



# SGM8477-1

## 1.8V, Low Noise, Zero-Drift Operational Amplifier

### PRODUCT DESCRIPTION

The SGM8477-1 CMOS operational amplifier provides very low offset voltage, low noise and zero-drift over time and temperature for precise differential signal process.

The miniature, high-precision, low quiescent current amplifier offers high-impedance rail to rail inputs that have a wide input common mode range 100mV beyond the rails and rail-to-rail output that swings within 6.5mV of the rails. Single or dual supplies as low as +1.8V ( $\pm 0.9V$ ) and up to +5.5V ( $\pm 2.75V$ ) may be used. It is optimized for low voltage, single-supply operation.

SGM8477-1 is a high performance amplifier for accurate high side current sensing of low voltage, such as single battery voltage, or accurate low side current sensing.

Integrated matched resistors for differential application save external components. The SGM8477-1 has different versions for 50, 300 gains.

The SGM8477-1 is available in Green SC70-6 package. It is specified over  $-40^{\circ}C$  to  $+125^{\circ}C$  temperature range.

### FEATURES

- **Low Offset Voltage: 3.5 $\mu$ V (TYP)**
- **Low 0.1Hz to 10Hz Noise: 250nV<sub>p,p</sub>**
- **Quiescent Current: 380 $\mu$ A (TYP)**
- **Low Noise: 10nV/ $\sqrt{Hz}$**
- **Integrated RFI Filter**
- **Single-Supply Operation**
- **Supply Voltage Range: 1.8V to 5.5V**
- **Rail-to-Rail Input and Output**
- **$-40^{\circ}C$  to  $+125^{\circ}C$  Operating Temperature Range**
- **SGM8477-1 is Available in Green SC70-6 Package**

### APPLICATIONS

Transducer Applications  
 Temperature Measurements  
 Electronic Scales  
 Medical Instrumentation  
 Battery-Powered Instrument  
 Handheld Test Equipment

**PACKAGE/ORDERING INFORMATION**

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8477-1B (Gain = 50)	SC70-6	-40°C to +125°C			
SGM8477-1G (Gain = 300)	SC70-6	-40°C to +125°C			

NOTE: XX = Date Code. XXXXX = Date Code and Vendor Code.

Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

**ABSOLUTE MAXIMUM RATINGS**

Supply Voltage.....6V  
 Input Common Mode Voltage Range  
 ..... (-V<sub>S</sub>) - 0.3V to (+V<sub>S</sub>) + 0.3V  
 Junction Temperature.....+150°C  
 Storage Temperature Range .....-65°C to +150°C  
 Lead Temperature (Soldering 10sec).....+260°C

**OVERSTRESS CAUTION**

Stresses beyond those listed may cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational section of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

**RECOMMENDED OPERATING CONDITIONS**

Specified Voltage Range .....1.8V to 5.5V  
 Operating Temperature Range .....-40°C to +125°C

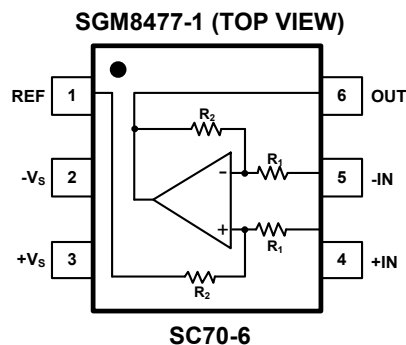
**ESD SENSITIVITY CAUTION**

This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

**DISCLAIMER**

SG Micro Corp reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time.

**PIN CONFIGURATION**



**ELECTRICAL CHARACTERISTICS**(At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ ,  $V_{\text{REF}} = +V_S/2$  and  $R_L = 10\text{k}\Omega$  to  $+V_S/2$ , unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
<b>INPUT CHARACTERISTICS</b>					
Input Offset Voltage ( $V_{\text{OS}}$ )	$V_S = +5\text{V}$		3.5		$\mu\text{V}$
Input Bias Current ( $I_{\text{b}}$ )	$V_S = V_{\text{CM}} = +5\text{V}$ , $V_{\text{REF}} = 0\text{V}$ , Gain = 300		17		$\mu\text{A}$
	$V_S = V_{\text{CM}} = +5\text{V}$ , $V_{\text{REF}} = 0\text{V}$ , Gain = 50		110		$\mu\text{A}$
Input Offset Current ( $I_{\text{OS}}$ )	$V_S = V_{\text{CM}} = +5\text{V}$ , $V_{\text{REF}} = 0\text{V}$ , Gain = 300		3		$\mu\text{A}$
	$V_S = V_{\text{CM}} = +5\text{V}$ , $V_{\text{REF}} = 0\text{V}$ , Gain = 50		16		$\mu\text{A}$
Input Common Mode Voltage Range ( $V_{\text{CM}}$ )		$(-V_S) - 0.1$		$(+V_S) + 0.1$	V
Common Mode Rejection Ratio (CMRR)	$(-V_S) - 0.1\text{V} < V_{\text{CM}} < (+V_S) + 0.1\text{V}$		100		dB
<b>OUTPUT CHARACTERISTICS</b>					
Output Voltage Swing from Rail	$R_L = 10\text{k}\Omega$		6.5		mV
Short-Circuit Current ( $I_{\text{SC}}$ )	$V_S = 5\text{V}$		45.0		mA
<b>POWER SUPPLY</b>					
Operating Voltage Range ( $V_S$ )		1.8		5.5	V
Power Supply Rejection Ratio (PSRR)	$V_S = +1.8\text{V}$ to $+5.5\text{V}$		120		dB
Quiescent Current ( $I_{\text{Q}}$ )	$I_{\text{O}} = 0$ , EN = 1.8V (active), $+V_S = 5.0\text{V}$ , $-V_S = 0\text{V}$		380		$\mu\text{A}$
<b>DYNAMIC PERFORMANCE</b>					
Slew Rate (SR)	$V_{\text{O}} = 2V_{\text{PP}}$		0.15		V/ $\mu\text{s}$
-3dB Bandwidth	$V_S = +5\text{V}$ , $C_L = 50\text{pF}$ , GAIN = 300		37		kHz
	$V_S = +5\text{V}$ , $C_L = 50\text{pF}$ , GAIN = 50		150		kHz
Gain Error	$V_S = +5\text{V}$ , $0.1\text{V} \leq V_{\text{OUT}} \leq 4.9\text{V}$		0.01		%
<b>NOISE</b>					
Input Voltage Noise	$f = 0.1\text{Hz}$ to $10\text{Hz}$		0.25		$\mu\text{V}_{\text{P-P}}$
Input Voltage Noise Density ( $e_n$ )	$f = 1\text{kHz}$		10		$\text{nV}/\sqrt{\text{Hz}}$

## APPLICATION INFORMATION

The SGM8477-1 provides low offset voltage and very low drift over time and temperature. For lowest offset voltage and precision performance, circuit layout and mechanical conditions should be optimized. Avoid temperature gradients that create thermoelectric (Seebeck) effects in the thermocouple junctions formed from connecting dissimilar conductors. These thermally-generated potentials can be made to cancel by assuring they are equal on both input terminals. Other layout and design considerations include:

- Use low thermoelectric-coefficient conditions (avoid dissimilar metals).
- Thermally isolate components from power supplies or other heat sources.
- Shield operational amplifier and input circuitry from air currents, such as cooling fans.

### Operating Voltage

The SGM8477-1 operational amplifier operates over a power supply range of +1.8V to +5.5V ( $\pm 0.9V$  to  $\pm 2.75V$ ). Supply voltages higher than +6V (absolute maximum) can permanently damage the device.

### Input Voltage

The SGM8477-1 input common mode voltage range extends 0.1V beyond the supply rails. The SGM8477-1 is designed to cover the full range without the troublesome transition region found in some other rail-to-rail amplifiers.

Normally, input bias current is about 17 $\mu A$ ; however, input voltages exceeding the power supplies can

cause excessive current to flow into or out of the input pins. The integrated input resistors will limit the current when input voltage beyond the power supplies.

### General Design Guidelines

Attention to good layout practices is always recommended. Keep traces short and, when possible, use a printed circuit board (PCB) ground plane with surface-mount components placed as close to the device pins as possible. Place a 0.1 $\mu F$  capacitor closely across the supply pins. These guidelines should be applied throughout the analog circuit to improve performance and provide benefits such as reducing the EMI (electromagnetic-interference) susceptibility. Operational amplifiers vary in their susceptibility to radio frequency interference (RFI). RFI can generally be identified as a variation in offset voltage or DC signal levels with changes in the interfering RF signal. The SGM8477-1 have been specifically designed to minimize susceptibility to RFI and demonstrates remarkably low sensitivity compared to previous generation devices. Strong RF fields may still cause varying offset levels. The circuit in Figure 1 is for thermocouple signal condition.

A low-side current shunt monitor is shown in Figure 2.  $R_N$  are operational resistors used to isolate the ADC from the noise of the digital I<sup>2</sup>C bus. Since the ADC is a 16-bit converter, a precise reference is essential for maximum accuracy. Related application circuits are shown in Figure 3 ~ 4.

APPLICATION INFORMATION

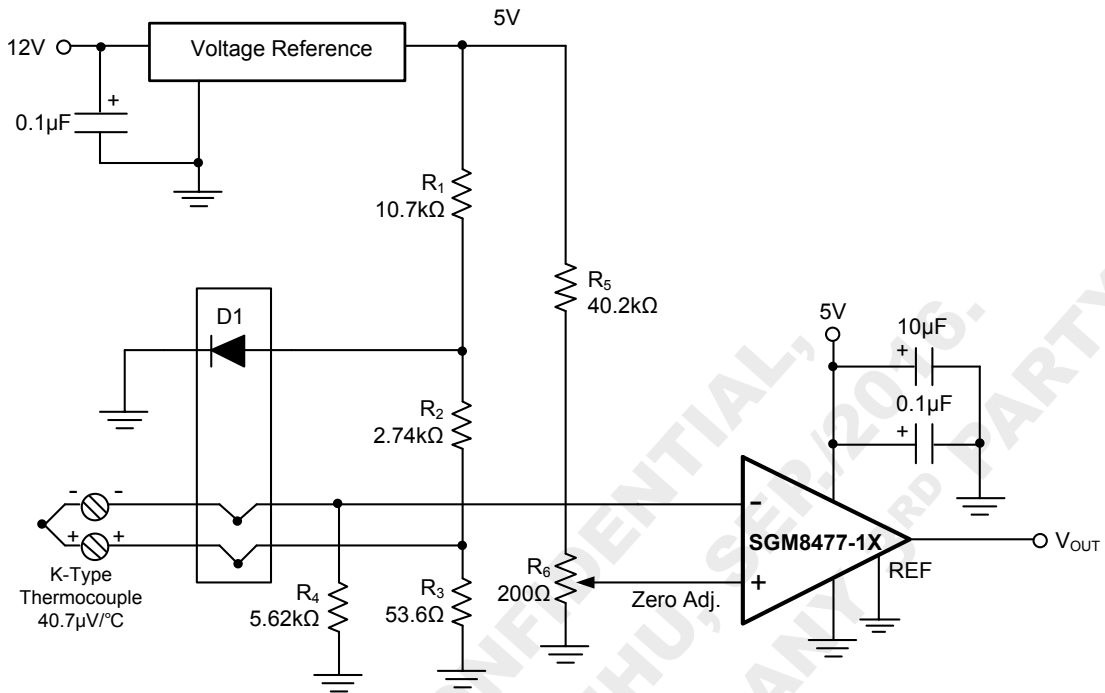


Figure 1. Thermocouple Temperature Circuit

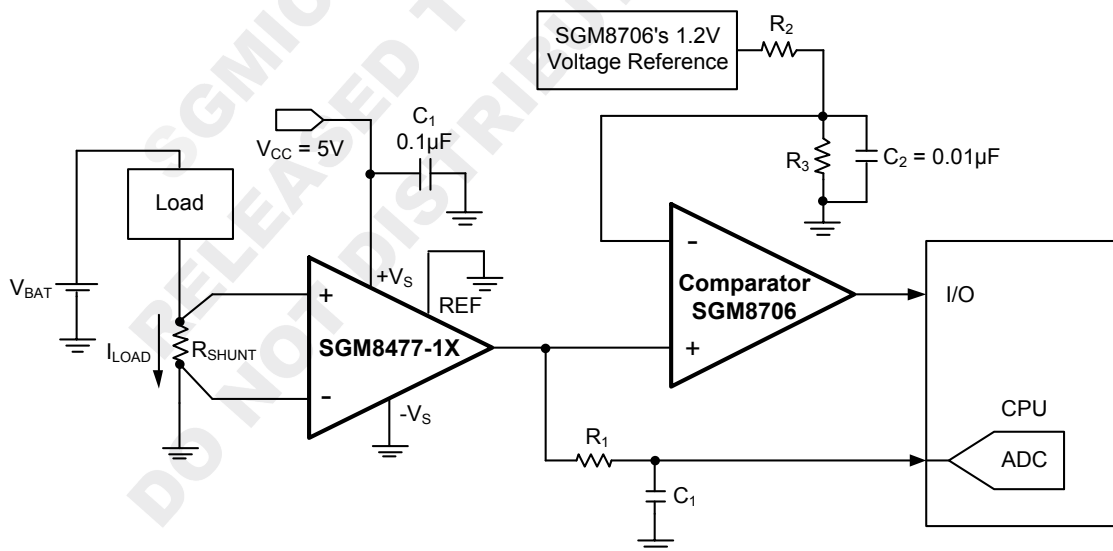


Figure 2. Accurate Low-side Current Sensing

APPLICATION INFORMATION

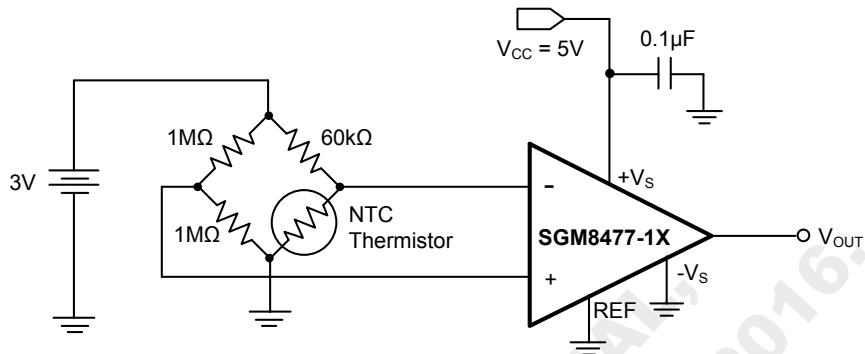


Figure 3. Thermistor Measurement

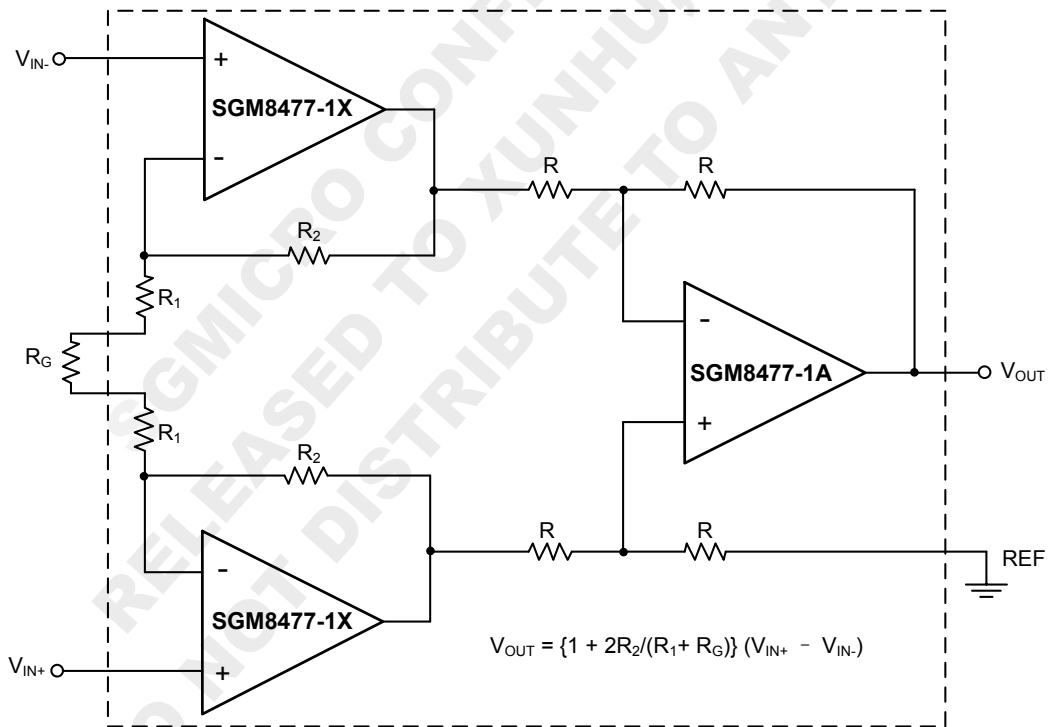
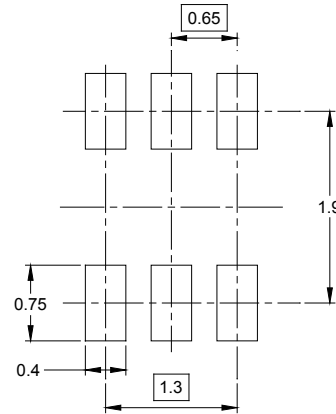
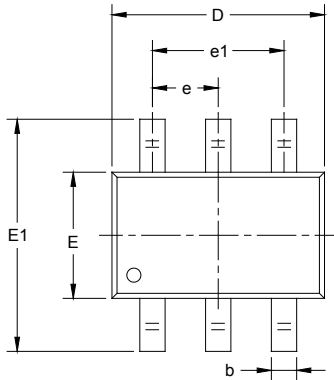


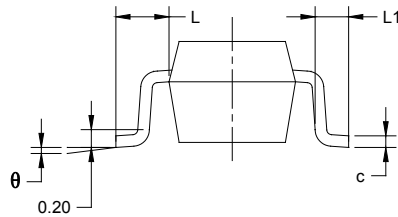
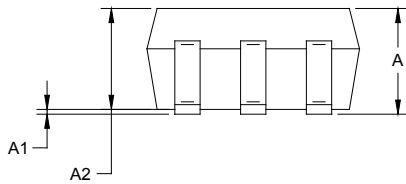
Figure 4. Precision Instrumentation Amplifier

PACKAGE OUTLINE DIMENSIONS

SC70-6



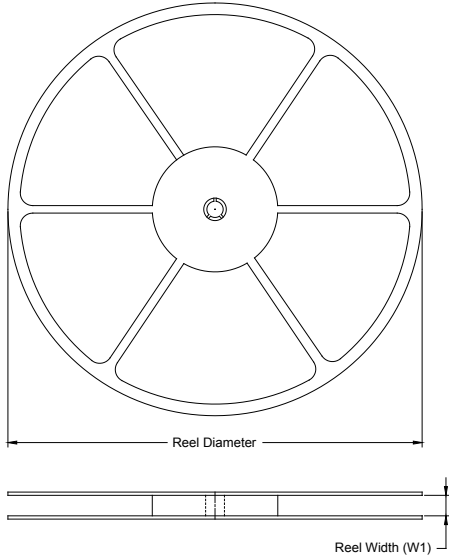
RECOMMENDED LAND PATTERN (Unit: mm)



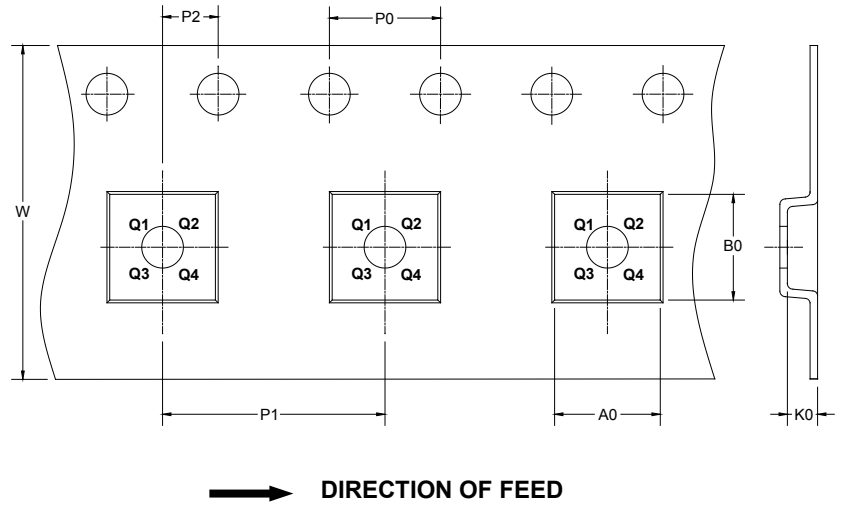
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.150	0.003	0.006
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.65 TYP		0.026 TYP	
e1	1.300 BSC		0.051 BSC	
L	0.525 REF		0.021 REF	
L1	0.260	0.460	0.010	0.018
$\theta$	0°	8°	0°	8°

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

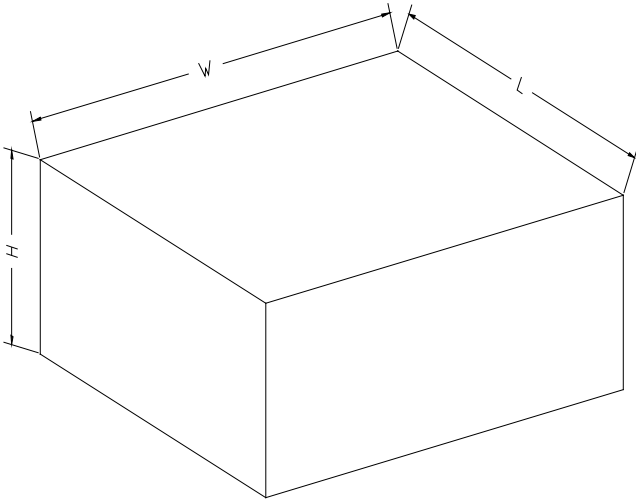
Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SC70-6	7"	9.5	2.4	2.5	1.2	4.0	4.0	2.0	8.0	Q3

000001



# PACKAGE INFORMATION

## CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

## KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
7" (Option)	368	227	224	8
7"	442	410	224	18

DD0002

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