Ground Fault Relay
K6EL

Economical, Compact, High-performance, DIN 48 × 48-mm Ground Fault Relay for Low Voltages

- Performs continuous monitoring and detection of ground faults in low-voltage circuits due to the deterioration of insulation in electrical devices.
- Higher reliability ensured with improved resistance to high-frequency noise when used for inverter loads.
- Remote monitoring of cubicles is possible with automatic-reset models.
- Ground Fault Relays and through-type ZCTs (zero-phase current transformers) are mutually compatible.
- The through-type ZCTs are equipped with test terminals, allowing operation tests for Ground Fault Relays to be performed with ease.
- Series now includes K6EL-R50, which operates at 50 mA ±10%.

Model Number Structure

■ Model Number Legend

K6EL-□□
1 2 3

1. **Ground Fault Relay**
2. **Operating Time and Reset Method**
   None: 0.1 s manual reset
   A: 0.3/0.8 s (switchable) manual reset
   R: 0.5 s automatic reset
3. **Sensed Current**
   30: 30 mA (fixed)
   50: 50 mA/150 mA (switchable)
   100: 100 mA/200 mA (switchable)
   200: 200 mA/500 mA (switchable)
   500: 500 mA/1,000 mA (switchable)

Ordering Information

■ List of Models

Manual-reset Ground Fault Relays

Type	Operating time	Type / Sensed current	High-sensitivity models	Medium-sensitivity models		
			30 mA (fixed)	100 mA/200 mA (switchable)	200 mA/500 mA (switchable)	500 mA/1,000 mA (switchable)
High-speed models	Less than 0.1 s		K6EL-30	K6EL-100	K6EL-200	K6EL-500
Delayed models	0.3/0.8 s (switchable)		---	K6EL-A100	K6EL-A200	K6EL-A500

Automatic-reset Ground Fault Relays

Type	Operating time	Type / Sensed current	High-sensitivity models	Medium-sensitivity models
			50 mA/150 mA (switchable)	500 mA/1,000 mA (switchable)
Delayed models	Less than 0.5 s		---	K6EL-R500
			K6EL-R50 (See note.)	---

Note: Operating Error
50-mA tap: ±10%
150-mA tap: ±20%

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ZCTs (Zero-phase Current Transformers)

Type / Rated current / Sensed current	Indoor through-type models		Indoor separate-type models	
	Model	Diameter of through-hole	Model	Diameter of through-hole
50 A	OTG-L21	21 mm	---	---
100 A	OTG-L30	30 mm	---	22 mm
200 A	OTG-L42	42 mm	OTG-CN52	52 mm
400 A	OTG-L68	68 mm	OTG-CN77	77 mm
600 A	OTG-L82	82 mm	OTG-CN112	112 mm
1,000 A	OTG-L156	156 mm	---	---

■ Ground Fault Relay and ZCT Combinations

(OK: Compatible)

ZCT / Ground Fault Relay	K6EL-30 K6EL-R50	K6EL-100, -200, -500, -R500 K6EL-A100, -A200, -A500
OTG-L21 (50 A)	OK	OK
OTG-L30 (100 A)	OK	OK
OTG-L42 (200 A)	OK	OK
OTG-L68 (400 A)	---	OK
OTG-L82 (600 A)	---	OK
OTG-L156 (1,000 A)	---	OK
OTG-CN52 (200 A)	---	OK
OTG-CN77 (400 A)	---	OK
OTG-CN112 (600 A)	---	OK

Note: **1.** "OK" indicates groupings that can be combined freely.
2. Combinations with the OTG-LA□□ are also possible.

■ Options

Flush Mounting Adapters

Model
Y92F-30
Y92F-71

Front Cover

Model
Y92A-48B (Hard Cover)
Y92A-48D(Soft Cover)

Specifications

■ Ground Fault Relay Ratings

Item / Type		High-speed models		Delayed models	Delayed high-sensitivity models
Control power supply		100/110 VAC or 200/220 VAC, 50/60 Hz (same for all) (See note 1.)			100 VAC
Rated current		Depends on the ZCT			
Sensed current		50% to 100% of the rated sensed current (50 mA ±10%, 150 mA ±20%) (See note 2.)			
Non-operating current		0% to 50% of the rated sensed current			
Rated short-time current		2,500 A			
Ground fault indication method		LED (red)			
Test method		Relay operation confirmed using a test button. (Independent of ZCT connection.)			
Reset method	**Manual**	Either press the reset button or turn the control power supply OFF and ON again.			
	Automatic	Automatically resets when the ground fault is cleared.			
Built-in contacts	**Contact form**	SPDT+SPST-NO			SPDT
	Carrying current	5 A			3 A
	Rated load		cosϕ = 1	cosϕ = 0.4 (L/R = 7 ms)	cosϕ = 1
		240 VAC	5 A	2 A	220 VAC, 3 A
		110 VDC	0.3 A	0.2 A	
		30 VDC	5 A	3 A	
Power (VA) consumption		3 VA max.			
Weight		Approx. 110 g			

Note: **1.** The K6EL-R50 requires a 100-VAC control power supply.
2. Only the K6EL-R50 can be switched between 50 mA ±10% and 150 mA ±20%.

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■ Ground Fault Relay Characteristics

Item / Type	High-speed models	Delayed models	Delayed high-sensitivity models
Operating time	Less than 0.1 s	0.3 s/0.8 s (switchable)	Less than 0.5 s
Inertial non-operating time	---	0.1 s when set to 0.3 s 0.5 s when set to 0.8 s	
Control power supply range	80% to 110% of the control power supply voltage		
Operating temperature range	–10 to 55 °C (with no icing)		
Operating humidity range	45% to 85% (with no condensation)		
Insulation resistance	5 MΩ min. at 500 VDC (between charged parts and the mounting panel)		
Dielectric strength	1,500 VAC, 50/60 Hz for 1 min (between charged parts and the mounting panel)		
Lightning impulse dielectric strength	1.2/50 μs, 7,000 V (between control power supply terminals)		
Lightning impulse operation failure	1.2/50 μs, 7,000 V (primary side of ZCT)		
Vibration resistance	Destruction: 16.7 Hz, 4-mm double amplitude for 1 min		
Shock resistance	98 m/s^2		

Note: The range for an operating time of 0.3 s is 0.15 to 0.45 s and the range for an operating time of 0.8 s is 0.6 to 1.2 s.

■ ZCT (Zero-phase Current Transformer)

Item / Structure	Indoor through-type models						Indoor separate-type models		
Model	**OTG-L21**	**OTG-L30**	**OTG-L42**	**OTG-L68**	**OTG-L82**	**OTG-L156**	**OTG-CN52**	**OTG-CN77**	**OTG-CN112**
Rated current	50 A	100 A	200 A	400 A	600 A	1,000 A	200 A	400 A	600 A
Diameter of through-hole	21 mm	30 mm	42 mm	68 mm	82 mm	156 mm	52 mm	77 mm	112 mm
Rated voltage	600 VAC max., 50/60 Hz, single-phase/three-phase								
Output terminal polarity	None (The ZCT's output terminals k and l can be connected to either input terminals 3 or 4 of the Relay.) (See note.)								
Insulation resistance	100 MΩ min. (between charged metal parts and ground)								
Dielectric strength	2,200 VAC, 50/60 Hz for 1 min (between charged metal parts and ground)								
Ambient operating temperature	–10 to 60 °C (with no icing)								
Weight	Approx. 90 g	Approx. 130 g	Approx. 230 g	Approx. 480 g	Approx. 700 g	Approx. 6.6 kg	Approx. 1.3 kg	Approx. 2.5 kg	Approx. 3.5 kg

Note: Do not connect ZCT output terminals k and l to ground. Doing so may result in damage to the Relay.

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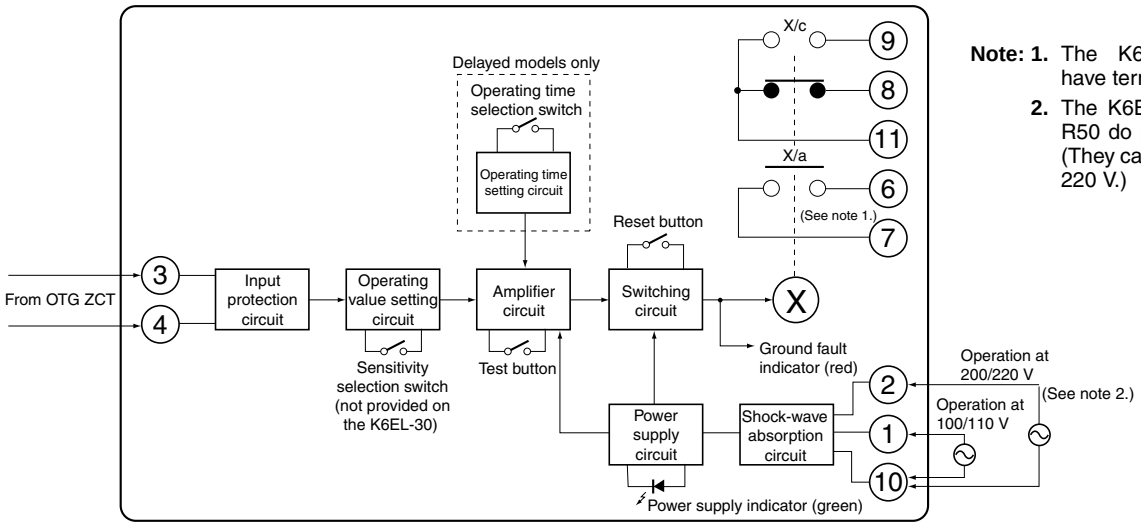
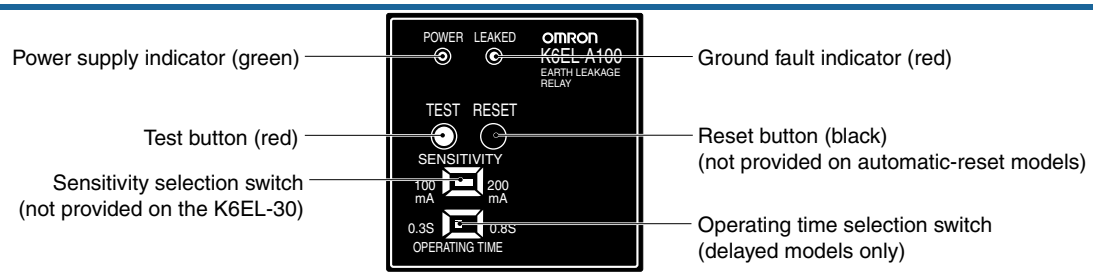
Internal Block Diagram



Note: 1. The K6EL-R50 does not have terminals 6 and 7.

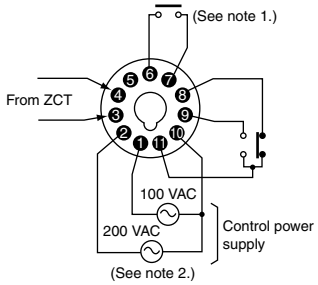
2. The K6EL-R500 and K6EL-R50 do not have terminal 2. (They cannot be used at 200/220 V.)

Nomenclature

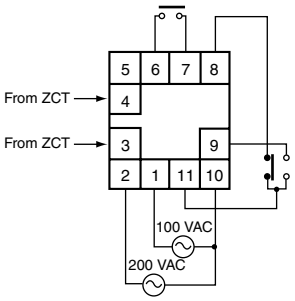


Connections

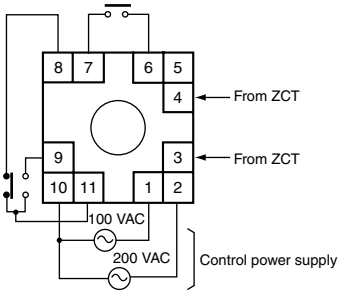
Ground Fault Relay (from Pin Side)



Ground Fault Relay with P3GA-11 (from Terminal Side)



Ground Fault Relay with P2CF-11 (from Terminal Side)



Note: 1. The K6EL-R50 does not have terminals 6 and 7.

2. The K6EL-R500 and K6EL-R50 do not have terminal 2. (They cannot be used at 200/220 V.)

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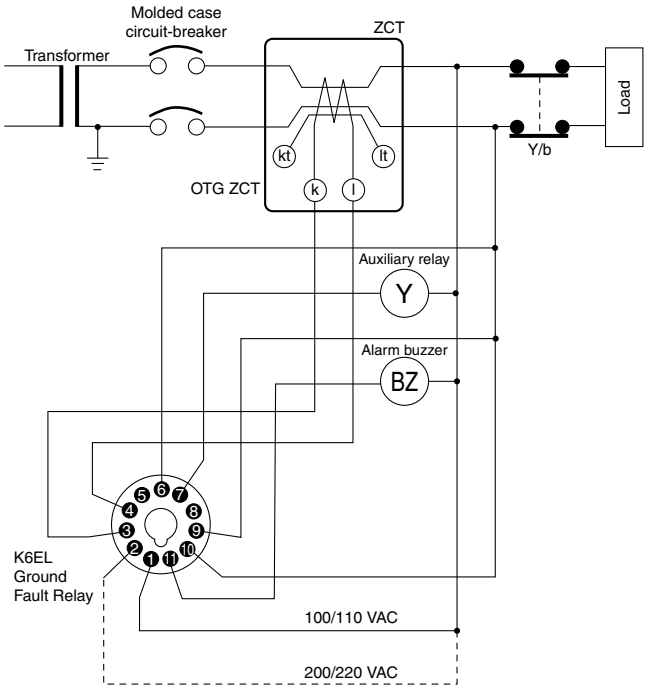
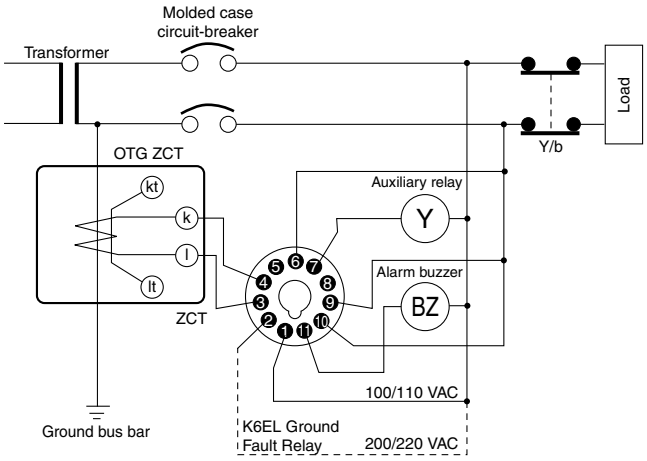
Connection Examples

Installation on the Electrical Path



Installation on a Ground Bus Bar



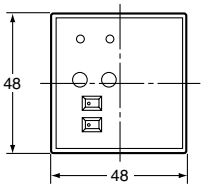
Do not, under any circumstances, connect the k and l lines to ground.

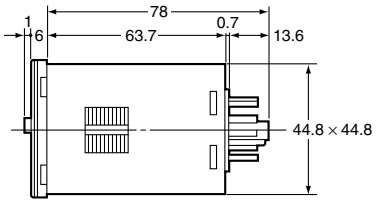
Note: When not using the kt and lt terminals (test terminals), leave them unconnected. The Relay may not be able to attain its performance characteristics if used with the kt and lt terminals connected.

Dimensions

Note: All units are in millimeters unless otherwise indicated.

Ground Fault Relay





Applicable Connecting Sockets
P2CF-11 Front Connecting Socket
P3GA-11 Back Connecting Socket
PL11 Back Connecting Socket

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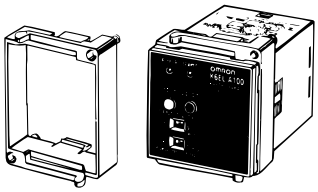
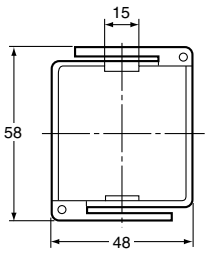
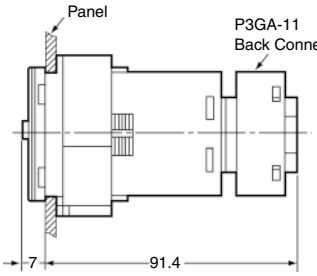
Dimensions with Adapter Mounted

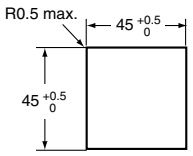
Y92F-30 Flush Mounting Adapter (Sold Separately)





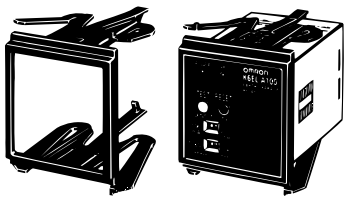


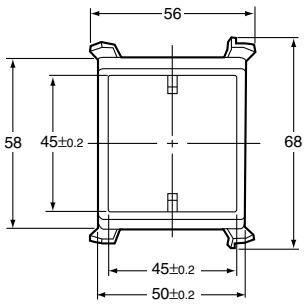
Mounting Hole Cutout Dimensions

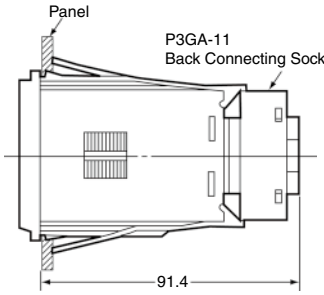


Note: Recommended panel thickness: 1 to 3.2 mm.

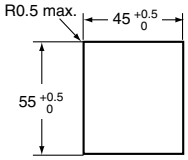
Y92F-71 Flush Mounting Adapter (Sold Separately)





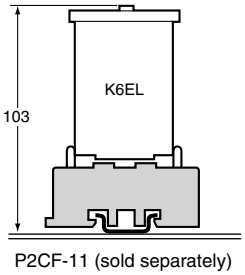


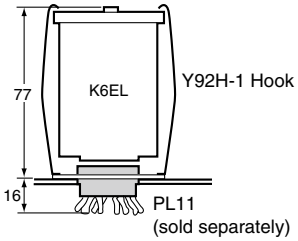
Mounting Hole Cutout Dimensions

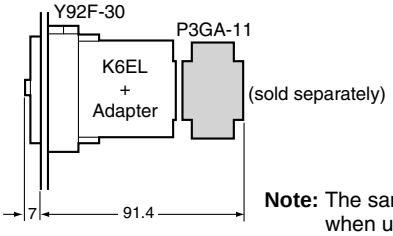


Note: Recommended panel thickness: 1 to 3.2 mm.

Dimensions for Socket Mounting



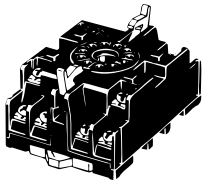


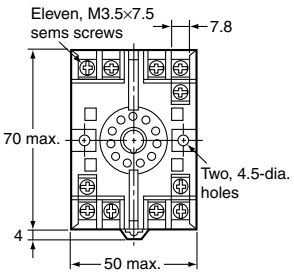


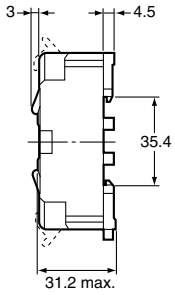
Note: The same dimensions apply when using the Y92F-71 Adapter.

Connecting Sockets

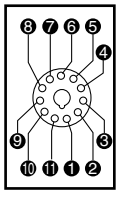
P2CF-11 Front Connecting Socket



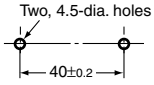




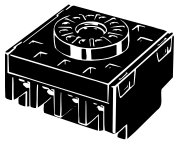
Terminal Arrangement (Top View)

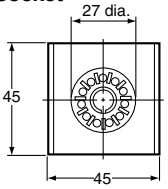


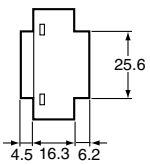
Mounting Holes



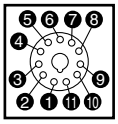
P3GA-11 Back Connecting Socket







Terminal Arrangement (Top View)



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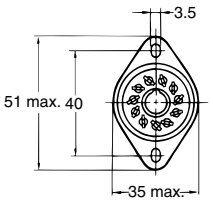
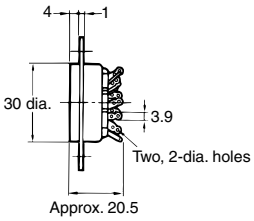
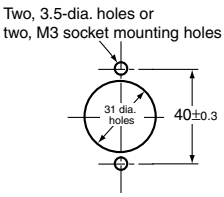
PL11 Back Connecting Socket





Terminal Arrangement (Bottom View)

Mounting Holes

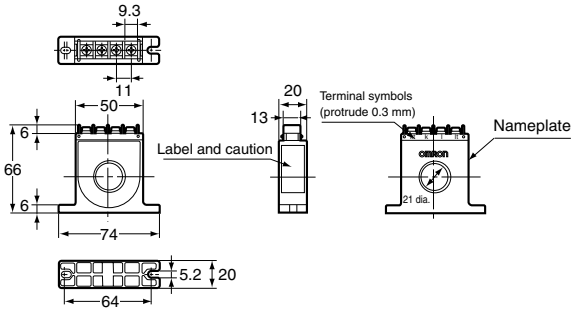


Front Cover

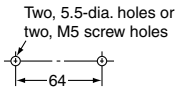
Model
Y92A-48B (Hard Cover)
Y92A-48D (Soft Cover)

ZCT

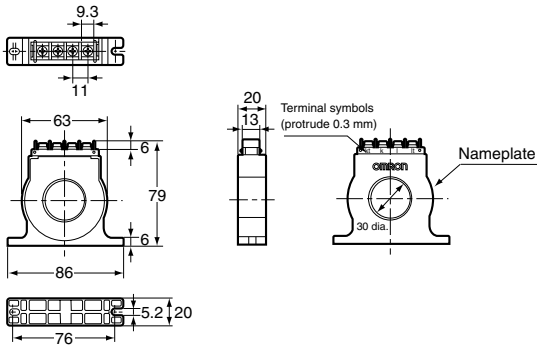
Indoor Through-type Models
OTG-L21 (50 A)



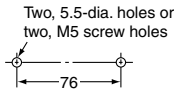
Mounting Hole Cutout Dimensions



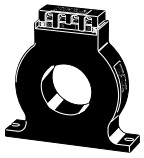
OTG-L30 (100 A)

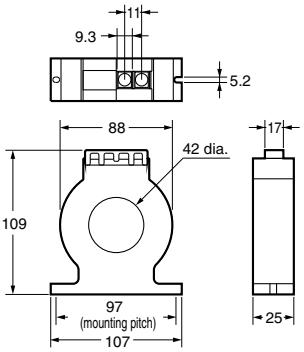


Mounting Hole Cutout Dimensions

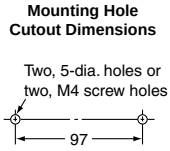


OTG-L42 (200 A)

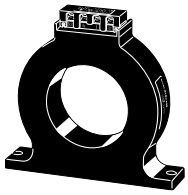


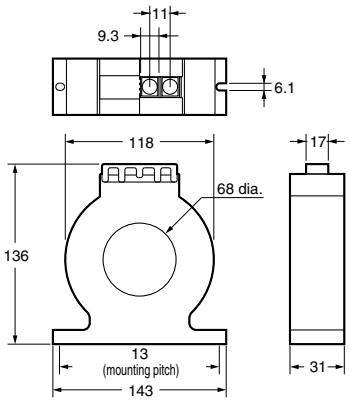


Mounting Hole Cutout Dimensions

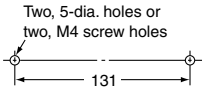


OTG-L68 (400 A)





Mounting Hole Cutout Dimensions



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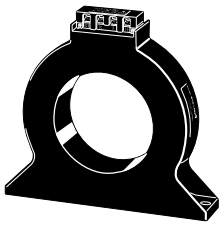
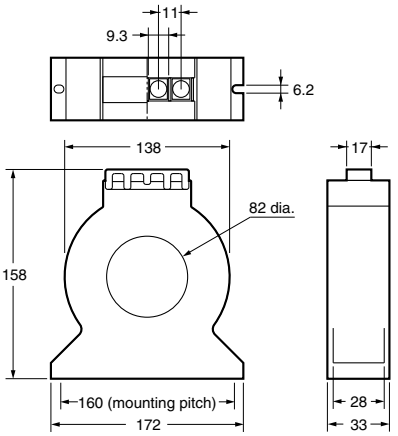
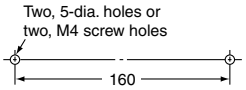
OTG-L82 (600 A)

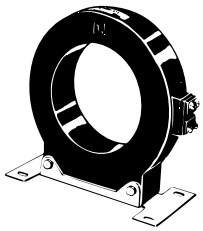


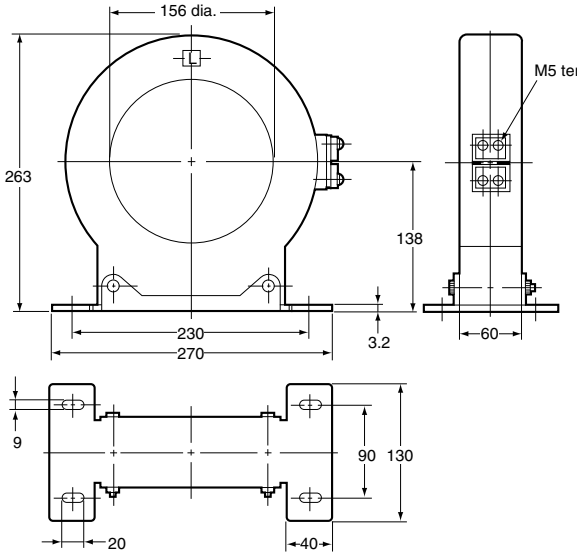


Mounting Hole Cutout Dimensions

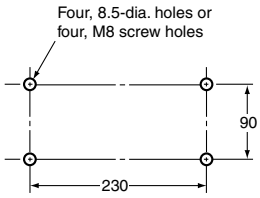


OTG-L156 (1,000 A)

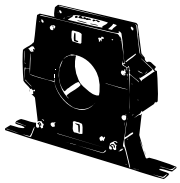


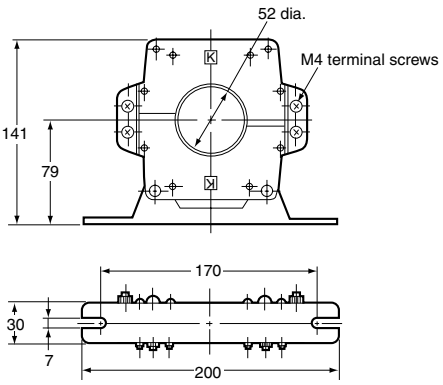


Mounting Hole Cutout Dimensions

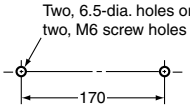


Indoor Separate-type Models
OTG-CN52 (200 A)





Mounting Hole Cutout Dimensions



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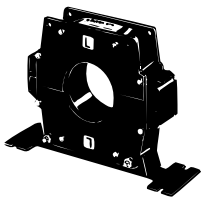
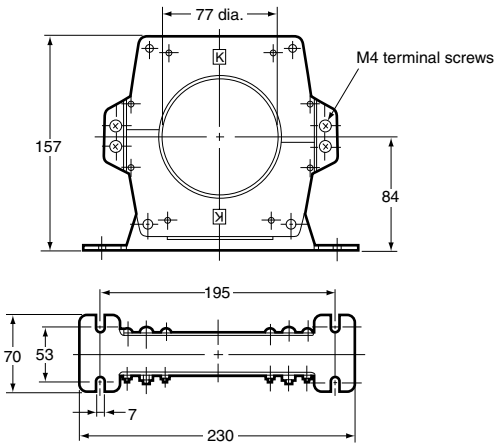
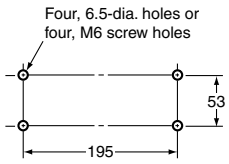
OTG-CN77 (400 A)

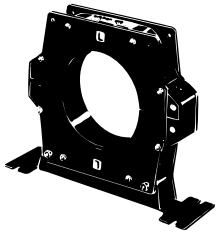


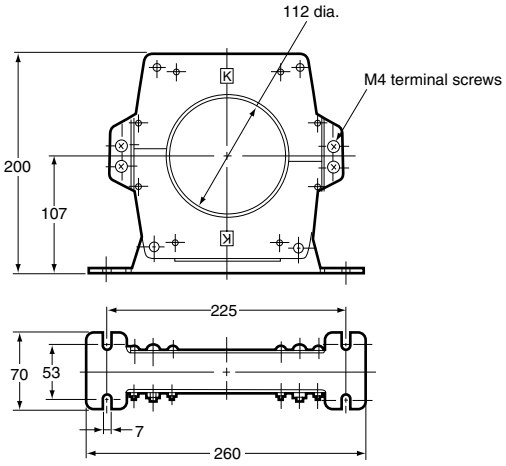


Mounting Hole Cutout Dimensions

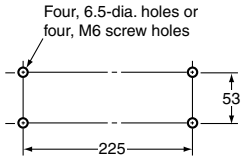


OTG-CN112 (600 A)





Mounting Hole Cutout Dimensions



■ Maximum Wire Sizes for ZCTs

Model	Rated current	Wire/cable Through-hole diameter	600-V vinyl-insulated wire (IV) 2-wire	600-V vinyl-insulated wire (IV) 3-wire	Cable (VVR) 2-wire	Cable (VVR) 3-wire
OTG-L21	50 A	21 dia.	22 mm^2	14 mm^2	8 mm^2	5.5 mm^2
OTG-L30	100 A	30 dia.	60 mm^2	38 mm^2	38 mm^2	38 mm^2
OTG-L42	200 A	42 dia.	100 mm^2	100 mm^2	100 mm^2	60 mm^2
OTG-L68	400 A	68 dia.	400 mm^2	325 mm^2	325 mm^2	250 mm^2
OTG-L82	600 A	82 dia.	500 mm^2	500 mm^2	400 mm^2	400 mm^2
OTG-L156	1,000 A	156 dia.	500 mm^2	500 mm^2	1,000 mm^2	1,000 mm^2
OTG-CN52	200 A	52 dia.	200 mm^2	200 mm^2	150 mm^2	100 mm^2
OTG-CN77	400 A	77 dia.	500 mm^2	400 mm^2	400 mm^2	325 mm^2
OTG-CN112	600 A	112 dia.	500 mm^2	500 mm^2	1,000 mm^2	1,000 mm^2

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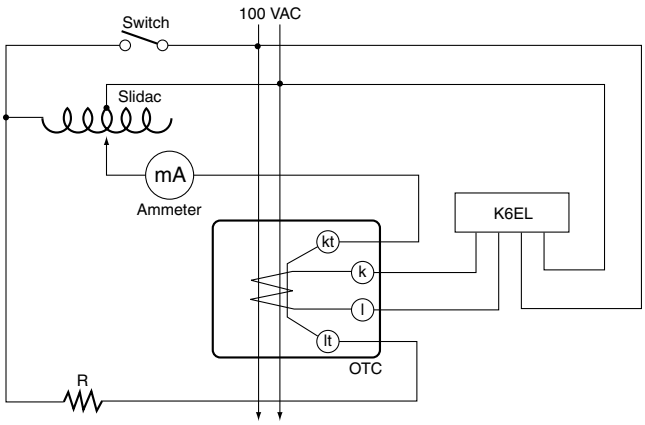
Test Circuit



Select the resistance R shown in the test circuit diagram according to the K6EL's rated sensed current. Change the current using the slidac and ascertain the K6EL's operating value each time by reading the ammeter.

For example, R could take the values shown below:
30 mA: 3.3 kΩ, 6 W
100 mA: 1 kΩ, 20 W
200 mA: 500 Ω, 50 W
500 mA: 200 Ω, 100 W
1,000 mA: 100 Ω, 200 W

Safety Precautions

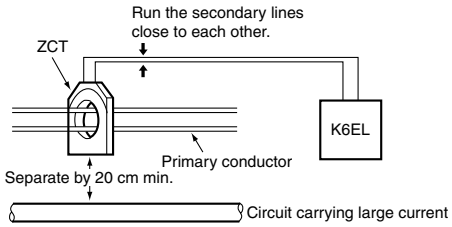
■ Correct Use

Installation and Wiring

- Do not, under any circumstances, connect the ZCT's output terminals k and l to ground. Doing so may result in damage to the Relay's internal circuits.
- Pass the primary conductor through the ZCT once.
- The Relay detects ground faults in internal wiring of devices due to insulation deterioration and so install the ZCT as close to the power supply side as possible.

ZCT Installation

- Install the ZCT at an outdoor cable inlet or on a ground bus bar at a location allowing easy inspection.
- When installing on the electrical path, use a ZCT with a value greater than the electrical path's rated current.
- If the secondary lines run in parallel to a circuit carrying a large current, either separate the lines as far as possible or use a shield line.



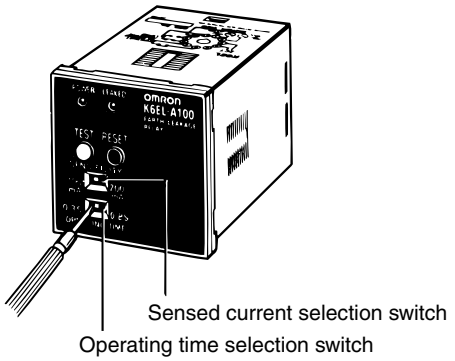
- When installing a separate-type ZCT with current flowing along the primary conductors, short the secondary terminals using clips or some other method.

Switching the Sensed Current

1. With the K6EL-□100, 200, 500, R50, and R500, the sensed current can be switched using a flat-bladed screwdriver.
2. The sensed current for the K6EL-30 is fixed and hence cannot be switched.

Switching the Operating Time

1. With the K6EL-A100, A200, and A500, the operating time can be switched using a flat-bladed screwdriver.
2. The operating time for the K6EL-30, 100, 200, 500, R50, and R500 is fixed and hence cannot be switched.



Testing

- If the ground fault indicator (red) lights when the Relay's test button is pressed, it means that the internal circuits are operating normally.
- To make an overall test, run a simulated ground fault current.

Resetting

- Once manual-reset models operate, they continue to operate until they are reset. Reset them either by pressing the reset button (black) or by turning the control power supply OFF and ON again.
- Automatic-reset models reset automatically when the ground fault is cleared (i.e., the current drops below the sensed current).

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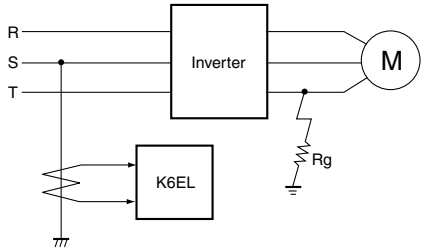
Q&A

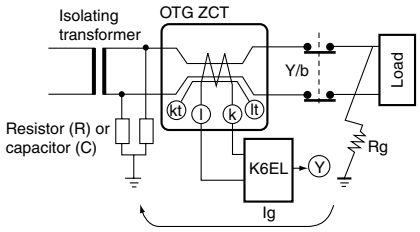
Q: How does the K6EL operate when used for inverter loads (e.g., inverter motors and inverter air conditioners)?

A: The influence of high-frequency noise generated by the inverter has been reduced by combining a special ground fault relay IC and a capacitor for cutting out high-frequencies. The possibility of malfunctions due to the influence of the inverter is much less than with the existing ESA Ground Fault Relay.



Q: What connection method should be used for ungrounded electrical paths?

A: With ungrounded electrical paths, connect the capacitor or resistor for detection in the way shown in the diagram. The table shows the formulas for calculating the resistance or capacitance as well as the formulas for calculating ground currents for complete ground faults. (Depending on the location, the allowable ground fault current may be restricted. In this case, use values of R and C that do not exceed the restrictions.)

	Connection method	Formula for resistor or capacitor		Formula for ground current	Formula for safety ground fault
Single-phase electrical path		Resistor: $R=\frac{V}{2It}(\Omega)$ $P=\frac{5V^2}{R}(W)$	It: Ground Fault Relay's set value V: Line voltage f: Frequency P: Allowable power for the resistor used (A tolerance is included in the formulas on the left.)	$Ig=\frac{V}{2Rg+R}(A)$	$Ig=\frac{V}{R}(A)$
		Capacitor: $C=\frac{2It}{2\pi fV}(F)$ Dielectric strength > 2 V (V)		$Ig=\frac{V}{\sqrt{(2Rg)^2+(\frac{1}{2\pi fC})^2}}(A)$	$Ig = 2\pi fCV (A)$

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

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