

## Earth Leakage Detector

### Description

The FA2803 is a semiconductor integrated circuit with amplifier for a high speed earth leakage circuit breaker. The FA2803 circuit for the amplifying parts of earth leakage circuit breaker consist of differential amplifier, latch circuit and voltage regulator.

It is connected to the secondary node of zero-current transformer (ZCT) which detects leakage current in the both input of the differential amplifier.

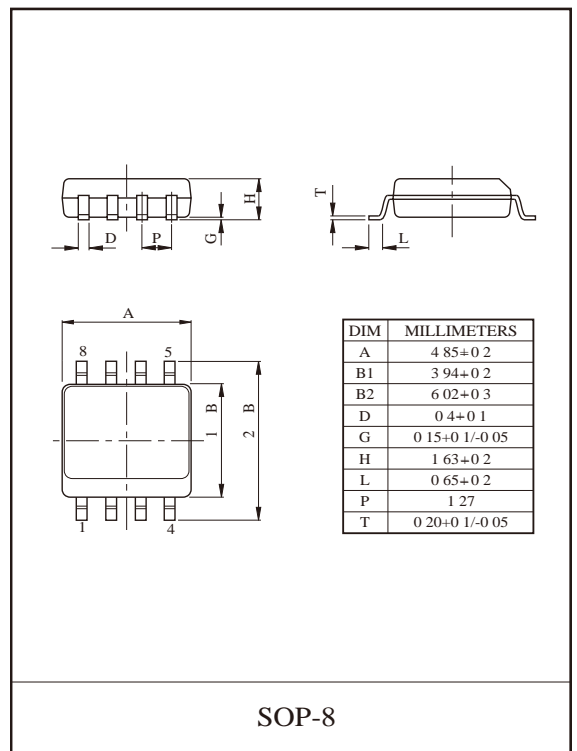
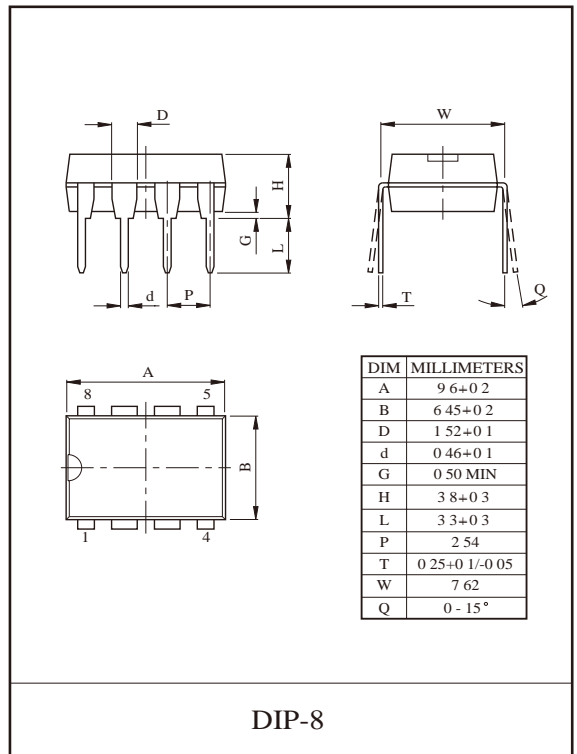
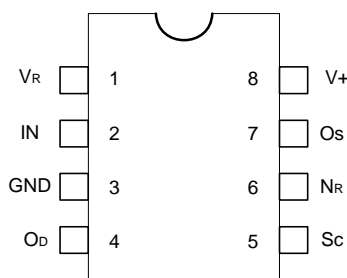
Signals amplified by differential amplifier are integrated by an external capacitor, and connects to the input terminal of latch circuit with output suitable for the characteristics of high-speed earth leakage circuit breaker. Latch circuit keeps low in the output till the input voltage reaches the fixed level, and output becomes high when the leakage current is greater than some level. It drives a thyristor connected to the output terminal of latch circuit.

### Features

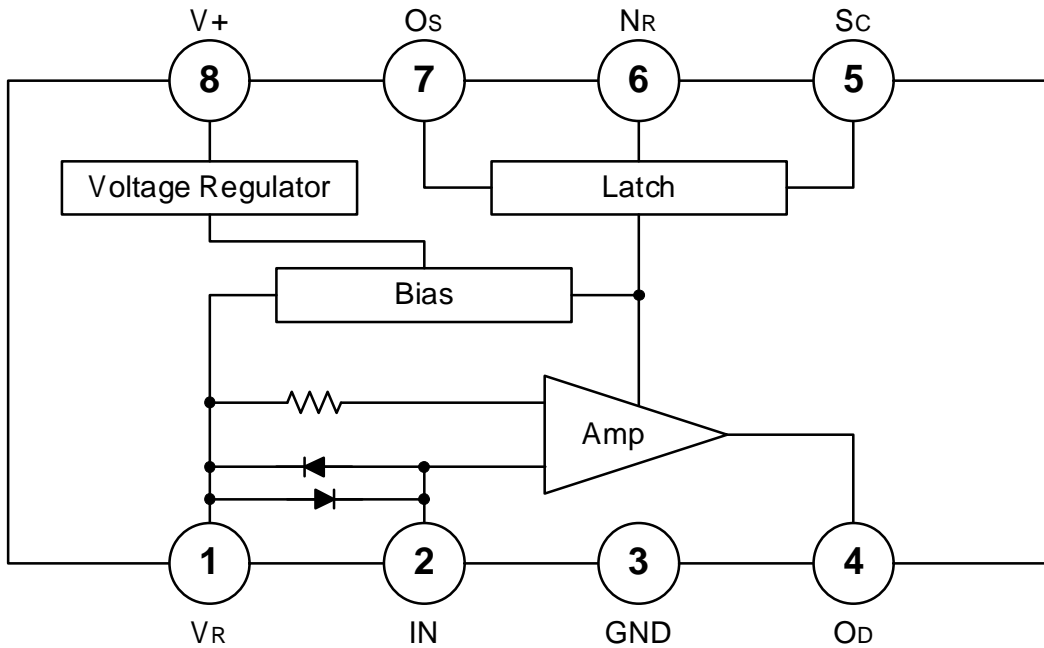
- Good temperature characteristics of input sensitivity current
- High Input Sensitivity ( $V_T = 13.5\text{mV}_{\text{rms}}$  Typ.)
- Low external component count
- High noise and surge- proof
- Low Power consumption ( $P_D = 5\text{mW}$ ) 100V/ 200V
- 100V/ 200V Common Built- in Voltage Regulator
- Wide Operating Temperature Range ( $T_A = -40$  to  $85^\circ\text{C}$ )

### Pin Assignment

(Top view)



## Block diagram



### Absolute Maximum Rating ( $T_A = -40 \sim 85^\circ\text{C}$ )

Parameter	Conditions	Symbol	Ratings	Unit
Supply Current		$I_{CC}$	8	mA
VR pin current	$V_R \sim IN(\text{Note1})$	$I_{VR}$	250	mA
	$V_R \sim GND$		30	
	$IN \sim V_R(\text{Note1})$		-250	
IN terminal current	$IN \sim V_R(\text{Note1})$	$I_{IN}$	250	mA
	$IN \sim GND$		30	
	$V_R \sim IN(\text{Note1})$		-250	
Sc terminal current		$I_{SC}$	5	mA
Power dissipation		$P_d$	200	mW
Operating temperature		$T_{opr}$	-40 ~ 85	$^\circ\text{C}$
Storage Temperature		$T_{stg}$	-55 ~ 125	$^\circ\text{C}$

Note1 : Current value between  $V_R$  and  $IN$ , and between  $IN$  and  $V_R$  is less than 1ms in the pulse width, and duty cycle is less than 12%. In applying AC current continuously, it is 100mArms in the off - state.

Remarks : GND terminal(pin③) of the circuit is a basis of all the voltages except differential input clamp voltage of DC electrical characteristics, and direction of current is plus(no signal) in flowing into the circuit and is minus (- signal) in flowing out of it. Maximum value and minimum one are shown as absolute value. Please don't apply voltage whose standard is GND terminal in  $V_R$  and  $IN$  pin.



# FA2803P/F

## Recommended Operating Condition ( $T_A = -40 \sim 85^\circ\text{C}$ )

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage when latch circuit is off - state	V+	12			V
Vs - GND Capacitor	Cvs	1			$\mu\text{F}$
Os - GND Capacitor	Cos			1	$\mu\text{F}$

## Electrical Characteristics ( $T_A = -40 \sim 85^\circ\text{C}$ , Typical values are at $T_A = 25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Temp ( $^\circ\text{C}$ )	Min	Typ	Max	Unit	Test Circuit
Supply Current1	Is1	V+=12V, VR-VI=30mV	-40	-	-	580	$\mu\text{A}$	1
			25	-	400	530		
			85	-	-	480		
Trip Voltage	VT	V+=16V. VR-VI=X(Note2)	-40~85	10.0	13.5	17.0	mVrms	2
Differential Amplifier Output Current1	ITD1	V+=16V, VR-VI=30mV VOD=1.2V	25	-12	-	-30	$\mu\text{A}$	3
Differential Amplifier Output Current2	ITD2	V+=16V, VR-VI=short VOD=0.8V	25	17	-	37	$\mu\text{A}$	4
Output Current	Io	Vsc=1.4V Vos=0.8V	Is1=580 $\mu\text{A}$	-40	-200	-	$\mu\text{A}$	5
			Is1=530 $\mu\text{A}$	25	-100	-		
			Is1=480 $\mu\text{A}$	85	-75	-		
Sc On Voltage(Note3)	Vsc ON	V+=16V	25	0.7	-	1.4	V	6
Sc Input Current	Isc ON	V+=12V	25	-	-	5	$\mu\text{A}$	7
Output "L" Current	IosL	V+12V, VosL = 0.2V	-40~85	200	-	-	$\mu\text{A}$	8
Input Clamp Voltage	Vic	V+=12V, Iic=20mA	-40~85	4.3	-	6.7	V	9
Differential Input Clamp Voltage	Vidc	Iidc = 100mA	-40~85	0.4	-	2	V	10
Max Current voltage	Vsm	ISM=7mA	25	20	-	28	V	11
Supply Current2 (Note4)	Is2	Vos=0.5V, VR-VI=X(Note5)	-40~85	-	-	900	$\mu\text{A}$	12
Latch Circuit off - state Supply Voltage(Note6)	V+ OFF		25	0.5	-		V	13
Operating time(Note7)	Ton	V+=16V, VR-VI=0.3V	25	2	-	4	ms	14

Note2 : When standard value of voltage (50/60Hz) between VR and VI is minimum, and output Os is low - level, or when standard value of voltage (50/60Hz) between VR and VI is maximum, and output Os is high - level, it is considered as a good one.

Note3 : When standard value of voltage Vsc ON is minimum, and output Os is low-level, or when standard value of voltage Vsc ON is maximum, and output Os is high - level, it is considered as a good one

Note4 : Supply current2 is necessary to keep high in output Os.

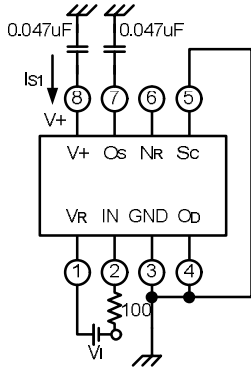
Note5 : After applying 30mV between VR and V1 and shorting between them, it is considered as a good one if standard value of IGT flows out of output Os.

Note6 : After supply voltage applies 12V and output Os is high - level, it is considered as a good one in the standard value of supply voltage and in the low - level of output Os.

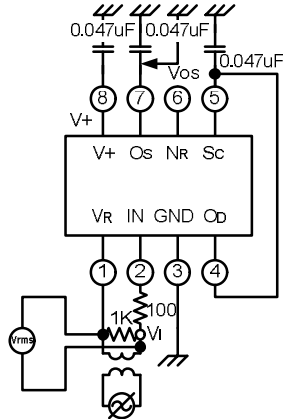
Note7 : Operating time is a time from applying fixed input till operating latch circuit in 0.047 $\mu\text{F}$  between Od and GND.

## Test Circuit

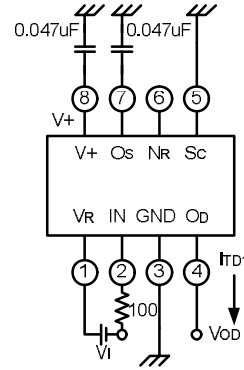
1.



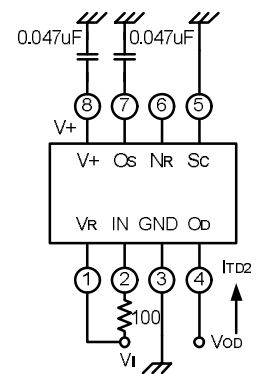
2.



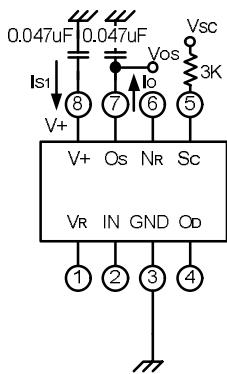
3.



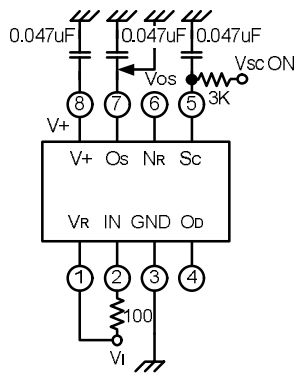
4.



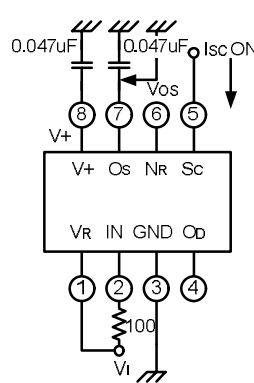
5.



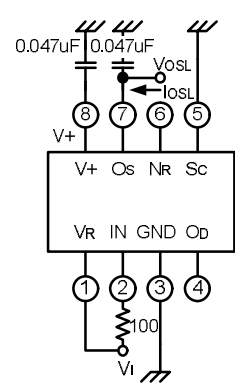
6.



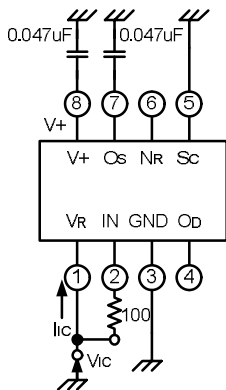
7.



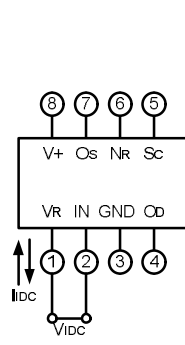
8.



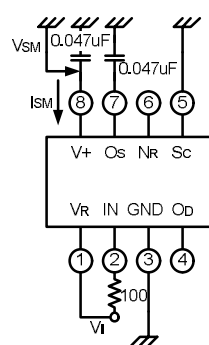
9.



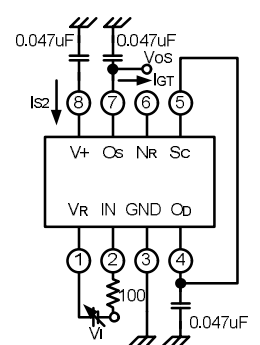
10.



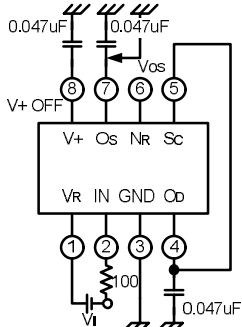
11.



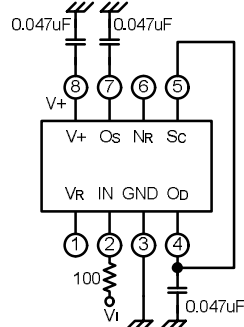
12.



13.

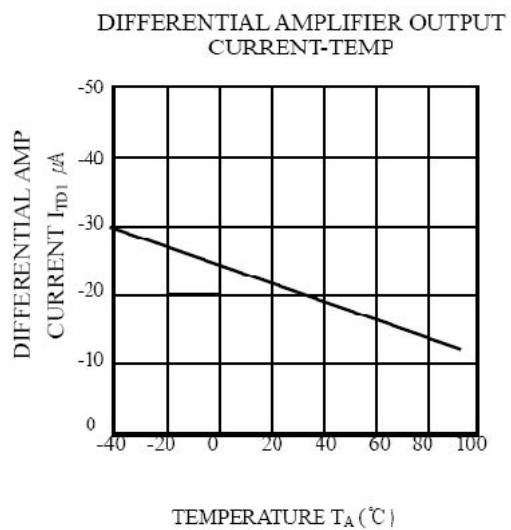
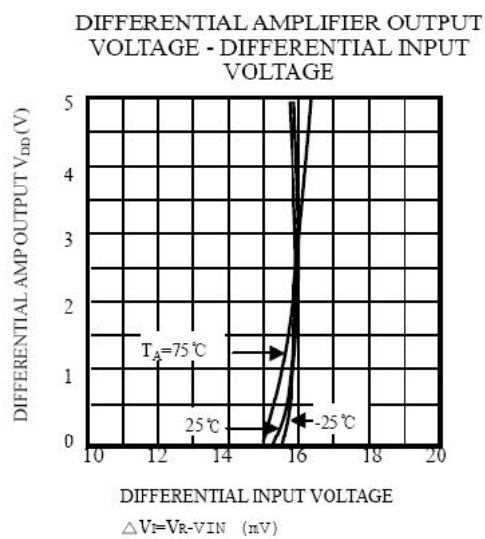
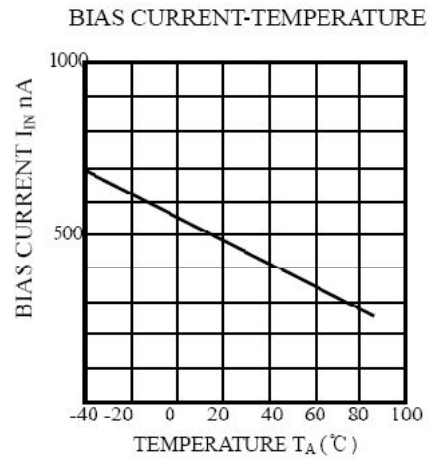
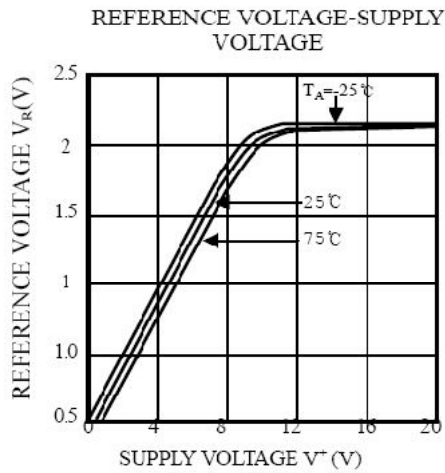
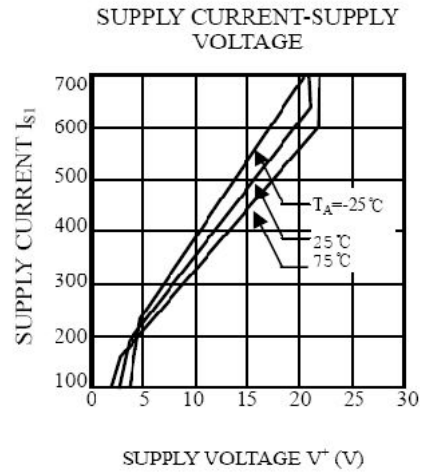
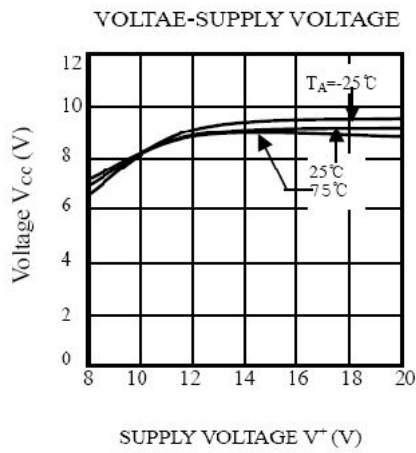


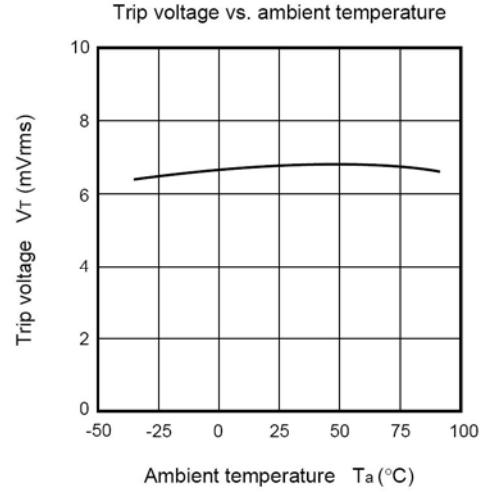
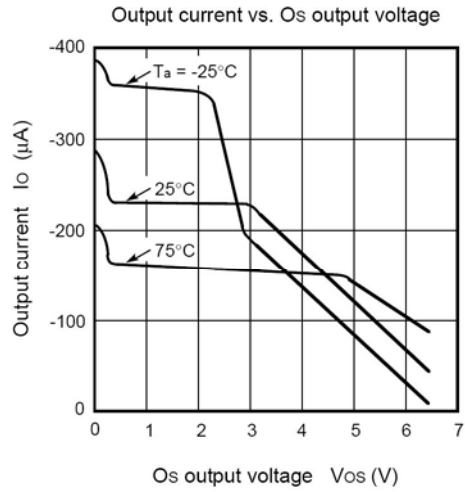
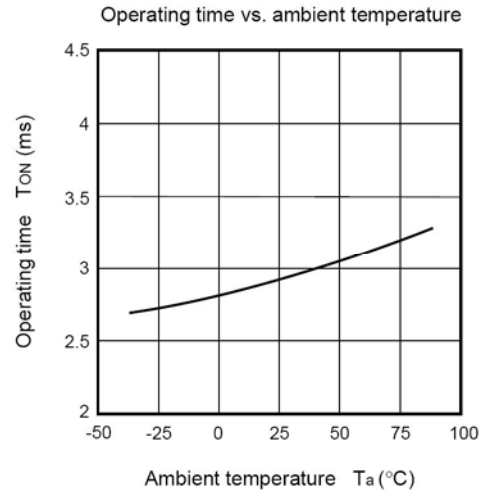
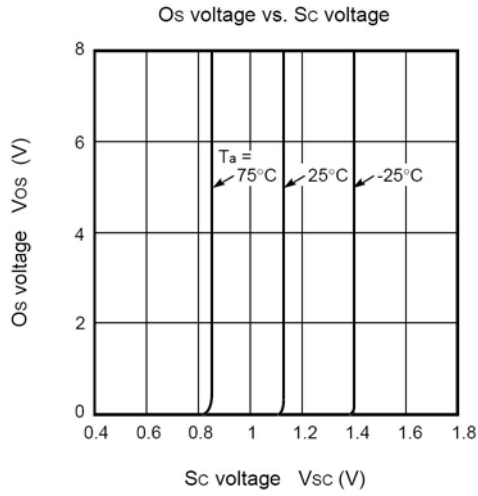
14.



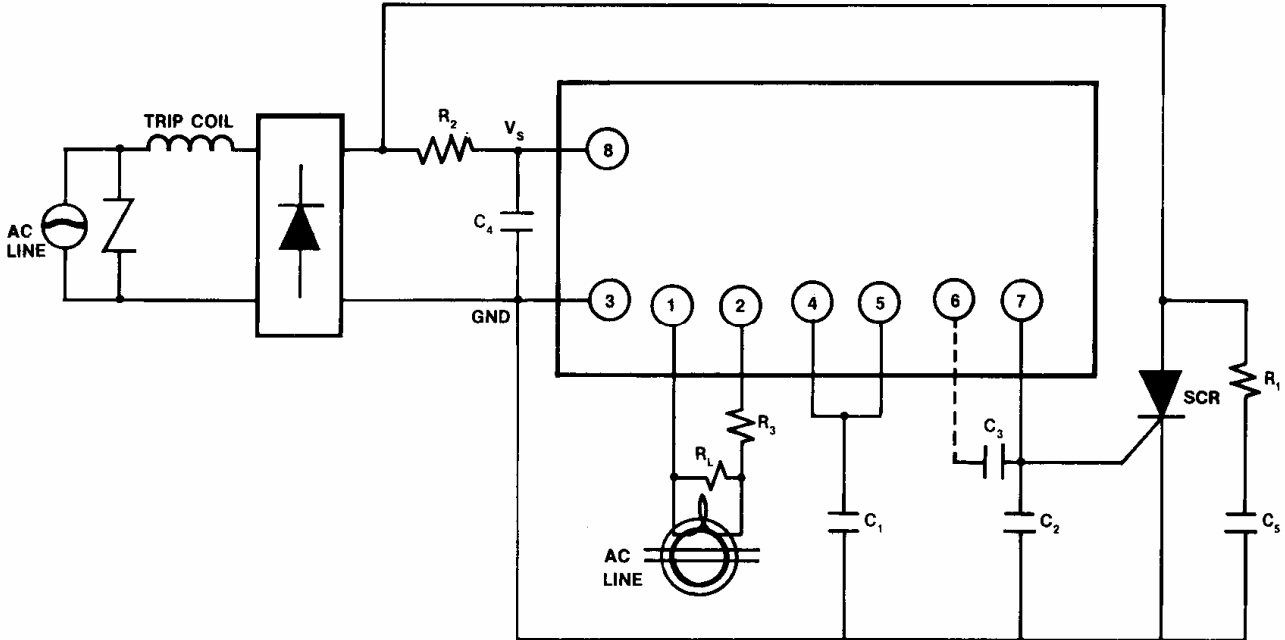
Note : The unit of resistor is ohm. Please insert 0.01uF between pin① and pin③ in test.

## Typical Characteristics Curves





## Typical Application



Supply voltage circuit is connected as a previous diagram. Please decide constants  $R_1$ ,  $R_2$ ,  $C_4$ , and  $C_5$  of a filter in order to keep at least 12V in  $V_+$ , when normal supply current flows.

In this case, please connect  $C_4$  (more than 1 $\mu$ F) and  $C_2$  (less than 1 $\mu$ F). ZCT and load resistance  $R_L$  of ZCT are connected between input pin① and ②. In this case protective resistance ( $R_3=100\Omega$ ) must be inserted. Sensitivity current is regulated by  $R_L$ , and output of amplifier shows in pin④. External capacitor  $C_1$  between pin④ and GND is used for noise removal.

When large current is grounded in the primary side (AC line) of ZCT, the waveform in the secondary side of ZCT is distorted and some signal doesn't appear in the output of amplifier. So please connect a varistor or a diode (2 pcs) to ZCT in parallel.

Latch circuit is used to inspect the output level of amplifier and to supply gate current on the external SCR. When input pin becomes more than 1.1V (Typ.), latch circuit operates and supply gate current in the gate of SCR connected to the output pin⑦.

Pin⑥ can be used in the open state, but please connect capacitor (about 0.047 $\mu$ F) between pin⑥ and pin⑦.