

Product characteristics

Protective functions

Product functions

Type	Function	MMP-C (Current type)	MMP-S (Select ground fault)	MMP-P (Power type)	MMP-IR (Insulation Resistance)
Currents	Overcurrent	●	●	●	●
	Locked Rotor	●	●	●	●
	Stall	●	●	●	●
	Phase loss	●	●	●	●
	Imbalance	●	●	●	●
	Phase reversal overcurrent	●	●	●	●
	Undercurrent	●	●	●	●
	Zero-phase ground current	●	●	●	●
	Residual ground current	●	●	●	●
	Instanteous	●	●	●	●
Voltages	Select ground fault	-	●	-	-
	Overvoltage	-	-	●	-
	Undervoltage	-	-	●	-
	Phase loss	-	-	●	-
	Imbalance	-	-	●	-
	Phase reversal overvoltage ground current overvoltage	-	●	-	-
Power	Overpower	-	-	●(Alarm)	-
	Underpower	-	-	●(Alarm)	-
	Over power factor	-	-	●	-
	Under power factor	-	-	●	-
Additional function	Insulation resistance	-	-	-	●
	Motor temperature	-	-	-	●

Measurement function

Measurement	Range	Accuracy(%)	Remarks
Voltage(V)	0.00V~9999V	±1.0%	Phase1 : Phase voltage, Phase3 : Line voltage
Current(A)	0.00A~9999A	±1.0%	Phase current
Zero-phase current(In)	0.00A~9999A	±3.0%	-
Reverse current(I ₂)	0.00A~9999A	±3.0%	-
Active power(W)	0.000W~999.9MW	±1.0%	Forward
Reactive power(VAR)	0.000W~999.9MVAR	±1.0%	Forward
Active power amount(WH)	0.000W~999.9MWH	±1.0%	-
Reactive power amount(WVARH)	0.000W~999.9MVARH	±1.0%	-
PF	-1.00~1.00	±0.03	cosθ
Voltage hamonics(%)	0~100%	±5.0%	2 nd ~16 th odd harmonics
Current hamonics(%)	0~100%	±5.0%	2 nd ~16 th odd harmonics
Insulation Resistance	0.2MΩ~50MΩ	±10%	-
Motor temperature	-50°C~200°C	±10%	-

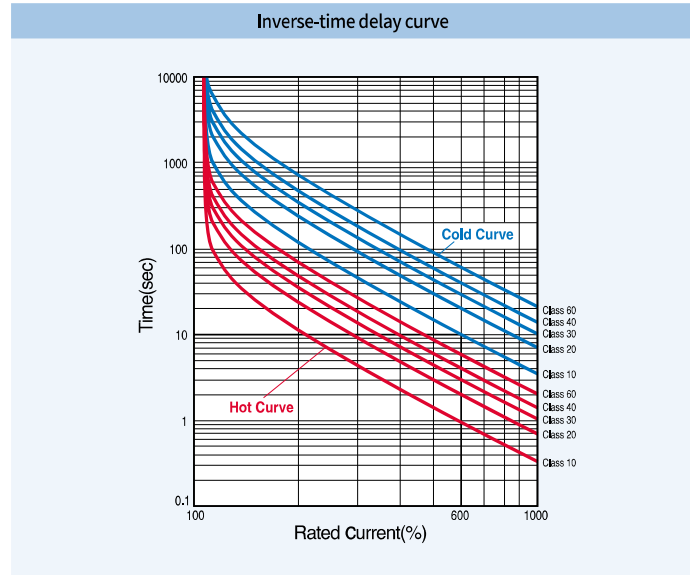
Current protection

Over current

The device provides overcurrent protection either with inverse-time or with definite-time element.

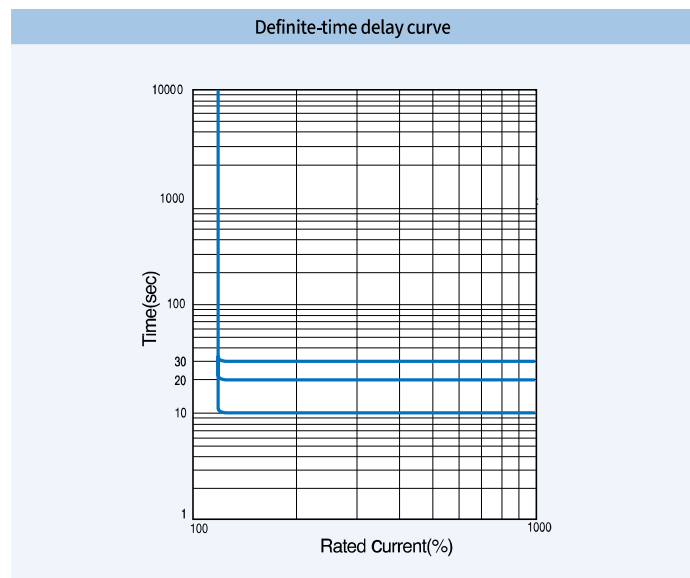
1) Inverse-time delay curve

The trip time decreases as the overcurrent increases in an inverse-time curve.



2) Definite-time delay curve

The operating time is unaffected by the magnitude of the overcurrent.



Stall/Locked rotor

Stall activates when the motor is unable to rotate due to any externally mechanical obstruction, and Lock activates due to internal issue of the motor.

Phase fail/Phase unbalance

The motor is unable to start under phase loss. If it occurs while the motor is running it causes motor stopping by lack of torque, or significant rotor heating by reverse current. The S-EMPR calculates the percent three-phase unbalance current. If it exceeds 70%, which is determined to be phase loss, the device trips within 1.5 sec. If it is between 10 to 70% the device trips within 3 sec. This function is disabled for a single-phase mode.

Product characteristics

Reverse phase

This protection is for preventing the motor from reverse rotation. The device detects motor phase rotation and trips within 0.1 sec. if phase sequence is incorrect. It detects when the motor is starting.

* This function is disabled for a single-phase mode.

Under current

If the real load current falls below the warning or trip level for longer than the time-delay setting, the device can issue a warning or trip signal.

Ground fault protection

Ground fault

Stall activates when the motor is unable to rotate due to any externally mechanical obstruction, and Lock activates due to internal issue of the motor.

Zero-phase ground current

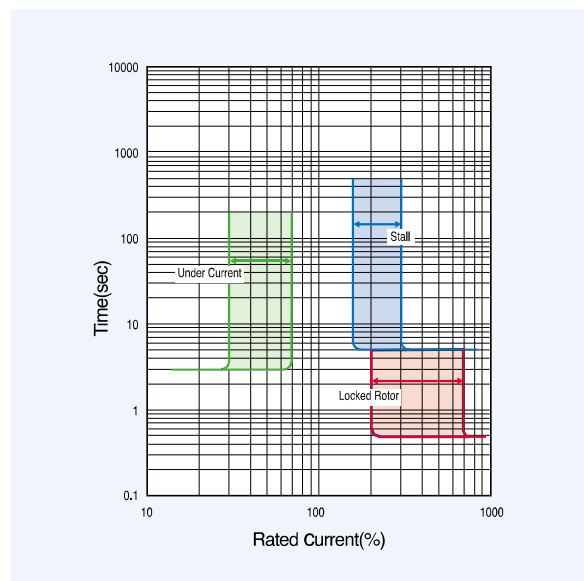
ZCT in or out of the product is used to detect zero current flowing in three phases.

Selective ground fault

If a non-grounding system has ground fault, the current over the zero current transformer of each distribution line flows from the load side to the power side in a good line, and from the power side to the load side in a bad line. This protection function is able to select and block a bad line by determining the direction of failure current on the basis of the zero voltage.

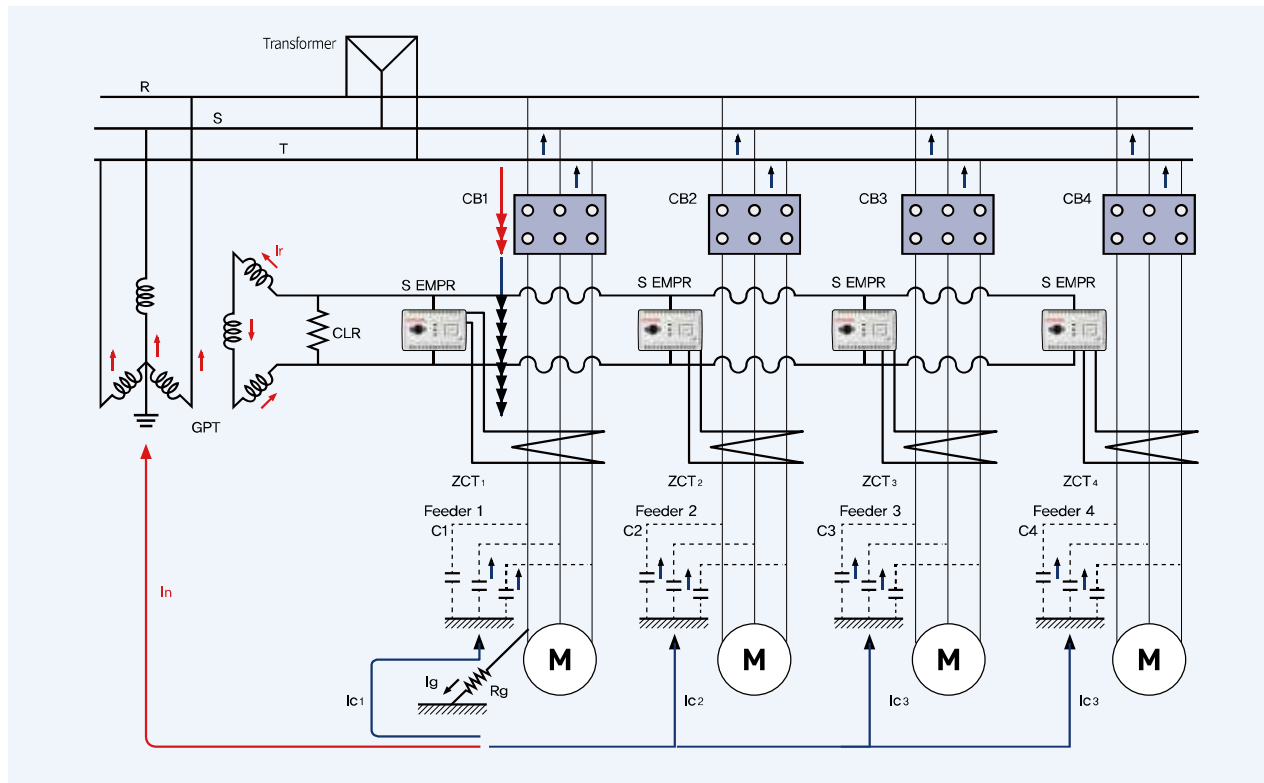
Instance

While an AC motor is running, if an actual load current value is higher than an set value of instantaneous current, Trip occurs in 50msec.



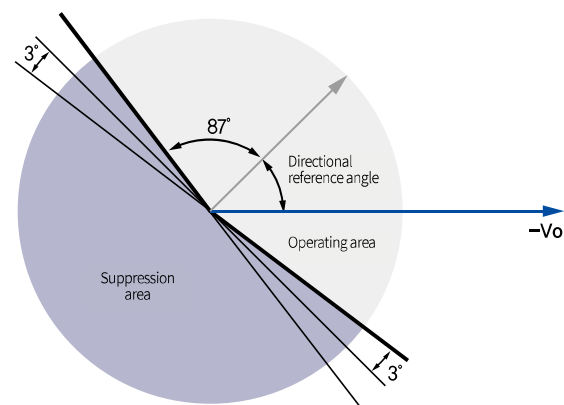
Selective ground fault protection

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- ① - GPT : Grounding Potential Transformer
- ② - ZCT1, ZCT2, ZCT3, ZCT4 : Zero current transformer
- ③ - CLR : Current-limiting resistor
- ④ - CB : Circuit breaker
- ⑤ - I_n : Current over GPT
- ⑥ - S-EMPR MMP S : Smart digital motor protection relay
- ⑦ - I_r : Current-limiting resistor current
- ⑧ - R_g : Ground fault resistance at ground fault point
- ⑨ - I_n : Current over GPT
- ⑩ - C_1, C_2, C_3, C_4 : Line capacitance of each feeder
- ⑪ - I_g : Ground fault current
- ⑫ - I_c : Line charging current ($I_{c1}+I_{c2}+I_{c3}+I_{c4}$)

Operating characteristic



As shown the figure, the bad line (Feeder1) and the good line has an opposite current direction. With the use of this current direction, it is possible to select one. If another line has a failure, the charging current of the line flows in an opposite direction from the current flowing at the time of the accident. Therefore, it does not run.

In a non-grounding system, the ground fault current is the sum of the line charging current and the limiting-resistance current. Since it is relatively small, zero CT (ZCT) is needed. This product has ZCT built in so that it is possible to make a system simply.

Product characteristics

Voltage & Power protection

Over current

Overvoltage protection detects the voltage levels and operates if they are greater than the setting to protect the sensitive loads or circuits against such condition.

Under voltage

If the voltage levels fall below the setting the Undervoltage protection issues a warning or trip signal to protect the sensitive loads such as a inductive motor.

Phase fail/Phase unbalance

This protection operates if the percent phase-to-phase voltage unbalance is greater than the setting. Used to prevent an excessive vibration of three-phase induction motor and a damage of the stator and rotor windings. This function is disabled under a single-phase mode.

Reverse phase

This protection operates if the percent phase reversal voltage is greater than the setting. It detects when the motor is starting. This function is disabled for a single-phase mode.

Over power

The overpower element operates if the three-phase active power exceeds the setting level. This element can be used to prevent the power from entering the generator before disconnecting from the system when the generator operation is finished.

Under power

The underpower element operates if the three-phase active power falls below the setting level.

Over power factor

The over power factor element operates if the power factor exceeds the setting level. If the load is very small, especially for no-load the capacitive current may flow due to overcapacity of the capacitor in line, which causes the power loss of the line and transformer, and electric stress on motors. This element can be used to protect against such current.

Under power factor

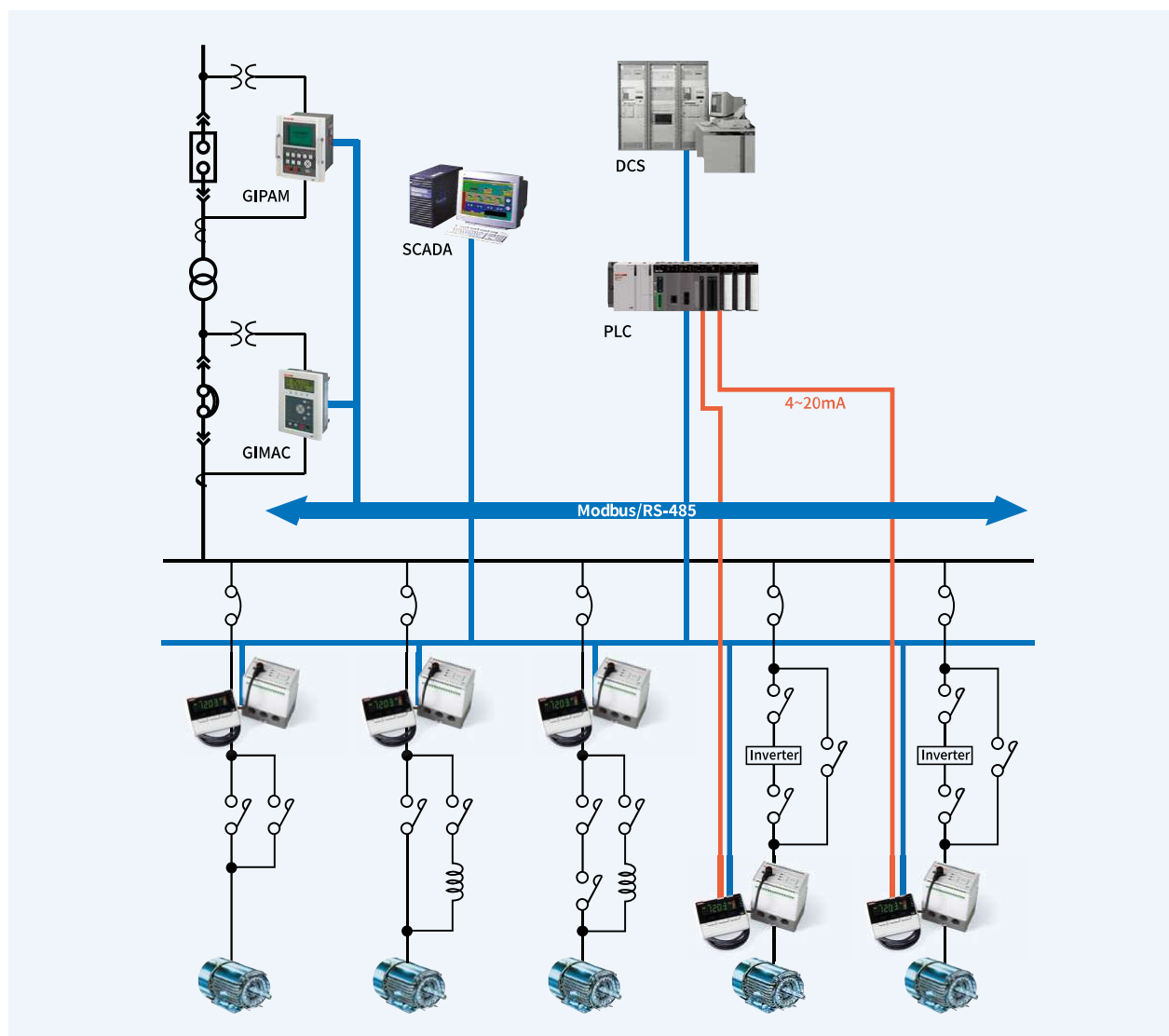
The under power factor element operates if the power factor falls below the setting level. If the power factor of a customer falls below that of a generator in a power plant the generator current increases over the rated current or the power output is limited. For this reason, the power factor of a customer is regulated. In addition, the under power factor causes the increase of the input current which prevents the temperature rise in cables, transformers and motors.

Communications

Modbus specification

Communication number	1~247
Baud rate	9600, 19200, 38400 bps
Communication Parity	None, Even, Odd
Stop Bit	1bit (fixed)
Communication data swap	OFF / ON (Limited to float, long data of 0x04 (Read Input Registers))
Operation mode	Differential
Communication distance	Max. 1.2km
Cable	RS-485 Shielded Twist 2-Pair Cable
Transmission Method	Half-Duplex-
Max. In/Output Voltage	-7V~+12V

Communication system configuration



Product characteristics

Analog (4~20mA) output function

Specification

- This function measures the maximum out of the 3-phase currents and converts it into DC 4~20mA for output, which can be converted back to the original value by a digital meter.

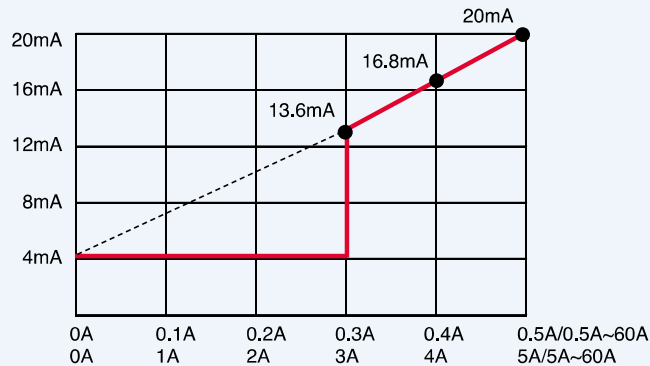
- 20mA Output Settings : 0.5~10A or 5~100A

Note) 1. In the 0.5~10A setting mode the device starts to measure from 0.15A, which means the current 0.15A or less is measured as 0A and the output becomes 4mA.
 (0.15A when one> 4mA is being a real measurement)
 2. Accuracy at 25°C : ± 0.15% / °C

- During stopping : 4mA
- Rated setting value or more : 20mA
- Load : 500Ω or less

Note) The allowable burden of cable must be less than 500Ω. Shielded cables are recommended in consideration of the resistance of the receiving meter (typically 250Ω) and the line resistance.

$$\begin{aligned}
 \text{* Output current} &= \frac{(I_{upper} - I_{lower})}{\text{TD setting}} \times \text{load current} + 4\text{mA} \\
 &= \frac{16\text{mA}}{\text{TD setting}} \times \text{load current} + 4\text{mA}
 \end{aligned}$$



Analog output for 10A (100A) output setting

Rated specifications

Connection		Tunnel type (Passing through CT holes)
Operation characteristic		Thermal-inverse / Inverse / Definite
Rated current		0.5~10A/5~100A (Select Rated on Order)
Display screen		4 digit, 7-Segment, LED
Control Power		110Vac or 220Vac 50/60Hz
Reset	Auto	1-20 minutes
	Manual	ON / OFF selectable
Mounting		Display unit : separately mountable
Accuracy		Current and voltage metering : $\pm 1\%$ of rating or $\pm 2\%$ of minimum rating 4~20mA output : $\pm 5\%$
Time delay	Start	1-200 seconds
	Operation	1-60 seconds
Auxiliary contacts	6 contacts (3A / 250VAC at resistive load, power type based)	
	Contact minimum load	10mA / 5VDC
ZCT input		Basic installation of built-in ZCT External ZCT (200mA/1.5mA, universal ZCT connectable)
I/O assured voltage	110V Type	63V $\pm 10\%$
	220V Type	140V $\pm 10\%$
Environment	Operation Temp.	-10~55°C
	Storage Temp.	-20~70°C
	Humidity	within 80% RH, no condensation
Insulation resistance		100M Ω /500VDC
Lightning impulse voltage		1.2 \times 50 μ s 5kV standard waveform applied
Fast Transient		2kV/1Min
Power consumption		5W or under

Model numbering system

