



Switchboard instruments



Panel instruments



Transducers

■ MEASURING INSTRUMENTS

■ ARRESTERS

■ TRANSDUCERS

■ POWER FACTOR CONTROLLERS

■ POWER MONITORING EQUIPMENT (F-MPC)



Arresters



Instrument transformers



Power monitoring equipment F-MPC



Automatic power factor regulators

LOW
VOLTAGE
EQUIPMENT
Up to 600 Volts

INDIVIDUAL CATALOG 09

from D&C CATALOG 20th Edition

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09

Measuring Instruments, Transducers Arresters, Power Factor Controllers Power Monitoring Equipment



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MINIMUM ORDERS

Orders amounting to **less than ¥10,000** net per order will be charged as ¥10,000 net per order plus freight and other charges.

WEIGHTS AND DIMENSIONS

Weights and dimensions appearing in this catalog are the best information available at the time of going to press.

FUJI ELECTRIC FA has a policy of continuous product improvement, and design changes may make this information out of date.

Please confirm such details before planning actual construction.

INFORMATION IN THIS CATALOG IS SUBJECT TO CHANGE WITHOUT NOTICE.

WM8N type wide-angle indicating switchboard instruments

■ Description

WN8N-type meters are used in many industrial applications such as switchboards, supervisory panels, metal-clad switchgear and control desks. These are compact in size and easy to read. Scales have equal intervals and indicate through a 240° angle, a feature which distinguishes them from the conventional meters. Meters can be read at a distance, since instrument surfaces are protected by a non-reflecting glass and are not affected by reflections from room lighting. Ammeters are provided with an overload scale in red. These instruments comply with the requirements of JIS C1102 and are highly reliable. They can withstand a great deal of abuse in use because of their rugged construction.

■ Features

- High accuracy
External magnetic fields cannot influence readings.
- Accuracy class: 1.5
- Easy-to-read long-scales and pointer-indications can easily be read from a distance.
- 110 × 110mm and 80 × 80mm front frame sizes.
- Auxiliary equipment such as shunt, impedance box and series resistor is available.



80mm square



110mm square

Meter	Description				110mm square Type	80mm square Type
AC ammeter	For direct connection				WM8NAR3 (RMS responding)	WM8NAR6 (RMS responding)
	Measuring range	Extended range type (0–X–3X)	Operating principle	Power consumption	WM8NAS3 (Moving iron)	WM8NAS6 (Moving iron)
	0 – 1A	0 – 1 – 3A	RMS responding	0.4VA		
	0 – 3A	0 – 3 – 9A	Moving iron	3VA		
	0 – 5A	0 – 5 – 15A				
	0 – 10A	0 – 10 – 30A				
	0 – 15A	0 – 15 – 45A				
	0 – 20A	0 – 20 – 60A				
	0 – 30A	–				
	For connection to CT					
	CT ratio	Measuring range	Extended type (0–X–3X)	Operating principle	Power consumption	
	5/5A	0 – 5A	0 – 5 – 15A	RMS responding	0.4VA	
	10/5A	0 – 10A	0 – 10 – 30A	Moving iron	3VA	
	15/5A	0 – 15A	0 – 15 – 45A			
	20/5A	0 – 20A	0 – 20 – 60A			
	30/5A	0 – 30A	0 – 30 – 90A			
	40/5A	0 – 40A	0 – 40 – 120A			
	50/5A	0 – 50A	0 – 50 – 150A			
	60/5A	0 – 60A	0 – 60 – 180A			
	75/5A	0 – 75A	0 – 75 – 225A			
	100/5A	0 – 100A	0 – 100 – 300A			
	150/5A	0 – 150A	0 – 150 – 450A			
	200/5A	0 – 200A	0 – 200 – 600A			
	300/5A	0 – 300A	0 – 300 – 900A			
	400/5A	0 – 400A	0 – 400 – 1200A			
	500/5A	0 – 500A	0 – 500 – 1500A			
	600/5A	0 – 600A	0 – 600 – 1800A			
	750/5A	0 – 750A	0 – 750 – 2250A			
	800/5A	0 – 800A	0 – 800 – 2400A			
	1000/5A	0 – 1000A	0 – 1000 – 3000A			
	1000/5A	0 – 1kA	0 – 1kA – 3kA			

■ Ordering information

Specify the following:

1. Type number (Ordering code)
2. Measuring range
3. Supply voltage and frequency
4. Connection (When connecting to VT or CT, specify VT ratio or CT ratio)

For further information, see page 09/04.

Switchboard Instruments

WM8N type

Meter	Description				110mm square Type (Ordering code)	80mm square Type (Ordering code)
AC voltmeter	For direct connection Measuring range 0 – 50V 0 – 100V 0 – 150V 0 – 300V 0 – 600V		Operating principle	Power consumption	WM8NVR3 (RMS responding) WM8NVS3 (Moving iron)	WM8NVR6 (RMS responding) WM8NVS6 (Moving iron)
			RMS responding	50V: 0.1V 100V: 0.1VA 150V: 0.9VA 300V: 1.8VA 600V: 1.2VA		
			Moving iron	8VA		
	For connection to VT VT ratio Measuring range 440/110V 0 – 600V 3300/110V 0 – 4.5kV 6600/110V 0 – 9kV 6600/110V 0 – 9000V VT ratio: Y/110 (Y: VT primary voltage)		Operating principle	Power consumption		
RMS responding			0.9VA			
Moving iron			8VA			
DC ammeter	For direct connection Measuring range 0 – 1mA 0 – 1A 0 – 3mA 0 – 5A 0 – 5mA 0 – 10A 0 – 10mA 0 – 15A 0 – 30mA 0 – 30A 0 – 50mA 0 – 100mA		Operating principle: Moving coil type Internal resistance: 1mA: Approx. 185Ω 3mA: Approx. 17Ω 5mA: Approx. 10Ω 10mA and above: Approx. 50mV		WM8NAM3 (Moving coil)	WM8NAM6 (Moving coil)
	For connection to shunt Measuring range 0 – 50A 0 – 200A 0 – 75A 0 – 250A 0 – 100A 0 – 500A 0 – 150A		Operating principle: Moving coil type Shunt ratings: 60mV			
DC voltmeter	For direct connection Measuring range 0 – 10V 0 – 200V 0 – 30V 0 – 300V 0 – 50V 0 – 500V 0 – 100V 0 – 600V 0 – 150V		Operating principle: Moving coil type Series resister: Internal Internal resistance: 10V: 10kΩ 200V: 200kΩ 30V: 30kΩ 300V: 300kΩ 50V: 50kΩ 500V: 500kΩ 100V: 100kΩ 600V: 600kΩ 150V: 150kΩ		WM8NVM3 (Moving coil)	WM8NVM6 ((Moving coil))
	For connection to series resistor Measuring range 0 – 750V 0 – 1kV 0 – 1.5kV 0 – 2kV		Operating principle: Moving coil type Series resister: External Power consumption: 1mA			

■ Ordering information

Specify the following:

1. Type number (Ordering code)
2. Measuring range
3. Supply voltage and frequency
4. Connection (When connecting to VT or CT, specify VT ratio or CT ratio)

For further information, see page 09/04.

Meter	Description		110mm square Type	80mm square Type
Frequency meter	Measuring range 45 – 55Hz 110V 55 – 65Hz 110V 45 – 55Hz 220V 55 – 65Hz 220V	Operating principle: Frequency/DC transducing type Power consumption: 1.5VA at 110V 1.5VA at 220V	WM8NP13	WM8NP16
Single-phase 2-wire wattmeter	For connection to VT and CT Measuring range 0 – ZkW $Z = 0.5 \times \frac{X}{5} \times \frac{Y}{110}$ Z: kWatt X: CT primary current Y: VT primary voltage	Operating principle: Power/DC transducing type Power consumption (WM8NC03) Current coil: 1VA (at 5A) Voltage coil: 2VA (at 110V) Power consumption (WM8NC06) Current coil: 0.5VA (at 5A) Voltage coil: 1.7VA (at 110V)	WM8NC03	WM8NC06
3-phase 3-wire wattmeter	For connection to VT and CT Measuring range 0 – ZkW $Z = \frac{X}{5} \times \frac{Y}{110}$ Z: kWatt X: CT primary current Y: VT primary voltage	Operating principle: Power/DC transducing type Power consumption Current coil: 0.5VA per element (at 5A) Voltage coil: 1.7VA per element (at 110V)	WM8NC23	WM8NC26
3-phase 4-wire wattmeter	For connection to VT and CT Measuring range 0 – ZkW $Z = \frac{X}{5} \times \frac{Y}{110}$ Z: kWatt X: CT primary current Y: VT primary voltage	Operating principle: Power/DC transducing type Power consumption Current coil: 0.5VA per element (at 5A) Voltage coil: 0.8VA per element (at 110V)	WM8NC33	WM8NC36
3-phase 3-wire varmeter	For connection to VT and CT Measuring range 0 – Zkvar $Z = \frac{X}{5} \times \frac{Y}{110}$ Z: kvar X: CT primary current Y: VT primary voltage	Operating principle: Reactive power/DC transducing type Power consumption Current coil: 0.5VA per element (at 5A) Voltage coil: 1.7VA per element (at 110V)	WM8NV23	WM8NV26
3-phase 4-wire varmeter	For connection to VT and CT Measuring range 0 – Zkvar $Z = \frac{X}{5} \times \frac{Y}{110}$ Z: kvar X: CT primary current Y: VT primary voltage	Operating principle: Reactive power/DC transducing type Power consumption Current coil: 0.5VA per element (at 5A) Voltage coil: 1.7VA per element (at 110V)	WM8NV33	WM8NV36
3-phase 3-wire power factor meter (for balanced circuit)	For connection to VT and CT VT ratio: $= \frac{Y}{110} V$ CT ratio: $= \frac{X}{5} A$	Operating principle: Phase angle/DC transducing type Power consumption Current coil: 0.9VA (at 5A) Voltage coil: 0.6VA per phase (at 110V)	WM8NA13	WM8NA16
3-phase 3-wire power factor meter (for unbalanced circuit)	For connection to VT and CT VT ratio: $= \frac{Y}{110} V$ CT ratio: $= \frac{X}{5} A$	Operating principle: Phase angle/DC transducing type Power consumption Current coil: 1.1VA per phase (at 5A) Voltage coil: 1.9VA per phase (at 110V)	WM8NA23	WM8NA26
3-phase 4-wire power factor meter (for unbalanced circuit)	For connection to VT and CT VT ratio: $= \frac{Y}{110} V$ CT ratio: $= \frac{X}{5} A$	Operating principle: Phase angle/DC transducing type Power consumption Current coil: 1.1VA per phase (at 5A) Voltage coil: 0.8VA per phase (at 110V)	WM8NA43	WM8NA46

Switchboard Instruments

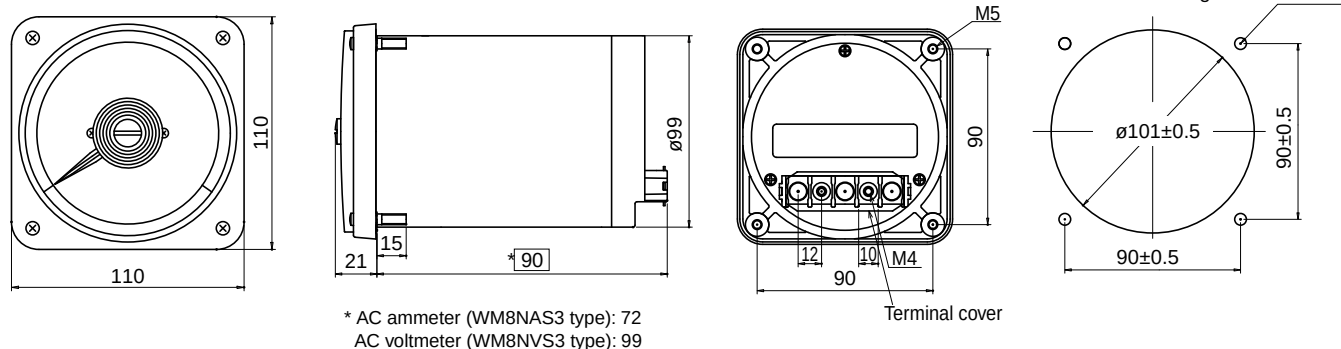
WM8N type

■ Type number nomenclature

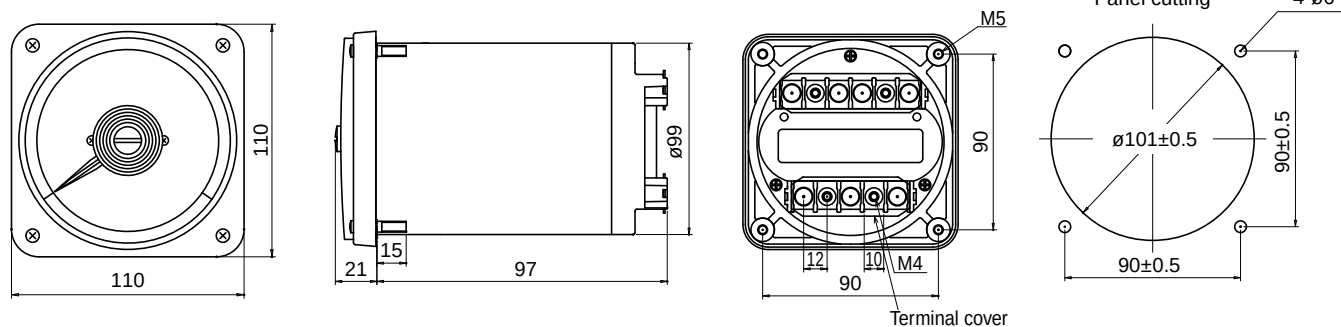
WM8N AR 3 - ALS 5YYY A Y			
Basic type		Additional specifications	
Category		Y : None (standard specification) R : Setting pointer equipped (red) Z : The following additional specifications (Specify the content.)	
AR : AC ammeter (including reception indicator) AS : AC ammeter (moving iron type only) VR : AC voltmeter (including reception indicator) VS : AC voltmeter (moving iron type only) AM : DC ammeter (moving coil type only) VM : DC voltmeter (moving coil type only) C0 : Single-phase, 2-wire wattmeter C1 : Single-phase, 3-wire wattmeter C2 : 3-phase, 3-wire wattmeter C3 : 3-phase, 4-wire wattmeter A0 : Single-phase, 2-wire power factor meter A1 : 3-phase power factor meter for balanced circuit A2 : 3-phase power factor meter for unbalanced circuit A4 : 3-phase, 4-wire power factor meter for unbalanced circuit P1 : Frequency meter V1 : Single-phase, 2-wire varmeter V2 : 3-phase, 3-wire varmeter V3 : 3-phase, 4-wire varmeter AT : 3-phase, 3-wire current power factor meter		Dimensions 3 : 110 x 110mm 6 : 80 x 80mm	
Rated Input		Scale unit	
●AC ammeter (AC) * ¹		1 : % D : mA R : t/h 2 : m E : kA S : MW 3 : mm F : m ³ /s T : kV 4 : m ³ /h G : min ⁻¹ U : mV 5 : Nm ³ /h H : Hz V : V 6 : ppm J : Mvar W : mg/l 7 : rpm K : kvar X : kW 8 : °C L : var Y : x $\frac{1}{3}$ kV 9 : l/h M : MPa Z : Not given above. A : A N : kPa (Be sure to specify.) B : μA P : Pa C : cosφ Q : pH	
For direct connection		Scale numbers	
Standard		□□□□ : Specify the scale numbers with four digits. Enter the specification from the left, and enter "Y" for any remaining digits. Enter "R" for a decimal point. If the scale unit is factored, specify the following at the end: S for x1000, H for x100, or T for x10.	
2 times		Example 1 : 500V → Specify "500Y".	
3 times		Example 2 : 5V → Specify "5YYY".	
5 times		Example 3 : 5.5V → Specify "5R5Y".	
Special		Example 4 : 5kV → Specify "5YYY".	
For CT connection		Example 5 : 5000V → Specify "5000".	
Standard		Example 6 : 1000ppm → Specify "1000".	
2 times		Example 7 : 1 x 1000ppm → Specify "1YYS".	
3 times		Example 8 : 4.7 x 100ppm → Specify "4R7H".	
5 times		Example 9 : 4.7 x 10ppm → Specify "4R7T".	
Special		Example 10 : ± scale → Specify "ZZZZ" and specify the scale. For an extended scale, specify the effective scale range (standard scale portion).	
For VT connection		Example 11 : 10/5A times 3 extension → Specify "10YY".	
Standard		CS05 : Power factor meter 0.5 - 1 - 0.5	
2 times		CST0 : Current power factor meter 0 - 1 - 0 - 1 - 0	
3 times		HZYY : Frequency meter	
5 times		01ML * ³ : 0 - 1 - 0 (power factor linear scale)	
Special		01MN * ³ : 0 - 1 - 0 (phase angle linear scale)	
For DC ammeter (DC)		05ML * ³ : 0.5 - 1 - 0.5 (power factor linear scale)	
Standard		05MN * ³ : 0.5 - 1 - 0.5 (phase angle linear scale)	
2 times		ZZZZ : Specifications not given above.	
3 times		(Be sure to specify the scale.)	
5 times		* ³ Power factor display for DC ammeter and voltmeter (reception indicator).	
Special		* ¹ If a CT or VT is used, be sure to specify the CT ratio or VT ratio. (If a power factor meter is used, the CT ratio or VT ratio does not have to be specified.) Also, if a power factor meter for an unbalanced circuit is used, be sure to specify the rated frequency.	
For DC voltmeter (DC)		* ² Table of rated voltages	
Standard		○ : Can be produced, — : Cannot be produced.	
2 times		Category	
3 times		Voltage between wires: 100V	
5 times		110 to 220V 105 to 210V 100 to 200V	
Special		Voltage between wires: 220V	
For Wattmeter, varmeter, and power factor meter * ¹ * ² * ⁴		Single-phase, 2-wire wattmeter/ power factor meter	
Standard		Single-phase, 3-wire wattmeter	
2 times		3-phase, 3-wire wattmeter	
3 times		3-phase, 4-wire wattmeter	
5 times		3-phase power factor meter for balanced circuit	
Special		3-phase power factor meter for unbalanced circuit	
For Frequency meter		3-phase, 4-wire power factor meter	
Standard		Single-phase, 2-wire varmeter	
2 times		3-phase, 3-wire varmeter	
3 times		3-phase, 4-wire varmeter	
5 times			
Special			

■ Dimensions, mm

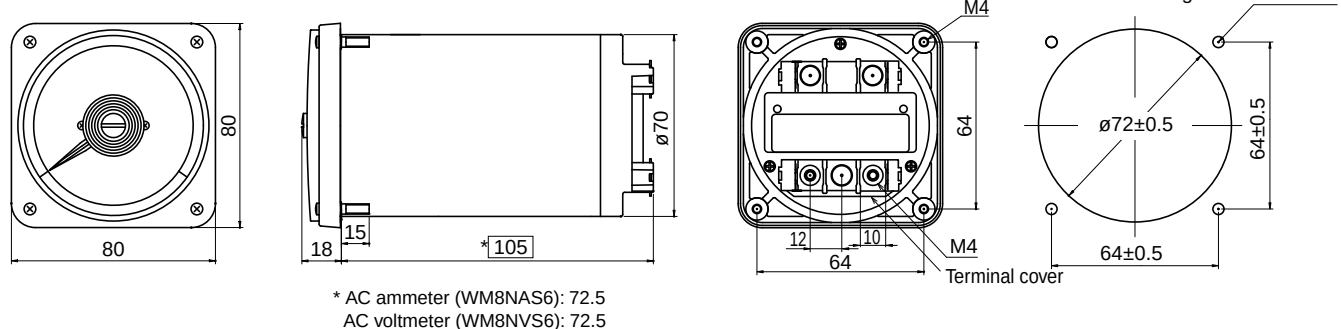
WM8NAS3, WM8NVS3, WM8NAR3, WM8NVR3, WM8NAM3, WM8NVM3, WM8NA13, WM8NP13, WM8NAT3



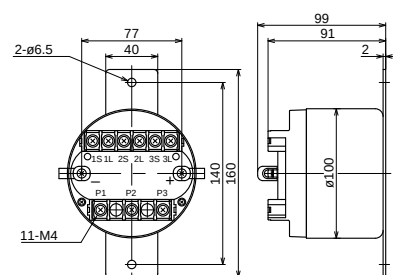
WM8NC03, WM8NC13, WM8NC23, WM8NC33, WM8NV23, WM8NV33, WM8NA23, WM8NA43



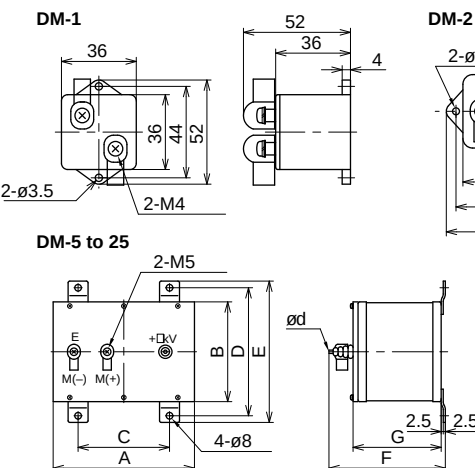
WM8N□6



• DC converter for WM8N□6



• Series resistor



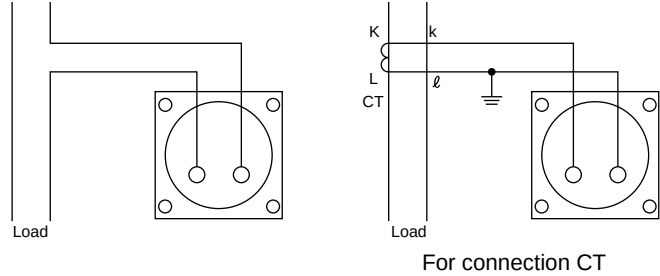
Type	Rating	A	B	C	D	E	F	G	d	Mass (kg)
DM-5	3 to 5kV	170	120	110	154	170	140	106	4	1.0 or less
DM-10	6 to 10kV	220	160	140	194	210	140	106	4	1.5 or less
DM-15	12 to 15kV	290	210	200	248	264	190	146	5	2.0 or less
DM-20	20kV	390	260	300	294	310	220	176	5	3.0 or less
DM-25	25kV	500	330	400	356	372	280	236	5	3.5 or less

Switchboard Instruments

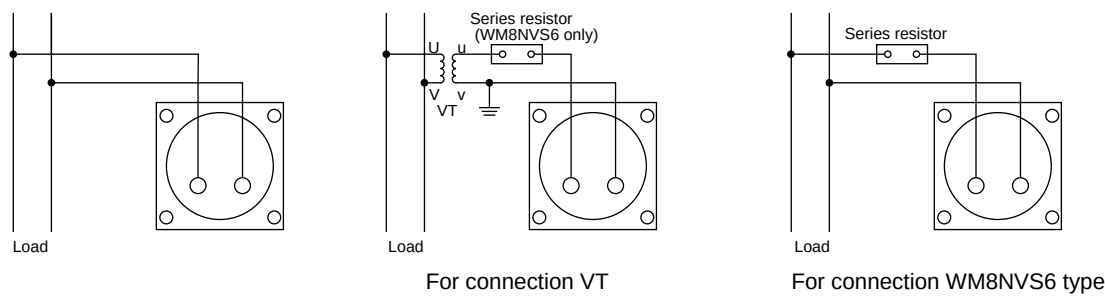
WM8N type

■ Wiring diagrams

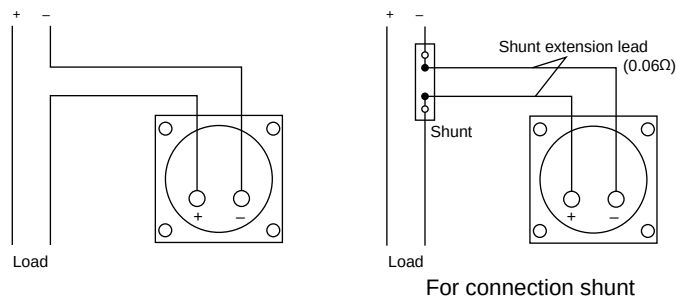
AC ammeter



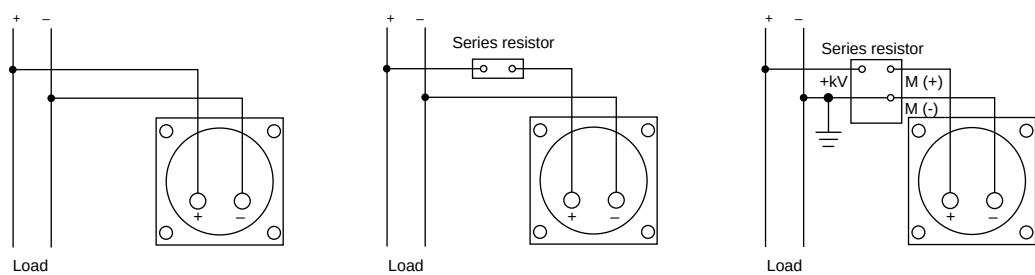
AC voltmeter



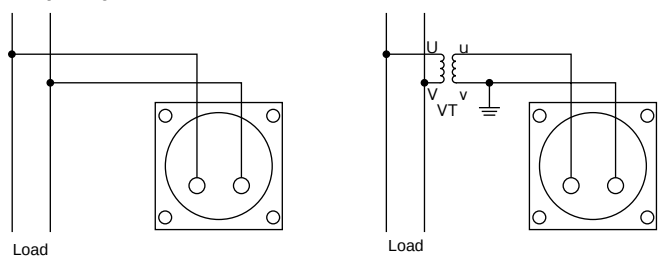
DC ammeter



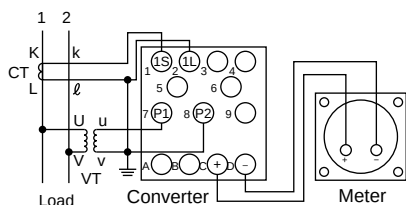
DC voltmeter



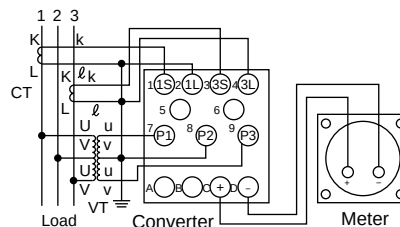
Frequency meter



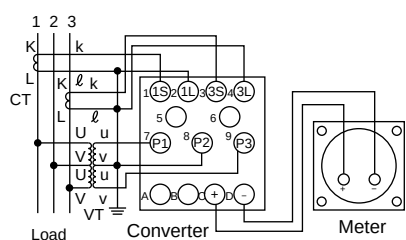
Wattmeter: WM8NC06
Varmerter: WM8NV16



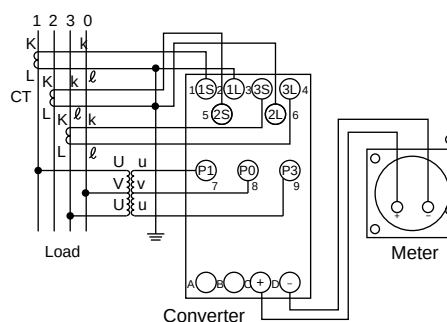
Wattmeter: WM8NC16



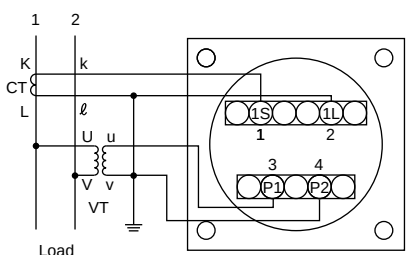
Wattmeter: WM8NC26
Varmerter: WM8NV26



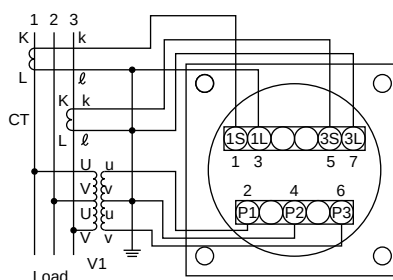
Wattmeter: WM8NC36



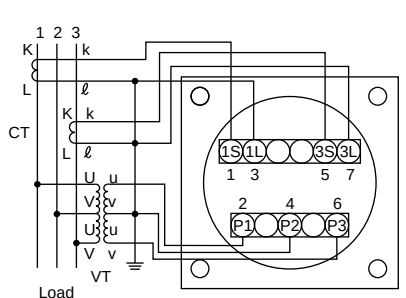
Wattmeter: WM8NC03
Varmerter: WM8NV13



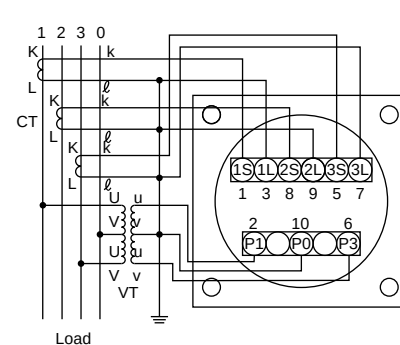
Wattmeter: WM8NC13



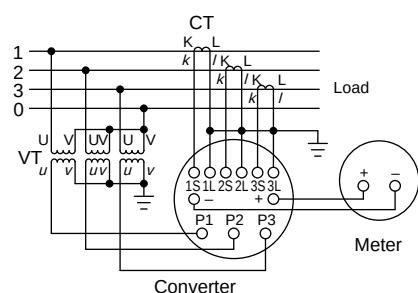
Wattmeter: WM8NC23
Varmerter: WM8NV23



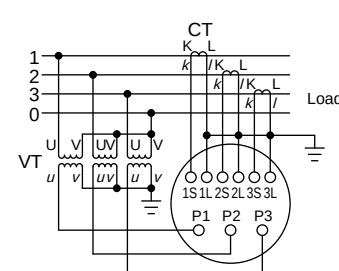
Wattmeter: WM8NC33



Varmerter: WM8NV36

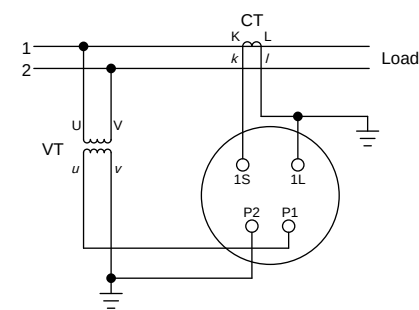


Wattmeter: WM8NV33

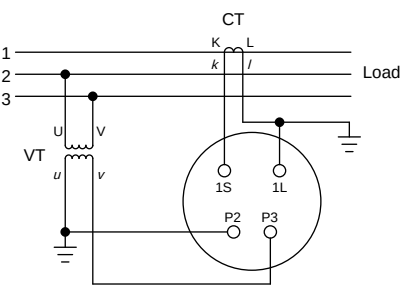


Switchboard Instruments
WM8N type

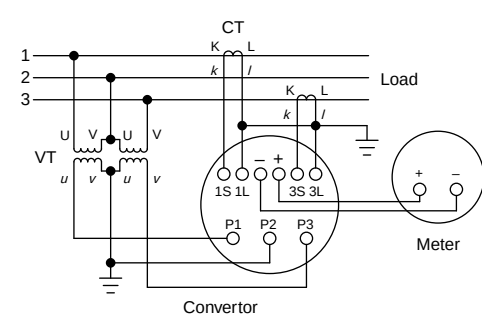
Power factor meter: WM8NA06, 03



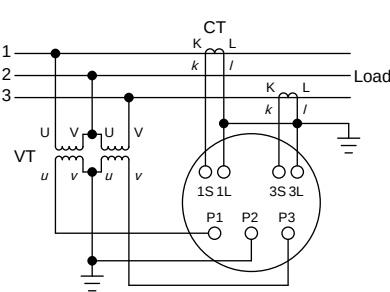
Power factor meter: WM8NA16, 13



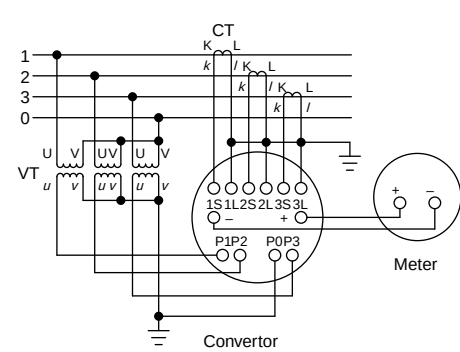
Power factor meter: WM8NA26



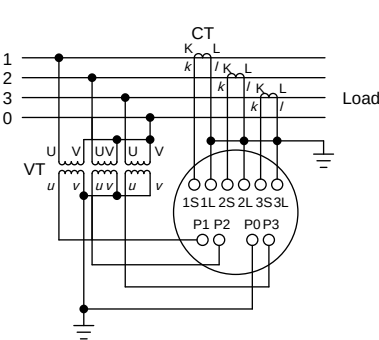
Power factor meter: WM8NA23



Power factor meter: WM8NA46



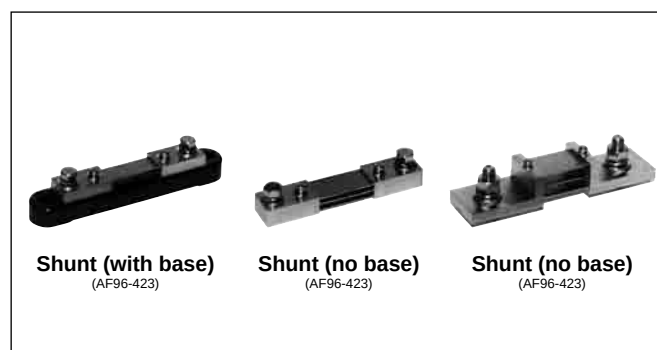
Power factor meter: WM8NA43



Shunt WM9N-1, -2

■ Features

- Shunt for DC ammeter. JIS (JIS C-1721) class 0.5 and class 1.0 models are available. Select the model based on the required accuracy.
- Keep in mind that a shunt is a source of heat generation, and select a shunt with a current value with sufficient margin. (As a general rule, select a shunt with approximately 1.5 times the continuous operating current.)
- The standard terminal voltage for the shunt is 60mV, but models with voltage of 100 mV can also be produced.



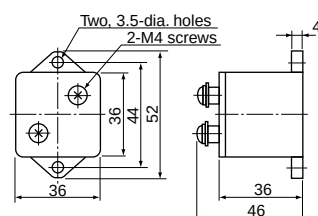
■ Functions and specifications

1 Functions and specifications							
Item	Applicable meter	JIS Class 0.5 (JIS C-1721)			JIS Class 1.0 (JIS C-1721)		
		Shunt rating	Shunt base / no base	Type	Shunt rating	Shunt base / no base	Type
Shunt	DC shunt Shunt connection items	60mV 1A	With base	WM9N-1	60mV 1A	With base	WM9N-2
		2A			2A		
		3A			3A		
		4A			4A		
		5A			5A		
		7.5A			7.5A		
		10A			10A		
		15A			15A		
		20A			20A		
		30A			30A		
		40A			40A		
		50A			50A		
		60A			60A		
		75A			75A		
		100A			100A		
		150A			150A		
		200A			200A		
		250A	No base		250A	No base	
		300A			300A		
		400A			400A		
		500A			500A		
		600A			600A		

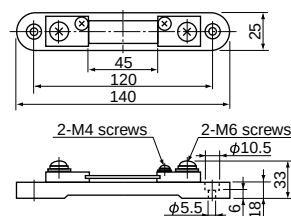
Note 1: Only one meter and can be connected to each shunt.

■ Dimensions, mm

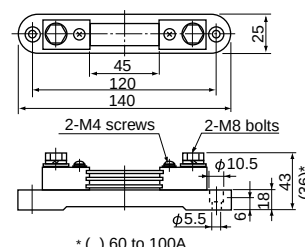
• 1 to 4A (with base)



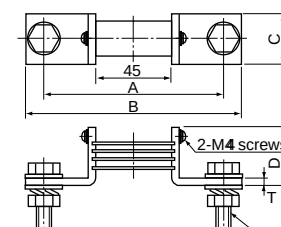
• 5 to 50A (with base)



• 60 to 200A (with base)



• 250 to 600A (no base)



■ Connection wires

Use a round-trip resistance of 0.06 Ω for the shunt connection conductors. The same applies for class 1.0 models without connection wires.

One-way length (m)	2	3	5.5	9	12.5	22	35
Cross-section area (mm ²)	1.25	2	3.5	5.5	8	14	22

• Dimensions, mm

Current	A	B	C	D	E	T
250•300A	110	130	30	36	M10x30	4
400A	110	140	40	36	M12x35	5
500A•600A	120	160	40	41	M12x35	6

Switchboard Instruments

Power line multi-meters

WE1MA power line multi-meters

■ Description

Perform measurement and monitoring for 213 points in 52 categories for Single-phase/2-wire, Single-phase/3-wire, 3-phase/3-wire, and 3-phase/4-wire

■ Features

- With one unit, you can measure or monitor the voltage, current, demand current, power, demand power, reactive power, apparent power, power factor, frequency, leakage current, harmonic effective value (A,V), distortion, harmonic content rate, power level, and reactive power level.
- The unit supports 3-phase/3-wire, Single-phase/3-wire, and Single-phase/2-wire and switching to 3-phase/4-wire is supported with 2VT, 3CT/3VT, or 3CT settings.
- The measurements are displayed using a four-element display: one display on the main monitor and three displays on the sub-monitors along with a bar graph.
- Measure and output alarms for leakage current.

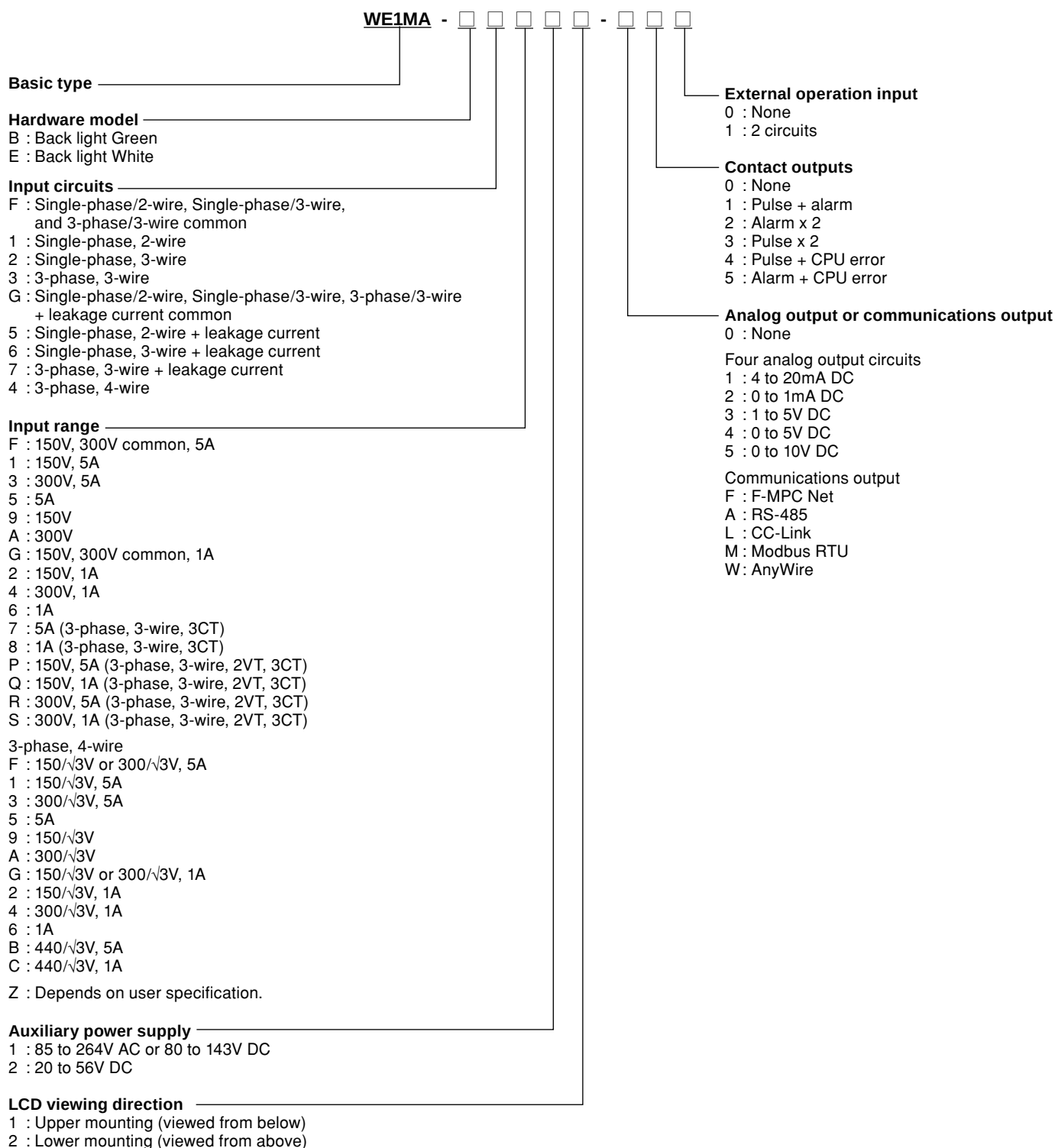


- Outputs include four analog circuits, a pulse output, an alarm output, a CPU error output, and a communications output (according to specification).
- Communications output supports F-MPC Net, CC-Link, AnyWire, Modbus RTU, and RS-485 (according to user specification).
- All models comply with the RoHS Directive (i.e., lead-free).

■ Types and ratings

Measurement	Input specifications		Type
	Input circuits	Input range	
Current (max. demand, demand, instantaneous), power (max. demand, demand, instantaneous), voltage, power factor, frequency, reactive power, power level, reactive power level, harmonic effective value, distortion, and harmonic content rate	Single-phase/2-wire, Single-phase/3-wire, 3-phase/3-wire or all common	150V/300V, 5A	WE1MA-A □ F □ □ -000
		150V, 5A	WE1MA-A □ 1 □ □ -000
		300V, 5A	WE1MA-A □ 3 □ □ -000
		5A	WE1MA-A □ 5 □ □ -000
		150V	WE1MA-A □ 9 □ □ -000
		300V	WE1MA-A □ A □ □ -000
		150V/300V, 1A	WE1MA-A □ G □ □ -000
		150V, 1A	WE1MA-A □ 2 □ □ -000
		300V, 1A	WE1MA-A □ 4 □ □ -000
		1A	WE1MA-A □ 6 □ □ -000
Current (max. demand, demand, instantaneous), power (max. demand, demand, instantaneous), voltage, power factor, frequency, reactive power, power level, reactive power level, harmonic effective value, distortion, harmonic content rate, and leakage current	Single-phase/2-wire + leakage current, Single-phase/3-wire + leakage current 3-phase/3-wire+leakege current or all common	150/300V, 5A	WE1MA-A □ F □ □ -000
		150V, 5A	WE1MA-A □ 1 □ □ -000
		300V, 5A	WE1MA-A □ 3 □ □ -000
		5A	WE1MA-A □ 5 □ □ -000
		150V	WE1MA-A □ 9 □ □ -000
		300V	WE1MA-A □ A □ □ -000
		150/300V, 1A	WE1MA-A □ G □ □ -000
		150V, 1A	WE1MA-A □ 2 □ □ -000
		300V, 1A	WE1MA-A □ 4 □ □ -000
		1A	WE1MA-A □ 6 □ □ -000
		Type given above and ZCT50A	
		Type given above and ZCT100A	
Current (max. demand, demand, instantaneous), power (max. demand, demand, instantaneous), voltage, power factor, frequency, reactive power, apparent power, power level, reactive power level, harmonic effective value, distortion, and harmonic content rate	3-phase, 4-wire	150/√3V or 300/√3V common, 5A	WE1MA-A4F □ □ -000
		150/√3V, 5A	WE1MA-A41 □ □ -000
		300/√3V, 5A	WE1MA-A43 □ □ -000
		5A	WE1MA-A45 □ □ -000
		150/√3V, 5A	WE1MA-A49 □ □ -000
		300/√3V, 5A	WE1MA-A4A □ □ -000
		150/√3V or 300/√3V common, 1A	WE1MA-A4G □ □ -000
		150/√3V, 1A	WE1MA-A42 □ □ -000
		300/√3V, 1A	WE1MA-A44 □ □ -000
		1A	WE1MA-A46 □ □ -000
		440/√3V, 5A	WE1MA-A4B □ □ -000
		440/√3V, 1A	WE1MA-A4C □ □ -000

■ Type number nomenclature



Switchboard Instruments

Power line multi-meters

■ Specifications and performance

● Standard specifications and performance

Item	Specification								
Measurements	Measurement		Display error	Output error	Measurement		Display error	Output error	
	Voltage (34 ranges)		±1.0%	±0.5%	nth harmonic effective value	Voltage, current	±1.5%	±1.5%	
	Current (76 ranges)		±1.0%	±0.5%	nth harmonic content rate	Voltage	±1.0%	±2.5%	
	Power		±1.0%	±0.5%		Current	±2.5%	±2.5%	
	Reactive power		±1.0%	±0.5%	5th harmonic conversion effective value	Voltage, current	±1.5%	±1.5%	
	Apparent power ^{*1}		±1.0%	±0.5%	5th harmonic conversion effective value	Voltage	±1.0%	±2.5%	
	Power factor		±2.0%	±2.0%		Current	±2.5%	±2.5%	
	Frequency		±0.5%	±0.5%	Power level	Power factor of 1	±2.0%	±2.0%	
	Leakage current Io method, Igr method		±2.5% ^{*2}	±2.5% ^{*2}		Power factor of 0.5	±2.5%	±2.5%	
					Reactive power level	Power factor of 1	±2.5%	±2.5%	
	Fundamental wave effective value		Voltage	±1.5%	±1.5%	Reactive power level	Power factor of 0.87	±2.5%	±2.5%
			Current	±1.5%	±1.5%	^{*1} For 3-phase/4-wire only ^{*2} Error for ZCT is not included. It is ± 0.0025A (ZCT primary) at a leakage current detection sensitivity current of 0.1A max.			
	Distortion		Voltage	±1.0%	±2.5%				
			Current	±2.5%	±2.5%				
Time limit setting	Demand current		0s, 5s, 10s, 20s, 30s, 40s, 50s, 1min, 2min, 3min, 4min, 5min, 6min, 7min, 8min, 9min, 10min, 15min, 20min, 25min, 30min (95% time limit)						
	Demand power								
	Harmonic measurement		Average time limit: 0min, 1min, 2min, 5min, 10min, 15min, 30min (average measurement)						
Bar graph error	±10% (% of span)								
Temperature effect	23±10°C permissible differential								
Conforming standards	JIS C 1102-1, -2, -3, -4, -5, -7(1997), JIS C 1111(1985), JIS C 1216(1995), JIS C 1263(1995), JIS C8374(1991), EIA standard RS-485								
Display refresh time	Approx. 1s (approx. 0.25s for a bar graph) (For current leakage measurement, the refresh time is 2s max. for the digital display and the bar graph and 10s for the digital display and the bar graph for harmonic measurement.)								
Display elements and composition	Liquid crystal display		Main monitor		Character height: 11mm, 5 digits				
			Sub-monitor on left		Character height: 6mm, 4 digits				
			Sub-monitor in center and on right		Character height: 6mm, 5 digits				
			Bar graph		20 dots				
LCD viewing angle	Standard item		Upper mounting (viewed from below): top: 10°, bottom: 60°, left/right: 60°						
	Special items		Lower mounting (viewed from above): top: 60°, bottom: 10°, left/right: 60°						
Backlight	LED backlight: Green or White, always ON, automatically turns OFF (after 5min with no operation), can be set to always OFF.								
Input power consumption (VA)	Voltage circuit		0.2VA max.						
	Current circuit		0.1VA max. (5A, 1A)						
Overload resistance	Voltage circuit		2 x rated voltage for 10s, 1.2 x rated current for continuous						
	Current circuit		40 x rated voltage for 1s, 20 x rated current for 4s, 10 x for 16 s, 1.2 x rated current for continuous						
	Power supply power		1.5 x rated voltage for 10s, 1.2 x rated current for continuous, 1.5 x rated voltage for 10s at 110V DC, 1.3 x rated voltage for continuous at 110V DC						
Insulation resistance JIS C 1102-1 JIS C 1111	Between electrical circuits and external cabinet (ground)				50MΩ min. with 500V DC tester				
	Between inputs, outputs, and auxiliary power supply								
	Between outputs (analog, communication, pulse, or alarm)								
	Between pulse outputs								
	Between alarm outputs								
	Analog outputs (negative common) are not isolated.								
Withstand voltage JIS C 1102-1 JIS C 1111	Between electrical circuits and external cabinet (ground)				2000V AC (50/60Hz), 1min.				
	Between inputs, outputs, and auxiliary power supply								
	Between outputs (analog, communication, pulse, or alarm)				1500V AC (50/60Hz), 1min.				
	Between pulse outputs								
	Between alarm outputs								
	Analog outputs (negative common) are not isolated.								
Impulse withstand voltage JIS C 1111	Between auxiliary power supply and cabinet (ground) (only with leakage current measurement)				7kV, 1.2/50μs, positive and negative polarity, three times each				
	Between electrical circuits (except analog outputs and communications outputs) and cabinet (ground)								
	Between analog outputs or communications outputs and cabinet (ground)				5kV, 1.2/50μs, positive and negative polarity, three times each				

Item	Specification						
Analog outputs	No. of outputs	4 circuits					
	Output specifications	4 to 20mA DC (550Ω max.) 0 to 5V/1 to 5V DC (600Ω min.) 0 to 10V DC (2kΩmin.) 0 to 1mA DC (10kΩ max.) Specify any one of the above.					
	Supported output elements	Voltage (RS-ST-TR), current (R-S-T), demand current (R-S-T), power, demand power, reactive power, apparent power, power factor, frequency, leakage current, distortion, fundamental wave effective value, 5th harmonic conversion content rate (automatic switching to maximum phase A or V), 5th harmonic conversion effective value, nth harmonic content rate, nth harmonic effective value (for phases A and V)					
	Response time	1s max. (time until ±1% of the last steady value is reached), Harmonic measurement: 10s max., Current leakage measurement: 2s max.					
	Output ripple	Maximum of 2 x inherent error (% of output span)					
	Outputs are not isolated (negative common).						
Pulse output*4	Power level or reactive power level Output method: Optical MOS-FET SPST-NO relay Contact capacity: AC/DC 125V, 70mA (resistive load/inductive load) Pulse width: 250±10ms (100 to 130ms depending on range setting and output pulse unit setting) The output pulse unit can be set in the following ranges. The output pulse unit will not change even if the measurement range is changed. • 3-phase/3-wire, 3-phase/4-wire: Full load power (kW, kvar) = √ 3 x Rated voltage (V) x Rated current (A) x 10-3 • Single-phase/3-wire: Full load power (kW, kvar) = 2 x Rated voltage (V) x Rated current (A) x 10-3 • Single-phase: Full load power (kW, kvar) = Rated voltage (V) x Rated current (A) x 10-3						
	Full load power (kW, kvar)		Output pulse unit (kWh (kvarh)/pulse)			Multiplying factor	
	Less than 1		0.1	0.01	0.001	0.0001	0.01*3
	1 min. to less than 10		1	0.1	0.01	0.001	0.1
	10 min. to less than 100		10	1	0.1	0.01	1
	100 min. to less than 1,000		100	10	1	0.1	10
	1,000 min. to less than 10,000		1,000	100	10	1	100
	10,000 min. to less than 100,000		10,000	1,000	100	10	1,000
	100,000 min. to less than 1,000,000		100,000	10,000	1,000	100	10,000
	Alarm output*4	Alarm elements: Set any of the following: demand current, demand power, leakage current, 5th harmonic conversion content rate, nth harmonic content rate, distortion, voltage, alarm OFF. Reset method: Automatic reset or manual reset (setting) Contact delay time: 0 to 300s (1s steps) Output contacts: No-voltage NO (OR output of each phase) Contact capacity: 250V AC 8A, 125V DC 0.3A (resistive load), 250V AC 2A, 125V DC 0.1A (inductive load)					
Alarm elements		Item	Specification				
Demand current		Function	Alarm display and alarm output when demand measurement value ≥ upper-limit set value				
		Setting accuracy	±1.0% (% of full scale)				
		Setting range	5% to 100% of max. scale value (1% steps)				
Demand power		Setting accuracy	±1.0% (% of full scale)				
		Setting range	5% to 100% of max. scale value (1% steps)				
Leakage current (only with leakage current management)		Sensitive current	Greater than 50% to 100% of rated sensitive current				
		Rated sensitive current	0.03A/0.05A/0.1A/0.2A/0.4A/0.8A				
		Operation time	Time delay type (greater than 0.1s to 2s max.)				
		Test function	Detection of leakage current can be tested in test mode.				
5th harmonic conversion content rate		Function	Alarm display and alarm output (detection at maximum phase) when measurement value ≥ Upper-limit set value				
		Setting accuracy	Current: ±2.5%, Voltage: ±1.0%, as percentage of content rate				
nth harmonic content rate		Setting range	Current	5th harmonic conversion content rate, nth harmonic content rate (n = 3, 4, 5, 7, 9, 11, 13, or 15), distortion 5% to 100% (1% steps)			
			Voltage	5th harmonic conversion content rate, nth harmonic content rate (n = 3, 4, 5, 7, 9, 11, 13, or 15), distortion 5% to 20% (0.1% steps)			
Distortion		Detection characteristics	Average value mode: Detection when the average measurement value exceeds the setting given above Inverse time limit mode: Detection according to inverse time limit characteristics of instantaneous value (only for 5th harmonic conversion content rate)				
		Function	Alarm display and alarm output (detection for maximum phase) when measurement value ≥ upper-limit set value Alarm display and alarm output (detection for minimum phase) when measurement value ≥ lower-limit set value				
		Setting accuracy	±1.0% (with full scale as 150%)				
		Setting range	30% to 150% (1% steps) with full scale as 150%				
CPU error output*4		Detection item (self-diagnosis item), OR output of detection items		Contact configuration	Capacity		
	(1) Watchdog timer (internal and external), (2) RAM check error, (3) A/D conversion error	OR output of detection items	NC contact	250V AC 5A, 125V DC 0.2A (resistive load), 250V AC 1.5A (inductive load)			

*3 The multiplying factor is 0.01, but 0.1 is displayed for the multiplying factor.

*4 (Four digits are displayed for the integer portion, and four digits are displayed below the decimal point for the expanded display.)

*4 A combination of two of the following outputs can be used: pulse output, alarm output, and CPU error output (only one CPU error output can be used).

Switchboard Instruments

Power line multi-meters

Item	Specification	
External operation input	No. of inputs	2 circuits and functions (4 types) switchable using settings
	External reset	The alarm output or maximum/minimum value can be reset by adding an external voltage signal. Alarm output reset and maximum/minimum value reset can be switched using settings. The input has the same ratings as the auxiliary power supply.
	External display switching	The display can be switched by adding an external voltage signal. Measurement element switching and phase switching can be set. The input has the same ratings as the auxiliary power supply.
	Minimum operation pulse width: 300ms continuous application supported (1) 100/110V AC 0.4 VA, 200/220V AC 1.4VA, 100/110V DC 0.4W, Accepts both AC and DC. Contact capacity: Approx. 3mA (100/110V AC/DC), approx. 6mA (200/220V AC) (2) 24V DC 0.3W, 48V DC 1.2W, Contact capacity: Approx. 10mA (24 V DC), approx. 20mA (48V DC)	
Vibration and shock resistance JIS C 1102-1 JIS C 0040, 0041	Vibration: 0.15mm single amplitude, 10 to 55Hz, 1 octave per minute for 5 sweeps Shock: 490m/s ² , three times each in X, Y, and Z directions	
Operating temperature and humidity range	-10 to 55°C, 30% to 85% RH (no condensation)	
Storage temperature range	-25 to 70°C	

• Communications specifications

Communications specification	Item	Specification		
F-MPC Net	Standard	EIA RS-485 (1983)	Cable length	1000m (total length)
	Transmission method	2-wire half-duplex	Address	1 to 99 and not used (Loc)
	Synchronization method	Asynchronous	No. of connectable units	Up to 31 units per system (including other devices)
	Transmission speed	4800/9600/19200bps		
RS-485 communications output	RS-485, 2-wire half-duplex, asynchronous		Cable length	1000m (total length)
	Transmission speed	1200/2400/4800/9600/19200bps	Address	1 to 254 (31 units max. can be connected)
Modbus RTU communications output	Standard	EIA RS-485	Cable length	1000m (total length)
	Synchronization method	Asynchronous	Address	1 to 247 (31 units max. can be connected)
	Transmission speed	4800/9600/19200/38400bps		
CC-Link Ver.1.10	Transmission speed	156k/625k/2.5M/5M/10Mbps	No. of allocated stations	1 remote device station allocated
	Maximum transmission distance	1200m(156kbps) / 900m(625kbps) / 400m(2.5Mbps) / 160m(5Mbps) / 100m(10Mbps)		
	No. of connectable units	42 (if only this unit is used)		
AnyWire	Full quadruplex or full duplex total frame cyclic communications			
	Protocol	AnyWireBus protocol	Address settings	0 to 63 (full quadruplex), 0 to 15 (full duplex)
	Transmission speed	Full quadruplex: 7.8kHz (1km), 15.6kHz (500m), 31.3kHz (200m), 62.5kHz (100m) Full duplex: 7.8kHz (1km), 31.3kHz (200m) The values in parentheses are the maximum overall cable extension lengths.		
	No. of connectable units	Full quadruplex: 64, Full duplex: 16		

■ Measurement range

• Voltage measurement range (34 ranges)

150.0V (110V)	1500V (1100V)	18.00kV (13.2kV)	180.0kV (132kV)
150V (110V)	2400V (1650V)	18.00kV (13.8kV)	210.0kV (154kV)
300.0V (220V)	3000V (2200V)	24.00kV (16.5kV)	270.0kV (187kV)
300V (220V)	3.00kV (2200V)	25.00kV (18.4kV)	300.0kV (220kV)
500V (380V)	4500V (3300V)	30.0 kV (22kV)	400.0kV (275kV)
600V (440V)	4.50kV (3300V)	45.0 kV (33kV)	500.0kV (380kV)
600V (460V)	9000V (6600V)	90.0 kV (66kV)	750.0kV (550kV)
600V (480V)	9.00kV (6600V)	120.0 kV (77kV)	
1200V (880V)	15.00kV (11kV)	150.0 kV (110kV)	

• Current measurement range (76 ranges)

5.00A	20.00A	80.0A	250A	1.00kA	2.00kA	6.00kA	15.00kA
6.00A	20.0A	100.0A	300.0A	1200A	2500A	7500A	15.0kA
7.50A	25.00A	100A	300A	1.20kA	2.50kA	7.50kA	20.00kA
8.00A	25.0A	120.0A	400A	1500A	3000A	8000A	20.0kA
10.00A	30.00A	120A	500A	1.50kA	3.00kA	8.00kA	30.00kA
10.0A	30.0A	150.0A	600A	1600A	4000A	9.00kA	
12.00A	40.0A	150A	750A	1.60kA	4.00kA	10.00kA	
12.0A	50.0A	200.0A	800A	1800A	5000A	10.0kA	
15.00A	60.0A	200A	900A	1.80kA	5.00kA	12.00kA	
15.0A	75.0A	250.0A	1000A	2000A	6000A	12.0kA	

- Current display sensitivity: Sets the full scale of the current meter.
The sensitivity can be set to between 40% and 120% of the CT ratio.

- Power (apparent power range)
480W to 1000MW range selection, maximum scale setting 40 to 115%
- Power factor
LEAD0.5 to 1 to LAG0.5 or LEAD0 to 1 to LAG0 range selection
- Reactive power
LEAD, LAG360var to 1000Mvar range selection, maximum scale setting 30% to 115%
- Frequency
45 to 55Hz or 55 to 65Hz, 45 to 65Hz range selection

■ Part names and functions

Bar graph display

Analog display of measurement value on main monitor
(Settings can be made for bar graph display of the measurement value on the sub-monitor.)

Digital display

Four elements can be measured and monitored at the same time.

- Main monitor
- Sub-monitor on right
- Sub-monitor in center
- Sub-monitor on left

Scale numbers

This is automatically set using the measurement range setting.

Upper limit or lower limit setting index

This displays the set value of the upper limit or lower limit.

Phase display

Unit display

This is automatically set using the measurement range setting.

Multiplying factor display

The multiplying factor is displayed in the lower right part of the main monitor when power level and reactive power level are displayed.

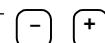
DISPLAY



Use this switch to toggle the phase display (between wires) for current (or voltage).

After the display is switched, it will return to the original phase display (between wires) if there is no operation for 10 minutes.

In setting mode, the switch is used to end setting mode.



Use this switch to switch the measurement display elements for the main monitor.

After the display is switched, it will return to the original measurement display element if there is no operation for 10 minutes.

In setting mode, the switch is used to change set values.

MAX/MIN



Use this switch to toggle between the normal measurement display and the maximum/minimum measurement display.

MODE



Use this switch to toggle between normal measurement display and harmonic (voltage/current) display. In setting mode, the switch is used to switch setting items.



This switch is used to toggle between a normal display (five integer digits) and an expanded display (two integer digits and three digits below the decimal point) for the total value of each power level.

After the display is switched, it will return to a normal display if there is no operation for 10 minutes.

The switch can also be used to switch into setting mode.

When the switch is pressed for 3s or longer, the mode will switch to setting mode.

In setting mode, the switch is used to enter set values.

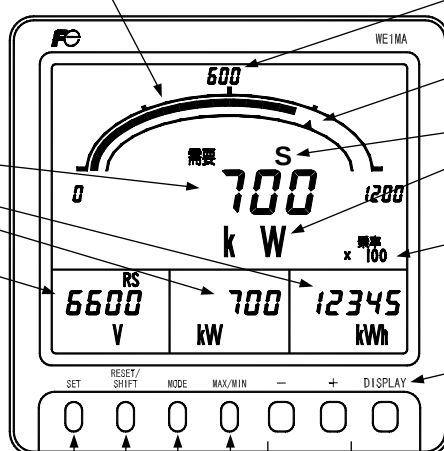
RESET/SHIFT



Use this switch to reset alarms.

The switch can also be used to reset maximum and minimum values for display of maximum and minimum measurements.

In setting mode, the switch is used to move between setting items.



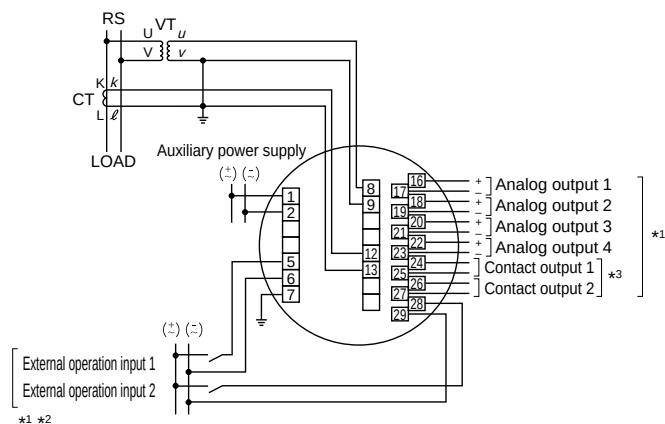
Switchboard Instruments

Power line multi-meters

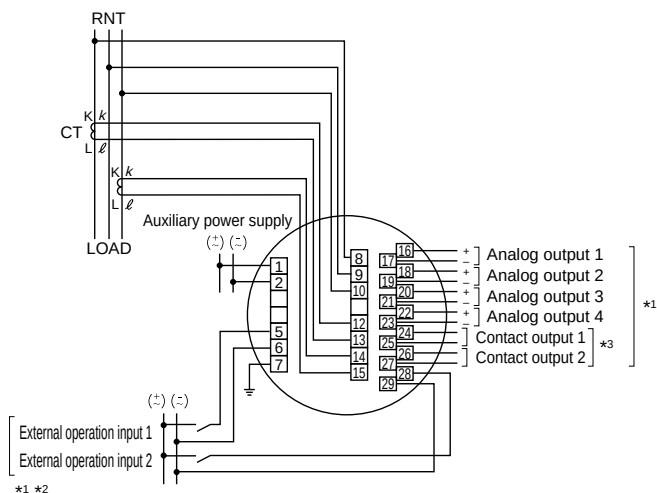
■ Wiring diagrams

• Single-phase/2-wire, Single-phase/3-wire, 3-phase/3-wire *4

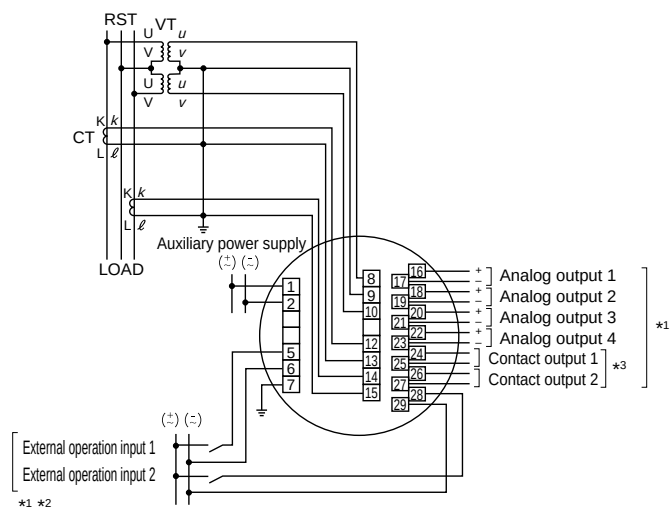
(1) Single-phase, 2-wire



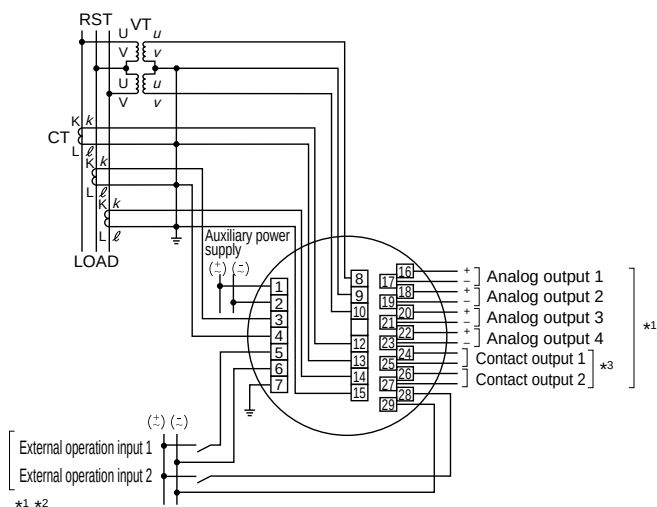
(2) Single-phase, 3-wire



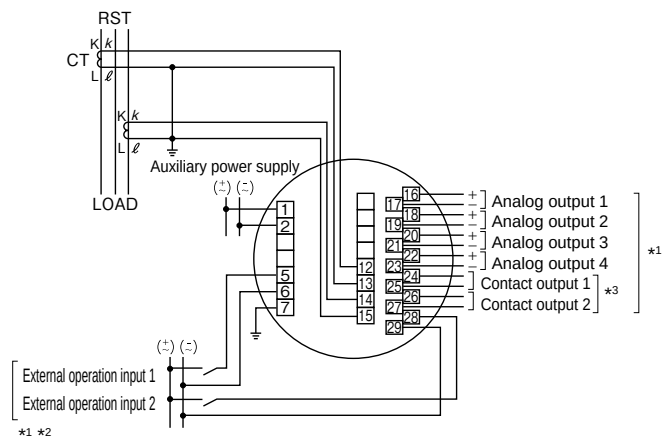
(3) 3-phase, 3-wire (2VT, 2CT)



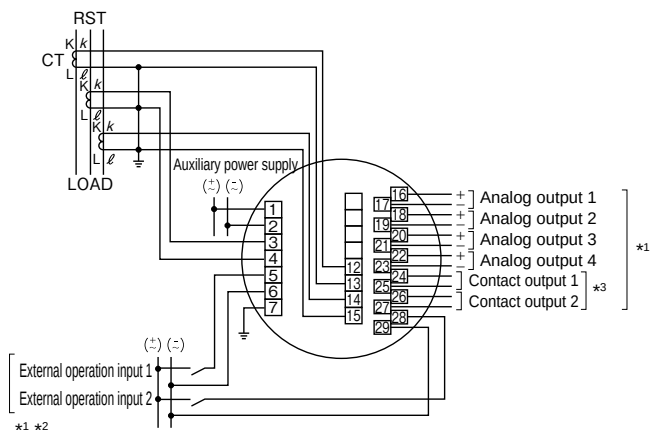
(4) 3-phase, 3-wire (2VT, 3CT)



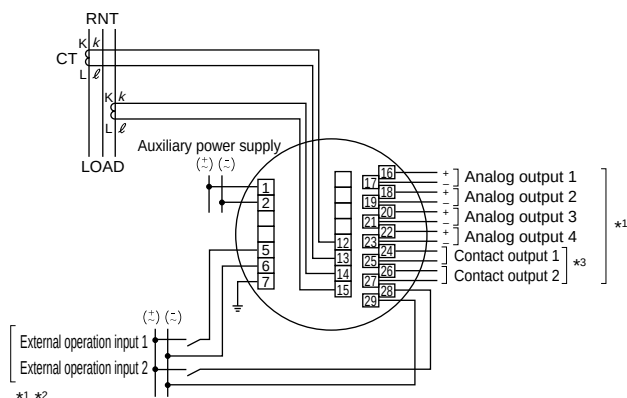
(5) Current input 3-phase, 3-wire (2CT)



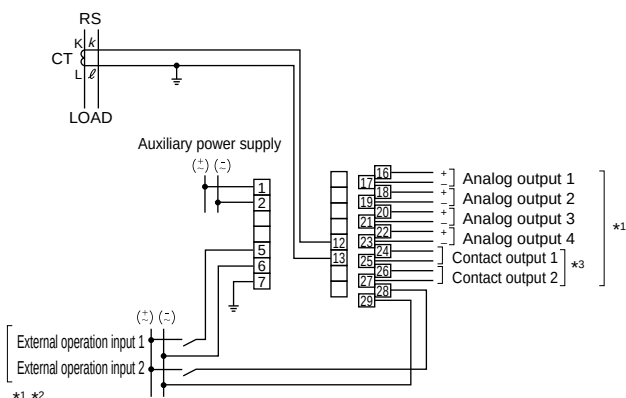
(6) Current input 3-phase, 3-wire (3CT)



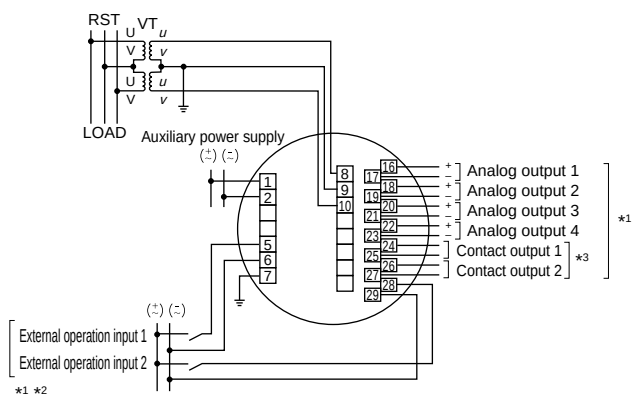
(7) Single-phase, 3-wire



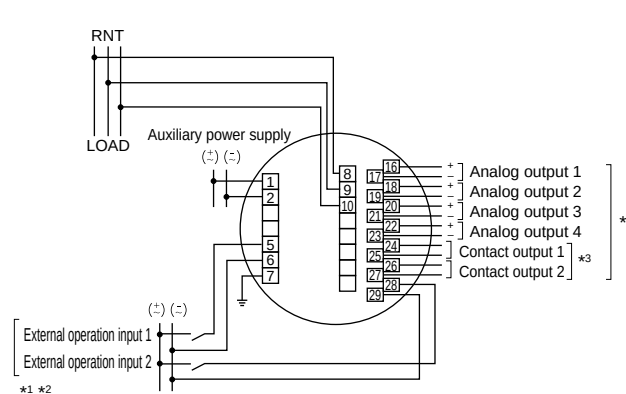
(8) Single-phase, 2-wire



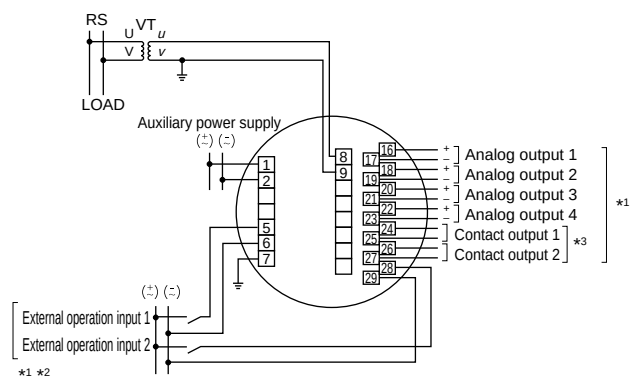
(9) Voltage input 3-phase, 3-wire



(10) Voltage input Single-phase, 3-wire



(11) Voltage input Single-phase, 2-wire



Notes:

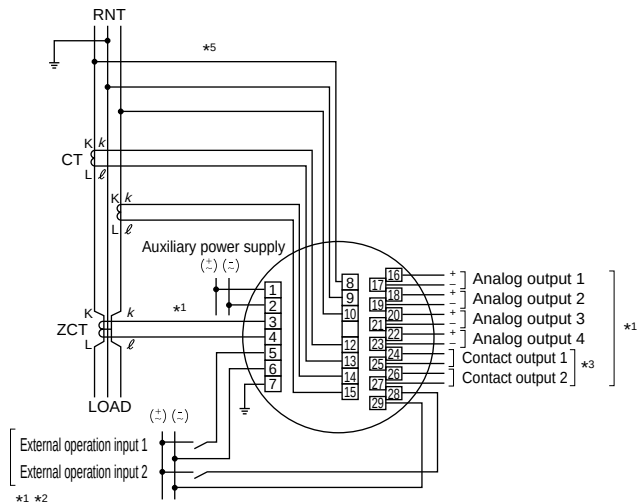
- *1 Analog outputs, contact outputs, and external operation inputs are options.
- *2 Functionality for external operation input can be switched between external reset and external display switching by using settings.
- *3 For contact outputs, you can select from the following:
pulse outputs, alarm outputs, or CPU error output. (by user specification)
- *4 Secondary grounding for VT and CT is not required if a low-voltage circuit is used.
Also, VT is not required if 110V or 220V direct input is used.

Switchboard Instruments

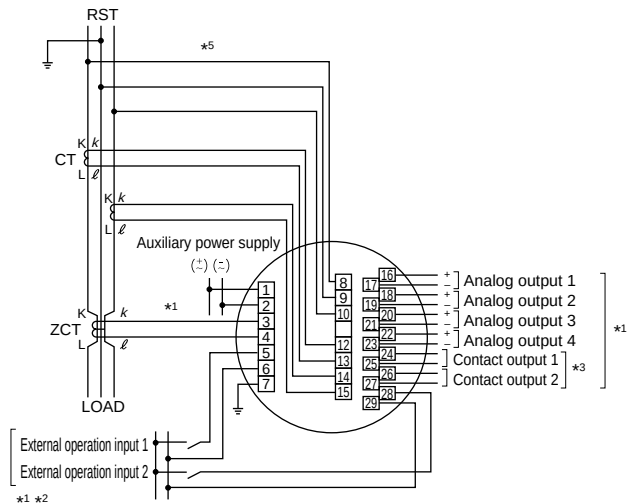
Power line multi-meters

• Wiring for monitoring leakage current of low-voltage circuit

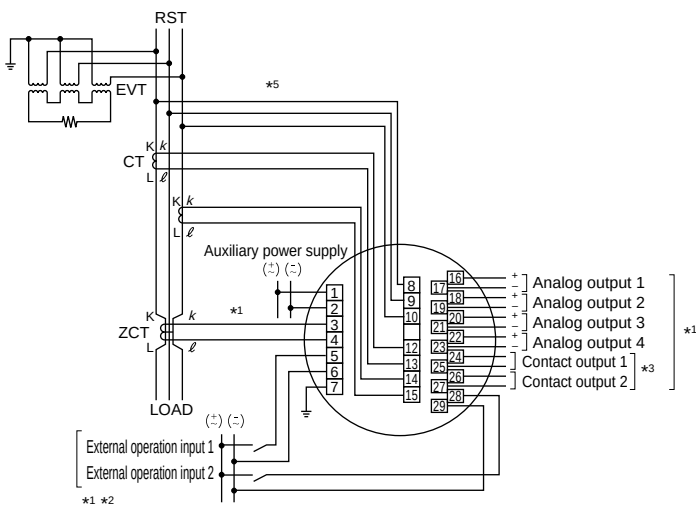
(1) Single-phase, 3-wire (N-phase ground)



(2) 3-phase, 3-wire (S-phase ground)



(3) 3-phase, 3-wire (no ground)



Notes:

*1 Analog outputs, contact outputs, and external operation inputs are options.

Models with zero-phase current input have only leakage current measurement.

*2 Functionality for external operation input can be switched between external reset and external display switching by using settings.

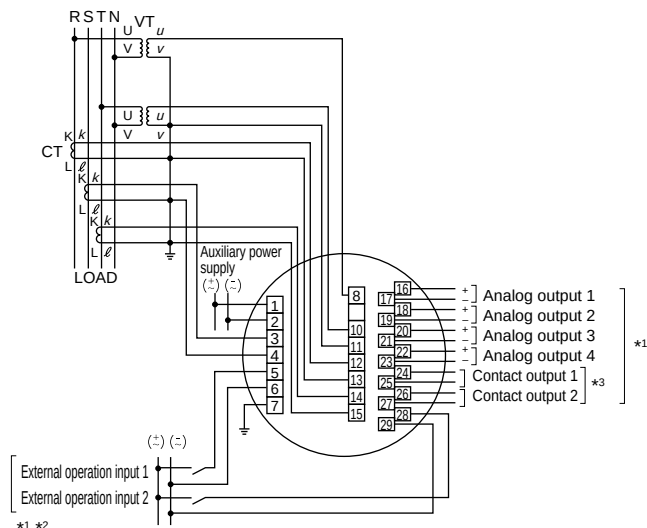
*3 For contact outputs, you can select from the following:
pulse outputs, alarm outputs, or CPU error output. (by user specification)

*4 Secondary grounding for VT and CT is not required if a low-voltage circuit is used.
Also, VT is not required if 110V or 220V direct input is used.

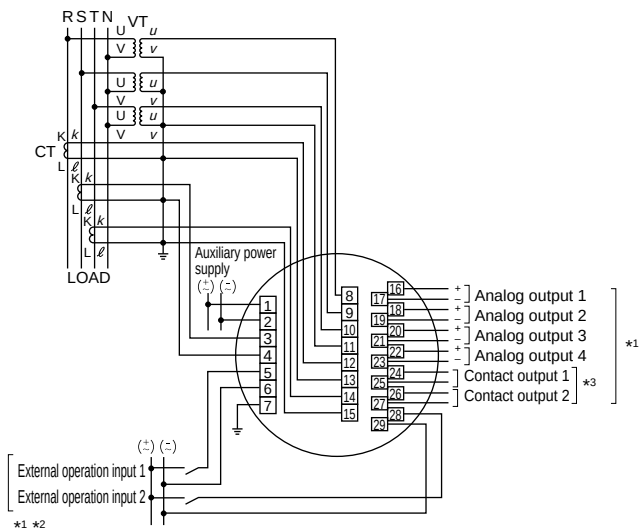
*5 Voltage input is required when leakage current Igr is used.

• 3-phase, 4-wire *4

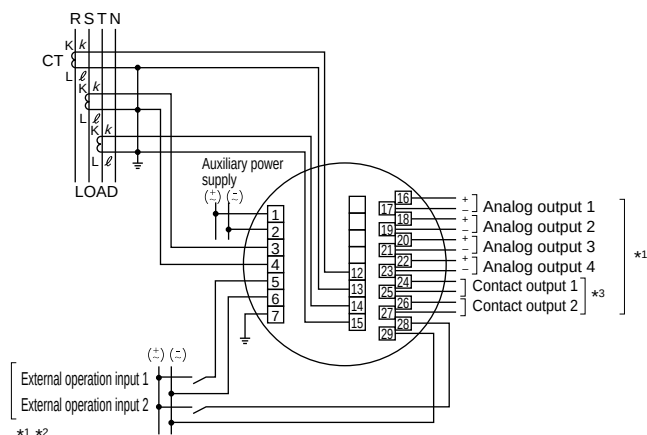
(1) Voltage and current input (2VT, 3CT)



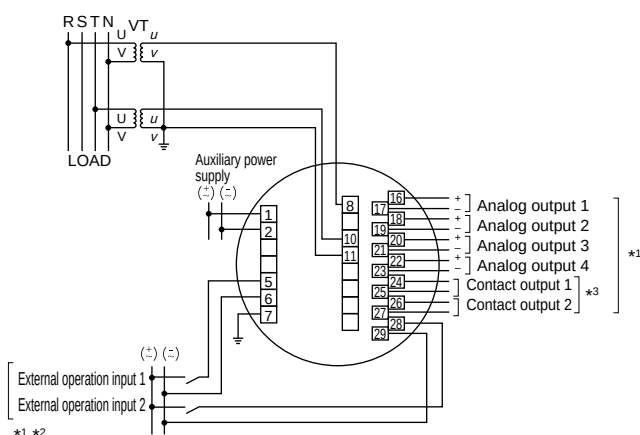
(2) Voltage and current input (3VT, 3CT)



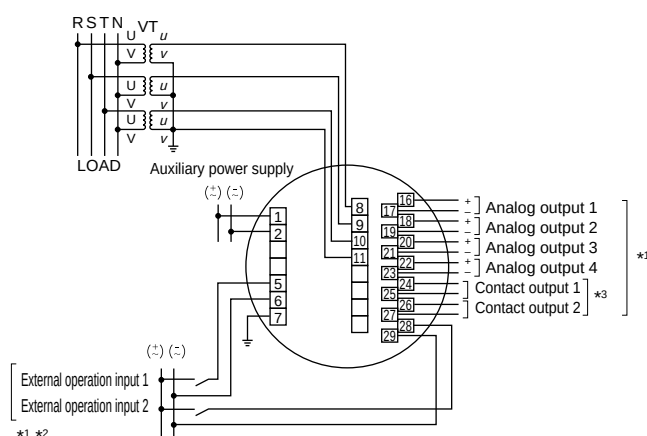
(3) Current input



(4) Voltage input (2VT)



(5) Voltage input (3VT)



Notes:

*1 Analog outputs, contact outputs, and external operation inputs are options.

*2 Functionality for external operation input can be switched between external reset and external display switching by using settings.

*3 For contact outputs, you can select from the following:
pulse outputs, alarm outputs, or CPU error output. (by user specification)

*4 Secondary grounding for VT and CT is not required if a low-voltage circuit is used. Also, VT is not required if 110V or 220V direct input is used.

Switchboard Instruments

Power line multi-meters

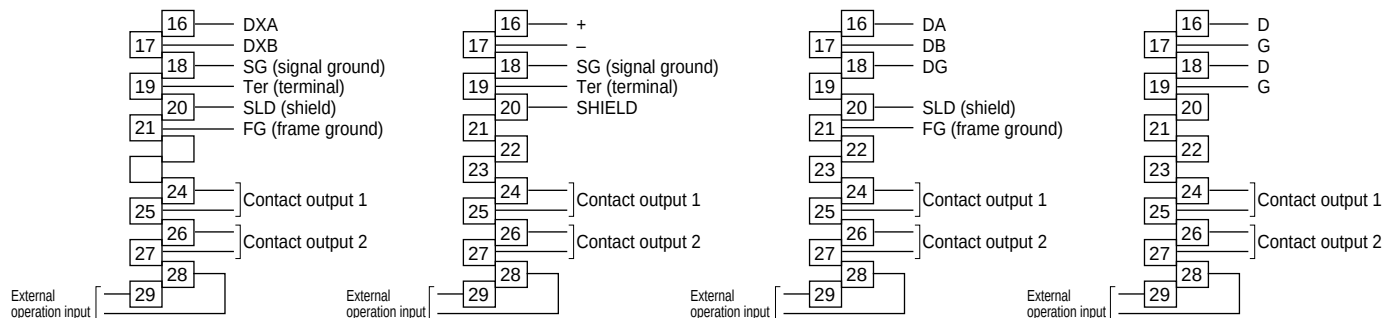
- **Communications output terminal arrangement**

(1) F-MPC Net

(2) RS-485, Modbus RTU

(3) CC-Link

(4) AnyWire

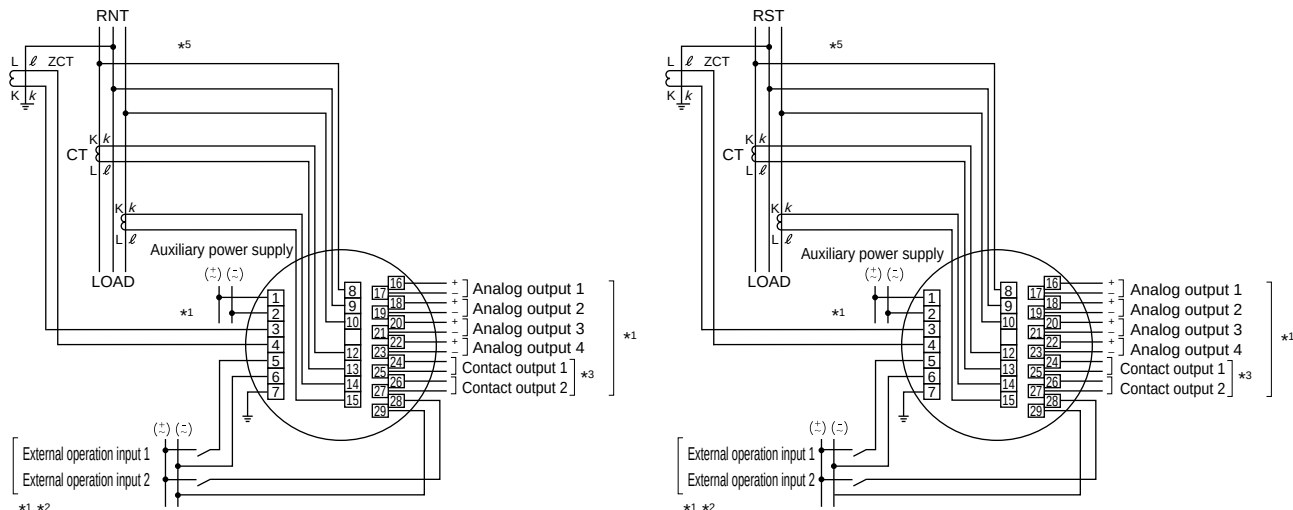


* Terminal resistance is connected internally by shorting terminal 17 (DXB) and terminal 19 (Ter). (Connect the terminal resistance only on a device that is the terminal node in the connection configuration.)

- **Mounting ZCT to ground wire (Be careful of ZCT polarity.)** *4

(1) Single-phase, 3-wire (N-phase ground)

(2) 3-phase, 3-wire (S-phase ground)



Notes:

*1 Analog outputs, contact outputs, and external operation inputs are options.
Models with zero-phase current input have only leakage current measurement.

*2 Functionality for external operation input can be switched between external reset and external display switching by using settings.

*3 For contact outputs, you can select from the following:

pulse outputs, alarm outputs, or CPU error output. (by user specification)

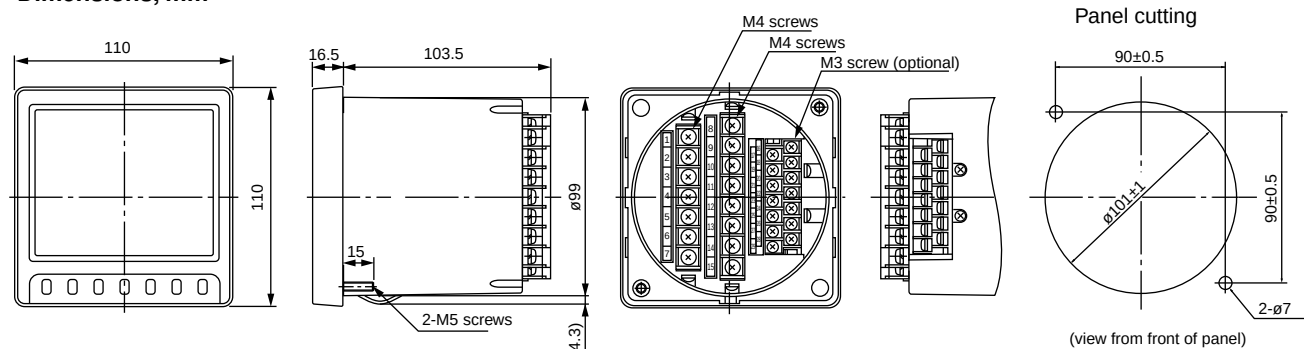
*4 Secondary grounding for VT and CT is not required if a low-voltage circuit is used. Also, VT is not required if 110V or 220V direct input is used.

- **Contact output combinations**

	Contact output combinations				
	Pulse + alarm	Alarm x 2	Pulse x 2	Pulse + CPU error	Alarm + CPU error
Contact output 1	Pulse output	Alarm output 1	Pulse output 1	Pulse output	Alarm output
Contact output 2	Alarm output	Alarm output 2	Pulse output 2	CPU error output	CPU error output

■ Dimensions and mounting precautions

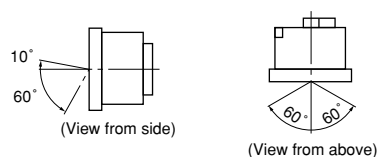
• Dimensions, mm



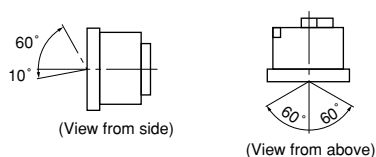
• Mounting precautions

- (1) The contrast of the LCD display depends on the angle at which it is viewed. Mount the display at the proper angle and position.

Upper mounting



Lower mounting



- (2) Use a mounting panel with a thickness of 10mm max. and mount the unit to the panel using the enclosed M5 nuts.
- (3) Use a tightening torque of 2.75 to 3.82 N·m.

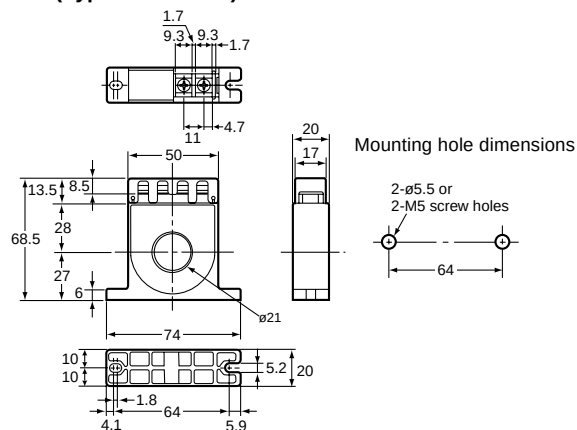
Switchboard Instruments

Power line multi-meters

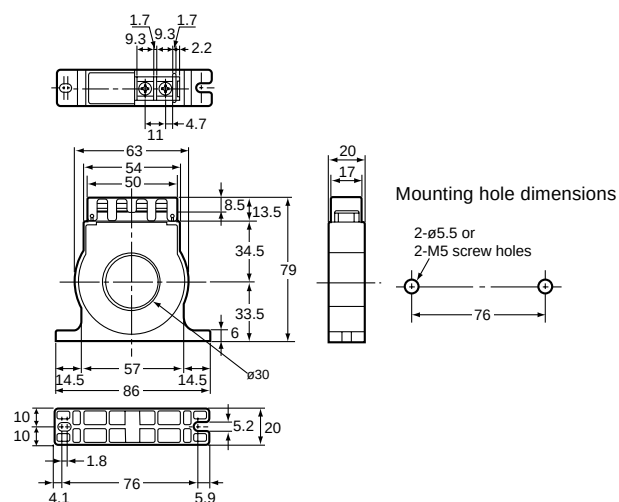
■ ZCT dimensions, mm

(The following ZCT is used when enclosed.)

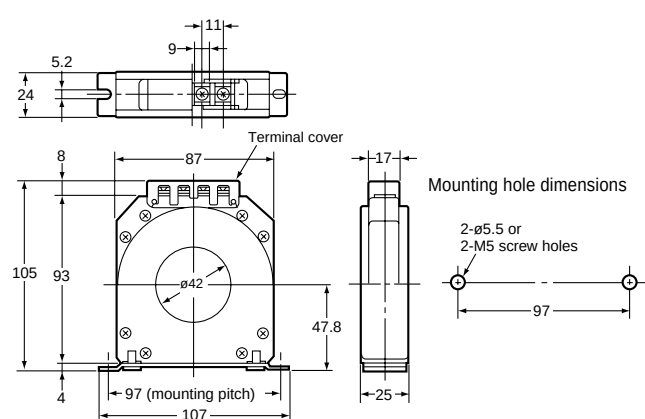
50A (Type: OTG-LA21)



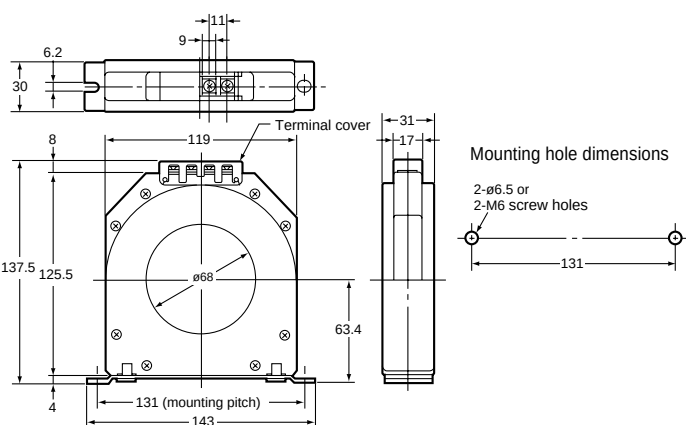
100A (Type: OTG-LA30A)



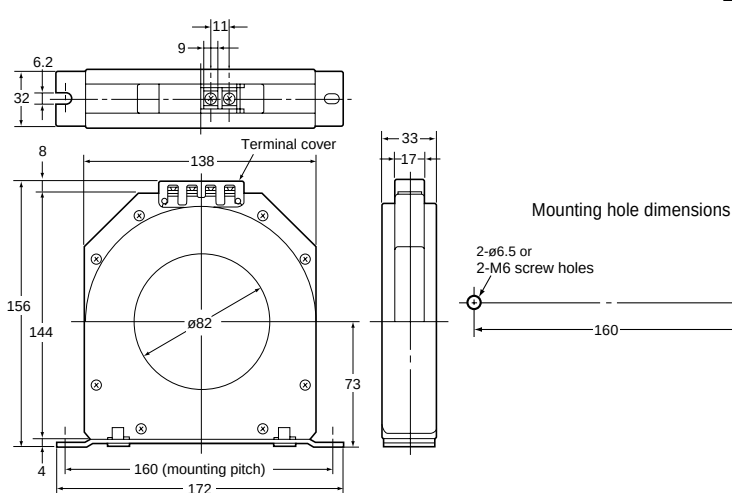
200A (Type: OTG-LA42)



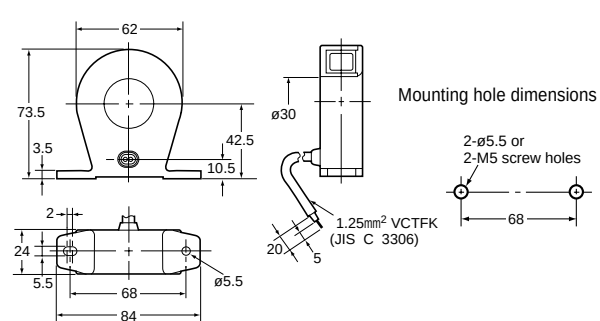
400A (Type: OTG-LA68)



600A (Type: OTG-LA82)



100A outdoor use (Type: OTG-LA30W)



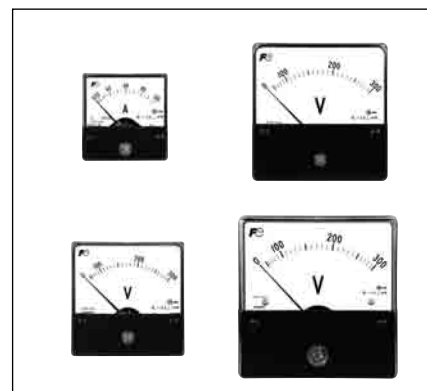
F-type panel instruments 60mm to 120mm square

■ Description

The F-type is both small in size and budget-priced. Since they take a minimum of installation space they are best suited for motor starter, control center and distribution board applications. Meter cases are made of a highly attractive and durable plastic.

■ Features

- Accuracy class: 2.5
- Meter scales are easy to read without error
- Compact design and budget-priced
- Meter accuracy is not affected by panel materials or adjacent current-carrying conductors
- Complies with requirements of JIS C1102
- Dielectric test: 3320V AC, 5sec.



Meter	Description	60mm square Type	80mm square Type	100mm square Type	120mm square Type
AC ammeter	For direct connection (up to 500V) Measuring range Extended range 0 – 500mA 0 – 500mA – 1.5A 0 – 1A 0 – 1A – 3A 0 – 3A 0 – 3A – 9A 0 – 5A 0 – 5A – 15A 0 – 7.5A 0 – 7.5A – 22.5A 0 – 10A 0 – 10A – 30A 0 – 15A 0 – 15A – 45A 0 – 20A 0 – 20A – 60A 0 – 30A 0 – 30A – 90A	FSN-60	FSN-80	FSN-100	FSN-120
	• Operating principle: Moving iron • Power consumption: 1VA				
	For connection to CT Measuring range Extended range 0 – X (A) 0 – X – 3X CT ratio: X/5 (X: CT primary current)				
	For direct connection (up to 500V) Measuring range 0 – 100μA 0 – 40mA 0 – 500μA 0 – 50mA 0 – 1mA 0 – 60mA 0 – 3mA 0 – 75mA 0 – 5mA 0 – 100mA 0 – 10mA 0 – 150mA 0 – 20mA 0 – 200mA 0 – 25mA 0 – 250mA 0 – 30mA 0 – 300mA	FRN-60	FRN-80	FRN-100	FRN-120
	• Operating principle: Rectifier • Power consumption: 1VA				
AC voltmeter	For connection to MR-CTN Measuring range 0 – 400mA 0 – 1A 0 – 500mA 0 – 2A 0 – 600mA 0 – 2.5A 0 – 750mA 0 – 3A	FSN-60	FSN-80	FSN-100	FSN-120
	• Operating principle: Rectifier • Power consumption: 1VA				
AC voltmeter	For direct connection Measuring range 0 – 150V 0 – 300V 0 – 600V Series resistor to be mounted externally	FSN-60	FSN-80	FSN-100	FSN-120
	• Operating principle: Moving iron • Power consumption 0 – 150V, 0 – 300V: 5VA 0 – 600V: 10VA				
AC voltmeter	For connection to VT Measuring range 0 – 600V 0 – 4.5kV 0 – 9kV	FSN-60	FSN-80	FSN-100	FSN-120
	• Operating principle: Moving iron • Power consumption: 5VA				

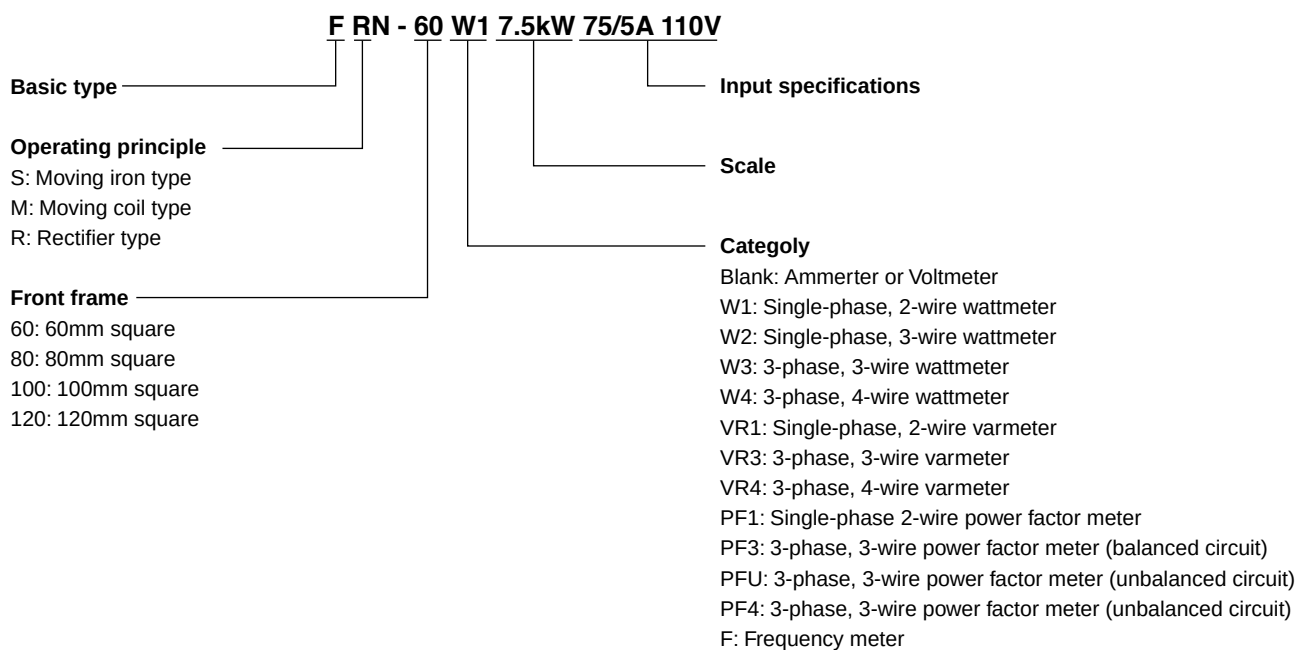
Panel Instruments

F type

Meter	Description		60mm square Type	80mm square Type	100mm square Type	120mm square Type
AC voltmeter	For direct connection Measuring range 0 – 10V 0 – 60V 0 – 15V 0 – 75V 0 – 20V 0 – 100V 0 – 25V 0 – 150V 0 – 30V 0 – 200V 0 – 40V 0 – 250V 0 – 50V 0 – 300V	• Operating principle: Rectifier • Internal resistance: 1000 Ω/V	FRN-60	FRN-80	FRN-100	FRN-120
DC ammeter	For direct connection Measuring range 0 – 1mA 0 – 200mA 0 – 10A 0 – 3mA 0 – 500mA 0 – 15A 0 – 5mA 0 – 1A 0 – 20A 0 – 10mA 0 – 1.5A 0 – 30A 0 – 20mA 0 – 2A 0 – 50mA 0 – 3A 0 – 100mA 0 – 5A	• Operating principle: Moving coil	FMN-60	FMN-80	FMN-100	FMN-120
	For connection to shunt Measuring range 0 – 50A 0 – 300A 0 – 75A 0 – 500A 0 – 100A 0 – X(A) 0 – 200A	• Operating principle: Moving coil • Shunt rating: 60mV				
DC voltmeter	For direct connection Measuring range 0 – 1V 0 – 50V 0 – 3V 0 – 75V 0 – 5V 0 – 100V 0 – 10V 0 – 150V 0 – 15V 0 – 300V 0 – 30V	• Operating principle: Moving coil • Series resistor: Internal Internal resistance: 1V: 1Ω 50V: 50Ω 3V: 3Ω 75V: 75Ω 5V: 5Ω 100V: 100Ω 10V: 10Ω 150V: 150Ω 15V: 15Ω 300V: 300Ω 30V: 30Ω	FMN-60	FMN-80	FMN-100	FMN-120
	For connection to series resistor Measuring range 0 – 500V 0 – 600V 0 – 750V 0 – 1kV 0 – 1.5kV 0 – 2kV	• Operating principle: Moving coil • Series resistor: Internal 500V: 500Ω 600V: 600Ω • Series resistor: External (3-terminal) 750V ~ 2kV				
Single-phase 2-wire wattmeter	For connection to VT and CT Measuring range 0 – ZkW Z= 0.5 x X/5 x Y/110 Z: kWatt X: CT primary current Y: VT primary voltage	• Operating principle: Power/DC transducing type Power consumption Current coil: 1VA (at 5A) Voltage coil: 3.5VA	FRN-60W1	FRN-80W1	FRN-100W1	FRN-120W1
3-phase 3-wire wattmeter	For connection to VT and CT Measuring range 0 – ZkW Z= 0.5 x X/5 x Y/110 Z: kWatt X: CT primary current Y: VT primary voltage	• Operating principle: Power/DC transducing type Power consumption Current coil: 1VA (at 5A) Voltage coil: 3.5VA	FRN-60W3	FRN-80W3	FRN-100W3	FRN-120W3
3-phase 3-wire varmeter	For connection to VT and CT Measuring range 0 – Zkvar Z= 0.5 x X/5 x Y/110 Z: kvar X: CT primary current Y: VT primary voltage	• Operating principle: Power/DC transducing type Power consumption Current coil: 1VA (at 5A) Voltage coil: 3.5VA	FRN-60VR3	FRN-80VR3	FRN-100VR3	FRN-120VR3

Meter	Description		60mm square Type	80mm square Type	100mm square Type	120mm square Type
3-phase 3-wire power factor meter (for balanced circuit)	For connection to VT and CT Measuring range Lead 0.5 – 1 – 0.5Lag VT ratio = Y/110V CT ratio = X/5A	• Operating principle: Power/DC transducing type Power consumption Current coil: 1VA Voltage coil: 1VA	FR-60PF3	FR-80PF3	FR-100PF3	FR-120PF3
Frequency meter	Measuring range 44 – 55Hz 110 or 220V 55 – 65Hz 110 or 220V 45 – 65Hz 110 or 220V	• Operating principle: Power/DC transducing type (built-in) Power consumption 1.7VA at 110V 2.5VA at 220V	FRN-60F	FRN-80F	FRN-100F	FRN-120F

■ Type number nomenclature (Ordering code)



■ Ordering information

Specify the following:

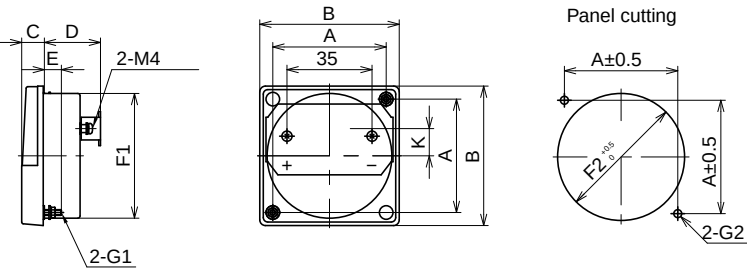
1. Type number (Ordering code)
2. Measuring range
3. Supply voltage and frequency
4. Connection (When connecting to VT or CT, specify VT ratio or CT ratio)

Panel Instruments

F type

■ Dimensions, mm

AC/DC ammeter, AC/DC voltmeter



• Rectifier type

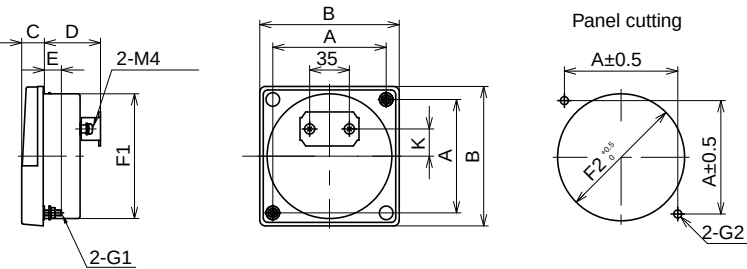
Type	A	B	C	D	E	F1	F2	G1	G2	K	Mass (g)
FRN • FMN-60	48	60	14.5	37.5	10	ø 52	ø 54 hole	M3 screw	ø 4 hole	6	90
FRN • FMN-80	64	80	14.5	37.5	10	ø 65	ø 67 hole	M3 screw	ø 4 hole	0	125
FRN • FMN-100	80	100	16	39	15	ø 85	ø 87 hole	M4 screw	ø 5.5 hole	0	180
FRN • FMN-120	100	123	20	49.5	15	ø 110	ø 112 hole	M5 screw	ø 7 hole	0	350

• Moving iron type

Type	A	B	C	D	E	F1	F2	G1	G2	K	Mass (g)
FSN-60	48	60	14.5	47.5	10	ø 52	ø 54 hole	M3 screw	ø 4 hole	6	130
FSN-80	64	80	14.5	47.5	10	ø 65	ø 67 hole	M3 screw	ø 4 hole	0	165
FSN-100	80	100	16	49.5	15	ø 85	ø 87 hole	M4 screw	ø 5.5 hole	15	260
FSN-120	100	123	20	49.5	15	ø 110	ø 112 hole	M5 screw	ø 7 hole	24	370

60/80mm square type

Wattmeter / Varmeter

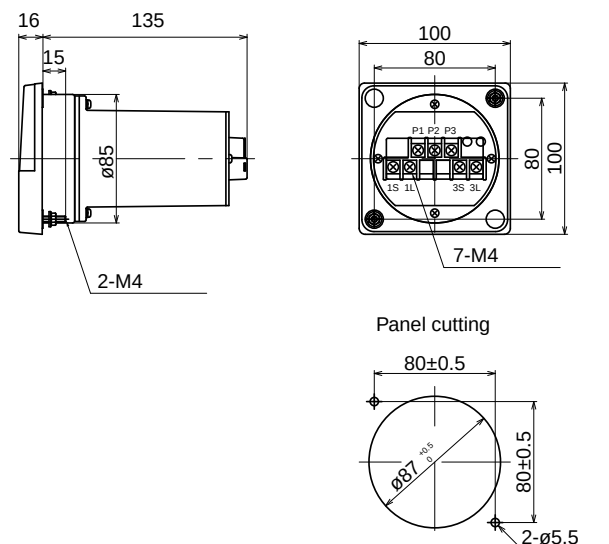


Type	A	B	C	D	E	F1	F2	G1	G2	K	Mass (g)
F□N-60	48	60	14.5	37.5	10	ø52	ø54 hole	M3 screw	ø4 hole	6	130
F□N-80	64	80	14.5	37.5	10	ø65	ø67 hole	M3 screw	ø4 hole	0	165

■ Dimensions, mm

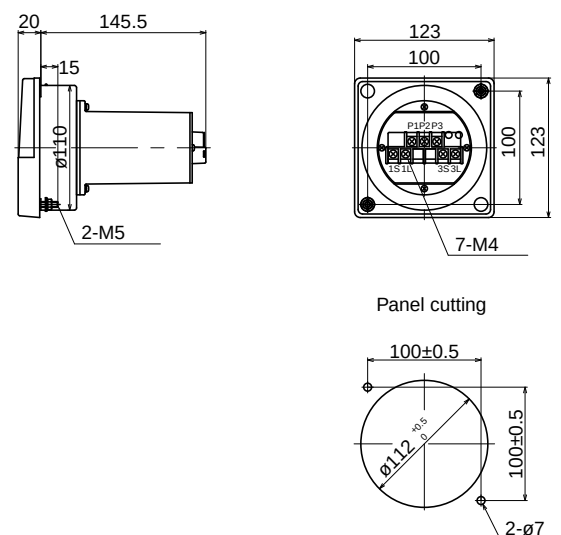
100mm square type

Wattmeter / Varmeter / 3-phase, 3-wire power factor meter



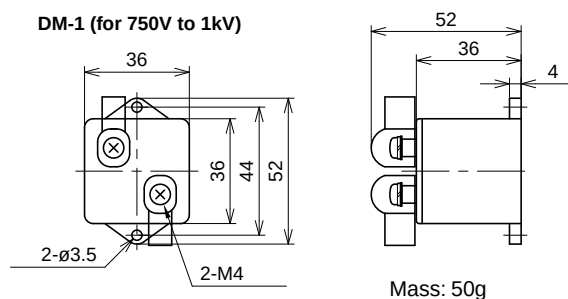
120mm square type

Wattmeter / Varmeter / 3-phase, 3-wire power factor meter

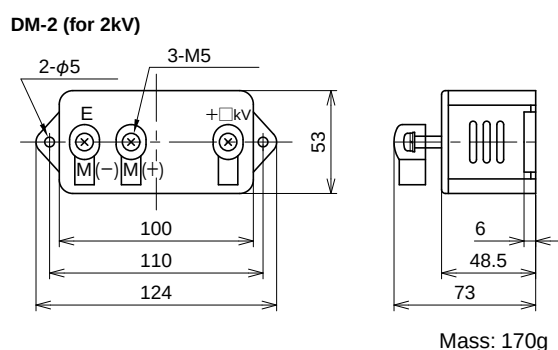


Series resistor for AC/DC voltmeter

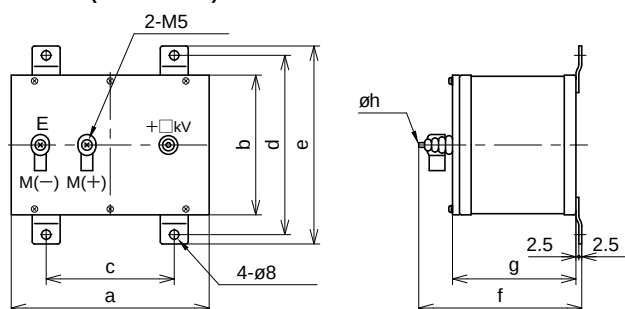
DM-1 (for 750V to 1kV)



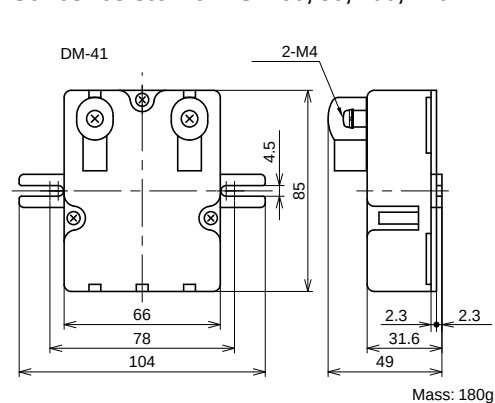
DM-2 (for 2kV)



DM-5 to 25 (for 3 to 25kV)



Series resistor for FSN-60, 80, 100, 120



Type	Rating	a	b	c	d	e	f	g	h	Mass
DM-5	3 to 5kV	170	120	110	154	170	140	106	4	1.0kg or less
DM-10	6 to 10kV	220	160	140	194	210	140	106	4	1.5kg or less
DM-15	12 to 15kV	290	210	200	248	264	190	146	5	2.0kg or less
DM-20	20kV	390	260	300	294	310	220	176	5	3.0kg or less
DM-25	25kV	500	330	400	356	372	280	236	5	3.5kg or less

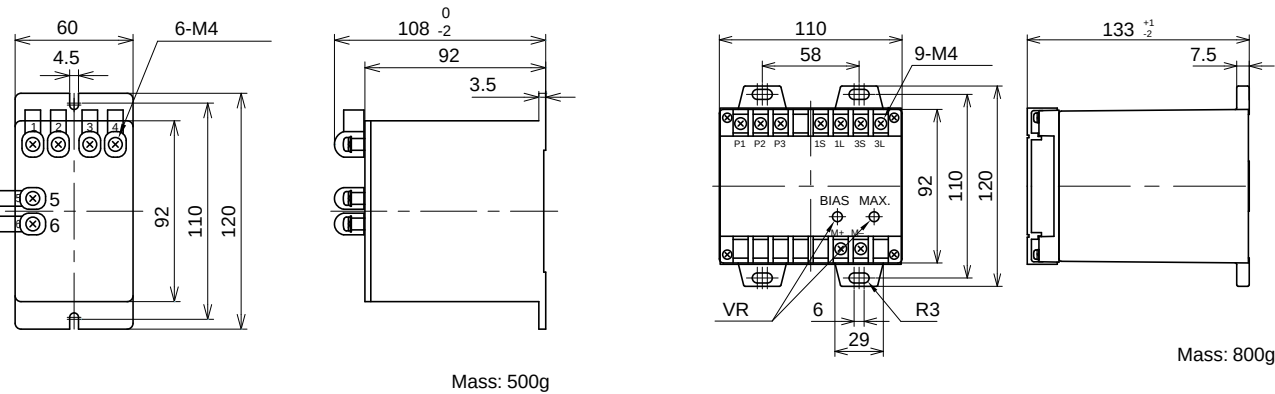
Panel Instruments

F type

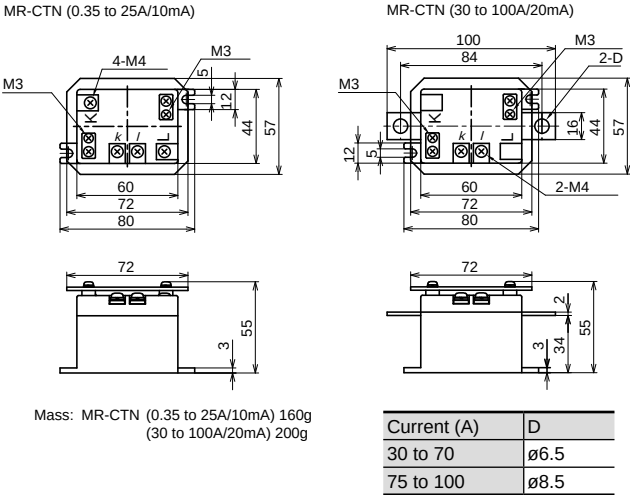
■ Dimensions, mm

DC converter

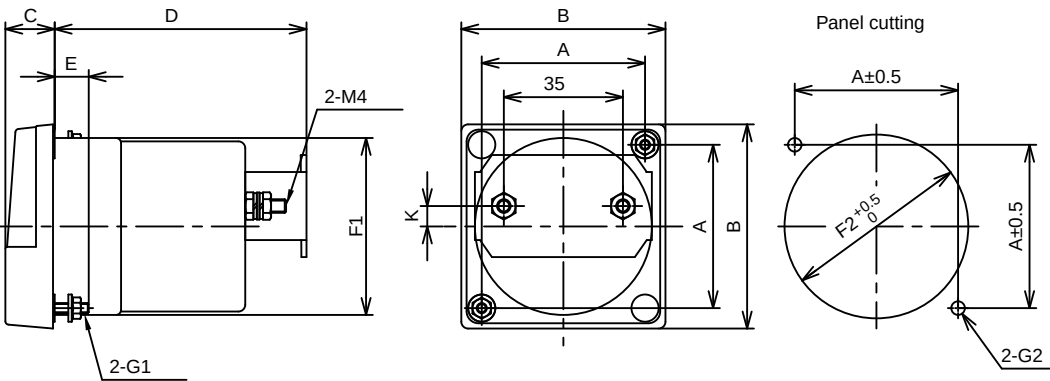
- For Singe-phase, 2-wire wattmeter
- For 3-phase, 3-wire power factor meter (balanced circuit)
- For 3-phase, 3-wire wattmeter meter
- For 3-phase, 3-wire varmeter



CT for AC ammeter



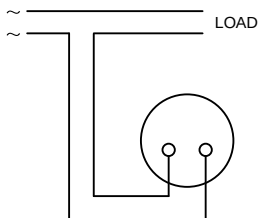
Frequency meter



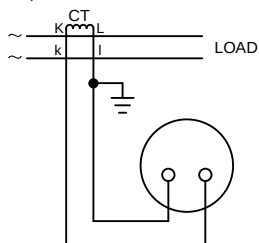
Type	A	B	C	D	E	F1	F2	G1	G2	K	Mass (g)
FRN-60F	48	60	14.5	74	10	ø52	ø54	M3 screw	ø4	6	150
FRN-80F	64	80	14.5	74	10	ø65	ø67	M3 screw	ø4	0	180
FRN-100F	80	100	16	75.5	15	ø85	ø87	M4 screw	ø5.5	0	300
FRN-120F	100	123	20	86	15	ø110	ø112	M5 screw	ø7	0	420

■ Wiring diagrams
Ammeter, voltmeter

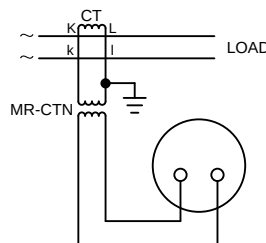
AC ammeter
(For direct connection)



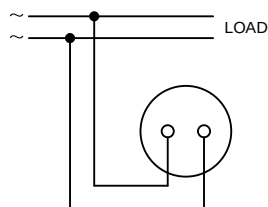
AC ammeter
(For connection to CT or MR-CTN)



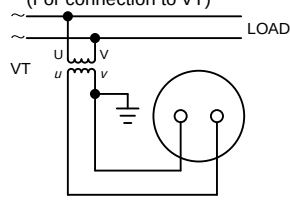
AC ammeter
(For connection to CT and MR-CTN)



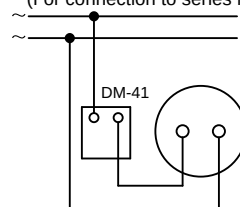
AC voltmeter



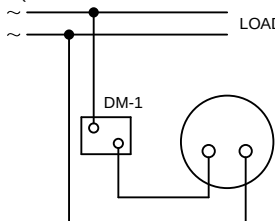
AC voltmeter
(For connection to VT)



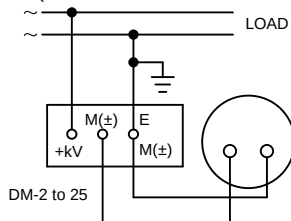
AC voltmeter 600V (FSN type)
(For connection to series resistor)



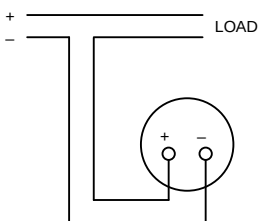
AC voltmeter 750V to 1kV (FRN type)
(For connection to series resistor)



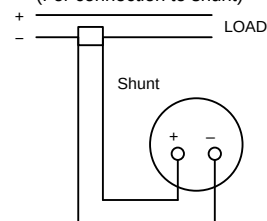
AC voltmeter 3 to 25kV (FRN type)
(For connection to series resistor)



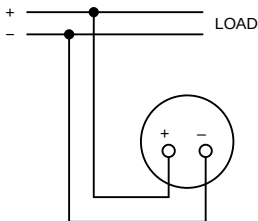
DC ammeter



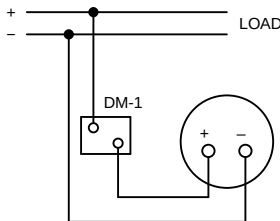
DC ammeter
(For connection to shunt)



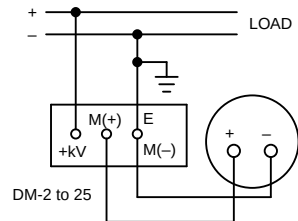
DC voltmeter



AC voltmeter
(For connection to series resistor (DM1))



AC voltmeter
(For connection to series resistor (DM2 to DM25))



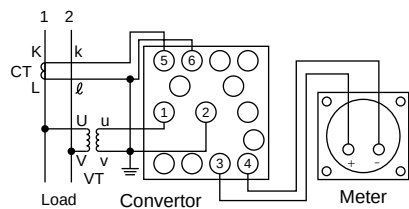
Panel Instruments

F type

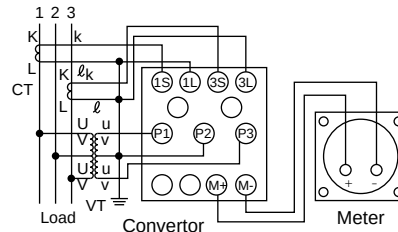
■ Wiring diagrams

Wattmeter

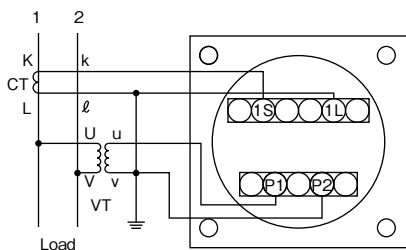
• FRN-60W1, FRN-80W1



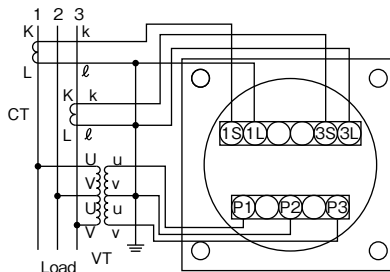
• FRN-60W3, FRN-80W3



• FRN-100W1, FRN-120W1

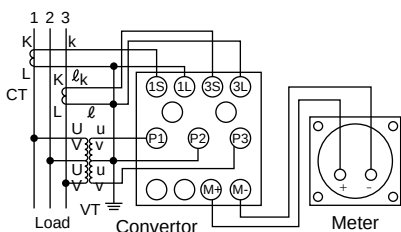


• FRN-100W3, FRN-120W3

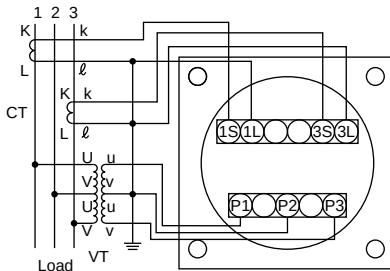


Varmeter

• FRN-60VR3, FRN-80VR3

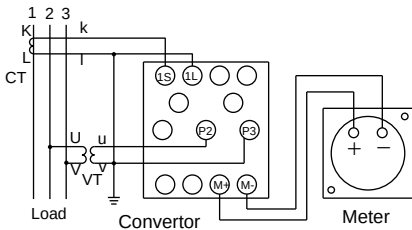


• FRN-100VR3, FRN-120VR3

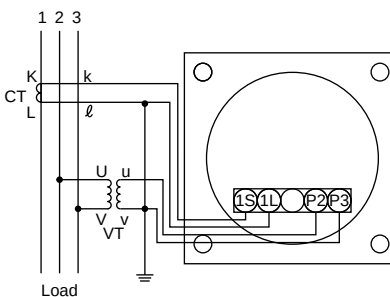


Power factor meter

• FRN-60PF3, FRN-80PF3



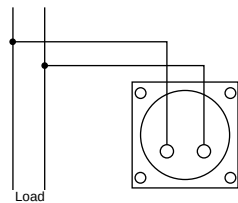
• FRN-100PF3, FRN-120PF3



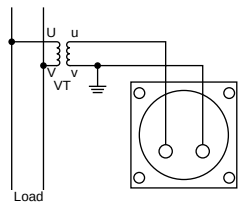
■ Wiring diagrams

Frequency meter

(For direct connection)



(For connection to VT)



Transducers

C series

C series transducers

■ Description

FUJI C series transducers are designed to convert various electrical characteristics of circuits into DC signals. Input and output circuits are isolated from each other. These transducers are ideal for handling the analog data input of microcomputer-incorporated control devices. Distorted waveforms from electronic power control devices can be accurately converted to DC signals with the innovative conversion methods used. (The r.m.s.-value method for voltage and current conversion, time-division multiplication for power conversion and differential method for frequency conversion.)

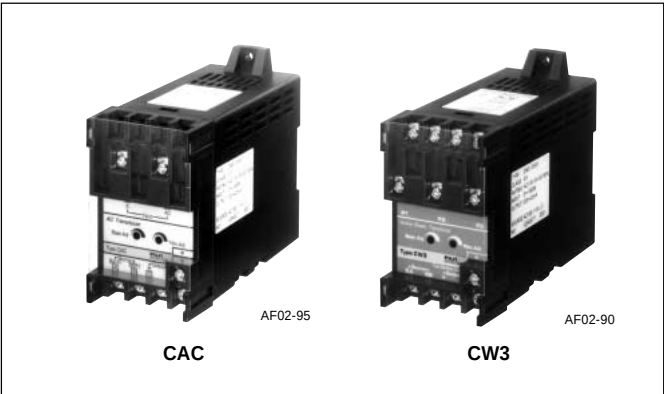
■ Features

- Superb-quality, high-reliability design
- Complete isolation between input and output
- Strong construction
- Provided with terminal protective covers

■ Specifications and types

• AC voltage and current transducers/CAC

Accuracy: 0.5%
Response time: 1.3s or less
Insulation resistance: 100MΩ, 500V megger
Dielectric strength: 2000V AC, 1 min. between input and output circuits, between input circuit and power supply
2000V AC, 1 min. between output circuit and power supply, output circuit and case (earth terminals)
Ambient temperature and humidity: -10 to +50°C, 90% RH or less (no condensation)

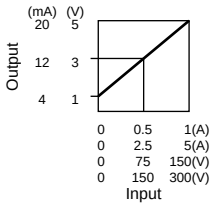


Input (AC)		Output (DC) (Load resistance)	Conversion method (▲)	Control (●) power supply	Type *
Voltage or current (□)	Power consumption				
AC voltage 0-150V 50/60Hz (150) 0-300V 50/60Hz (300)	0.45VA	1-5V (1kΩ or more) (A) 0-5V (1kΩ or more) (B) 0-10V (2kΩ or more) (C) 4-20mA (500Ω or less) (H)	Effective value method (1) Mean value method (2)	100/110V AC 50/60Hz (1) or 200/220V AC 50/60Hz (2)	CAC-□■●▲1
AC current 0-1A (010) 0-5A (050)	0.1VA	1-5V (1kΩ or more) (A) 0-5V (1kΩ or more) (B) 0-10V (2kΩ or more) (C) 4-20mA (500Ω or less) (H)	Effective value method (1) Mean value method (2)	Approx. power consumption 2VA	CAC-□■●▲1

Note: * Replace the marks □ ■ ● ▲ in the type number by codes indicated in parenthesis.

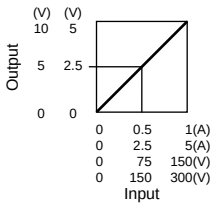
Input-output

Input	Output
0-1A	1-5V
0-5A	4-20mA
0-150V	
0-300V	



Input-output

Input	Output
0-1A	0-5V
0-5A	0-10V
0-150V	
0-300V	



• Frequency transducers/CF1

Accuracy: 0.5%

Response time: 1s or less

Insulation resistance: 100MΩ or more, 500V megger

Dielectric strength: 2000V AC, 1 min. between input and output circuits, between input circuit and power supply
2000V AC, 1 min. between output circuit and power supply, output circuit and case (earth terminals)

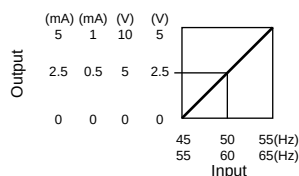
Ambient temperature and humidity: -10 to +50°C, 90% RH or less (no condensation)

Input		Output (DC) (■)	Control power supply (●)	Type *
Voltage and frequency (□)	Power consumption	(Load resistance)		
110V 45Hz–110V 55Hz(115) 110V 55Hz–110V 65Hz(116) 220V 45Hz–220V 55Hz(225) 220V 55Hz–220V 65Hz(226)	0.3VA	1–5V (1kΩ or more) (A) 0–5V (1kΩ or more) (B) 0–10V (2kΩ or more) (C) 4–20mA (600Ω or less) (H) 0–1mA (10kΩ or less) (J) 0–5mA (2kΩ or less) (K)	100/110V AC 50/60Hz (1) or 200/220V AC 50/60Hz (2) 24V DC ±10% (3) None (9) Approx. power consumption 2.1VA	CF1-□■●

Note: * Replace the marks □ ■ ● ▲ in the type number by codes indicated in parenthesis.

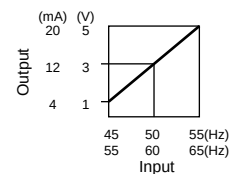
Input-output

Input	Output
45–55Hz	0–5V 0–10V 0–1mA 0–5mA
55–65Hz	



Input-output

Input	Output
45–55Hz	1–5V 4–20mA
55–65Hz	



Transducers
C series

• Active and reactive power transducers/CW, CR

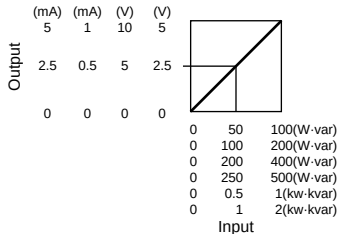
Accuracy: 0.5%
Response time: 0.5s or less
Insulation resistance: 100MΩ, 500V megger
Dielectric strength: 2000V AC, 1 min. between input and output circuits, between input circuit and power supply
2000V AC, 1 min. between output circuit and power supply, output circuit and case (earth terminals)
Ambient temperature and humidity: -10 to +50°C, 90% RH or less (no condensation)

Description		Input (AC)						Output (DC) 		Control  power supply	Type *		
Active or reactive power	Circuit	Voltage	Current	Power 		Frequency 	Power consumption Voltage Current						
Active power	Single phase 2-wire	110V	1A	0–100W (11)		50Hz	(5)	Approx. 0.35VA	Approx. 0.2VA	1 – 5V (1kΩ or more) (A)	100/110V AC 50/60Hz (1)	CW1-    	
		110V	5A	0–500W (15)		or 60Hz	(6)	(110V)	(5A)	0 – 5V (1kΩ or more) (B)			
		220V	1A	0–200W (21)						– 5 – 0– +5V (1kΩ or more) (S)	200/ 220V AC 50/60Hz (2)		
		220V	5A	0–1kW (25)									
	3-phase 3-wire	110V	1A	0–200W (11)		50Hz	(5)	Approx. 2×0.35VA	Approx. 2×0.2VA	0 – 10V (2kΩ or more) (C)	24V DC±10% (3)	CW3-    	
		110V	5A	0–1kW (15)		or 60Hz	(6)	(110V)	(5A)		110V DC±10% Except CW4(4)		
		220V	1A	0–400W (21)						4 – 20mA (600Ω or less) (H)	None (9)		
		220V	5A	0–2kW (25)									
	3-phase 4-wire	110V	1A	0–200W (11)		50Hz	(5)	Approx. 3×0.35VA	Approx. 3×0.2VA	0 – 1mA (10kΩ or less) (J)	Approx. power consumption CW1: 1.8VA CW3: 1.9VA CW4: 2VA	CW4-    	
		110V	5A	0–1kW (15)		or 60Hz	(6)	(110V)	(5A)	0 – 5mA (2kΩ or less) (K)			
		220V	1A	0–400W (21)									
		220V	5A	0–2kW (25)									
Reactive power	Single phase 2-wire	110V	1A	0–100var (11)		50Hz	(5)	Approx. 0.35VA	Approx. 0.2VA	1 – 5V (1kΩ or more) (A)	100/110V AC 50/60Hz (1)	CR1-    	
		110V	5A	0–500var (15)		or 60Hz	(6)	(110V)	(5A)	0 – 5V (1kΩ or more) (B)			
		220V	1A	0–200var (21)						– 5 – 0– +5V (1kΩ or more) (S)	200/220V AC 50/60Hz (2)		
		220V	5A	0–1kvar (25)									
	3-phase 3-wire	110V	1A	0–200var (11)		50Hz	(5)	Approx. 2×0.35VA	Approx. 2×0.2VA	0 – 10V (2kΩ or more) (C)	24V DC±10% (3)	CR3-    	
		110V	5A	0–1kvar (15)		or 60Hz	(6)	(110V)	(5A)		None (9)		
		220V	1A	0–400var (21)						4 – 20mA (600Ω or less) (H)			
		220V	5A	0–2kvar (25)									
	3-phase 4-wire	110V	1A	0–200var (11)		50Hz	(5)	Approx. 3×0.35VA	Approx. 3×0.2VA	0 – 1mA (10kΩ or less) (J)	Approx. power consumption CR1: 1.8VA CR3: 1.9VA CR4: 2.0VA	CR4-    	
		110V	5A	0–1kvar (15)		or 60Hz	(6)	(110V)	(5A)	0 – 5mA (2kΩ or less) (K)			
		220V	1A	0–400var (21)									
		220V	5A	0–2kvar (25)									

Note: * Replace the marks □ ■ ● ▲ in the type number by codes indicated in parenthesis.

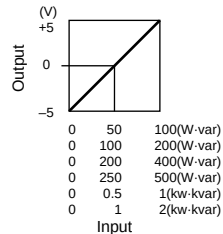
Input-output

Input	Output
0–100W·var	0–5V
0–200W·var	0–10V
0–400W·var	0–1mA
0–500W·var	0–5mA
0–1kW·kvar	
0–2kW·kvar	



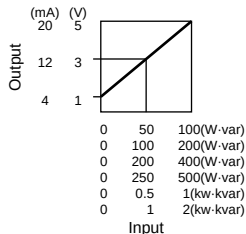
Input-output

Input	Output
0–100W·var	–5–0–+5V
0–200W·var	
0–400W·var	
0–500W·var	
0–1kW·kvar	
0–2kW·kvar	



Input-output

Input	Output
0–100W·var	1–5V
0–200W·var	4–20mA
0–400W·var	
0–500W·var	
0–1kW·kvar	
0–2kW·kvar	



• Power factor transducers/CC

Accuracy: 3.0%

Response time: 0.7s or less

Insulation resistance: 100MΩ or more, 500V megger

Dielectric strength: 2000V AC, 1 min. between input and output circuits, between input circuit and power supply

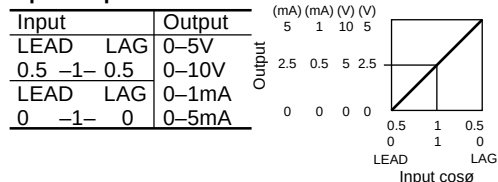
2000V AC, 1 min. between output circuit and power supply, output circuit and case (earth terminals)

Ambient temperature and humidity: -10 to +50°C, 90% RH or less (no condensation)

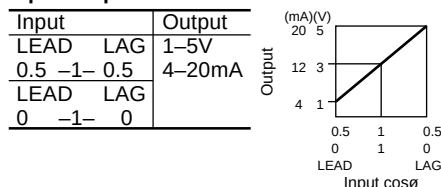
Description		Input (AC)					Output (DC) (●)		Control (▲)	Type	
Power factor	Circuit	Voltage Current (□)			Power factor (■)	Frequency	Power consumption Voltage Current		Load resistance	power supply	
	Single phase 2-wire	110V	1A	(11)	LEAD LAG 0.5 — 1 — 0.5 (5) 0 — 1 — 0 (0)	50/60Hz	Approx. 0.35VA (110V)	Approx. 0.25VA (5A)	1 – 5V (A)	100/110V AC 50/60Hz (1)	CC1-□■●▲
		110V	5A	(15)					0 – 5V (B)		
		220V	1A	(21)					(1 kΩ or more)		
		220V	5A	(25)					– 5 – 0 – +5V (S)		
	3-phase 3-wire	110V	1A	(11)			Approx. 2×0.35VA (110V)	Approx. 2×0.25VA (5A)	0 – 10V (C)	24V DC±10% (3)	CC3-□■●▲
		110V	5A	(15)					(2kΩ or more)		
		220V	1A	(21)					4 – 20mA (H)		
		220V	5A	(25)					(600Ω or less)		
	3-phase 4-wire	110V	1A	(11)			Approx. 3×0.35VA (110V)	Approx. 3×0.25VA (5A)	0 – 1mA (J)	Approx. power consumption 2.2VA	CC4-□■●▲
		110V	5A	(15)					(10kΩ or less)		
		220V	1A	(21)					0 – 5mA (K)		
		220V	5A	(25)					(2kΩ or less)		

Note: * Replace the marks □ ■ ● ▲ in the type number by codes indicated in parenthesis.

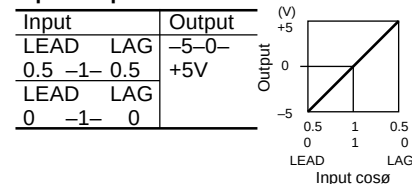
Input-output



Input-output



Input-output



Transducers
C series

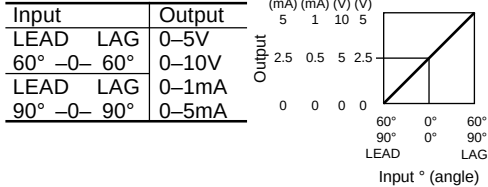
• Phase angle transducers/CP

Accuracy: 3.0%
Response time: 0.7s or less
Insulation resistance: 100MΩ or more, 500V megger
Dielectric strength: 2000V AC, 1 min. between input and output circuits, between input circuit and power supply
2000V AC, 1 min. between output circuit and power supply, output circuit and case (earth terminals)
Ambient temperature and humidity: -10 to +50°C, 90% RH or less (no condensation)

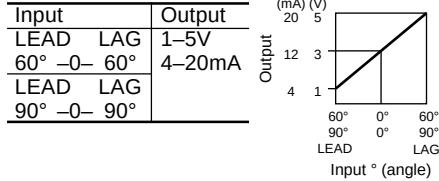
Description		Input (AC)				Output (DC)		Control	Type
Phase angle	Circuit	Voltage	Current (□)	Phase angle (■)	Frequency	Power consumption Voltage	Power consumption Current	Load resistance (●)	
	Single phase 2-wire	110V	1A (11)	LEAD LAG 60° — 0 — 60° (6) 90° — 0 — 90° (9)	50/60Hz	Approx. 0.35VA (110V)	Approx. 0.25VA (5A)	1 – 5V (A)	CP1-□■●▲
		110V	5A (15)					(1kΩ or more)	
		220V	1A (21)					0 – 5V (B)	
		220V	5A (25)					(1kΩ or more)	
	3-phase 3-wire	110V	1A (11)			Approx. 2×0.35VA (110V)	Approx. 2×0.25VA (5A)	– 5 – 0 – +5V (S)	CP3-□■●▲
		110V	5A (15)					(1kΩ or more)	
		220V	1A (21)					0 – 10V (C)	
		220V	5A (25)					(2kΩ or more)	
	3-phase 4-wire	110V	1A (11)			Approx. 3×0.35VA (110V)	Approx. 3×0.25VA (5A)	4 – 20mA (H)	CP4-□■●▲
		110V	5A (15)					(600Ω or less)	
		220V	1A (21)					0 – 1mA (J)	
		220V	5A (25)					(10kΩ or less)	
		220V	1A (21)					0 – 5mA (K)	
		220V	5A (25)					(2kΩ or less)	
								Approx. power consumption 2.2VA	

Note: * Replace the marks □ ■ ● ▲ in the type number by codes indicated in parenthesis.

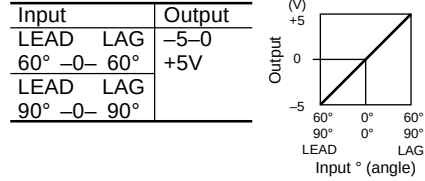
Input-output



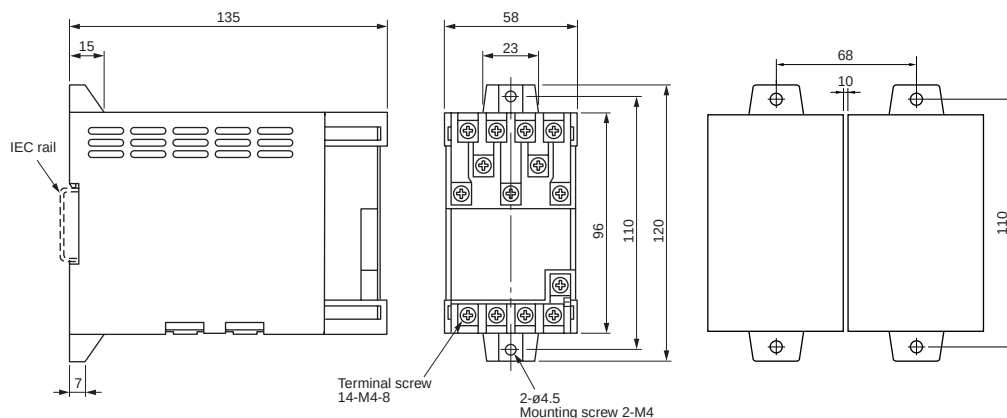
Input-output



Input-output



■ Dimensions, mm

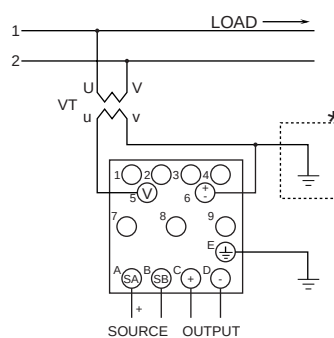


■ Mass

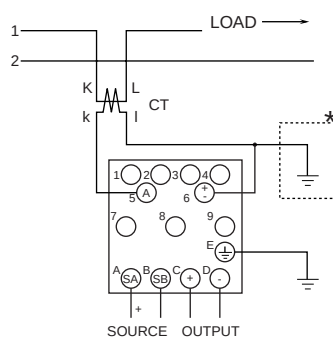
Type	Mass
CAC	0.3kg
CW1, CW3, CW4	0.5kg
CR1, CR3, CR4	0.5kg
CF1	0.4kg
CC1	0.5kg
CC3, CC4	0.55kg
CP1	0.5kg
CP3, CP4	0.55kg

■ Wiring diagrams

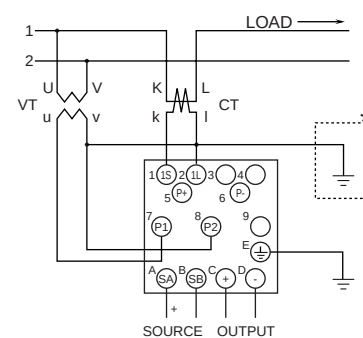
CAC (Voltage input), CF1



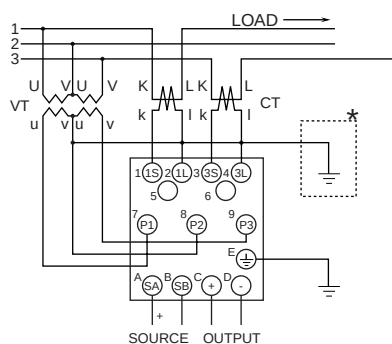
CAC (Current input)



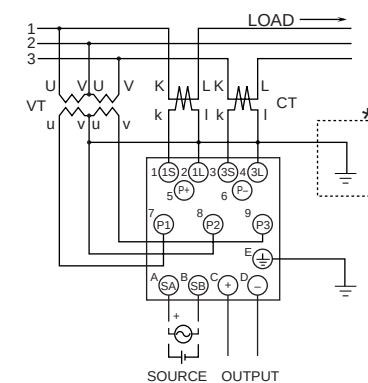
CW1, CR1, CC1, CP1



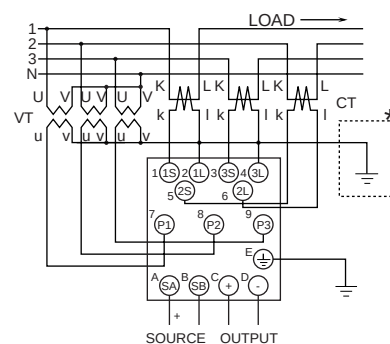
CR3, CC3, CP3 (3-phase, 3-wire)



CW3 (3-phase, 3-wire)



CR4, CC4, CP4, CW4 (3-phase, 4-wire)



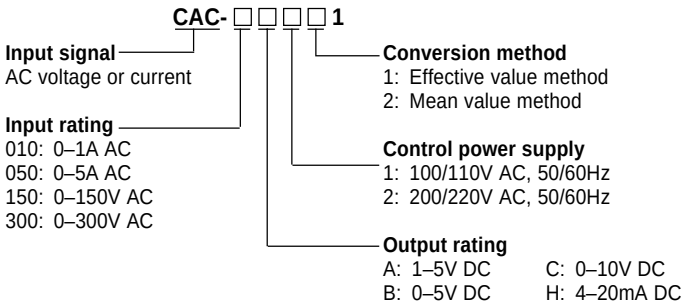
Note: * Never ground when VT and CT are not used.

Transducers

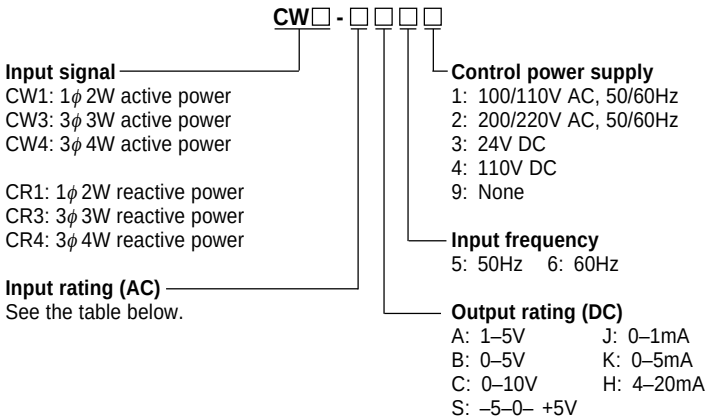
C series

■ Type number nomenclature

• AC voltage and current transducers



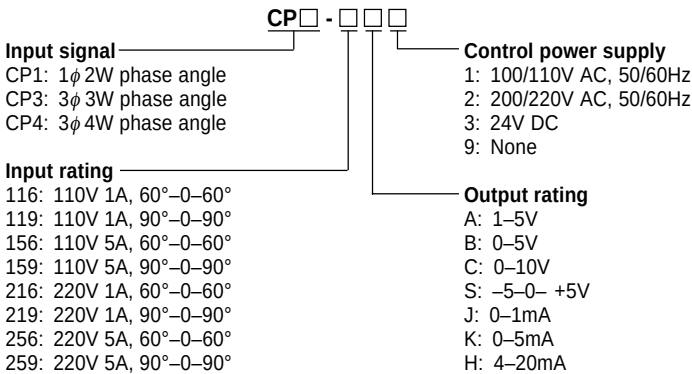
• Active and reactive power transducers



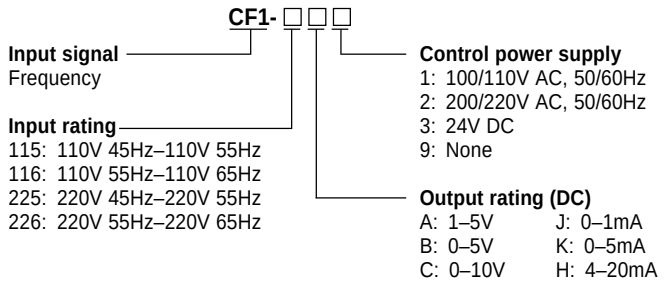
Input ratings (AC)

Code	Voltage (V)	Current (A)	Active power (W)		Reactive power (var)	
			1 ϕ	3 ϕ 3W 3 ϕ 4W (CW1) (CW3, CW4)	1 ϕ	3 ϕ 3W 3 ϕ 4W (CR1) (CR3, CR4)
11	110	1	100	200	100	200
15	110	5	500	1000	500	1000
21	220	1	200	400	200	400
25	220	5	1000	2000	1000	2000

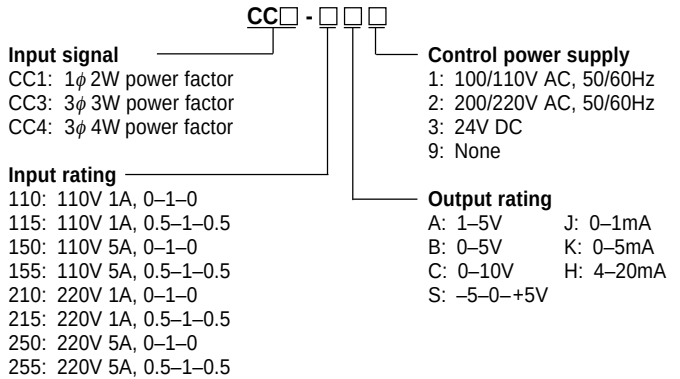
• Phase angle input transducers



• Frequency transducers



• Power factor transducers



■ Ordering information

Specify the following:

1. Type number
2. 3-phase or single-phase circuit

WF1MA self-powered, DC-isolated transducers

■ Features

- No power supply is required.
- Isolated between input and output circuits
- Snap-on mounting on IEC 35mm rail
- Safe, secured connection of screw terminal with cover

■ Specifications

• Conversion performance

Accuracy: $\pm 0.1\%$ FS (full scale)
 Temperature characteristic: $\pm 0.01\%/^{\circ}\text{C}$ FS (Typ.)
 Response: 50ms or less (0 to 90%)
 Load fluctuation: $+0.1\%/100\Omega$ or less (at 250Ω or less)
 $-0.1\%/100\Omega$ or less (at 250Ω or more)

• Input specifications

Input signal		Internal resistance	Max. allowable current
Current input	0 to 20mA DC (common with 4 to 20mA DC)	250Ω	30mA

• Output specifications

Output signal		Allowable load resistance
Current output	0 to 20mA DC (common with 4 to 20mA DC)	$1k\Omega$ or less

Internal voltage drop: 3.3V or less
 Ripple in output : 0.5% or less (at 250Ω , 200mA load)

• General specifications

Structure: Screw-terminal integrated structure
 Connection: M3.5 screw terminal
 Housing material: Black PC resin
 Insulation resistance:
 $100M\Omega$ or more (500V DC)
 Between input, output circuits, power supply, and ground
 Dielectric strength:
 1500V AC, 1min
 Between input, output circuits, power supply, and ground

• Installation specifications

Power supply: Not required
 Operating temperature: -5 to $+50^{\circ}\text{C}$
 Operating humidity: 90%RH or less (no condensation)
 Storage temperature: -10 to $+70^{\circ}\text{C}$
 Storage humidity: 60%RH or less (no condensation)

■ Ordering information

Specify the following:

1. Type number



■ Type number nomenclature

WF1MA-22 P 9 1

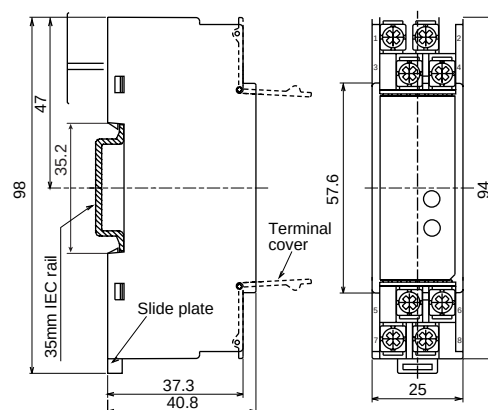
Input signal
 22: 0 to 20mA DC
 (common with 4 to 20mA DC)

Power supply
 9: None

Output signal
 P: 0 to 20mA DC
 (common with 4 to 20mA DC)

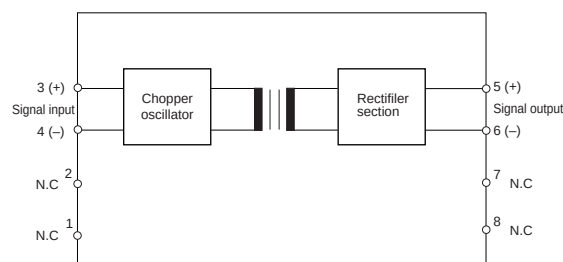
Note: The value of output signal is the same as that of the input signal (ratio: 1-1). Example: 4-20mA DC input — 4-20mA DC output

■ Dimensions, mm



Mass: Approx. 80g

■ Wiring diagram



Transducers
WF series

WF5HS high-speed, DC-isolated transducers

■ Features

- 3 ports isolated between input, output circuits, and power supply
- Snap-on mounting on IEC 35mm rail
- Saves wiring time by using push-terminal

■ Specifications

● Conversion performance

Accuracy: $\pm 0.25\%$ FS (full scale)
Temperature characteristic: $\pm 0.02\%/^{\circ}\text{C}$ FS (Typ.)
Response: 1ms or less (0 to 90%)

● Input specifications

Input signal		Input impedance
Voltage input	0 to 5V, 1 to 5V, 0 to 10V DC -10 to 10V, 0 to 1V, 0 to 100mV DC	Input impedance: 1M Ω or more
Current input	4 to 20mA DC	Internal resistance: 250 Ω

● Output specifications

Output signal		Allowable load resistance
Voltage output	0 to 5V, 1 to 5V DC 0 to 10V, -10 to 10V DC	550 Ω or more
Current output	4 to 20mA DC	550 Ω or less

Output adjustment – adjustable from front

Zero adjustment: -5 to +5%

Span adjustment: 95 to 105%

● General specifications

Structure: Push-terminal integrated structure

Connection: Push-terminal

Solid wire of 1.4mm dia., stranded wire of 1.5mm² or less

Housing material: Black polycarbonate resin

Insulation resistance:

100M Ω or more (500V DC)

Between input, output circuits, power supply, and ground

Dielectric strength:

1500V AC, 1min

Between input, output circuits, power supply, and ground

● Installation specifications

Power supply: 24V DC $\pm 0\%$, 80mA or less

Operating temperature: -5 to +50 $^{\circ}\text{C}$

Operating humidity: 90%RH or less (no condensation)

Storage temperature: -10 to +70 $^{\circ}\text{C}$

Storage humidity: 60%RH or less (no condensation)

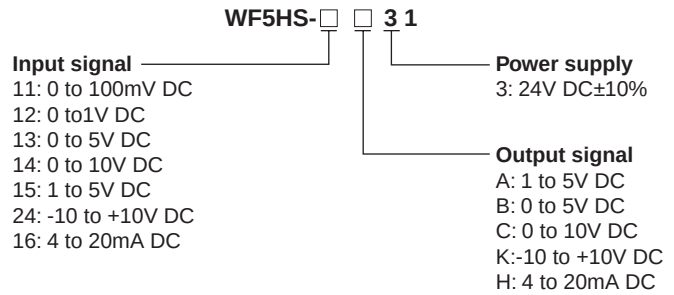
■ Ordering information

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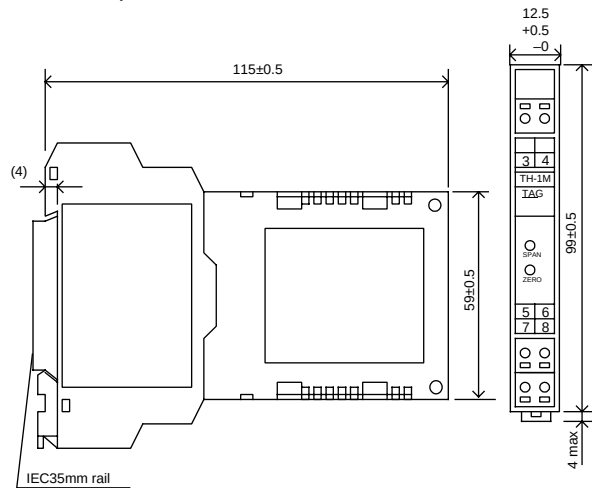
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■ Type number nomenclature

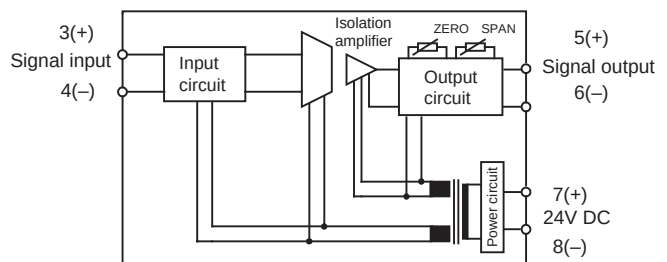


■ Dimensions, mm



Mass: Approx. 80g

■ Wiring diagram



WF5PM potentiometer transducers

■ Features

- WF5PM can be used irrespective of potentiometer's resistance, if the value is within the range between 100Ω and 10kΩ.
- 3 ports isolated between input, output circuits, and power supply
- Snap-on mounting on IEC 35mm rail
- Saves wiring time by using push-terminal

■ Specifications

● Conversion performance

Accuracy: $\pm 0.25\%$ FS (full scale)

Temperature characteristic: $\pm 0.02\%/^{\circ}\text{C}$ FS (Typ.)

Response: 50ms or less (0 to 90%)

● Input specifications

	Input signal	Input resistance
Potentiometer	100Ω to 10kΩ	0.5V

Note: No adjustment is required if it is used at all resistance values (0 to 100%) of potentiometers.

● Output specifications

	Output signal	Allowable load resistance
Voltage output	1 to 5V, 0 to 5V DC	2kΩ or more
	0 to 10V, -10 to +10V DC	4kΩ or more
Current output	4 to 20mA DC	550Ω or less

Output adjustment – adjustable from front

Zero adjustment: 0 to +5%

Span adjustment: 50 to 100%

● General specifications

Structure: Push-terminal integrated structure

Connection: Push-terminal

Solid wire of 1.4mm dia., stranded wire of 1.5mm² or less

Housing material: Black polycarbonate resin

Insulation resistance:

100MΩ or more (500V DC)

Between input, output circuits, power supply, and ground

Dielectric strength:

1500V AC, 1min

Between input, output circuits, power supply, and ground

● Installation specifications

Power supply: 24V DC $\pm 0\%$, 80mA or less

Operating temperature: -5 to +50°C

Operating humidity: 90%RH or less (no condensation)

Storage temperature: -10 to +70°C

Storage humidity: 60%RH or less (no condensation)

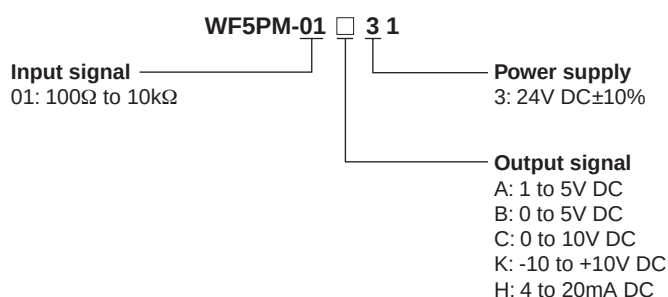
■ Ordering information

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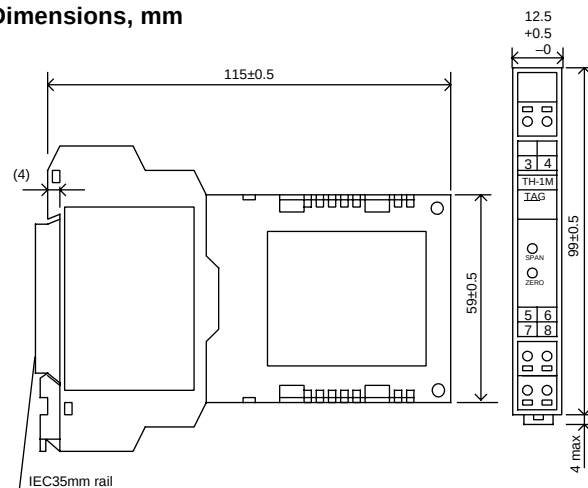
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■ Type number nomenclature

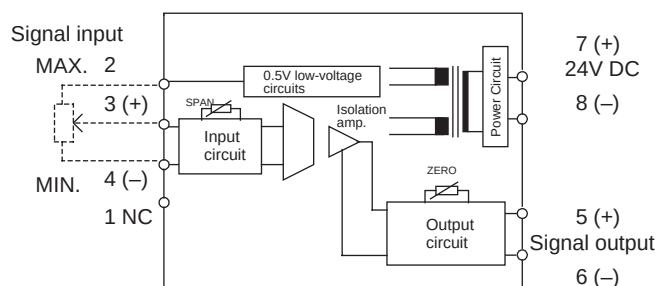


■ Dimensions, mm



Mass: Approx. 80g

■ Wiring diagram



Transducers

WF series

WF5MA self-powered, DC-isolated transducers

■ Features

- Analog process signal conversion to current output in 1:1 ratio
- No power supply is required.
- Snap-on mounting on IEC35mm rail
- Saves wiring time by using push-terminal

■ Specifications

● Conversion performance

Accuracy: $\pm 0.1\%$ FS (at res. load of 250Ω)

Temperature characteristic:

$\pm 0.01\%$ FS/ $^{\circ}\text{C}$ FS (at res. load of $250\Omega \pm 200\Omega$)

$\pm 0.04\%$ FS/ $^{\circ}\text{C}$ FS (at res. load of other than the above)

Load fluctuation:

+0.1% FS / 100Ω or less (at res. load of $\leq 250\Omega$ max.)

-0.1% FS / 100Ω or less (at res. load of $\geq 250\Omega$ min.)

+0.3% FS / 100Ω or less (at res. load of $\leq 50\Omega$ max.)

Response: 20ms or less (0 to 90%)

Internal voltage drop: 3V or less

● Input specifications

	Input signal	Internal resistance	Max. allowable input current
Current input	0 to 20mA DC, 4 to 20mA DC (common use)	250Ω	30mA at 30V DC

● Output specifications

	Output signal	Allowable load resistance
Current output	0 to 20mA DC, 4 to 20mA DC (common use)	$1k\Omega$ or less

● General specifications

Structure: Push-terminal integrated structure

Connection: Push-terminal

Solid wire of 1.4mm dia., stranded wire of 1.5mm^2 or less

Housing material: Black polycarbonate resin

Insulation resistance:

$100M\Omega$ or more (500V DC)

Between input, output circuits, power supply, and ground

Dielectric strength:

2000V AC, 1min

Between input, output circuits, power supply, and ground

● Installation specifications

Power supply: Not required

Operating temperature: -5 to $+50^{\circ}\text{C}$

Operating humidity: 90%RH or less (no condensation)

Storage temperature: -10 to $+70^{\circ}\text{C}$

Storage humidity: 60%RH or less (no condensation)

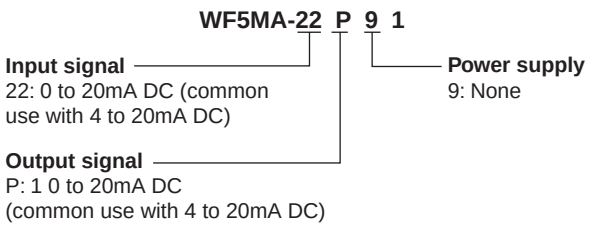
■ Ordering information

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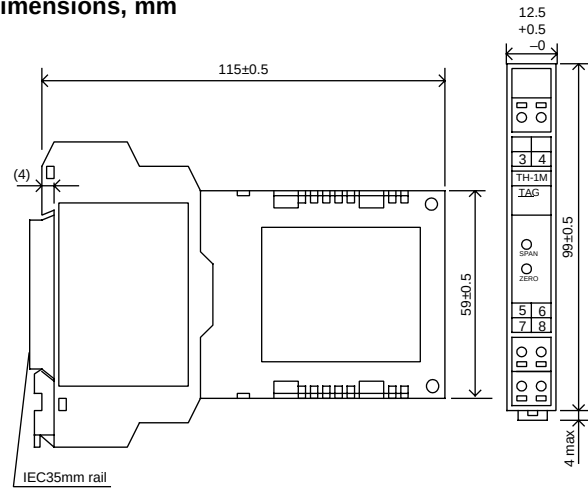
1. Type number



■ Type number nomenclature

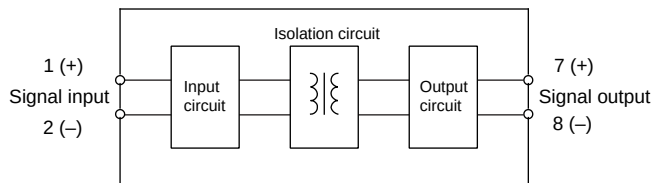


■ Dimensions, mm



Mass: Approx. 80g

■ Wiring diagram



WH7DC isolated DC transducers

■ Description

The WH7DC isolated DC transducer is designed to convert a DC voltage or current values into a DC signal. Input and output circuits are electrically isolated from each other. These transducers are ideal for the amplifying and isolating minute signals that are output from a variety of sensors.

■ Features

- Power supply of 24V DC. I/O circuits isolated from the power supply.

■ Applications

- Signal exchange between electrically isolated systems
- Prevention of control signal sneak currents
- Remote transmission of output signals

■ Standards

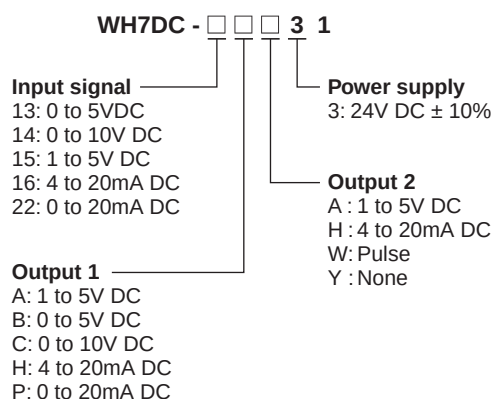
UL recognized and CSA File No. E206961

■ Specifications

Type		WH7DC
Insulation method		Photocoupler
Accuracy		±0.1% (Pulse output: ±0.2%)
Temperature characteristics		±0.015% /°C
Response time		0.5s max. (0 to 90%)
Insulation resistance		100MΩ or more (500V DC megger)
Dielectric strength		2000V AC, 1 min. between input-output-power supply and ground 1000V AC, 1 min. between output 1 and output 2
Auxiliary power supply		24V DC ±10%
Power consumption		Approx. 120mA at 24V DC
Ambient temperature and humidity		−5 to 55°C, 90% RH or less (no condensation)
Input signal (Input impedance)	Voltage	0 to 1V DC (1MΩ min.), 0 to 5V DC (1MΩ min.), 0 to 10V DC (1MΩ min.), 1 to 5V DC (1MΩ min.)
	Current	0 to 20mA DC (250Ω), 4 to 20mA DC (250Ω)
Output 1 (Load resistance)	Voltage	0 to 5V DC (1kΩ min.), 0 to 10V DC (2kΩ min.), 1 to 5V DC (1kΩ min.)
	Current	0 to 20mA DC (750Ω max.), 4 to 20mA DC (750Ω max.)
Output 2 (Load resistance)	Voltage	1 to 5V DC (1kΩ min.)
	Current	4 to 20mA DC (350Ω max.)
	Pulse output	Open collector signal: 0 to 0.01Hz min. and 1kHz max. with 100mA max. at 30V Shutdown frequency: 2% of full scale
Zero adjustment range: Approx. -5% to +5%		• Only output 1 is adjustable with the WH7AJ adjuster.
Span adjustment range: Approx. 95% to 105%		



■ Type number nomenclature



■ Ordering information

Specify the following:
1. Type number

■ Dimensions and wiring diagrams

See page 09/53.

Transducers

WH7 series

WH7TC thermocouple temperature transducers

■ Description

The WH7TC transducer converts a thermocouple input into a DC voltage or current signal output with reference point compensation of thermal-electromotive force. Input and output circuits are electrically isolated from each other.

■ Features

- Power supply of 24V DC. I/O circuits isolated from the power supply.
- Reference point compensation function, linearizer function, and upper limit burnout function

■ Applications

- Temperature input control of electric, gas, or heavy oil furnaces

■ Standards

UL recognized and CSA File No. E206961

■ Specifications

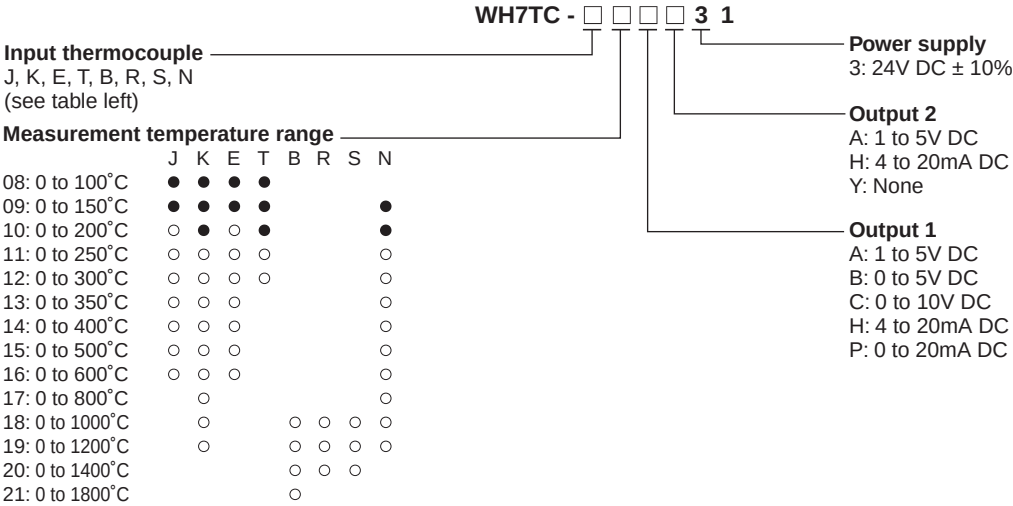
Type (Ordering code)	WH7TC	
Insulation method	Photocoupler	
Accuracy	±0.3% (±0.5% for low-range)	
Temperature characteristics	±0.02%/°C (±0.04% /°C for low-range)	
Response time	1s max. (0% to 90%)	
Reference point compensation accuracy	±1°C max.	
Burnout time	10s max.	
Permissible external resistance	10Ω max.	
Input thermocouple (Input impedance)	J, K, E, T, B, R, S, N (1MΩ min.)	
Output 1 (Load resistance)	Voltage	0 to 5V DC (1kΩ min.), 0 to 10V DC (2kΩ min.), 1 to 5V DC (1kΩ min.)
	Current	0 to 20mA DC (750Ω max.), 4 to 20mA DC (750Ω max.)
Output 2 (Load resistance)	Voltage	1 to 5V DC (1kΩ min.)
	Current	4 to 20mA DC (350Ω max.)
Zero adjustment range: Approx. -5% to +5%	Only output 1 is adjustable with the WH7AJ adjuster.	
Insulation resistance	100MΩ or more (500V DC megger)	
Dielectric strength	2000V AC, 1 min. between input-output-power supply and ground	
	1000V AC, 1 min. between output 1 and output 2	
Auxiliary power supply	24V DC ±10%	
Power consumption	Approx. 120mA at 24V DC	
Ambient temperature and humidity	-5 to 55°C, 90% RH or less (no condensation)	



■ Input thermocouple range

Thermocouple code	Available temperature	Min. measurable temperature range	Thermocouple code	Available temperature	Min. measurable temperature range	Thermocouple code	Available temperature	Min. measurable temperature range
J	-100 to 1000°C	100°C	T	-150 to 400°C	100°C	S	0 to 1760°C	500°C
K	-100 to 1200°C	100°C	B	0 to 1820°C	900°C	N	-100 to 1200°C	150°C
E	0 to 700°C	100°C	R	0 to 1760°C	500°C			

Type number nomenclature



- Note:
- Black circles ● indicate low-range types.
 - White circles ○ indicate standard-range types that can be manufactured (the guaranteed accuracy ranges of thermocouples R and B are over 400°C and 800°C respectively).
 - Compensation wires are used to compensate the difference in temperature between thermocouples and transducer terminals. Types of compensation wires are classified by color. Select the right one according to the thermocouple at site.
 - Each transducer is shipped in combination with an RJC temperature resistance thermometer block. Use them in pairs.
 - A transducer with a lower limit burnout function is available on request.
 - When the lower limit burnout function is triggered, the output of the transducer will scale out for a moment, then it will be set to the minimum value.

Ordering information

Specify the following:

1. Type number

Dimensions and wiring diagrams

See page 09/53.

Transducers
WH7 series

WH7PT resistance transducers

■ Descriptions

The WH7PT transducer converts resistance changes in a temperature resistance thermometer into a DC voltage or current signal. Input and output circuits are electrically isolated.

■ Features

- Power supply of 24V DC. I/O circuits isolated from the power supply.
- Linearizer function and upper limit burnout function

■ Applications

- Temperature input control from electric, gas, or heavy oil furnaces.
- Temperature input control of cold-storage warehouse.

■ Standards

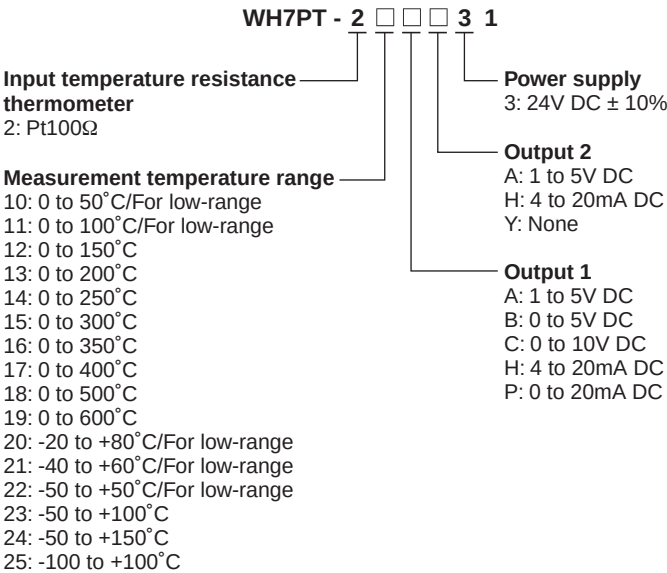
UL recognized and CSA File No. E206961

■ Specifications

Type (Ordering code)		WH7PT
Insulation method		Photocoupler
Accuracy		±0.2% (±0.4% for low-range, span 100°C max.)
Temperature characteristics		±0.02% /°C (±0.04% low-range)
Response time		1s max. (0% to 90%)
Burnout time		10s max.
Permissible external resistance		20Ω max. per wire (Use three wires with the same resistance.)
Input resistance thermometer		Pt100Ω
Output 1 (Load resistance)	Voltage	0 to 5V DC (1kΩ min.), 0 to 10V DC (2kΩ min.), 1 to 5V DC (1kΩ min.)
	Current	0 to 20mA DC (750Ω max.), 4 to 20mA DC (750Ω max.)
Output 2 (Load resistance)	Voltage	1 to 5V DC (1kΩ min.)
	Current	4 to 20mA DC (350Ω max.)
Zero adjustment range: Approx. -5% to +5%		Only output 1 is adjustable with the WH7AJ adjuster.
Insulation resistance		100MΩ or more (500V DC megger)
Dielectric strength		2000V AC, 1 min. between input-output-power supply and ground 1000V AC, 1 min. between output 1 and output 2
Auxiliary power supply		24V DC ±10%
Power consumption		Approx. 120mA at 24V DC
Ambient temperature and humidity		-5 to 55°C, 90% RH or less (no condensation)



■ Type number nomenclature



Note: When the lower limit burnout function is triggered, the output of the transducer will scale out for a moment, then it will be set to the minimum value.

■ Ordering information

Specify the following:

1. Type number

■ Dimensions and wiring diagrams

See page 09/53.

WH7PM potentiometer transducers

■ Description

The WH7PM transducer converts resistance changes in potentiometers into a DC voltage or current signal.

■ Features

- Power supply of 24V DC
- I/O circuits isolated from the power supply

■ Applications

- Float water gages
- Solenoid valve, gate, and damper valve opening meters
- Plunger pump and jack stroke detectors

■ Standards

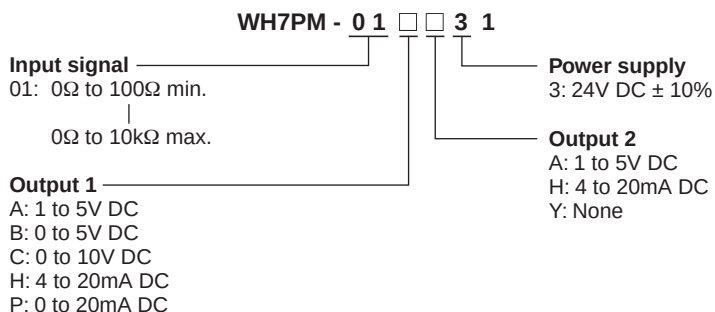
UL recognized and CSA File No. E206961

■ Specifications

Type	WH7PM	
Insulation method	Photocoupler	
Accuracy	±0.1%	
Temperature characteristics	±0.015% /°C	
Response time	0.5s max. (0% to 90%)	
Input signal	Entire resistance range of potentiometer 100Ω to 10kΩ	
Input span	50% min. of entire resistance range of potentiometer	
Output 1 (Load resistance)	Voltage	0 to 5V DC (1kΩ min.), 0 to 10V DC (2kΩ min.), 1 to 5V DC (1kΩ min.)
	Current	0 to 20mA DC (750Ω max.), 4 to 20mA DC (750Ω max.)
Output 2 (Load resistance)	Voltage	1 to 5V DC (1kΩ min.)
	Current	4 to 20mA DC (350Ω max.)
Zero adjustment range: Approx. -5% to +5%	Only output 1 is adjustable with the WH7AJ adjuster.	
Insulation resistance	100MΩ or more (500V DC megger)	
Dielectric strength	2000V AC, 1 min. between input-output-power supply and ground 1000V AC, 1 min. between output 1 and output 2	
Auxiliary power supply	24V DC ±10%	
Power consumption	Approx. 120mA at 24V DC	
Ambient temperature and humidity	-5 to 55°C, 90% RH or less (no condensation)	



■ Type number nomenclature



■ Ordering information

Specify the following:

1. Type number
2. Input signal range (Potentiometer resistance range)

■ Dimensions and wiring diagrams

See page 09/53.

WH7RV reverse transducers

■ Description

The WH7RV reverse transducer inversely converts an input signal into an output signal. Input and output circuits are electrically isolated from power supply.

■ Features

- Power supply of 24V DC.
I/O circuits isolated from the power supply.

■ Applications

- Reversing control operation from input
- Fail-safe circuits and output subtraction circuits

■ Standards

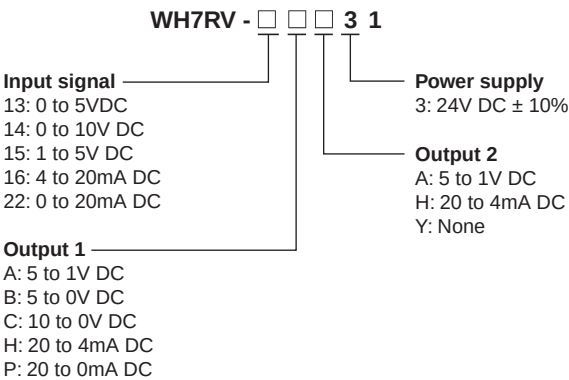
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■ Specifications

Type	WH7RV	
Insulation method	Photocoupler	
Accuracy	±0.1%	
Temperature characteristics	±0.015%/°C	
Response time	0.5s max. (0% to 90%)	
Input signal (Input impedance)	Voltage	0 to 5V DC (1MΩ min.), 0 to 10V DC (1MΩ min.), 1 to 5V DC (1MΩ min.)
	Current	0 to 20mA DC (250Ω), 4 to 20mA DC (250Ω)
Output 1 (Load resistance)	Voltage	5 to 0V DC (1kΩ min.), 10 to 0V DC (2kΩ min.), 5 to 1V DC (1kΩ min.)
	Current	20 to 0mA DC (750Ω max.), 20 to 4mA DC (750Ω max.)
Output 2 (Load resistance)	Voltage	5 to 1V DC (1kΩ min.)
	Current	20 to 4mA DC (350Ω max.)
Zero adjustment range: Approx. -5% to +5%	Only output 1 is adjustable with the WH7AJ adjuster.	
Insulation resistance	100MΩ or more (500V DC megger)	
Dielectric strength	2000V AC, 1 min. between input-output-power supply and ground	
	1000V AC, 1 min. between output 1 and output 2	
Auxiliary power supply	24V DC ±10%	
Power consumption	Approx. 120mA at 24V DC	
Ambient temperature and humidity	-5 to 55°C, 90% RH or less (no condensation)	



■ Type number nomenclature



■ Ordering information

Specify the following:
1. Type number

■ Dimensions and wiring diagrams
See page 09/53.

Transducers

WH7 series

WH7SP slow pulse transducers

■ Description

The WH7SP slow pulse transducers are designed to convert ON-OFF pulse and voltage pulse signals into a DC voltage or current signal, isolating input and output circuits.

■ Features

- Power supply of 24V DC, with dielectric strength 2000V AC for 1min and 4 ports isolated. (1000V AC for 1 min between output 1 and output 2)

■ Applications

- Flow rate control combined with various types of flow meters
- Monitoring automated machines and wind force combined with rotary encoder
- Speed control of rotating machines combined with pulse transmitter and controller

■ Specifications

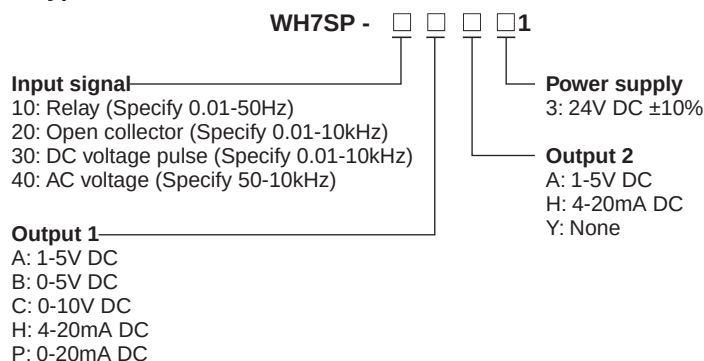
Type	WH7SP	
Insulation method	Photocoupler	
Accuracy	±0.1%	
Temperature characteristics	±0.015%/°C	
Response time	0.5s + twice of input cycle (0% to 90%)	
Shut down frequency	Approx. 5% of input frequency	
Input signal	ON/OFF pulse	Relay Open collector (NPN)
	DC voltage pulse	
		0.01 to 50Hz (pulse width: 10ms or more)
		0.01 to 10kHz (12V at OFF, approx. 3mA at ON)
		0.01 to 10kHz (Duty ratio 20-80% with pulse width 50μs or more, 2V ^{P-P} to 50V ^{P-P})
		AC voltage 50 to 10kHz (2V ^{P-P} to 50V ^{P-P})
Output 1 (Load resistance)	Voltage	0 to 5V DC (1kΩ min.), 0 to 10V DC (2kΩ min.), 1 to 5V DC (1kΩ min.)
	Current	0 to 20mA DC (750MΩ max.) 4 to 20mA DC (750MΩ max.)
Output 2 (Load resistance)	Voltage	1 to 5V DC (1kΩ min.)
	Current	4 to 20mA DC (350MΩ max.)
Zero adjustment range: Approx. -5% to +5%		Only the output 1 is adjustable with the WH7AJ adjuster.
Insulation resistance		100MΩ or more (500V DC megger)
Dielectric strength		2000V AC, 1 min. between input-output-power supply and ground 1000V AC, 1 min. between output 1 and output 2
Auxiliary power supply		24V DC ±10%
Power consumption		Approx. 120mA at 24V DC
Ambient temperature and humidity		-5 to 55°C, 90% RH or less (no condensation)



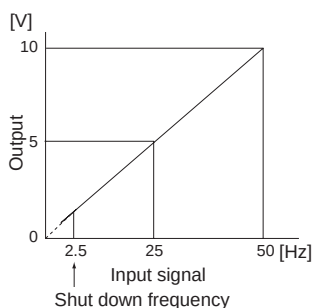
■ Standards

- UL recognized and CSA File No. E206961 (24V DC power supply models only)

■ Type number nomenclature



- Shut down frequency
 When the input frequency becomes too low against the full scale, the output ripple cannot be removed. Hence, when the input frequency becomes 5% lower than the full scale, the output is forcibly zero.



■ Ordering information

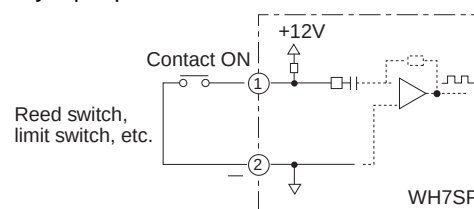
Specify the following:

1. Type number
2. Input frequency

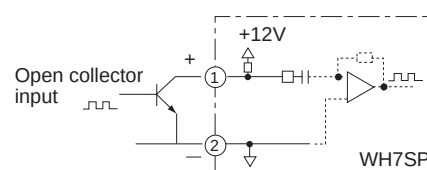
■ Input circuit diagram

● ON-OFF pulse input circuit

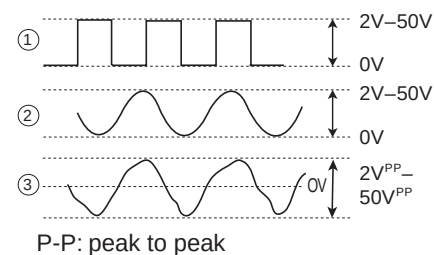
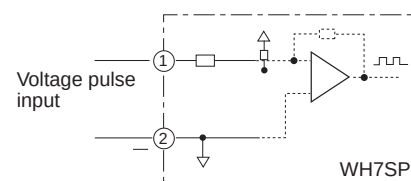
Relay input pulse



Open collector pulse



● Voltage pulse input circuit



■ Dimensions and wiring diagrams

See page 09/53.

WH7DY isolation type transducers

■ Description

The WH7DY transducers (isolation type distributor) are designed to use by combining 2-wire type transmitter. The WH7DY supplies DC power to the transmitters on site through signal line and converts 4 to 20mA DC signal generated by the transmitters into input signals suitable for monitoring and control equipment, isolating input and output circuits from each other. Pulse output signal can be output as the output 2.

■ Features

- Power supply of 24V DC, with dielectric strength 2000V AC for 1min and 4-port isolated. (1000V AC 1 min, between output 1 and output 2)
- Short-circuit protection

■ Specifications

Type	WH7DY	
Power supply fro transmitter	Voltage	24 to 28V DC at no load
	Current	Max. 22mA DC (short-circuit current: approx. 30mA)
	Ripple	0.1V ^{P-P} or less
	Allowable short-circuit time	No limitation
	Tolerance against load fluctuation	2% or less at 0 to 100% load
Insulation method	Photocoupler	
Accuracy	±0.1%	
Temperature characteristic	±0.02%/°C	
Response time	0.5s or less (0% to 90%)	
Input signal (input impedance)	4 to 20mA DC (250Ω)	
Input signal (with square root operation)	$Y = \sqrt{\frac{X = (\text{Input 0\% value})}{\text{Input span}}} \times \text{Output span} + (\text{Output 0\% value})$ Where: X = Input value, Y = Output value E.g. If input = 4-20mA, output range = 4-20mA; $\text{Output } Y = \sqrt{\frac{20 - 4}{16}} \times 16 + 4 = 20\text{mA}$	
Output 1 (Load resistance)	Voltage	0 to 5V DC (1kΩ min.), 0 to 10V DC (2kΩ min.), 1 to 5V DC (1kΩ min.)
	Current	0 to 20mA DC (500MΩ max.), 4 to 20mA DC (500MΩ max.)
Output 2 (Load resistance)	Voltage	1 to 5V DC (1kΩ min.)
	Current	4 to 20mA DC (350MΩ max.)
Zero adjustment range: Approx. -5% to +5%	Only the output 1 is adjustable with the WH7AJ adjuster.	
Insulation resistance	100MΩ or more (500V DC megger)	
Dielectric strength	2000V AC, 1 min. between input-output-power supply and ground 1000V AC, 1 min. between output 1 and output 2	
Auxiliary power supply	24V DC ±10%	
Power consumption	Approx. 120mA at 24V DC	
Ambient temperature and humidity	-5 to 55°C, 90% RH or less (no condensation)	

Note: *1 The addressing of RS-485 can be set by the WH7PD PC loader.
• When ordering, specify the output frequency. The frequency can also be changed by the WH7PD PC loader.



■ Standards

- UL recognized and CSA File No. E206961 (24V DC power supply models only)

■ Type number nomenclature

WH7DY - □ □ □ 1

Power supply for transmitter

01: 24-28V DC

02: 24-28V DC with square root operation

Output 1

A: 1-5V DC

B: 0-5V DC

C: 0-10V DC

H: 4-20mA DC

P: 0-20mA DC

Power supply

3: 24V DC $\pm 10\%$

Output 2

A: 1-5V DC

H: 4-20mA DC

W: Pulse

Y: None

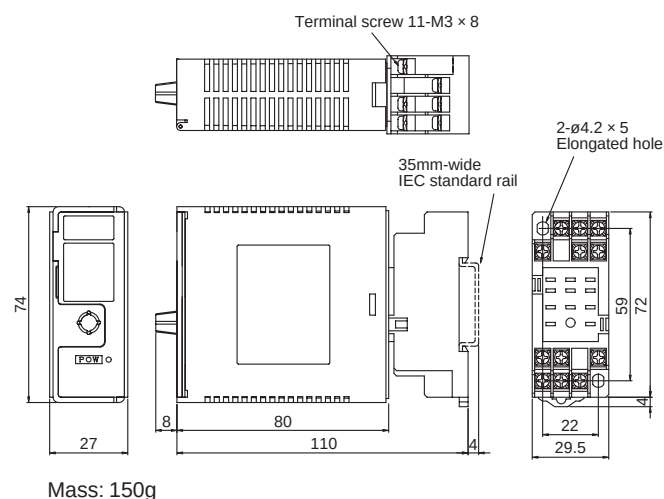
■ Ordering information

Specify the following:

1. Type number

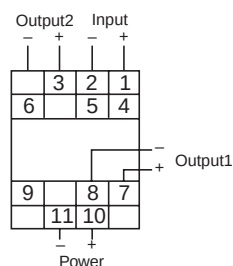
■ Dimensions, mm

WH7DC, WH7PT, WH7PM, WH7RV, WH7SP, WH7DY

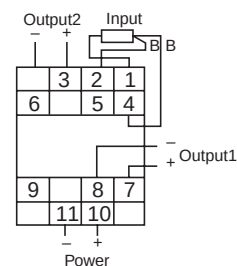


■ Wiring diagrams

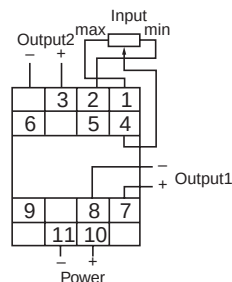
WH7DC, WH7RV, WH7DY



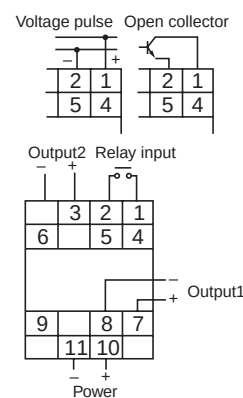
WH7PT



WH7PM



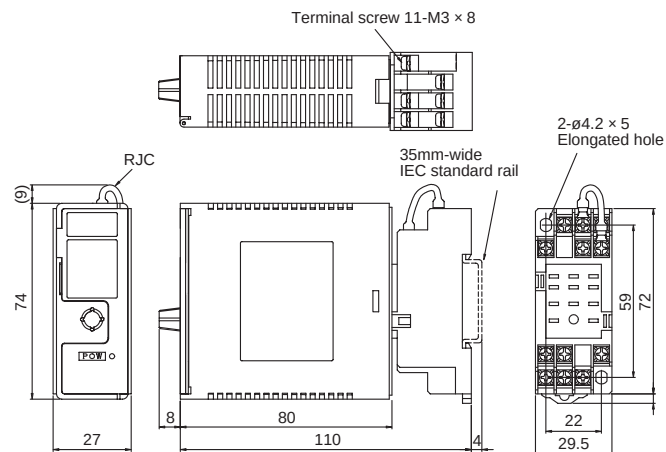
WH7SP



Transducers

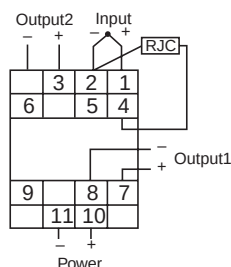
WH7 series

■ Dimensions, mm WH7TC

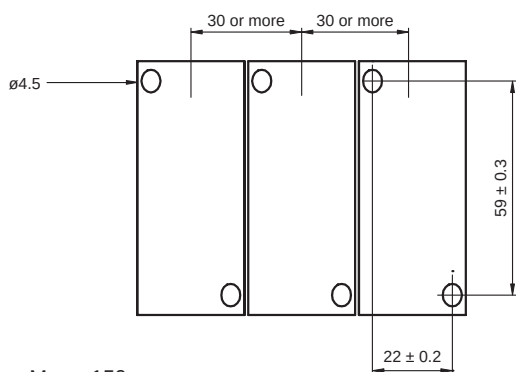


Mass: 150g

■ Wiring diagrams WH7TC



Panel drilling



Mass: 150g

Optional accessories

Simplified adjuster WH7AJ, cable WH7CB

■ Description

- The adjuster WH7AJ is connected to a WH7 series transducer to do zero point adjustment or span adjustment.
- Use a dedicated cable WH7CB (separately sold) to connect the adjuster WH7AJ to a WH7 series transducer.

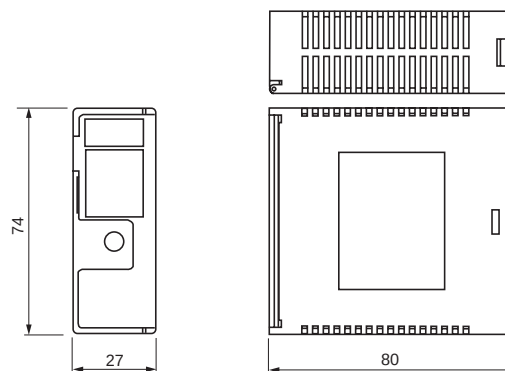
■ Ordering information

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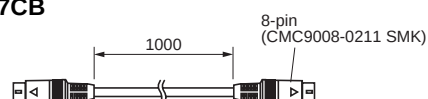
- Type number

■ Dimensions, mm

● Simplified adjuster WH7AJ



● Cable WH7CB



WT2AC AC voltage and current transducers

■ Features

FUJI WT2AC AC voltage and current transducers convert AC voltage/current into DC voltage/current, and also isolate input/output circuits and power supplies.

- Select from an 85 to 264V AC, 24V DC, or 110V DC auxiliary power supply
- Three isolated ports: input, output, and power supply
- Thin profile and excellent cost performance
- Use either IEC 35mm rail mounting or screw mounting
- Screw terminals with cover ensure safe, sure connection.

■ Performance

Accuracy: $\pm 0.4\%$ FS

Temperature characteristic: $\pm 0.2\%/10^\circ\text{C}$ FS(Typical)

Response time: 0.5s max. (0 to 90%)

Insulation resistance: 100M Ω (500V DC megger)

Withstand voltage: 2000V AC 1min

■ Input specifications

	Input signal	Input frequency
Voltage input	0 to 110V AC	50Hz, 60Hz
	0 to 150V AC	
	0 to 300V AC	
Current input	0 to 1A AC	
	0 to 5A AC	

■ Output specifications

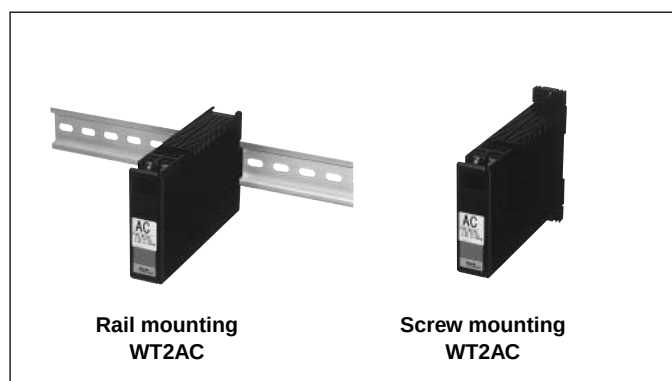
	Output signal	Permissible external resistance
Voltage output	0 to 10mV	10k Ω or more
	0 to 100mV	100k Ω or more
	0 to 1V	200 Ω or more
	0 to 5V DC, 1 to 5V DC	1k Ω or more
	0 to 10V DC	2k Ω or more
Current output	0 to 1mA DC	5k Ω or less
	0 to 5mA DC	3k Ω or less
	0 to 10mA DC	1.5k Ω or less
	0 to 16mA DC	900 Ω or less
	0 to 20mA DC	750 Ω or less
	1 to 5mA DC	3k Ω or less
	2 to 10mA DC	1.5k Ω or less
	4 to 20mA DC	750 Ω or less

Output adjustment: Zero adjustment -5 to $+5\%$
Span adjustment 95 to 105%

■ Ordering information

Specify the following:

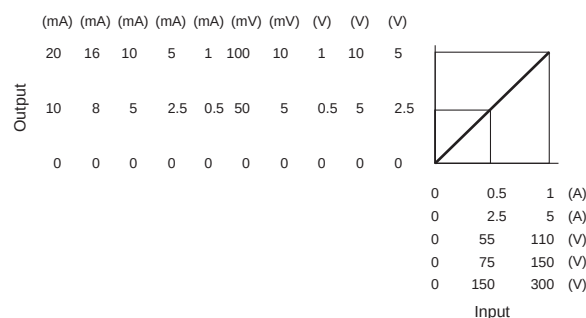
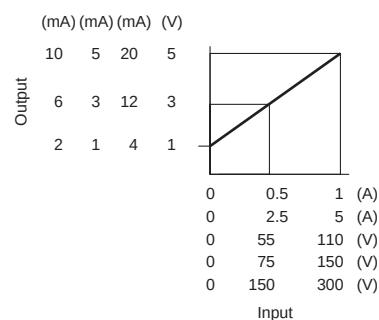
1. Type number



■ Specifications

Type	WT2AC
Terminal connection	M3.5 screw
Housing material	Enclosure: Polycarbonate resin UL94V-0 Terminal: ABS UL94V-0
Insulation resistance	100M Ω (500V DC megger)
Dielectric strength	2000V AC 1min
Auxiliary power supply	85 to 264V $\pm 10\%$ (50/60Hz), approx. 3VA 24V DC $\pm 10\%$, approx. 100mA 110V DC $\pm 10\%$, approx. 30mA
Operating temperature	-5 to $+50^\circ\text{C}$
Operating humidity	90%RH or less (no condensation)
Storage temperature	-20 to $+60^\circ\text{C}$
Storage humidity	90%RH or less (no condensation)

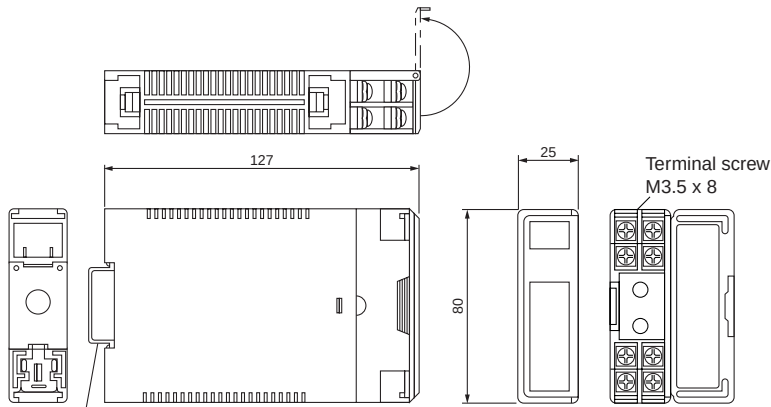
■ Input-output



Transducers
WT2AC

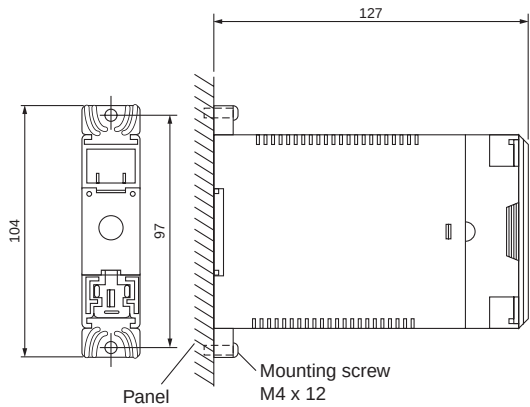
■ Dimensions, mm

• Rail mounting



35mm wide IEC rail
Mass: Approx. 200g

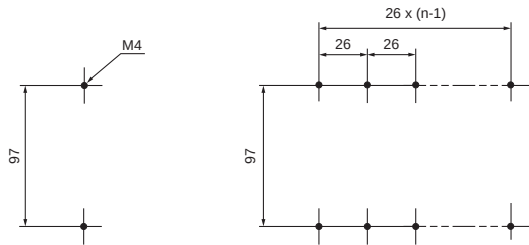
• Screw mounting



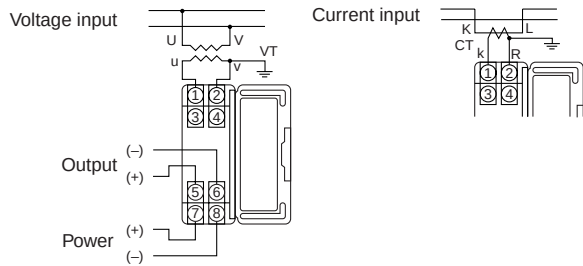
Panel drilling

One-unit mounted

n-unit mounted



■ Wiring diagram



CN232 and CN233 arresters (surge protective devices) for low voltage circuit

■ Description

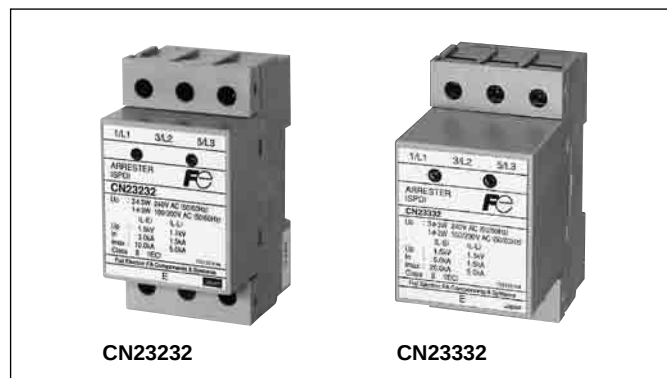
Arresters (surge protective devices) protect devices connected to power supplies from lightning damage by absorbing inductive lightning surges from power supply.

■ Features

- Normal-mode surges and common-mode surges can be absorbed using only one arrester.
- Coordinated operation of 2 types of varistor enables extremely fast response to surges and a high level of surge absorption.
- Built-in thermal fuses prevent problems such as short-circuit due to deterioration of elements.
- Indicators for easy confirmation of device status (i.e., normal or malfunction)
- Integrated terminal construction reduces space and wiring requirements for easier handling of the arrester.
- Mount to rails, using screws, or to brackets for standardized distribution boards.
- Standard-feature terminal cover to protect against electrical shock

■ Specifications

Type	CN23211	CN23212	CN23232	CN2324E	CN2324L
Applicable circuit and rated voltage (max. continuous operating voltage) Uc (50/60Hz)	Single-phase, 2-wire, 120V	Single-phase, 2-wire, 240V	Single-phase, 3-wire, 100/200V	3-phase, 3-wire, 440V (voltage to ground)	3-phase, 3-wire, 440V (between wires)
Test class (JIS C 5381-1)	Class II				
Max. discharge current I _{ma} x (8/20μs)	Voltage to ground	10kA	10kA	10kA	–
	Between wires	5kA	5kA	–	5kA
Nominal discharge current I _n (8/20μs)	Voltage to ground	5kA	5kA	5kA	–
	Between wires	1.5kA	1.5kA	–	1.5kA
Discharge start voltage (V 1mA)	Voltage to ground	420 to 520V	610 to 750V	990 to 1,210V	–
	Between wires	240 to 310V	420 to 520V	–	800 to 1,100V
Voltage protection level (Up)	Voltage to ground	1,100V max.	1,500V max.	2,500V max.	–
	Between wires	700V max.	1,100V max.	–	2,000V max.
Operating environment	Temperature: –20 to 60°C, Humidity: 95% max. RH (no icing or condensation)				
Connection terminals/connection wires	Screw terminal connection: M5 (with protective cover for charged parts) Applicable connection wire: 2 to 14mm, Max. round crimp terminal width: 12.4mm (nominal size: JIS C 2805 R14-5), Tightening torque: 2.0 to 2.5 N·m				
Dimensions (L x W x H)	95 x 50 x 60 mm				



■ Applications

- Electronic devices, such as computers, measurement devices, and communications devices
- Inverters
- Electronic devices inside distribution boards (e.g., power distribution boards and lighting distribution boards)

Arresters

CN232, CN233

■ Specifications

Type		CN23311	CN23312	CN23332	CN2334E
Applicable circuit and rated voltage (max. continuous operating voltage) Uc (50/60Hz)		Single-phase, 2-wire, 120V	Single-phase, 2-wire, 240V	Single-phase, 3-wire, 100/200V	3-phase, 3-wire, 240V
Test class (JIS C 5381-1)		Class II			
Max. discharge current I _{ma} x (8/20μs)	Voltage to ground	20kA	20kA	20kA	20kA
	Between wires	5kA	5kA	5kA	–
Nominal discharge current I _n (8/20μs)	Voltage to ground	5kA	5kA	5kA	5kA
	Between wires	1.5kA	1.5kA	1.5kA	–
Discharge start voltage (V 1mA)	Voltage to ground	420 to 520V	610 to 750V	610 to 750V	850 to 1,100V
	Between wires	240 to 310V	420 to 520V	420 to 520V	–
Voltage protection level (Up)	Voltage to ground	1,100V max.	1,500V max.	1,500V max.	2,500V max.
	Between wires	700V max.	1,100V max.	1,100V max.	–
Operating environment		Temperature: –20 to 60°C, Humidity: 95% max. RH (no icing or condensation)			
Connection terminals/connection wires		Screw terminal connection: M5 (with protective cover for charged parts)			
		Applicable connection wire: 2 to 14mm, Max. round crimp terminal width: 12.4mm (nominal size: JIS C 2805 R14-5), Tightening torque: 2.0 to 2.5 N·m			
Dimensions (L x W x H)		95 x 50 x 83 mm			

• Selection table for power supply arresters and arrester shunts

Arrester shunt	Plug fuse		Circuit breaker			
Max. discharge current	10kA	20kA	10kA			
Type	AFaC-30X x 3 (rail mounting)*	AFaC-60 x 3	EA33AC/30	SA33C/30	SA53C/30	SA53RC/30
Interrupting capacity	600V AC 100kA		220V AC 2.5kA 440V AC 1.5kA	220V AC 5kA 440V AC 2.5kA	220V AC 10kA 440V AC 7.5kA	220V AC 25kA 440V AC 10kA

Arrester shunt	Circuit breaker					
Max. discharge current	20kA					
Type	EA53AC/50	EA53C/50	SA53C/50	SA53RC/50	SA63RC/60	SA103C/60
Interrupting capacity	220V AC 2.5kA 440V AC 1.5kA	220V AC 5kA 440V AC 2.5kA	220V AC 10kA 440V AC 7.5kA	220V AC 25kA 440V AC 10kA	220V AC 25kA 440V AC 10kA	220V AC 50kA 440V AC 25kA

* If required, separately order a protective cover for charged parts (30A). (Type number: CG-30)

■ Type number nomenclature

CN23 **2** **32**

Rated voltage

- 11: Single-phase 2-wire, 120V
- 12: Single-phase 2-wire, 240V
- 32: 3-phase 3-wire, 240V
- Single-phase 3-wire, 100/200V
- 4E: 3-phase 3-wire, 440V (for common-mode surges)
- 4L: 3-phase 3-wire, 440V (for normal-mode surges)

Discharge current (ground)

- 2: 10kA
- 3: 20kA

Basic type

■ Ambient conditions

- Ambient operating temperature: –20 to 50°C (No condensation)
- Relative operating humidity: 45 to 85% (No condensation)
- For indoor use

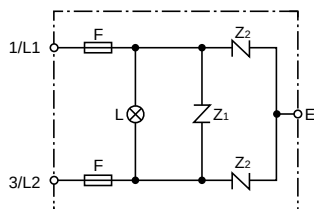
■ Ordering information

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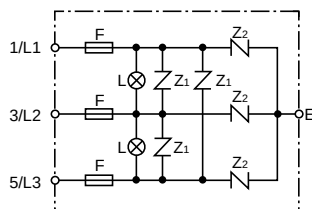
1. Type number or ordering code

Internal circuit diagrams

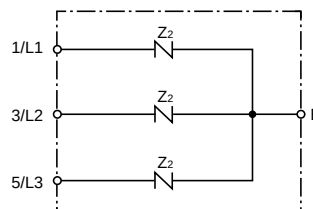
CN23211, CN23212
CN23311, CN23312



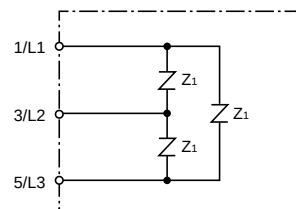
CN23232
CN23332



CN2324E
CN2334E



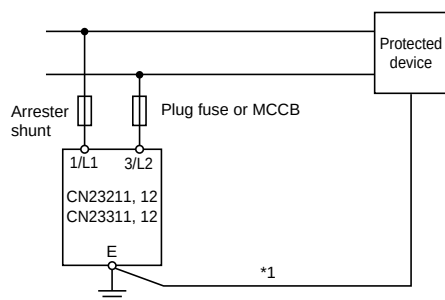
CN2324L



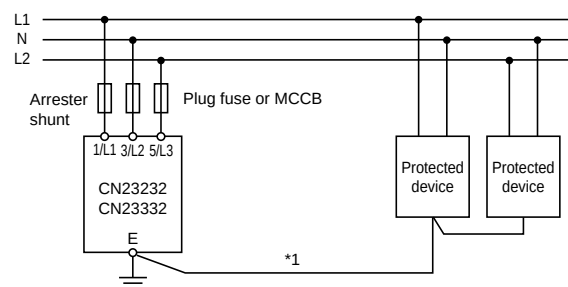
F: Thermal fuse
L: Indicator
Z₁, Z₂: Components for surge protective devices

Application examples

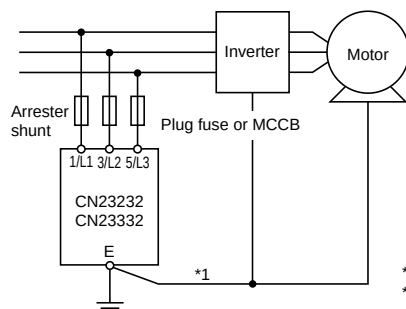
Single-phase 2-wire, 120V, 240V AC



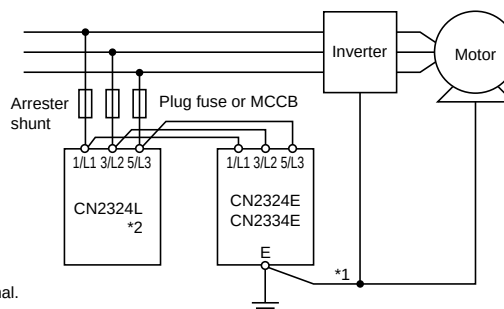
Single-phase 3-wire, 100/200V AC



3-phase 3-wire, 240V AC

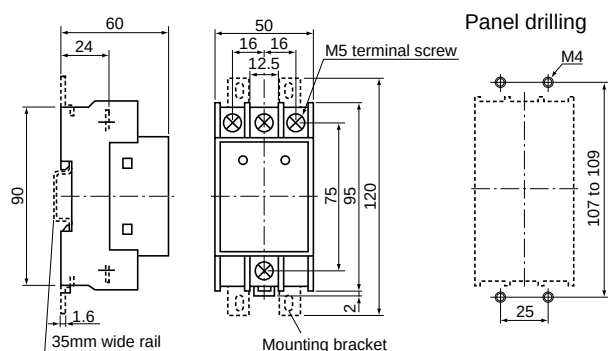


3-phase 3-wire, 440V AC

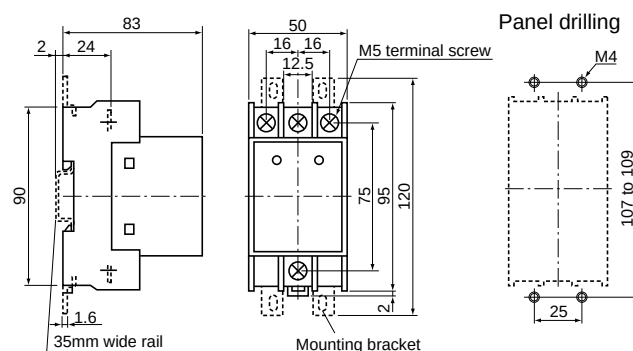


*1 Male the connection at the shortest distance.
*2 Do not wire to the black-colored screw terminal.

Dimensions, mm CN232



Dimensions, mm CN233



Arresters

CN226 series

CN226 series arresters (surge protective devices) for signal line and control circuit

■ Features

- Highly effective surge suppression using protection method combining gas discharge tube, varistor, and avalanche diode.
- Large surge discharge current
- Fast response to surges reduces influence on device.
- A comprehensive lineup to suit all kinds of signal line applications (e.g., transducers, remote terminals, and sensors).
- Simple mounting to IEC rail.
- The arrester mounts to the terminal block using a plug-in connection for simple inspection and replacement. Signal lines are not opened even if the arrester is removed.

■ Specifications

• For signal line circuit

Type		CN226-A20	CN226-A50	CN226-TC	CN226-PT	CN226-PM	CN226-SP	CN226-24	CN226-48	CN226-100
Application		4-20mA	10-50mA	Thermocouple	Resistance thermometer	Potentiometr	Slow pulse	24V DC	48V DC	100V DC
Rated voltage		24V DC	48V DC	5V DC	8V DC	5V DC	12V DC	24V DC	48V DC	100V DC
Rated current		100mA						200mA		
Leakage current		5μA max.		10μA max.	2μA max.	10μA max.		5μA max.		
Operation start voltage (V1mA)	Between wires	30V min.	61V min.	6.7V min.	11V min.	6.7V min.	14V min.	30V min.	60V min.	150V min.
	Voltage to ground	150V min.								180V min.
Clamping voltage (Vp)	Between wires	40V max.	100V max.	14V max.	22V max.	14V max.	25V max.	55V max.	130V max.	700V max.
	Voltage to ground	300V max.								800V max.
Internal resistance		10Ω 10% (Single)			2Ω 10% (Single)	10Ω 10% (Single)		1Ω 10% (Single)		
No. of ports		2-port, combination type								
Response time		0.1μs max.								
Max.discharge current (8/20us)	Between wires	5,000A								
	Voltage to ground	10,000A								

• For control power supply circuit

Type	CN226-24A	CN226-48A	CN226-100B
Application	24V AC/DC	48V AC/DC	100V AC/DC
Rated voltage	24V AC/DC	48V AC/DC	100V AC/DC
Rated current	2A		
Leakage current	10A max.		
Operation start voltage (V1mA)	Between wires	40V min.	84V min.
	Voltage to ground	300V min.	
Clamping voltage (Vp)	Between wires	250V max.	400V max.
	Voltage to ground	400V max.	
Internal resistance	—	—	—
No. of ports	1-port, combination type		
Response time	0.1μs max.		
Max.discharge current (8/20μs)	Between wires	2,000A	
	Voltage to ground	2,000A	

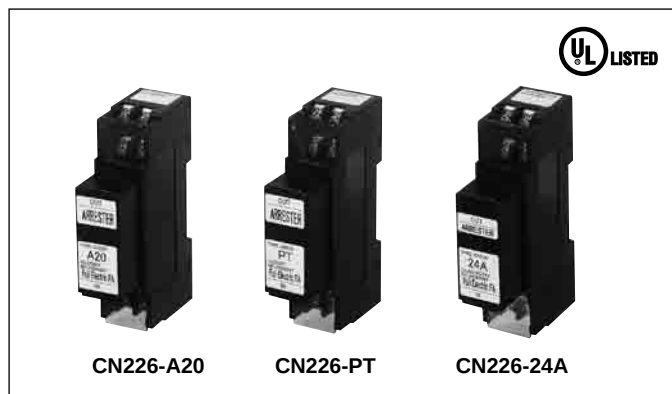
■ UL-approved type (Applicable standard: UL 497B File No. E253735)

Category	Signal circuit							
Type number (i.e., product code)	CN226-A20	CN226-A50	CN226-TC	CN226-PT	CN226-PM	CN226-SP	CN226-24	CN226-48
Application	4-20mA	10-50mA	Thermocouple	Resistance thermometer	Potentiometer	Slow pulse	24V DC	48V DC

* Refer to the table above or rated specifications, prices, and shipment.

■ Ambient conditions

- Ambient operating temperature: -20 to 50°C (No condensation)
- Relative operating humidity: 45% to 85% (No condensation)
- For indoor use



■ Type number nomenclature

CN226 - 

Application circuit

A20: 4 to 20mA
A50: 10 to 50mA
TC: Thermocouple
PT: Resistance thermometer
PM: Potentiometer
SP: Slow pulse

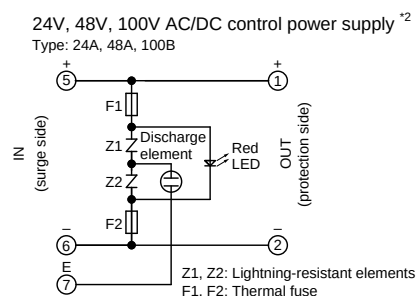
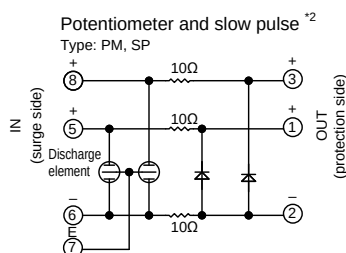
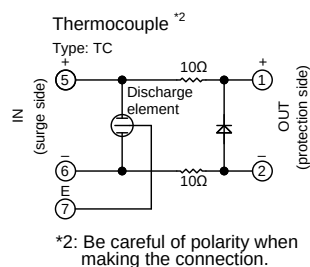
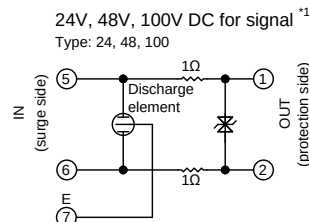
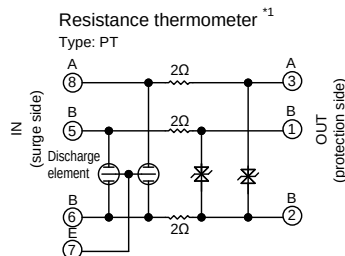
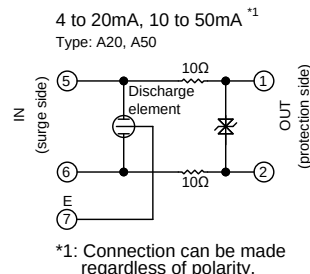
24: Signal circuit 24V DC
48: Signal circuit 48V DC
100: Signal circuit 100V DC
24A: Control power supply circuit 24V AC/DC
48A: Control power supply circuit 48V AC/DC
100B: Control power supply circuit 110V AC/DC

Basic type

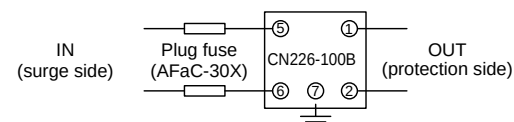
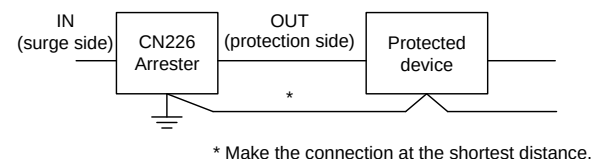
■ Ordering information

- Specify the following:
1. Type number or ordering code

Internal wiring

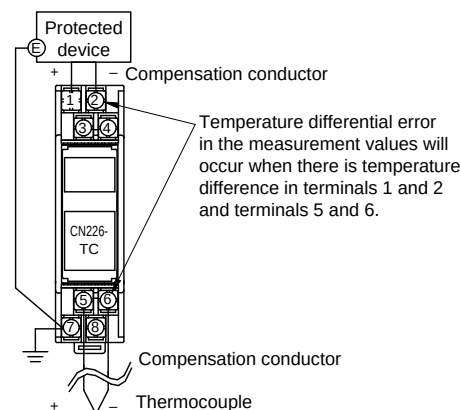


Application circuit example

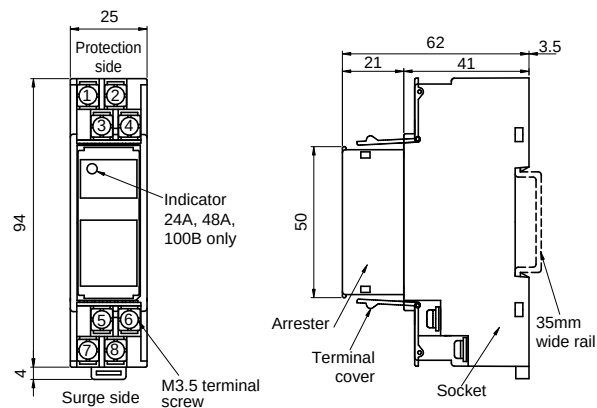


Note: When using a CN226-100A arrester, use a plug fuse (AFaC-30X) for disconnection and short-circuit protection.

Note for CN226-TC thermocouple



Dimensions, mm



Operating precautions

- Install the arrester as close as possible to the protected device.
- Be sure to securely connect the grounding terminal (E terminal) to the grounding the terminal of the panel. Consecutively ground the protected device and the arrester at the shortest distance using a grounding wire of 2mm² min. with grounding on the arrester side.
- Use an arrester that is appropriate for the operating voltage and application. Incorrect application may result in failure or loss of protection.
- Remove the arrester from the socket before performing a withstand test or insulation resistance test on the device. Incorrect testing may damage the arrester or result in measurement value errors.
- Use a DC power supply with the following specifications to connect to the signal arrester.
Using a large-capacity power supply may result in damage or fire due to inability to interrupt the short-circuit current that flows when the arrester operates.

Applicable types: CN226-24, CN226-48, CN226-100
DC power supply: CN226-24: 24V DC, 40W max., 1.7A max.,
CN226-48: 48V DC, 30W max., 0.6A max.,
CN226-100: 100V DC, 40W max., 0.4A max.

Arresters

CN227 series

■ Features

The arrester protects network circuits from lightning surges.

- Communications networks are supported (e.g., 10Base-5, 100Base-TX, RS-485, PLC T-Link).
- Ideal design for applications with high-performance in protection against lightning surges.
- Support for CN227-EBT
High-speed communications (100Mbps min.) enables high-performance response to surges.
Compact, lightweight, and easy to connect (RJ-45 modular connector).
- CN227-EB5
Extremely small signal loss enables high-performance response.
Easy installation and replacement (mounting bracket and grounding wire included).
- CN227-RS42, RS44
The body is slim (22.5mm wide) and European-style terminal blocks are used.
Types are available to support 2-wire (RS42) or 4-wire (RS44).
The arrester provides a long service life and high surge resistance (10kA, 8/20μs) and protection characteristics that satisfied categories C2 and D1 of the JIS C 5381-21 standard.



■ Ratings, specifications, models, product codes, prices (excluding tax), and shipment

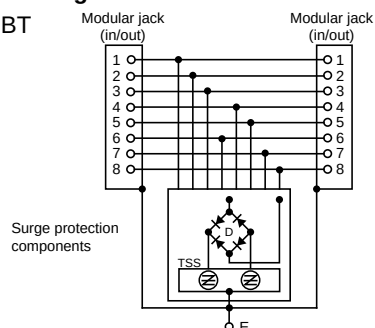
Type		CN227-EBT	CN227-EB5	CN227-RS42	CN227-RS44
Application		Ethernet 10Base-T 100Base-TX	Internet 10Base-5	RS-485, PLC (T link), remote terminals, 60V DC max. signal circuits	
				2-wire	4-wire
Max. continuous operating voltage (Uc)		52V DC	3.5V DC	60V DC	
Rated current		100mA	100mA	500mA	
Transmission frequency bandwidth		DC 0 to 100MHz	DC 0 to 20MHz	DC 0 to 2MHz	
Insertion loss		2dB max.	0.5dB max.	1dB max.	
Transmission speed/DC resistance		100Mbps	10Mbps	DC resistance: 0.1Ω max.	
DC operating voltage (V 1mA)/DC discharge start voltage (100V/s)	Between wires	—	DC4.5V±15% (100V/s)	DC82V±10% (V _{1mA})	
	Voltage to ground	DC65V±15% (100V/s)	DC90V±25% (100V/s)	DC90V±20% (100V/s)	
Voltage protection level (impulse limit voltage) (Up)	Between wires *1	150V max.	40V max.	400V max.	
	Voltage to ground	150V max.	350V max.	400V max.	
Impulse withstand *2	Category C2 (8/20μs)	500A	10kA	10kA	
	Category D1 (8/350μs)	—	—	2.5kA	
Environment		Temperature: -20 to 60°C, Humidity: 95% max. RH (no icing or condensation)			
Interface and applicable connection wire		Modular (RJ-45)	Coaxial tap (transceiver connection)	Screw terminal connection method Solid wire: 0.4 to 1.6mm dia., stranded wire: 0.14 to 2.5mm ²	
Mechanical durability	Vibration resistance (durability)	—	—	Frequency: 10 to 55Hz, Double amplitude: 0.75mm (4.5G max.), 2 hours in each direction for a total of 6 hours	
Dimensions (L x W x H)		(Thickness: Oval) 35 x 40 x (length) 81 mm	28 x 67 x 119 mm	90 x 22.5 x 70 mm	

Note *1: This gives the value when lightning surge voltage is applied between wires with one wire grounded.

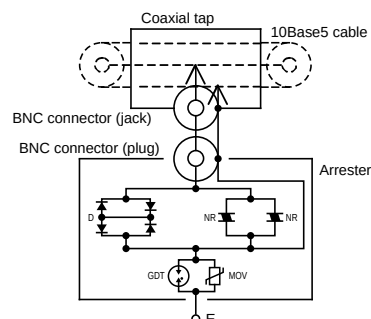
*2: This gives the total value for voltage to ground for each wire. Category C2 indicates the current value with power applied 5 times each for positive and negative polarities at a current waveform of 8/20μs, and category D1 indicates the current value with power applied one time each for positive and negative polarities at a current waveform of 10/350μs.

Internal wiring

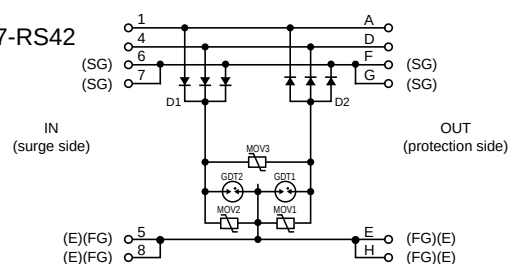
CN227-EBT



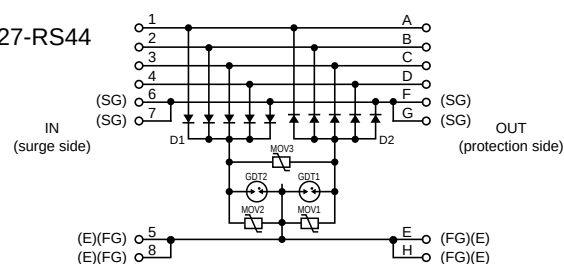
CN227-EB5



CN227-RS42

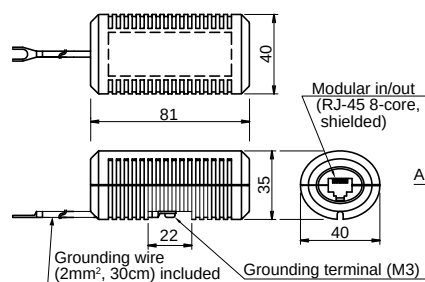


CN227-RS44

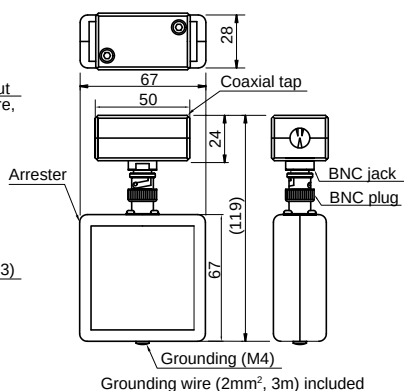


Dimensions, mm

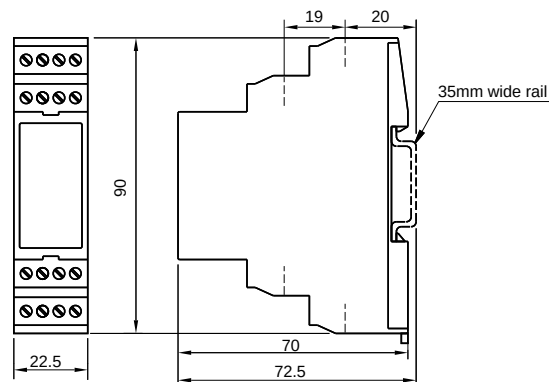
CN227-EBT



CN227-EB5



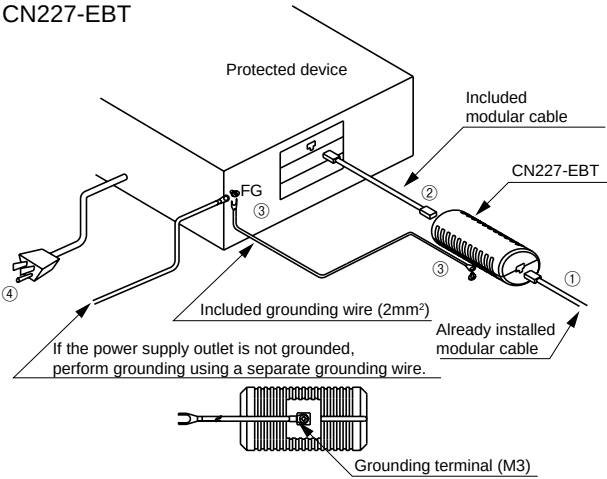
CN227-RS42, -RS44



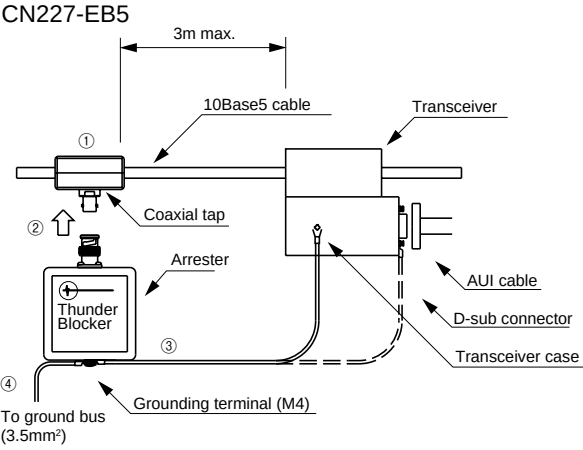
Arresters
CN227 series

■ Application circuit example

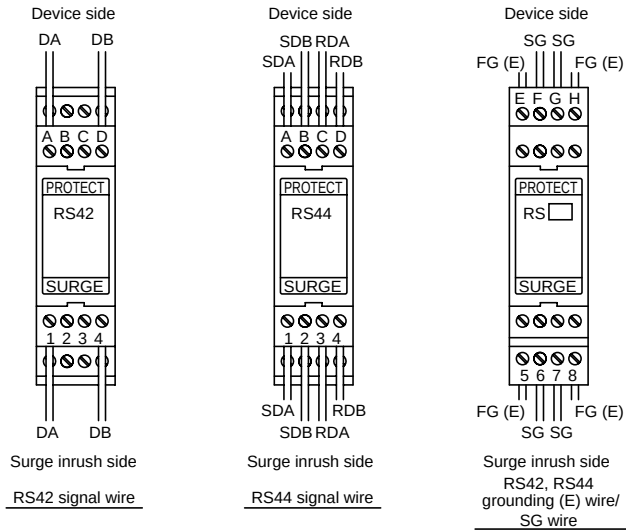
CN227-EBT



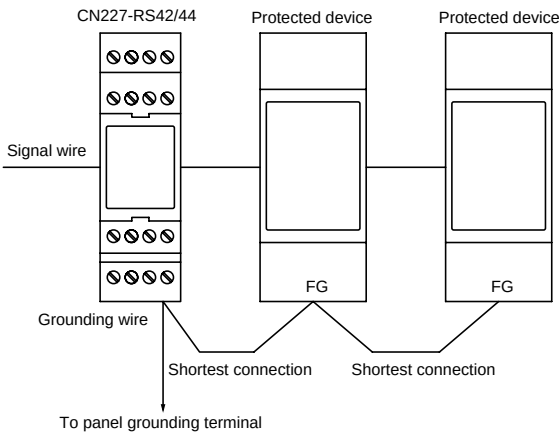
CN227-EB5



■ Wiring method



■ Grounding wiring



The arrester protects network circuits from lightning surges.

• **CN227-RS44A**

■ **Application**

- Devices are protected from lightning surges that may enter instrument cables or control cables of RS-485, 24V DC-max. signal circuits.

■ **Features**

- Entrance of high-frequency noise from arrester grounding circuits is prevented.
- Protection characteristics satisfy categories C2 and D1 of the JIS C5381-21 standard.
- Use of screwless connection terminals eliminates the need for crimp terminals.
- IEC rail mounting.

• **CN227-350S**

■ **Application**

- Broadcasting equipment is protected from lightning surges that may enter broadcasting speaker circuits or 100/200V-AC contact signal circuits.

■ **Features**

- Protection characteristics satisfy categories C2 and D1 of the JIS C5381-21 standard.
- Use of screwless connection terminals eliminates the need for crimp terminals.
- IEC rail mounting.

• **CN227-SD**

■ **Application**

- Communications equipment is protected from lightning surges that may enter telephone lines or other communications lines.

■ **Features**

- Protection characteristics satisfy categories C2 and D1 of the JIS C5381-21 standard.
- Use of screwless connection terminals eliminates the need for crimp terminals.
- IEC rail mounting.

• **CN227-UCP**

■ **Application**

- Communications equipment is protected from lightning surges that may enter telephone lines or other communications lines.

■ **Features**

- Support for UCS (universal connection system).
- Modular plug-in for high-density wiring system.
- Equipped with failure display.



• **CN227-NT**

■ **Application**

- Equipment is protected from lightning surges that may enter coaxial cables of ITV and monitor cameras or data transmission devices.

■ **Features**

- Ideal protection for ITV coaxial lines with weak withstand voltage.
- Transmission noise is absorbed with improved production characteristics by combining gas discharge tubes at noise filters.
- Protection characteristics satisfy categories C2 and D1 of the JIS C5381-21 standard.
- IEC rail mounting.
- Ideal for transmission lines on which a DC power supply(30V DC, 250mA max.) is superimposed on the coaxial.

• **CN227-TV**

■ **Application**

- Devices are protected from lightning surges that may enter coaxial cables for a satellite digital TV.

■ **Features**

- Composed with coaxial connectors and high-performance gas discharge tubes.
- Compact size with high impulse resistance.
- Excellent transmission performance (large frequency bandwidth and little insertion loss).

Arresters

CN227 series

■ Ratings, specifications, types, prices (excluding tax), and shipment

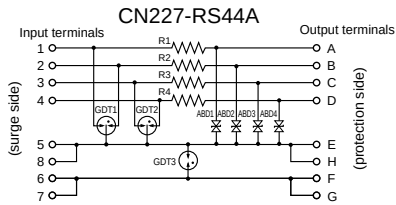
Type		CN227-RS44A	CN227-350S	CN227-SD
Application		RS-485, remote terminals, 24V DC max. signal circuits	Broadcasting speaker circuits 100/200V AC contact signal circuits	General telephone lines
		Low electrostatic capacity, 4-wire	4-wire	2-wire
Max. continuous operating voltage (Uc)		27V DC	275V AC/350V DC	180V DC
Rated current		100mA	2A	120mA
Transmission frequency bandwidth		DC 0 to 500kHz	DC 0 to 100MHz	DC 0 to 5MHz
Insertion loss		1dB max.	1dB max.	1.5dB max.
Transmission speed/DC resistance		DC resistance: 5Ω±10% (1 wire)	DC resistance: 0.5Ω max.	DC resistance: 20Ω max. (1 wire)
DC operating voltage (V _{1mA})/DC discharge start voltage (100V/s)	Between wires	—	—	—
	Voltage to ground	Between 1, 2, 3, 4-5, 8: 33V±10% DC (V _{1mA}) Between 5, 8-6, 7: 90V±20% DC (100V/s)	Between 1, 2, 3, 4-5, 8: 470V±10% DC (V _{1mA}) Between 5, 8-6, 7: 90V±20% DC (100V/s)	230V DC±20% (100V/s)
Voltage protection level (impulse limit voltage) (Up)	Between wires *1	Between A, B, C, D: 100V max.	Between A, B, C, D: 1,300V max.	400V max.
	Voltage to ground	Between A, B, C, D-E, H: 100V max.	Between B, C, D-E, H: 1,300V max.	400V max.
		Between E, H-F, G: 600V max.	Between E, H-F, G: 600V max.	
Impulse withstand *2	Category C2 (8/20μs)	10kA	10kA	10kA
	Category D1 (8/350μs)	2.5kA	0.5kA	5kA
Environment		Temperature: -20 to 60°C, Humidity: 95% max. RH (no icing or condensation)		
Interface and applicable connection wire		Screw terminal connection method Solid wire: 0.4 to 1.6mm dia., stranded wire: 0.14 to 2.5mm ²		
Mechanical durability	Vibration resistance (durability)	Frequency: 10 to 55Hz, Double amplitude: 0.75mm (4.5G max.), 2 hours in each direction for a total of 6 hours		
Dimensions (L x W x H)		90 x 22.5 x 70 mm		

Type		CN227-UCP	CN227-NT	CN227-TV
Application		General telephone lines (modular)	ITV and monitor cameras	Satellite digital TV
		2-wire		
Max. continuous operating voltage (Uc)		170V DC	30V DC	60V DC
Rated current		130mA	250mA	500mA
Transmission frequency bandwidth		DC 0 to 10MHz	DC 0 to 10MHz	DC 0 to 2.2GHz
Insertion loss		1dB max.	1.5dB max.	0.5dB max.
Transmission speed/DC resistance		DC resistance: 13Ω max. (1 wire)	DC resistance: 4Ω max.	—
DC operating voltage (V _{1mA})/DC discharge start voltage (100V/s)	Between wires	—	—	—
	Voltage to ground	175 to 275V DC (100V/s)	90V DC±20% (100V/s)	90V DC±20% (100V/s)
Voltage protection level (impulse limit voltage) (Up)	Between wires *1	300V max.	250V max.	—
	Voltage to ground	300V max.	250V max.	600V max. (between central conductor and external conductor)
Impulse withstand *2	Category C2 (8/20μs)	10kA	10kA	10kA
	Category D1 (8/350μs)	2.5kA	2.5kA	2.5kA
Environment		Temperature: -20 to 60°C, Humidity: 95% max. RH (no icing or condensation)		
Interface and applicable connection wire		Plug-in solid wire: 0.4 to 0.8 dia.	BNC jack - BNC jack	F jack - F jack
Mechanical durability	Vibration resistance (durability)	—	Frequency: 10 to 55Hz, Double amplitude: 0.75mm (4.5G max.), 2 hours in each direction for a total of 6 hours	
Dimensions (L x W x H)		19 x 9.5 x 59.5 mm	60 x 32 x 91 mm	(Thickness) 28 x 30 x (length) 60 mm

Note *1: This gives the value when lightning surge voltage is applied between wires with one wire grounded.

*2: This gives the total value for voltage to ground for each wire. Category C2 indicates the current value with power applied 5 times each for positive and negative polarities at a current waveform of 8/20μs, and category D1 indicates the current value with power applied one time each for positive and negative polarities at a current waveform of 8/350μs.

■ Internal wiring



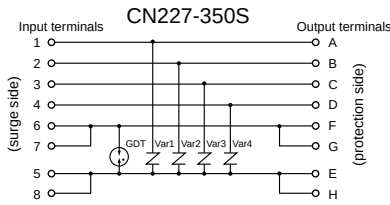
Terminal number

Protection of device with low withstand voltage between signal line and grounding wire

Terminal name	Signal line terminal	Ground terminal
surge side	1/2/3/4	5/8 (to ground pole)
protection side	A/B/C/D	E/H (to device case)

Reducing electrostatic capacity between signal line and ground line

Terminal name	Signal line terminal	Ground terminal
surge side	1/2/3/4	6/7 (to ground pole)
protection side	A/B/C/D	F/G (to device case)



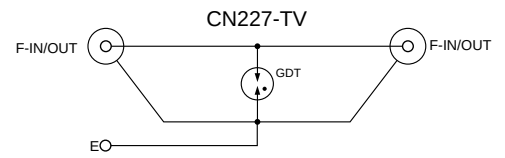
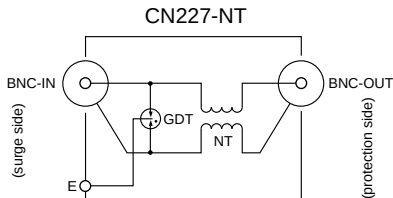
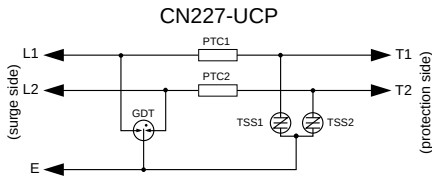
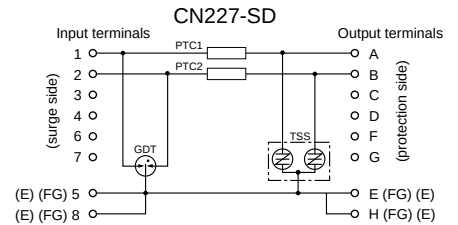
Terminal number

Protection of device with low withstand voltage between signal line and grounding wire

Terminal name	Signal line terminal	Ground terminal
surge side	1/2/3/4	5/8 (to ground pole)
protection side	A/B/C/D	E/H (to device case)

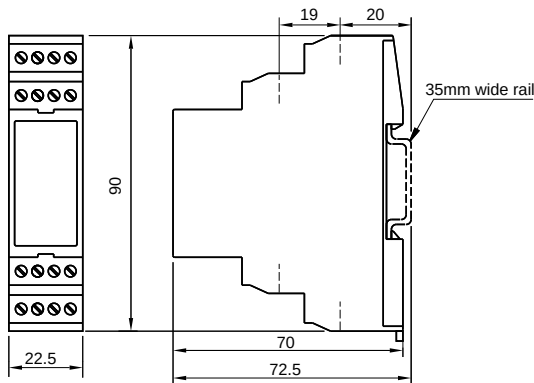
Relay contact signal circuit

Terminal name	Signal line terminal	Common terminal	Ground terminal
surge side	1/2/3/4	5/8	6/7 (to ground pole)
protection side	A/B/C/D	E/H	E/H (to device case)

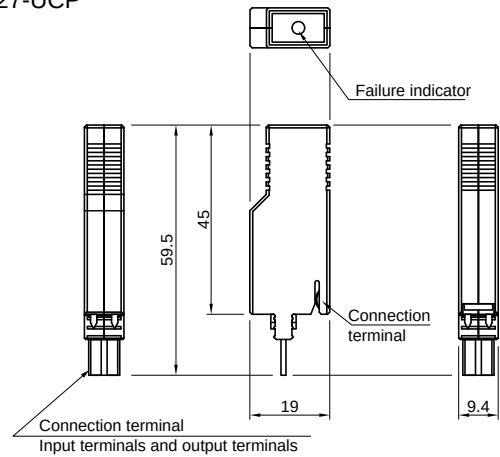


■ Dimensions, mm

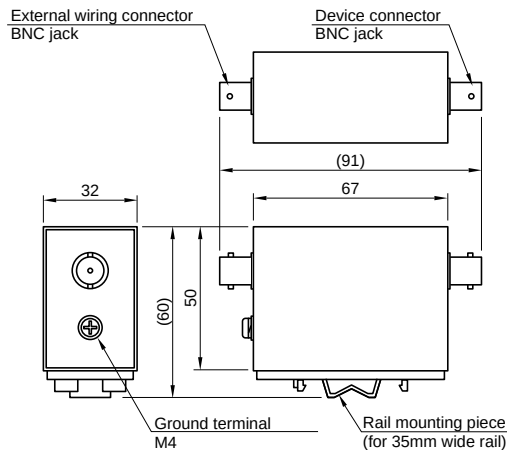
CN227-RS44A, -350S, -SD



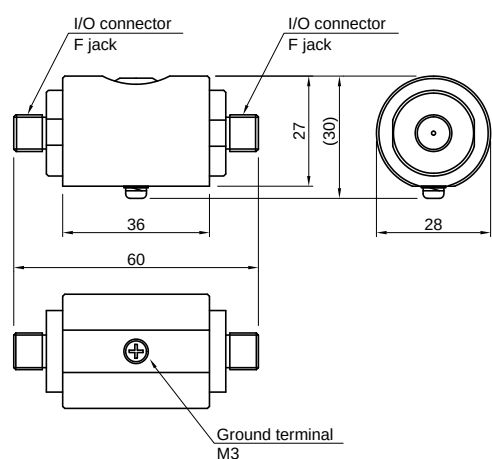
CN227-UCP



CN227-NT



CN227-TV



Arresters

CN227 series

Overview and features

- The AS-i arrester protects AS-interface modules connected to AS-i networks and networks from overvoltage due to inductive lightning surge and switching surge.
- Only the AS-i arrester is required to protect AS-i signal circuits and auxiliary power supply circuits.
- The construction, network connectivity, and protection level (IP67) of the AS-i arrester are the same as for waterproof connector slaves (slim type).
- The AS-i arrester does not require assigning addresses in the AS-interface network.
- A FM6B1-04FE or FM6B2-04FE slave base is required to connect the AS-interface cable (yellow) and auxiliary power supply cable (black).



Ratings, specifications, types, prices (excluding tax), and shipment

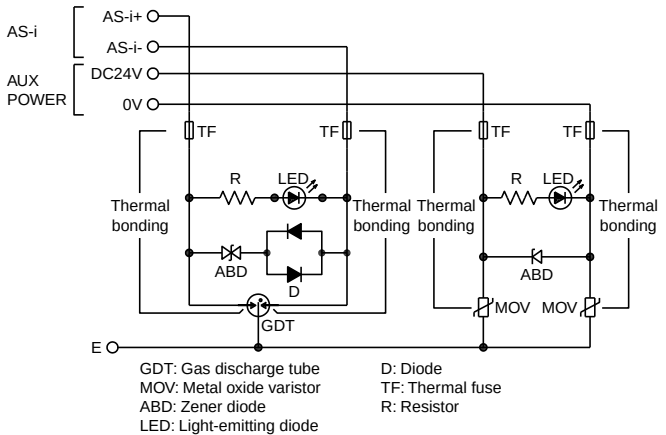
Type		CN227-ASI	
Application		AS-i signal circuit	Auxiliary power supply circuit
Max. continuous operating voltage (Uc)		31.6V DC	30V DC
Rated current (In)		0.5A	5A
Insertion loss: DC 0 to 5MHz (110Ω)		0.2dB max.	—
Electrostatic capacity (100kHz)	Between wires	100pF max.	—
	Voltage to ground	10pF max.	—
Voltage protection level (Up)	Between wires	100V max.	100V max.
	Voltage to ground	700V max.	400V max.
Impulse withstand category C2 *1	Between wires	8/20μs 400A	8/20μs 400A
	Voltage to ground	8/20μs 1000A	8/20μs 1000A
Impulse withstand current *2	Voltage to ground	8/20μs 2000A	8/20μs 2000A

Note *1: Impulse withstand category C2 indicates the performance that is possible with power applied 5 times for positive and negative polarities at a current waveform of 8/20μs.

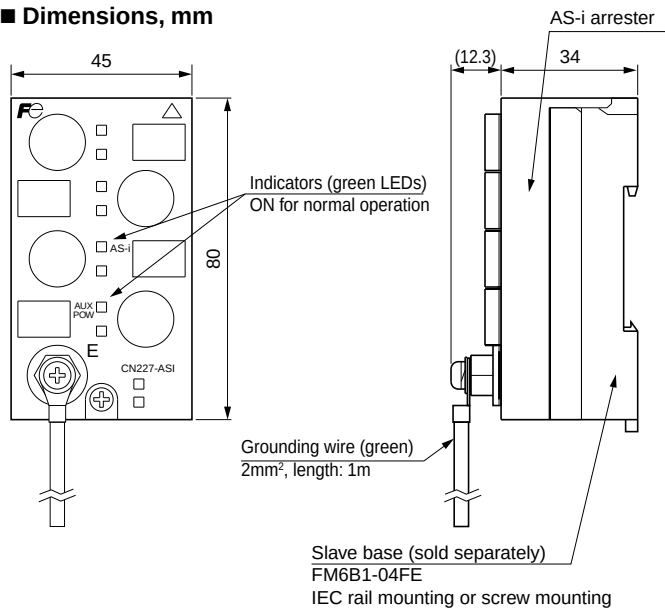
*2: Impulse withstand current indicates the performance possible with power applied for 1 time max. at a current wavelength of 8/20μs.

Type		CN227-ASI	
Application		AS-i signal circuit	Auxiliary power supply circuit
DC operating voltage	Between wires	DC39V±10% (V=5mA)	DC39V±10% (V=5mA)
	Voltage to ground	DC90V±20 (100V/s)	DC82V±10% (V=1mA)
Operating environment		Temperature: -20 to 60°C, Humidity: 95% max. (no condensation)	
Shock resistance	Rail mounting	150m/s ² (11ms)	
Vibration resistance	Rail mounting	10 to 55Hz, 0.5mm single amplitude	

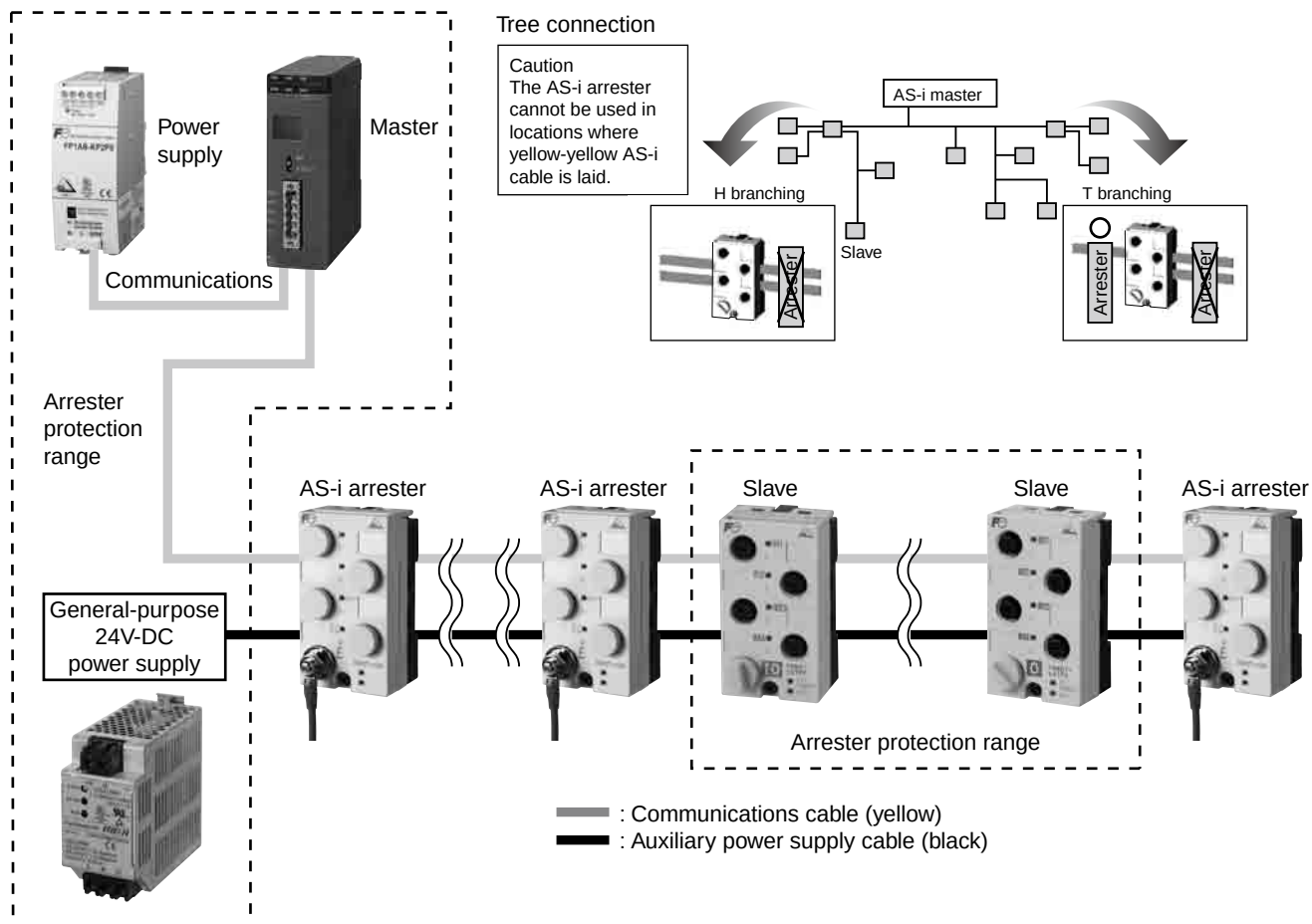
Internal wiring



Dimensions, mm



■ Application circuit example



Arresters

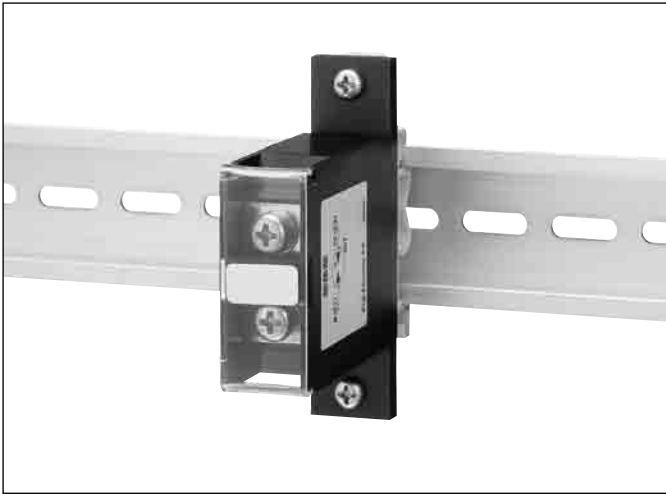
CN2340, CN2341

■ Features

Single-pole arrester with gas discharge tube.
Is important to use the same equipotential bonding and ground when building systems to protect against lightning.

Sometimes, however, various types of grounds are independently installed inside equipment, and grounding circuit arresters enable potential equalization between grounding polls.

- CN2340: Used when the same ground cannot be used between power circuits.
(For example, performing grounding with provisions based on electrical equipment technology standards, such as independent B-type grounding.)
- CN2341: Used when the same ground cannot be used for power circuits and control circuits.
(For example, performing independent grounding of devices to prevent noise from entering, such as with inverter grounding.)
- With a rail mounting construction that is 18mm wide, the design is ideal for applications.



■ Ratings, specifications, types, prices (excluding tax), and shipment

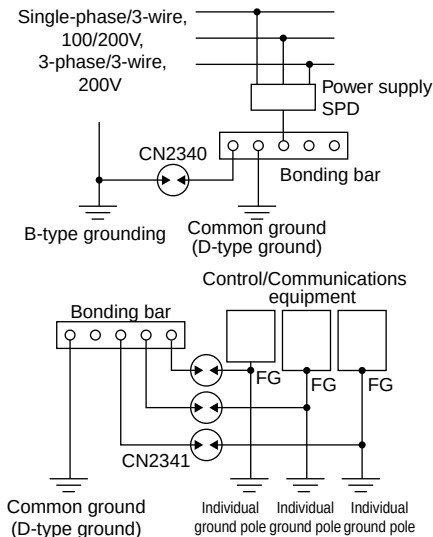
Type	CN2340	CN2341
Application	Between ground and grounded circuits Grounding between power circuits	Between ground and grounded circuits Grounding between power circuits and control circuits
Test class	Class I/II	Class I/II
Voltage protection level (Up) (limit voltage)	1,500V max.	800V max.
Operation start voltage	490V DC±70V	90V DC±18V
Impulse current (I imp)	10/350μs 5kA	10/350μs 2.5kA
Nominal discharge current (In)	8/20μs 20kA	8/20μs 20kA
Max. discharge current (I max)	8/20μs 30kA	8/20μs 25kA
Connection terminals/connection wires	Screw terminal connection: M5 (for bare round crimp terminals) Recommended connection wire (stranded wire: 3.5 to 14mm ²) Round crimp terminal size: 3.5mm ² : R3.5 to 5 8mm ² : R8 to 5 5.5mm ² : R5.5 to 5 14mm ² : R14 to 5	
Operating environment	Temperature: -20 to 60°C, Humidity: 95% max. (no condensation)	

■ Internal wiring

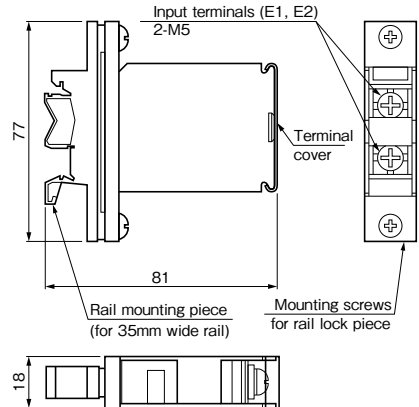


GDT: Gas discharge tube

■ Application circuit example



■ Dimensions, mm



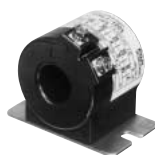
■ Description

The FUJI low-voltage instrument transformers are available as current transformers and potential transformers. These transformers have a *maximum voltage of 1150V and are suitable for circuits up to 600V. Windings have excellent mechanical, thermal and electrical performance since CT's are molded in polyester resin and VT's in epoxy resin. They are also moisture proof and have good insulation properties. The laminated iron core is made of oriented silicon steel strip. Both VT's and CT's have a class 1.0 accuracy rating, and conform to the requirements of JIS C 1731, JEC 1201 and other standards. Current transformers are available in either through-type or primary-winding versions.

*Maximum voltage: $\frac{\text{Nominal voltage}}{1.1} \times 1.15$

■ Low voltage current transformers

CC3L



AF00-103

The CC3L type is a round hole through-type current transformer. The ratio can be changed according to the number of turns of the primary windings. It has excellent insulation characteristics and is both compact and light in weight.

CC3P



AF00-102

The CC3P type is a current transformer which has a primary winding thus facilitating connection work. The installation angle can be varied from the standard position through 90°. They can be supplied with the primary current rating from 5 to 50 Amps.

CC3M



AF00-107

The CC3M type is a current transformer which has a flat terminal primary winding. It is used in the bus section of the load center or the control center. It can be mounted either horizontally or vertically.

CC2



AF99-266

The CC2D and 2C current transformers are split-types. The CTs can be mounted to existing panels, such as control centers or load centers, to measure or monitor the wattage. These can be mounted without removing existing cables for easier installation. Rated primary currents are available from 5 to 1200A.

■ Low voltage potential transformers CD 32, 34



AF00-215

The CD32 and CD34 transformers are low-voltage types. Types with a fuse of a 100kA interrupting capacity have been added to the series. This series is available for burdens of 15 and 50VA.

■ Varieties of instrument transformers

Description		Type	Burden	Primary current	Secondary current
CT	Round hole through-type	CC3L1	5VA	60–750A	5 or 1A
		CC3L2	15VA	100–750A	5 or 1A
		CC3L3	40VA	150–750A	5 or 1A, 5A
	With primary winding	CC3P1	5VA	1–50A	5 or 1A
		CC3P2	15VA	1–50A	5 or 1A
		CC3P3	40VA	1–50A	5 or 1A
	Rectangular hole through type	CC3M1	5VA	150– 600A	5A
		CC3M2	15VA	150–2000A	5 or 1A
		CC3M3	40VA	200–6000A	5 or 1A, 5A
	Split type	CC2D	0.2693mVA–0.5VA	5– 400A	7.34mA–1A
		CC2C	0.5VA	800–1200A	1A

Description		Type	Burden	Primary voltage	Secondary voltage
VT	Single-phase	CD32F	15VA	220, 440V	110V
		CD32N	15VA	220, 440V	110V
		CD34F	50VA	220, 440V	110V
		CD34N	50VA	220, 440V	110V

Instrument Transformers

Through-type CT/CC3L

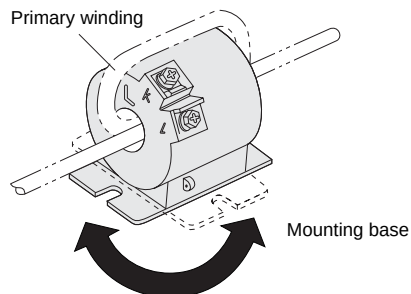
CC3L round hole through-type current transformers

Primary current: 60 to 750A
Secondary current: 5A or 1A

Description

The CC3L transformers are round-hole through-types. A double-mold structure gives CC3L transformers excellent moisture resistance and good insulation properties.

The CT ratio can be changed freely by changing the number of primary winding turns. Consequently, these CTs are highly adaptable and economical. Select from a lineup of three types with rated burdens of 5VA, 15VA, and 40VA. The mounting base can be rotated anywhere in a 90° range to facilitate installation.



Types and ratings

Burden (VA)	Rated primary current (A)	Secondary current (A)	Accuracy class	Thermal limit current	Max voltage (kV rms.)	Dielectric strength (kV 1min)	Diameter of window (mm)	Mass (kg)	Type* (secondary current: □)					
5	60 75	5 or 1	1.0	40 times rated primary current, 1 second	1.15	4.0	26	1.9	CC3L1-060□ CC3L1-075□					
	100 120 150 160 180						23	0.5	CC3L1-100□ CC3L1-120□ CC3L1-150□ CC3L1-160□ CC3L1-180□					
									0.4	CC3L1-200□				
									32	0.6	CC3L1-250□ CC3L1-300□			
										0.5	CC3L1-400□			
	200						50	0.7	CC3L1-500□					
	250 300	0.6						CC3L1-600□ CC3L1-750□						
	400													
	500	5 or 1												
600 750														
15	100 120	5 or 1	1.0	40 times rated primary current, 1 second	1.15	4.0	26	2.0	CC3L2-100□ CC3L2-120□					
	150 160 180 200						25	1.0	CC3L2-150□ CC3L2-160□ CC3L2-180□ CC3L2-200□					
									32	0.6	CC3L2-240□ CC3L2-250□ CC3L2-300□ CC3L2-400□			
											50	0.8	CC3L2-500□ CC3L2-600□ CC3L2-700□	
	500 600 750	5 or 1												
	40	150 160 180 200					5 or 1	1.0	40 times rated primary current, 1 second	1.15	4.0	26	2.0	CC3L3-150□ CC3L3-160□ CC3L3-180□ CC3L3-200□
		240 250 300 400										32	1.2	CC3L3-240□ CC3L3-250□ CC3L3-300□ CC3L3-400□
							50							0.8
500 600 750		5												

Notes: * Replace the □ mark by the secondary current code.

5: 5A 1: 1A

Instrument Transformers

Through-type CT/CC3L

■ Number of turns in the primary winding and CT ratio

The following table lists the rated primary current, number of turns of primary windings, and the maximum nominal cross-section area

of the 600V IV cable that can pass through. (ø indicates the diameter of a single wire.) The table data satisfies allowable current for

a 600V IV cable at an ambient temperature of 40°C.

● 5VA CC3L1

Rated primary current (Ampere turn AT)	Primary current (A)	No. of turns	Primary conductor (mm ²)
60	10	6	5.5
	15	4	14
	20	3	22
	30	2	22
	60	1	150
75	15	5	8
	25	3	22
	75	1	150
100	10	10	ø2
	20	5	8
	25	4	14
	50	2	22
	100	1	150
120	15	8	5.5
	20	6	8
	30	4	14
	40	3	22
	60	2	22
	120	1	150
150	15	10	ø2
	25	6	8
	30	5	8
	50	3	22
	75	2	22
	150	1	150
160	20	8	5.5
	40	4	14
	80	2	22
	160	1	150
180	20	9	ø2
	30	6	8
	60	3	22
	180	1	150
200	20	10	ø2
	25	8	5.5
	40	5	8
	50	4	14
	200	1	150
250	25	10	8
	50	5	22
	125	2	60
	250	1	325
300	30	10	8
	50	6	14
	60	5	22
	75	4	38
	100	3	60
	150	2	60
	300	1	325
400	40	10	8
	50	8	14
	100	4	38
	400	1	325
500	50	10	22
	100	5	60
	125	4	100
	250	2	200
	500	1	500
600	60	10	22
	75	8	38
	100	6	60
	150	4	100
	200	3	150
	300	2	200
	600	1	500
750	75	10	22
	150	5	60
	750	1	200 2 pcs.

● 15VA CC3L2

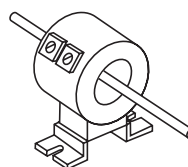
Rated primary current (Ampere turn AT)	Primary current (A)	No. of turns	Primary conductor (mm ²)
100	10	10	5.5
	20	5	14
	25	4	22
	50	2	38
	100	1	200
120	15	8	8
	20	6	14
	30	4	22
	40	3	22
	60	2	38
	120	1	200
150	10	15	3.5
	15	10	5.5
	25	6	8
	30	5	14
	50	3	22
	75	2	38
160	150	1	200
	20	8	8
	40	4	22
	80	2	38
	100	1	200
180	20	9	5.5
	30	6	8
	60	3	22
	90	2	38
	180	1	200
200	20	10	5.5
	25	8	8
	40	5	14
	50	4	22
	100	2	38
	200	1	200
240	30	8	8
	40	6	14
	60	4	38
	80	3	60
	120	2	60
	240	1	325
250	25	10	8
	50	5	22
	125	2	60
	250	1	325
300	30	10	8
	50	6	14
	60	5	22
	75	4	38
	100	3	60
	150	2	60
	300	1	325
400	40	10	8
	50	8	14
	100	4	38
	400	1	325
500	50	10	22
	100	5	60
	125	4	100
	250	2	200
	500	1	500
600	60	10	22
	75	8	38
	100	6	60
	150	4	100
	200	3	150
	300	2	200
	600	1	500
750	75	10	22
	150	5	60
	750	1	200 2 pcs.

● 40VA CC3L3

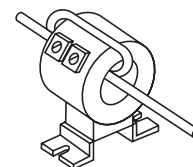
Rated primary current (Ampere turn AT)	Primary current (A)	No. of turns	Primary conductor (mm ²)
150	10	15	3.5
	15	10	5.5
	25	6	14
	30	5	14
	50	3	22
	75	2	38
	150	1	200
160	20	8	8
	40	4	22
	80	2	38
	160	1	200
180	20	9	5.5
	30	6	14
	60	3	22
	90	2	38
	180	1	200
200	25	8	8
	40	5	14
	50	4	22
	100	2	38
	200	1	200
240	40	6	14
	60	4	22
	80	3	38
	120	2	60
	240	1	325
250	25	10	8
	50	5	22
	125	2	60
	250	1	325
300	30	10	8
	50	6	14
	60	5	22
	75	4	38
	100	3	60
	150	2	60
400	300	1	325
	40	10	8
	50	8	14
	100	4	38
	400	1	325
500	50	10	22
	100	5	60
	125	4	100
	250	2	200
	500	1	500
600	60	10	22
	75	8	38
	100	6	60
	150	4	100
	200	3	150
	300	2	200
	600	1	500
750	75	10	22
	150	5	60
	750	1	200 2 pcs.

Example: 100AT, secondary 5A

• 1-ampere turn
100/5A



• 2-ampere turn
50/5A



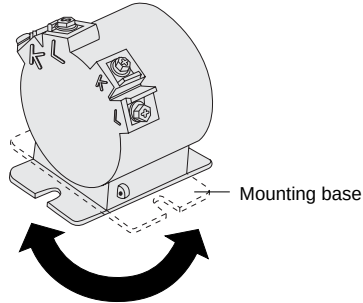
Note: The rated primary current is given for one turn of the primary winding.

CC3P current transformers with primary winding

Primary current: 5 to 50A
Secondary current: 5A or 1A

■ Description

CC3P CTs support primary winding for easy wiring.
The mounting base can be rotated anywhere in a 90° range to facilitate installation.
A double-mold structure gives CC3P CTs excellent moisture resistance and good insulation properties.
Select from a lineup of three types with rated burdens of 5VA, 15VA, and 40VA.



■ Types and ratings

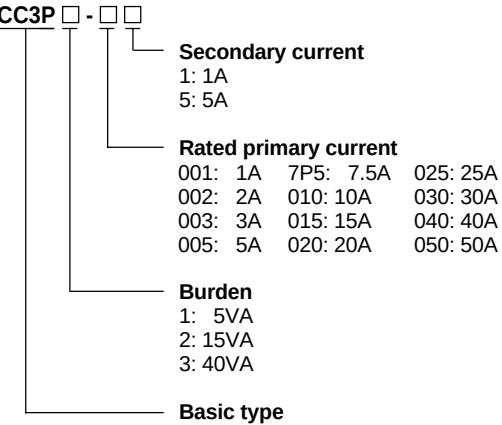
Burden (VA)	Rated primary current (A)	Secondary current (A)	Accuracy class	Thermal limit current	Max. voltage (kV rms.)	Dielectric strength (kV 1 min.)	Mass (kg)	Type
5	1 2 3 5 7.5 10 15 20 25 30	5 or 1	1.0	40 times rated primary current	1.15kV	4.0kV	0.7	CC3P1-001□ CC3P1-002□ CC3P1-003□ CC3P1-005□ CC3P1-7P5□ CC3P1-010□ CC3P1-015□ CC3P1-020□ CC3P1-025□ CC3P1-030□
	40 50				1.15kV			CC3P1-040□ CC3P1-050□
15	1 2 3 5 7.5 10 15 20 25 30 40 50	5 or 1	1.0	40 times rated primary current	1.15kV	4.0kV	1.1	CC3P2-001□ CC3P2-002□ CC3P2-003□ CC3P2-005□ CC3P2-7P5□ CC3P2-010□ CC3P2-015□ CC3P2-020□ CC3P2-025□ CC3P2-030□ CC3P2-040□ CC3P2-050□
40	1 2 3 5 7.5 10 15 20 30	5 or 1	1.0	40 times rated primary current, 1 second	1.15kV	4.0kV	1.1	CC3P3-001□ CC3P3-002□ CC3P3-003□ CC3P3-005□ CC3P3-7P5□ CC3P3-010□ CC3P3-015□ CC3P3-020□ CC3P3-030□
	40 50				1.15kV			CC3P3-040□ CC3P3-050□

Notes: * Replace the □ mark by the secondary current code.
5: 5A 1: 1A

Instrument Transformers

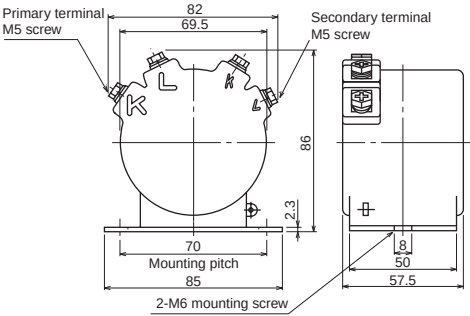
CT with primary winding/CC3P

■ Type number nomenclature

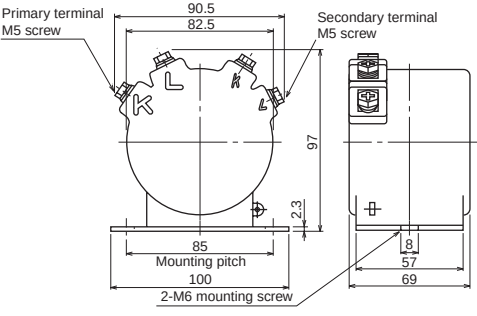


■ Dimensions, mm

CC3P1: 1 to 30A



CC3P1: 40, 50A CC3P2, CC3P3

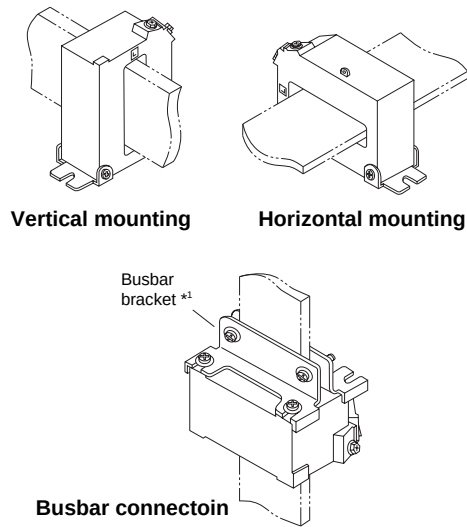


CC3M rectangular hole through-type current transformers

Primary current: 150 to 6000A
Secondary current: 5A

■ Description

CC3M CTs can be mounted vertically or horizontally by changing the position of the mounting base. Also, the busbar can be mounted directly using a mounting bracket as illustrated, so a busbar mounting angle or holes are not required.



■ Types and ratings

Burden (VA)	Rated primary current (A)	Secondary current (A)	Accuracy class	Thermal limit current	Max. voltage (kV rms.)	Dielectric strength (kV 1 min.)	Mass (kg)	Type
5	150	5	1.0	40 times rated primary current	1.15kV	4.0kV	2.1	CC3M1-1505
	200 300						1.1	CC3M1-2005 CC3M1-3005
	400 500 600						0.6	CC3M1-4005 CC3M1-5005 CC3M1-6005
15	150	5 or 1	1.0	40 times rated primary current	1.15kV	4.0kV	2.1	CC3M2-150□
	200 250 300	5 or 1	1.0		1.15kV	4.0kV	1.1	CC3M2-200□ CC3M2-250□ CC3M2-300□
	400 500	5 or 1	1.0		1.15kV	4.0kV	0.6	CC3M2-400□ CC3M2-500□
	600 750 800						0.5	CC3M2-600□ CC3M2-750□ CC3M2-800□
	1000 1200 1500 2000						1.2	CC3M2-10X□ CC3M2-12X□ CC3M2-15X□ CC3M2-20X□
40	200 250	5 or 1	1.0	40 times rated primary current	1.15kV	4.0kV	2.3	CC3M3-200□ CC3M3-250□
	300 400 500	5 or 1	1.0		1.15kV	4.0kV	1.1	CC3M3-300□ CC3M3-400□ CC3M3-500□
	600 750 800	5 or 1	1.0		1.15kV	4.0kV	1.1	CC3M3-600□ CC3M3-750□
	1000 1200 1500 2000	5 or 1	1.0				0.9	CC3M3-800□
							1.3	CC3M3-10X□
					1.2	CC3M3-12X□		
	2500 3000 4000	5	1.0		1.15kV	4.0kV	1.5	CC3M3-15X□ CC3M3-20X□
							4.8	CC3M3-25X5 CC3M3-30X5
5000*2 6000*2	5	1.0	1.15kV	4.0kV	6.3	CC3M3-40X5		
					14	CC3M3-50X5 CC3M3-60X5		

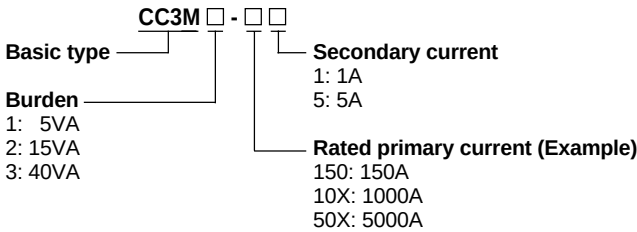
Notes: *1 Busbar mounting brackets are sold separately. When ordering, specify the CT type number and rated primary current. If the rated primary current is 1000 to 2000A, also specify the number of busbars required.

*2 Epoxy resin mold is used to isolate rated primary currents of 5000 or 6000A.

- CC3M CTs are mounted vertically at the factory.
- Replace the □ mark by the secondary current code.
5: 5A 1: 1A

Instrument Transformers
Through-type CT/CC3M

■ Type number nomenclature



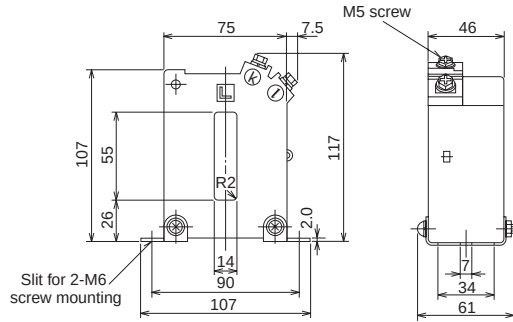
■ Ordering information

- Specify the following:
1. Type number
 2. Busbar mounting bracket if required.
Primary current

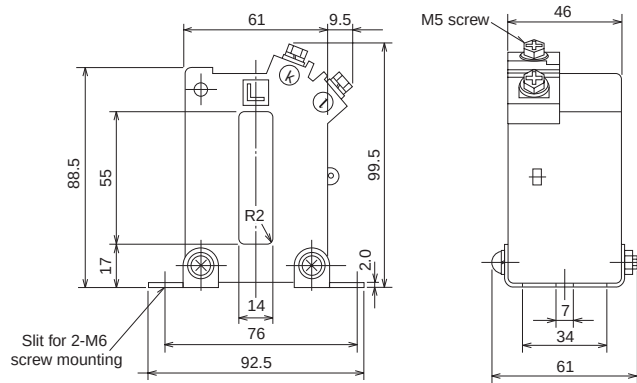
■ Dimensions, mm

● Vertical mounting

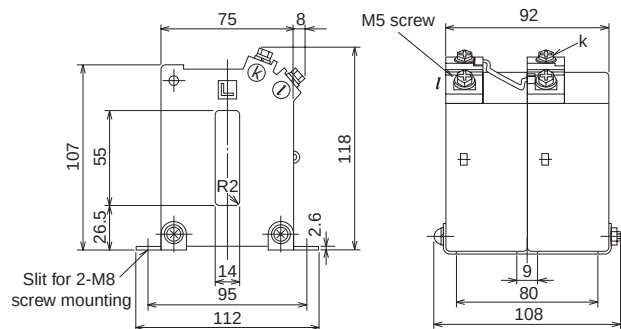
CC3M1: 150 to 300A CC3M2: 200 to 300A
CC3M3: 300 to 500A



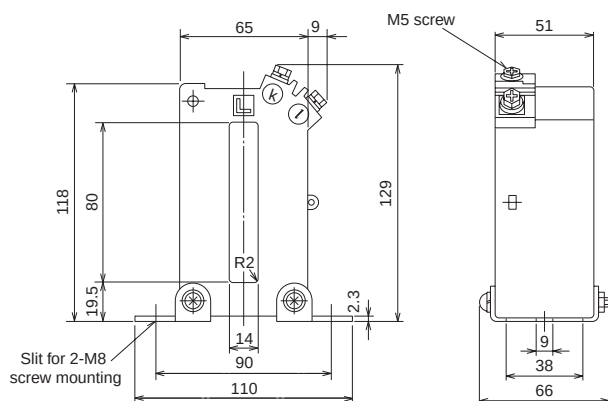
CC3M1: 400 to 600A CC3M2: 400 to 750A



CC3M2: 150A
CC3M3: 200, 250A

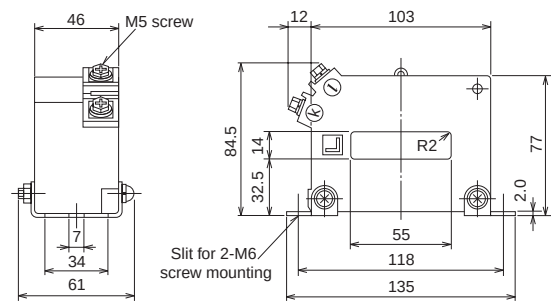


CC3M2: 800A CC3M3: 600 to 800A

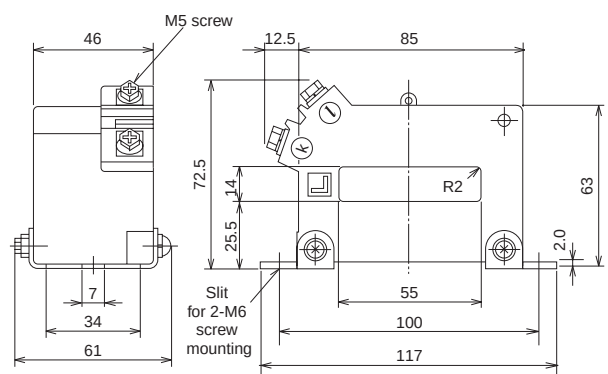


● Horizontal mounting

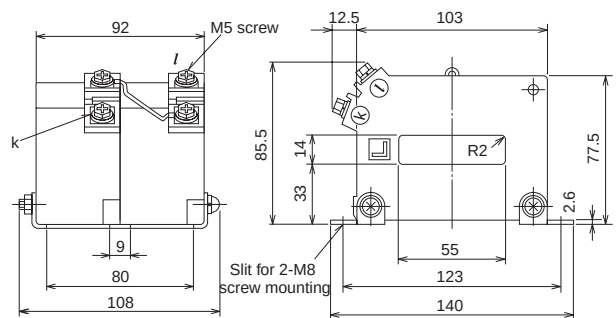
CC3M1: 150 to 300A CC3M2: 200 to 300A
CC3M3: 300 to 500A



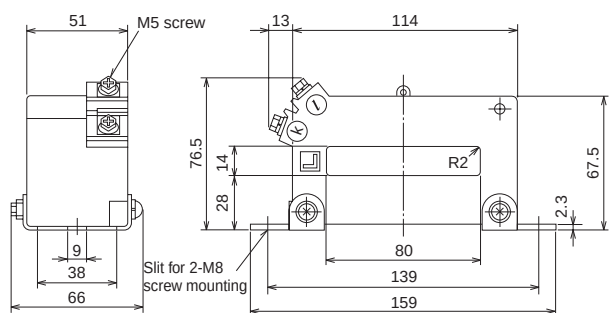
CC3M1: 400 to 600A CC3M2: 400 to 750A



CC3M2: 150A
CC3M3: 200, 250A



CC3M2: 800A CC3M3: 600 to 800A

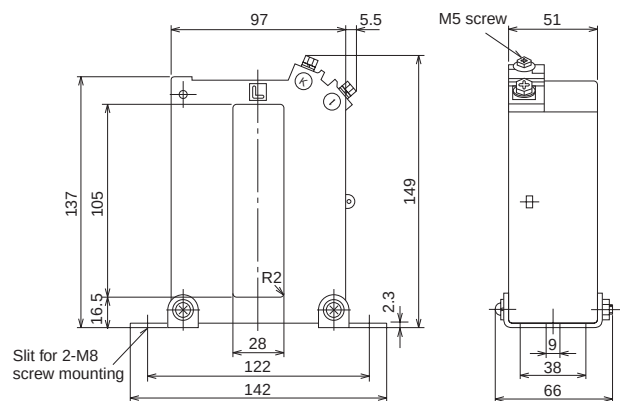


Instrument Transformers Through-type CT/CC3M

■ Dimensions, mm

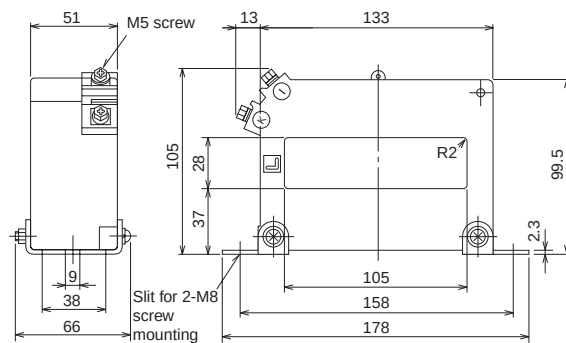
● Vertical mounting

CC3M2, CC3M3: 1000 to 2000A

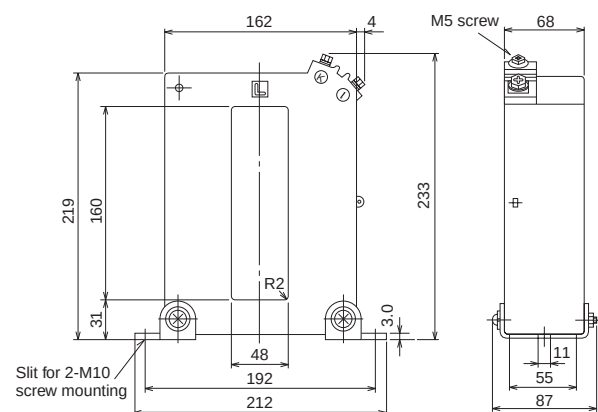


● Horizontal mounting

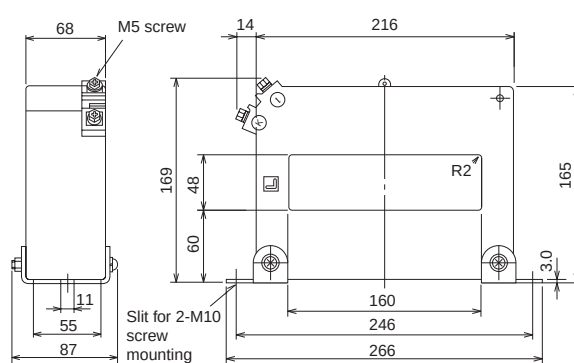
CC3M2, CC3M3: 1000 to 2000A



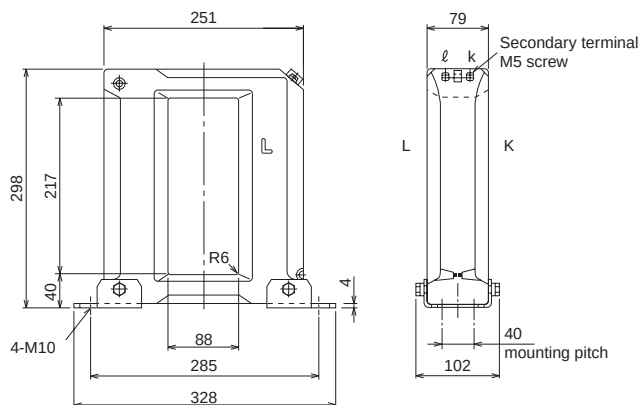
CC3M3: 2500 to 4000A



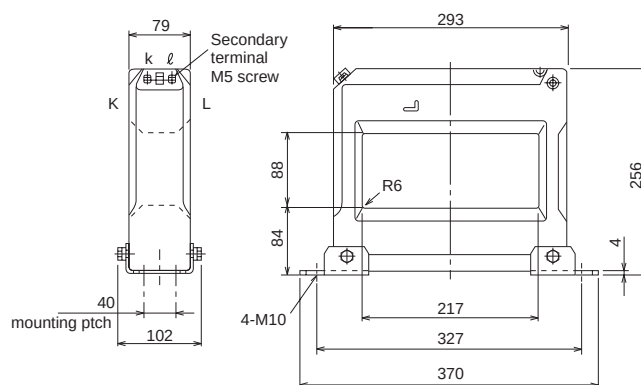
CC3M3: 2500 to 4000A



CC3M3: 5000, 6000A



CC3M3: 5000, 6000A



■ Dimensions, mm

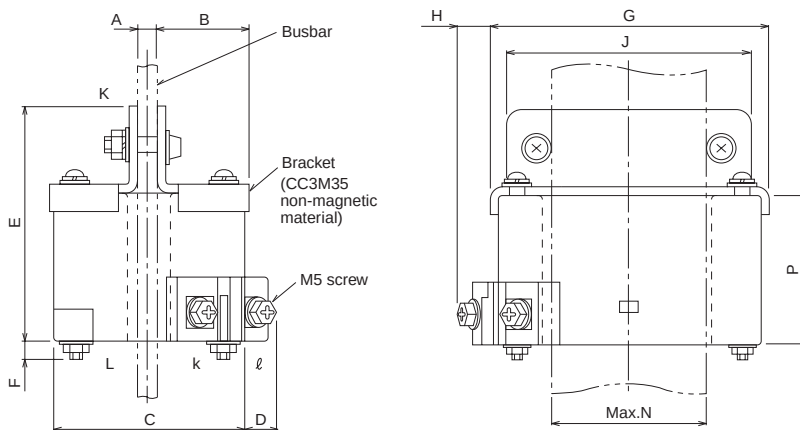
Direct busbar mounting

CC3M2 CTs with a rated primary current of 150A or CC3M3 CTs with a rated primary current of 200A, 250A or 4000 to 6000A cannot be mounted directly to a busbar because the CT is too heavy for the cross section of the busbar.

The busbar must be located in the center of the through hole of the CT. Be sure that the busbar does not come into contact with the wall of the through hole.

● Single busbar mounting

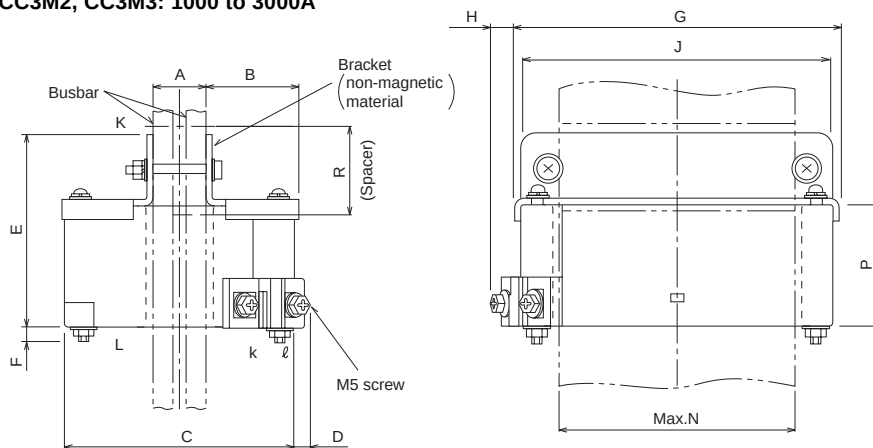
CC3M1: 150 to 600A CC3M2: 200 to 2000A CC3M3: 300 to 2000A



Type	Primary current (A)	Bracket type	A	B	C	D	E	F	G	H	J	N	P
CC3M1	150 to 300	CC3M33	5 to 10	33.5	75	7.5	74	6.5	110	8.5	90	50	46
	400 to 600	CC3M22	5 to 10	26.5	61	9.5	73.5	7	90.5	9.5	81	50	46
CC3M2	200 to 300	CC3M33	5 to 10	33.5	75	7.5	74	6.5	110	8.5	90	50	46
	400 to 750	CC3M22	5 to 10	26.5	61	9.5	73.5	7	90.5	9.5	81	50	46
	800	CC3M34	5 to 10	27.5	65	9	79	6.5	121	9	107	75	51
	1000 to 2000	CC3M35	6 to 12	43.5	97	5.5	80.5	7	139	10	129	100	51
CC3M3	300 to 500	CC3M33	5 to 10	33.5	75	7.5	74	6.5	110	8.5	90	50	46
	600 to 800	CC3M34	5 to 10	27.5	65	9	79	6.5	121	9	107	75	51
	1000 to 2000	CC3M35	6 to 12	43.5	97	5.5	80.5	7	139	10	129	100	51

● Two-busbar mounting

CC3M2, CC3M3: 1000 to 3000A



Primary current (A)	Bracket type	A	B	C	D	E	F	G	H	J	N	P	R
1000, 1200, 1500, 2000	CC3M36	15 to 24	39	97	5.5	80.5	7	139	10	129	100	51	Approx. 40
2500, 3000	CC3M37	15 to 45	72	162	4	102	17	223	11	210	150	68	Approx. 60

Instrument Transformers

Split type CT/CC2

Split type current transformers, CC2

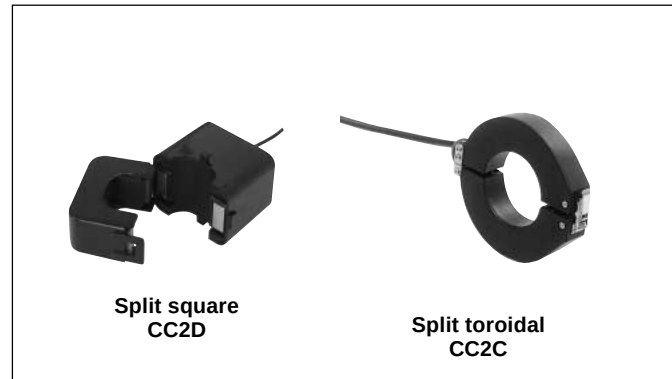
Primary current: 5 to 1200A

Secondary current: 7.34mA to 1A

■ Description

The CC2D and CC2C are split-type current transformers. The CT can be mounted to existing panels, such as control centers or load centers, to measure or monitor wattage. These CTs can be mounted without removing existing cables for easier installation.

Five rated burdens are available: 0.26mVA, 44.4mVA, 0.18VA, 0.5VA



■ Types and ratings

Description	Burden	Rated primary current (A)	Secondary current	Dia. of hole (mm)	Overcurrent resistance (A)	Connection	Mass (g)	Type
Split square	0.2693mVA Load resistance 5Ω	5	7.34mA	10	40 In/1.0s	Heat-resistant IV cable AWG22 1000mm supplied	45	CC2D81-0057
	26.93mVA Load resistance 5Ω	50	73.4mA	10	10 In/1.0s		45	CC2D81-0506
	44.4mVA Load resistance 10Ω	200	66.67mA	24	40 In/1.0s	Heat-resistant IV cable AWG18 1000mm supplied	200	CC2D65-2008
	0.18VA Load resistance 10Ω	400	133.33mA	36			300	CC2D54-4009
Split toroidal	0.5VA Load resistance 5Ω	100 200 400	1A	36			300	CC2D74-1001 CC2D74-2001 CC2D74-4001
		800 1200	1A	60			500	CC2C76-8001 CC2C76-12X1

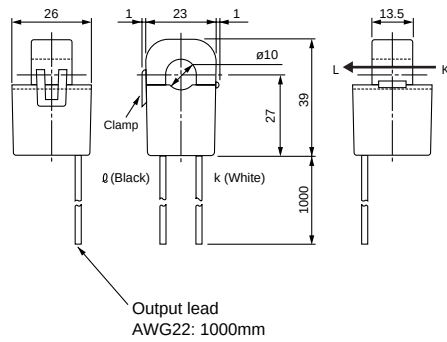
■ Performance

Application	Type	Ratio error	Phase difference	Insulation resistance	Dielectric strength	Output protection
For F-MPC	CC2D81-0057	±1% In	150' ±90' /In	100MΩ (500V DC megger)	2000V AC/1min, between sensor core and output	Not provided
	CC2D81-0506	±1.5%/0.2 In	180' ±120' /0.2 In			
	CC2D65-2008	±1% In	±60' /In	100MΩ (500V DC megger)	2000V AC/1min, between sensor core and output	Provided, built-in clamping diode ±3Vp
	CC2D54-4009	±1.5%/0.2 In	±90' /0.2 In			
General purpose	CC2D74-1001	±1% In ±1.5%/0.2 In	±80' /In ±100' /0.2 In	100MΩ (500V DC megger)	2000V AC/1min, between sensor core and output	Provided, built-in clamping diode ±1.4Vp
	CC2D74-2001	±1% In ±1.5%/0.2 In				
	CC2D74-4001	±1% In ±1.5%/0.2 In				
	CC2C76-8001 CC2C76-12X1	±1% In ±1.5%/0.2 In	±80' /In ±100' /0.2 In	100MΩ (500V DC megger)	2000V AC/1min, between sensor core and output	Provided, built-in clamping diode ±1.4Vp

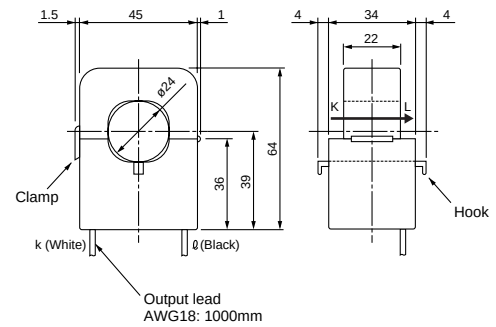
■ Dimensions, mm

• Split-toroidal

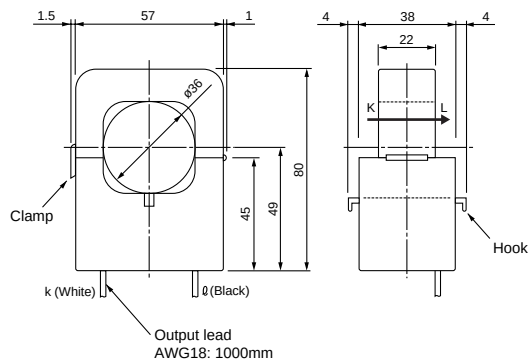
CC2D81



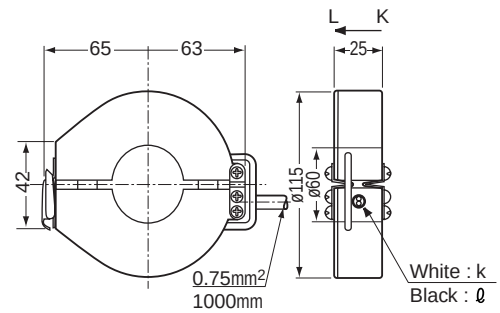
CC2D65



CC2D54, 74



CC2C76



■ Ordering information

Specify the following:

1. Type number

Instrument Transformers

Voltage transformers/CD32, 34

CD32 and CD34 potential transformers

Primary: 220V, 440V
Secondary: 110V

Description

The CD32 and CD34 transformers are of double-mold structure that provide excellent characteristics, such as thermal resistance and moisture resistance.

VTs with a fuse of a 100kA interrupting capacity have been added to the series. The accuracy class of a type with a rated burden of 15VA is 1.0, 1P and that of a type with a rated burden of 50VA is 3.0, 3P.

A transparent insulation cover is available for the terminal and fuse mounting blocks.



Types and ratings

Burden (VA)	Primary voltage (V)	Secondary voltage (V)	Accuracy class	Dielectric strength	Fuse*		Applicable load (VA, Max.)	Mass (kg)	Type
					Type	Rating			
15	220, 50/60Hz 440, 50/60Hz	110 110	1.0 · 1P	2000V, 1 minute 3000V, 1 minute	CD3F	600V, 2A(T) IC: 100kA	100	3.5	CD32F-21 CD32F-41
	220, 50/60Hz 440, 50/60Hz	110 110	1.0 · 1P	2000V, 1 minute 3000V, 1 minute	Not provided		100	3.5	CD32N-21 CD32N-41
50	220, 50/60Hz 440, 50/60Hz	110 110	3.0 · 3P	2000V, 1 minute 3000V, 1 minute	CD3F	600V, 2A(T) IC: 100kA	100	3.5	CD34F-21 CD34F-41
	220, 50/60Hz 440, 50/60Hz	110 110	3.0 · 3P	2000V, 1 minute 3000V, 1 minute	Not provided		100	3.5	CD34N-21 CD34N-41

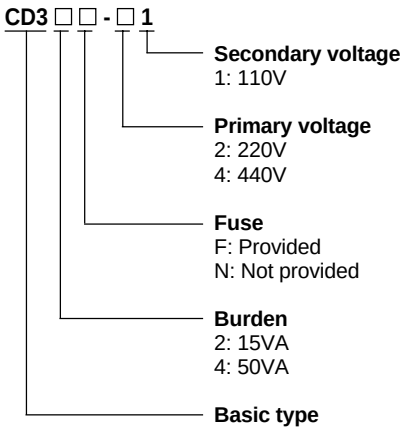
Notes: T: Fuse for transformer protection. IC: Interrupting capacity
* When the load limit is 100VA, the maximum tolerance is 5% or less.

Characteristics

Type		CD32F, 34F
Primary voltage (V)		220, 440
Applicable load (VA, max.)	Continuos rating	100
	2-second rating (For transformer protection)	200
Error at max. applicable load (%)	Continuos rating	-5
	2-second rating (For transformer protection)	-10
Fuse	Rated current (A)	T2
	Interrupting capacity (kA)	100
% impedance voltage	% resistance voltage (%)	0.69
	% reactance voltage (%)	0.15
	% impedance voltage (%)	0.71

Note: The 2-second rating is the value provided considering a 10-cycle duty on condition that the current is provided for 0.2s at 1.8s intervals.

Type number nomenclature



Ordering information

Specify the following:
1. Type number

Power Factor Controllers

Automatic power factor regulators

QC06E and QC12E

Automatic power factor regulator QC06E, QC12E

■ Description

Automatic power factor regulator (APFR) is a device which is designed to maintain the target power factor by regulating lagging or leading current. The APFR is designed to monitor the reactive power within the circuit continuously and to provide ON/OFF signals automatically to control circuit breakers in a capacitor bank. In an electrical network such as an industrial plant using induction motors which produce reactive power, the power factor will drop. This will cause a power loss, a line voltage drop and other disadvantages. In conventional electrical systems the efficiency of transmission and distribution equipment is improved by installing fixed capacitors across the line. However, an over-compensation may arise when there is a light load, such as at night, which would result in an increase in line voltage and excess current. The APFR supervises the power factor in the system, and controls the power factors by switching capacitors ON or OFF as the situation requires in the face of a reactive leading or lagging load.

Low power loss

Correcting the power factor with a power capacitor reduces the line current. This also reduces the power loss caused by the resistances of the power cables and transformer windings.

Effective use of power receiving facility

Correcting the power factor with a power capacitor reduces the line current. Since this produces margins in the transformer capacity and the current-carrying capacity of cables, a heavier load can be carried without adding more facilities.

Stable supply voltage for long equipment service life

A reactive power, especially a leading reactive power at a light load (at night), often produces an overvoltage and shortens the service life of lamps. Use an automatic power factor regulator to suppress a voltage decrease at a heavy load and a voltage increase at a light load.

Laborsaving unmanned operations

This regulator outputs capacitor connection and disconnection commands automatically to maintain an optimum power factor. The simple setup for this output saves labor applied to power factor correction.

■ Features

• Compact (DIN size) and lightweight

The DIN-size compact unit permits easy mounting hole on the panel and enhances work efficiency.

The 6-bank and 12-bank models have front panels of the same size (144mm × 144mm). Since in the panel cutout hole sizes are also the same (138mm × 138mm), it is possible to use panel cutout holes of one uniform size.



QC06E

• 220V and 440V power supplies

The regulator can be connected to a 220V or 440V power supply. Set the voltage input switch on the front panel to the control power supply voltage being used. Connect control power cables to the correct terminals of the terminal block in accordance with the control power supply voltage being used.

• Automatic setting of control level by microcomputer

The mode and data are set simply by using four keys. The microcomputer automatically sets the levels at which capacitors should be connected or disconnected.

• Three types of capacitor connection and disconnection control by purpose

1. Cyclic control or optimum control (automatic selection)

Under cyclic control, capacitors of the same capacitance are connected and disconnected in ascending order of capacitor number.

Under optimum control to keep the number of connections and disconnections minimal, a capacitance change is calculated from the measured reactive power and the target power factor and a capacitor of the nearest capacitance is connected or disconnected.

Either control is selected in accordance with the set capacitor capacitance.

2. Unconditional cyclic control

Capacitors are controlled cyclically, irrespective of their capacitances.

3. Multistep control

Capacitors having capacitances incremented in multiples of two (e.g. 1:2:2:2:2:2:, 1:2:4:4:4:4, and 1:2:4:8:8:8) are simultaneously connected or disconnected to optimize the capacitance with a minimal number of steps.

Power Factor Controllers

Automatic power factor regulators

QC06E and QC12E

• Useful functions

1. Polarity error diagnosis function

If a polarity error in wiring is detected, the regulator lights the alarm lamp and sounds the buzzer to indicate the miswiring.

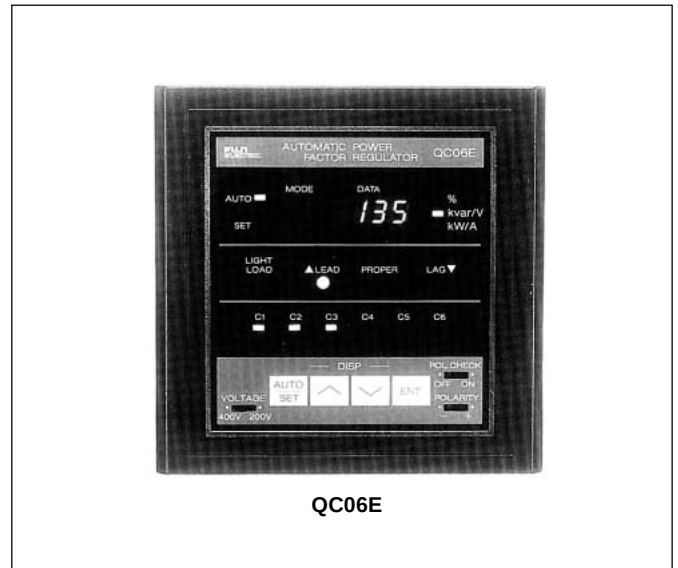
2. Forced disconnection function

To protect capacitors from being damaged or reactors from being burnt by excessive harmonics, or to disconnect capacitors unconditionally at night, external time switch signals can be input to the regulator. The signals automatically disconnect the connected capacitors in proper order.

• Automatic capacitor disconnection at light load

When the load of a power line decreases at night, the connected capacitors may increase the leading reactive power and cause an overvoltage.

A voltage increase on the power receiving side will shorten the service life of lamps and other load equipment. To prevent an excessive leading power factor at a light load, the regulator automatically disconnects capacitors.



QC06E

• Abundant regulator status information display

Power factor



Reactive power



Active power



Voltage



Current



Power Factor Controllers

Automatic power factor regulators

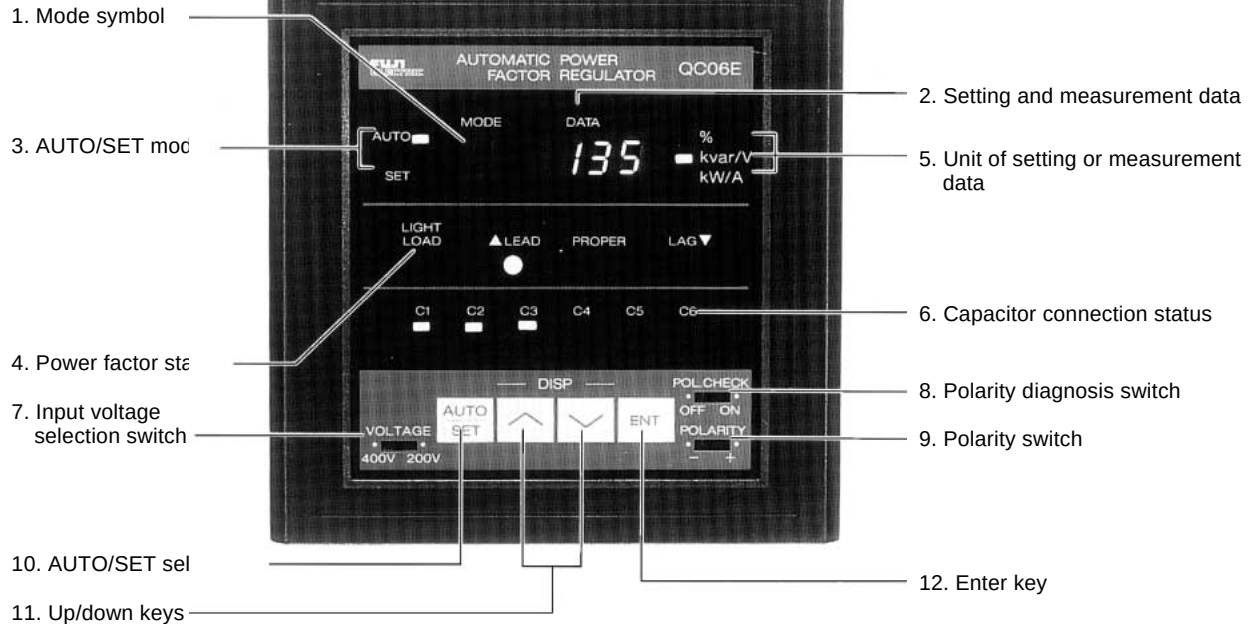
QC06E and QC12E

■ Specifications

Item		Specification	
		QC06E	QC12E
Voltage input	Frequency	50/60Hz	
	Rated voltage	200 – 220V/400 – 440V selectable	
	Allowable voltage fluctuation range	170 – 264V at 220V 323 – 528V at 440V	
	Power consumption	13VA at 220V, 13VA at 440V	15VA at 220V, 15VA at 440V
Current input	Frequency	50/60Hz	
	Rated current	5A	
	Power consumption	1VA	
Reactive power control range	Connection control level (kvar)	Automatic setting in accordance with the target power factor	
	Disconnection control level (kvar)	Already-connected minimum capacitor capacitance × 1.2 – connection control level (When the calculation result becomes negative, the disconnection control level is automatically set to 0).	
	Correct control range (kvar)	Already-connected minimum capacitor capacitance × 1.2 (Automatic setting)	
	Control error	±0.05 (kvar) × CT ratio (at 220V input)	
Light-load disconnection control value		When the active power level falls below the numeric-input minimum load, the capacitor are disconnected successively from the capacitor banks in descending order of capacitance at disconnecting time intervals. When the minimum load is set to 0, however, no capacitors are disconnected even when the active power level falls below the numeric-input minimum load. [Control error: ±0.05 (kvar) × CT ratio] (at 220V input)	
Capacitor control output	No. of connectable banks	6-circuit (NO contact common on one side)	12-circuit (NO contact common on one side)
	Applicable minimum load	1V DC, 1mA	
	On/Off switching capacity	250V AC, 5A 30V DC, 5A 100V DC, 0.5A	
	Electrical life expectancy	Approx. 100,000 operations at 220V AC, 2A inductive load	
Output control system		A1: Cyclic/optimum control, selectable automatically A2: Unconditional cyclic control A3: Multistep control, 1:2:2:2:2:2----- A4: Multistep control, 1:2:4:4:4:4----- A5: Multistep control, 1:2:4:8:8:8----- (Control modes A3 to A5 are effective for C1 only 0 to 9999)	
Setting item		1. Bank capacitor capacitance C1 to C6 (0kvar *) (Modes 1 to 6) Output control system A3 to A5 are available only for bank C1.	Bank capacitor capacitance C1 to C12 (0kvar *) (Modes 1 to 9, o, b, c) Output control system A3 to A5 are available only for bank C1.
		2. Target power factor $\cos\theta = 98\%^*$	Mode F (85 to 100)
		3. CT ratio 0*	Mode C (1 to 1200)
		4. Control mode 1*	Mode A (1 to 5)
		5. Minimum load 0kW*	Mode L (0 to 9999)
		6. Delay time 300 sec.*	Mode d (30, 60, 120, 300, 600)
Display	Digital display	Current power factor (%), reactive power (kvar) (no mode symbol: leading, -: lagging), active power (kW), primary voltage (V) and primary current (A) on 7-segment LED panel.	
	Display error: 0.5A or less at CT input Power factor lead (+60%) to lag (–60%)	Power factor: ±5% or less, Reactive/active power: ±0.05kvar/kW × CT ratio or less (at 220V input) Primary current: ±0.1A × CT ratio or less	
	Control status display (LED)	Light load: Active power equal to or lower than the light-load disconnection control level Lagging, leading, optimum: Reactive power lagging, leading, or optimum in the control range	
	Control output display (LED)	Lit: Control output ON, Unlit: Control output OFF	
Operating ambient temperature		–10 to +55°C	
Dielectric strength		2500V AC 1 minute (between all terminals and E terminal)	
Outline dimensions (mm)		Height: 144, Width: 144, Depth: 114.5	Height: 144, Width: 144, Depth: 140
Mass (kg)		Approx. 1.5	Approx. 1.8

Note: * Value at shipment

■ Display and setting panel



1. Mode symbol

Displays the set mode (mode symbol) or the kind of measurement data.

2. Setting and measurement data

• Data setting mode

The digital LED display displays the following setting data:

Mode symbol	Setting item	Setting data	Setup at shipment
1 to 9	Capacitance of capacitor C1 to C9 ^{*6}	0 to 9999kvar ^{*1}	0
o, b, c	Capacitance of capacitor C10, C11, C12 ^{*6}	0 to 9999kvar ^{*1}	0
A	Capacitor control system	1 to 5 ^{*2}	1
C	CT ratio	1 to 1200 ^{*3}	0
F	Target power factor	85 to 100%	98
L	Disconnection at light load	0 to 9999kW ^{*4}	0
d	Delay time	30, 60, 120, 300, or 600s ^{*5}	300

Notes:

^{*1} When the capacitance is set to 0 or 9999, the control output contact goes ON for 0 or OFF for 9999 during automatic operation.

^{*2} See the table at right for the meanings of the capacitor control system numbers.

^{*3} The CT ratio is set to 0 when the regulator is shipped from the factory. Set this value to accommodate the use requirements. The regulator does not operate automatically when the set value is 0 or 1201 or greater.

^{*4} When the set value is 0, the light-load disconnection function is not activated. To disconnect capacitors when the load becomes light, set the minimum capacitor capacitance.

^{*5} Select an optimum delay time for the capacitor discharging unit. (Set "300" or "600" if a discharging resistor is used.)

^{*6} The mode symbols are 1 to 6 (C1 to C6) for type QC06E and 1 to 9, o, b, and c (C1 to C12) for type QC12E.

• Auto operation mode

When the Up (⬆) and Down (⬇) keys are pressed at the same time, the LED display displays measurement data in the following order:

Model symbol	Display item	Measurement data display
(-) ^{*7}	Power factor	-0 to 100 to 0%
(-) ^{*7}	Reactive power	-9999 to 0 to 9999kvar ^{*8}
A	Active power	0 to 9999kW ^{*8}
U	Primary voltage	0 to 9999V ^{*8}
I	Primary current	0 to 6000 (5X1200)A
	No display	—

Notes:

^{*7} No mode symbol is displayed for a lead; a negative sign (-) is displayed for a lag.

^{*8} The LED display always displays "9999" for any value greater than 9999.

Capacitor control system

Set value	Description
1	Cyclic/optimum control
2	Unconditional cyclic control
3	Multistep control (capacitance ratio: 1:2:2:2:2:2:2:2:2)
4	Multistep control (capacitance ratio: 1:2:4:4:4:4:4:4:4)
5	Multistep control (capacitance ratio: 1:2:4:8:8:8:8:8:8)

Power Factor Controllers

Automatic power factor regulators

QC06E and QC12E

3. AUTO/SET mode

The green lamp lights in the auto operation mode and the red one in the data setting mode.

4. Power factor status

Light load: The yellow lamp lights when the active power of the circuit is equal to or lower than the set level for light-load disconnection.

△ Lead:

The red lamp lights when the reactive power of the circuit is leading, compared to the set level for disconnection.

Acceptable:

The green lamp lights when the reactive power of the circuit is within the optimum control range.

Lag ▽ :

The red lamp lights when the reactive power of the circuit is lagging, compared to the set level for connection.

5. Unit of setting or measurement data

A green lamp lights at %, kvar, kW, V, or A.

6. Capacitor connection status

The red lamps light at the capacitors for which the capacitor control output contacts are ON (make) and go out at the capacitors for which the contacts are OFF (break).

7. Input voltage selection switch

Set this switch to “200V” for 200/220V input power or “400” for 400/440V input power.

8. Polarity diagnosis switch

The polarity switch must initially be toggled to “+”. Toggle the polarity diagnosis switch to the right to check the voltage or current input polarity. If the polarity is incorrect, “E□□□3” is displayed and the buzzer sounds.

9. Polarity switch

If the voltage or current input polarity is incorrect, toggle this switch to “-” and press the enter key to clear the error display and stop the buzzer. The regulator then operates normally because the input polarity is handled as being reversed.

10. AUTO/SET select key

Press this key to select the auto operation or data setting mode.

11. Up/down keys

Use these keys to select a data setting mode.

Use these keys to increment (+1) or decrement (-1) a numeric value in each setting mode.

12. Enter key

After selecting a data setting mode, start numeric input. The numeric display changes from being continuously lit to blinking.

Press this key to confirm a set value in each data setting mode. The value is stored in the internal memory and the numeric display changes from blinking to being continuously lit.

Press two keys of the four keys, (   and ), at the same time for the following operation or display:

● Data setting mode



Clears the set value to 0. (This key operation is effective only when the mode symbol is 1 to 9, o, b, c, C, or L and the numeric display is blinking.)



Resets the set value to the shipping setup. (This key operation is effective only when the mode symbol is 1 to 9, o, b, c, C, or L and the numeric display is blinking.) (Keep the keys depressed for five seconds or longer.)

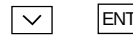
● Auto operation mode



Changes the measurement data display. (Each time the keys are pressed, the display changes in the following order: power factor, reactive power, active power, primary voltage, primary current, and no display. The initial display at power-on is always power factor data.



Tests a capacitor connection. (Press the keys at the same time for reactive power lag display. Keep the keys depressed to connect the capacitors in the specified order.)



Tests a capacitor disconnection. (Press the keys at the same time for reactive power lead display. Keep the keys depressed to disconnect the capacitors in the specified order.)

■ Type number nomenclature and ordering code

JD006 – E

Series

E: E series

No. of connectable banks

JD006: QC06, 6 circuits

JD012: QC12, 12 circuits

■ Ordering information

Specify the following:

1. Type number or ordering code
2. Input voltage and current
3. Operating voltage
4. Number of connectable capacitor banks

Power Factor Controllers

Automatic power factor regulators

QC06E and QC12E

• Optimum control

Under optimum control, the regulator connects or disconnects the capacitor with the capacitance closest to the change of reactive power among capacitors of different capacitances. If there are two or more capacitors of the same capacitance, the regulator connects or disconnects the capacitors cyclically for optimum control (the number of switchings) match.

1. Capacitor connection

The red lag lamp lights when the reactive power level exceeds the level at which more capacitors should be connected. The regulator calculates the difference between the current reactive power and the level at which more capacitors should be connected, and integrates the calculated value for the set delay time. The average value per unit time is calculated from the integrated total and a capacitor having the capacitance closest to the average value is selected. The capacitor control output for the capacitor is turned ON and the red lamp of the capacitor bank lights.

The regulator continues integrating and averaging the differences between the current reactive power level and the level at which more capacitors should be connected, and selecting optimum capacitors. The capacitor control output is turned ON repeatedly until the reactive power of the circuit falls within the allowable range.

Figure 1 shows an example of a capacitor connection control with a load variation pattern.

2. Capacitor disconnection

When the circuit load decreases, the already-connected capacitors increase the leading reactive power level. If the reactive power level exceeds the level at which capacitors should be disconnected, the red lead lamp lights. The regulator calculates the difference between the current reactive power level and the level at which capacitors should be disconnected, and integrates the calculated value for the set delay time. The average value per unit time is calculated from the integrated total and a capacitor having the capacitance closest to the average value is selected. The capacitor control output for the capacitor is turned OFF and the red lamp of the capacitor bank goes OFF.

The regulator continues integrating and averaging the differences between the current reactive power level and the level at which capacitors should be disconnected, and selecting optimum capacitors. The capacitor control

output is turned OFF repeatedly until the reactive power level of the circuit falls within the allowable range. Figure 2 shows an example of capacitor disconnection control with a load variation pattern.

Fig. 1

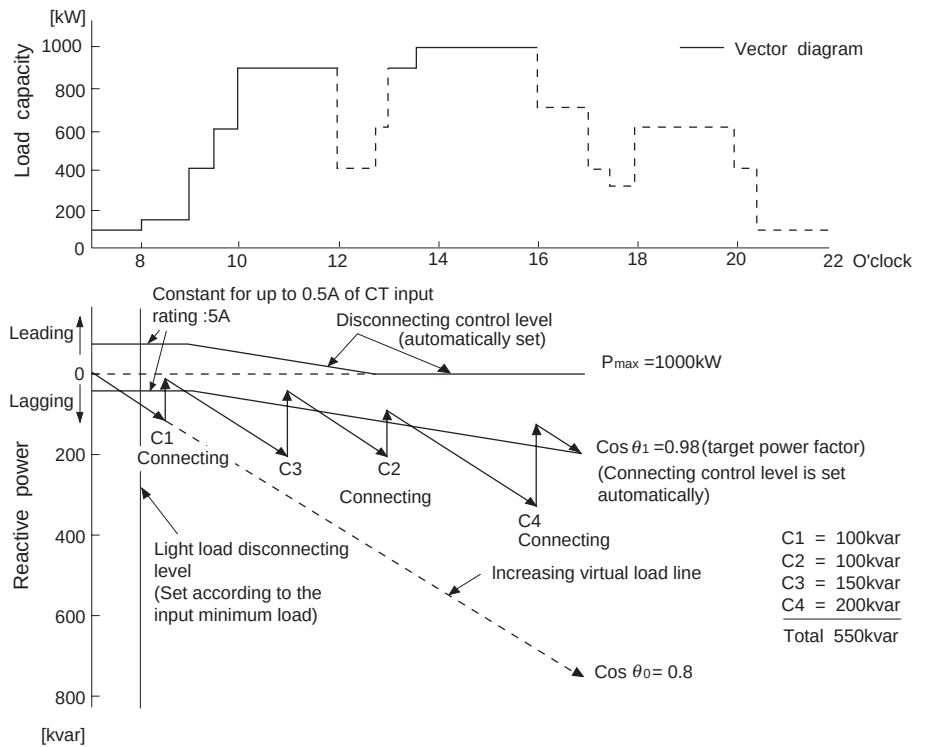
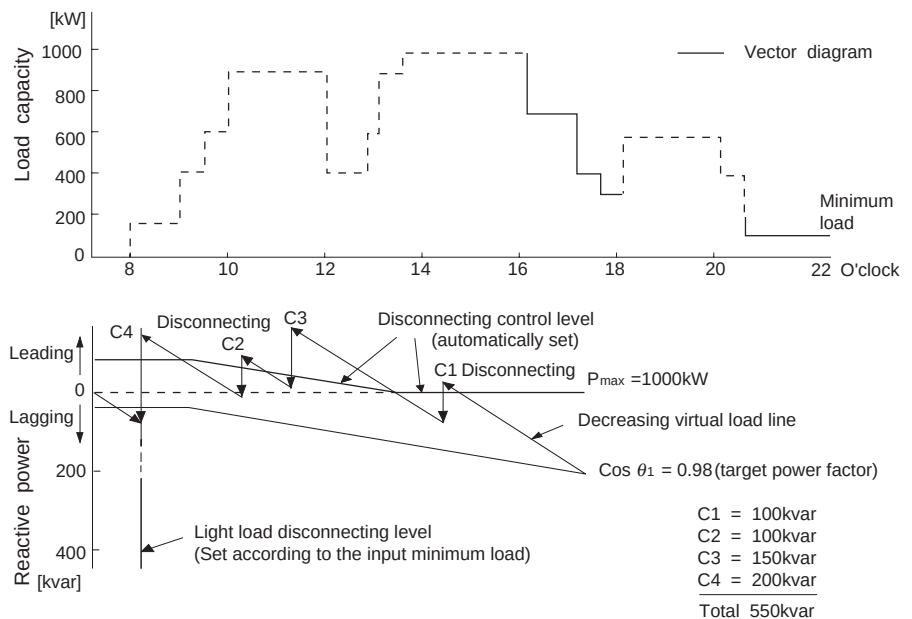


Fig. 2



• **Multistep control (step-by-step control)**

Under multistep control, the regulator connects or disconnects in units of the minimum capacitance set at C1 in accordance with the changes of the reactive power to approximate the power factor to the target value. The power factor at a light load can be controlled in the same way.

1. Capacitor connection

When the reactive power level exceeds the level at which more capacitors should be connected, the red lag lamp lights. If the red lamp remains lit for the set delay time or longer, the capacitor control outputs for the next step go ON or OFF and the red lamps of the capacitors light or go OFF. If the reactive power level of the circuit is still over the level at which more capacitors should be connected and the red lag lamp remains lit, the capacitor control outputs for the next capacitor go ON or OFF after the set delay time.

The capacitor control output is turned ON or OFF sequentially at the delay time intervals until the reactive power level of the circuit falls within the allowable range.

2. Capacitor disconnection

The red lead lamp lights when the load decreases and the connected capacitors increase the leading reactive power level of the circuit beyond the level at which capacitors should be disconnected. When the red lamp remains lit for the set delay time or longer, the capacitor control outputs for the next step go OFF or ON and the red lamps of the capacitor banks go OFF or light. The capacitor control output is turned OFF or ON sequentially at the delay time intervals until the reactive power level of the circuit falls within the allowable range.

**Capacitor connection and disconnection signal output operation
Signal output in multistep control mode/QC06E**

Example 1

Lag/Lead	Step	C1=10kvar C2=20kvar C3=20kvar C4=20kvar C5=20kvar C6=20kvar Control system [3] Capacitance ratio C1:C2:C3:C4:C5:C6=1:2:2:2:2:2							Lag/Lead	C1=10kvar C2=20kvar C3=20kvar C4=20kvar C5=20kvar C6=20kvar Control system [3] Capacitance ratio C1:C2:C3:C4:C5:C6=1:2:2:2:2:2							
		C1	C2	C3	C4	C5	C6	Total capacitance		C1	C2	C3	C4	C5	C6	Total capacitance	
Lag ▽	1	○						10kvar	Lead △	○	○	○	○	○	○	110kvar	
	2		○					20			○	○	○	○	○	○	100
	3	○	○					30		○		○	○	○	○	○	90
	4		○	○				40				○	○	○	○	○	80
	5	○	○	○				50		○			○	○	○	○	70
	6		○	○	○			60					○	○	○	○	60
	7	○	○	○	○			70		○				○	○	○	50
	8		○	○	○	○		80						○	○	○	40
	9	○	○	○	○	○		90		○						○	30
	10		○	○	○	○	○	100								○	20
	11	○	○	○	○	○	○	110		○							10

Example 2

Lag/Lead	Step	C1=10kvar C2=20kvar C3=40kvar C4=40kvar C5=40kvar C6=40kvar Control system [4] Capacitance ratio C1:C2:C3:C4:C5:C6=1:2:4:4:4:4							Lag/Lead	C1=10kvar C2=20kvar C3=40kvar C4=40kvar C5=40kvar C6=40kvar Control system [4] Capacitance ratio C1:C2:C3:C4:C5:C6=1:2:4:4:4:4							
		C1	C2	C3	C4	C5	C6	Total capacitance		C1	C2	C3	C4	C5	C6	Total capacitance	
Lag ▽	1	○						10kvar	Lead △	○	○	○	○	○	○	190kvar	
	2		○					20			○	○	○	○	○	○	180
	3	○	○					30		○		○	○	○	○	○	170
	4			○				40				○	○	○	○	○	160
	5	○		○				50		○	○		○	○	○	○	150
	6		○	○				60			○		○	○	○	○	140
	7	○	○	○				70		○			○	○	○	○	130
	8			○	○			80					○	○	○	○	120
	9	○		○	○			90		○	○			○	○	○	110
	10		○	○	○			100			○			○	○	○	100
	11	○	○	○	○			110		○				○	○	○	90
	12			○	○	○		120						○	○	○	80
	13	○		○	○	○		130		○	○				○	○	70
	14		○	○	○	○		140			○					○	60
	15	○	○	○	○	○		150		○						○	50
	16			○	○	○	○	160								○	40
	17	○		○	○	○	○	170		○	○						30
	18		○	○	○	○	○	180			○						20
	19	○	○	○	○	○	○	190		○							10

Power Factor Controllers
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Example 3

Lag/Lead	Step	C1=10kvar C2=20kvar C3=40kvar C4=80kvar C5=80kvar C6=80kvar Control system [5] Capacitance ratio C1:C2:C3:C4:C5:C6=1:2:4:8:8:8							Lag/Lead	C1=10kvar C2=20kvar C3=40kvar C4=80kvar C5=80kvar C6=80kvar Control system [5] Capacitance ratio C1:C2:C3:C4:C5:C6=1:2:4:8:8:8							
		C1	C2	C3	C4	C5	C6	Total capacitance		C1	C2	C3	C4	C5	C6	Total capacitance	
Lag ▽	1	○						10kvar	Lead △	○	○	○	○	○	○	310kvar	
	2		○					20			○	○	○	○	○	300	
	3	○	○					30			○		○	○	○	290	
	4			○				40				○	○	○	○	280	
	5	○		○				50			○	○		○	○	270	
	6		○	○				60				○		○	○	260	
	7	○	○	○				70			○			○	○	○	250
	8				○			80					○	○	○	240	
	9	○			○			90			○	○	○		○	○	230
	10		○		○			100				○	○		○	○	220
	11	○	○		○			110			○		○		○	○	210
	12			○	○			120				○			○	○	200
	13	○		○	○			130			○	○			○	○	190
	14		○	○	○			140				○			○	○	180
	15	○	○	○	○			150			○				○	○	170
	16				○	○		160						○	○	160	
	17	○			○	○		170			○	○	○			○	150
	18		○		○	○		180				○	○			○	140
	19	○	○		○	○		190			○		○			○	130
	20			○	○	○		200					○			○	120
	21	○		○	○	○		210			○	○				○	110
	22		○	○	○	○		220				○				○	100
	23	○	○	○	○	○		230			○					○	90
	24				○	○	○	240								○	80
	25	○			○	○	○	250			○	○	○				70
	26		○		○	○	○	260				○	○				60
	27	○	○		○	○	○	270			○		○				50
	28			○	○	○	○	280					○				40
	29	○		○	○	○	○	290			○	○					30
	30		○	○	○	○	○	300				○					20
	31	○	○	○	○	○	○	310			○						10

Power Factor Controllers

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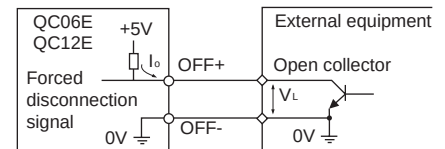
■ Terminals

Used for	Terminal symbol	Terminal name	Description
Input	P2 (at 220V) P3	Voltage input (220V)	Connect this terminal directly to a 220V power line. Note: The current for the internal control power supply flows between terminal P2 and P3.
	P2 (at 440V) P3	Voltage input (440V)	Connect this terminal directly to a 440V power line. Note: The current for the internal control power supply flows between terminal P2 and P3.
	1S, 1L	Current input	Connect these terminals to the secondary side of a CT.
	E	Ground	Grounding resistance: 100Ω or less
Contact output	COM	Capacitor control output common	Connect the common cable for capacitor connection and disconnection signals. Be sure to connect the upper and middle COM terminals (QC12E)
	C 1 to C12	Control output terminal for C 1 to C12	This terminal output control signals to the capacitor control section (Ex. VMC ^{*1}) connected to the terminal.
External forced disconnection signal input ^{*2}	OFF +	Forced disconnection signal input (positive)	Connect this terminal to one side of a contact for a contact signal input. Connect this terminal to a collector for NPN transistor open-collector signal input.
	OFF –	Forced disconnection signal input (negative)	Connect this terminal to opposing side of a contact for a contact signal input. Connect this terminal to 0V for NPN transistor open-collector signal input.

Notes:

^{*1} VMC: Vacuum magnetic contactor

^{*2} Signal input circuits
ON voltage $V_L < 1.0V$
Drain current $I_o = \text{Approx. } 10mA$



QC06E and QC12E

Upper terminal arrangement	Main circuit								
	C6	C5	C4	C3	C2	C1	COM	OFF–	OFF+

Lower terminal arrangement	Control circuit								
	* NC	* NC	1S	1L	* NC	P3	P2 (220V)	P2 (440V)	E

*NC: No connection

QC12E only

Middle terminal arrangement	Main circuit						
	C12	C11	C10	C9	C8	C7	COM

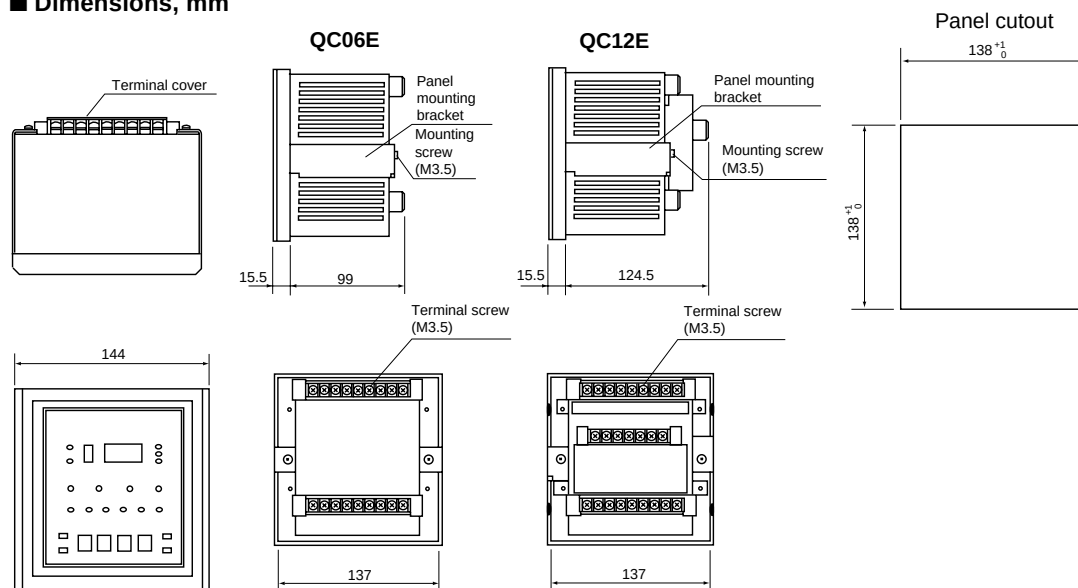
Note: For QC12E, the upper and middle COM terminals are not connected internally. Be sure to connect these terminals.

Power Factor Controllers

Automatic power factor regulators

QC06E and QC12E

■ Dimensions, mm



■ Key operations

● Data setting mode

Operation	Key operation	Remarks
Selecting a setting item	or	
Setting a value		
Incrementing the data value (+1)		Control mode (Mode A): 1 to 5
Decrementing the data value (-1)		Target power factor (Mode F): 85 to 100
Shifting the digit up		Delay time (Mode d): 30, 60, 120, 300, or 600
		For other modes, be sure to enter a four-digit numeric value. The input order is thousands, hundreds, tens, then ones. Change the set value if a high-order digit is not required, skip the digit by pressing the key, then enter a numeric value (1 to 9) to the next digit. (The skipped digit is not displayed.)
Enter capacitance 0 value		When the value "0" is blinking, press the key four times to set the value.
Determining the set value		
Clearing the set value to 0	+ Press at the same time.	This key operation is effective only when the mode symbol is 1 to 9, o, b, c, C, or L and numeric display is blinking.
Resetting all set value	+ Press for five seconds or longer at the same time.	This key operation is effective only when the mode symbol is 1 to 9, o, b, c, C, or L and numeric display is blinking. (All the set items are reset to the shipping setup.)
Stopping the buzzer giving error notification during diagnosis		Any key may be pressed.
Changing mode to auto operation		

● Auto operation mode

Operation	Key operation	Remarks
Changing measurement display	+ Press at the same time.	The measurement data display changes cyclically in the following order: Power factor, reactive power, active power, primary voltage, primary current, and no display. The initial display at power-on is power factor data.
Testing capacitor connection	+ Press continually at the same time.	For the operation sequence, operation time, and other details, refer to the instruction manual.
Testing capacitor disconnection	+ Press continually at the same time.	
Stopping the buzzer giving error notification during diagnosis		Any key may be pressed.
Changing mode to data setting		

■ Data setting procedure

• Set the following items

1. Capacitor capacitance: Capacitor 1 (150kvar) to 3 (150kvar)
2. Capacitor control mode (example): 2
3. CT ratio (example): 20 (current transformation ratio: 100/50)
4. Target power factor: 100(%)
5. Minimum load: 100(kW)
6. Delay time: 120(s)

• Data setting and change procedure

Data setting flow	Key operation	Display status		Explanation
		Mode	Data	
Power-on *1	Press key to change already-input data.	1		"0" is set at shipping from the factory.
Mode-1 initial value display				
Capacitor-1 capacitance input awaited	1	1		"0" starts blinking to wait for capacitor-1 capacitance input. An entry in the thousands place is awaited.
Enter 0 in the thousands place	2	1		The display value does not change but "0" is set at the thousand place. An entry in the hundreds place is awaited.
Enter 1 in the hundreds place	3	1		Enter 1 in the hundreds place.
	4	1		"1" is set at the hundreds place. An entry in the tens place is awaited.
Enter 5 in the tens place	5 Press five times	1		Enter 5 in the tens place.
Enter 0 in the ones place	6	1		"5" is set at the tens place. An entry in the ones place is awaited.
	7	1		Capacitor-1 capacitance input has been completed.
Mode-2 initial value display		2		"0" is set at shipping from the factory.
Capacitor-2 capacitance input awaited		2		"0" starts blinking to wait for capacitor-2 capacitance input. An entry in the thousands place is awaited.
Set each place following the above order	2 to 7			Capacitor-2 capacitance input has been completed.
Mode-3 initial value display		3		"0" is set at shipping from the factory.
Enter capacitor-3 capacitance	1 to 7			Capacitor-3 capacitance input has been completed.
Enter 0 for capacitance of capacitor 4 to 12		4		The confirmation of capacitance setup (0) has been completed.
To correct an input error or change a set value		Each mode		Data can be entered in a blinking field.
Control-mode initial value display		A		Capacitor control mode: 1 is set at shipment from the factory.
Control-mode input awaited		A		Capacitor control mode: An entry in the control mode is awaited.
Enter 2 in control mode	or	A		Capacitor control mode input is in progress.
		A		The input in capacitor control mode has been completed.
CT ratio initial display		C		CT ratio setting mode: "0" is set at shipping from the factory.
CT ratio input awaited		C		"0" starts blinking to wait for CT ratio input. An entry in the thousand place is awaited.
Enter 0 in the thousands place		C		"0" is set at the thousands place. An entry in the hundreds place is awaited.
Enter 0 in the hundreds place		C		"0" is set at the hundreds place. An entry in the tens place is awaited.
Enter 2 in the tens place	two times	C		Enter 2 in the tens place.

Note:

*1 The initial value setup in mode 1 is always displayed at the first power-on after the unit is delivered from the factory, or displayed if all data have been reset to the factory setup.

*2 Although 0 is set at shipping from the factory, check the setup by incrementing the capacitor numbers with this key.

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Data setting flow	Key operation	Display status		Explanation
		Mode	Data	
Enter 0 in the ones place	ENT	C	0020	"2" is set at the tens place. An entry in the ones place is awaited.
	ENT	C	0020	CT ratio input has been completed.
Target power factor initial display	^	F	98	Target power factor: "98" is set at shipping from the factory.
Target power factor input awaited	ENT	F	98	An entry of target power factor is awaited.
Enter target power factor "100"	^ or v	F	100	Target power factor input is in progress.
	ENT	F	100	Target power factor input has been completed.
Minimum load initial display	^	L	0	Minimum load: "0" is set at shipping from the factory.
Minimum load input awaited	ENT	L	0000	"0" is set at the thousands place. An entry in the thousand place is awaited.
Enter 0 in the thousands place	ENT	L	0000	"0" is set at the thousands place. An entry in the hundreds place is awaited.
Enter 1 in the hundreds place	^	L	0100	Enter "1" in the hundreds place.
Enter 0 in the tens place	ENT	L	0100	"1" is set at the hundreds place. An entry in the tens place is awaited.
	ENT	L	0100	"0" is set at the tens place. An entry in the ones place is awaited.
Enter 0 in the ones place	ENT	L	0100	Minimum load input has been completed.
Delay time initial display	^	d	300	Delay time: "300" is set at shipping from the factory.
Delay time input awaited	ENT	d	300	An entry of delay time is awaited.
Enter delay time 120	^ or v	d	120	Delay time input is in progress.
	ENT	d	120	Delay time input has been completed.
Data setting completed	AUTO SET	Display item	Measured data	Measured data is displayed.

• **Supplemental explanations**

1. Mode symbols 1 to 9 and o, b, c.
- The capacitor bank is never connected when the capacitance is set to 0.
- The capacitor bank is never disconnected when the capacitance is set to 9999.
- When multistep control is selected, only the capacitance of mode symbol 1 becomes valid. No data needs to be set for mode symbols 2 to 9 and o, b, c.

2. Capacitor connection and disconnection

Mode symbol	Set value	Description
A	1	Cyclic/optimum control
	2	Unconditional cyclic control
	3	Multistep control, capacitance ratio 1:2:2:2:2:2:2:2:2:2
	4	Multistep control, capacitance ratio 1:2:4:4:4:4:4:4:4:4
	5	Multistep control, capacitance ratio 1:2:4:8:8:8:8:8:8:8

A capacitor discharger recommended for multistep control of A3, A4, or A5 is a discharging coil which reduces the residual voltage of the capacitor to 50 volts or less within five seconds.

3. If "100%" is set as the target power factor of mode symbol F, a control of leading reactive power is performed.
4. Set the minimum load value to one slightly higher than the actual minimum load of the equipment to ensure an accurate light-load disconnection even when the measuring error or circuit constant fluctuates slightly.

Example: When the actual minimum load of the equipment is 100kW, set the value to 120kW (100×1.2).

Note:

Select a delay time suitable for the capacitor discharger. When using a discharging resistor, set the delay time to 300s (5min) or 600s (10min). An inappropriate delay time may damage capacitors or reduce their service lives.

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Automatic power factor regulators

QC06E and QC12E

■ Calculating CT ratios

• CT ratio

Example: When the primary current is 400A and secondary current is 5A.
 $400 \div 5 = 80$ CT ratio = 80

■ Determining capacitances and number of capacitor banks to improve the power factor by switching-on capacitors

The capacitances and the number of capacitor banks are determined as follows:

• For capacitors having the same capacitances

When load variation (increase and decrease of load) is frequent.

1. Determining the target power factor

Consider how far the power factor can be improved from the current value by automatic control.

Example

Current power factor (before improvement): 0.8

Target power factor (after improvement): 0.98

Maximum demand power: 1000kW

θ : Favor: θ

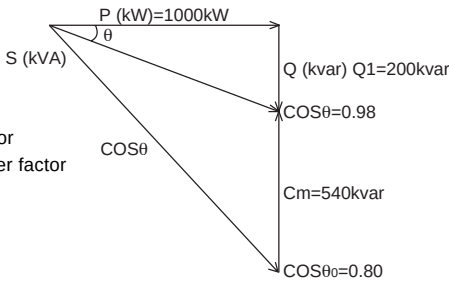
P: Active power

Q: Reactive power

S: Max. demand power

$\cos\theta$: Target power factor

$\cos\theta_0$: Improve the power factor



2. Calculating the capacitances needed to improve the power factor

See the capacitor selection chart (Page 09/101) to calculate the necessary capacitance.

Example

To improve the power factor from 0.8 to 0.98, the factor K_1 should be 0.54. Therefore, the necessary capacitance (C_m) is obtained as follows:

$C_m = \text{Maximum demand power} \times K_1 = 1000\text{kW} \times 0.54 = 540\text{kvar}$
 The necessary capacitance is 540kvar.

3. Calculating the target reactive power

Calculate the target reactive power from the target power factor (after improvement) and the maximum demand power.

Example

The target value is calculated using the factor K_2 selection table. (Page 09/101)

Target power factor: 0.98

$K_2=0.2$

The target reactive power (Q_1):

$Q_1 = \text{Maximum demand power} \times K_2$
 $= 1000\text{kW} \times 0.2$
 $= 200\text{kvar}$

4. Determining the number of capacitor banks

Determine the number of capacitor banks from the necessary capacitance for power factor improvement and target reactive power.

Example

Determine the number of capacitor banks as follows:

$$n = \frac{\text{Necessary capacitance for power factor improvement (Cm)}}{\text{Target reactive power (Q}_1\text{)}}$$

(1) If $n \geq 6$, the number of banks should be six.

(2) If $n < 6$, the number of banks should be n .

(Round up any fraction)

In this example,

$$n = \frac{540\text{kvar}}{200\text{kvar}} = 2.7 < 6$$

If the fraction is rounded up, the number of necessary banks is 3.

Note: The necessary capacitance for power factor improvement (C_m) means the total capacitance to be controlled by this unit.

5. Calculating the capacitance per capacitor bank

If each bank should have the same capacitance, the capacitance needed to improve the power factor must be divided by the number of banks calculated at step 4.

Example

Capacitance per capacitor bank:

$$C_0 = \frac{\text{Capacitance needed to improve the power factor (Cm)}}{\text{Number of capacitor banks (n)}}$$

In this example,

$$C_0 = \frac{C_m}{n} = \frac{540\text{kvar}}{3 \text{ (banks)}} = 180\text{kvar}$$

Since there are no 180kvar capacitors, a 200kvar-capacitor can be used.

• For capacitors having unequal-capacitances

When load variation is a slight and stable all the year round. Target power factor and the necessary capacitance for power factor improvement are calculated using step 1 and 2.

Current power factor (before improvement): 0.8

Target power factor (after improvement): 0.98

Necessary capacitance for power factor improvement (C_m): 540kvar

For load variation as shown below, calculate the reactive power variation using K_1 .

Example

• When P_1 is 150kW, $Q_1 = P_1 \times K_1 = 150 \times 0.54 = 81\text{kvar}$

Capacitor $C_1 = 100\text{kvar}$

• When P_2 is 400kW, $Q_2 = 216\text{kvar}$

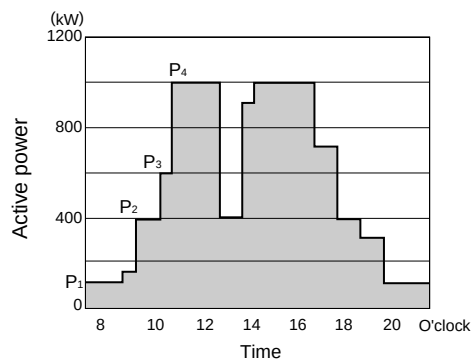
Capacitor $C_2 = Q_2 - C_1 = 116\text{kvar}$, $C_2 = 150\text{kvar}$

• When P_3 is 600kW, $Q_3 = 324\text{kvar}$

Capacitor $C_3 = Q_3 - (C_1 + C_2) = 74\text{kvar}$, $C_3 = 100\text{kvar}$

• When P_4 is 1000kW, $Q_4 = 540\text{kvar}$

Capacitor $C_4 = Q_4 - (C_1 + C_2 + C_3) = 190\text{kvar}$, $C_4 = 200\text{kvar}$



■ Capacitor selection / Factor K₁

Obtain the value of the capacitor required for improving the power factor by referring to the following list:

		Power factor after being improved = $\cos\theta_1$																														
		1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.9	0.875	0.85	0.825	0.8	0.775	0.75	0.725	0.7	0.675	0.65	0.625	0.6	0.575	0.55	0.525	0.5	0.475	0.45	0.425	
Power factor before being improved = $\cos\theta_0$	0.4	2.30	2.16	2.10	2.05	2.01	1.97	1.94	1.90	1.87	1.84	1.82	1.75	1.68	1.61	1.55	1.49	1.42	1.35	1.28	1.21	1.13	1.05	0.96	0.88	0.78	0.68	0.57	0.45	0.32	0.17	
	0.425	2.13	1.98	1.92	1.88	1.84	1.80	1.76	1.73	1.70	1.67	1.64	1.57	1.51	1.44	1.38	1.31	1.24	1.18	1.11	1.04	0.96	0.88	0.79	0.71	0.61	0.51	0.40	0.27	0.15		
	0.45	1.98	1.83	1.77	1.73	1.68	1.65	1.61	1.58	1.55	1.52	1.49	1.42	1.36	1.29	1.23	1.16	1.10	1.03	0.96	0.89	0.81	0.73	0.64	0.56	0.46	0.36	0.24	0.12			
	0.475	1.85	1.71	1.65	1.61	1.56	1.53	1.49	1.46	1.43	1.40	1.37	1.30	1.23	1.16	1.10	1.04	0.98	0.91	0.84	0.76	0.68	0.60	0.52	0.44	0.33	0.23	0.12				
	0.5	1.73	1.59	1.53	1.48	1.44	1.40	1.37	1.34	1.30	1.28	1.25	1.18	1.11	1.04	0.98	0.92	0.85	0.78	0.71	0.64	0.56	0.48	0.40	0.31	0.21	0.11					
	0.525	1.62	1.48	1.42	1.37	1.33	1.29	1.26	1.22	1.19	1.17	1.14	1.07	1.00	0.93	0.87	0.81	0.74	0.67	0.60	0.53	0.45	0.37	0.29	0.20	0.10						
	0.55	1.52	1.38	1.32	1.27	1.23	1.19	1.16	1.12	1.09	1.06	1.04	0.97	0.90	0.83	0.77	0.71	0.64	0.57	0.50	0.43	0.35	0.27	0.19	0.10							
	0.575	1.42	1.28	1.22	1.17	1.14	1.10	1.06	1.03	0.99	0.96	0.94	0.87	0.80	0.74	0.67	0.60	0.54	0.47	0.40	0.33	0.25	0.17	0.08								
	0.6	1.33	1.19	1.13	1.08	1.04	1.01	0.97	0.94	0.91	0.88	0.85	0.78	0.71	0.65	0.58	0.52	0.46	0.39	0.32	0.24	0.16	0.085									
	0.625	1.25	1.11	1.05	1.00	0.96	0.92	0.89	0.85	0.82	0.79	0.77	0.70	0.63	0.56	0.50	0.44	0.37	0.30	0.23	0.16	0.08										
	0.65	1.17	1.03	0.97	0.92	0.88	0.84	0.81	0.77	0.74	0.71	0.69	0.62	0.55	0.48	0.42	0.36	0.29	0.22	0.15	0.08											
	0.675	1.09	0.95	0.89	0.84	0.80	0.76	0.73	0.70	0.66	0.64	0.61	0.54	0.47	0.40	0.34	0.28	0.21	0.14	0.07												
	0.7	1.02	0.88	0.81	0.77	0.73	0.69	0.66	0.62	0.59	0.56	0.54	0.46	0.40	0.33	0.27	0.20	0.14	0.07													
	0.725	0.95	0.81	0.75	0.70	0.66	0.62	0.59	0.55	0.52	0.49	0.46	0.39	0.33	0.26	0.20	0.13	0.07														
	0.75	0.88	0.74	0.67	0.63	0.58	0.55	0.52	0.49	0.45	0.43	0.40	0.33	0.26	0.19	0.13	0.065															
	0.775	0.81	0.67	0.61	0.57	0.52	0.49	0.45	0.42	0.39	0.36	0.33	0.26	0.19	0.12	0.065																
	0.8	0.75	0.61	0.54	0.50	0.46	0.42	0.39	0.35	0.32	0.29	0.27	0.19	0.13	0.06																	
	0.825	0.69	0.54	0.48	0.44	0.40	0.36	0.33	0.29	0.26	0.23	0.21	0.14	0.07																		
	0.85	0.62	0.48	0.42	0.37	0.33	0.29	0.26	0.22	0.19	0.16	0.14	0.07																			
	0.875	0.55	0.41	0.35	0.30	0.26	0.23	0.19	0.16	0.13	0.10	0.07																				
0.9	0.48	0.34	0.28	0.23	0.19	0.16	0.12	0.09	0.06	0.028																						
0.91	0.45	0.31	0.25	0.21	0.16	0.13	0.09	0.06	0.028																							
0.92	0.43	0.28	0.22	0.18	0.13	0.10	0.06	0.031																								
0.93	0.40	0.25	0.19	0.15	0.10	0.07	0.033																									
0.94	0.36	0.22	0.16	0.11	0.07	0.036																										
0.95	0.33	0.18	0.12	0.08	0.035																											
0.96	0.29	0.15	0.09	0.04																												
0.97	0.25	0.11	0.05																													
0.98	0.20	0.06																														
0.99	0.14																															

k: Figures obtained by $\cos\theta_0$ and $\cos\theta_1$

k: Figures obtained by cosθ₀ and cosθ₁

■ Factor K₂ selection

Power factor (cosθ ₂)	0.7	0.75	0.8	0.85	0.875	0.9	0.91	0.92	0.93	0.94	0.95	0.96	0.97	0.98	0.99
$K_2 = \sqrt{\frac{1}{\cos^2 \theta_2} - 1}$	1.02	0.88	0.75	0.62	0.55	0.48	0.45	0.43	0.40	0.36	0.33	0.29	0.25	0.20	0.14

K₂: Figures obtained by cos θ₂

Power Monitoring Equipment

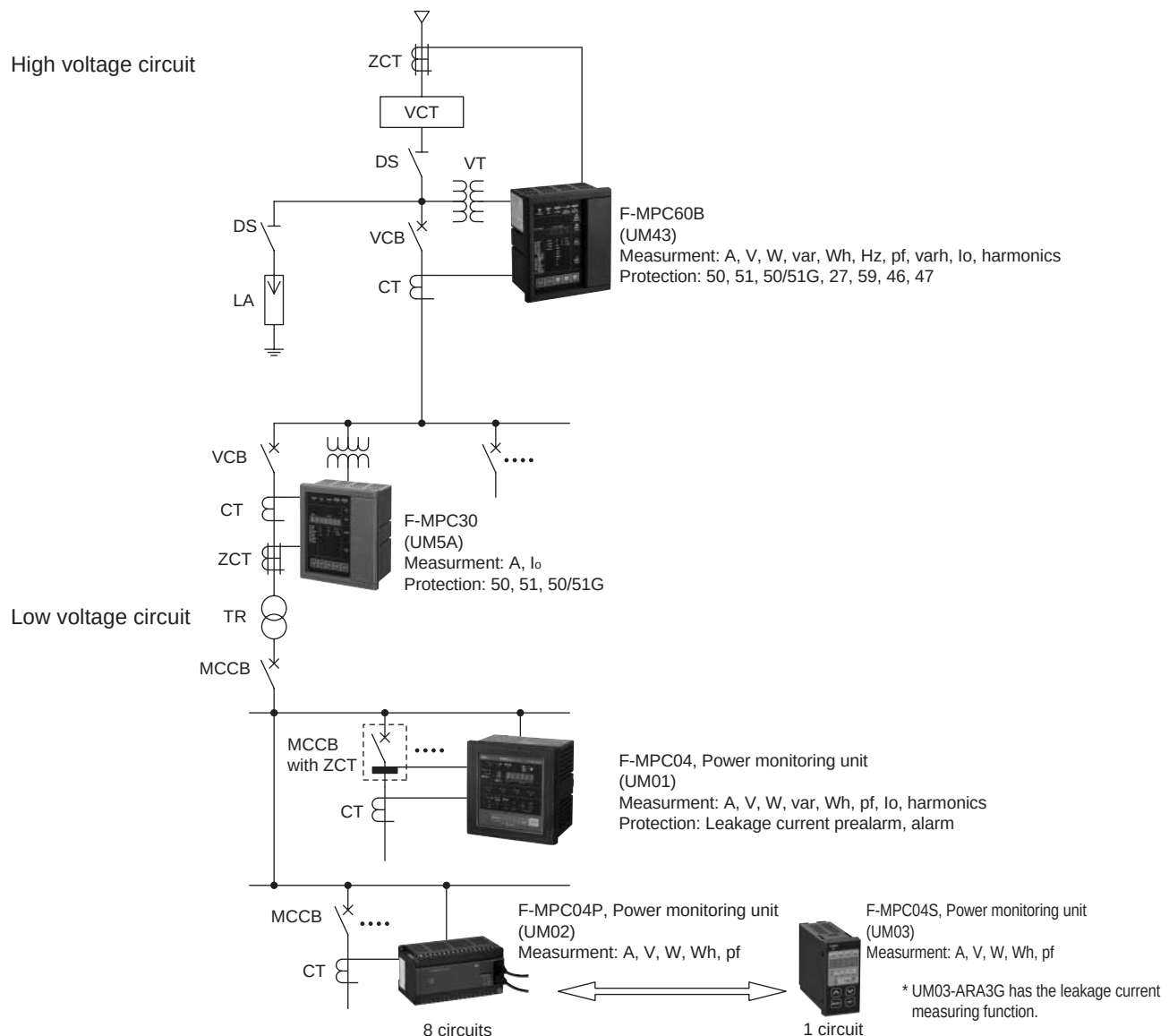
General Information

Power monitoring equipment (F-MPC) F-MPC60B, F-MPC30, F-MPC04 series

■ Description

- FUJI power monitoring equipment (F-MPC) realizes fine power management to contribute to energy-saving.
- We can offer you various F-MPC equipment such as F-MPC04 series power monitoring unit that measures electric power of one to multi-circuits, and compact size F-MPC60B, F-MPC30 series multifunctional digital relay that protects, controls, and measures high-voltage distribution facilities.
- As support tool, a power monitoring system software, F-MPC-Net is also available, which collects and analyzes data measured by F-MPC.
- As related products of F-MPC, molded case circuit breaker with ZCT and split type current transformer are introduced.

■ Power monitoring equipment used in power distribution system



Power Monitoring Equipment

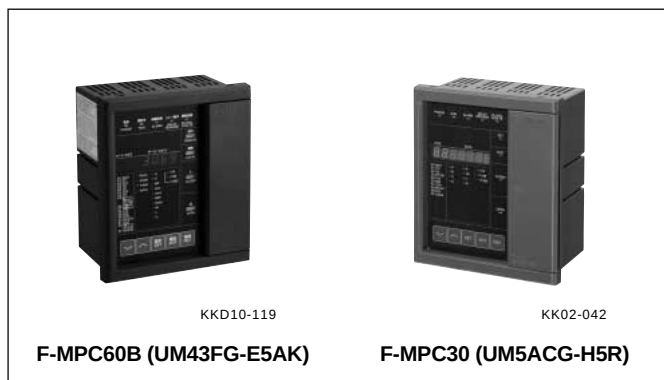
Multiple function protectors and controllers

F-MPC60B, F-MPC30

Multiple function protectors and controllers F-MPC60B, F-MPC30 series

■ Description

- FUJI multiple function protector and controller (F-MPC) performs energy control to contribute to energy-saving. The F-MPC60B and F-MPC30 are a kind of multifunctional digital relays.
- Although these series are very compact, they integrate multiple functions in a compact body, such as protection, measurement, operation, and monitoring of high-voltage power distribution and switching facilities. They can also transmit data obtained from these functions to upper level controllers.



■ Functions

The functions of F-MPC60B and F-MPC30 series are listed below.

Series		F-MPC60B	F-MPC30
Type		UM43FG-E5AK	UM5ACG-H5R
Installation location		Receiving or feeder	Feeder
Application (phase: line)		3:3, 3:4	3:3, 3:4
VT voltage	Input	2VT/3VT star	—
	Voltage indication	Between phases, between lines	—
Ground fault system		Direct/resistance	Direct/resistance
IO detection	System type	Direct/resistance	Direct/resistance
	①Residual (3XCT)	○	○
	②Tertiary winding (100/5A)	○	○
	③ZCT (5 to 100/5A)	○	○
	④ZCT (5 to 400/5A)	○	○
	⑤ZCT (200/1.5mA)	—	—
E0 detection * Feeder: Depending on MN signal.	⑥ZCT (100/1A) or (70/1A) or secondary I input (0.002 to 0.4A)	—	—
	EVT (3Ry= 110V)	—	—
	EVT (3Ry= 190V)	—	—
	ZPD-1 (FUJI-made)	—	—
	MN signal output	—	—
	MN signal input	—	—
Protective characteristic (current)	SI, VI, LT, EI, I ² t	○	○ (without I ² t)
	DT1 (short-time)	○	○
	DT2 (definite-time)	○	○
Control voltage	Rating	100V DC	100/200V DC
	Allowable range	80 to 143V DC	80 to 286V DC
Transducer output selection	No. of output pole	6	—
	(Function and terminal)	Select	—
No. of DI/DO		8 : 8	1 : 3
No. of CPU		2	1
External plug		—	○
CB close/open	CB making slow-down monitoring function	○	—
	Harmonic voltage (3, 5, 7, Total)	—	—
	Harmonic current (3, 5, 7, Total)	○	—
	Demand current	○	—
Display mode	All or part: changeable	○	— (All only)

○ Available — Not available

Power Monitoring Equipment

Multiple function protectors and controllers

F-MPC60B, F-MPC30

■ Functions (continued)

Series			F-MPC60B	F-MPC30
Type			UM43FG-E5AK	UM5ACG-H5R
Installation location			Receiver or feeder	Feeder
Protection	Overcurrent Instantaneous	50	○	○
	Overcurrent Short-time	51DT1	○	○
	Overcurrent Definite-time	51DT2	○	○
	Overcurrent Inverse-time *1	51	○	○ *2
	Ground-fault Instantaneous	50G	○	○
	Overcurrent Inverse-time *2	51G	○	○
	Ground fault directional	67	—	—
	Phase-loss	46	○ *3	—
	Inverse-phase	47	○ *3	—
	Voltage established	84	—	—
	Undervoltage	27	○	—
	Overvoltage	59	○	—
	Ground-fault overvoltage	64	—	—
	Current prealarm	OCA	○	○
	Ground-fault current prealarm	OCGA	○	○
Measurement	Current (r, s, t)	A	○	○
	Voltage (line)	V	○	—
	Voltage (phase)		○	—
	Active power (±)	W	○	—
	Reactive power (±)	Var	○	—
	Power-factor (±)	PF	○	—
	Frequency	Hz	○	—
	Active electric energy (+)	WHM	○	—
	Active electric energy (–)	WHM	○	—
	Reactive electric energy (+)	VarH	○	—
	Reactive electric energy (–)	VarH	○	—
	Ground fault (zero-phase) voltage	V0	—	—
	Ground fault (zero-phase) current	A0	○	○
	Harmonic current (3, 5, 7, Total)	HA	○	—
	Harmonic voltage (3, 5, 7, Total)	HV	—	—
	Demand current (r, s, t)	DA	○	—
	Demand active power	DW	○	—
	Max. zero-phase current value		○	○
	Max. zero-phase voltage value		—	—
	Max. demand current value (r, s, t)		○	—
	Max. demand power		○	—
	Total electric energy (+)		○	—
	Total electric energy (–)		○	—
	Min. voltage value (between lines)		○	—
Preventive maintenance	50(INST)	Operation Count	○	○
	51DT1	Operation Count	○	○
	51DT2	Operation Count	○	○
	51	Operation Count	○	○
	67DG	Operation Count	—	—
	50G	Operation Count	○	○
	51G	Operation Count	○	○
	OCA	Operation Count	○	○
	OCGA	Operation Count	○	○
	Phase loss	Operation Count	○ *3	—
	Inverse phase	Operation Count	○ *3	—
	27	Operation Count	○	—
	59	Operation Count	○	—

*1 with SI, VI, LT, EI, and I²t characteristics *3 Available for version 1 or later.

*2 with SI, VI, LT, and EI characteristics

○ Available — Not available

Multiple function protectors and controllers F-MPC60B series, UM43FG-E5AK

■ Description

Although the F-MPC60B series is very compact, it integrates multiple functions in one body, such as protection, measurement, operation, and monitoring of high-voltage power distribution and switching facilities. It can also transmit the data obtained with these functions to upper level controllers.

■ Features

Flexibility

In accordance with changes in circuit conditions such as CT ratio, the setting of the F-MPC60B can be easily changed.

Improved maintainability

Preventive maintenance and fault analysis can be easily made with the functions that display operation history and fault data.

High reliability

To prevent operation errors such as circuit disconnection, the F-MPC60B series has dual CPUs that check with each other for confirmation and dual output circuits from which output signals are always checked.



RS-485 communication interface

Two protocol types are available: MPC-Net protocol and MODBUS protocol.*

Note: * MODBUS protocol is available for version 1 or later.

■ Specifications

• General specifications

Type	UM43FG-E5AK	
Control power supply	100V DC (80 to 143V)/ 100V AC (85 to 132V) common use	
Control power consumption	Max. 15W	
Power consumption of CT, VT	Max. 1.0VA	
Rated current (CT secondary current)	5A AC ("1A AC" model is also available (non-standard).)	
Rated voltage	Line voltage	Select "110V AC" or " 110X√3 AC" (VT secondary voltage)
	Phase voltage	Select "110V /√3 AC" or "110V AC" (VT secondary voltage)
Zero-phase current	5A AC	
Insulation resistance	10MΩ (min.) between ground and electric circuits connected together	
Vibration resistance	16.7Hz 1.96m/s ² , 0.4mm double amplitude, 10 minutes each in X, Y, and Z directions	
Shock resistance	300m/s ² , three times each in X, Y, and Z directions	
Withstand voltage	2kV AC 1 minute between ground and electric circuits connected together, excluding, RS-485 signal, MN signal, and kWh-pulse output signal cables	
Noise resistance	JEC2500 (conforming to ANSI), square wave, 1.5kV, 1ns/1μs, for 10 minutes.	
Overload resistance	CT circuit: at rating 40times, a second, 2 times VT circuit: at rating 1.25 times, 10 second	
Lightning impulse noise resistance	5.0kV (between ground and electrical circuits connected together)	
Dropout tolerance	20ms (Operation continues, however, display goes out.)	
Electrostatic discharge	Contact discharge: ±8kV Aerial discharge: ±15kV	
Ambient temperature	Operating: -10 to + 60°C (operation guaranteed) 0 to + 40°C (characteristics guaranteed) (no icing) *1 Storage: - 25 to + 70°C (no icing)	
Humidity	20 to 90% RH (no condensation)	
Atmosphere	No corrosive gas and no heavy dirt and dust.	
Grounding	Class D grounding (100Ω or less)	
Applicable standard	JEC2500 (Protective relays for electric power systems), JEC-2510 (Overcurrent relays), JEC-2511 (Voltage relays), JIS C4602 (Overcurrent relays for 6.6kV receiving), JIS C1102-1 to -9 (Direct acting analogue electrical instrument and their accessories), IEC255-3 (1989), -5, -6	
Mass	1.4kg	

*1: The operation guaranteed temperature is a temperature at which operation is guaranteed within two times of the guaranteed accuracy value at JEC characteristics guaranteed temperature, or within the accuracy of influence of JIS temperature.

Power Monitoring Equipment
Multiple function protectors and controllers
F-MPC60B

■ Specifications

• Input/output specifications

Input circuit		Applicable to both 100V DC (max. 143V) and 100V AC (max. 132V) Pick up voltage: 40 to 70V DC/40 to 70V AC
Output circuit	Circuit breaker ON/OFF/trip	Making current: 15A (110V DC), allowable continuous current: 4A
	Other than above	Making/breaking current: 0.2A (110V DC, inductive load L/R = 15ms or less), allowable continuous current: 1A

• Measurement and display specifications

	Effective measuring and display range	Accuracy *2
Current/Demand current/ Max. demand current	0, 0.8% to CT rating to 8 × CT rating *1	±1.5% (0, 0.8 to 100%), ±5% (100 to 800%)
Zero-phase current/Max. zero-phase current	CT: 0, 2% to CT rating to 8 × CT rating	±1.5%: 0, 2% to CT rating, ±5%: others
Active power Demand active power/ Reactive power	±0.004 to ±1kW at VT secondary circuit (The value is converted into the VT rated voltage)	±1.5% : 0, ±0.004 to ±1kW See the figure below.
Power factor	Lead 0% - 100% - Lag 0%	±5% (Lagging: no sign, leading: - sign) See the figure below.
Active electric energy *3 Reactive electric energy	0 to 99999, multiplying factor: 1, 10, 100, 1000	Equivalent to ordinary instruments shown in Table 4 specified in JIS C 1216 (instrument with a transformer)
Line voltage	9.5 to 260V on VT secondary side	±1.5%
Phase voltage	5.5 to 150V on VT secondary side	±1.5%
Frequency	45 to 55Hz (50Hz), 55 to 65Hz (60Hz)	±0.5%
Max. demand value	Same as the above range	—
Harmonics current	3rd, 5th, 7th, overall harmonics	—

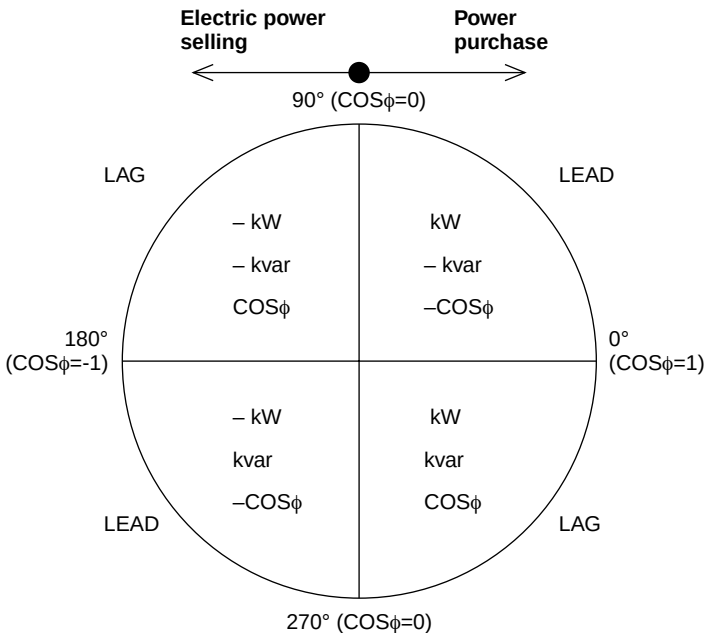
*1 The fault current up to 2000% (accuracy: ±5%) can be displayed.

*2 "0, a to n%" means that "0" is indicated if a value is less than a%.

*3 There are two indications in the electric energy indication; total electric energy indication (zero clear disable) and periodic electric energy indication (zero clear is enable).

The sign "±" in electric measuring

The sign "±" is used to display "LEAD/LAG" in power-factor. measuring and "electric power selling/purchase" in electric power measuring. No signs are used if a value is "+". The sign "±" has the following meanings depending on the measured items.



- Active power: kW
 - +: Power purchase (Consumed electric power)
 - : Electric power selling (Inverse electric power flow)
- Reactive power: kvar
 - +: Lagging current by reactive volt-ampere meter method
 - : Leading current by reactive volt-ampere meter method
 - * "LEAD/LAG" reverses with electric power selling/purchase.
- Power factor: COSφ
 - +: LAG -: LEAD

■ Specifications

● History data

Item	Display range	Display code
50 (INST) operation count	0 to 9999	H0
51DT1 operation count	0 to 9999	H1
51 (OC) operation count	0 to 9999	H2
51G operation count	0 to 9999	H3
50G operation count	0 to 9999	H4
59 (OV) operation count	0 to 9999	H6
27 (UV) operation count	0 to 9999	H7

* Other history display: Fault value display (on occurrence of a fault), history maximum values of zero-phase current/voltage, maximum demand value (A, W), and minimum instantaneous voltage

Item	Display range	Display code
46 operation count	0 to 9999	H9
47 operation count	0 to 9999	HA
OCA operation count	0 to 9999	Hb
Running time	0 to 9999 × 100 (h)	Hc
ON/OFF operation	0 to 9999 × 10 (times)	Hd
OCGA operation count	0 to 9999	Hn
51DT2 operation count	0 to 9999	HP

* The display codes are the codes to be displayed on this F-MPC60B (UM43FG-E5AK).

● Specifications of protective relays

Item	Setting range of current/ voltage operate value	Setting range of operate time (timer)	Characteristics	
			Operate value	Operate time
50 (Instantaneous)	1 to 20 times of CT rated current (in 0.2 times step), Lock	Fixed	±5%	40ms or less
51DT1 (Definite time)	1 to 20 times of CT rated current (in 0.2 times step), Lock	0 to 5s (in 0.05 step)	±5%	Less than 1s ±50ms More than 1s ±5%
51DT2 (Definite time)	20 to 240% of CT rated current (2% step), Lock	0 to 10s (0.1s step)	±5%	Less than 1s ±50ms More than 1s ±5%
51 (Inverse time) SI, EI, VI, LT, I ² t	20 to 240% of CT rated current (2% step), Lock	Time multiplication: 0.5 to 20 times, (in 0.1 times step) (Minimum operation time: 150ms)	±5%	Setting = 300%: ±12% 500, 1000%: ±7% (lower limit ± 100ms)
50G, 50N (Instantaneous/definite time)	0.2 to 8 times of CT rated current (in 0.1 times step), Lock	0.0 to 10s to 180s *1	±5%	±5% (lower limit ±50ms)
51G, 51N SI, EI, VI, LT	0.02 to 1.00 times of CT rated current (in 0.01 times step), Lock	Time multiplication: 0.5 to 20 times (in 0.1 times step) (Minimum operation time: 150ms) *1	±5% (min. ± 100mA)	Setting = 300%: ±12% 500, 1000%: ±7% (lower limit ± 100ms)
59V (OV)	VT secondary voltage: 60 to 150V (1V step), lock	0.0 to 5.0s to 60s (in 0.5s step) (in 1s step)	±5%	±5% (min. ±50ms)
27V (UV)	VT secondary voltage: 10 to 100V (1V step), lock	0.0 to 5.0s to 60s (in 0.5s step) (in 1s step)	±5%	±5% (min. ±35ms)
46 (Open-phase)	—	—	Unbalanced rate 50 - 80%	2s (fined)
47 (Phase sequence relay)	—	—	—	0.5s or less
OCA (Overcurrent pre-alarm)	10 to 100% of CT rated current (in 5% step), Lock	10 to 200s (in 10s step)	±10%	±5%
OCGA (Leakage current pre-alarm)	50, 60, 70, 80% of the setting value of "51G operating current", Lock	10 to 200s (in 10s step)	±10% (min±200mA)	±5%

*1 When a current exceeds 15% of the rated fundamental wave current, the malfunction preventive function against the exciting inrush current activates. (When the contents of the second higher harmonics are about 15% or higher, the feature will lock outputs.) Note that with the 50G relay, the malfunction preventive function against the exciting inrush current will not activate if you set the operate time at 0s.

● Communications specifications

Protocol	MODBUS protocol mode	MPC-Net mode
Standard	EIA-485	EIA-485
Data exchange method	polling/selecting system	1: N polling/selecting system
Transmission distance	1000m (total length)	1000m (total length)
No. of connectable units	Up to 32 units (including master unit)	Up to 32 units (including master unit)
Station number address	01 to 99	01 to 99
Transmission speed	4800/9600/19200 bps (selectable)	4800/9600/19200 bps (selectable)
Data format	Number of start bits: 1 (fixed) Data length: 8 bits (fixed) Parity bit: None/even/odd (selectable) Stop bits: 1 bit or 2 bit (automatic selection) 1 bit: for "even or odd" parity 2 bit: for "none" parity	Number of start bits: 1 (fixed) Data length: 7/8 bits (selectable) Parity bit: None/even/odd (selectable) Stop bits: 1 (fixed) BCC= Even horizontal parity

Power Monitoring Equipment

Multiple function protectors and controllers

F-MPC60B

■ Specifications

• Specifications of transducer outputs

Transducer output signal		4 to 20mA DC (external load resistance: 270Ω or less)	
Signal type	Current (Ia, Ib, Ic)	4 to 20mA for 0 to CT rated current	Accuracy ±1.5%
	Line voltage (Vab, Vbc, Vca)	For VT secondary 0 to 150V, 4 to 20mA * ¹ 0 to 150V $\times \sqrt{3}$, 4 to 20mA * ²	
	Phase voltage (Van, Vbn, Vcn)	For VT secondary 0 to 150V/ $\sqrt{3}$, 4 to 20mA * ¹ 0 to 150V, 4 to 20mA * ²	
	Active power (W)	For 0 to 1kW (CT5A, VT110V AC conversion), 4 to 20mA	
	Reactive power (var)	For -1 to 0 to 1kvar (CT5A, VT110V AC conversion), 4 to 12 to 20mA	
	Frequency (Hz)	For 45 to 55Hz or 55 to 65Hz, 4 to 20mA	
	Power factor	For LEAD 0.5 to 1 to 0.5 LAG, 4 to 12 to 20mA	

Note: • Output signals are connected to a common terminal (minus side).

• An upper or lower limiter operates when the output signal is about to exceed the upper or lower limit.

The upper limit is fixed at 20mA, and the lower limit is fixed at 20mA.

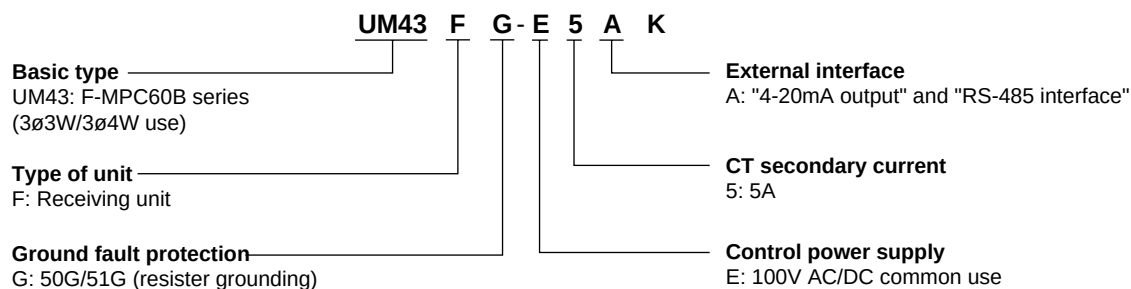
*¹: Applied line voltage: 100V/110V/120V AC.

*²: Applied line voltage: 100V/110V/120V AC $\times \sqrt{3}$, AC.

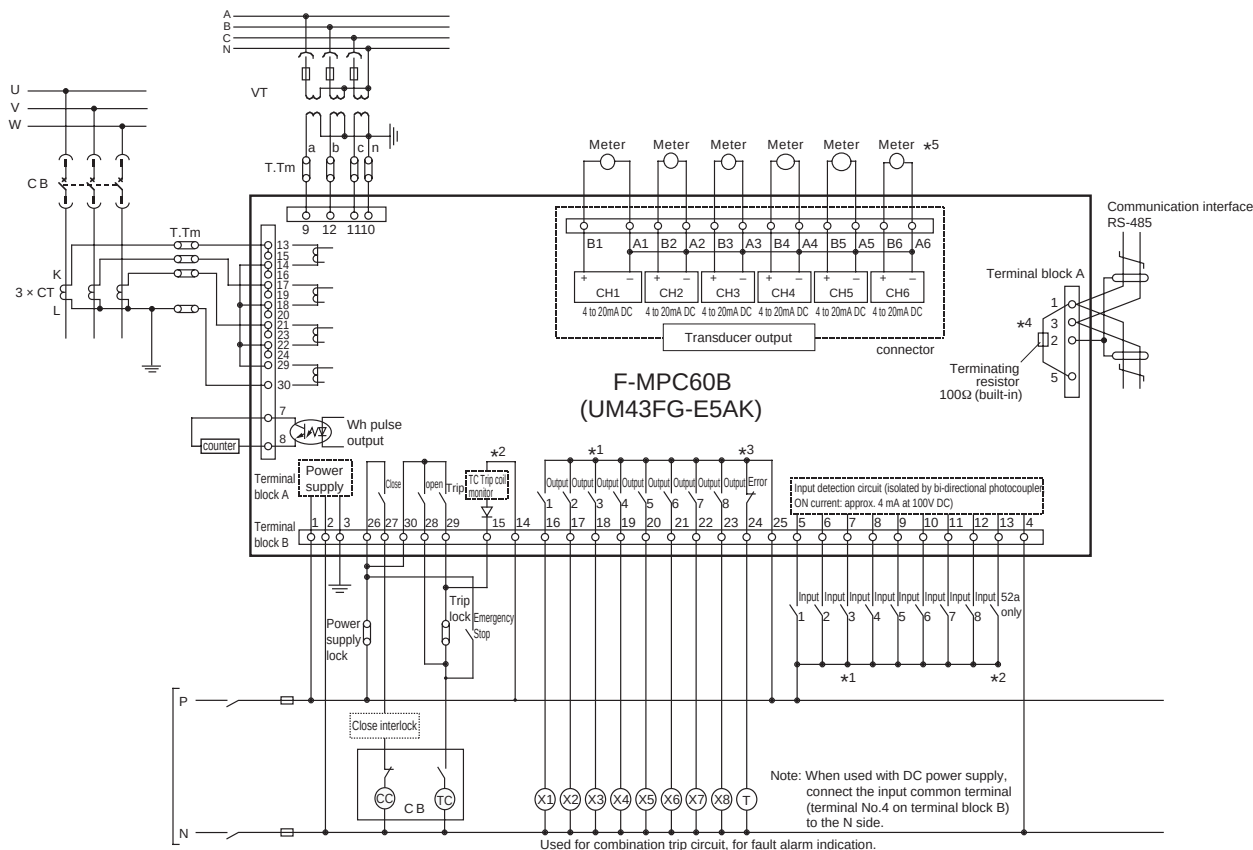
• Specifications of kWh pulse output

Type of output	Transistor, open collector
Ratings	Max. 150V DC, 100mA
Pulse width	200 ± 20ms
Pulse rate	10 ⁿ kWh per pulse (n=-2 to 4) (integer), or 2000 pulses per kWh

■ Type number nomenclature



■ Example of external wiring diagrams



- Note:
- *1 Use selective input 1 to 8 and selective output 1 to 8 by selecting the function type by setup.
 - *2 Outputs of "ON, OFF, TRIP and equipment error" are used exclusively. Inputs of "52a: the answer back signal of CB ON" and "the monitoring of TC coil" are used exclusively.
 - *3 Equipment error output is a normally closed contact (normally excited, and if an error occurs, excitation terminates and contact opens). Therefore, a time delay of about 100ms occurs before the contact opens, since the power has been on (in operation). Consider the use of a timer, if necessary, if you create an external sequence.
 - *4 If this unit, being provided with RS-485 communication function, is located at the termination of a communication line, connect terminals No.3 and 5. With this, the 100Ω terminating resistor is connected across the RS-485 bus.
 - *5 Use twisted wires (cables) as the output cable of transducer.
 - If you have to connect a heavy load exceeding relay's contact rating, be sure to use it in combination with FUJI's miniature power relay HH6□. See page 09/106 "Input/output specifications."

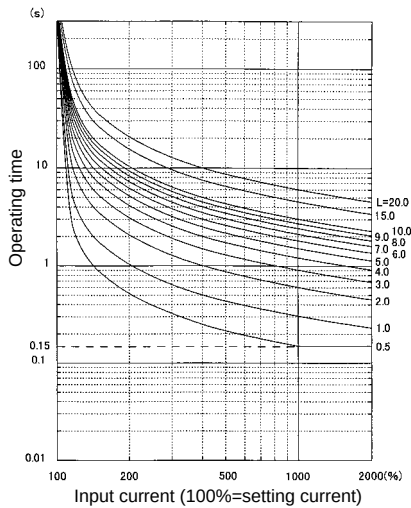
Power Monitoring Equipment

Multiple function protectors and controllers

F-MPC60B

■ Time-current characteristic

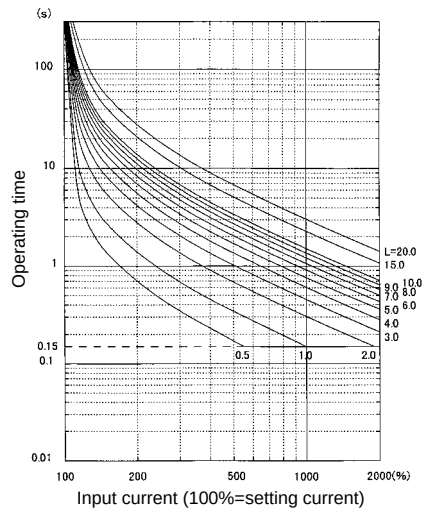
Standard inverse (SI) characteristics



Note:
Time setting (lever) is of 0.1 times step (Lower limit: 0.5, upper limit: 20.0). Indication of a part of the lever is omitted in the characteristics indicated above.

$$t = \frac{0.14}{I^{0.02} - 1} \times \frac{L}{10} \quad (L: \text{time magnification})$$

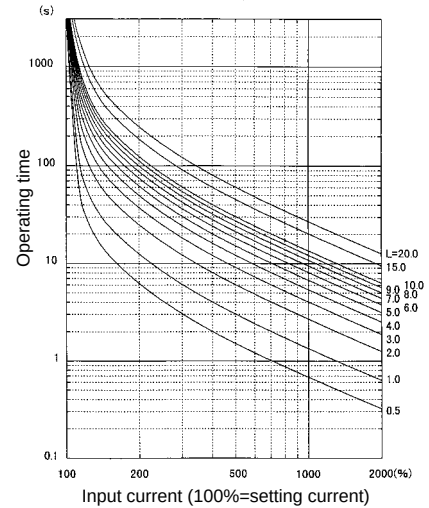
Very inverse (VI) characteristics



Note:
Time setting (lever) is of 0.1 times step (Lower limit: 0.5, upper limit: 20.0). Indication of a part of the lever is omitted in the characteristics indicated above.

$$t = \frac{13.5}{I - 1} \times \frac{L}{10} \quad (L: \text{time magnification})$$

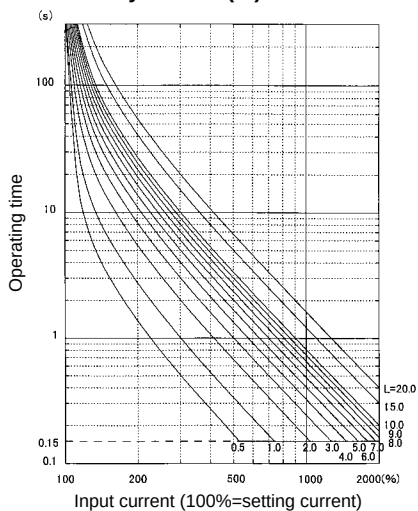
Very inverse (LT) characteristics



Note:
Time setting (lever) is of 0.1 times step (Lower limit: 0.5, upper limit: 20.0). Indication of a part of the lever is omitted in the characteristics indicated above.

$$t = \frac{120}{I - 1} \times \frac{L}{10} \quad (L: \text{time magnification})$$

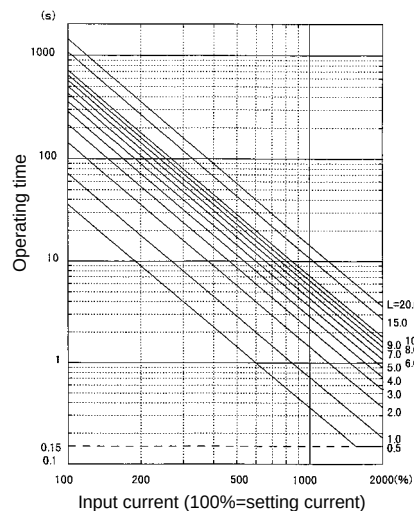
Extremely inverse (EI) characteristics



Note:
Time setting (lever) is of 0.1 times step (Lower limit: 0.5, upper limit: 20.0). Indication of a part of the lever is omitted in the characteristics indicated above.

$$t = \frac{80}{I - 1} \times \frac{L}{10} \quad (L: \text{time magnification})$$

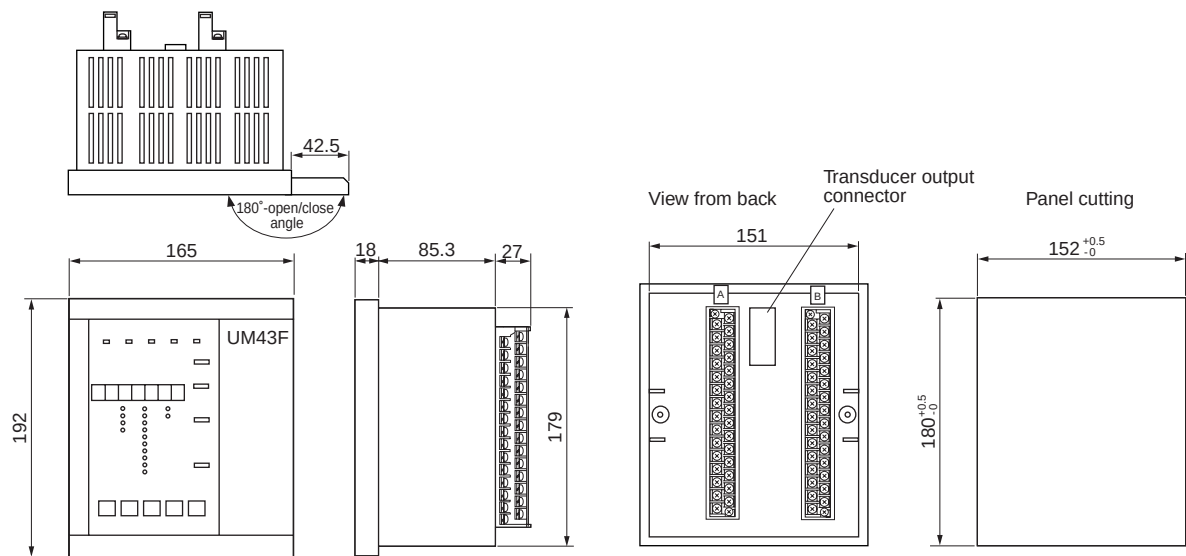
I²t characteristics



Note:
Time setting (lever) is of 0.1 times step (Lower limit: 0.5, upper limit: 20.0). Indication of a part of the lever is omitted in the characteristics indicated above.

$$t = \frac{720}{I} \times \frac{L}{10} \quad (L: \text{time magnification})$$

■ Dimensions, mm



Minimum clearance from adjacent upper and lower devices or panel plate: 100mm

■ Characteristics of overcurrent relay (OCR)

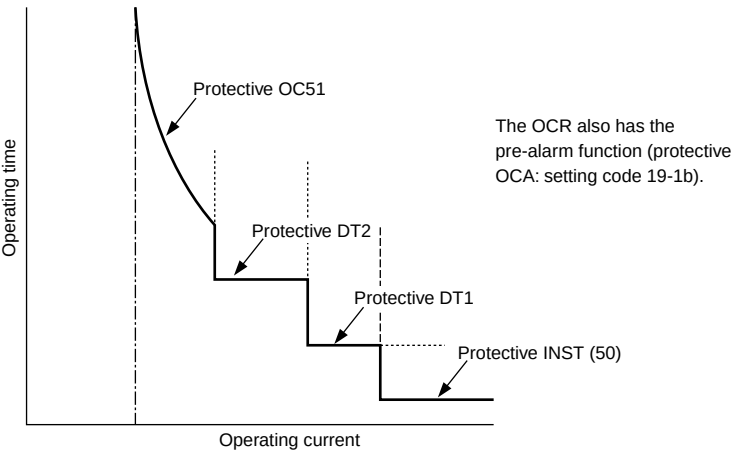
The characteristics of overcurrent relays (OCR) are, in general, divided into the protective INST (50) (setting code 10, 11), the protective DT1 (setting code 12 to 14), protective DT2 (setting code 1c, 1d, 1E) and the protective OC 51 (setting code 15 to 18). The characteristics of protective OC 51 consist of 5 kinds

of inverse characteristic curves, such as standard inverse (SI) characteristics, very inverse (VI) characteristics, long time inverse (LT) characteristics, extremely inverse (EI) characteristics and I²t characteristics). Combination of the protective INST (50), protective DT1, protective DT2 and OC 51 carries out coordinative protection.

Outline of characteristic of overcurrent relay

Item	Operating current	Operating time
Protective INST (50)	1 to 20 times of CT rated current 5A (0.2 times step)	Fixed (40ms or less)
Protective DT1		0 to 5s (0.05s step)
Protective DT2	20 to 240% of CT rated current 5A (2% step) *1	0 to 10s (0.1s step)
Protective OC (51)		Select from 5 characteristic curves. Time magnification: 0.5 to 20 times (0.1 times step)

*1: The operating time of protective OC51 is saturated at about 150ms.
The operating time will be saturated at 20 times of CT rated current when the setting exceeds 200%.
For example, the operating time becomes 833% (= 2000%/(240%×100)) of the CT rated current in 240% setting.



Power Monitoring Equipment

Multiple function protectors and controllers

F-MPC30

Multiple function protectors and controllers

F-MPC30 series, UM5ACG-H5R

■ Description

The F-MPC30 series is a multiple function protectors and controllers in the power monitoring equipment, which integrates protective, measurement, and transfer functions for power feeder facilities. Versatile functions such as preventive maintenance and history data and abnormal value recording can be achieved with excellent economy and reliability. These works have been very complicated as you must have used individual power monitoring devices in combination.

■ Features

Economical system configuration

Includes measurement and protective functions limited to the current ranges most frequently used, thus allowing the construction of economical systems.

Improved operating reliability

Includes an automatic monitor function, an automatic diagnostic function supported by continuous monitoring and automatic inspection, and a fail-safe function, thus ensuring high operating reliability while minimizing daily and regular inspection tasks.



Easily designed coordination protection

Provided with 51DT1 and 51DT2 definite time trip characteristics that simplify the designing of coordination protection between overcurrent relays.

RS-485 communications interface

Two protocol types are available:
MPC-Net protocol and MODBUS protocol.

■ Specifications

• General specifications

Type	UM5ACG-H5R
Control power supply	100/200V DC (80 to 286V DC) 100V AC (85 to 132V) common use
Control power consumption	Max. 15W (100/200V DC), Max 25 VA (100V AC)
Power consumption of CT, VT	Max. 1.0VA
Rated current (CT secondary current)	5A AC ("1A model" is also available (non-standard))
Zero-phase current	5A AC
Insulation resistance	10MΩ min. between ground and electric circuits connected together
Vibration resistance	16.7Hz, 0.4mm double amplitude, 1.96m/s ² , 10 minutes each in X, Y, and Z directions
Shock resistance	300m/s ² , three times each in X, Y, and Z directions
Withstand voltage	2kV AC 1 minute between ground and electric circuits connected together, excluding RS-485 signal lines
Noise resistance	JEC 2500 (conforming to ANSI), square wave, 1.5kV, 1ns/1μs, for 10 minutes
Overload resistance	CT circuit: at rating 40 times, a second, 2 times
Lightning impulse noise resistance	4.5kV (between ground and electrical circuits connected together)
Dropout tolerance	20ms (Operation continues, however, display goes out.)
Electrostatic discharge	Contact discharge: ±8kV, Aerial discharge: ±15kV
Ambient temperature	−10 to +60°C (operation guaranteed), 0 to +40°C (characteristic guaranteed) (no icing) *1
Storage temperature	−25 to +70°C (no icing)
Humidity	20 to 90%RH (no condensation)
Atmosphere	No corrosive gas and no heavy dirt and dust.
Grounding	Class D grounding (100Ω or less)
Applicable standard	JEC2500 (Protective relays for electric power systems), JEC-2510 (Overcurrent relays), JIS C4602 (Overcurrent relays for 6.6kV receiving), JIS C1102-1 to -9 (Direct acting analogue electrical instrument and their accessories), IEC255-3 (1989) -5, -6.
Mass	1.4kg

*1: The operation guaranteed temperature is a temperature at which operation is guaranteed within two times of the guaranteed accuracy value at JEC characteristics guaranteed temperature, or within the accuracy of influence of JIS temperature.

• **Input/output specifications**

Input circuit		100/200V DC (286V DC or less) common use Pick-up voltage: 40 to 70V DC (Input current; 1.2mA at 100V DC, 2.4mA at 200V DC)
Output circuit	Circuit trip	The closing current: 15A (110V DC), 10A (220V DC), the allowable continuous conduction current: 4A
	Other than above	The switching current: 0.2A (110V DC, inductive load L/R = 15ms or less) The allowable continuous conduction current: 1A
		The making current: 0.1A (220V DC, inductive load L/R = 15ms or less) The allowable continuous conduction current: 1A

• **Measurement and display specifications**

	Effective measuring and display range	Accuracy *2
Current	0, 0.8% to CT rating to 8 × CT rating *1	±1.5% (0, 0.8 to 100%), ±5% (100 to 800%)
Zero-phase current	CT: 0, 2% to CT rating to 8 × CT rating	±1.5% (0, 2% to CT rating), ±5% (more than CT rating)

*1 The fault current up to 2000% (accuracy: ±5%) can be displayed.

*2 "0, a to n%" means that "0" is indicated if a value is less than a%.

• **History data and display ranges**

Item	Display range	Display code
50 (INST) operation count	0 to 9999	H0
51DT1 operation count	0 to 9999	H1
51 (OC) operation count	0 to 9999	H2
51G operation count	0 to 9999	H3
50G operation count	0 to 9999	H4

* Other history display: Fault value display (on occurrence of a fault), history maximum values of zero-phase current/voltage, maximum demand value (A, W), and minimum instantaneous voltage

Item	Display range	Display code
OCA operation count	0 to 9999	Hb
Running time	0 to 9999 × 100 (h)	Hc
Close operation count	0 to 9999 × 10 (times)	Hd
OCGA operation count	0 to 9999	Hn
51DT2 operation count	0 to 9999	HP

* The display codes are the codes to be displayed on this F-MPC30 (UM5ACG-H5R).

• **Specifications of protective relays**

	Setting range of current/voltage operate value	Setting range of operate time (timer)	Characteristics (accuracy)	
			Operate value	Operate time
50 (Instantaneous)	1 to 20 times of CT rated current (in 0.2 times step), Lock	Fixed	±5%	40ms or less
51DT1 (Definite-time)	1 to 20 times of CT rated current (in 0.2 times step), Lock	0 to 5s (in 0.05s step)	±5%	Less than 1s ±50ms More than 1s ±5%
51DT2 (Definite-time)	20 to 240% of CT rated current (in 2% step), Lock	0 to 10s (in 0.1s step)	±5%	Less than 1s ±50ms More than 1s ±5%
51 (Inverse time) SI, EI, VI, LT	20 to 240% of CT rated current (in 2% step), Lock	Time multiplication: 0.5 to 20 times (in 0.1 times step) (Min. operation time: 150ms)	±5%	Setting value 300%: ±12% 500, 1000%: ±7% (lower limit ±100ms)
50G, 50N (Instant/definite time)	0.1 to 8 times of CT rated current (in 0.1 times step), Lock	0.0 to 10s to 180s (in 0.1s step.) (in 1s step.) *1 *2	±5%	±5% (lower limit ±50ms)
51G, 51N SI, EI, VI, LT	0.02 to 1.00 times of CT rated current (in 0.01 times step), Lock	Time multiplication: 0.5 to 20 times (in 0.1 times step) (Min. operation time: 150ms)*1	±5% (min. ±100mA)	Setting value 300%: ±12% 500, 1000%: ±7% (lower limit ±100ms)
OCA (Overcurrent pre-alarm)	10 to 100% of CT rated current (in 5% step), Lock	10 to 200s (in 10s step)	±10% (min. ±100mA)	±5%
OCGA (Leakage current pre-alarm)	50, 60, 70, 80% of the setting value of "51G operating current", Lock	10 to 200s (in 10s step)	±10% (min. ±200mA)	±5%

Notes: *1 When a current exceeds 15% of the rated fundamental wave current, the malfunction preventive function against the exciting inrush current activates. (When the contents of the second higher harmonics are about 15% or higher, the feature will lock outputs.) Note that with the 50G relay, the malfunction preventive function against the exciting inrush current will not activate if you set the operate time at 0s.

Power Monitoring Equipment

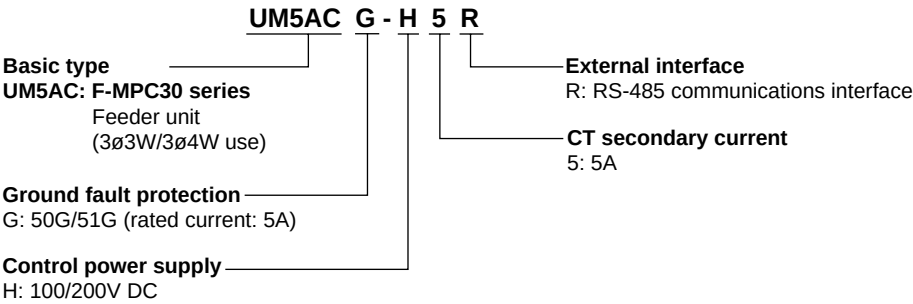
Multiple function protectors and controllers

F-MPC30

• Communications specifications

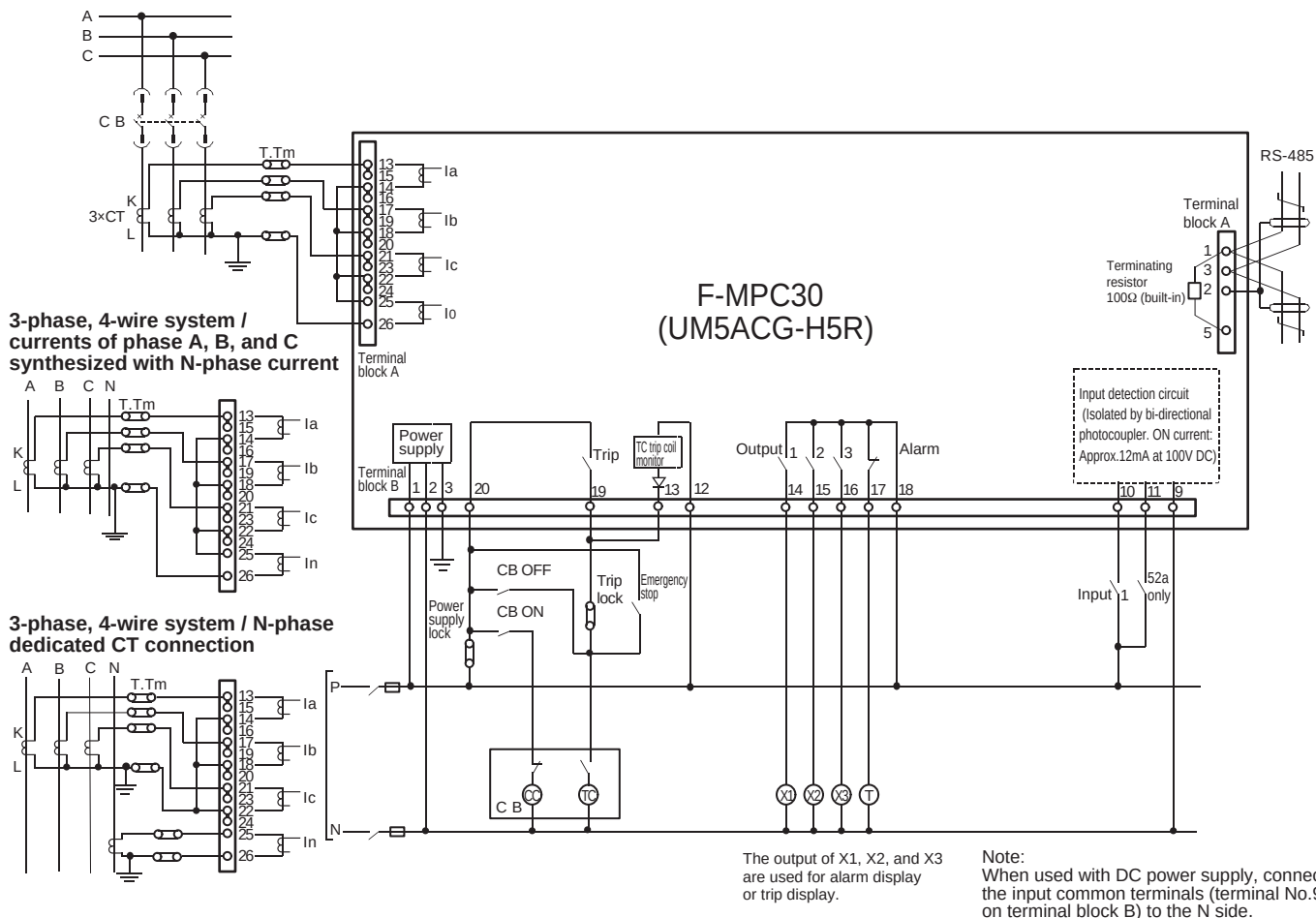
Protocol	MODBUS protocol mode	MPC-Net mode
Standard	EIA-485	EIA-485
Data exchange method	Polling/selecting system	1: N polling/selecting system
Transmission distance	1000m (total length)	1000m (total length)
No. of connectable units	Up to 32 units (including master unit)	Up to 32 units (including master unit)
Station number address	01 to 99	01 to 99
Transmission speed	4800/9600/19200 bps (selectable)	4800/9600/19200 bps (selectable)
Data format	Number of start bits: 1 (fixed) Data length: 8 bits (fixed) Parity bit: None/even/odd (selectable) Stop bits: 1 bit or 2 bit (automatic selection) 1 bit: for "even or odd" parity 2 bit: for "none" parity	Number of start bits: 1 (fixed) Data length: 7/8 bits (selectable) Parity bit: None/even/odd (selectable) Stop bits: 1 (fixed) BCC: Even horizontal parity

■ Type number nomenclature



■ Example of external wiring diagram (External 3 CTs)

3-phase, 4-wire system / zero-phase current



- Note:
- Use selective input 1 and selective output 1 to 3 by selecting the function type by setup. See page 09/113 for details.
 - Outputs of "TRIP and device error" are used exclusively. Inputs of "52a: the answer back signal of CB ON" and "the monitoring of TC coil" are used exclusively.
 - Device error output is a normally closed contact (normally excited, and if an error occurs, excitation terminates and contact opens). Therefore, a time delay of about 100ms occurs before the contact opens, since the power has been on (in operation). Consider the use of a timer, if necessary, if you create an external sequence.
 - If you have to connect a heavy load exceeding relay's contact rating, be sure to use it in combination with FUJI's miniature power relay HH6□. See page 09/113 "Input/output specifications."
 - If this unit, being provided with RS-485 communication function, is located at the termination of a communication line, connect terminals No.3 and 5. With this, the 100Ω terminating resistor is connected across the RS-485 bus.

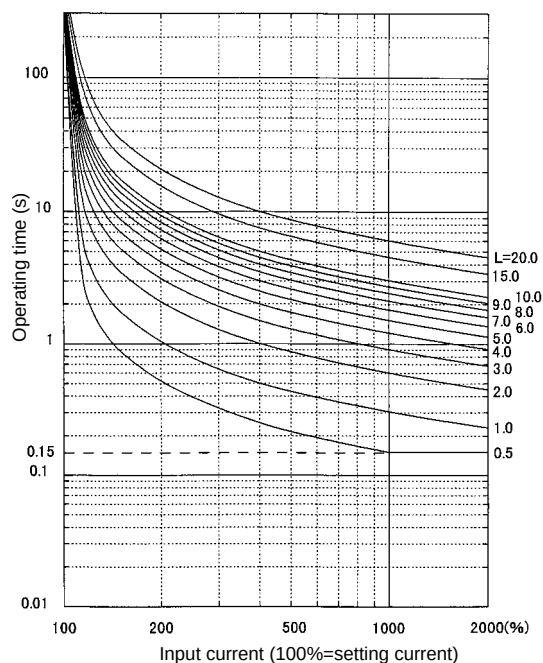
Power Monitoring Equipment

Multiple function protectors and controllers

F-MPC30

■ Time-current characteristics of an overcurrent relay

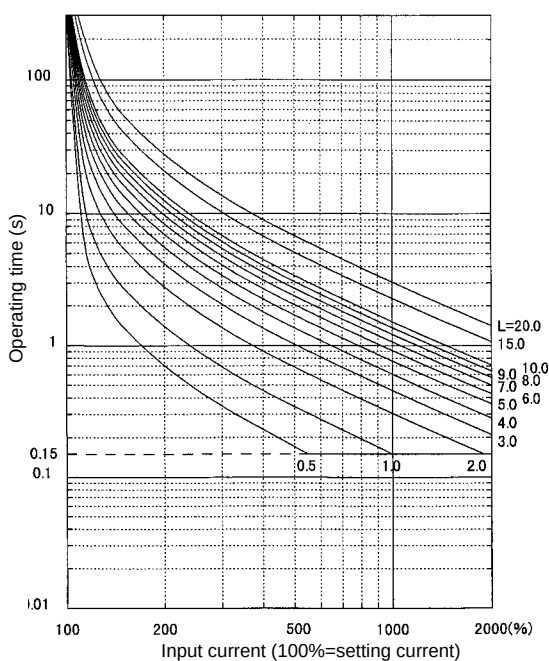
Standard inverse (SI) characteristics



Note:
Time setting (lever) is of 0.1 times step (Lower limit: 0.5, upper limit: 20.0). Indication of a part of the lever is omitted in the characteristics indicated above.

$$t = \frac{0.14}{I^{0.02} - 1} \times \frac{L}{10} \quad (L: \text{Time magnification})$$

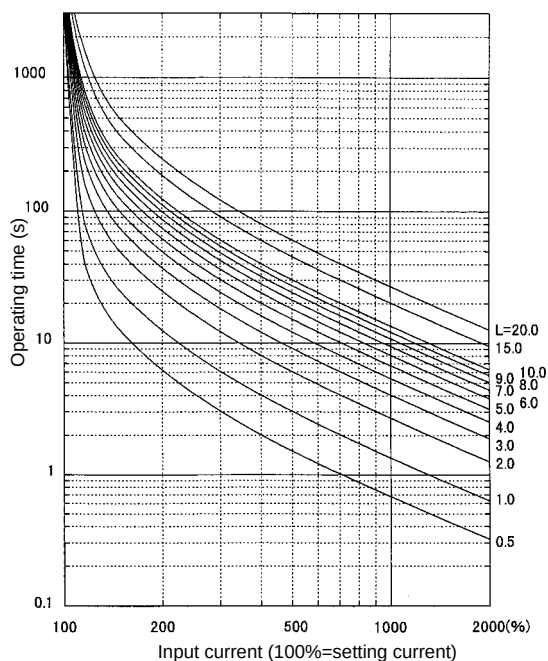
Very inverse (VI) characteristics



Note:
Time setting (lever) is of 0.1 times step (Lower limit: 0.5, upper limit: 20.0). Indication of a part of the lever is omitted in the characteristics indicated above.

$$t = \frac{13.5}{I - 1} \times \frac{L}{10} \quad (L: \text{Time magnification})$$

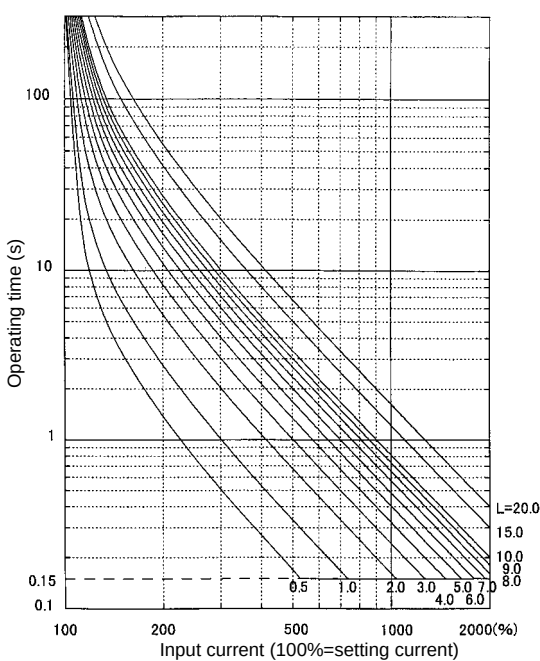
Long time inverse (LT) characteristics



Note:
Time setting (lever) is of 0.1 times step (Lower limit: 0.5, upper limit: 20.0). Indication of a part of the lever is omitted in the characteristics indicated above.

$$t = \frac{120}{I - 1} \times \frac{L}{10} \quad (L: \text{Time magnification})$$

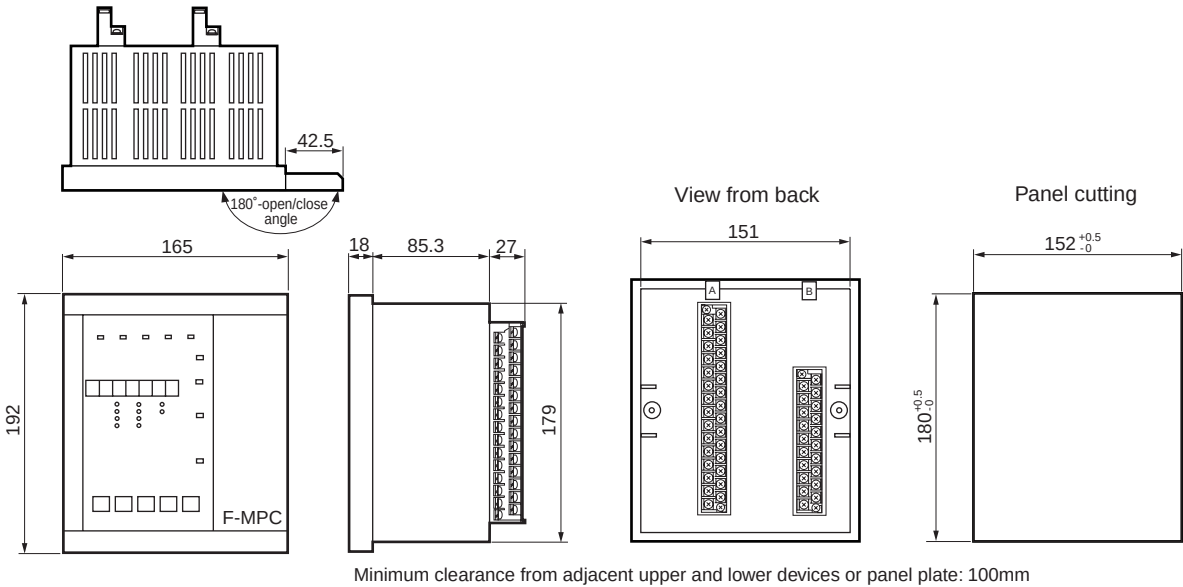
Extremely inverse (EI) characteristics



Note:
Time setting (lever) is of 0.1 times step (Lower limit: 0.5, upper limit: 20.0). Indication of a part of the lever is omitted in the characteristics indicated above.

$$t = \frac{80}{I^2 - 1} \times \frac{L}{10} \quad (L: \text{Time magnification})$$

■ Dimensions, mm



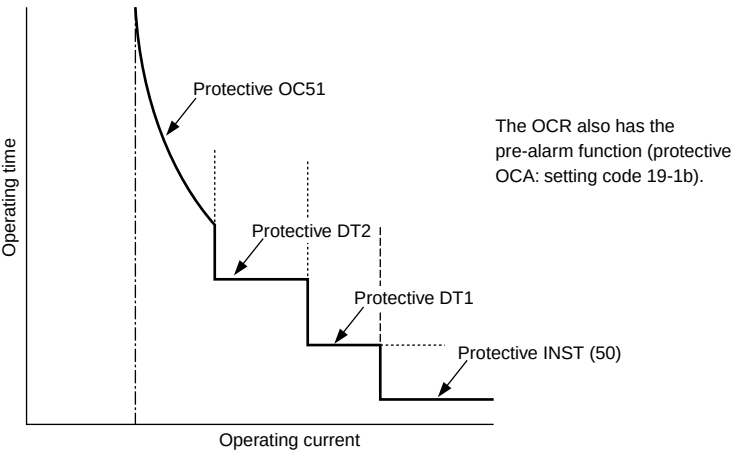
■ Characteristics of overcurrent relay (OCR)

The characteristics of overcurrent relays (OCR) are, in general, divided into the protective INST (50) (setting code 10, 11), the protective DT1 (setting code 12 to 14), protective DT2 (setting code 1c, 1d, 1E) and the protective OC 51 (setting code 15 to18). The characteristics of protective OC 51 consist of 4 kinds of inverse characteristic curves, such as standard inverse (SI) characteristics, very inverse (VI) characteristics, long time inverse (LT) characteristics, extremely inverse (EI) characteristics. Combination of the protective INST (50), protective DT1, protective DT2 and OC 51 carries out coordinative protection.

Outline of characteristic of overcurrent relay.

Item	Operating current	Operating time
Protective INST (50)	1 to 20 times of CT rated current 5A (0.2 times step)	Fixed (40ms or less)
Protective DT1		0 to 5s (0.05s step)
Protective DT2	20 to 240% of CT rated current 5A (2% step) *1	0 to 10s (0.1s step)
Protective OC (51)		Select from 4 characteristic curves. Time magnification: 0.5 to 20 times (0.1 times step)

*1: The operating time of protective OC 51 is saturated at about 150ms.
The operating time will be saturated at 20 times of CT rated current when the setting exceeds 200%.
For example, the operating time becomes 833% (= 2000%/(240%×100)) of the CT rated current in 240% setting.



Power Monitoring Equipment

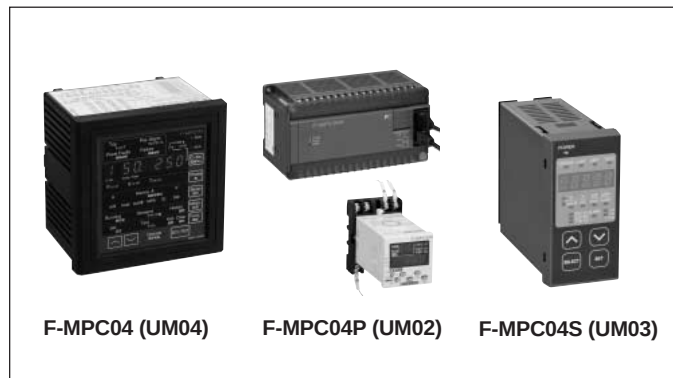
Power monitoring unit

F-MPC04, F-MPC04P, F-MPC04S

Power monitoring unit F-MPC04 series

■ Description

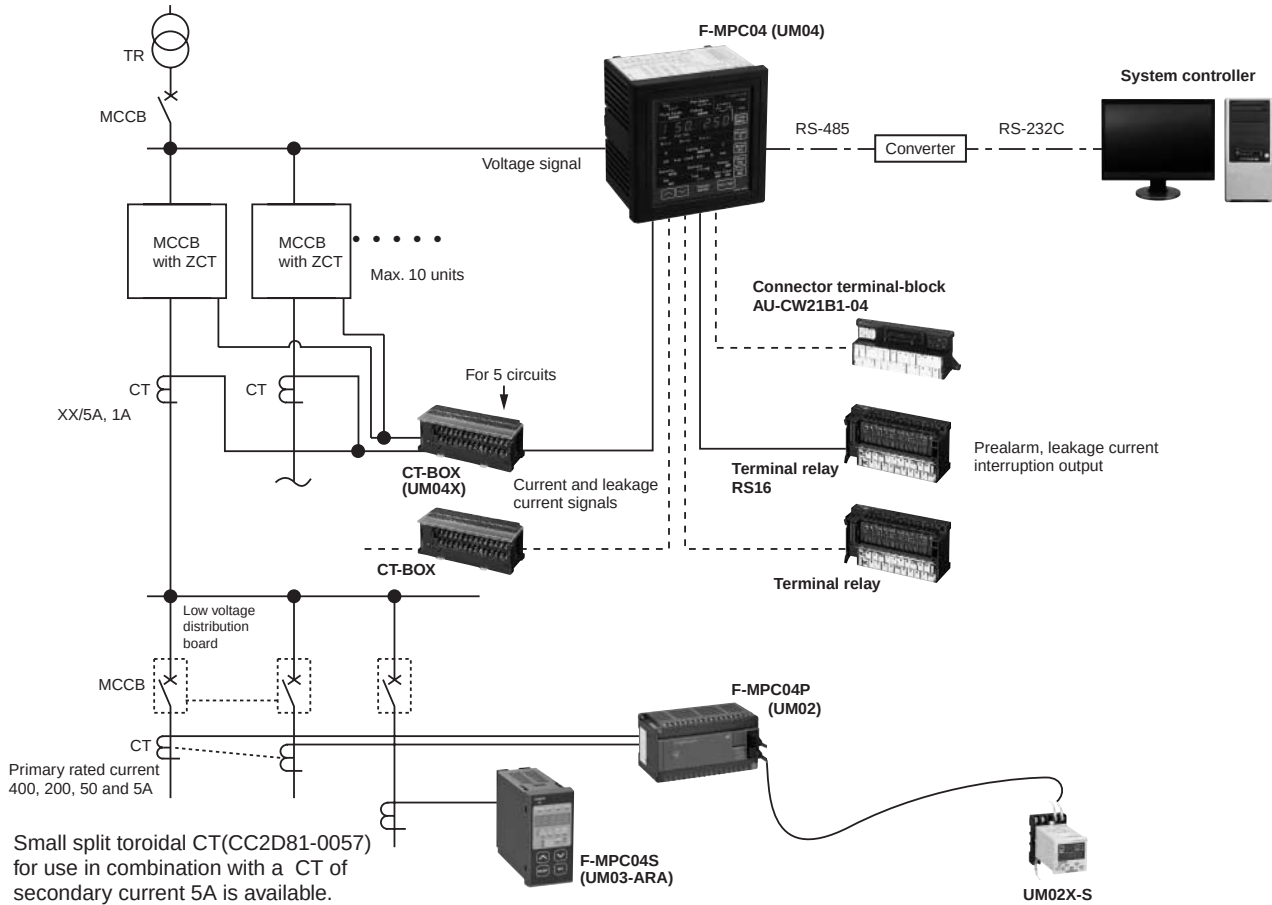
- F-MPC04 series power monitoring equipment, designed for used in low voltage circuits, can perform electric power management and monitoring from high to low voltage circuit efficiently and economically, used together with F-MPC60B and F-MPC30 series.
- F-MPC04 series consists of 3 types: type UM04 integrated power monitoring unit that can monitors up to 10 feeders, type UM02 multi-circuit power monitoring unit that is space-saving and can monitor up to 8 feeders in three-phase three-wire system, and type UM03 single circuit power monitoring unit, being compact, that has optimum output functions for preventive maintenance, and is best suited for installation in a unit of facility, section, and floor.
- RS-485 communications interface is standard. With our application software of F-MPC-Net power monitoring system, you can automatically display, print, and save the data measured by F-MPC 04 on your PC.



Type				F-MPC04	F-MPC04P			F-MPC04S	
				UM04-ARAE	UM02-AR2	UM02-AR3	UM02-AR4	UM03-ARA3G	UM03-ARA3
				Integrated power monitoring unit	Multi-circuit power monitoring unit			Single-circuit power monitoring unit	
Measuring function	No. of phase and wire	1-phase 2-wire		10 circuits	12 circuits	—	—	1 circuit	1 circuit
		1-phase 3-wire		10 circuits	—	8 circuits	—		
		3-phase 3-wire							
		3-phase 4-wire		6 circuits	—	—	4 circuits	—	—
	No. of voltage circuit			2	1			1	1
	Measuring item	Voltage [V]		○	○			○	○
		Current [A]		○	○			○	○
		Power [W]		○	○			○	○
		Active power [Wh]		○	○			○	○
		Reactive power [var]		○	○			○	○
		Reactive energy [varh]		○	—			○	○
		Power-factor		○	○			○	○
		Leakage current [Io]		○	—			○	—
		Basic component of leakage current [Iob]		○	—			○	—
	Maintenance item	Demand	Current	○	—			○	○
			Power	○	—			○	○
			Max. current	○	—			○	○
			Max. power	○	○			○	○
		Max. voltage value		○	○			—	—
		Min. voltage value		○	○			—	—
	Harmonic current			○	—			○ (Demand only)	
Protection	Current prealarm (OCA)			○	—			○	○
	Leakage current prealarm (OCGA)			○	—			○	—
	Leakage current trip (OCG)			○	—			○	—
Communications interface				RS-485, Modbus	RS-485			RS-485	RS-485
Display and setting				○	Display and setting unit UM02X-S			○	○
Devices to be connected	Current sensor (Current Transformer:CT)			○ *1	CT: 5, 50, 200, 400A				
	ZCT (separately installed)			○	—			○	—
	MCCB with ZCT			○	—			○	—

Note *1: FMPC 04 (UM04) is connected to CT via CT-BOX. For combination of F-MPC04 (UM04), CT-BOX and CT, See page 09/120 and 09/135 ; "Applicable CT."

■ System configuration example
Low voltage



Power Monitoring Equipment

Power monitoring unit

F-MPC04

Integrated power monitoring unit, UM04

■ Description

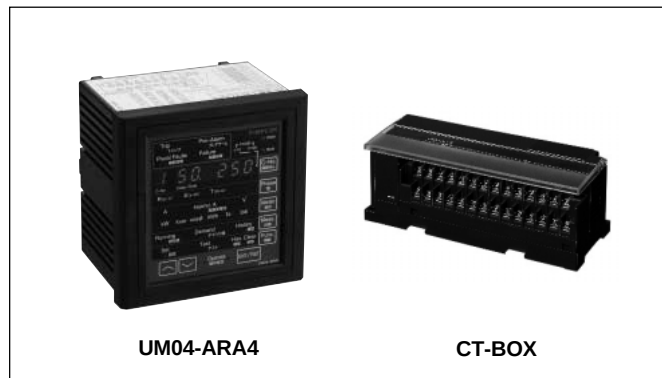
Integrating complete functions required for power distribution and power line data management in a single unit (up to 10 circuits for 3-phase 3-wire system)

- Supports multiple power distribution lines
UM04 allows economical management of each facility and installation by means of communications interface.
- Easy mounting to existing switchboards
Split-through type CTs enables UM04's easy mounting to existing boards.
- Flexible energy management
UM04 manages power line data such as measurement, preventive maintenance, maintenance and electricity quality, and transmit those data to upper level controller, thus promises energy and labor-saving.
- Harmonics current measurement
The third, fifth, seventh, and total harmonic current can be measured.
- Monitor insulation deterioration and implement preventive maintenance by measuring leakage current.
Provides deterioration trend analysis with trend data and preventive maintenance with 2-stage output (leakage current pre-alarm and leakage current relays).
- Compatible with MODBUS RTU protocol.
Select between the MODBUSRTU protocol or the F-MPC-Net protocol for the F-MPC series.

■ Type number nomenclature

Integrated power monitoring unit

UM04-ARA4
F-MPC04 basic type



- Handles digital input.
Four inputs (ON/OFF status and pulse count digital signals) from the relay connector terminal block.
- Related Equipment
Molded case circuit breakers with ZCT and split type current transformers are also introduced as related products, RS16 Terminal Relay which outputs leakage current prealarm and the connector terminal-block which outputs kWh pulse, are also explained (UM04 use only).

■ Types

Description	Specification	Type	Remarks
Integrated power monitoring unit	RS-485, 2VT-conformed	UM04-ARA4	
CT-BOX	For CT secondary current 5A	UM04X-5	
	For CT secondary current 1A	UM04X-1	
Related product			
Terminal Relay	15 output	RS16-DE04H	See page 09/137.
Connector cable	Length 1m/2m/3m	AUX014-20□	See page 09/137.
Connector terminal block	kWh pulse output For digital input	AU-CW21B1-04	See page 09/138.

■ Applicable CT

Current transformer (CT)	CT secondary current	Applicable CT-BOX	Applicable integrated power monitoring unit
Split CT Type CC2C76-□□□1 Type CC2D74-□□□1	1A	UM04X-1	UM04-ARA4
General-purpose CT XX/1A	1A		
General-purpose CT XX/5A	5A	UM04X-5	

Applicable circuit	CT-BOX	
	One unit	Two units
Three-phase/3-wire	5 feeders max.	10 feeders max.
Single-phase/2-wire		
Single-phase/3-wire		
Three-phase/4-wire	3 feeders max.	6 feeders max.

* The number of countable feeders depends on the number of CT boxes.

■ Specifications
• General specifications

Item		Specification
Rating	Rated frequency	50 or 60Hz (Selectable by the setting)
	Rated voltage	Applicable to both 110V and 220V AC, 110V AC for use with a VT secondary circuit
	Rated current	Depends on CT-BOX specifications (5A, 1A in a CT secondary circuit, power consumption: 0.1VA max., excluding power loss in the external cable resistance)
	Zero-phase CT	EW type or MCCB with a ZCT (zero-phase current transformer) type (FUJI model)
Control power supply		85 to 264V AC (By exclusive control power supply terminal)
Inrush current		40A max., 3ms max. (AC) 85A max., 3ms max. (DC)
Control power consumption *1		25VA max. (Power monitoring unit + two CT-BOXes + Terminal Relays with all contacts ON)
Rated input	Voltage input (VT ratio)	100V direct input, 200V direct input VT primary/secondary : AC220/110V, AC440/110V, AC440/220V, AC240/110V, AC400/110V, AC3.3k/110V, AC6.6k/110V
	Current input (CT ratio)	Primary rating setting : 10A, 15A, 20A, 25A, 30A, 40A, 50A, 60A, 75A, 80A, 100A, 120A, 150A, 160A, 200A, 250A, 300A, 320A, 400A, 500A, 600A, 630A, 750A, 800A, 100A, 1200A, 1250A, 1500A, 1600A, 2000A, 2500A, 3000A, 3150A, 3200A, 4000A, 5000A, 6000A, 7500A
Ambient temperature		-10 to + 55°C (no icing or no condensation)
Storage temperature		-20 to + 70°C (no icing or no condensation)
Humidity		20 to 90% RH (no condensation)
Atmosphere		No corrosive gas and no heavy dirt and dust
Alarm and shutdown outputs		Continuous output current: 1A max. (with output of terminal relay, RS16-DE04H) Make and break current: 250V AC 5A, 30V DC 5A max.
Insulation resistance		10MΩ min.: between ground and electric circuits connected together 5MΩ min.: between electric circuits, between contacts
Dielectric strength		2000V AC, 1 minute between ground and electric circuits connected together, excluding T-link and RS-485 signal circuits
Impulse		4.5kV (1.2 × 50μs) between ground and electric circuits connected together, excluding T-link and RS-485 signal circuits
Momentary overload capability		20 times rated current, nine times for 0.5s, once for 2s
Shock resistance		Approx. 300m/s ² , three times in each of X, Y, and Z axes
Noise immunity		1 to 1.5MHz damped oscillation noise having 2.5 to 3kV peak voltage for 2s 1.5kV square wave (rise time: 1ns, pulse width: 1μs) for 10 minutes continuously
Vibration resistance		JIS C 60068-2-6 10-58Hz: single amplitude 0.075mm. 58-150Hz=constant acceleration 10m/s ² X, Y, Z directions 8minutes X10 cycles
Electrostatic noise resistance		Mounting steel panel surface: ± 8kV F-MPC04 (UM04) front panel surface: ± 15kV
Permissible momentary power failure		20ms, continuous operation (excluding display)
Mass		Power monitoring unit UM01: 1000g, CT-BOX: 300g Terminal relay: 200g

Note *1 The control power consumption on the table applies to where CT-BOXes and Terminal relays are connected to the power monitoring unit UM04.

Power Monitoring Equipment

Power monitoring unit

F-MPC04

• Measurement and display specifications

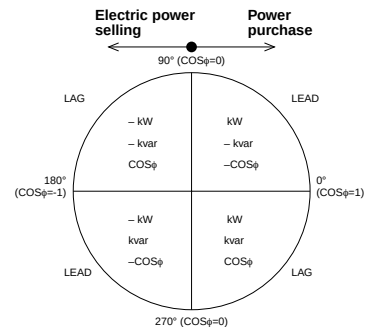
Measurement type	Effective measuring range	The main body display	Communication data	Accuracy (%)	Remarks
Current: I(r), I(s), I(t)	0, 0.5% to 150% of CT secondary rated current	4 digits	4 digits	±2.5% FS	"0.00" is displayed, if the measured value is about 1.0% or less.
Voltage: *3 V(uv), V(vw), V(wu)	VT secondary voltage: 3Ø3W : max 264V 3Ø4W (Phase voltage): max.264V 3Ø4W (Line voltage): $\sqrt{3}\times 264V$			±2.5% FS	VT secondary voltage is jointly used as internal control power supply. (For U-V)
Zero-phase current Io	0, 50 to 3600mA			±20% FS	"0" is displayed, if the measured value is about 50mA or less.
Active power *4*5	0 to 3.5kW (220V) as converted to current transformer secondary value	4 digits with the code	4 digits with the code	±2.5% FS	Two-wattmeter method: Measured when the value is 0.4% or higher of the rated current. (Ir, It, Vuv, Vvw)
Reactive power *4*5	0 to 3.5kvar (220V) as converted to current transformer secondary value			±2.5% FS	Two-wattmeter method
Power factor *4	Lead : 0%-100%-Lag : 0%	3 digits with the code	4 digits with the code	±5% The "90°" phase angle conversion	
Active electric power	0 to 99999 (kWh) The effective power quantity of the plus	5 digits	*6	Equivalent to ordinary class specified in JIS	±2.0% (Power factor of 1 between 5% and 120% of CT primary rated current)
	0 to 99999 (kWh) The effective power quantity of the minus				±2.5% (Power factor of 0.5 between 10% and 120% of CT primary rated current)
The reactive energy	0 to 9999 (kvar) The reactive energy of the plus	none	*6	±0.5% (No display)	
	0 to 9999 (kvar) The reactive energy of the minus				
The voltage minimum value	"264V from 85V" in VT secondary of each phase	4 digits		±2.5% FS	
The voltage maximum value	"264V from 85V" in VT secondary of maximum-phase			±2.5% FS	
Harmonic current	3rd & 5th order : 0, 2.5% to 150% 7th order : 0, 5.0% to 150%			±2.5% (7th order: ±5%)	*7

Note : *1. The measurement accuracy includes the error in the CT boxes and ZCT. The error in the combined VTs and CTs are not included.
 *2. Current, voltage, and power performance characteristics are according to JIS C 1102 (indicating electrical measuring instruments). The measurement display value is the average value over approximately 1 second.
 *3. The values in the table are the line voltages for 3-phase, 3-wire systems and the phase voltages for 3-phase, 4-wire systems. For 3-phase, 4-wire applications, the setting in this table can be used to display either the phase voltages or line voltages.
 *4. Selling/purchasing for power measurement and lead/lag for power factor measurements are displayed with one sign (blank for positive). The meaning of positive/negative for each measurement item is given below.
 *5. The maximum values of the active power and reactive power are ±3.5kW at a 5A secondary current for 3-phase, 3-wire systems, ±0.69kW at 1A for 3-phase, 3-wire systems, ±6.0kW at a 5A secondary current for 3-phase, 4-wire systems, and ±1.2kW at a 1A secondary current for 3-phase, 4-wire systems.
 *6. For the F-MPC-Net protocol, the lower four digits of the display are sent. For the MODBUS RTU protocol, 0 to 999999.999kWh is sent and the step value for the total countup depends on the VT ratio and CT ratio.
 *7. For 3-phase, 3-wire systems, the harmonic currents for phases R and T are measured. For 3-phase, 4-wire systems, the harmonic currents for phases R, S, and T are measured.

The sign "±" in electric measuring

The sign "±" is used to display "LEAD/LAG" in power-factor, measuring and "electric power selling/purchase" in electric power measuring. No signs are used if a value is "+". The sign "±" has the following meanings depending on the measured items.

- Active power: kW
 - +: Power purchase (Consumed electric power)
 - : Electric power selling (Inverse electric power flow)
- Reactive power: kvar
 - +: Lagging current by reactive volt-ampere meter method
 - : Leading current by reactive volt-ampere meter method
 - * "LEAD/LAG" reverses with electric power selling/purchase.
- Power factor: COSφ
 - +: LEAD -: LAG



• Demand measurement

Item	Specification
Current (I(r), I(s), I(t)) Effective power Zero-phase current (rms:Io, 50/60Hz:Iob) Harmonics currents, voltage	Time: Select one from 0, 1 to 15 minutes (1 minute increments) and 30 minutes it at the initial setting (common to all 10 circuits). Display item: 1. Demand values 2. Maximum demands (maximum values recorded before the last reset operation)

● Specifications of a leakage current relay

Sensitive current

Setting value	200/500/1000/2000/3000mA or Lock (Io or Iob selectable)
Operating Level	50 to 100% of setting value (Operate at less than 50%, no operate at 100%)

Operation time characteristics

Setting time	Inertia non-operating time	Operating time
0.1s	—	100ms max.
0.3s	150ms min.	0.3s max.
0.5s	250ms min.	0.5s max.
1.0s	500ms min.	1.0s max.
3.0s	1,500ms min.	3.0s max.

Note: • Sensitive current and operation time can be set by an arbitrary combination.
• The values on the table is for a trip relay's specifications. The pre-alarm relay operates at half the operating level on the table, and its operation time is 10s fixed. The pre-alarm relay can be used as an alarm against leakage current increase in case of cable insulation deterioration or flood.

● Data display at fault occurrence

Pre-alarm of load current, pre-alarm of leakage current relay (auto-reset), maximum current indication at circuit interruption (indication reset by resetting)

● kWh-pulse-output specifications (for products with a kWh-pulse-output feature)

Transistor open collector output: 35V DC, 50mA max., (residual voltage at ON state: 2.5V max.)

Output pulse width: 200ms ±20ms

Output period: 1,000ms min.

Output pulse rate: 10ⁿ kWh/pulse, n = -2, -1, 0, 1, 2, or 3 (selected from VT and CT ratio.)

● ZCT with Leakage Current Relay

The UM04 can be used together with a MCCB with ZCT or a zero-phase current transformer.

■ Communications specifications

Item	Specifications	
	F-MPC-Net protocol *	MODBUS RTU protocol *
Standard	EIA-485	
Transmission method	Half duplex, 2-wire	
Data exchange method	1:N (UM04) polling/selecting	
Transmission distance	1,000m (total length)	
Number of stations	31 max. per system (excluding master)	
Transmission speed	4,800/9,600/19,200bps (selectable)	
Address setting	1 to 99	
RS-485 terminal names	DXA, DXB	Connect DXA as D1(+) and DXB as D0(-).
Transmitted characters	ASCII	Binary
Data format	Start bits	1 bit (fixed)
	Data length	7 or 8 bits (selectable)
	Parity bit	None, even, or odd (selectable)
	Stop bits	1 bit (fixed)
	BCC	Even vertical parity
		CRC-16

* The F-MPC-Net or MODBUS RTU protocol can be set for communications for the UM04.

■ Digital input specifications

Item	Specification	Remarks
Number of inputs	4	Communications transmissions and UM04 display of ON/OFF status and pulse count.
Exterior input signals	No-voltage contact input or transistor open-collector input	
Input specifications	24V DC, approx. 5mA flow OFF level: 1mA max.	
Minimum input signal width	50ms	

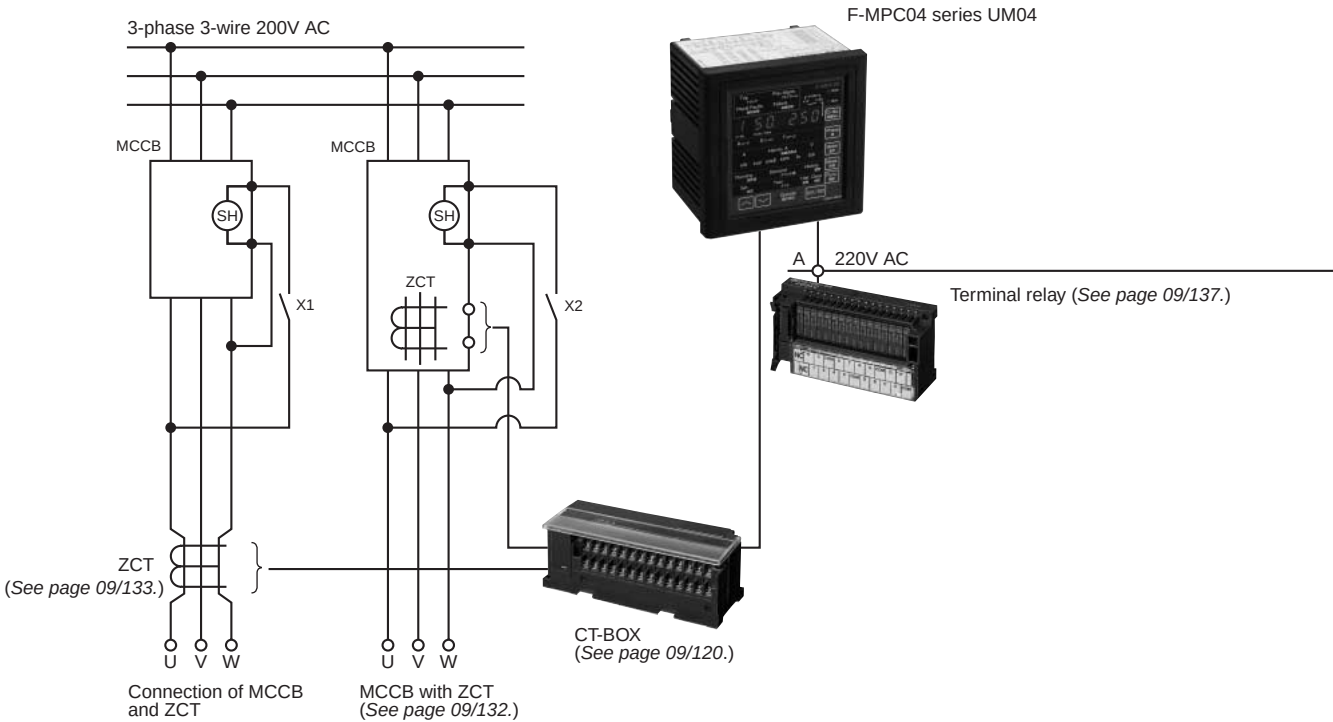
Power Monitoring Equipment

Power monitoring unit

F-MPC04

System configuration

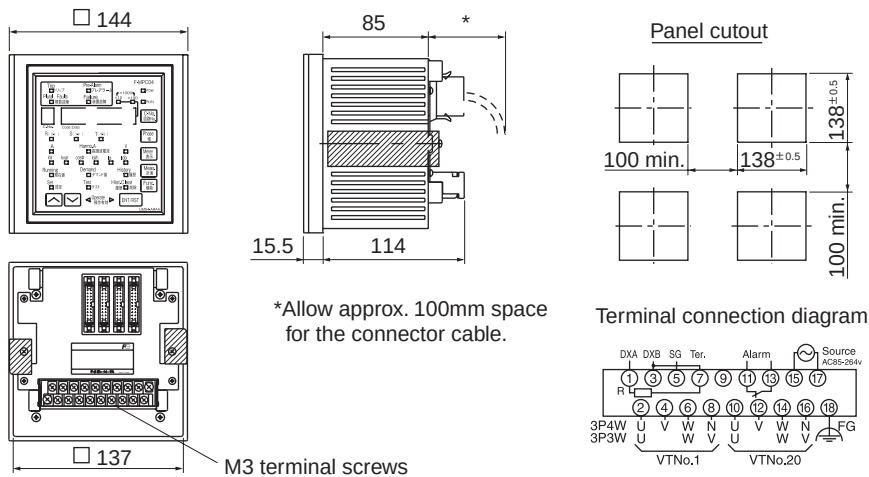
With an integrated power monitoring unit UM04, you can easily construct a low-voltage power distribution system equipped with leakage current measuring, leakage current pre-alarm, and earth leakage circuit shutdown.



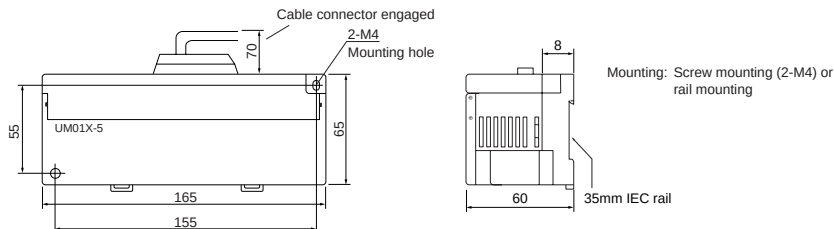
(SH) : Shunt trip device

Dimensions, mm

Integrated power monitoring unit, UM04



CT-BOX, UM04X

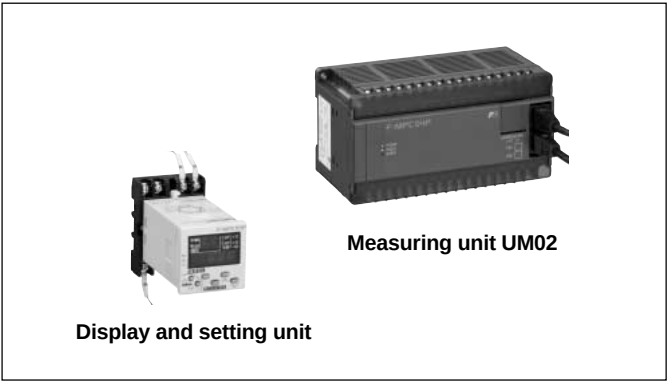


Multi-circuit power monitoring unit, UM02

■ Description

Integrating measuring functions required for power monitoring in one unit

- A single unit measures multiple circuits
A single UM02 can measure up to 8 feeders in 3-phase 3-wire, 12 feeders in single-phase 2-wires and up to 4 feeders in 3-phase 4-wire circuit.
- Easy installation into existing switchboards
Compact UM02 can be easily installed into on-site power distribution or lighting panel, irrespective of new panel or existing panel, to create power monitoring system economically.
- On-site measuring instrument
UM02 can be used an on-site measuring instrument by combining with an optional display and setting unit UM02X-S.
- Communication interface
As UM02 has an RS-485 communications interface as standard, it can communicate with other power monitoring equipment with RS-485



■ Type number nomenclature

Multi-circuit power monitoring unit (Measuring unit)

UM02-AR 3	
Basic type	Applicable circuit
UM02-AR: Measuring unit	2: Single-phase 2-wire, up to 12 feeders
	3: 3-phase 3-wire, Single-phase 3-wire, Single-phase 2-wire, up to 8 feeders
	4: 3-phase 4-wire, up to 4 feeders

■ Type and applicable circuit

Description	Applicable circuit	Type
Measuring unit	Single-phase 2-wire, up to 12 feeders	UM02-AR2
	3-phase 3-wire, Single-phase 3-wire, Single-phase 2-wire, up to 8 feeders	UM02-AR3
	3-phase 4-wire, up to 4 feeders	UM02-AR4
Sold separately		
Display and setting unit	The TP48X socket and connecting cable are provided as accessories.	UM02X-S
Cable for UM02-AR connection	0.5m	UM02X-C005
	5m	UM02X-C050

Power Monitoring Equipment

Power monitoring unit

F-MPC04P

■ Specifications F-MPC04P (UM02)

• General specifications

Item		Specification
Ratings	Voltage	Direct input: 100 or 200V AC, 400V AC (AR4 only) VT primary/ secondary: 220, 440V AC, 3.3k, 6.6kV AC/110V AC, 440/220V AC *1
	Current	Split CT: 5, 50, 200, 400A AC Small split current sensor CT: 5A AC (primary rated set range 10 to 7500A) *1
Control power supply		100/200V AC common use (85 to 264V AC) AR2: between terminals P1-N, AR3: between terminals U-V, AR4: between terminals P1-P2
Inrush current		15A max., 3ms max. (100V AC 50Hz) 30A max., 3ms max. (200V AC 50Hz)
Control power consumption		20VA or less (or approx. 15VA at 200V AC, 10VA at 100V AC)
Ambient temperature		Operating: -10 to 55°C (no icing or no condensation) Storage: -20 to 70°C (no icing or no condensation)
Humidity		20 to 90% RH (no condensation)
Atmosphere		Free from corrosive gases and excessive dusts or particles
Insulation resistance		10MΩ min. between electric circuits and ground
Dielectric strength		2000V AC, 1 minute (2500V AC, 1 minute for AR4) between control power circuits and ground
Lightning impulse noise resistance		4.5kV (1.2 × 50μs) between control power circuits and ground (6.0kV for AR4)
Momentary overload capability		20 times rated current, 9 times for 0.5s.
Vibration resistance		JIS C 60068-2-6 10 to 58Hz: single amplitude of 0.075mm, 58 to 150Hz, constant acceleration of 10m/s ² 8 minutes × 10 cycles in each of X, Y, and Z directions
Shock resistance		JIS C 60068-2-27 Half sine wave 300m/s ² , for 11 ms × 3 times in each of X, Y, and Z directions
Noise immunity		1.5kV square wave (rise time: 1ns, pulse width: 1μs) for 10minutes continuously
Permissible momentary power failure		20ms (continuous operation) except RS-485 communications
Mass		Measuring unit: Approx. 500g, Display and setting unit: Approx. 200g

Note *1 Make VT and CT ratio settings through the display and setting unit UM02X-S or from the host controller.

• Measurement specifications

Item	Effective measurement range		Display	Accuracy *1
Current (N-phase current measured in AR4)	With split CT (200A and 400A AC) combined 0, 0.4% of In to 500A		4 digits	±1.5%
Active power	With small split current sensor (50A AC) combined 0, 0.4% of In to 50A			±2.5% for S-phase current of AR3 and N-phase current of AR4
Reactive power *2	with small split current sensor (5A) combined *4			
Power-factor	0 to n times CT rating		□. □□	±5% (converted into a phase angle of 90°)
Active electric energy *2			5 digits	Equivalent to JIS ordinary class *4
Max. active power *3	Same as above. (with a demand time set to 0, 1, 5, 10, 15, or 30min.)		4 digits	±1.5%
Min. voltage each phase *2	AR2, R3 85 to 264V (directly or VT secondary voltage conversion) The minimum and maximum voltage are average values for 0.3s.	AR4 Phase voltage 50 to 288V (directly or VT secondary voltage conversion) Line voltage 86 to 498V The minimum and maximum voltage are average values for 0.3s.	4 digits	±1.5%
Max. voltage *2				±1.5%

Notes *1 Measurement accuracy does not include CT and current sensor.

*2 In measurement mode display is the number of digits of RS-485 communications data. The display and setting unit does not display communications data on reactive power, minimum voltage, and maximum voltage values.

*3 Max active power and active electric energy values can be reset by the display and setting unit and host controller. And, when VT ratio or CT ratio is changed, these are automatically reset.

*4 With 1-turn or 3-turn primary winding selected for the 5A small split current sensor, the lower limit of minute current measurement is selected as specified below.

Classification	Measurement and display range	Measurement lower limit (Electric energy starting current)	Accuracy	
			Current and power	Electric energy
1 turn	0, 2% to rating × 10	2% of rating	0 to rating: ±1.5% of rating	±2.5% (5% to 100% of rating, load power factor -0.8 to 1.0 to +0.8)
3 turns	0, 0.7% to rating × 3	0.7% of rating	Exceeding rating: ±1.5% (FS)	

Note: * Sampling interval/measurement display value (communication) of current and power, and sampling and integration intervals of electric energy are shown below. In the case of an intermittent load, such as a welding machine, accurate measurement may be disturbed and therefore the use of the single-circuit F-MPC04S (refer to page 118) is recommended.

• Sampling interval and display value

Type	Sampling interval/display value of current and power (Communication)	Sampling and cumulative interval of power
UM02-AR2	Approx. 0.2s / Average voltage for aprox. 1.5s	Approx. 0.2s
UM02-AR3	Approx. 0.2s / Average voltage for aprox. 1.5s	Approx. 0.2s
UM02-AR4	Approx. 0.1s / Average voltage for aprox. 0.4s	Approx. 0.1s

■ Display and setting unit UM02X-S, specifications

Item	Specification	Remarks
Control power supply	Supplied from the measuring unit UM02-AR	
Measuring unit UM02-AR communications specifications	EIA-485 (always 19200bps fixed)	
Number of connectable measuring unit UM02-AR	5 max.	UM02-AR2, AR3, AR4
Max. cable length between UM02-AR and UM02X-S	23m	Total length between UM02X-S and all UM02-ARs
Display item	Operating status, measurement value VT, CT setting value, fault	Selective indication by a switch
Setting	Voltage, current (CT), demand time, pulse multiplication rate, No. of turns of CT secondary winding, host controller communications mode (different communications interface)	UM02-AR incorporates a different RS-485 interface to communicate with a host controller.

Note : The display and setting unit UM02X-S provides a function to start initial communications to recognize the UM02-AR automatically when UM02X-S is turned on. If on-site indication is not necessary once the setting to the measuring unit UM02-AR is complete, UM02-AR fully operates even without UM02X-S.

■ Communications specifications

Item		Specification
Standard		EIA-485
Transmission system		2-wire half duplex
Data exchange		1: N (F-MPC04P, UM02-AR) polling/selecting
Transmission distance		1000m (total length)
No. of connectable units		Max.32 (including master)
Station number setting		01 to 99 (set with digital switch)
Transmission characters		ASCII
Transmission speed		4800, 9600, or 19200 bps (selectable)
Data format	Number of start bits	1 (fixed)
	Data length	7 or 8 bits (selectable)
	Parity bit	None, even, or odd (selectable)
	Number of stop bits	1 (fixed)
	BCC	Even horizontal parity

Note : Use the display and set unit to change the transmission setting.
The communications specifications cannot be changed through the host controller.

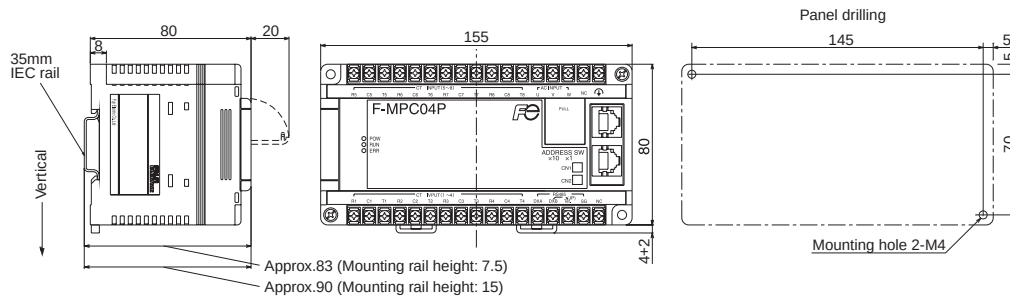
Power Monitoring Equipment

Power monitoring unit

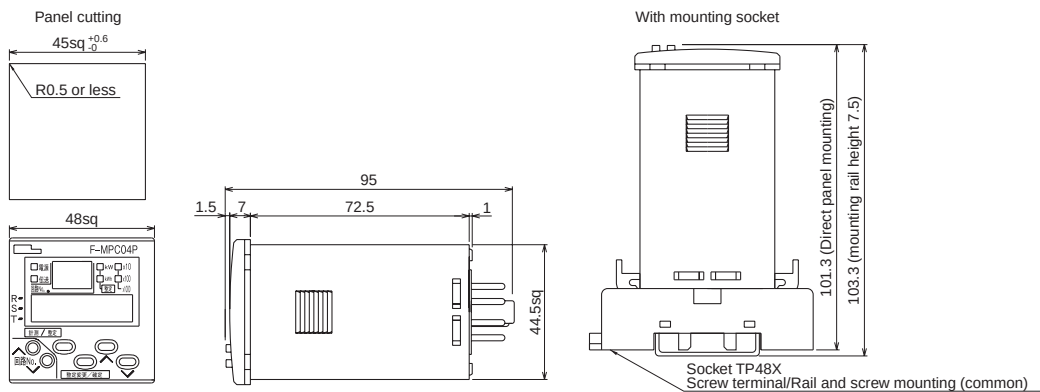
F-MPC04P

■ Dimensions, mm

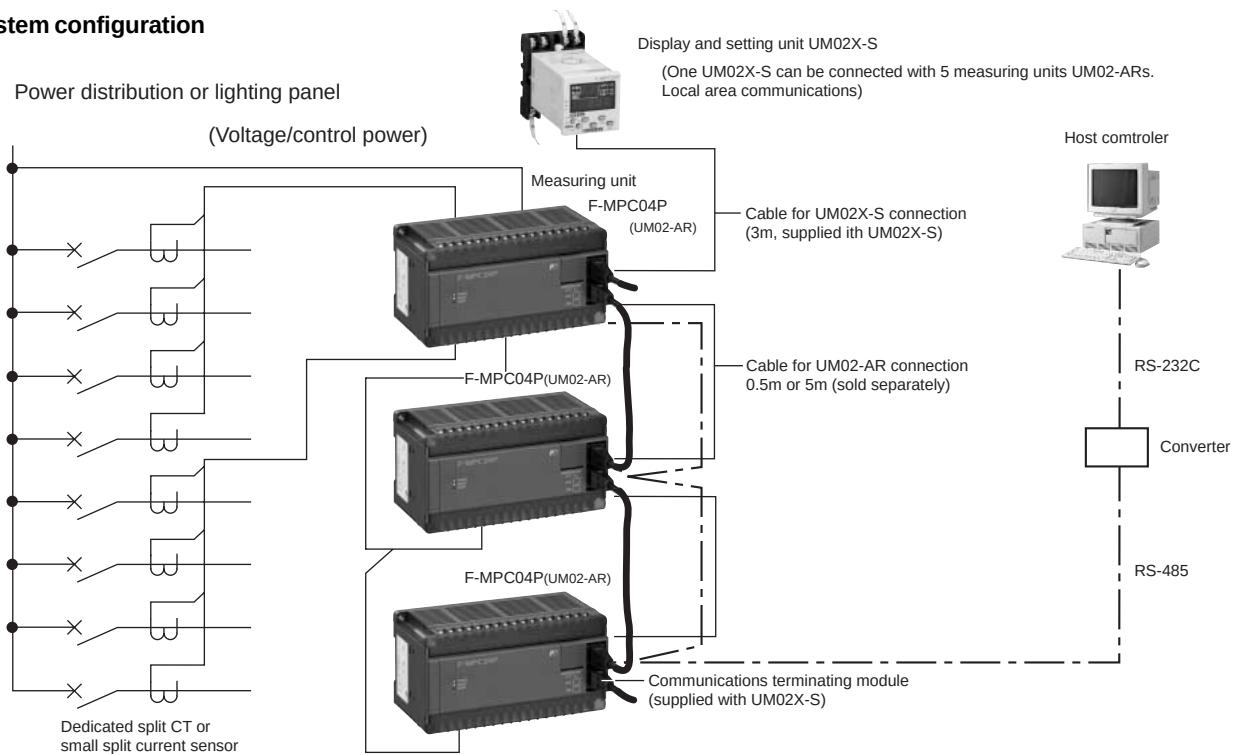
● Measuring unit UM02-AR



● Display and setting unit UM02X-S



■ System configuration



Note: * The display and setting unit UM02X-S is a local area communications master and can monitor and be able to set maximum five measuring units, UM02-ARs.

** Station address setting of measuring unit UM02-AR

Use a digital switch on the measuring unit to set a different station address (communication address to host controller).

In local area communication of the display and setting unit UM02X-S, the UM02X-S will automatically read out the address of the measuring units connected with cables for unit connection, and communicate with them.

Single circuit power monitoring unit, UM03

■ Description

Integrating measuring functions required for power monitoring in one unit

● Output functions for preventive maintenance selectable

- Power alarm/current prealarm
- kWh pulse output
- Leakage current alarm, leakage current prealarm output (model with leakage current measuring function) only

● Capable of measuring inrush current of welders

- High-speed sampling and calculation of voltage and current

● Compact design allows installation almost anywhere.

- Space-saving construction simplifies installation.
- Suited for monitoring individual equipment, section, and floor

● Networking capability

- RS-485 interface.
- Can be connected to power distribution system same way as the power monitoring equipment F-MPC 60B, 30, 04 (UM04, UM02) series products

■ Type numbers

Single circuit power monitoring unit		Type
Leakage current measuring function	Not provided	UM03-ARA3
	Provided	UM03-ARA3G

Note : As CTs, use type numbers CC2D81-0057, CC2D81-0506, CC2D65-2008, CC2D54-4009, CC2B65-2008, and CC2B54-4009. Refer to page 134.
General-purpose CTs (secondary rated current 5A or 1A) cannot be connected directly. Use the general-purpose CT (5A) together with type number CC2D81-0057. Use dedicated ZCT as combination ZCT with the UM03-ARA3.

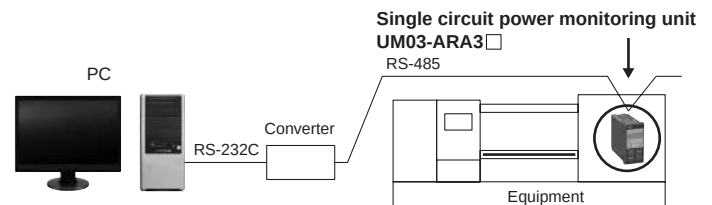
■ Specifications

• General specifications

Applicable circuit		Single circuit 3-phase 3-wire: 2-CT, single-phase 3-wire: 2-CT, single-phase 2-wire: 1-CT
Control power supply		100 to 200V AC (85 to 264V AC) 50/60Hz (45 to 66Hz)
Inrush current		15A, 3ms or less (at 110V AC, 50Hz) 30A, 3ms or less (at 220V AC, 50Hz)
Control power consumption		Approx. 7VA (at 220V AC) Approx. 5VA (at 110V AC)
VT consumed burden		Approx. 0.2VA
Continuous overload capability	Current input circuit	110% of maximum setting value (150% of rated current), 2 hours
	Voltage input circuit	291V AC (1.1×264V AC), 2 hours
Short-time overload capability	Current input circuit	2000% of max. setting value (150% of rated current), 9 times for 0.5s
	Voltage input circuit	200% of max. setting value (264V AC), 9 times for 0.5s
Vibration		10 to 58Hz 0.075mm (one-way amplitude) 58 to 150Hz: constant acceleration 10m/s ² , 10 cycles for 8 min in each X, Y, and Z directions
Shock		300m/s ² , in each X, Y, and Z directions, 2 times
Withstand voltage / Insulation resistance (500V DC megger)		2kV /10MΩ Between power supply terminals connected together and other terminals connected together 2kV /10MΩ Between measurement input terminals connected together and other terminals connected together 2kV /10MΩ Between alarm output terminals connected together and other terminals connected together 500V /10MΩ Between watt-hour pulse output terminals connected together and other terminals connected together
Ambient temperature		-10 to +55°C
Storage temperature		-20 to +70°C
Humidity		20 to 90%RH (no condensation)
Atmosphere		Free from corrosive gases and excessive of dusts
Grounding		Type D ground (100 Ω or less)
Allowable momentary power failure time		20ms (operation will continue)
Altitude		2,000m or less
Mass		Approx. 400g (main unit only, CT excluded)



■ System configuration



Power Monitoring Equipment

Power monitoring unit

F-MPC04S (UM03)

• Measurement specifications

Item	Effective measurement range	Display	Accuracy *1
Current (R/S/T), demand current	• With CT (200A AC) 0, 0.4% of In (0.8A) to 300A • With CT (400A AC) 0, 0.4% of In (1.6A) to 600A • With CT (5A) 0, 0.4% of In (0.2A) to 50A 0, to 1.5 times CT rating (for 5A) (converted into CT secondary: 7.5A) (Max. display range: up to 9,999A) • Demand time setting: 0, 1 to 15min (by 1min step) 30min setting: Available	4-digit	±1.5%: R- and T-phase ±2.5%: S-phase
Max. demand current value		4-digit	± 2.5%
Demand value and max. demand value of total harmonic current *2		4-digit	±1.5%
Active power (±)		4-digit	±3%
Demand power		3-digit	±5% (Converted into a phase angle of 90°)
Max. active demand power value		5-digit	Equivalent to JIS ordinary class (pf: 0.5-1.0- -0.5)
Reactive power (±)	30min setting: Available	5-digit	±5%
Power factor (±)		5-digit	±5%
Active electric energy (+only)	30min setting: Available	5-digit	±5%
Reactive electric energy (±absolute value addition)		5-digit	±5%
Voltage	Converted into an input voltage 60 to 264 V AC	4-digit	±1.5% ±2.5%: Vv-w
Frequency *3	45 to 66Hz *2	3-digit	±0.5%
Leakage current (Io/Iob) *4	0, 10 to 1000mA	4-digit	±2.5%
Max. demand value			

Note: *1 The measurement accuracy is a value for FS (full span).

*2 The total harmonic current relates only to phase R and phase T. Only the demand value and max demand value are displayed. The current value is not displayed.

*3 If the frequency is out of the measurement range (lower than 45 Hz or higher than 66 Hz), 0.0 [Hz] is displayed.

*4 Measurement of leakage current is possible only with UM03-ARA3G.

• Output specifications

Item	UM03-ARA3	UM03-ARA3G	Specification
Watt-hour pulse output	Provided	Provided	Transistor open collector output 35V DC 100mA
Alarm output	Current prealarm (OCA), power alarm *	Provided	Replay output 250V AC 1A
	Leakage current prealarm (OCGA) (Io operation)	Not Provided	
	Leakage current alarm (OCG)	Provided	

Note: * Choose the current prealarm (OCA) output or power alarm by change of setting.

Watt-hour pulse output details

Output specifications	35V DC 100mA (residual 2.5V or less at ON)
Output pulse width	100ms±20ms
Output interval	200ms or more
Pulse multiplication rate	10°kWh/pulse (n=3 to 2 setup)

Alarm output details

	Setting range		Accuracy	
	Operate value	Time	Operate value	Time
Current prealarm (OCA) *1	I: 20 to 120% of rated value, Lock (5% step)	Depending on the demand time setting	±5% (rated min ±1.5%)	±10%
Power alarm *1	0 to 9999kW (1kW step)			
Leakage current alarm (OCG) (Io operation)	Operate current 100, 200, 500mA, Lock	0.1, 0.3, 0.5, 1.0s	75%±5% of setting value	75%±5% of setting value (min±25ms)
Leakage current prealarm (OCGA)	50±5mA 100 to 500mA (50mA step), Lock	0.1, 0.3, 0.5, 1.0, 10s or demand time *2	±5%	±5%

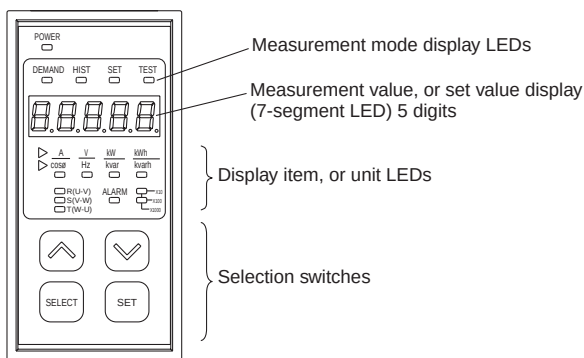
Note: *1 Select either the current pre-alarm output or the power alarm output through setup.

*2 When demand time is selected, the unit operates on Iob (leakage current only with fundamental wave).

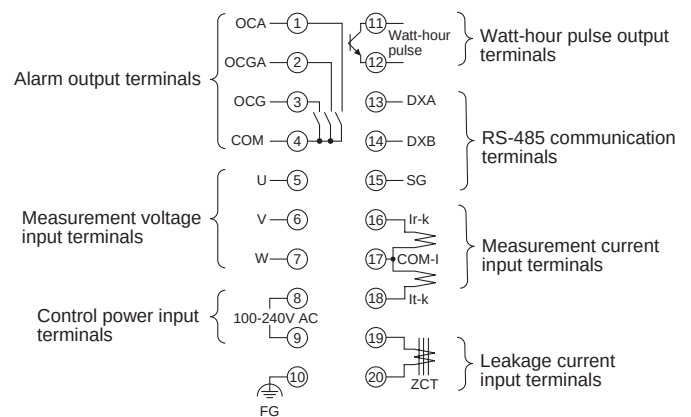
■ Communications specifications

Item	Specification	Factory setting
Standard	EIA-485	—
Transmission system	2-wire half duplex	—
Data exchange	1: N polling/selecting	—
Transmission distance	1000m (total length)	—
No. of connectable units	max.32 (including master)	—
Station number setting	1 to 99	Without station number setup
Transmission characters	ASCII	—
Transmission speed	4800, 9600, or 19200 bps (selectable)	19200 bps
Data format	Number of start bits	1 (fixed)
	Data length	7 or 8 bits (selectable)
	Parity bit	None, even, or odd (selectable)
	Number of stop bits	1 (fixed)
	BCC	Even horizontal parity

■ Front panel

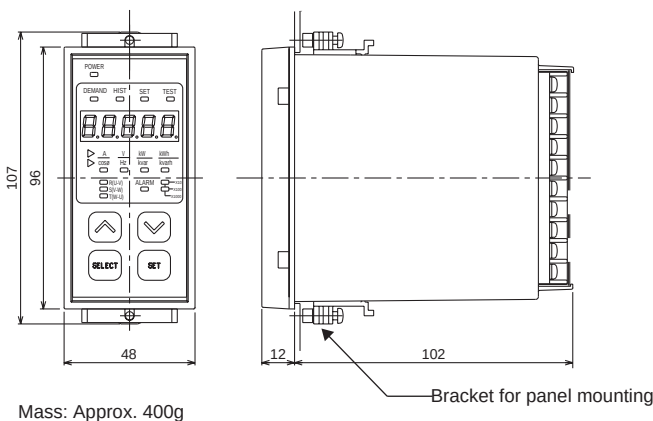


• Terminal layout

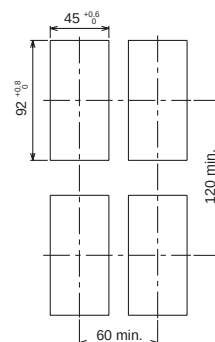


Note: Alarm output terminal ② ③ and ZCT input terminal ⑲ ⑳ of the UM03-ARA3 (without leakage current measuring function) are NC terminals. Do not connect anything to these terminals.

■ Dimensions, mm



Panel cutting



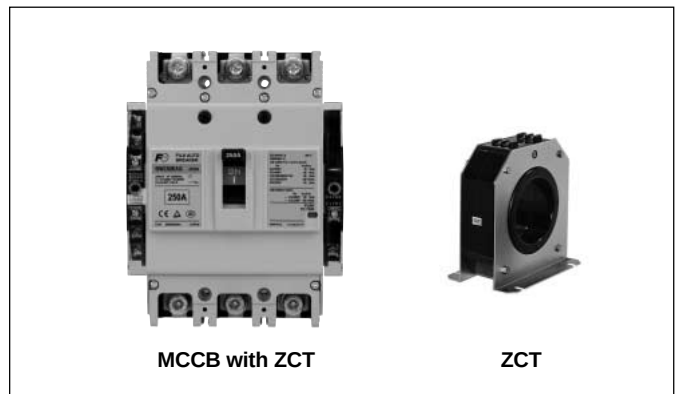
Power Monitoring Equipment

MCCB with ZCT and zero-phase CT

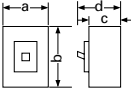
Molded case circuit breakers with ZCT

■ Description

A leakage current monitoring and breaking system can be easily constructed by combining one of the following models with a UM04 integrated power monitoring unit or a UM03-ARA3G single-circuit power monitoring unit with leakage current measurement.



■ Specifications, MCCB with ZCT for line protection

Frame (AF)			125		250		400		630		800					
Type			BW125JAZ	BW125RAZ	BW250JAZ	BW250RAZ	BW400JAZ	BW400RAZ	BW630RAZ	BW800RAZ						
Number of poles and number of elements			3P3E		3P3E		3P3E		3P3E		3P3E					
Rated insulation voltage U_i [V]			AC 690		690		690		690		690					
Rated impulse withstand voltage U_{imp} [kV]			6		6		6		6		6					
Rated current I_n [A]			15,20,30,40,50,60,75,100,125		125,150,160,175,200,225,250		250,300,350,400		500,600,630		700,800					
Reference ambient temperature: 40°C																
Rated frequency [Hz]			50-60													
Rated breaking capacity[kA]		AC 440/415/400/380V	30	50	30	50	36	50	50	50						
JISC8201-2-1 Ann2[Icu]		AC 240/230V	50	100	50	100	85	100	100	100						
Isolation complaint			Compliant													
Reverse connection			Possible													
Utilization category			Cat.A													
Dimensions [mm]					a		115		130		178		248		248	
			b		155		165		257		275		275		275	
			c		68		68		103		103		103		103	
			d		95		95		146		146		146		146	
Mass			1.5		2		6.2		9.5		10					
Connection method		Front	(screw terminals)		(screw terminals)		(flat terminals)		(flat terminals)		(flat terminals)		(flat terminals)		(flat terminals)	
Standard Internal accessories *1	Auxiliary switch		W	●	●	●	●	●	●	●	●	●	●	●	●	●
	Alarm switch		K	●	●	●	●	●	●	●	●	●	●	●	●	●
	Trip device		F	●*3	●*3	●*3	●*3	●*3	●*3	●*3	●*3	●*3	●*3	●*3	●*3	●*3
	Test terminal		T ₁ , T ₂	●	●	●	●	●	●	●	●	●	●	●	●	●
	ZCT output		Z ₁ , Z ₂	●	●	●	●	●	●	●	●	●	●	●	●	●
Certified standards	Certified standards		Specified Electrical Appliance and Material *2				Not applicable.									
	JISC8201-2-1		Self declaration													
	IEC60947-2		—													
	EN60947-2 (CE marking)		—													
Overcurrent tripping method			Thermal-magnetic													
Trip button			Provided													

● : Available

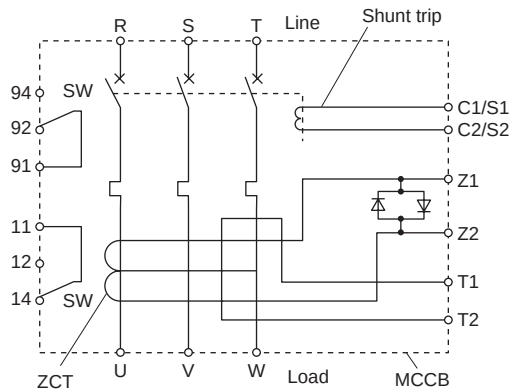
*1 The auxiliary switch, alarm switch, and tripping device are provided as accessories. Only models with terminal blocks are available. Lead wires are not provided.

*2 Not applicable for a rated current of 125A.

*3 Specify 100 to 120V AC/100 to 110V DC or 200 to 240V AC/200 to 220V DC for the voltage rating.

*4 The voltage rating is 100 to 240V AC/100 to 220V DC for all models.

Internal wiring



*S1, S2 : Shunt trip coil input terminal
*Z1, Z2 : ZCT output terminal
*T1, T2 : ZCT trip test current input terminal

EW series zero-phase current transformers (low-voltage circuit use)

Description	Type	Rated current (A)	Sensor hole diameter (mm)	Hole-through cable			Mass (kg)
				1φ2W	1φ3W, 3φ3W	3φ4W	
Round hole through-type	EW-ZB-30M05	50	30	IV 14mm ²	IV 8mm ²	IV 8mm ²	0.22
	EW-ZB-30M1	100	30	IV 60mm ²	IV 50mm ²	IV 38mm ²	0.32
	EW-ZB-58M2	200	58	IV 125mm ²	IV 100mm ²	IV 80mm ²	0.6
	EW-Z70A4	400	70	IV 400mm ²	IV 325mm ²	IV 250mm ²	1.1
	EW-Z70A6	600	70	IV 400mm ²	IV 325mm ²	IV 250mm ²	1.1
	EW-Z90	800	90	IV 500mm ²	IV 500mm ²	IV 500mm ²	3.1
	EW-Z115	1200	115	—	—	—	4.8
	EW-Z160	2000	160	—	—	—	10
Split through-type	EW-Z250	3000	250	—	—	—	28.5
	EW-ZD30	100	30	IV 60mm ²	V 50mm ²	IV 38mm ²	0.55
	EW-ZD45	200	45	IV 125mm ²	V 100mm ²	IV 80mm ²	0.89
	EW-ZD65	400	65	IV 325mm ²	V 250mm ²	IV 200mm ²	1.15

Description	Type	Rated current (A)	Sensor hole diameter (mm)	Hole-through conductor		Mass (kg)
				3φ3W	3φ4W	
With conductors, 3-pole	EW-Z3B40	400	70	5×40mm	—	2.8
	EW-Z3B50	500	70	6×40mm	—	3.1
	EW-Z3B60	600	90	6×50mm	—	7.6
	EW-Z3B80	800	90	8×50mm	—	8.8
	EW-Z3B100	1000	90	12×50mm	—	11.5
	EW-Z3B120	1200	115	10×75mm	—	15.2
	EW-Z3B160	1600	160	12×100mm	—	30.5
	EW-Z3B200	2000	160	6×100mm×2	—	30.5
With conductors, 4-pole	EW-Z3B300	3000	250	8×150mm×2	—	68.6
	EW-Z4B40	400	90	—	5×40mm	6.4
	EW-Z4B50	500	90	—	6×40mm	6.9
	EW-Z4B60	600	90	—	6×50mm	11.5
	EW-Z4B80	800	90	—	8×50mm	14.1
	EW-Z4B100	1000	115	—	12×50mm	15.5
	EW-Z4B120	1200	115	—	10×75mm	24.9
	EW-Z4B160	1600	160	—	12×100mm	36.4
	EW-Z4B200	2000	160	—	6×100mm×2	36.4
	EW-Z4B300	3000	250	—	8×150mm×2	80.3

Note : Twist the ZCT secondary wires (normally once every 50mm) and separate the wires from power line.

Power Monitoring Equipment

Current transformers

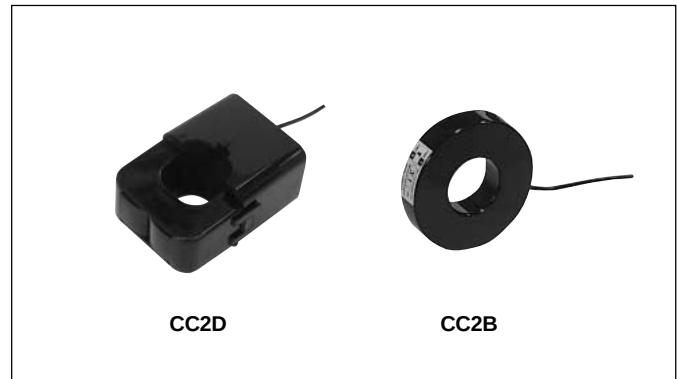
CC2

Current transformers, CC2

■ Description

Designed for even easier handling. Line-up consists of two types; models exclusively used for FUJI power monitoring unit (F-MPC 04 series), and models for general-purpose instrumentation.

- Improved design enables easier mounting.
- Large K → L display allows easier identification of primary conductor direction.
- Hook attached makes it easier to secure the primary conductor with a cable-tie.
- Clamping diode built in CT will not burn out even with the secondary circuit open (except for the CC2D81).



■ Specifications

- CTs are dedicated CTs. General-purpose CTs (secondary rated current 5A or 1A) cannot directly be connected because there is a risk of damage.

CT for F-MPC04P (type number UM02), and F-MPC04S (type number UM03)

Model	Compact split		Square split		Toroidal	
Type	CC2D81-0057	CC2D81-0506	CC2D65-2008	CC2D54-4009	CC2B65-2008	CC2B54-4009
Dimesions	Fig.1	Fig.1	Fig.2	Fig.3	Fig.4	Fig.5
Rated primary current	5A	50A	200A	400A	200A	400A
Linear output limit	Depends on the measurement range of the main unit.					
Rated secondary current	7.34mA	73.4mA	66.67mA	133.33mA	66.67mA	133.33mA
Through hole diameter	ø10		ø24	ø36	ø24	ø36
Rated frequency	50 to 60Hz		50 to 60Hz			
Overcurrent strength	10In continuous	1.0In continuous	1.0In continuous			
Ratio error	±1%/In ±1.5%/0.2In					
Phase difference	150°±90°/In, 180°±120°/0.2In		±60°/In, ±90°/0.2In			
Rated burden	0.2693mVA (5Ω load resistance)		44.4mVA (10Ω load resistance)	0.18VA (10Ω load resistance)	44.4mVA (load resistance of 10Ω or less)	177.8mVA (load resistance of 10Ω or less)
Insulation resistance	500VDC/100MΩ or more (between sensor core and output lead wire)				500VDC/100MΩ or more (between through hole and output lead wire)	500VDC/100MΩ or more (between through hole and output terminal)
Dielectric strength	2000VAC/min (between sensor core and output lead wire)				2,500VAC/min (between through hole and output lead wire)	2,500VAC/min (between through hole and output terminal)
Output protection	—		3Vp built-in clamp diode	±3Vp built-in clamp diode	—	
Operating conditions	-20 to 75°C, 80%RH or lower (No condensation)		-20 to 75°C, 80%RH or lower (No condensation)			
Split portion securing method	Clamp		Clamp		—	
Mounting method	Hanger		Hanger			
Connection	Heat-resistant IV cable 0.3mm ² x 1,000mm		Heat-resistant IV cable AWG18, 1,000mm		PVC cable 0.3mm ² x 1,000mm	M3 screw terminal
Mass	45g		200g	300g	60g	180g

■ Specifications

CT for F-MPC04 (type number UM04)

Model	Square split			Toroidal split	
Type	CC2D74-1001	CC2D74-2001	CC2D74-4001	CC2C76-8001	CC2C76-12X1
Dimesions	Fig.3			Fig.6	
Rated primary current	100A	200A	400A	800A	1,200A
Linear output limit	Depends on the measurement range of the main unit.				
Rated secondary current	1A				
Through hole diameter	ø36			ø60	
Rated frequency	50 to 60Hz				
Overcurrent strength	1.0In continuous				
Ratio error	±1%/In ±1.5%/0.2In			±1%/In ±1.5%/0.2In ±3%/0.05In	
Phase difference	90±90'/In	60±60'/In	±80'/In	±80'/In, ±100'/0.2In	
Rated burden	0.5VA (0.5Ω load resistance)				
Insulation resistance	500VDC/100MΩ or more (between sensor core and output lead wire)			500VDC/100MΩ or more (between through hole and output)	
Dielectric strength	2000VAC/min (between sensor core and output lead wire)			2500VAC/min (between through hole and output)	
Output protection	±1.4Vp with built-in clamp diode				
Operating conditions	-20 to 75°C, 80%RH or lower (No condensation)				
Split portion securing method	Clamp				
Mounting method	Hanger				
Connection	Heat-resistant IV cable AWG18, 1,000mm			Vinyl cabtire cable 0.75mm ² x 1,000mm 2-core	
Mass	300g			500g	
Combination CT-BOX	UM04X-1			UM04X-1	

Note: • To cope with extension of CT output wire, CT with connector and relay cable are available.
 • For CTs without build-in output protection diode, be sure to draw a primary current after connecting a rated load. Drawing a primary current without connecting the rated load is dangerous because high voltage appears at the output terminal.
 • CT-BOX to be used together with general-purpose CT (10 to 7500A/5A) is the UM04X-5.

Power Monitoring Equipment

Current transformers

CC2

■ Dimensions, mm

Fig1 CC2D81

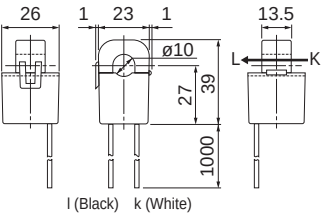


Fig2 CC2D65

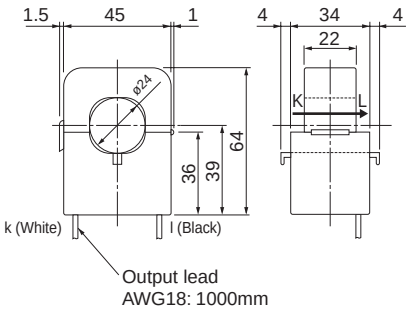


Fig3 CC2D54, CC2D74

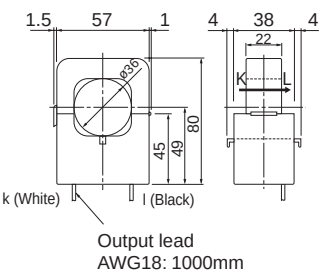


Fig4 CC2B65

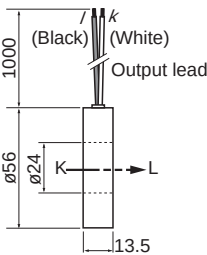


Fig5 CC2B54

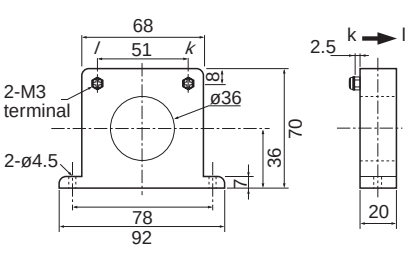
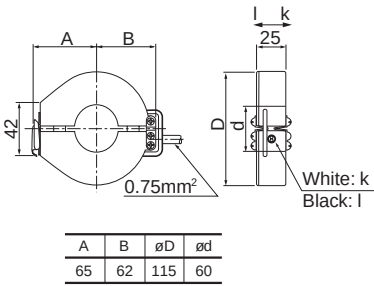


Fig6 CC2C76



Terminal relay RS16

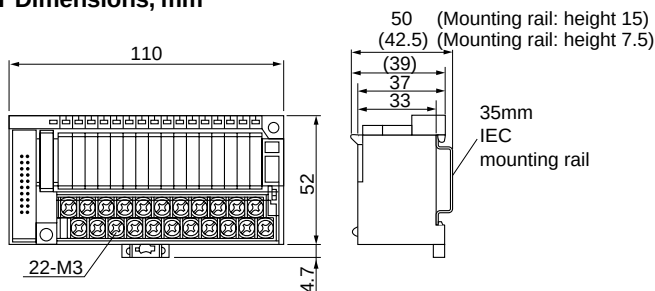
■ Description

The RS16 relay, in combination with F-MPC04 (type: UM01) power monitoring unit, outputs the current prealarm signal and leakage current pre alarm signal, and the signal to trip circuit breakers.

■ Specifications

Type	RS16-DE04H	
No. of connectable circuits	5	
Operate time	10ms or less	
Release time	10ms or less	
Vibration	Malfunctions durability	10–55Hz 1mm double amplitude (0.61N max.)
	Mechanical durability	10–55Hz 1mm double amplitude (0.61N max.) 3 times in each X, Y, Z direction, total 18 times
Shock	Malfunctions durability	100m/s ²
	Mechanical durability	200m/s ² , 2 hours in each X, Y, Z direction, total 6 hours
Operating ambient temperature		-25 to 55°C (no icing or no condensation)
Operating ambient humidity		35 to 85%RH
Terminal screw size		M3
Tightening torque		0.5–0.7N • m
Mounting		Rail mounting (screw mounting also available)
Applicable crimp terminal		R1.25–3 (Max 6mm)
Applicable wire size		Max. 1.4mm dia.
LED color	Operation indication	Red
	Power source indication	Green
Coil surge suppressor		Diode
Max. No. of rely insertion		50
Insulation resistance (initial)		100MΩ (500V DC megger)
Dielectric strength	Between contact and coil	2000V AC, 1 minute
	Between same polarity contacts	1000V AC, 1 minute
	Between reverse polarity contacts	2000V AC, 1 minute
	between heteropolar coils	500V AC, 1 minute
Mass	200g	

■ Dimensions, mm



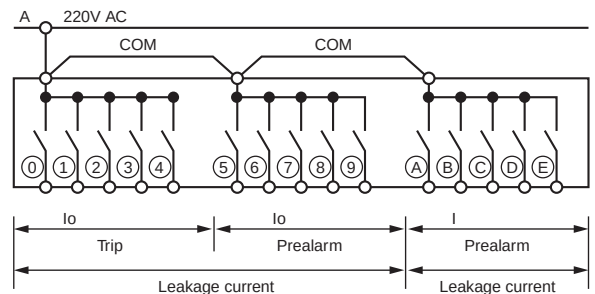
■ Connector cable

For connecting CT-BOX, Terminal relay RS16, and Connector terminal block AU-CW.

1m long	AUX014-201
2m long	AUX014-202
3m long	AUX014-203

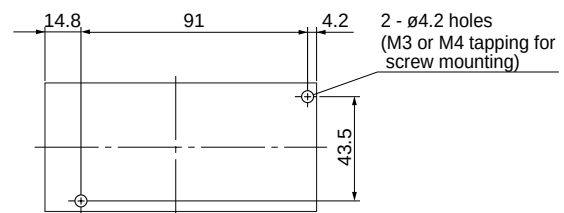


■ Terminal arrangement



3-phase 3-wire	3-phase 4-wire
① :Io trip (No.1 or 6)	Io trip (No.1 or 4)
② :Io trip (No.2 or 7)	Io trip (No.2 or 5)
③ :Io trip (No.3 or 8)	Io trip (No.3 or 6)
④ :Io trip (No.4 or 9)	Unused
⑤ :Io trip (No.5 or 0)	Unused
⑥ :Io prealarm (No.1 or 6)	Io prealarm (No.1 or 4)
⑦ :Io prealarm (No.2 or 7)	Io prealarm (No.2 or 5)
⑧ :Io prealarm (No.3 or 8)	Io prealarm (No.3 or 6)
⑨ :Io prealarm (No.4 or 9)	Unused
⑩ :Io prealarm (No.5 or 0)	Unused
A :I prealarm (No.1 or 6)	I prealarm (No.1 or 4)
B :I prealarm (No.2 or 7)	I prealarm (No.2 or 5)
C :I prealarm (No.3 or 8)	I prealarm (No.3 or 6)
D :I prealarm (No.4 or 9)	Unused
E :I prealarm (No.5 or 0)	Unused
F :Unused	Unused

Panel drilling



Power Monitoring Equipment

Connector terminal-block

AU-CW21B1

Connector terminal-block, AU-CW21B1

■ Description

The AU-CW21B connector terminal-block, in combination with the FMPC04 (type: UM04) power monitoring unit, can output a kWh pulse.

■ Specifications

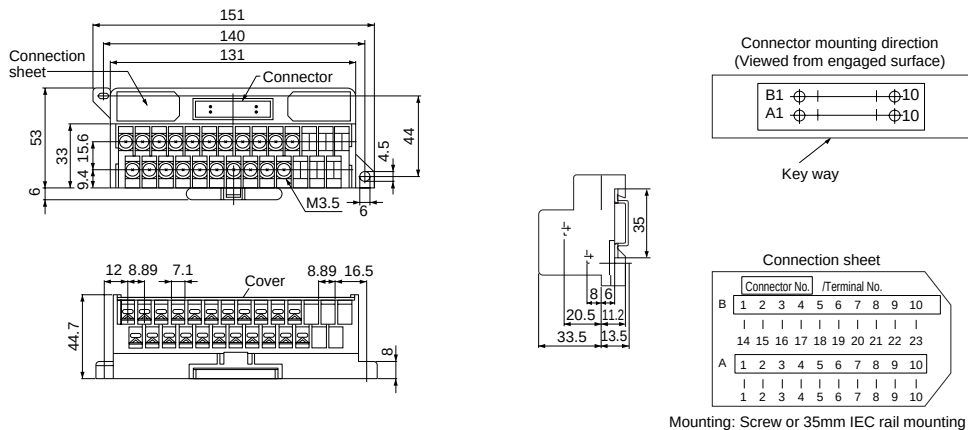
Type	Front mounting	AU-CW21B1-04
	Rear mounting	AU-CW21B1-04R
Insulation voltage		60V AC/DC
Continuous current		1A (at 40°C)
No. of terminals		21
No. of connectors		20
Terminal screw size		M3.5
Insulation resistance		100Ω or more
Dielectric strength		500V 1min
Allowable ambient temperature		−5 to +40°C
Allowable ambient humidity		45 to 85%RH
Flame resistance		UL94-V1
Connection cable	Multi-core cable	AUX014-20□ *
	Flat cable	AUX024-20□ *

Note: * Specify cable length by replacing □ with 1: 1m, 2: 2m, or 3: 3m.

■ Terminal arrangement and output

Terminal No.		Pulse output circuit No.	Remarks
	23	Circuit 1 pulse output	Circuit 1 to 6 pulse outputs are valid in 3-phase 4-wire system.
	22	Circuit 2 pulse output	
	21	Circuit 3 pulse output	
	20	Circuit 4 pulse output	
	19	Circuit 5 pulse output	
	18	Circuit 6 pulse output	
	17	Circuit 7 pulse output	
	16	Circuit 8 pulse output	
	10	Circuit 9 pulse output	
	9	Circuit 10 pulse output	
15, 2		Common (−)	

■ Dimensions, mm



■ Ordering information

Specify the following:
1. Type number

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- Follow the regulations of industrial wastes when the product is to be discarded.
- The products covered in this catalog have not been designed or manufactured for use in equipment or systems which, in the event of failure, can lead to loss of human life.
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03 Industrial Relays, Industrial Control Relays
Annunciator Relay Unit, Time Delay Relays

04 Pushbuttons, Selector Switches, Pilot Lights
Rotary Switches, Cam Type Selector Switches
Panel Switches, Terminal Blocks, Testing Terminals

05 Limit Switches, Proximity Switches
Photoelectric Switches

06 Molded Case Circuit Breakers
Air Circuit Breakers

07 Earth Leakage Circuit Breakers
Earth Leakage Protective Relays

08 Circuit Protectors
Low Voltage Current-Limiting Fuses

09 Measuring Instruments, Arresters, Transducers
Power Factor Controllers
Power Monitoring Equipment (F-MPC)

10 AC Power Regulators
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Control Power Transformers

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Air Load Break Switches
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12 Vacuum Circuit Breakers, Vacuum Magnetic Contactors
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