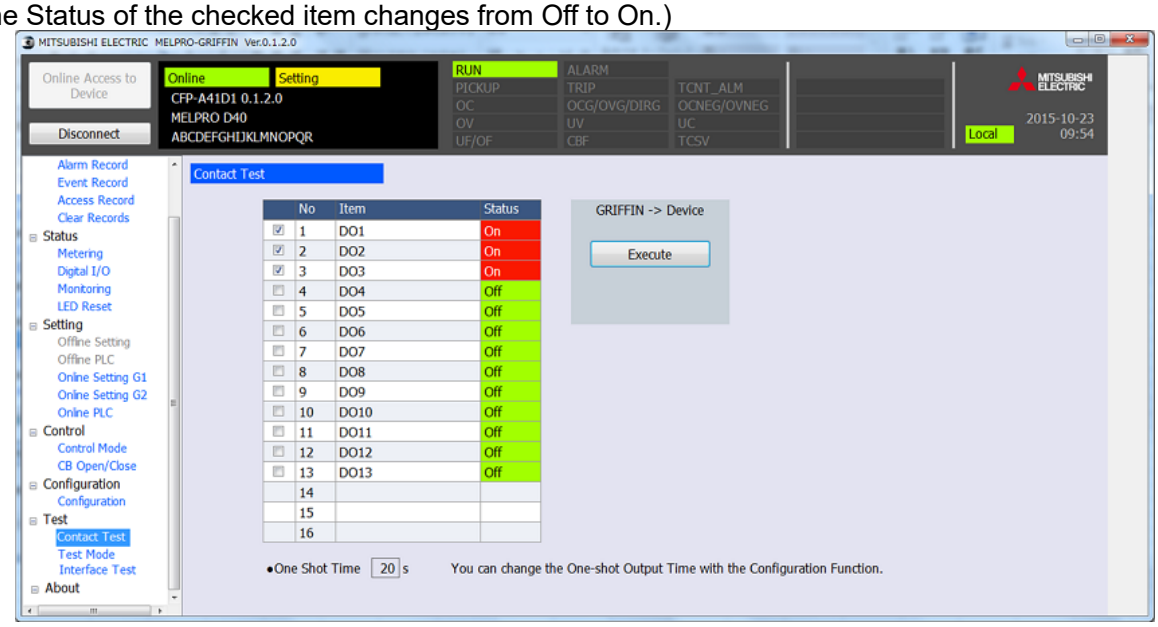
11.15. Test functions

11.15.1. DO Contact Test

Contact Test forces activation of the relay output contact.

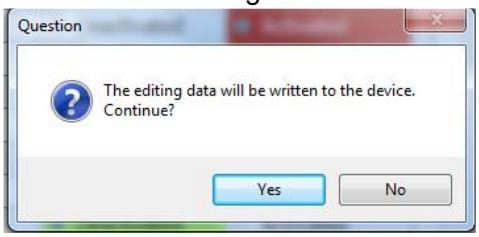


1. From the Function menu, click Contact Test.
2. Click the check box on the left of the item to conduct the DO contact test.
   (The Status of the checked item changes from Off to On.)

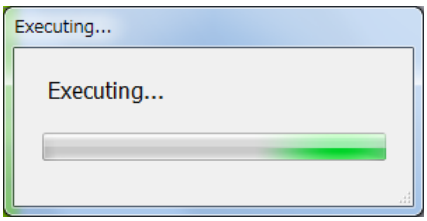


Note) To change the operating time for the contact test, change One Shot Time in 11.14.7.

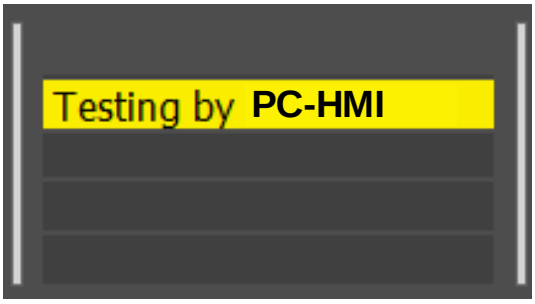
3. From PC-HMI -> Device, click “Execute.” The dialog to confirm execution appears. Click “Yes” to execute.



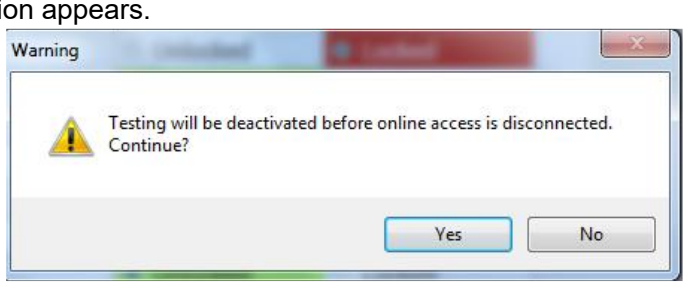
4. The execution dialog as shown below appears and the contact test for the specified DO item is executed.



5. During execution, the Testing indication is given in the status area.



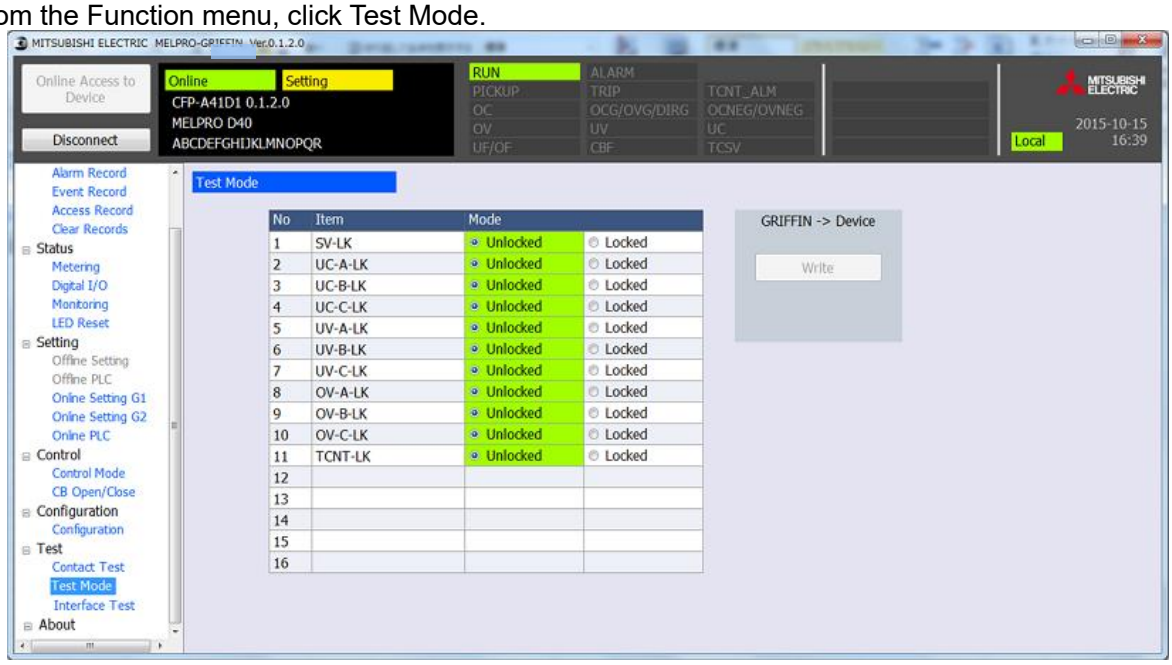
Note) If disconnection or PC-HMI termination is attempted during a contact test, the message to confirm contact test cancellation appears.



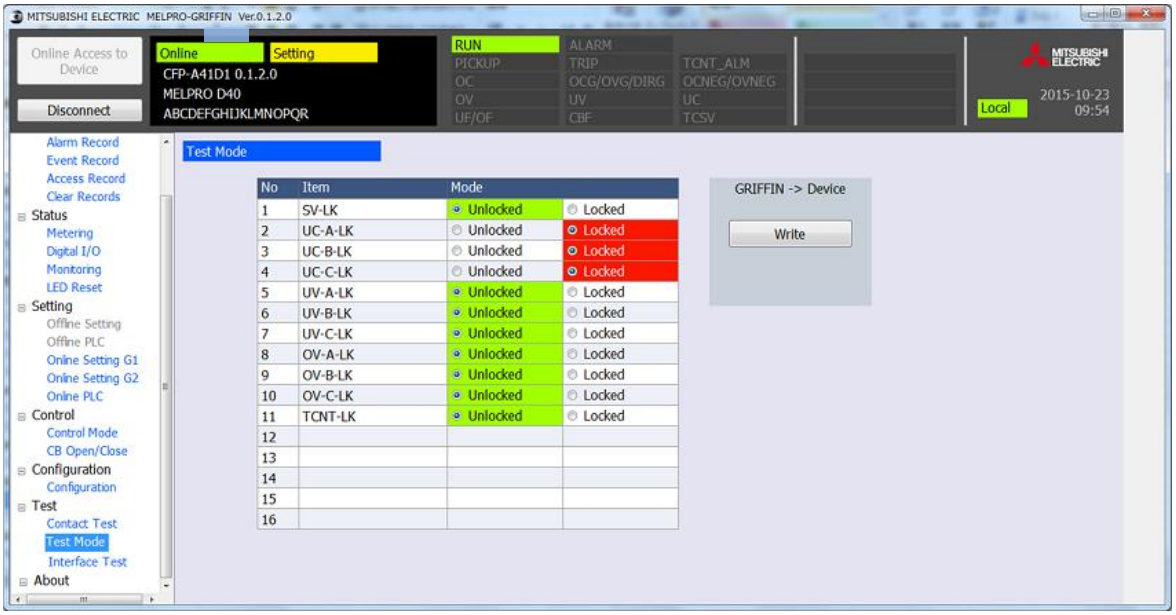
11.15.2. Test Mode

Test Mode allows setting of the temporary test mode for the relay.

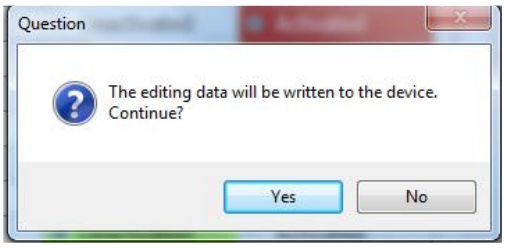
1. From the Function menu, click Test Mode.



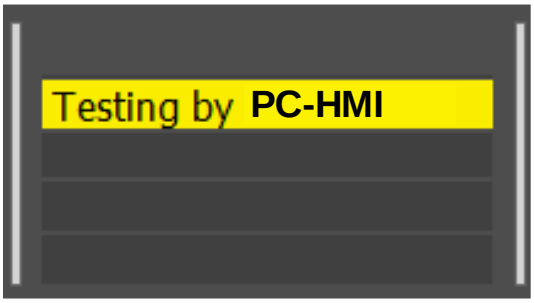
2. Select the mode for each item.
   Unlocked : Test mode disabled
   Locked : Test mode enabled



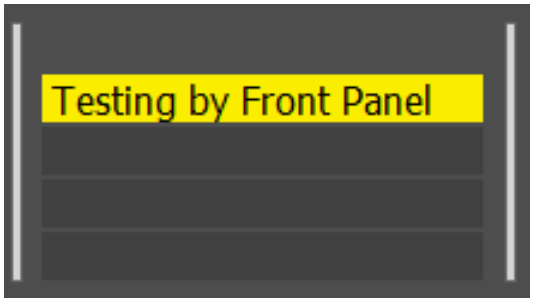
3. From PC-HMI -> Device, click “Write.” The dialog to confirm writing the data to the device appears. Click “Yes” to execute.



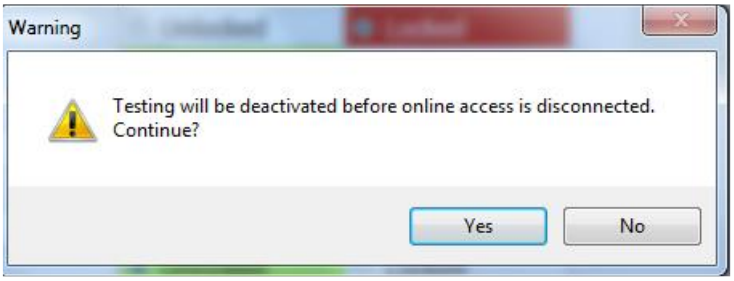
4. During the test, the “Testing by PC-HMI” indication is given in the status area.



Note) During a test from the front panel, the “Testing by Front Panel” indication is given.



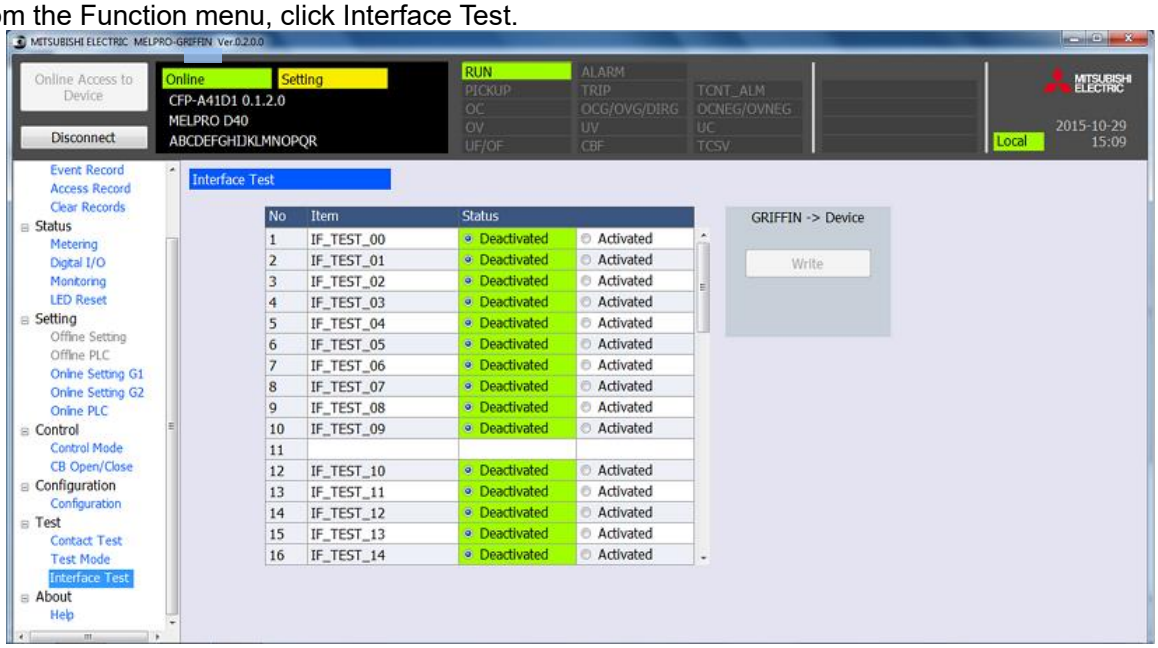
Note) If disconnection or PC-HMI termination is attempted during a contact test, the message to confirm contact test cancellation appears.



11.15.3. Relay Interface Test

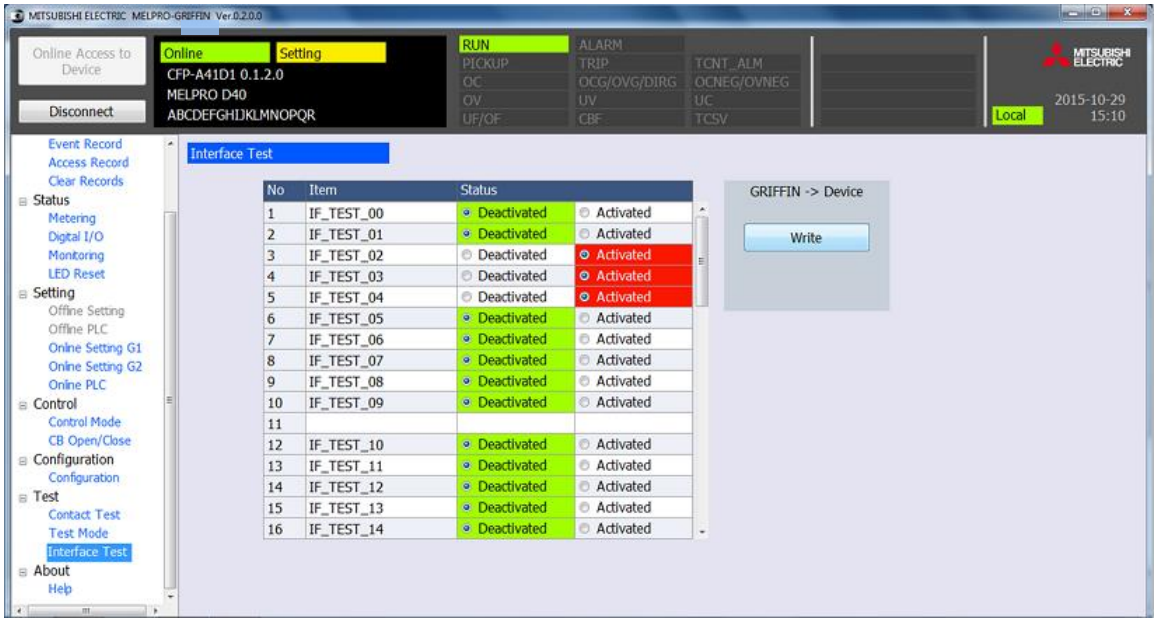
Interface Test allows simulated testing of relay operation without inputting any voltage or current.

1. From the Function menu, click Interface Test.

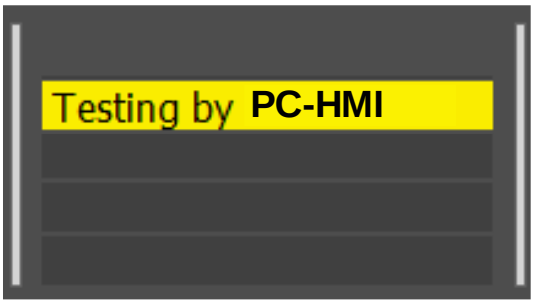


2 . Select the status for each item.

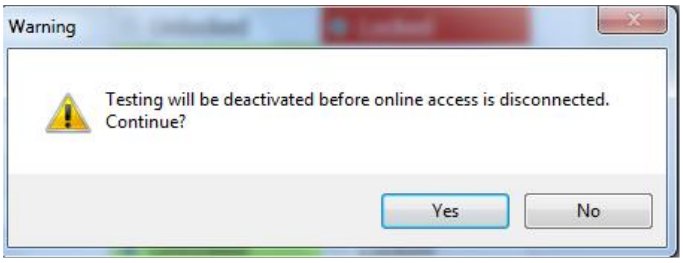
Deactivated : Disables the test.
Activated : Enables the test.



3. From PC-HMI -> Device, click “Write” to write the setting to the device.
During the test, the “Testing by PC-HMI” indication is given in the status area.



Note) If disconnection or PC-HMI termination is attempted during an interface test, the message to confirm interface test cancellation appears. The relay interface test is automatically canceled when 30 minutes have elapsed.



11.16. Showing the PC-HMI operation manual

1. From the menu screen, click Help.
2. Acrobat Reader is launched and the PC-HMI operation manual is shown as a pdf file.

Note) If Acrobat Reader is not installed on the PC, an error message appears.

12. Waveform Analysis

12.1. Introduction

Waveform Analysis tool in PC-HMI is provided, which enables the waveform data, the internal signal conditions, the digital inputs, the digital outputs etc.
The details of PC-HMI are described in PC-HMI instruction manual (JEPF-IL9504).