MITSUBISHI ELECTRIC

Numerical Protection Relay

MELPRO™-D Series

GENERATOR PROTECTION RELAY

MODEL

CGP2-A01D2

INSTRUCTION MANUAL

Request

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

－ Safety section －

This Safety section should be read before starting any work on the relay. Be sure to read the instruction manuals and other related documents prior to commencing any work on the relay in order to maintain them in a safe condition. Be sure to be familiar with the knowledge, safety information and all caution items of the product prior to use.

CAUTION

Caution means that failure to un-observe safety information, incorrect use, or improper use may endanger personnel and equipment and cause personnel injury or physical damage.

Items as classified to the caution may become to occur more sever results according to the circumstance. Therefore, all items described in the safety section are important and to be respected without fail.

CAUTION

1. Items concerning transportation
   (1) Be sure the equipment to be kept in normal direction
   (2) Avoid the bumps, shock, and vibration, otherwise the product performance /life might be unfavorably affected.
2. Items concerning storage
   (1) Environment shall be as below, otherwise the product performance/life might be unfavorably affected.
   -Ambient temperature: -20℃～+60℃ (with no condensation nor freezing)
   -Relative humidity: 30~80% average of a day
   -Altitude: Less than 2000m
   -Avoid applying unusual shock, vibration or leaning or magnetic field
   -Not expose to harmful smoke, gas, salty air, water, vapor, dust, powder, explosive material or wind, rain.
3. Items concerning mounting/wiring work
   (1) Mounting and wiring work should be done correctly.
   Otherwise, damage, burning or erroneous operation might occur.
   (2) Screw terminal should be tightened securely.
   Otherwise, damage and burning might occur.
   (3) Grounding should be done correctly in case it is required.
   Otherwise, electric shock, damage, burning or erroneous operation might occur.
   (4) Wiring should be done without mistake especially observing the correct polarity.
   Otherwise, damage, burning or erroneous operation might occur.
   (5) Wiring should be done without mistake especially observing the phase ordering.
   Otherwise, damage, or erroneous operation might occur.
   (6) Auxiliary power source, measuring transformer and power source which have enough capacity for correct operation of product should be used.
   Otherwise, an erroneous operation might occur.
   (7) Be sure to restore the front cover, terminal cover, protection cover, etc to the original position, which have been removed during the mounting/ wiring work.
   Otherwise, electrical shock might occur at the time of checking.
   (8) Connection should be done correctly using designated and right connectors.
   Otherwise, damage or burning might occur.
   (9) Fully insert the sub unit into the case until you can hear a click while pressing the handles located on both sides of the sub unit front face.
   Otherwise, incomplete inserting the sub unit might only establish a poor contact with the terminals located on the back side of unit, which might cause erroneous operation or heating.
4. Concerning equipment operation and settings
   (1) Operational condition should be as below.
   Otherwise, the product performance/life might be unfavorably affected.
   -Deviation of auxiliary power: within +10%~-15% of rated voltage
   -Deviation of frequency: within ±5% of rated frequency
   -Ambient temperature: 0℃～+40℃ (-10℃～+50℃ is permissible during couples of hour per day, with no condensation nor freezing)
   -Relative humidity: 30~80% average of a day
   -Altitude: Less than 2000m
   -Avoid to be exposed to unusual shock, vibration, leaning or magnetic field

-Not expose to harmful smoke, gas, salty air, water, vapor, dust, powder, explosive material, wind or rain.

(2) Qualified personnel may work on or operate this product, otherwise, the product performance/life might be unfavorably affected and/or burning or erroneous operation might occur.

(3) Be sure to read and understand the instruction manuals and other related documents prior to commencing operation and maintenance work on the product. Otherwise, electrical shock, injury, damage, or erroneous operation might occur.

(4) While energizing product, be sure not to remove any unit or parts without permissible one. Otherwise, damage, or erroneous operation might occur.

(5) While energizing product, be sure to make short circuit of current transformer secondary circuits before setting change or drawing out the sub unit. Otherwise, secondary circuit of live current transformer might be opened and damage or burning might occur due to the high level voltage.

(6) While energizing product, be sure to open trip lock terminal before setting change or drawing out the internal unit of product. Otherwise, erroneous operation might occur.

(7) Be sure to use the product within rated voltage and current.
Otherwise, damage or mal-operation might be occurred.

(8) While energizing product, be sure not to clean up the product.
Only wiping a stain on the front cover of product with a damp waste might be allowable. (Be sure to wring hardly the water out of the waste.)

5. Items concerning maintenance and checking

(1) Be sure that only qualified personnel might work on or operate this product.
Otherwise, electrical shock, injury, damage, or erroneous operation might occur.

(2) Be sure to read and understand the instruction manuals and other related documents prior to commencing operation and maintenance work on the product. Otherwise, electrical shock, injury, damage, or erroneous operation might occur.

(3) In case of replacing the parts, be sure to use the ones of same type, rating and specifications, etc.
If impossible to use above parts, be sure to contact the sales office or distributor nearest you.
Otherwise, damage or burning might occur.

(4) Testing shall be done with the following conditions.
-Ambient temperature: 20℃±10℃
-Relative humidity: Less than 90%
-Magnetic field: Less than 80A/m
-Atmospheric pressure: 86~106×10^3 Pa
-Installation angle: Normal direction±2°
-Deviation of frequency: within ±1% of nominal frequency
-Wave form(in case of AC): Distortion factor less than 2%
(Distortion factor=100%×effective value of harmonics/effective value of fundamental)
-Ripple (in case of DC): Ripple factor less than 3%
(Ripple factor=100%×(max-min)/average of DC)
-Deviation of auxiliary power: within ±2% of nominal voltage
-Be sure not to inject the voltage or current beyond the overload immunity.
Otherwise, damage or burning might occur.
-Be careful not to touch the energized parts.
Otherwise, the electric shock might occur.

6. Items concerning modification and/or repair work

Be sure to ask any modification and/ or repair work for product to the sales office or distributor nearest you.

Unless otherwise, any incidents occurred with modification or repair works (including software) done by any other entity than MITSUBIHI ELECTRIC CORPORATION shall be out of scope on warranty covered by MITSUBISHI ELECTRIC CORPORATION.

7. Items concerning disposal

Particular regulations within the country of operation shall be applied to the disposal.

- Introduction -

Thank for your purchasing MITSUBISHI ELECTRIC **MELPRO** TM – D Series Digital Protection Relay.

Please read this manual carefully to be familiar with the functions and performances enough to use the product properly.

Please provide this instruction manual to end users.

For operation of the product, this manual should be used in conjunction with the following materials:

Title of document	Document No.
MELPRO – D Series Protection Relay General Operation Manual	JEP0-IL9416

When the protection relay is used together with a communication card, use the following documents too:

(For CC-Link)

Title of document	Document No.
MELPRO – D Series Protection Relay CC-COM Communication Card (CC-Link) Operation Manual (General information)	JEP0-IL9417
MELPRO – D Series Protection Relay CC-COM Communication Card (CC-Link) Operation Manual (Model-specific information)	JEP0-IL9418

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1 Features

1.1 General description

Mitsubishi Electric MELPRO-D Series is a digital protection relay with a microprocessor for protecting high/extra-high-voltage electric power system.

With its improved functions, including operation support using the advanced communication networks, data saving at the power system faults and power system voltage/current measurement, this series of protection relay will allow stable and effective control and monitoring of electric power systems as well as provide high-reliable protection.

1.2 Features

(1) High-reliable protection

CGP2-A01D2 relay is applied for the generator protection and includes the following protection elements;

- Biased differential element (87G)
- Loss of excitation element (40)

(2) Lock function by external control input

The relay is provided with 2 DI (Digital Input) input circuits. It is available to lock any operating element by DI inputs.

(3) Communication Network

- With an open field bus system, the relays can be used to build a high-speed, high-performance network system. In addition, the relay's multi-drop serial wiring reduces the amount of labor required for communication wiring.
- Control of measurement values, operation status, as well as setting changes, etc., can be performed from a remote location.
- In consideration of future network system variations and compatibility with communication networks, communication features are mounted in the relay using a replaceable card.

(4) Measurement & Recording Functions

- Real time monitor of relay input data

  The relay can measure steady state relay input values, supporting energy management.
- Fault Data Monitor

  When a fault occurs, the relay saves the past 5 effective input values and waveform data to assist with fault analysis.

(5) Programmable Output Configuration

The operating output contacts (DO) can be set by combining the outputs of the protection relay element using 'OR' logic, thereby simplifying sequence design.

(6) High Accurate Digital Computation

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

(7) Self-diagnosis

The relay continuously monitors electronic circuits from input to output so that it can detect internal

failure before that failure causes damage on the power system, thereby improving reliability.

(8) Easy Replacement

The dimensions of the panel cutout are the same as the prior MULTICAP series. Changing from an existing relay type to this new type is easy.

(9) Easy Maintenance

The relays are adopted as draw-out unit mechanisms with automatic CT shorting at drawing, thereby making maintenance easy.

(10) Easy wiring check

It is possible to carry out forced operation of the output contacts individually. This will allow an easy wiring check.

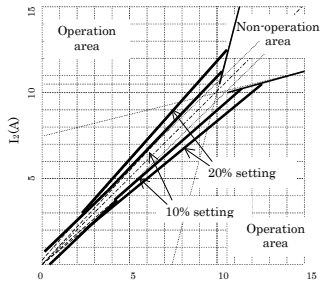
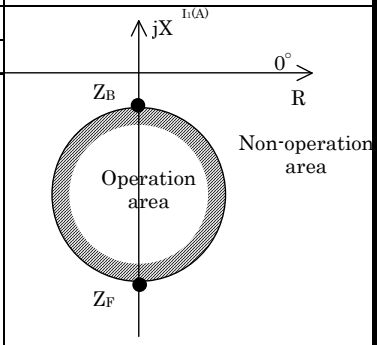
2 Rating and specifications

2.1 General information

Type name			CGP2-A01D2		
Style			304PQB	305PQB	
Element	Protection		Biased differential element (87G) × 3		
			Loss of excitation (40) × 1		
	Measurement		Phase current, Differential current, Voltage (V_{AB}), Phase (I_A – V_{AB}, I_B - V_{AB}), Frequency		
Rating	Frequency		50 Hz	60 Hz	
	Phase current		5 A		
	Voltage		100~120V		
	Photo-coupler input voltage		DC110V (Operative range: DC77~143V)		
	Auxiliary power supply *21	Voltage	Common use for 100 ~ 220VDC / 100 ~ 220VAC		
		Operative range	DC : 85 ~ 242 V (Range of 80 ~ 286VDC is allowable temporarily.) AC : 85 ~ 242 V (Range of 80 ~ 253VAC is allowable temporarily.)		
Display	RUN		Indicate the result of self-diagnosis. The lamp is lit for normal conditions and off for abnormal.		
	Unit		Indicate the unit symbol for measurements.		
	Item No., Item data		Display measurement, status, setting and option data selected with an item number.		
	Communication		With a communication card installed: the lamp is lit for normal conditions, blinking during communication and off for abnormal. With a communication card not installed: the lamp is off.		
Self-diagnosis			Monitor the electronic circuit and internal power supply to output signal to the RUN LED and self-diagnosis output (ALARM).		
Output contacts	Configurations	For trip	2 make contacts: X_5 and X_6 (programmable output)		
		For signaling	4 make contacts: X_0 to X_3 (programmable output)		
		For self-diagnosis output	1 break contact: Y (open for normal result of self-diagnosis with power on) 1 make contact: X_4 (open for normal result of differential current check)		
	Capacity	For trip	Make	110VDC, 15A, 0.5 s (L/R = 0 s) 220VDC, 10A, 0.5 s (L/R = 0 s)	
			Break	110VDC, 0.3A (L/R≤40 ms) 220VDC, 0.15A (L/R≤40 ms)	
			Carry	1.5 A, continuously	
		For signaling and self-diagnosis output	Make and Break	500 VA (cosφ= 0.4), 60W (L/R = 0.007 s)	
			Max. current	5 A	
			Max. voltage	380VAC, 125VDC	
Burden	Phase circuit		0.5 VA or less (with rated current)		
	Voltage circuit		1.0 VA or less (with rated voltage)		
	Auxiliary power supply circuit		For 100VDC: approx. 6 W (approx. 8W including communication card) For 100VAC: approx. 12VA (approx. 14VA including communication card) For 220VDC: approx. 6 W (approx. 8W including communication card) For 220VAC: approx. 14VA (approx. 16VA including communication card)		
Mass			Net weight of relay unit : approx. 3.8 kg Including case : approx. 5.2 kg		
Case/cover			Size : D2 type Color : N1.5		

*21 When an uninterruptible AC power source is not provided in your system for the auxiliary supply voltage, use the type B-T1 backup power supply or commercially available uninterruptible power supply (UPS).
Type B-T1 back up power supply unit can be applied for DASH series protection relay with 100V～200V auxiliary power supply voltage rating only.
In addition, the power supply duration of the type B-T1 back up power supply is confirmed about 2 seconds in combination with one MELPRO-D series relay. Therefore, in the case that the required power supply duration after power source loss exceeds 2 seconds, please use a suitable commercial uninterruptible power supply.
When the power supply back up for the control power supply of a circuit breaker is required, it is necessary to prepare the backup power supply different from the type B-T1 back up power supply.

2.2 Protective elements

<table>
<tr><td colspan="3">Style</td><td>304PQB</td><td>305PQB</td></tr>
<tr><td rowspan="6">Setting
*24</td><td rowspan="3">Biased differential</td><td>Operation current</td><td>LOCK – 0.4 ~ 1.0A (0.2A step)</td><td rowspan="3"> 
</td></tr>
<tr><td>Bias
(τ=Differential current/Restraining current)</td><td>10 – 15 – 20%</td></tr>
<tr><td>Operation time</td><td>INST (<60ms) – 0.1 ~ 0.5s (0.1s step)</td></tr>
<tr><td rowspan="3">Loss of excitation</td><td>Impedance Z_F</td><td>LOCK – 5.0 ~ 50.0Ω (0.5Ω step)</td><td rowspan="3"> 
</td></tr>
<tr><td>Impedance Z_B</td><td>0.4 ~ 4.0Ω (0.04Ω step)</td></tr>
<tr><td>Operation time</td><td>0.2 ~ 10s (0.1s step)</td></tr>
<tr><td>DI</td><td>DI Lock time</td><td colspan="2">0.1 ~ 5.0s (0.1s step)</td></tr>
<tr><td colspan="3">Forced operation</td><td colspan="2">Trip and control contacts can be forcefully tripped independently.</td></tr>
<tr><td colspan="3">Operation indication</td><td colspan="2">Operation indicator LED (red) comes on when the relay operates.</td></tr>
</table>

2.3 Measurement elements

Style				304PQB	305PQB
Option *24	CT primary			5-10-12-12.5-15-20-25-30-40-50-60-75-80-100-120-125-150-200-250-300-400-500-600-750-800-1000-1200-1250-1500-2000-2500-3000-4000-5000-6000-7500-8000[A]	
	VT primary			100 ~ 999V (1V step) 1000 ~ 9990V (10V step) 10.0K ~ 99.9KV (0.1KV step) 100K ~ 300KV (1KV step)	
	VT secondary			100-110-115-120 [V]	
Display	Phase current	Real time	Conversion	Indication value = Relay input value × CT primary setting / 5	
			Range *22	0.00 ~ CT primary setting × 2 [A]	
			Update	Approx. 200 ms	
		Max. records	Conversion	Indication value = Relay input value × CT primary setting / 5	
			Range *22	0.00 ~ CT primary setting × 2 [A]	
		Fault records *23	Conversion	Indication value = Relay input value × CT primary setting / 5	
			Range *22	0.00 ~ CT primary setting × 15 [A]	
	Differential current	Real time	Conversion	Indication value = Relay input value × CT primary setting / 5	
			Range *22	0.00 ~ CT primary setting × 2 [A]	
			Update	Approx. 200 ms	
		Max. records	Conversion	Indication value = Relay input value × CT primary setting / 5	
			Range *22	0.00 ~ CT primary setting × 2 [A]	
		Fault records *23	Conversion	Indication value = Relay input value × CT primary setting / 5	
			Range *22	0.00 ~ CT primary setting × 15 [A]	
	Voltage (V_{AB})	Real time	Conversion	Indication value = Relay input value × VT primary setting / VT secondary setting	
			Range *22	0.00 ~ VT primary setting / VT secondary setting × 165[V]	
			Update	Approx. 200 ms	
		Max. records	Conversion	Indication value = Relay input value × VT primary setting / VT secondary setting	
			Range *22	0.00 ~ VT primary setting / VT secondary setting × 165[V]	
		Fault records *23	Conversion	Indication value = Relay input value × VT primary setting / VT secondary setting	
			Range *22	0.00 ~ VT primary setting / VT secondary setting × 165[V]	
	Phase *25	Real time	Range *22	-179 ~ 0 ~ 180[°]	
			Update	Approx. 200 ms	
		Fault records *23	Range *22	-179 ~ 0 ~ 180[°]	
	Frequency *26	Real time	Range *22	40 ~ 70[Hz]	
			Update	Approx. 200 ms	

*22 The form of display depends on value range as shown in the tables below:

(1) Phase current / Differential current display

CT primary setting value determines the minimum number of digits to be displayed on each measurement display.

When a value to be displayed exceeds the max. value of the display range, the max. value will blink.

Phase current primary settings		5 ~ 40[A]	50 ~ 400[A]	500 ~ 4000[A]	5000 ~ 8000[A]
Form of display	0.00 ~ 9.99[A]	□.□[A]	□[A]	-	-
	10.0 ~ 99.9[A]	□□.□[A]	□□[A]	□.□□[kA]	-
	100 ~ 999[A]	□□□[A]	□□□[A]	□.□□[kA]	□.□[kA]
	1.00 ~ 9.99[kA]	□.□□[kA]	□.□□[kA]	□.□□[kA]	□.□[kA]
	10.0 ~ 99.9[kA]	□□.□[kA]	□□.□[kA]	□□.□[kA]	□□.□[kA]
	100 ~ 999[kA]	□□□[kA]	□□□[kA]	□□□[kA]	□□□[kA]

(2) Voltage display

VT setting value determines the minimum number of digits to be displayed on each measurement display.

When a value to be displayed exceeds the max. value of the display range, the max. value will blink.

VT primary settings		100 ~ 500[V]	501 ~ 10000[V]	11 ~ 300[KV]
Form of display	0 ~ 999[V]	□□□[V]	□.□□[kV]	□.□[kV]
	1.00 ~ 9.99[kV]	□.□□[kV]	□.□□[kV]	□.□[kV]
	10.0 ~ 99.9[kV]	□□.□[kV]	□□.□[kV]	□□.□[kV]
	100 ~ 999[kV]	□□□[kV]	□□□[kV]	□□□[kV]

(3) Phase display

Range of display	Form of display
-179 ~ -1[°]	-□□□[°]
0 ~ 180[°]	□□□[°]

(4) Frequency display

Range of display	Form of display
40.0 ~ 70.0[Hz]	□□.□ [Hz]

*23 When a communication card is connected, waveform data at power system fault can be read.

*24 When the product is shipped from the factory, each setting value is “Lock” (With lock setting element) or “minimum setting value“ (Without lock setting element).

*25 The phase metering displays I_A phase angle between I_A and V_{AB} and I_B phase angle between I_B and V_{AB}.
The phase metering can be done over 0.4A input current and over 2V input voltage.

*26 Frequency metering can be done over 35V input voltage.

3 Characteristics

Common conditions	(1) Rated frequency: ±1% (2) Ambient temperature: 20°C±10°C (3) Aux. supply voltage : Rated voltage±2%	The conditions shown on the left should be applied unless otherwise specified.

3.1 Protective elements

(1) Biased differential element

<table>
<tr><th>Items</th><th>Conditions</th><th>Guaranteed performance</th></tr>
<tr><td>Operation current</td><td>Setting: All operation current
All bias
Minimum operation time
Input: One terminal feeding condition</td><td>Setting value ± 5%</td></tr>
<tr><td>Reset value</td><td>Same as above</td><td>Operating value× 95% or more</td></tr>
<tr><td rowspan="2">Biased differential characteristics</td><td>Setting: All operation current
All bias
Minimum operation time
Input: Fixed I_1 according to right chart, and vary I_2.</td><td>
<table>
<tr><th>Bias setting</th><th>I_1</th><th>I_2</th></tr>
<tr><td>10%</td><td>11A</td><td rowspan="3">I_2=10(A) ±5%</td></tr>
<tr><td>15%</td><td>11.5A</td></tr>
<tr><td>20%</td><td>12A</td></tr>
</table>
</td></tr>
<tr><td>Input: Fixed I_1 to 30A, and vary I_2.</td><td>I_2 : 15(A) ± 10%</td></tr>
<tr><td>Phase characteristics</td><td>Setting: Minimum operation current
All bias
Minimum operation time
Input: Fixed I_1 and I_2 to 10A, and vary the phase between I_1 and I_2. Measure operating angle.</td><td>Bias setting = 10%: 174.3 ± 5°
Bias setting = 15%: 171.4 ± 5°
Bias setting = 20%: 168.5 ± 5°</td></tr>
<tr><td>Operation time</td><td>Setting: Minimum operation current
Minimum bias
All operation time
Input: One terminal feeding condition.
0 → operation current setting × 300 %</td><td>Setting value ±20ms
INST = 60 ms or less.</td></tr>
<tr><td>Reset time</td><td>Setting: Minimum operation current
Minimum bias
All operation time
Input: One terminal feeding condition.
operation current setting × 300 % → 0</td><td>200ms ± 20ms</td></tr>
</table>

(2) Loss of excitation element

Items	Conditions	Guaranteed performance
Impedance Z_F Operation value	Setting: All Impedance Z_F, Z_B Minimum operation time Input: Current: 2 * rated current constant (10A) (I_A=5(A), I_B=5(A), I_A-I_B=10(A)) 270° lag based on voltage. (Note) When measuring operation values, if voltage reaches 110V with the 2 * rated current being constant, measurement is realized by reducing the current with voltage constant at 110V.	Setting value ± 5%
Impedance Z_F Reset value	Same as above	Operating value× 105% or less
Impedance Z_B Operation value	Same as above	Setting value ± 5%
Impedance Z_B Reset value	Same as above	Operating value× 95% or more
Impedance Z_F V-I characteristic	Setting: All Impedance Z_F, Z_B Minimum operation time Input: Current: 0.8 ~ 40(A) (No operation below 0.8(A)) 270° lag based on voltage.	Setting value ± 5%
Impedance Z_B V-I characteristic	Same as above	Setting value ± 5%
Phase characteristics	Setting: Minimum Impedance Z_F, Z_B Minimum operation time Input: Current: 2 * rated current constant (10A) (I_A=5(A), I_B=5(A), I_A-I_B=10(A)) 270° lag based on voltage. The characteristics guaranteed points are the points where current shows 240° and 300° lag based on voltage. (For the method of seeking the operation theoretic value, see item of test.)	Nominal phase angle ± 5° and operation theoretic value at characteristics guaranteed point ± 5%
Operation time	Setting: Minimum Impedance Z_F, Z_B All operation time Input: Current: 0 → 2 * rated current (10A) 270° lag based on voltage. Voltage: 110(V) → 40(V)	・0.2 ~ 0.4s setting Setting value ±20ms ・0.5 ~ 10s setting Within ±5% of setting value
Reset time	Setting: Minimum Impedance Z_F, Z_B All operation time Input: Current: 2 * rated current (10A) → 0 270° lag based on voltage. Voltage: 40(V) → 110(V)	200ms ± 20ms
Fail-safe over current element operation value	(Common conditions)	0.8A ± 5%

(3) DI Lock element

Items	Conditions	Guaranteed performance
DI Lock time	Setting: All Lock time Input: Operate all elements set to lock, and input rated voltage to DI circuit. Voltage: rated voltage → 0(V) Measure time before locked elements operating.	・0.1 ~ 0.4s setting Setting value ±20ms ・0.5 ~ 5s setting Within ±5% of setting value

3.2 Measurement elements

Items		Condition	Guaranteed performance
Real time	Phase current (Output side CT)	CT primary setting ×2	±1%
	Differential current	CT primary setting ×2	±2%
	Voltage	VT primary setting / VT secondary setting ×165	±1%
	Phase	0°	±1°
	Frequency	70Hz	±1%
Max. records	Phase current (Output side CT)	CT primary setting ×2	±1%
	Differential current	CT primary setting ×2	±2%
	Voltage	VT primary setting / VT secondary setting ×165	±1%

3.3 Common technical data

ITEM		DESCRIPTION	CONDITION	STANDARD
Environment	Ambient operating temperature	-10°C to +55°C		IEC60255-6
	Ambient storage and transport temperature	-25°C to +70°C		IEC60255-6
	Damp heat	+40°C, 95%RH, 4 days		IEC60068-2-3
Thermal withstand	VT	1.15Vn, 3h		
	CT	40In, 1s		
Dielectric test	Circuit of 60V or below	500VAC, 1min.	1) Between each circuit and the exposed conductive parts, the terminals of each independent circuit being connected together 2) Between independent circuits, the terminals of each independent circuit being connected together	IEC60255-5
	Circuit of more than 60V and 500v or below	2000VAC 1min.		
	Open contact	1000VAC, 1min.	Between open contact poles	
Impulse voltage test		5kV, 1.2μs/50μs	1) Between each circuit and the exposed conductive parts, the terminals of each independent circuit being connected together 2) Between independent circuits, the terminals of each independent circuit being connected together	IEC60255-5
High-frequency disturbance test	Common mode	2.5kV peak, 1MHz with 200Ω source impedance for 2s	Between independent circuits, and between independent circuit and earth	IEC60255-22-1 class 3
	Differential mode	1.0kV peak, 1MHz with 200Ω source impedance for 2s	Across terminals of the same circuit	
Electrostatic discharge test		8kV	Contact discharge	IEC60255-22-2 Class 4
		15kV	Air discharge	
Radiated electromagnetic field disturbance test		68 to 87Mhz 146 to 174MHz 420 to 470MHz		IEC60255-22-3 class 3
Fast transient disturbance test		2.0kV, 5ns/50ns, 1min		IEC60255-22-4
Vibration test		Refer to class 1		IEC60255-21-1 Class 1
Shock response		Refer to class 2		IEC60255-21-2 Class 2
Shock withstand		Refer to class 1		IEC60255-21-2 Class 1
Bump		Refer to class 1		IEC60255-21-2 Class 1
Enclosure protection		IP51		IEC60529

Vn: Rated voltage, In: Rated current

4 Functions

4.1 Protection

4.1.1. Biased differential element (87G)

The biased differential element is designed for protection against phase faults arising in the windings of generators and rotary condensers. This element calculates differential current from the generator neutral-side current I_1 and the output side current I_2, and detects fault of generator.

(1) Principle of operation

Provided that the current for neutral side of generator is I_1, and current for output side of generator is I_2.

Differential current:

$$I_{DIF} = |\dot{I}_1 - \dot{I}_2|$$

The bias is expressed as the bias of differential current I_{DIF} to the minimum of I_1 and I_2. When the bias exceeds the bias setting, and I_{DIF} exceeds the operation current setting, the relay operates.

Operation judgment: $\dfrac{I_{DIF}}{\text{Minimum}\ (I_1\ 、\ I_2)} = \dfrac{|\dot{I}_1 - \dot{I}_2|}{\text{Minimum}\ (I_1\ 、\ I_2)} \geqq$ bias setting

$$I_{DIF} = |\dot{I}_1 - \dot{I}_2| \geqq \text{operation current setting}$$

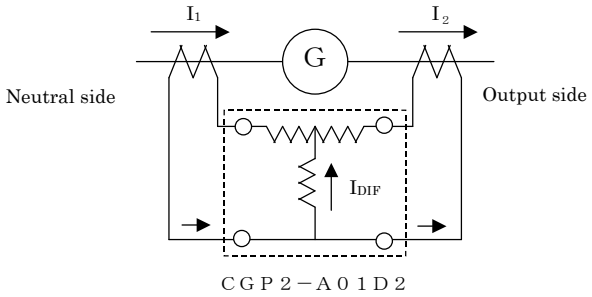


Figure 4-1 Operating principle

When large current by external fault flows through the protected zone, the differential current may rush by an unbalance of CT characteristics, CT burden and lead-wire length. In the large-current range (I_1 or I_2 are 10.5A or more), it makes the bias ratio larger to prevent mal-operation by the differential current.

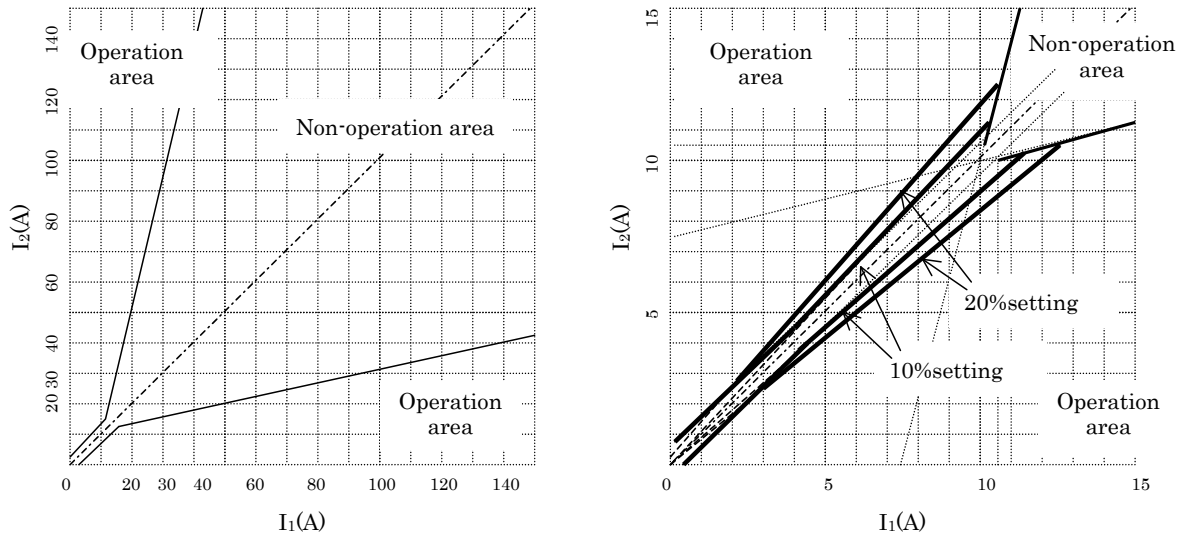


Figure 4-2 Biased differential characteristics between I_1 and I_2

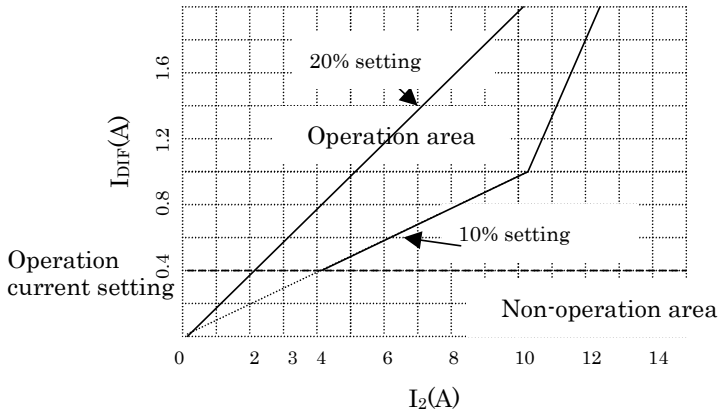


Figure 4-3 Biased differential characteristics between I_2 and I_{DIF}

(2) Biased differential element function diagram

The differential current I_{DIF} is calculated from I_1 (neutral side current of generator) and I_2 (output side current of generator) for the bias differential element. And I_1 is compared with I_2, and biased ratio is calculated from the minimum (of I_1 and I_2) and differential current. The calculated biased ratio is compared with biased setting. At the same time, the differential current is compared with operation current setting. If the ratio and differential current are larger than setting value, the operation indicator LED blinks. When the timer expires, the operation indicator LED lights, and the element outputs an operation signal.

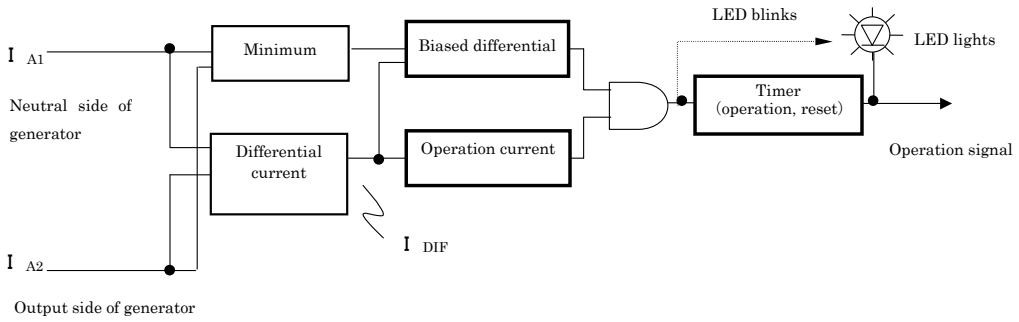


Figure 4-4 Bias differential element function diagram (A-phase)

4.1.2. Loss of excitation element (40)

The loss of excitation element is designed for detecting the decline or loss of field due to the opening or phase-fault of field circuit of the generator. The terminal voltage or the armature current of the generator is used as input in order to detect the change in the impedance at the time of loss of excitation.

(1) Loss of excitation element

The impedance detected by the loss of excitation element, at the time of loss of excitation or out-of-step, is explained below.

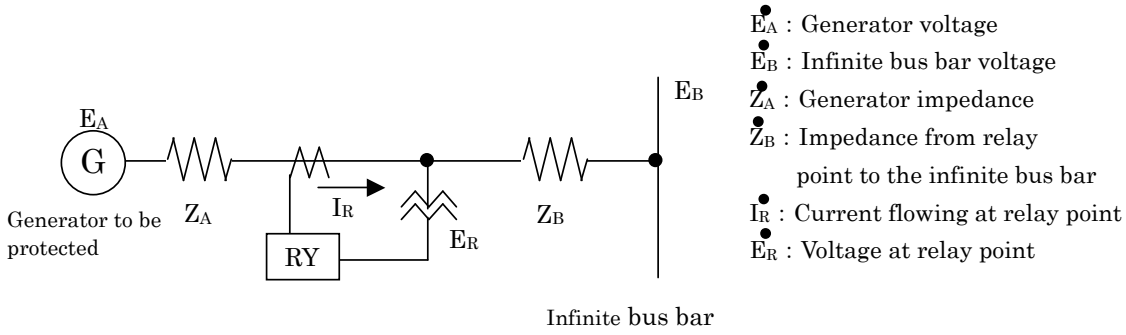


Figure 4-5 System diagram

In the system shown in Figure 4-5, the system voltage and current are expressed respectively as follows:

$$\dot{I}_R = \frac{\dot{E}_A - \dot{E}_B}{\dot{Z}_A + \dot{Z}_B} \quad \cdots\cdots(1)$$

$$\dot{E}_R = \dot{E}_A - \dot{I}_R \cdot \dot{Z}_A \quad \cdots\cdots(2)$$

The following equation is obtained by substituting (1) with (2).

$$\dot{E}_R = \frac{\dot{E}_A \dot{Z}_B + \dot{E}_B \dot{Z}_A}{\dot{Z}_A + \dot{Z}_B} \quad \cdots\cdots(3)$$

Therefore, impedance setting from the element $\dot{Z}_R$:

$$\dot{Z}_R = \frac{\dot{E}_R}{\dot{I}_R} = \frac{\dot{E}_A \dot{Z}_B + \dot{E}_B \dot{Z}_A}{\dot{E}_A - \dot{E}_B} \quad \cdots\cdots(4)$$

(a) At loss of excitation

When the field is completely lost, the generator voltage (E_A) finally becomes 0; and, from equation (4) the impedance detected by the element is as follows:

$$\dot{Z}_R = -\dot{Z}_A \qquad \cdots\cdots(5)$$

If Z_A is replaced by direct-axis transient reactance jxd',

$$\dot{Z}_R = -j\,x\,d' \qquad \cdots\cdots(6)$$

Thus, the impedance locus is known to head towards –jxd'.

And, from the (synchronous) relationship with the generator not to be impedance locus is found to finally head towards the direct-axis synchronous reactance –jxd'.

On the R-X diagram, it is shown in Figure 4-6

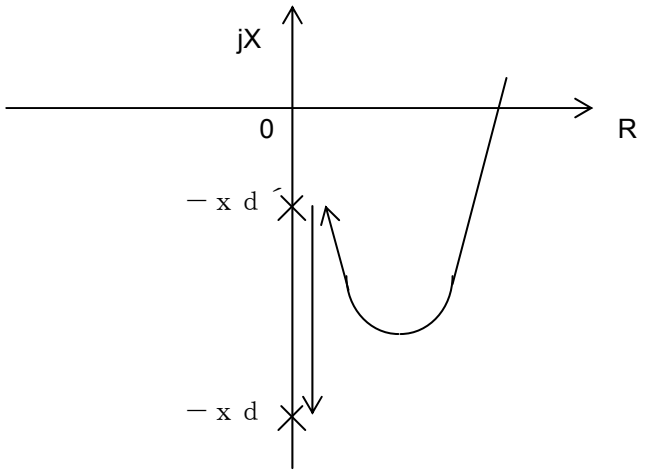


Figure 4-6

(b) Out-of-step

If the generator voltage and the infinite bus bar voltage are the same in value, and the phase is different by 180°,

$$\dot{E}_A = -\dot{E}_B \qquad \cdots\cdots(7)$$

Thus,

$$\dot{Z}_R = -\frac{1}{2}\left(\dot{Z}_A - \dot{Z}_B\right) \qquad \cdots\cdots(8)$$

Now, if Z_A is replaced by generator transient reactance jxd', and Z_B is replaced by transformer reactance jxt, equation (8) becomes as follows:

$$Z_R = -j\,\frac{1}{2}\,x\,d' + j\,\frac{1}{2}\,x\,t \qquad \cdots\cdots(9)$$

Therefore, the impedance locus at out-of-step is found to pass at value smaller than –xd'/2 on –X axis, or on the +X axis, as shown in Figure 4-7.

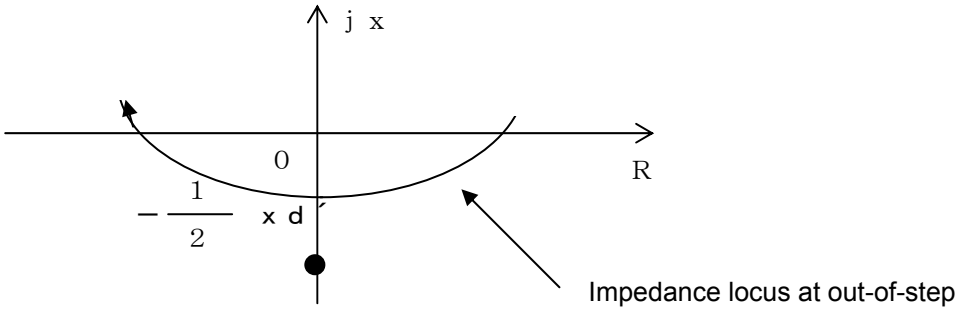


Figure 4-7

However, it is not that the generator voltage E_A immediately becomes E_A= - E_B or 0 for both during loss of excitation and at out-of-step; and, its process is determined by the time constant of field circuit, system conditions, response status of AVR, etc.

For the impedance locus during loss of excitation, by taking into account the impedance locus at out-of-step, it is possible to detect the loss of excitation by installing this relay, which has the operation area inside the circle with the center on the X axis and the diameter determined by the –xd'/2 point (transient impedance –xd') and the synchronous impedance -xd point.

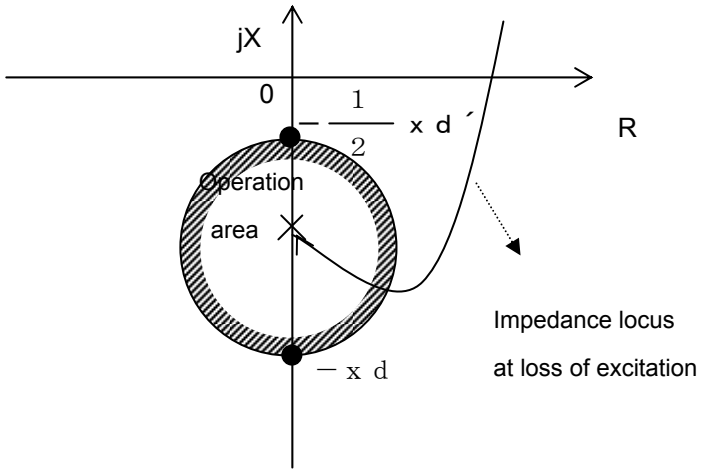


Figure 4-8

(2) Principle of operation

The impedance has to be computed by the current and voltage of the in-phase relation. For this relay, as the line voltage E_{AB} is used, I_A and I_B are taken in for current in order to match phase; and, $I_A - I_B$, which is internally computed, is used.

For the principle of operation of this relay, the voltage signal proportional to the generator voltage and current is obtained from the voltage input transformer and current input transformer, whereby Vectors V_1 and V_2 are derived.

$$V_1 = E_{AB\,(n)} - Z_F\,(I_A - I_B)$$

$$V_2 = -E_{AB\,(n)} + Z_B\,(I_A - I_B)$$

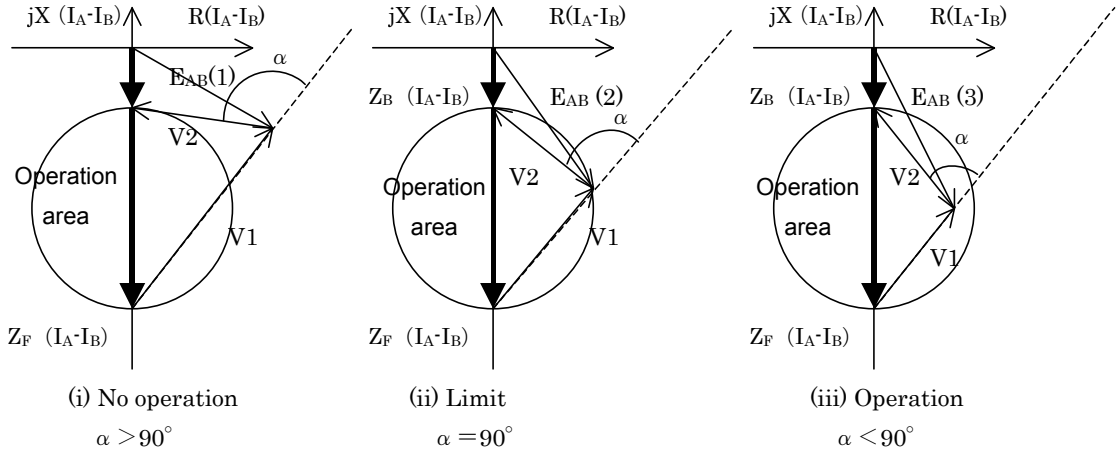


Figure 4-9 Operating principle (phase discriminating principle)

When the phase difference of the vectors V_1 and V_2, as illustrated in Figure 4-9(i), is greater than 90°, this relay is not in operation, while this relay is in operation if α is smaller than 90° as shown in Figure 4-9(iii).

As can be seen in Figure 4-9(ii), therefore, α = 90° is a threshold for operation, whereby circular characteristic having an operating zone in the circle is obtained.

When we consider the above characteristics based on V_1, it follows that V_2 operates is within 90° for V_1 as in Figure 4-10.

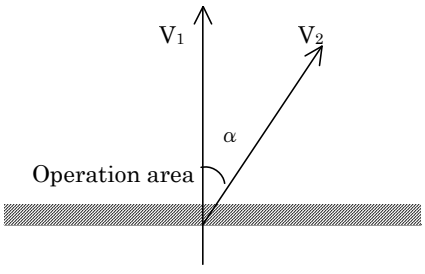


Figure 4-10 Phase Discriminating Characteristic

This relay is provided with overcurrent fail-safe element for prevention of the mal-operation of the phase discriminating element. The minimum operation current of the element is 0.8A base if $(I_A - I_B)/2$.

(3) Loss of excitation element function diagram

Figure 4-11 shows operation of the loss of excitation element. Impedances Z_F and Z_B calculated from voltage (V_{AB}) and phase current (I_A, I_B) for the loss of excitation element. The calculated impedance is compared with the impedance setting. If impedances is in the operation area, the operation indicator LED blinks. When the timer expires, the operation indicator LED lights, and the element outputs an operation signal.

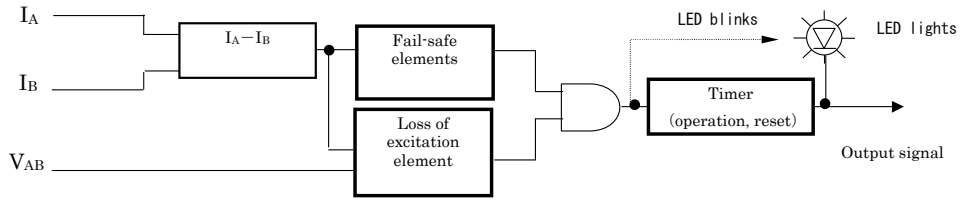


Figure 4-11 Loss of excitation element function diagram

(4) Setting calculation

Realize setting for this relay is as follows:

The generator constants are:

Generator rated capacity ・・・・・・・・・・・・	KVA
Rated voltage ・・・・・・・・・・・・・・・・	KV
Synchronous impedance (p.u. value) ・・・・・	xd p.u.
Transient impedance (p.u. value) ・・・・・・・	xd' p.u.
CT ratio, PT ratio	

From the above the following are obtained:

Reference impedance of generator:

$$GZ = \frac{(\text{rated voltage})^2}{\text{Generator rated capacity}} \times 1000$$

Convert GZ to value for relay input:

$$RZ = GZ \times \frac{\text{CT ratio}}{\text{PT ratio}}$$

Convert synchronous impedance (xd) to value for relay input:

$$R\,x\,d = RZ \times xd\ \text{p.u.}\ (\Omega)$$

Convert transient impedance (xd') to value for relay input:

$$R\,x\,d' = RZ \times xd'\ \text{p.u.}\ (\Omega)$$

Therefore, the setting impedance circle at the relay side is as follows:

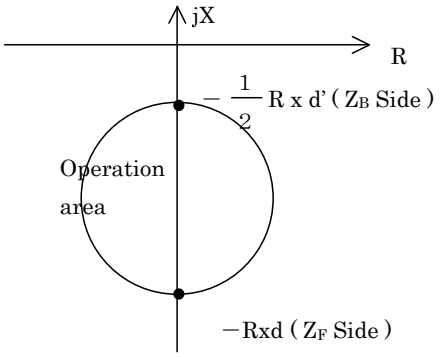


Figure 4-12

An example of setting: the loss of excitation element

Generator rated capacity ・・・・・・・・・・・・・	KVA	112500	KVA
Rated voltage ・・・・・・・・・・・・・・・・・	kV	11	kV
Synchronous impedance (p.u. value) ・・・・・・・	xd p.u.	2.66	p.u.
Transient impedance (p.u. value) ・・・・・・・・・	xd' p.u.	24	p.u.
CT ratio		8000/5	A
PT ratio		11000/110	V

The reference impedance of generator:

$$GZ = \frac{(\text{rated voltage})^2}{\text{Generator rated capacity}} \times 1000$$

$$= \frac{11^2}{112500} \times 1000$$

$$= 1.08\ (\Omega)$$

Convert GZ to value for relay input:

$$RZ = GZ \times \frac{\text{CT ratio}}{\text{PT ratio}}$$

$$= 1.08 \times \frac{8000/5}{11000/110}$$

$$= 17.28\ (\Omega)$$

Convert synchronous impedance to value for relay input:

$$R\,x\,d = RZ \times xd\ p.u.$$

$$= 17.28 \times 2.66$$

$$= 45.96\ (\Omega)$$

Convert transient impedance to value for relay input:

$$R\,x\,d' = RZ \times xd'\ p.u.$$

$$= 17.28 \times 0.24$$

$$= 4.15\ (\Omega)$$

Therefore, the setting is calculated as follows:

$$Z_B = \frac{1}{2} R\,x\,d' = \frac{1}{2} \times 4.15$$

$$= 2.075 \fallingdotseq 2.1\ (\Omega)$$

$$Z_F = R\,x\,d$$

$$= 45.96\ (\Omega) \fallingdotseq 46.0\ (\Omega)$$

4.1.3 General functions

(1) Setting of operation value

The operation current setting for the bias differential element is indicated with current value [A], and the operation bias setting is indicated with ratio [%]. The impedance Z_F and Z_B setting for loss of excitation element are indicated with impedance [Ω].

When the “Lock” was set, the elements selected are locked for operation.

(2) Setting of operation time

The operation time settings are indicated with time value [s].

(3) Operation display

For the bias differential element, when the bias ratio becomes larger than the bias setting and the differential current becomes larger than the operation current setting, the operation indicator LED of the bias differential element will blink. For the loss of excitation element, when impedance is within circle that determined by impedance setting Z_F and Z_B, the operation indicator LED of the loss of excitation element will blink. The LED lamp will come on as soon as an operation output is made when a period of operation time has elapsed.

The operation indicator LED has been set to “self-hold” in the factory. This setting can be freely changed to “auto reset”.

With the “self-hold” setting, data of the latest operation indication will be stored in the internal memory even if the auxiliary power supply runs down.

The data stored will be cleared when the “indicator reset” switch is pressed.

Up to latest five phenomena can be stored and displayed as a history record. (Older data than the latest five phenomena will automatically be cleared).

Item No.	History	Sequence of recording
311	1st phenomena	Latest fault record data
312	2nd phenomena	↓
313	3rd phenomena	↓
314	4th phenomena	↓
315	5th phenomena	Oldest fault record data

(4) Output contacts

The signaling outputs X_0 to X_3 and trip outputs X_5 and X_6 are all programmable type.

The factory default setting of the arrangement of these outputs is as shown in the internal function block diagram of Figure 5-2 This setting can be freely changed by specifying outputs of the internal elements based on the OR logic.

All the outputs have been set to “auto reset” in the factory. Any of them can be changed to “self hold”.

And the output X_4 for differential current check closes at differential current error. This contact is “auto-reset”. If the differential current error is discovered, the contact will open. This contact is not programmable.

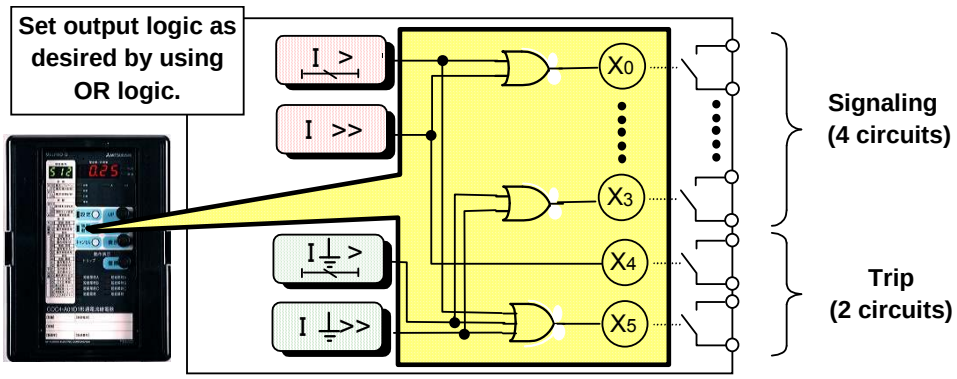


Figure 4-13 Schematic image of Programmable Outputs (example: COC4-A01)

(5) Forced operation

It is possible to carry out forced operation of any of the signaling outputs X_0 to X_3, differential current check output X_4, and trip outputs X_5 and X_6 independently. Forced operation is useful for checking the wiring.

When forced operation is carried out, the corresponding LED lamps will come on to show the current status of the programmable outputs. Checking the lamp status will be useful not only for wiring check but also to check the programmable outputs arrangement.

(6) Lock function by external control input

Two DI circuits are installed for the interlock by external control signals, and a relay element can be locked by DI input. As an interlock example, unwanted operation by inrush current can be locked. Moreover, the relay element locked at the time of a DI input arising can be set up to each DI circuit. The operating element indication is made to turn on according to the interlock conditions.

A timer of DI lock can be set every DI circuit. The timer means that time before turning of DI input after releasing lock.

In the state of DI lock, if a protection element is operated, the operation indicator LED will be blinking. In the state of DI lock released, the contacts operate after timer of DI lock, and the operation indicator LED will be lit.

When setup for a certain element differs in DI input (1) and DI input (2) and both of DI (1) and DI (2) input arise, LOCK is carried out with priority.

Example: When a setup for 87G element is LOCK at the time of DI (1) input and Not Lock at the time of DI (2) input and both of DI (1) and DI (2) input arise, 87G will be locked.

Reset timer of protection element is set behind the sequence of DI lock to prevent resetting in short time, when a protection element is locked right after making contact. When DI lock is carried out during a contact making, the contact will be broken after reset time for the protection element.

Moreover, please carry out setting change of an output lock element by the item numbers 880 and 890. (refer to 6.4.2 operation procedure).

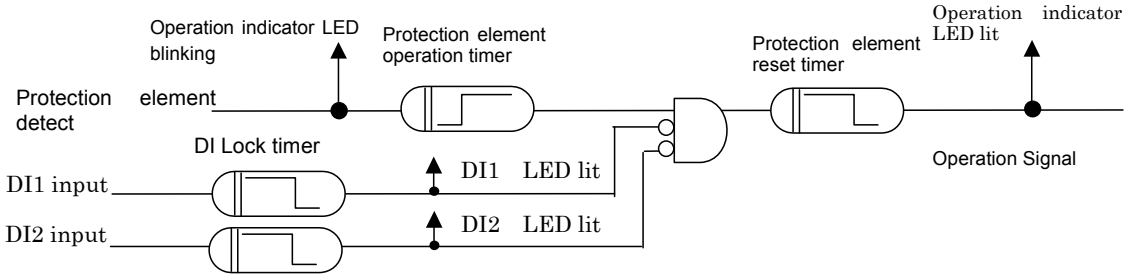


Figure 4-14 Example of Lock function by external control input

4.2 Measurement

Currents and voltages input into the relay are measured and converted into freely set CT primary currents or VT primary voltage, then indicated in the display.

(1) Real time measurement

The effective current/voltage input to the relay under steady state can be displayed for each phase. And phase and frequency input to the relay under steady state also can be displayed.

The displayed currents are phase current for output side of generator, and differential current.The displayed phases are lag of I_A and I_B with V_{AB} standard.

(2) Max. records

The maximum effective current/voltage can be recorded and stored for each phase. The max. record will be all cleared when “aux. power supply OFF” or “max. record reset” operation is made.

(3) Fault record

In the event of system fault, the effective current/voltage and waveform data that have been measured at the time when one of the protection elements operates to issue an output signal are stored. Data of up to five phenomena can be stored and displayed for each phase.

In addition, the phase can also be stored and displayed for five phenomena.

With “aux. power supply OFF”, only the waveform data will be cleared and the effective current data will remain. With “fault record reset” operation, however, both of the data items will be all cleared.

(Records older than the 5th phenomenon will automatically be cleared.)

Item No.	History	Sequence of recording
211	1st phenomena	Latest fault record data
212	2nd phenomena	↓
213	3rd phenomena	↓
214	4th phenomena	↓
215	5th phenomena	Oldest fault record data

The following fault waveform data can be collected if a communication card is installed:

Item	Specification
Data sampling cycle	Fixed to the electric angle of 30° of rated frequency
Data storing capacity (for a phenomenon)	224 cycles of rated frequency (Data point: 224×360°/30° = 2688 points)
Permissible setting range	224 cycles before trip ~ 224 cycles after trip
Collected data	The range for data collection can be set by cycle within the “data storing capacity” in the “permissible set range”.

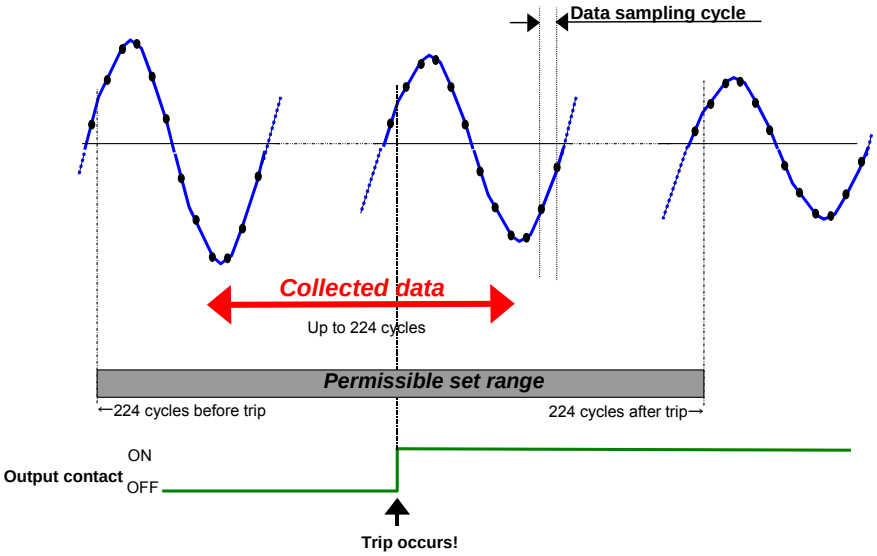


Figure 4-15 Concept of recording fault waveform

4.3 Self-diagnosis

The self-diagnosis function monitors the electronic circuit and built-in power source continuously. If an abnormal condition occurs, the protection elements will be locked for operation. Also, the RUN LED lamp will go off and the self-diagnosis output contact (break contact) will be closed.

(1) Checking defect code at failure detection

When a failure is detected, the defect code will be recorded. This defect code can be checked through the self-diagnosis (ALARM) status indication.

(2) Resetting self-diagnosis output

If a failure is detected, **the failure status may be reset by turning off/on the power**.

In this case, **be sure to lock the trip circuit on the external wiring of the relay** before resetting. (If the failure persists, an erroneous output may be caused).

(3) Clearing the defect code

The defect code data stored at failure detection can not be cleared only by carrying out the power on/off procedure in the item (2) above. All the defect code numbers that have been detected since the previous “self-diagnosis reset” (RESET ALARM) operation was made are accumulated in the memory.

To clear the record data, carry out “self-diagnosis reset” (RESET ALARM) operation.

(4) Differential current check

When a difference of the burden of CT’s at neutral side and at output side is large, or when analogue circuit be fault, differential current may be generated. The relay always checks an analogue circuit by AD accuracy check, Analogue filter check, and Duplicated A/I check. However, those check function cannot detect the slight fault of analogue circuit, so the relay checks also by Differential current check.

For differential current check, the differential current is calculated from the neutral side current and output side current, and the current is compared with operation current setting. If the differential current is larger than 80% of operation current setting, and the state keeps over 20 seconds, the differential current error is detected.

If the differential current error is detected, differential current check indicator LED is lit, and the contact (X_4) for the differential current check will be closed. In this time, the operation of each element is not locked. If the differential current is smaller than 80% of operation current setting, indicator LED and contact will be reset.

Table 4.1 Output for protection relay failures

Status	Detected items	Output			
		Display		ALARM (break contact)	Operation output lock
		RUN	Defect code		
Normal	-	On	No display	Open	Not locked
Power circuit failure	-	Off		Closed	Locked
CPU failure	-				*45
Monitor error	ROM check		0001		Locked
	RAM check		0002		
	A/D accuracy check		0003		
	A/I check		0004		
	A/D check		0005		
	SRAM check		0006		
	D/O status check		0008		
	D/O operation check		0009		
	Analog filter check		0010		
	A/I double check		0011		
	D/I check *41		0012		
	E^2PROM check		0013		
	Computing function check		0014		
	WDT check		0015		
	Data transfer check *42		0016		
	Differential current check	On	-	Open	Not locked
	Communication card check *44		0028		
	Communication card channel No. switch setting error *44		0029		
	Communication card baud rate switch setting error *44		0030		
	Communication card channel No. switch change error *44		0031		
	Communication card baud rate switch change error *44		0032		

*41 Monitored only in the models with built-in D/I function.
*42 Monitored only in the models with D2 unit.
*44 Monitored only when the relay is installed with communication card.
*45 No necessary to lock the operation output as any signals can't be output in case of CPU stop.

4.4 Communication

Figure 4-16 shows an example of network system configuration.

For more information on the communication facilities, see the materials shown in the introduction (page 2).

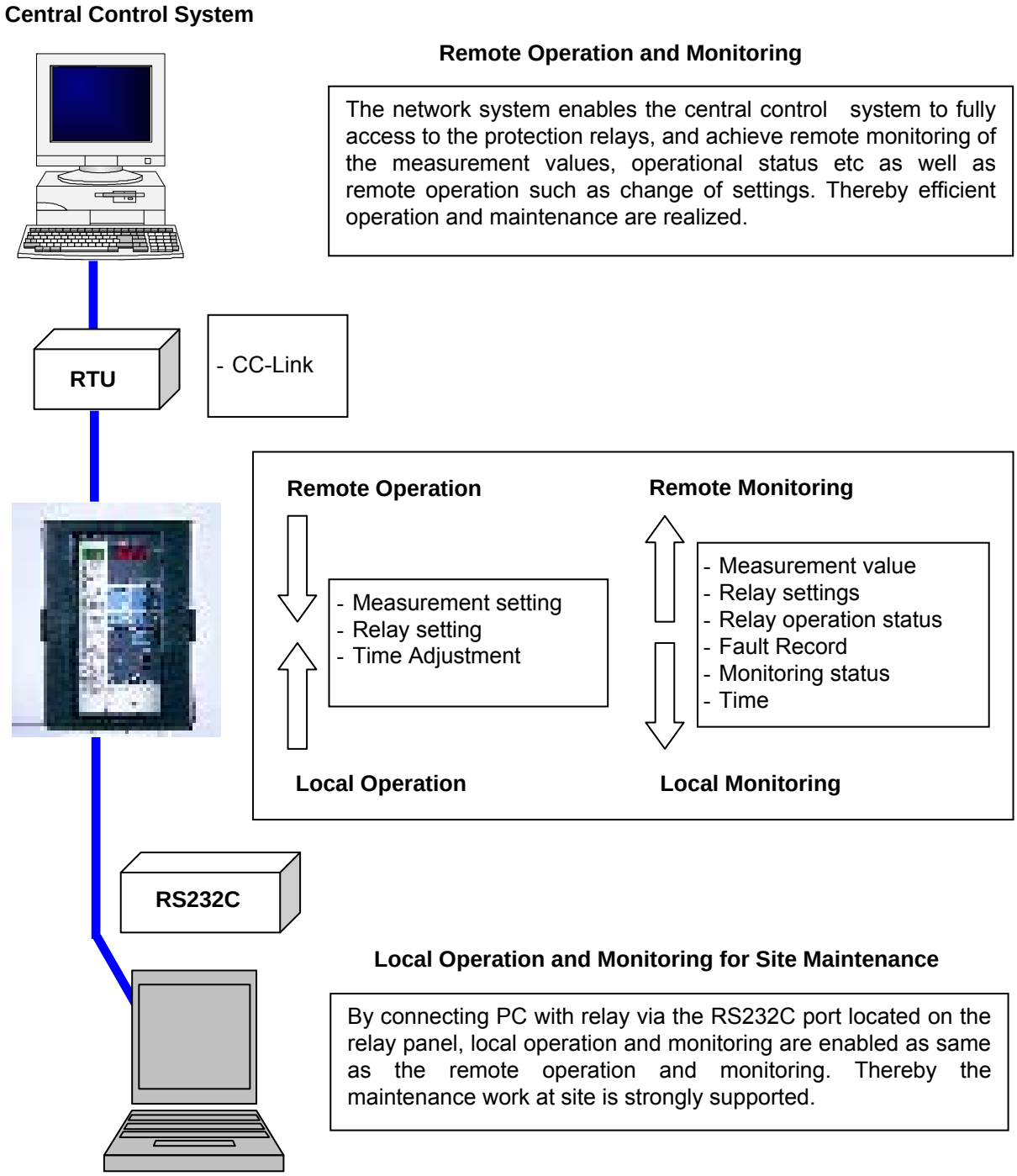


Figure 4-16 Example of communication network system configuration

Using the communication facilitates, it is possible to perform Remote Monitoring and Remote Operation with the various useful functions shown in Table 4.2.

Table 4.2 Outline of functions enabled by communication network

Direction of communication	Item	Description
Remote Monitoring RTU ⇐ Protection relay	Setting	Read the settings stored in the protection relay.
	Measurement	Read the measurements stored in the protection relay.
	Max. value	Read the max. values stored in the protection relay.
	Fault record	Read the measurements at the time of trip.
	Self-diagnosis (ALARM)	Read the result of self-diagnosis.
	Operation element	Read the elements that operated at the time of trip.
	Operation time	Read the time at the time of trip.
	Current time	Read the internal time of the communication card.
	Waveform record	Read the wave form at the time of trip.
Remote Operation RTU ⇒ Protection relay	Setting	Change the setting of the protection relay.
	Indicator reset	Reset the LED lamp that came on at the time of trip.
	Self-diagnosis (ALARM) reset	Clear the result of self-diagnosis.
	Fault record reset	Clear the fault record, operation elements and operation time data.
	Max. record reset	Clear the max. record.
	Forced operation	Carry out forced operation of output contact.
	Time	Set time of communicate card.

5 Configuration

5.1 Internal configuration

(1) I/O and CPU circuits

Figure 5-1 shows the internal block diagram of the model CGP2-A01D2.

Current and voltage inputs are converted into AC signals at the electronic circuit level via the auxiliary transformer and filter circuits. These signals are retained as a form of DC signal in the sample hold circuit on each channel sharing a same time. The multiplexer selects a channel to take the signal and sends it to an A/D converter. The signals are converted to digital signals sequentially in the converter to be sent to the CPU.

The setting circuit is used to input setting data into the CPU.

These inputs will be used to carry out the functions shown in Figure 5-2 “Internal function block diagram” , then issue output signals to the display and output relay.

(2) Self-diagnosis circuit

When the self-diagnosis function detects that the electronic and power circuits are normal, the output relay will be energized to open the self-diagnosis output contact (break contact).

The self-diagnosis output contact (break contact) will be closed when a failure occurs in the circuits above or when the built-in power fuse burns.

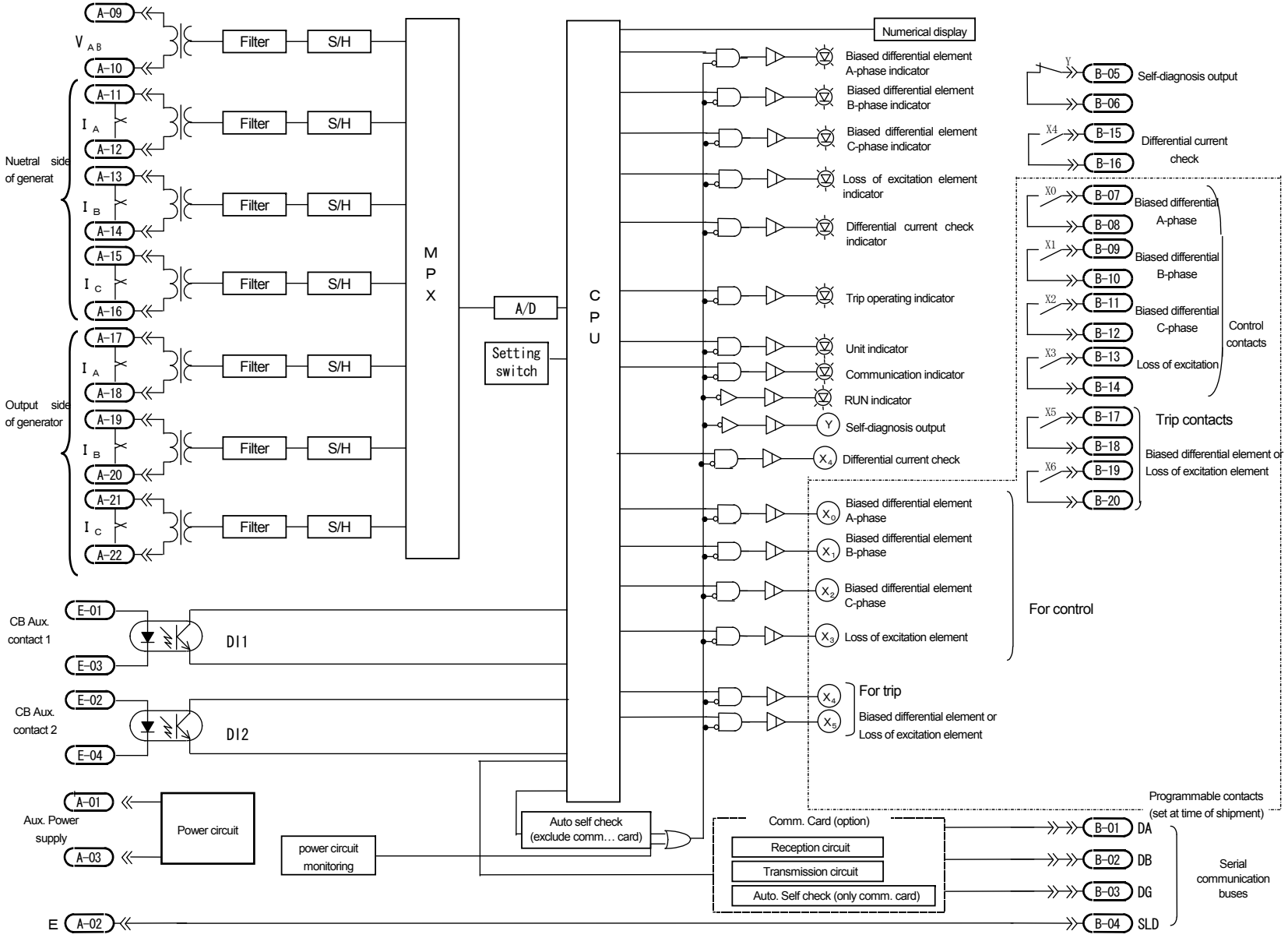


Figure 5-1 Internal block diagram of Type CGP2-A01D2 relay

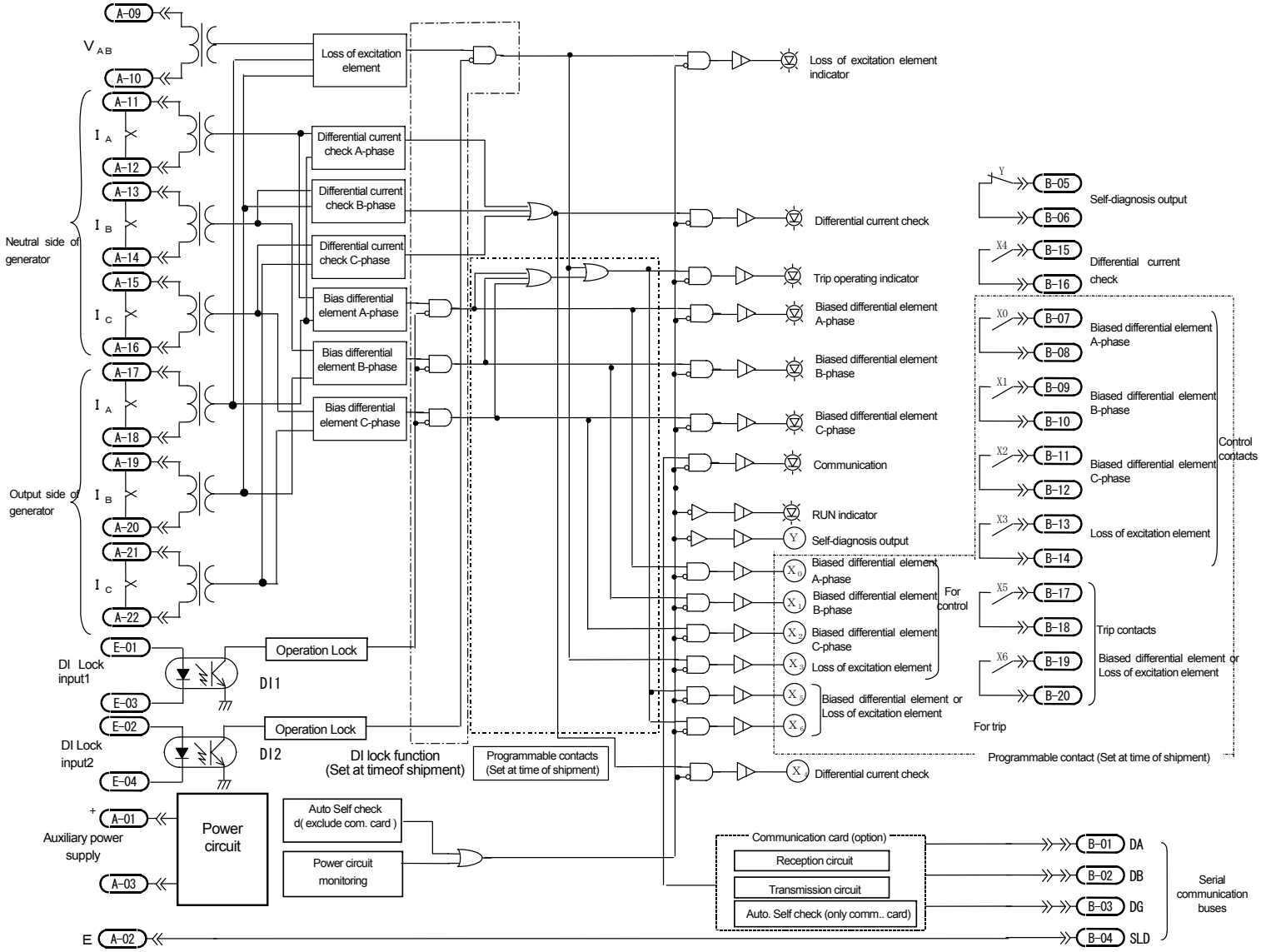


Figure 5-2 Internal function block diagram of Type CGP2-A01D2 relay

5.2 External connection

(1) Connection diagram

Figure 5-4 and Figure 5-5show examples of input circuit (AC circuit) connection, Figure 5-6 an example of control circuit (DC circuit) connection and Figure 5-7a terminal arrangement. Note that the terminal arrangement is different from that of CAC3-10-M2 and CZF1-10-M1 for MULTICAP Series. In the case of that the loss of excitation element is set at neutral side of generator, current value in the measurement function reads current at neutral side of generator, not output side.

In the terminals, M3.5 screws should be used and wires with 2 mm^2 or less.

(2) Precautions for wiring work

a. Important facilities should be provided with fail safe measures such as dual system to improve reliability of the facilities.

b. Effects of external surge

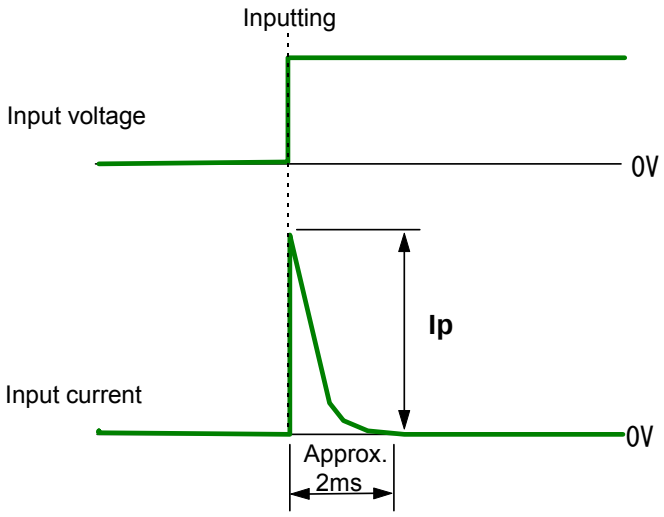
Some type of surge with a certain condition may inversely affect the relay. If so, take it into account to install **MF type surge absorbers made by** Mitsubishi Electric.

c. Guarantee of AC auxiliary power supply against power interruption

The AC auxiliary power supply of the relay is not **guaranteed against power interruption**. When you do not have an uninterruptible AC power source, use the **type B-T1 back up power supply manufactured by** Mitsubishi Electric or uninterruptible power source (UPS) that is commercially available.

d. Inrush current of auxiliary supply

Since **inrush current may flow** in the relay when the auxiliary power supply is turned on as shown in the figure below, make consideration of this point when selecting the breaker for the auxiliary supply power circuit.



Input voltage		Inrush current Ip
DC	110V	Approx. 20A
	220V	Approx. 55A
AC	100V	Approx. 25A
	220V	Approx. 65A

Figure 5-3 Inrush current of auxiliary power supply

e. Trip circuit

Only the contacts X_5 and X_6 can be used for the trip circuit. Please keep in mind that the contacts X_0 to X_3, and X_4 can not be used for the trip circuit. (If used, the contact may burn).

Connect the pallet contact (52a) of the circuit breaker to the trip circuit.

f. Self-diagnosis output circuit

The self-diagnosis output contact is so configured that the auxiliary relay can be energized (break contact) with normal result of monitoring, in order to be able to continue monitoring even if the built-in power fuse burns. Therefore, connect the timer to the external wiring. (See Figure 5-6 “DC circuit connection diagram”).

g. Earth circuit

Be sure to earth the earth terminal located on the back of the relay according to the Class D earth wiring method.

h. Characteristics of current transformer

If the characteristics such as saturation of current transformer are different in the neutral side and the output side of generator, when large current caused by external fault or inrush current, the differential current flows and may cause unwanted operation.

In order to prevent the unwanted operation, please use the current transformer with the over-current constant of 20 or more and Class 1.0 or more within the rated burden.

For CT’s of neutral side and output side of generator, use CT’s of the same lot and same characteristics, and try to match the load on both neutral side and output sides as far as possible.

i. Provision for unwanted operation of loss of excitation element

Since the unbalance of PT circuits or the abnormal burden of PT circuit, unwanted operation may be occur. Please prevent the unwanted operation with voltage balance relay.

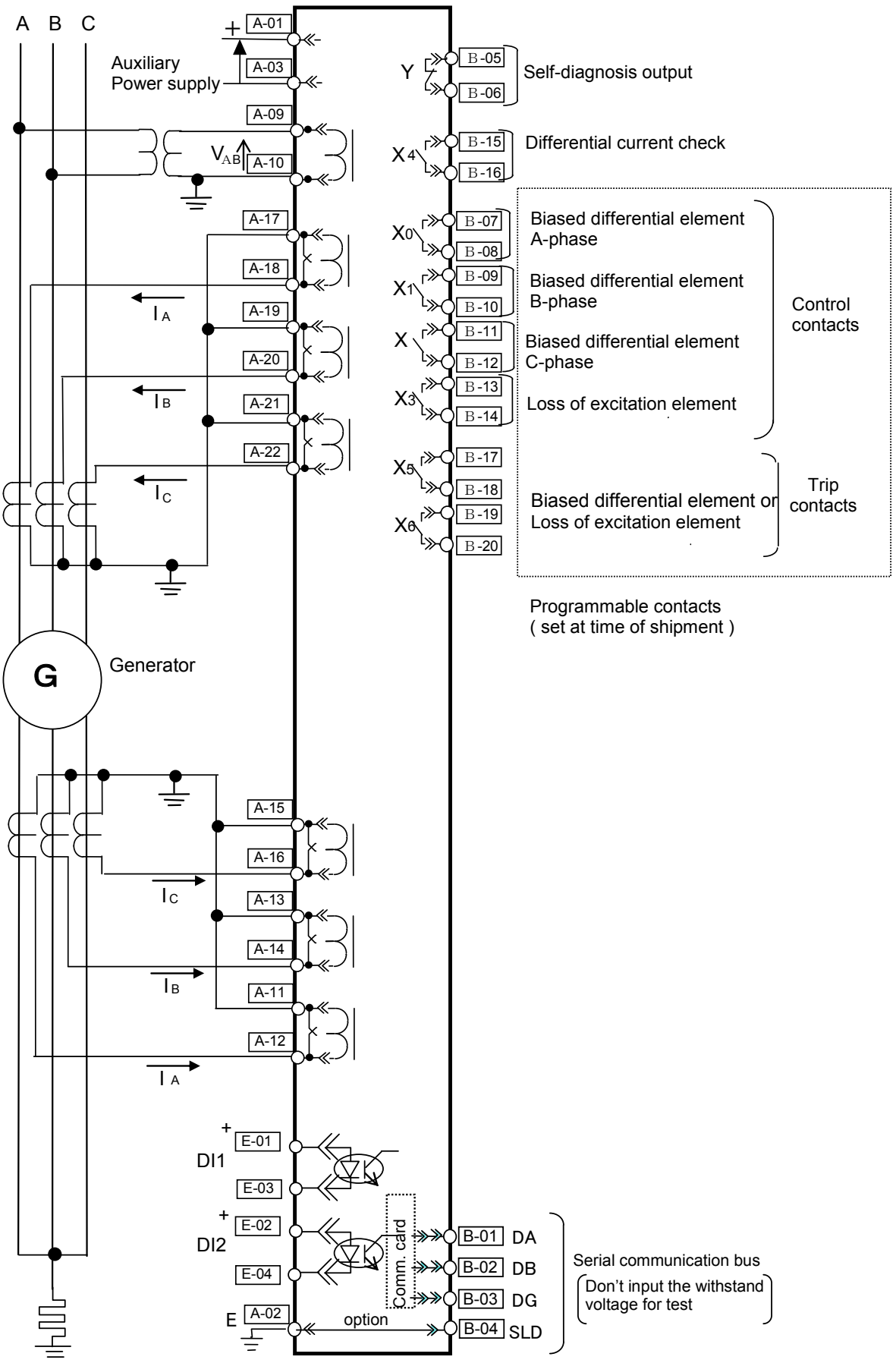


Figure 5-4 External connection diagram for CGP2-A01D2 relay

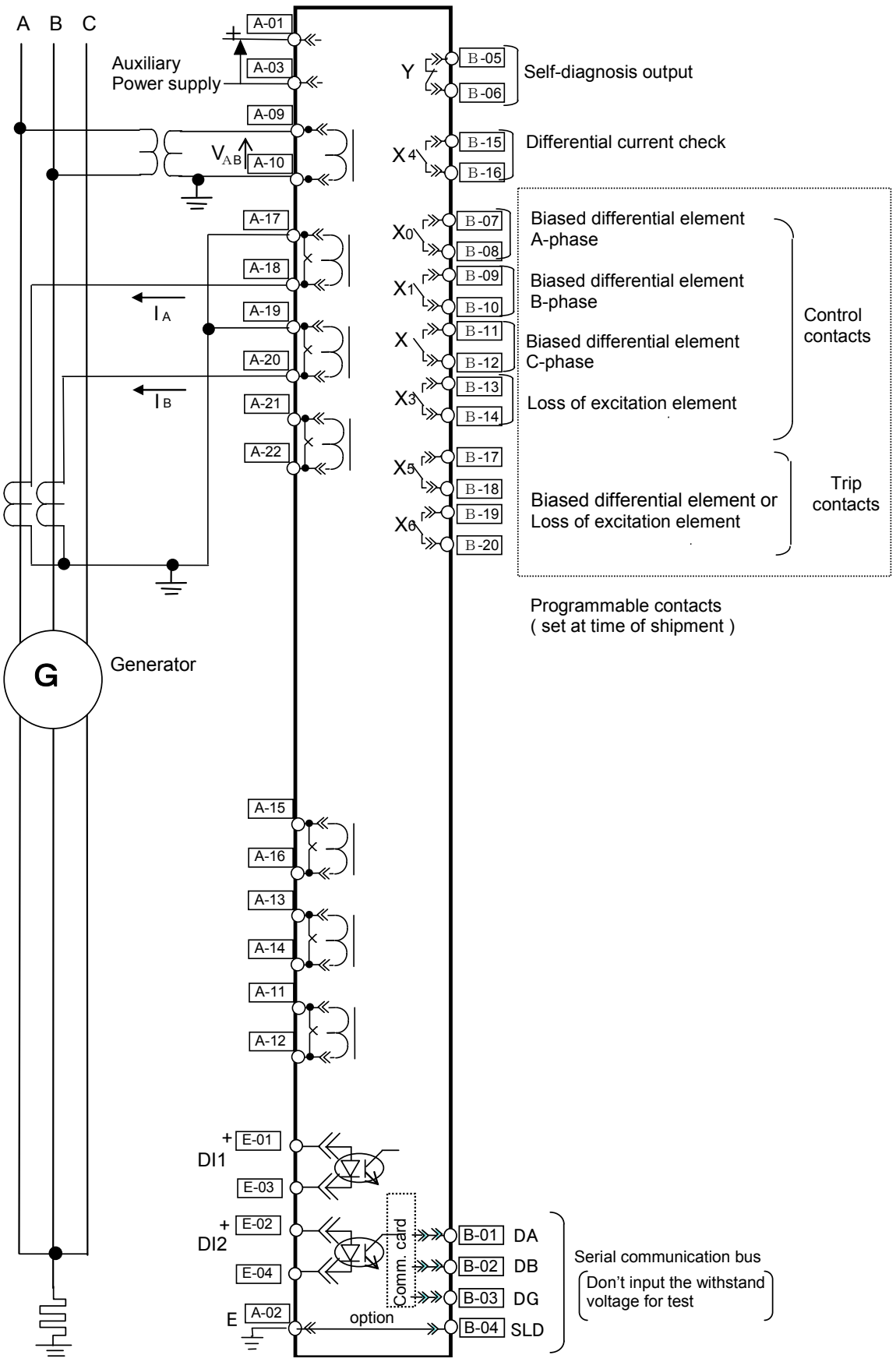
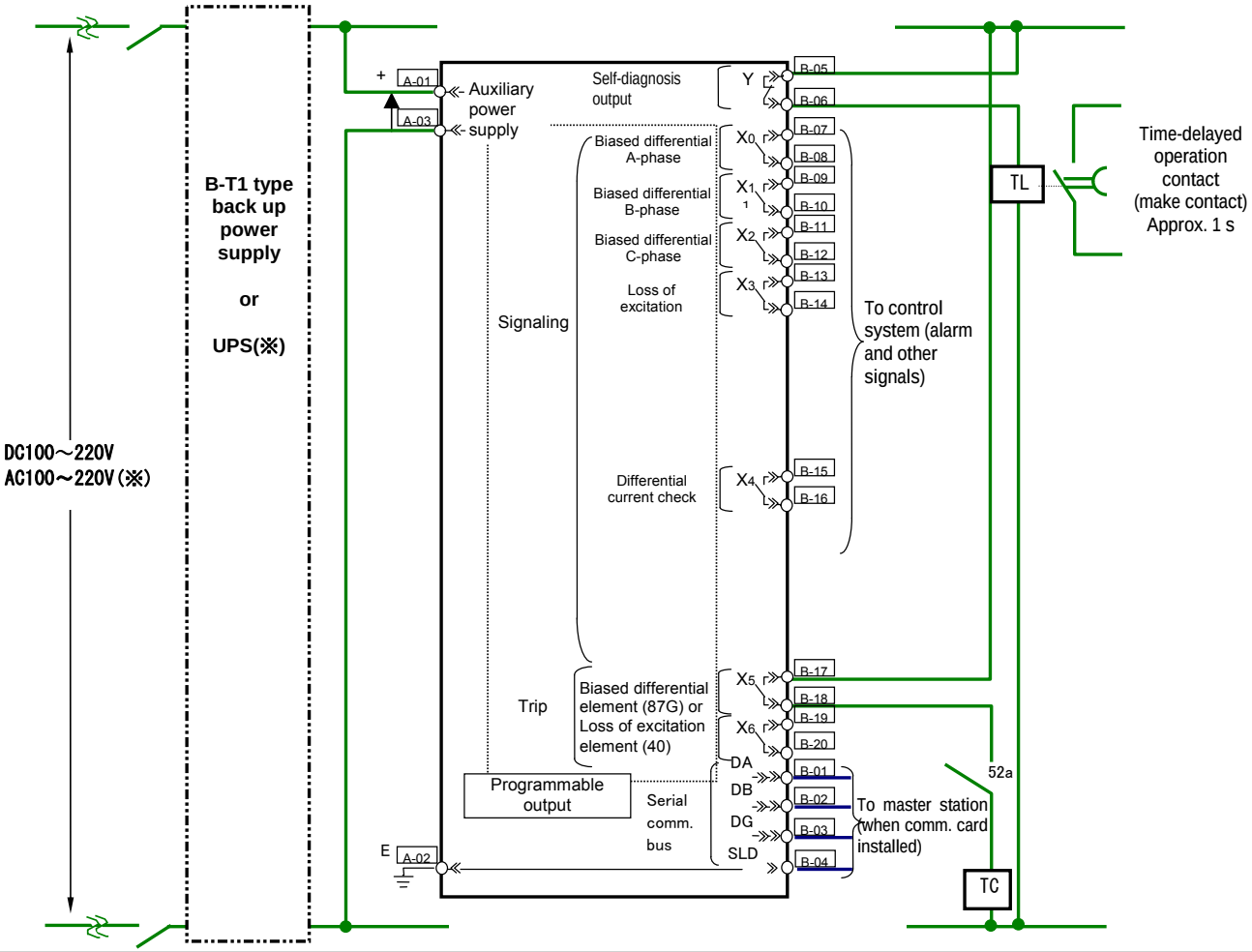


Figure 5-5 External connection diagram for CGP2-A01D2 relay

(In the case of applying loss of excitation element alone)



Note 1)	The self-diagnosis output contact is so configured as below mentioned that alarm can be issued even after the built-in power fuse burns. This type of auxiliary relay circuit configured such that relay will be energized (“break contact” opened) when normal result of self-diagnosis is received. Therefore, the “break contact” is closed when the power is applied and will be opened after about 50ms. If the auxiliary power supply of the relay and the self-diagnosis output contact shares a same power source, **the “break contact” will be closed temporarily after the auxiliary power supply is turned on**. In the case where the phenomenon stated in the above would conflict with your system requirement, it is recommended that the self-diagnosis output contact should be **connected via the time-delayed timer** as shown in the left of the figure.
Note 2)	Regarding to the type CPS1 AC/DC converter or commercially available uninterruptible power supply (UPS), refer to the note *21 in the section 2.1 General information.

(※) Refer to the page 40, 5.2 External connection (2) Precautions for wiring work c. Guarantee of AC auxiliary power supply against power interruption.

Figure 5-6 Auxiliary supply circuit connection example of type CGP2-A01D2 relay

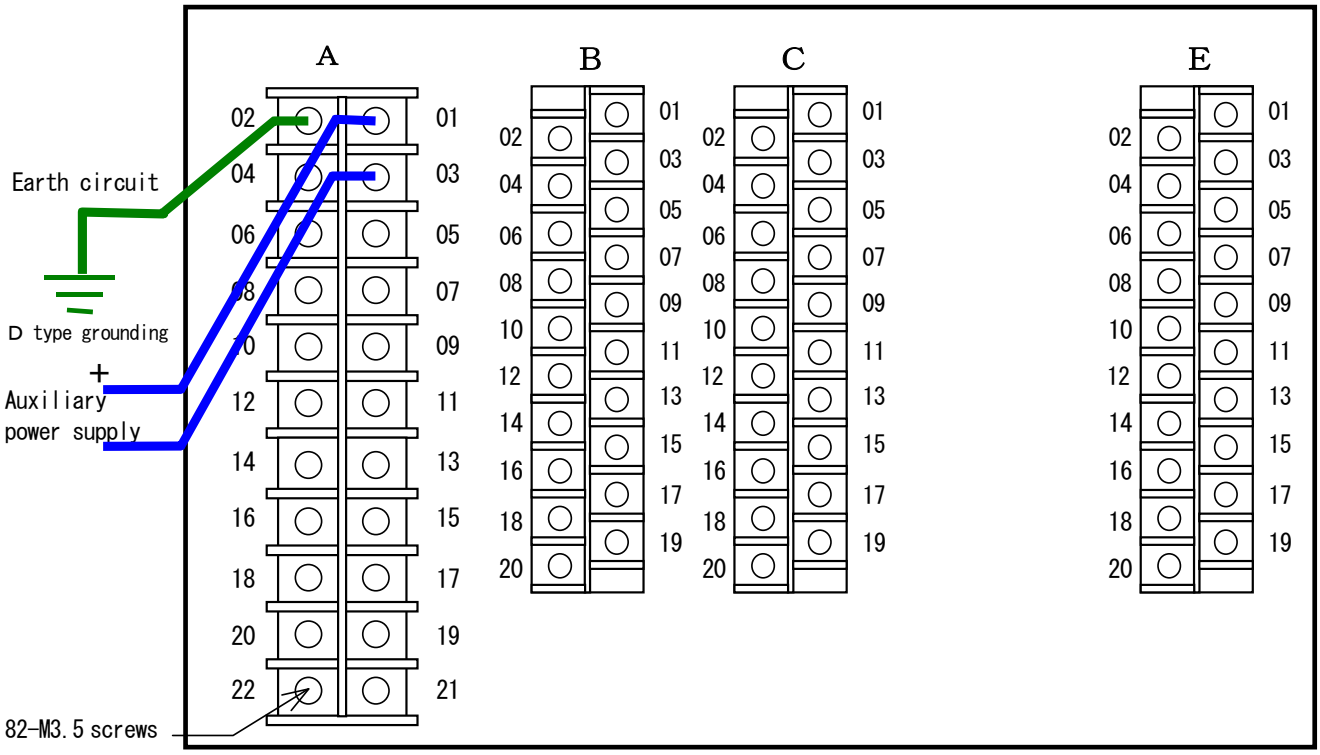


Figure 5-7 Rear view of type CGP2-A01D2 relay

6 Handling

6.1 Unpacking

Usually this relay is packed in a D2 case for transportation. However, it may occur that only the sub unit is transported independently for the convenience at repair. In such a case, fully brush off the dust, dirt, etc. adhered to the sub unit after completion of unpacking, and further visually check that the parts mounted on the front panel or built in the sub unit are not damaged.

6.2 Transportation and storage

To carry the equipment within the place of use, handle it carefully so that the parts installed on the front panel of the sub unit or built-in parts can not be deformed or broken.

6.3 Appearance and how to pull sub unit out

The relay is so constructed that the sub unit can be drawn out, in order to facilitate inspection or test. It is possible to pull the sub unit out without disconnecting the external wiring.

Note that the sub unit should not be drawn out with the line hot. Before drawing out, be sure to take the following actions.

- Lock the tripping circuit including breakers.
- Stop the main circuit.
- Shorten and isolate the CT circuit
- Open the auxiliary power supply circuit.

Bear in mind that careless opening of circuits may result in opening the other control circuits too to impair the protective function. Be sure to only shut off the concerned circuit.

The CT circuit is provided with an automatic short circuit mechanism. In case that you have pulled the sub unit out without isolating the CT circuit by mistake, the automatic short circuit mechanism will work to prevent the CT secondary circuit from opening.

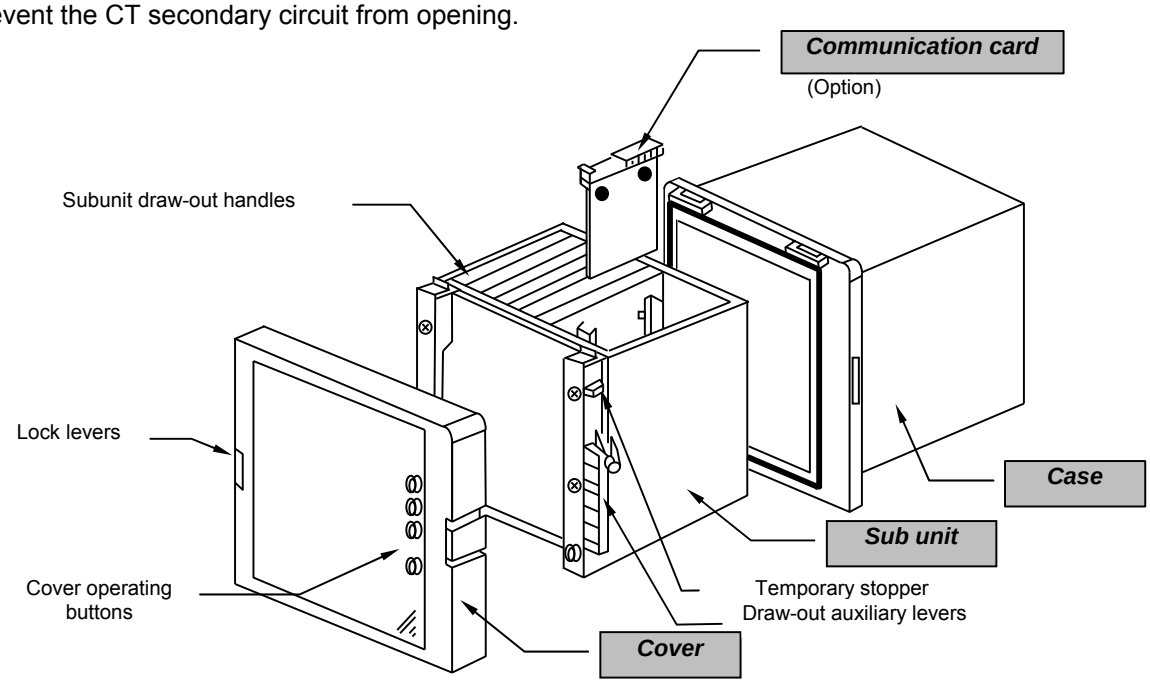
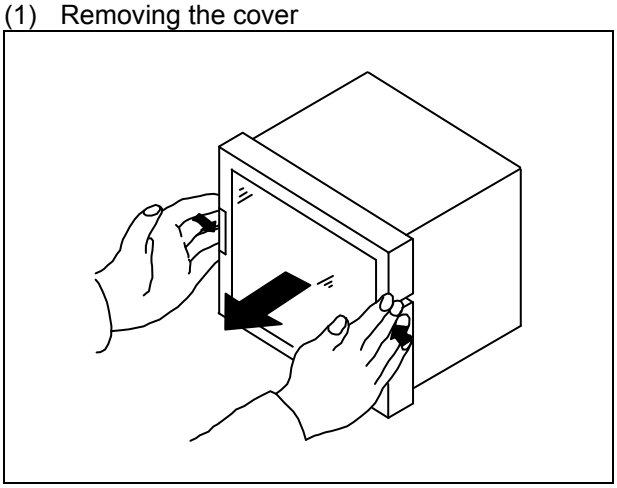


Figure 6-1 Outside view of type CGP2-A01D2 relay

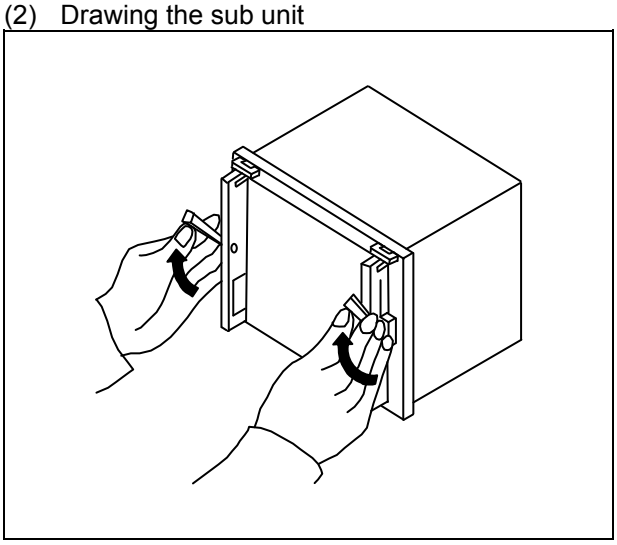
6.3.1 How to draw sub unit out

(1) Removing the cover



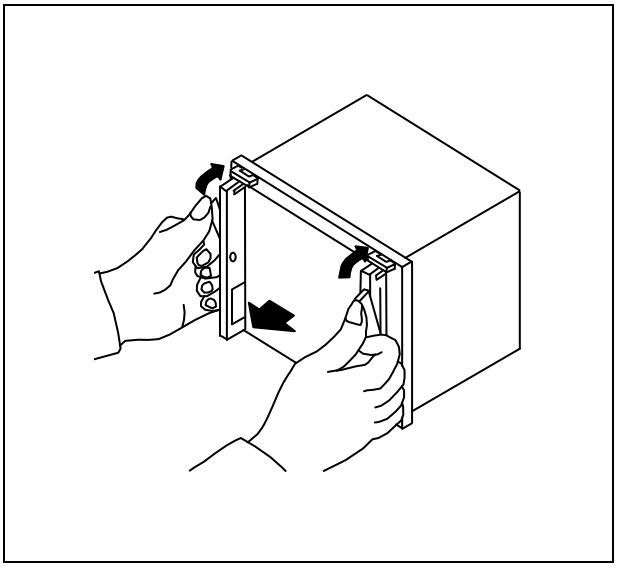
Hold the **lock levers**, which are located at both sides of the cover, on their front sections. Take off the cover **straight toward you** while pushing the levers **inwards**.

(2) Drawing the sub unit



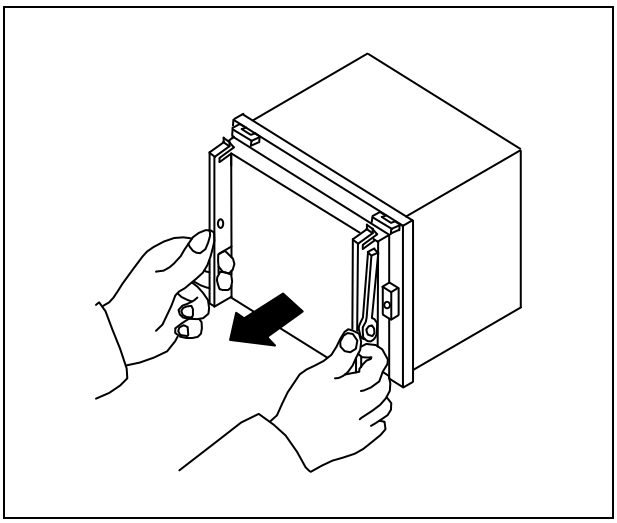
Please from under to upper direction turn round the draw-out auxiliary levers located on both sides of the front of the sub unit until the levers touch the metallic parts located on both sides of draw-out handles completely.
(Rotated angle is approx. 120°)

Note) Be careful not to put your fingers into the space between drawing-out auxiliary levers and the case.



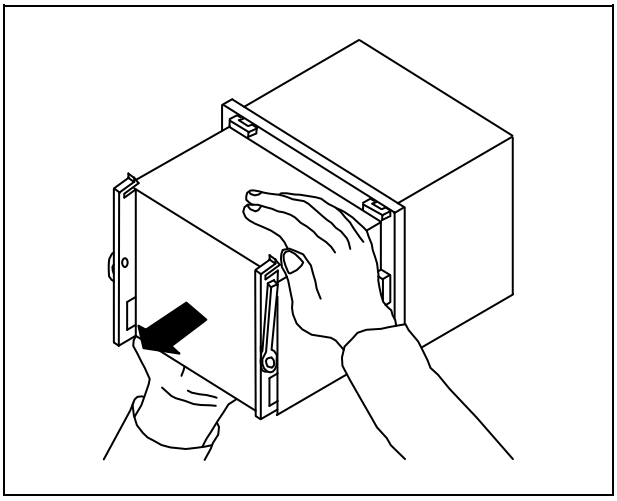
With the draw-out auxiliary levers touching the metallic parts, **exert your strength to turn round the levers** continuously, the sub unit will be drawn out a little from the case.
Then be careful not to let the draw-out auxiliary levers fall down and to **make the draw-out auxiliary levers into a locked status by the with-holders** located on the both sides upper the auxiliary levers please.
(**Rotated angle is from approx. 120°to 180°**)

Note) Be careful not to put your fingers into the space between drawing-out auxiliary levers and the case.



Grip the draw-out handles (located at both sides of the front of the sub unit), and **pull the sub unit towards you** until about a half portion of the sub unit is pulled out of the case**.**

Note) Be careful not to pull out the sub unit too much in order to prevent the sub unit falling.

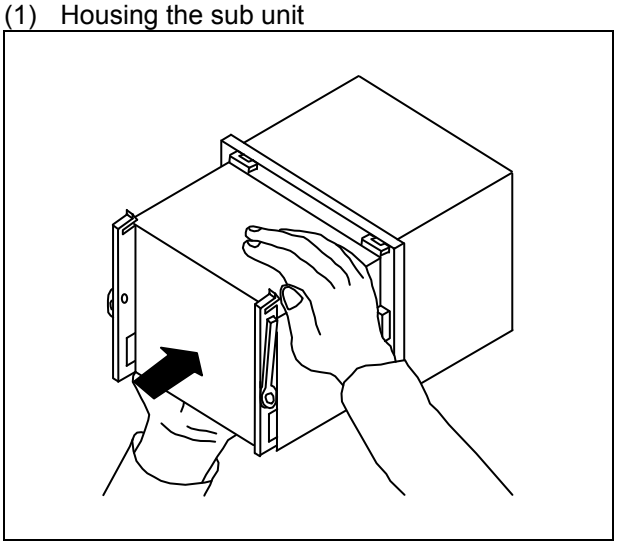


When about a half portion of the sub unit is pulled out of the case, just stop the drawing motion. Then, **hold the top and bottom of the sub unit to pull it out completely**, in order to prevent the unit from falling.

Note) Be careful not to touch the printed circuit board and parts inside the sub unit.

6.3.2 Housing the sub unit

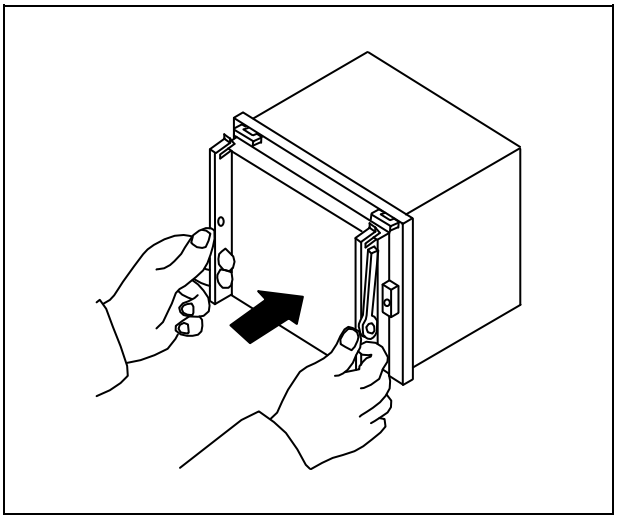
(1) Housing the sub unit



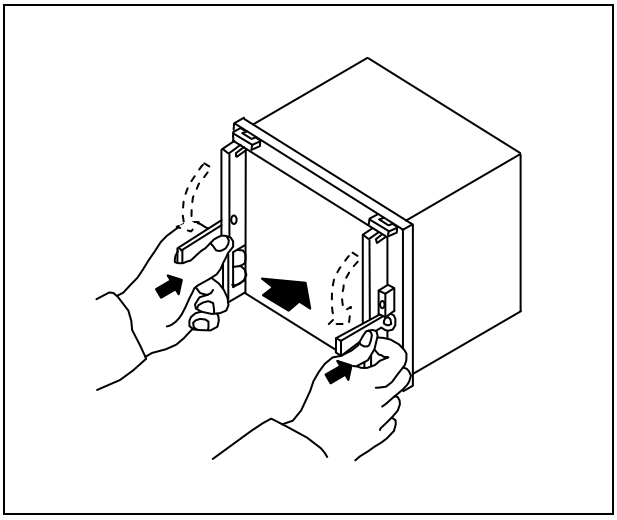
Hold the sub unit on the top and bottom to push the unit into the case approx. a half of the unit.

Note)

- Be careful not to touch the PCB and parts inside the sub unit.
- The sub unit is so constructed that it can not be housed in the case upside down.

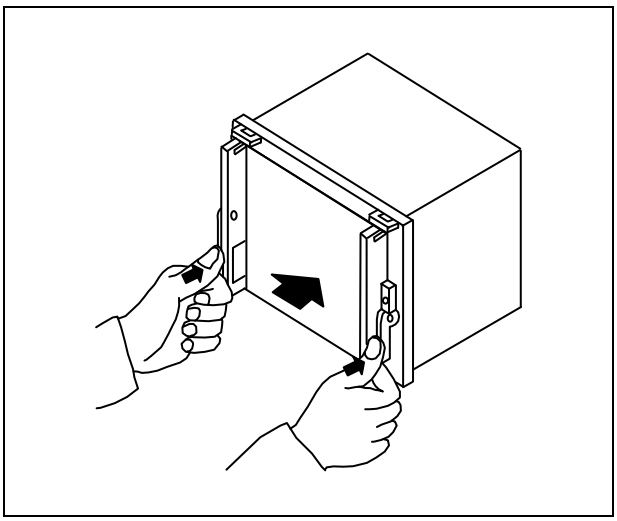


Under holding the auxiliary levers locked status by the with-holder (not to let the draw-out auxiliary levers fall down), **Insert the sub unit into the case until the auxiliary levers touch the metallic parts** while pressing the handles located on both sides of the front of the sub unit.



More fully insert the sub unit into the case until the auxiliary levers fall down automatically and catch the metal holes inside with its hooks.
(**Rotating angle is from 180°to approx. 45°**)

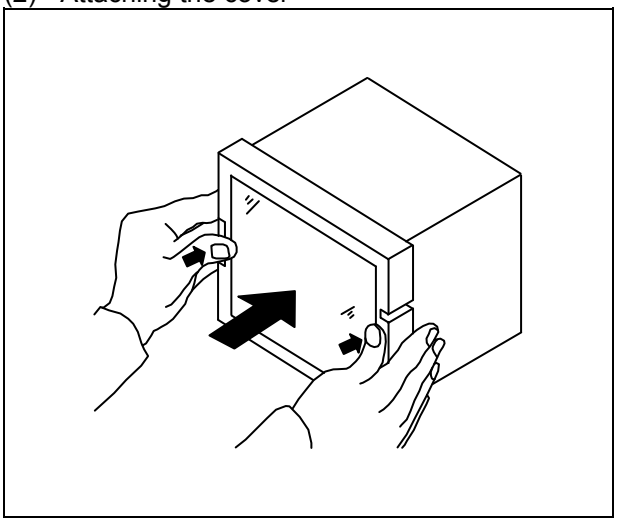
Note) If the auxiliary levers are not available to complement the wanted operation automatically, operate the auxiliary levers and make it achieve the above status please. At this time be also careful that do not injure your fingers.



Exert your strength to press the lower parts of the auxiliary levers to fully insert the sub unit into the case until you hear a click.
(**Rotated angle is from 45°to approx. 0°**)

Note) Please note that inserting the sub-unit incompletely may only establish a poor contact of the terminals located on the back of the unit, which may cause operational failure or heating.

(2) Attaching the cover



Fit the cover straight to the case. Hold the cover frame to **fully push the lock levers, located both side of the cover, to case side until it is clicked** and locked.

Note) After setting the cover, check if the buttons can be smoothly pressed from over the cover.

6.4 How to use front control panel

6.4.1 Front control panel layout

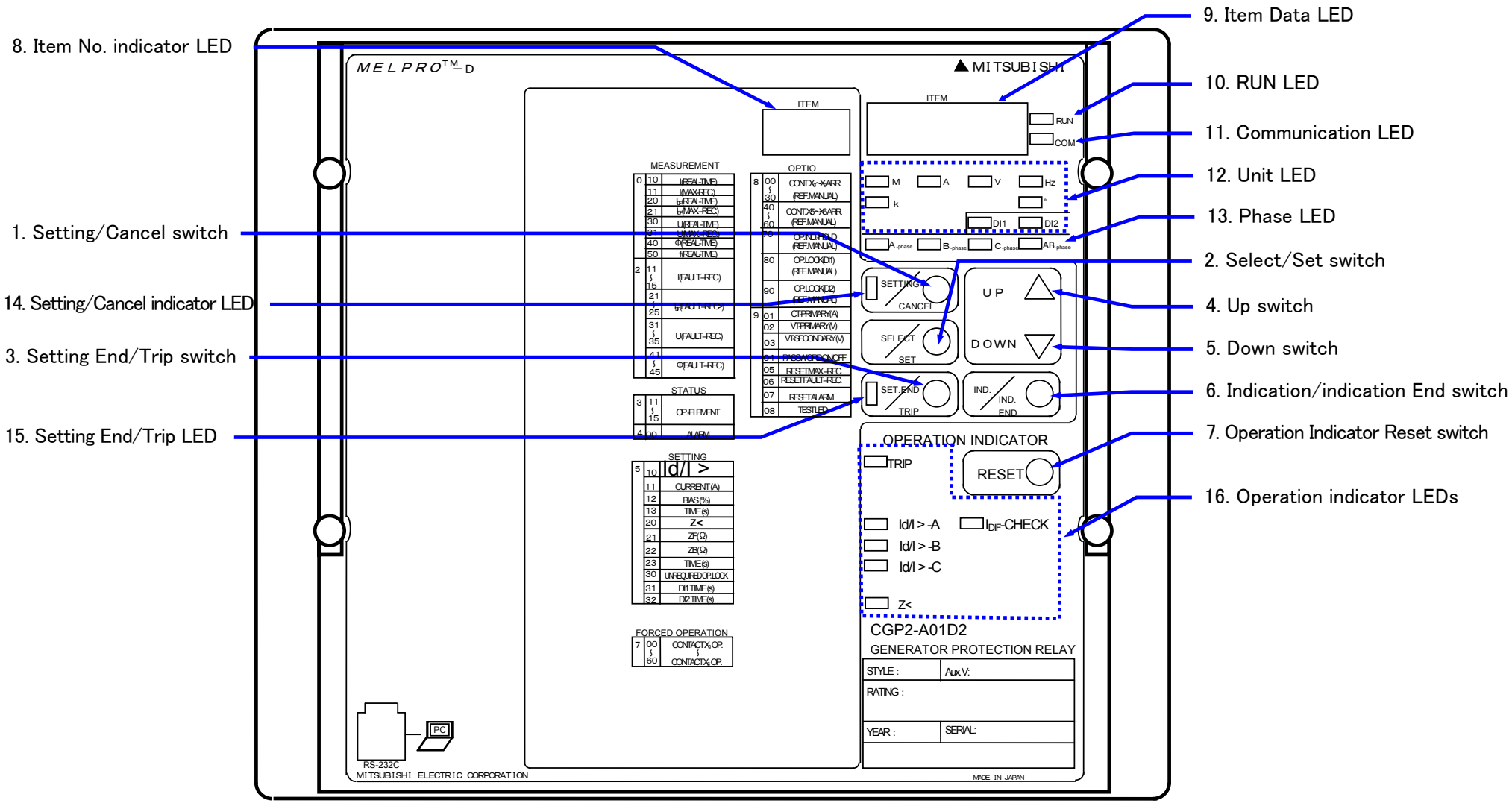
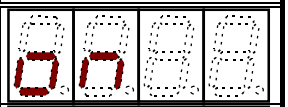
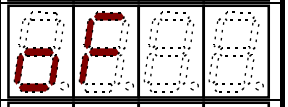
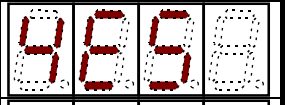
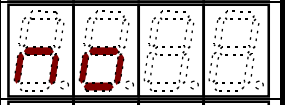
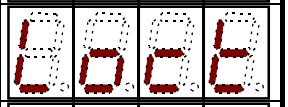
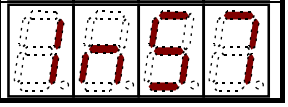


Figure 6.1 Front view of type CGP2-A01D2 relay

Table 6.1 Front control panel guide

No.	Designation		Symbol	Description
1	Operational key switches	Setting / Cancel	SETTING/CANCEL	Pressing this switch will start the procedure for setting, forced operation or option. When this switch is pressed again instead of the SET.END/TRIP switch, data that has been programmed will be all cleared to terminate the selected procedure. The SETTING/CANCEL indicator LED is lit during the procedure.
2		Select / Set	SELECT/SET	This switch is used to select an item number and to program item data during setting, forced operation or option procedure. When data is programmed to be ready for replacing the currently used setting, the SET.END/TRIP LED will blink.
3		Setting End / Trip	SET. END/TRIP	When the SET.END/TRIP switch is pressed with its LED blinking during setting, forced operation or option procedure, the currently enabled setting will be replaced by data given by programming. The new setting will be thus enabled.
4		UP select	UP	These switches are used for selecting data elements. Pressing these switches for a while will allow fast forwarding. With the cover operating buttons, you can use the switches without removing the cover.
5		DOWN select	DOWN	
6		Indication / Indication End	IND./IND.END	Pressing this switch will start or end the display of settings and measurements. With the cover operating button, you can use the switch without removing the cover.
7		Reset	RESET	Pressing this switch will reset output contacts after the relay operated and extinguish the operation indicator LEDs. With the cover operating button, you can use the switch without removing the cover.
8	Indicator LEDs	Item No. Green	–	A number allocated to the selected setting, forced operation or option item is indicated here.
9		Item Data Red	–	Data that corresponds to the item number selected is displayed here. For the indication of individual letters, see Table 6.2.
10		RUN Green	–	Indicate the result of the automatic self-check. The lamp will be lit for normal results while off for abnormal.
11		Communication Green	–	Indicate the operational status of the communication card. - With a communication card installed: the lamp will be lit for normal conditions, blinking during communication and off for abnormal conditions. - With a communication card not installed: the lamp will be off.
12		Unit Yellow	–	Indicate the unit used for the item data.
13		Phase Yellow	–	Indicate the phase that corresponds to the item data.
14		Setting / Cancel Yellow	–	This lamp will be lit during setting, forced operation or option procedure.
15		Setting End / Trip Yellow	–	This lamp will blink when new data is programmed to be ready for replacing the currently enabled setting.
16		Operation Red	–	Indicate the corresponding operation elements and phases of the relay.

Table 6.2 Letter representation of item data indicator LEDs

Item		Display in item data box
Designation	Letters	
On	ON	
Off	OFF	
Yes	YES	
No	NO	
Operation lock	LOCK	
Instantaneous	INST	

6.4.2 Operational procedure

For more information about the operational procedure shown below, see the MELPRO-D Series General Operation Manual (JEP0-IL9416).

Table 6.3 Operational procedure

Item					Corresponding section of general operation manual	
No.	Designation			Description	Indication mode	Setting / forced operation / option mode
010 ~ 050	Measurement	Real time		Measure and display effective current, voltage, phase, frequency at real time.	A-1	
011 ~ 031	Measurement	Max. record		Display the maximum of effective current and voltage.	A-2	
211 ~ 241	Measurement	Fault record	1st phenomena	Keep in record and display effective value currents for up to five latest phenomena of relay trip caused by system fault. The 1st phenomena is the latest trip and the 5th the oldest. Record and display effective current, voltage, and phase for up to 5 latest phenomena of relay trip caused by system fault. The 1st phenomena is the latest trip and the 5th the oldest one.	A-3	
212 ~ 242	Measurement	Fault record	2nd phenomena			
213 ~ 243	Measurement	Fault record	3rd phenomena			
214 ~ 244	Measurement	Fault record	4th phenomena			
215 ~ 245	Measurement	Fault record	5th phenomena			
311	Status	Operation elements	1st phenomena	Keep in record and display the status of the operation indicator LEDs for up to five latest phenomena of relay trip caused by system fault. The 1st phenomena is the latest trip and the 5th the oldest.	A-4	
312	Status	Operation elements	2nd phenomena			
313	Status	Operation elements	3rd phenomena			
314	Status	Operation elements	4th phenomena			
315	Status	Operation elements	5th phenomena			
400	Status	Self-diagnosis (ALARM)		Keep in record and display defect codes in the case where an abnormal condition is detected by the self-diagnosis.	A-6	

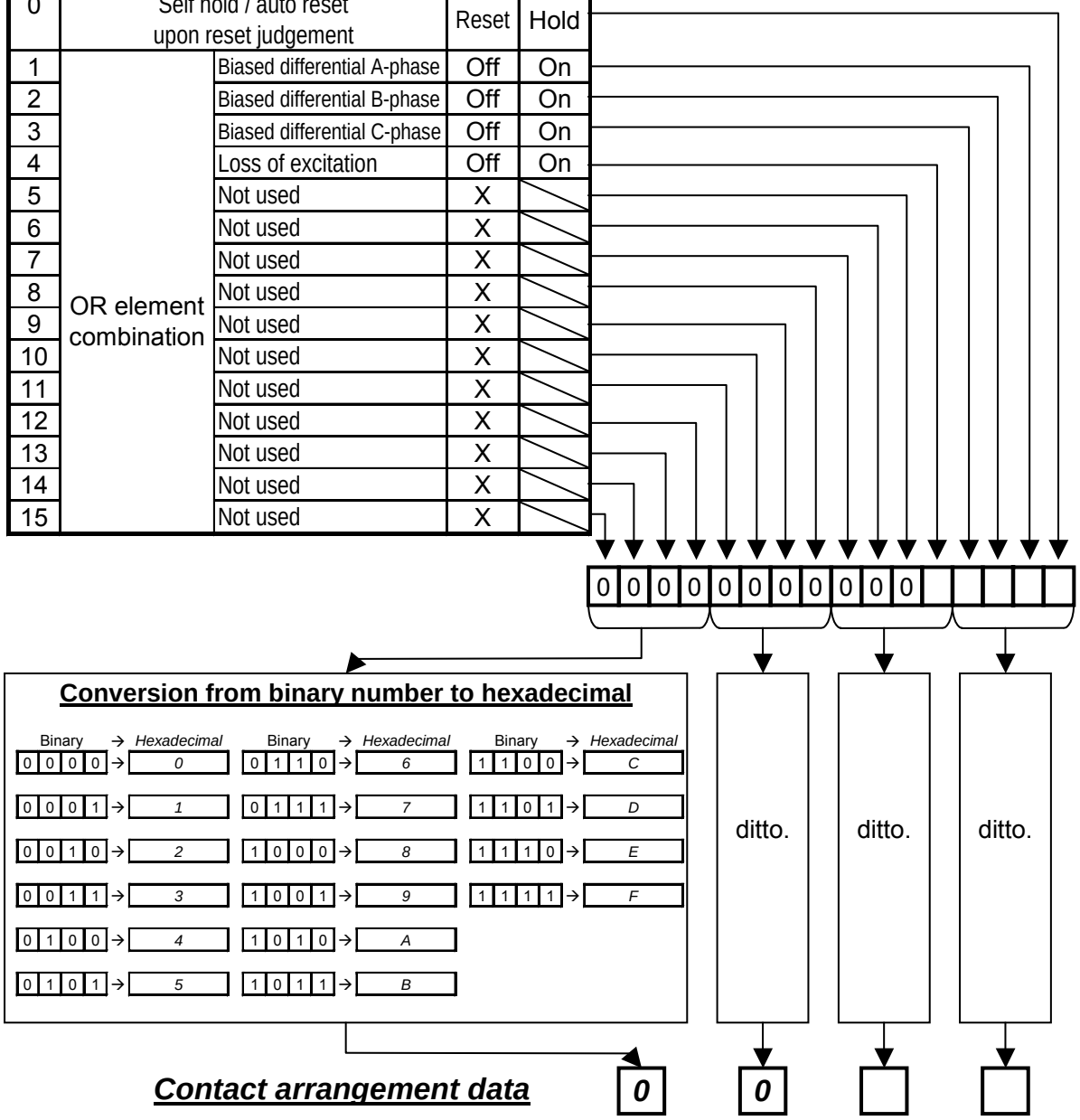
Item					Corresponding section of general operation manual	
No.	Designation			Description	Indication mode	Setting / forced operation / option mode
511	Setting	Biased differential	Operation current [A]	Set and display settings.	A-7	B-1
512			Bias [%]			
513			Operation time [s]			
521		Loss of excitation	Impedance Z_F [Ω]			
522			Impedance Z_B [Ω]			
523			Operation time [s]			
531		DI	DI1 Lock time [s]			
532			DI2 Lock time [s]			
700	Forced operation	Contact X_0 operation		Carry out forced operation of output contacts individually. The setting of the programmable outputs can be checked through the operation indicator LEDs.		C-1
710		Contact X_1 operation				
720		Contact X_2 operation				
730		Contact X_3 operation				
740		Contact X_4 operation				
750		Contact X_5 operation				
760		Contact X_6 operation				
800	Option	Contact arrangement	Contact X_0	Configure the programmable outputs. Also, set and display self-hold/reset setting of the programmable outputs. For the guide for setting, see the section 6.4.3 (1) below.	A-7	D-1
810			Contact X_1			
820			Contact X_2			
830			Contact X_3			
850			Contact X_5			
860			Contact X_6			
870		Operation indicator LED hold		Set and display self-hold/auto reset setting of the operation indicator LEDs. For the guide for setting, see the section 6.4.3 (2) below.		D-2
880		DI operation lock	DI 1	Set and display the lock information of elements. For setting, refer to following item 6.4.3 (3).		
890			DI 2			
901		CT primary side [A]		Set the CT primary current of the phase current circuit connected to the relay.		D-3
902		VT primary side [V]		Set the VT primary voltage of the voltage circuit connected to the relay.		
903		VT secondary side [V]		Set the VT secondary voltage of the voltage circuit connected to the relay.		
904		Relay password ON/OFF		Set relay password enable or disable for setting.		D-9
905		Max. record reset		Clear data of the max. record.		D-4
906		Fault record reset		Clear data of the fault record.		
907		Self-diagnosis (ALARM) reset		Clear data of the self-diagnosis record.		
908		LED lamp test		Carry out forced illumination of all the LED lamps on the front of the relay unit.		D-5

6.4.3 Guide for option function

(1) Specifying contact arrangement data of output contacts

The table below shows the setting guide table. See the section D-1 of the general operation manual for the detailed procedure.

Digit No.	Setting item		Input 0	Input 1
0	Self hold / auto reset upon reset judgement		Reset	Hold
1	OR element combination	Biased differential A-phase	Off	On
2		Biased differential B-phase	Off	On
3		Biased differential C-phase	Off	On
4		Loss of excitation	Off	On
5		Not used	X	
6		Not used	X	
7		Not used	X	
8		Not used	X	
9		Not used	X	
10		Not used	X	
11		Not used	X	
12		Not used	X	
13		Not used	X	
14		Not used	X	
15		Not used	X	



When the product is shipped from the factory, contact arrangement data are set as follows.

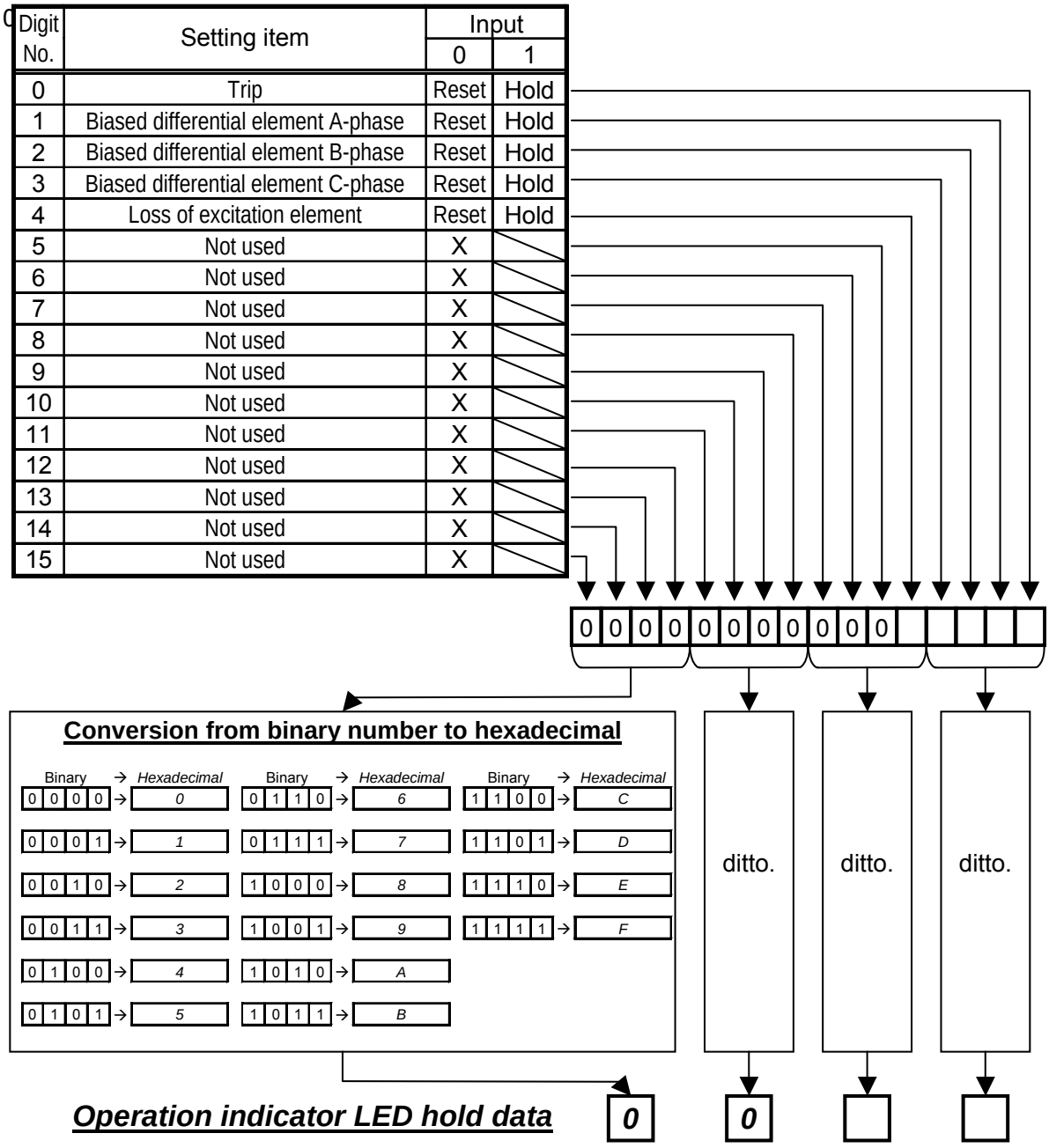
Contact	Item number	Contact arrangement data	Setting of the element
X0	800	0002	Biased differential element A-phase
X1	810	0004	Biased differential element B-phase
X2	820	0008	Biased differential element C-phase
X3	830	0010	Loss of excitation element
X5	850	001E	OR of all elements
X6	860	001E	

*The “Self hold/auto reset” setting are “Reset” (auto reset) for all contacts.

(2) Specifying operation indicator LED hold data

The table below shows the setting guide table. See the section D-2 in the general operation manual for the detailed procedure.

Digit No.	Setting item	Input 0	Input 1
0	Trip	Reset	Hold
1	Biased differential element A-phase	Reset	Hold
2	Biased differential element B-phase	Reset	Hold
3	Biased differential element C-phase	Reset	Hold
4	Loss of excitation element	Reset	Hold
5	Not used	X	
6	Not used	X	
7	Not used	X	
8	Not used	X	
9	Not used	X	
10	Not used	X	
11	Not used	X	
12	Not used	X	
13	Not used	X	
14	Not used	X	
15	Not used	X	



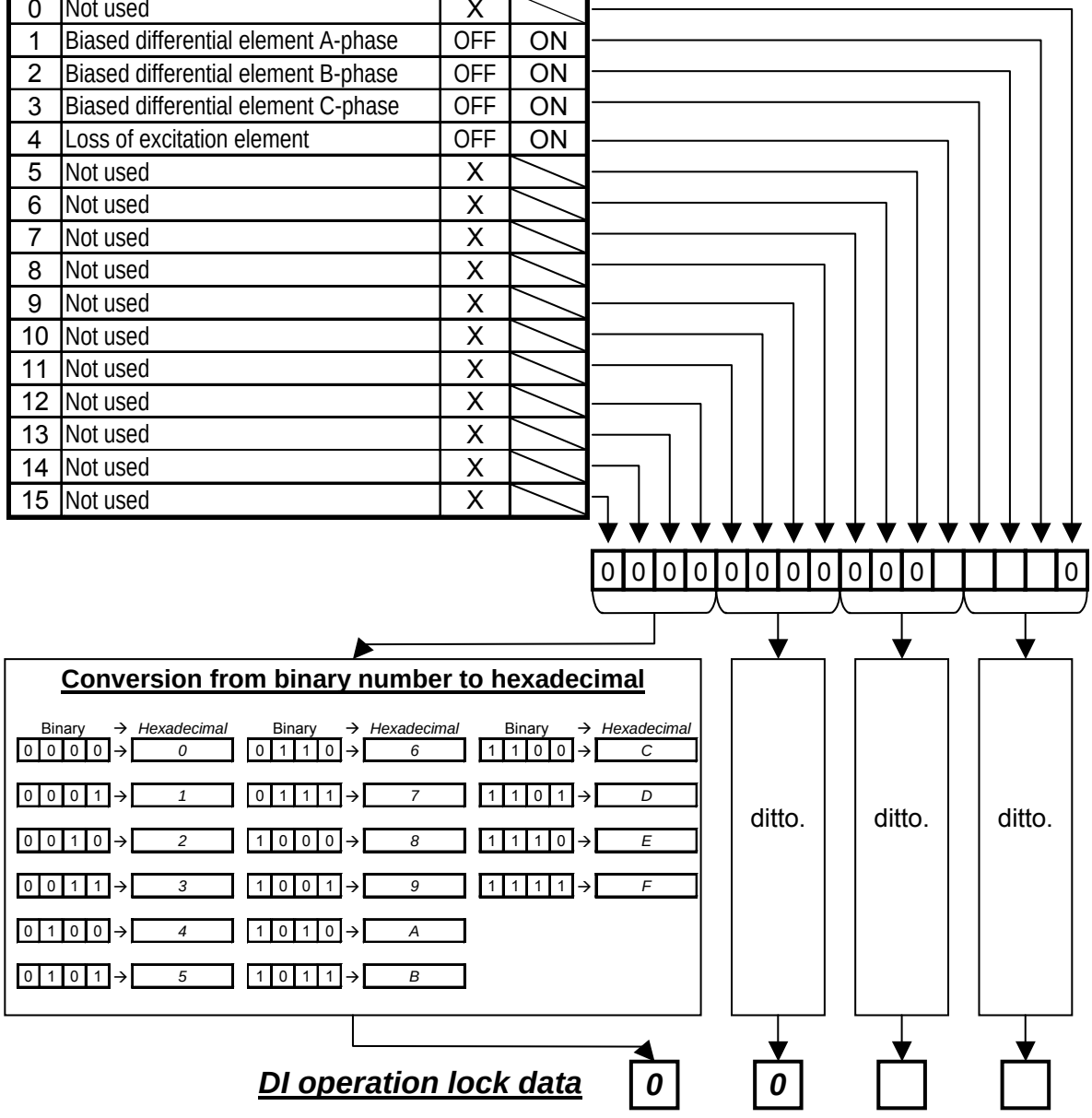
When the product is shipped from the factory, all LEDs are set to self-hold.

Item number	Operation indicator LED hold data
870	001F

(3) Specifying data of Lock function by external control input

The table below shows the setting guide table.

Digit No.	Setting item	Input 0	Input 1
0	Not used	X	
1	Biased differential element A-phase	OFF	ON
2	Biased differential element B-phase	OFF	ON
3	Biased differential element C-phase	OFF	ON
4	Loss of excitation element	OFF	ON
5	Not used	X	
6	Not used	X	
7	Not used	X	
8	Not used	X	
9	Not used	X	
10	Not used	X	
11	Not used	X	
12	Not used	X	
13	Not used	X	
14	Not used	X	
15	Not used	X	



When the product is shipped from the factory, DI1 is set to lock of bias differential element lock, and DI2 is set to lock of loss of excitation like the following table.

D I	Item number	DI operation lock data	Setting of the element
DI 1	880	000E	Biased differential element
DI 2	890	0010	Loss of excitation element

Note) At the case of that more than one element output drive one output contact in OR logic, the output contact may operate if any element output driving this contact is not locked by DI. Pay attention please.

7 Mounting

7.1 Mounting dimension

Mount the case to the panel according to Fig. 7.1 “Mounting dimension”.

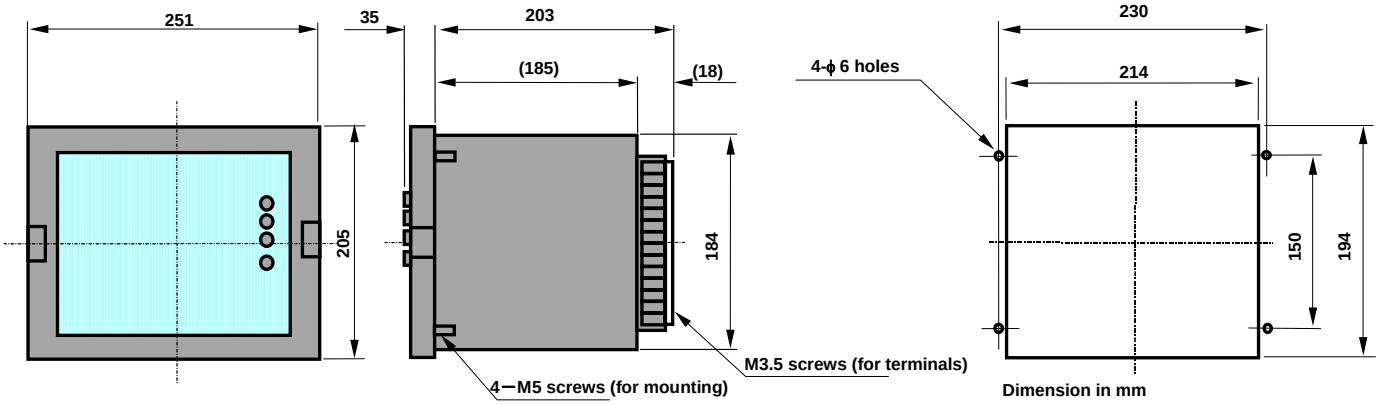


Figure 7-1 Outside dimension /drilling drawing

7.2 Standard operating environment

Install the relay in the environment described in section 3.3 Common technical data. In addition, the following conditions should be kept:

- Abnormal vibration, shock, inclination or magnetic field should be avoided.
- Harmful smoke or gas, salt gas, excessive humidity, water drop or vapor, excessive dust or fine powder, rain and wind should be avoided.

8 Test

The relay has been fully tested prior to shipment. However, it is recommended to carry out a test again by referring to the following test guide before use.

8.1 Appearance inspection

Check the relay for appearance according to the following procedure:

Objects		Check points
Unit	Coil/conductor	(1) Discoloring and burning due to overheat. (2) Abnormal conditions including loosened screws.
	Printed card	(1) Discoloring of the printed card due to overheated parts. (2) Contact between the printed card and connector
	Mechanism	(1) Deformation (2) Operation of the operating key switches. (3) Damage of the draw-out lever of the sub unit. (4) Discoloring and deformation of the name plate on the front panel. (5) Damage of the terminal section.
Case/cover		(1) Damage of the cover. (2) Stain of the cover. (3) Clouding of the cover. (4) Damage of the lock lever of the cover. (5) Damage of the operating buttons of the cover. (6) Operation of the operating buttons of the cover. (7) Damage of the terminal section.
Others		Invasion of foreign matters including dust and iron chips.

8.2 Characteristic test

8.2.1 Precautions in testing

(1) Standard test conditions

Ensure the following test conditions whenever possible:

Note that carrying out a test under an environment that significantly differs from the following conditions may produce an incorrect result.

- Ambient temperature : 20°C±10°C
- Rated frequency : ± 5%
- Waveform (AC) : 2% (distortion ratio)
- Auxiliary power supply voltage : rated voltage ± 2%

(2) Characteristic control point

See the section 3 “Characteristics”.

The characteristic control point refers to the characteristic of a relay unit only. Note that, when a characteristic test is carried out on a relay system connected with external equipment such as CT and VT, the result obtained would be a combined characteristic added with the fluctuation of the external equipment.

For special control in terms of a specific control point (for instance, using the operation setting), first carry out a test at “Characteristic control point” at the time when the relay is received or put in service to determine the acceptance/rejection. Thereafter, perform another test at each control point, so that the data obtained can be used for future reference.

(3) Changing setting

Change the setting according to the section 6 “Handling”.

(4) Operation judgment

Determine the operation currents and time and other values of the relay unit basically by turning on and off the corresponding output relay contact of each element.

(5) Communication card

Whatever the communication card is inside or not, for the test of withstand voltage and lightning impulse withstand voltage, please avoid inputting test voltage to the serial communication network circuit (DA, DB, DG, SLD contacts).

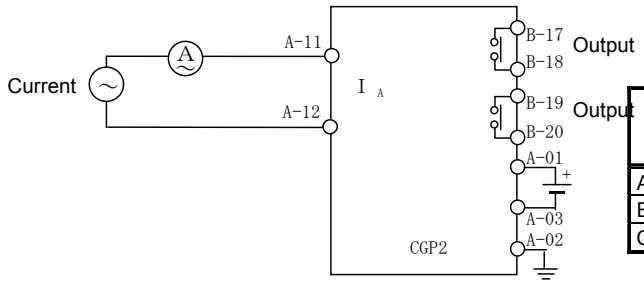
Note: it is not necessary to take the communication card out when test if the communication card was inside unit.

8.2.2 Characteristic test

8.2.2.1 Test circuit

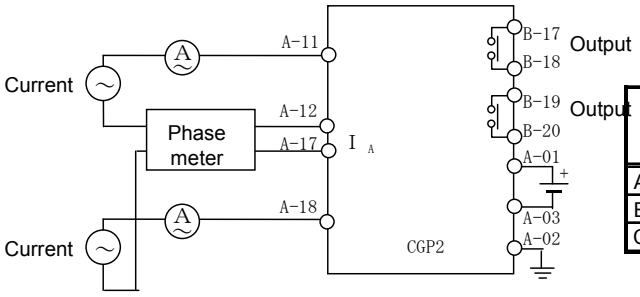
Connect the external wiring referring to the AC input circuit diagram shown below:

(1) Biased differential element (operation current test)



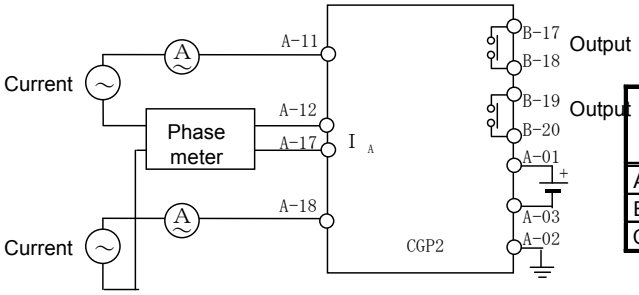
Test phase	Terminal No. (Neutral side of generator)	Terminal No. (Output side of generator)
A-phase	A-11～A-12	A-17～A-18
B-phase	A-13～A-14	A-19～A-20
C-phase	A-15～A-16	A-21～A-22

(2) Biased differential element (bias ratio characteristics test)



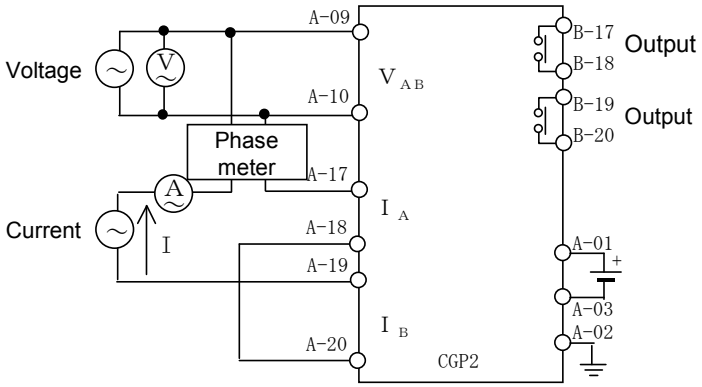
Test phase	Terminal No. (Neutral side of generator)	Terminal No. (Output side of generator)
A-phase	A-11～A-12	A-17～A-18
B-phase	A-13～A-14	A-19～A-20
C-phase	A-15～A-16	A-21～A-22

(3) Biased differential element (phase characteristics test)



Test phase	Terminal No. (Neutral side of generator)	Terminal No. (Output side of generator)
A-phase	A-11～A-12	A-17～A-18
B-phase	A-13～A-14	A-19～A-20
C-phase	A-15～A-16	A-21～A-22

(4) Loss of excitation element



The current value measured by this test circuit is expressed as I.

$$Z = \frac{V_{AB}}{2 \times I}$$

Z(Ω) is calculated from the above equation.

(Note) $2 \times I = (I_A - I_B)$

I: Input current.

(Supplement)

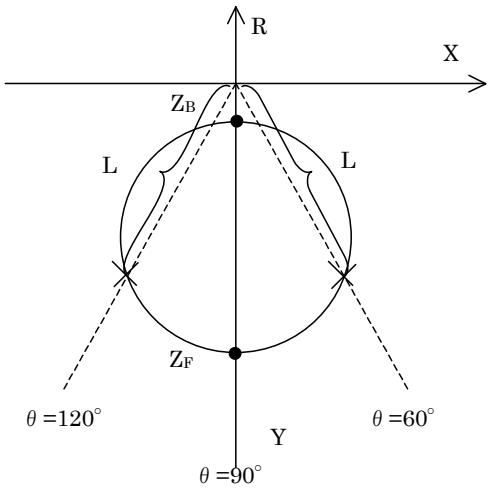
The characteristic control points for phase characteristics.

Z_F: Operation measurement value (Ω) at θ =90°

Z_B: Operation measurement value (Ω) at θ =90°

L: Operation theoretical value at θ =90° +30° , θ =90° -30°

(Ω:Point marked with an (×) in the right figure)



(Note) Max. sensitivity angle θ =90°

The operation area in the right figure is expressed as follows:

$$X^2 + \left(y - \frac{Z_F + Z_B}{2}\right)^2 = \left(\frac{Z_F - Z_B}{2}\right)^2 \quad \cdots\cdots(1)$$

By substituting X=Lsin30° and Y=Lcos30° for (1), the following quadratic equation is obtained.

$$L^2 - L0.866(Z_F + Z_B) + Z_F Z_B = 0 \quad \cdots\cdots(2)$$

By seeking the radical of equation, the theoretical operation values(L) at θ =60° and θ =120° are obtained as follows:

$$L = 0.433(Z_F + Z_B) + \sqrt{(0.187(Z_F + Z_B)^2 - Z_F Z_B)} \quad \cdots\cdots(3)$$

The value of the theoretical operation value ±5% at the characteristic control point is included in the range of impedance value of characteristics point ±5° ; therefore the guaranteed performance should be the theoretical operation value ±5% at characteristic control point.

Therefore, the guaranteed performance is as follows:

Z_F = 5、Z_B = 0.4 3.99＜L＜4.41 （Ω）

8.2.2.2 Test items and characteristic control point

(1) Forced operation test

See “Front control panel operational procedure” in the section 6 “Handling”.

(2) Operation value test

See “Operation and reset values” in the section 3 “Characteristic”.

(3) Operation time test

See “Operation time” in the section 3 “Characteristic”.

(4) Reset time test

See “Reset time” in the section 3 “Characteristic”.

(5) Phase characteristic test

See “Phase characteristic” in the section 3 “Characteristic”.

9 Maintenance

9.1 Daily inspection

Take every opportunity to carry out the following inspection:

- Check that the cover is not damaged and is attached properly.
- Check that no dust or iron chips have invaded into the unit.
- Check that the cover is not clouded notably.
- Check that abnormal noise is not generated.
- Check that the RUN LED lamp is lit.

9.2 Periodical inspection

It is recommended to carry out periodic inspections to check the relay for proper function.

For periodical inspections, perform the appearance inspection and characteristic test in accordance with the section 8 “Test”.

10 Ordering

The product and specification shown in this manual may subject to changes (including specification change and production suspend) without notice. It is advisory to inquire the nearest Mitsubishi Electric's branch or sales office, if required, to confirm that the latest information is given in the manual, prior to placing an order.

Notify the following items when placing an order.

Item	Example of order	Remarks
Model	CGP2-A01D2	For more information, see the section 2 "Rating and specification".
Frequency	50 Hz	Select 50Hz or 60Hz.
Rating	Phase current: 5A, Voltage: 110V	For more information, see the section 2 "Rating and specification".
Setting range		For more information, see the section 2 "Rating and specification".
Communication card	One of the followings can be selected: a. CC-Link communication card (Manual No.: JEP0-IL9417, JEP0-IL9418) b. No communication card	Only purchasing a communication card separately will allow customer to add the communication facilities. If customer does not need the communication facilitates at the time of introducing the system, just purchase the relay unit without communication card. Customer can add the communication facilities whenever he/she needs to introduce them. This will help decrease the initial cost and upgrade the system in stages.

11 Guarantee

11.1 Guarantee period

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

11.2 Scope of guarantee

When any fault or defect is detected during the period of guarantee and such fault or defect is proved to be caused apparently at the responsibility of MITSUBISHI ELECTRIC CORPORATION, the defective unit concerned will be repaired or replaced with substitute with free of charge.

However, the fee for our engineer dispatching to site has to be covered by the user.

Also, site retesting or trial operation caused along with replacing the defect units should be out of scope of our responsibilities.

It is to be acknowledged that the following faults and defects should be out of this guarantee.

①When the faults or defects are resulted from the use of the equipment at the range exceeding the condition/environment requirements stated in the catalogue and manual.

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

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

④When the faults or defects are resulted from a phenomenon which can not be predicted with the

science and technology put into practical use at the time of purchase or contract

⑤In case of integrating our products into your equipment, when damages can be hedged by the proper function or structure in the possession of your equipment which should be completed according to the concept of the de fact standard of industry.

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

⑦In case that the faults or defects are resulted from force majeure such a fire or abnormal voltage and as an act of God such as natural calamity or disaster.

11.3 Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, MITSUBISHI ELECTRIC CORPORATION shall not be liable for compensation of damages caused by any cause found not be the responsibility of MITSUBISHI ELECTRIC CORPORATION, loss in opportunity, lost profits incurred to the user by failures of MITSUBISHI ELECTRIC CORPORATION products, special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than MITSUBISHI ELECTRIC CORPORATION products and other tasks

11.4 Applications of products

①The user is requested to confirm the standards, the regulations and the restrictions which should be applied, in case of utilizing products described in this catalogue and another one in combination.

Also, the user is requested to confirm the suitability of our products to your applied system or equipment or apparatus by yourself.

MITSUBISHI ELECTRIC CORPORATION shall not be liable for any suitability of our products to your utilization.

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

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

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

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

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

⑤The user is requested to understand and to respect completely all warning and caution items so that unexpected damages of the user or the third party arising out of un-correct application of our products would not be resulted.

11.5 Onerous repair term after discontinuation of product

①MITSUBISHI ELECTRIC CORPORATION shall accept onerous product repairs for 7(seven) years after production of the product is discontinued. (However, please consider the replacement of products after 15 years have been passed from ex-work of products.)

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

11.6 Changes in product specification

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

11.7 Scope of service

The technical service fee such as engineer dispatching fee is excluded in the price of our products. Please contact to our agents if you have such a requirement.

12 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 them 15 years.

However, there may be some possibilities to occur some defects before reaching 15 years due to above mentioned the degree of degradation of parts and materials being depended on the condition in use.

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

MITSUBISHI ELECTRIC CORPORATION

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