

# 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	High-sensitivity models	Medium-sensitivity models		
Type	Operating time	Sensed current	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	High-sensitivity models	Medium-sensitivity models
Type	Operating time	Sensed current	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%

## ZCTs (Zero-phase Current Transformers)

Rated current	Type	Indoor through-type models		Indoor separate-type models	
	Sensed current	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  $\pm$ 10% and 150 mA  $\pm$ 20%.

## ■ 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 M $\Omega$ 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 $\mu$ s, 7,000 V (between control power supply terminals)		
Lightning impulse operation failure		1.2/50 $\mu$ s, 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 <sup>2</sup>		

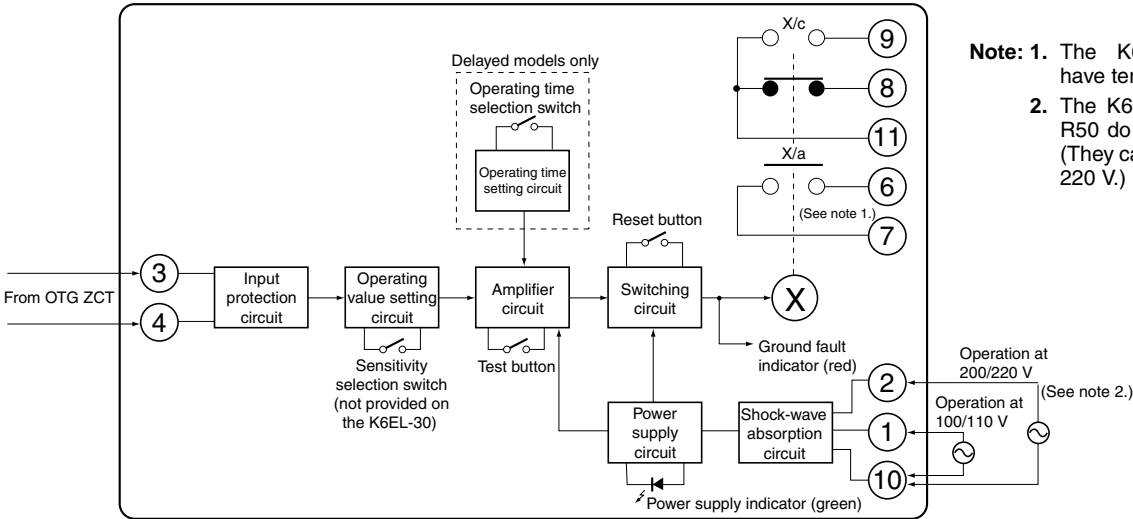
**Note:** The range for an operating time of 0.3 s is 0.15 to 0.45 s and the range for an operating time of 0.8 s is 0.6 to 1.2 s.

## ■ ZCT (Zero-phase Current Transformer)

Item	Structure Model	Indoor through-type models					Indoor separate-type models		
		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 M $\Omega$ 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 3.5 kg

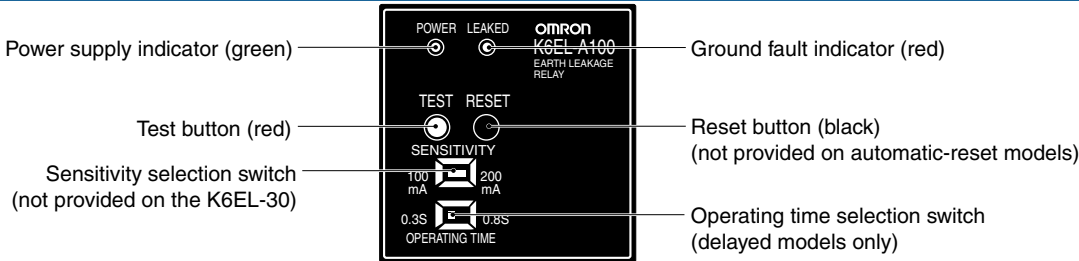
**Note:** Do not connect ZCT output terminals k and l to ground. Doing so may result in damage to the Relay.

# Internal Block Diagram



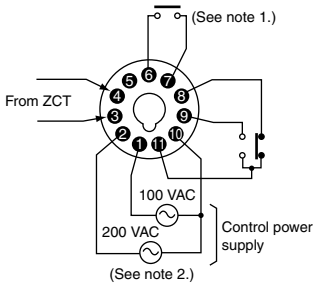
- Note:** 1. The K6EL-R50 does not have terminals 6 and 7.  
2. The K6EL-R500 and K6EL-R50 do not have terminal 2. (They cannot be used at 200/220 V.)

# Nomenclature

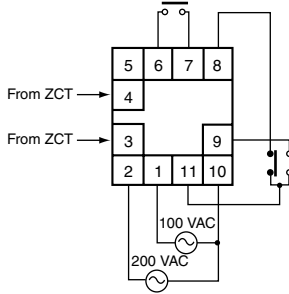


# Connections

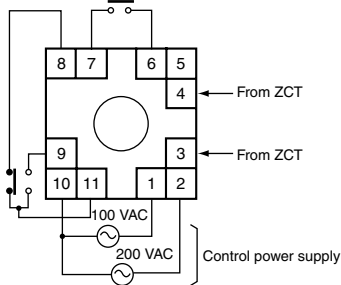
**Ground Fault Relay (from Pin Side)**



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



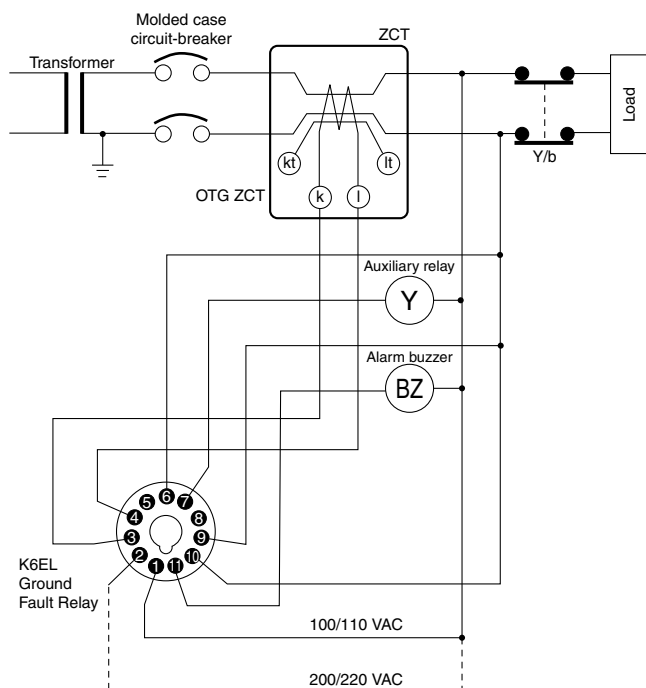
**Ground Fault Relay with P2CF-11 (from Terminal Side)**



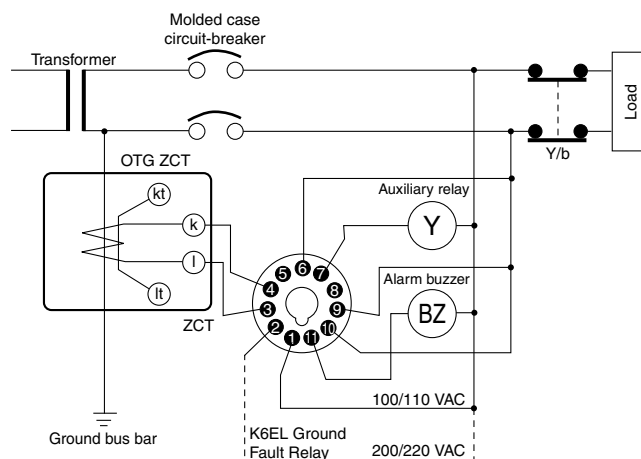
- Note:** 1. The K6EL-R50 does not have terminals 6 and 7.  
2. The K6EL-R500 and K6EL-R50 do not have terminal 2. (They cannot be used at 200/220 V.)

## Connection Examples

### Installation on the Electrical Path



### Installation on a Ground Bus Bar



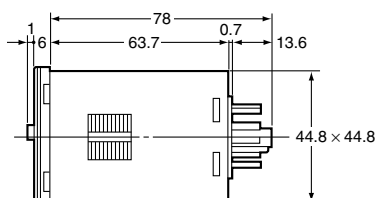
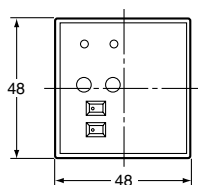
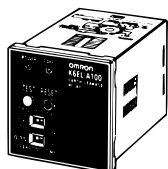
**Do not, under any circumstances, connect the k and l lines to ground.**

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

## Dimensions

**Note:** All units are in millimeters unless otherwise indicated.

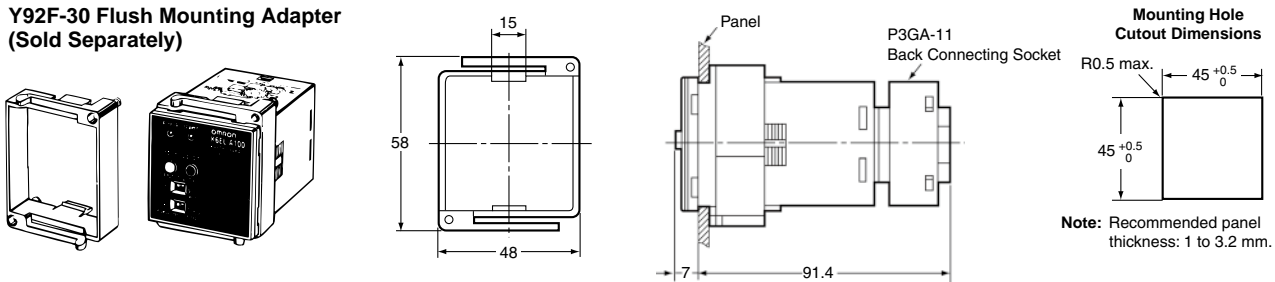
### Ground Fault Relay



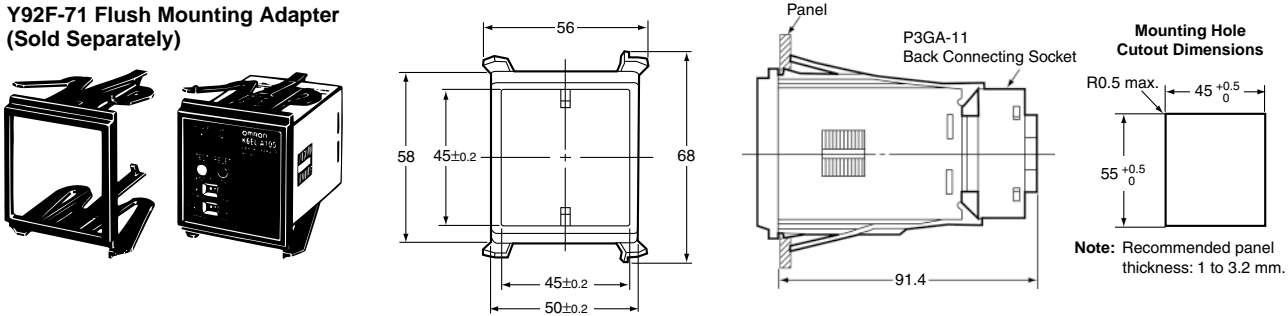
**Applicable Connecting Sockets**  
P2CF-11 Front Connecting Socket  
P3GA-11 Back Connecting Socket  
PL11 Back Connecting Socket

# Dimensions with Adapter Mounted

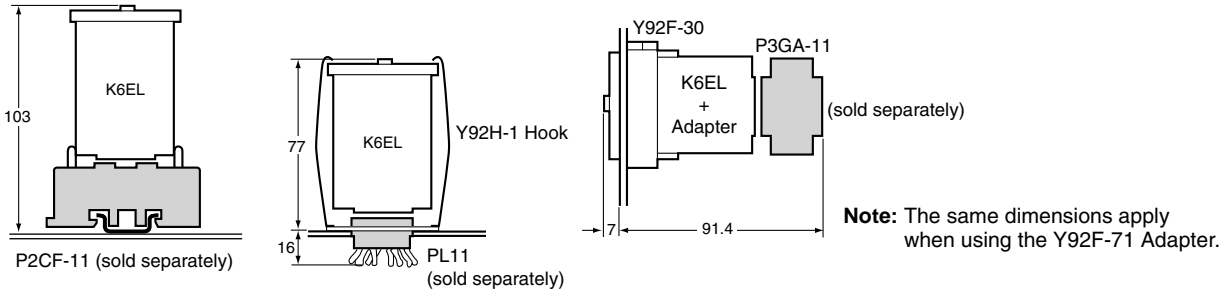
## Y92F-30 Flush Mounting Adapter (Sold Separately)



## Y92F-71 Flush Mounting Adapter (Sold Separately)

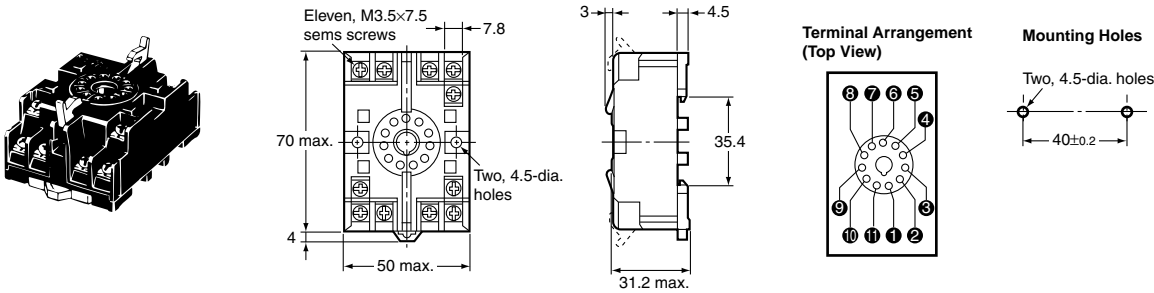


# Dimensions for Socket Mounting

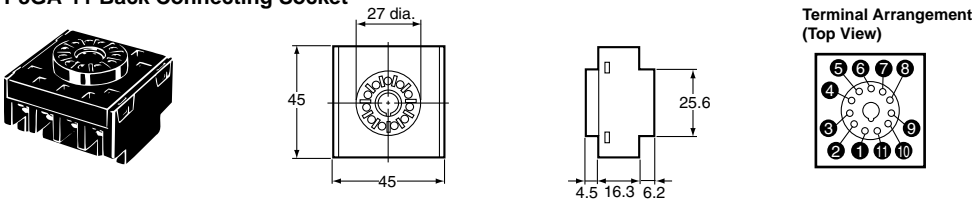


# Connecting Sockets

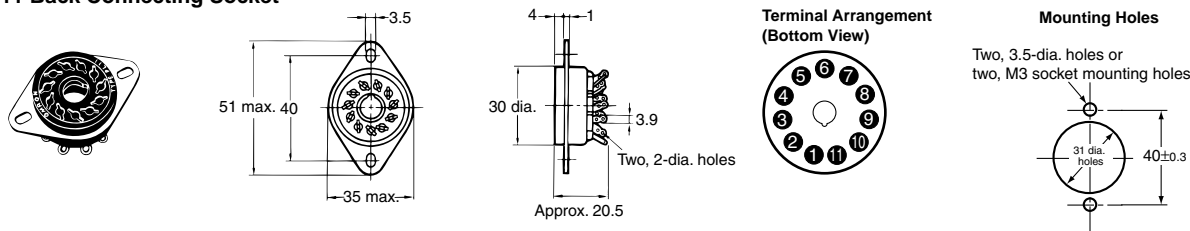
## P2CF-11 Front Connecting Socket



## P3GA-11 Back Connecting Socket



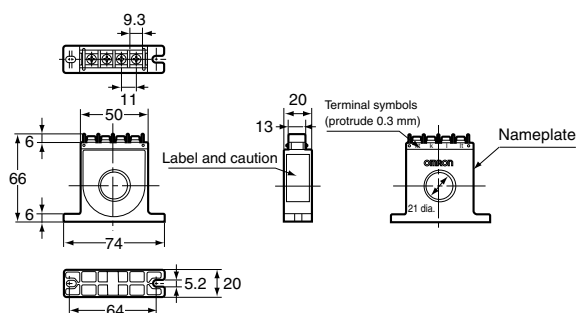
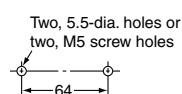
## PL11 Back Connecting Socket



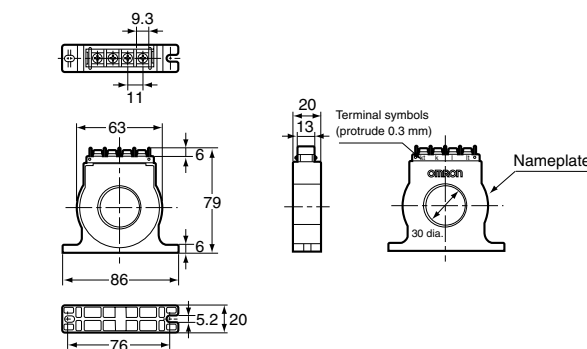
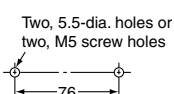
## Front Cover

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

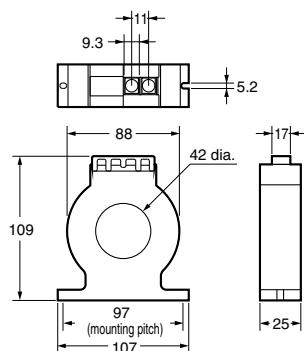
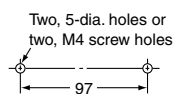
## ZCT

Indoor Through-type Models  
OTG-L21 (50 A)Mounting Hole  
Cutout Dimensions

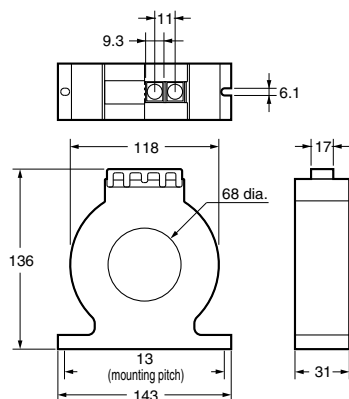
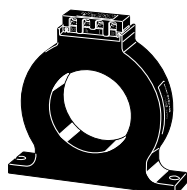
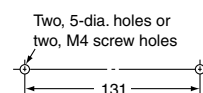
## OTG-L30 (100 A)

Mounting Hole  
Cutout Dimensions

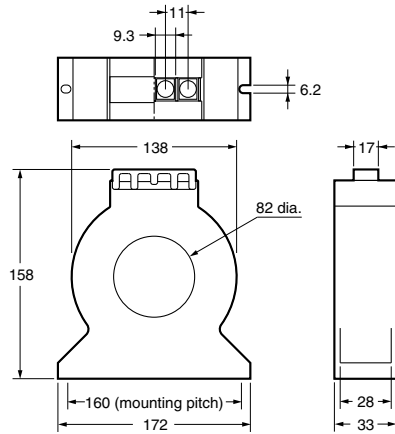
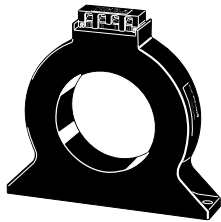
## OTG-L42 (200 A)

Mounting Hole  
Cutout Dimensions

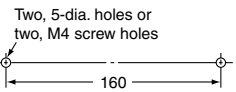
## OTG-L68 (400 A)

Mounting Hole  
Cutout Dimensions

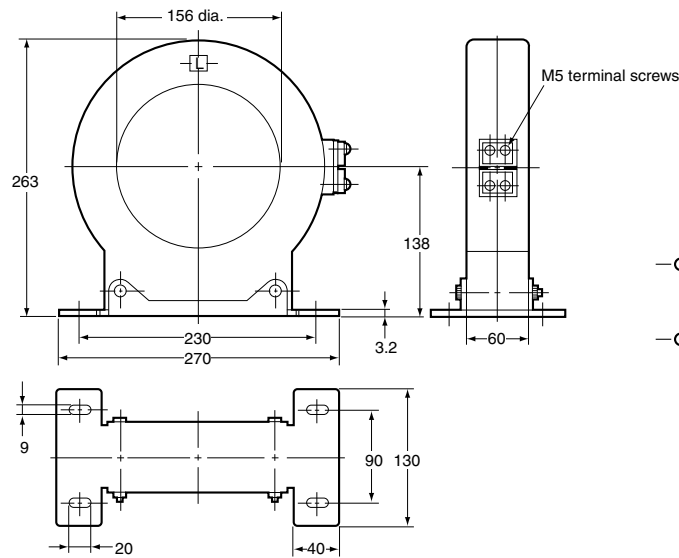
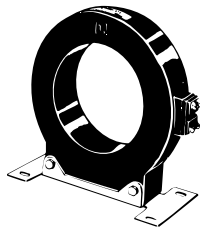
OTG-L82 (600 A)



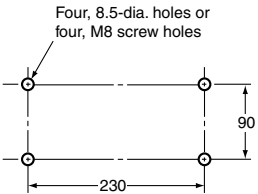
Mounting Hole  
Cutout Dimensions



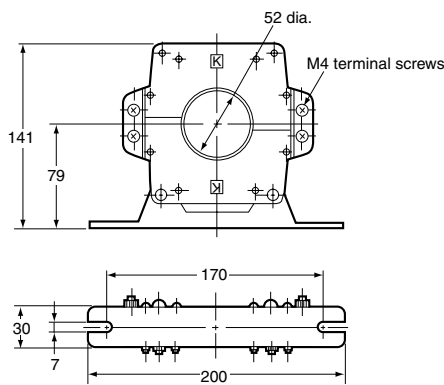
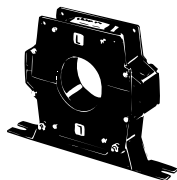
OTG-L156 (1,000 A)



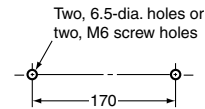
Mounting Hole  
Cutout Dimensions



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

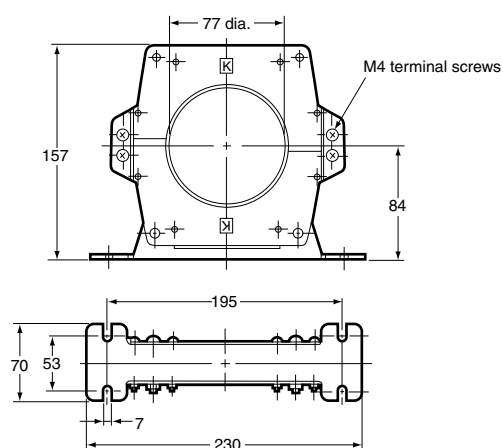
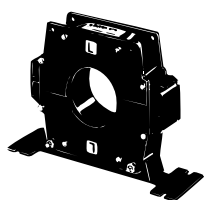
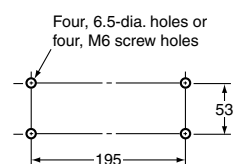


Mounting Hole  
Cutout Dimensions

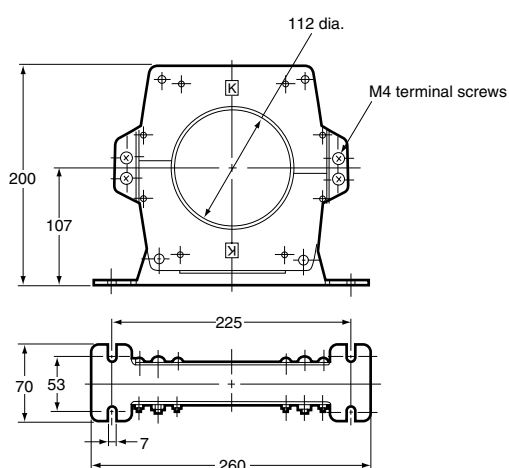
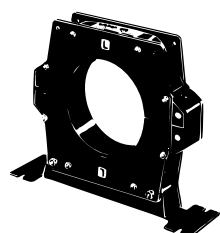
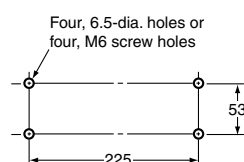




OTG-CN77 (400 A)

Mounting Hole  
Cutout Dimensions

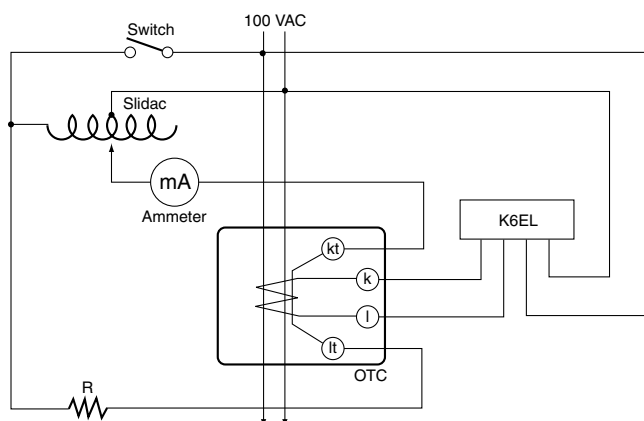
OTG-CN112 (600 A)

Mounting Hole  
Cutout Dimensions

## ■ Maximum Wire Sizes for ZCTs

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

## Test Circuit



200 mA: 500  $\Omega$ , 50 W  
 500 mA: 200  $\Omega$ , 100 W  
 1,000 mA: 100  $\Omega$ , 200 W

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 k $\Omega$ , 6 W  
 100 mA: 1 k $\Omega$ , 20 W

## Safety Precautions

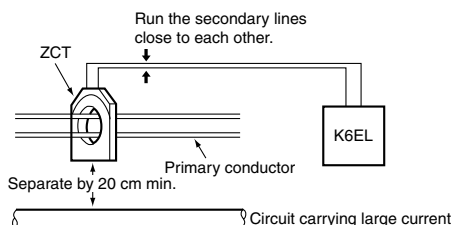
### ■ Correct Use

#### 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.



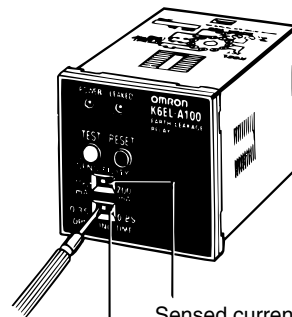
- When installing a separate-type ZCT with current flowing along the primary conductors, short the secondary terminals using clips or some other method.

#### Switching the Sensed Current

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

#### Switching the Operating Time

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



Sensed current selection switch  
 Operating time selection switch

#### 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.

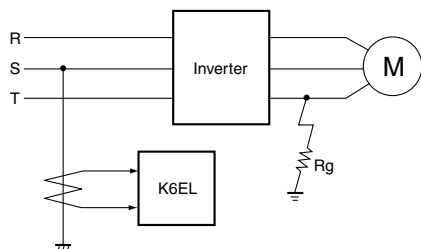
#### Resetting

- 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).

## 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: $R = \frac{V}{2It}$ (Ω) $P = \frac{5V^2}{R}$ (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.)	$I_g = \frac{V}{2Rg + R}$ (A)	$I_g = \frac{V}{R}$ (A)
		Capacitor: $C = \frac{2It}{2\pi fV}$ (F) Dielectric strength > 2 V (V)		$I_g = \frac{V}{\sqrt{(2Rg)^2 + \left(\frac{1}{2\pi fC}\right)^2}}$ (A)	$I_g = 2\pi fCV$ (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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