



## GF4146

CMOS IC

### GROUND FAULT INTERRUPTER

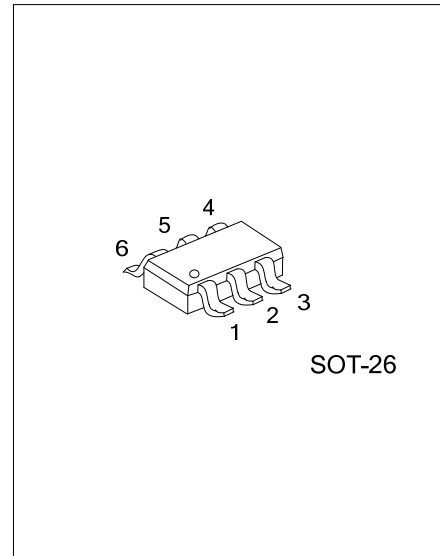
#### DESCRIPTION

The UTC **GF4146** is a two-wire low-power controller for Residual Current Devices (RCD) and AC outlet Appliance Leakage Circuit Interrupters (ALCI). The UTC **GF4146** detects hazardous grounding conditions and open circuits the line before a harmful shock occurs.

Internally, the UTC **GF4146** contains a diode rectifier, 12V shunt regulator using a precision temperature-compensated bandgap reference, precision low  $V_{OS}$  offset-sense amplifier, time delay noise filter, window-detection comparators, and a SCR driver. With the addition of a minimum number of external components, the UTC **GF4146** detects and protects against a hot-wire-to-ground fault.

The UTC **GF4146** circuitry has a built-in rectifier and shunt regulator that operates with a low quiescent current. This allows for a high-value, low-wattage-series supply resistor.

The internal temperature compensated shunt regulator, sense amplifier, and bias circuitry provide for precision ground-fault detection. The low  $V_{OS}$  offset-sense amplifier allows direct coupling of the sense coil to the amplifier's feedback signal. This eliminates the large 50/60Hz AC-coupling capacitor. The internal delay filter rejects high-frequency noise spikes common with inductive loads. This decreases false nuisance tripping. The internal SCR driver is temperature compensated and designed to satisfy the current requirements for a wide selection of external SCRs.



#### FEATURES

- \* For Two-Wire ALCI and RCD Applications
- \* Precision Sense Amplifier and Bandgap Reference
- \* Built-in AC Rectifier
- \* Direct DC Coupled to Sense Coil
- \* Low-Voltage SCR Disable
- \* Adjustable Sensitivity
- \* Built-in Noise Filter
- \* SCR Gate Driver
- \* Minimum External Components
- \* Ideal for 120V or 220V Systems

#### ORDERING INFORMATION

Ordering Number		Package	Packing
Lead Free	Halogen Free		
GF4146L-AG6-R	GF4146G-AG6-R	SOT-26	Tape Reel

GF4146G-AG6-R	
(1) Packing Type	(1) R: Tape Reel
(2) Package Type	(2) AG6: SOT-26
(3) Green Package	(3) G: Halogen Free and Lead Free, L: Lead Free

Pin configuration diagram for the 6-pin connector:

- Pin 1: SCR
- Pin 2: Neutral
- Pin 3: Line
- Pin 4:  $V_{REF}$
- Pin 5:  $V_{FB}$
- Pin 6: AmpOut

PIN NO.	PIN NAME	DESCRIPTION
1	SCR	Gate drive for external SCR
2	Neutral	Supply input
3	Line	Supply input
4	V <sub>REF</sub>	Non-inverting input for current-sense amplifier
5	V <sub>FB</sub>	Inverting input for current-sense amplifier
6	AmpOut	External resistor sets the I <sub>fault</sub> sensitivity threshold connected to V <sub>FB</sub>

The diagram illustrates a precision zero-current SCR turn-off circuit. The input stage consists of two diodes connected to  $V_{FB}$  and  $V_{REF}$ , feeding into op-amp  $A_1$ . The output of  $A_1$  is connected to the non-inverting input of comparator  $COMP2$  and the inverting input of comparator  $COMP1$ . The inverting input of  $COMP2$  is also connected to  $V_{TH}$ , and the non-inverting input of  $COMP1$  is connected to  $V_{REF}$ . The outputs of  $COMP1$  and  $COMP2$  are connected to a delay block  $t_1$ , which then feeds into an SCR driver. The SCR driver controls the gate of the SCR ( $Q_1$ ) and the current  $I_1$  through the SCR. The SCR is connected to the  $V_S$  supply and a parallel combination of the SCR and resistor  $R_1$ . The output of the circuit is  $AmpOut$ . A Rectifier and Bias block provides  $V_{REF}$  and  $V_{TH}$  to the comparators and the input stage.

# ■ ABSOLUTE MAXIMUM RATING

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Current	$I_{CC}$	15	mA
Supply Voltage	All other pins $V_{CC}$	16	V
		-0.8 ~ 15	V
Storage Temperature Range	$T_{STG}$	-65 ~ +150	°C

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

# ■ ELECTRICAL CHARACTERISTICS ( $I_{shunt}=1mA$ , $T_A=25^{\circ}C$ , Unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Power Supply Shunt Regulator Voltage	$V_{REG}$	Line to Neutral	12.2	12.7	13.2	V
		Line to Neutral, $I_{shunt}=-2mA$	-0.9	-0.7		V
Quiescent Current	$I_Q$	Line to Neutral=10V	350	450	550	$\mu A$
Reference Voltage	$V_{REF}$	$V_{REF}$ to Neutral	5.8	6.0	6.2	V
Trip Threshold	$V_{TH}$	AmpOut to $V_{REF}$	3.4	3.5	3.6	V
Amplifier Offset	$V_{OS}$	$R_{SET}=511K\Omega$ , $R_{IN}=500\Omega$	-450	0	450	$\mu V$
Amplifier Positive Voltage Swing	$V_{SW}$	AmpOut to $V_{REF}$ , $I_{FAULT}=10\mu A$	4.0			V
Amplifier Negative Voltage Swing	$V_{SW}$	$V_{REF}$ to AmpOut, $I_{FAULT}=-10\mu A$	4.0			V
Amplifier Current Sink	$I_{SINK}$	AmpOut= $V_{REF}+3V$ , $V_{FB}=V_{REF}+100mV$	400			$\mu A$
Amplifier Current Source	$I_{SRL}$	AmpOut= $V_{REF}-3V$ , $V_{FB}=V_{REF}-100mV$	400			$\mu A$
Delay Filter	$t_d$	Delay from COMP1 Trip to SCR, Low to High	1	1.35	1.7	ms
SCR Output Resistance	$R_{OUT}$	SCR to Neutral=250mV, AmpOut= $V_{REF}$		0.5	1.0	$K\Omega$
SCR Output Voltage	$V_{OUT}$	SCR to Neutral, AmpOut= $V_{REF}$		1	10	mV
		SCR to Neutral, AmpOut= $V_{REF}+4V$	2.5			V
SCR Output Current	$I_{OUT}$	SCR to Neutral=1V, AmpOut= $V_{REF}+4V$	350	600		$\mu A$



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