# SGM8040-1
# 600nA, Rail-to-Rail I/O High Precision Operational Amplifier

## GENERAL DESCRIPTION

The high precision single SGM8040-1 is guaranteed to operate with a single supply voltage as low as 1.4V, while drawing less than 600nA (TYP) of quiescent current. The device is also designed to support rail-to-rail input and output operation. This combination of features supports battery-powered and portable applications.

The SGM8040-1 has a gain-bandwidth product of 12kHz (TYP) and is unity gain stable. These specifications make this operational amplifier appropriate for low frequency applications, such as battery current monitoring and sensor conditioning.

The SGM8040-1 is available in Green SOT-23-5 package. It operates over an ambient temperature range of -40℃ to +85℃.

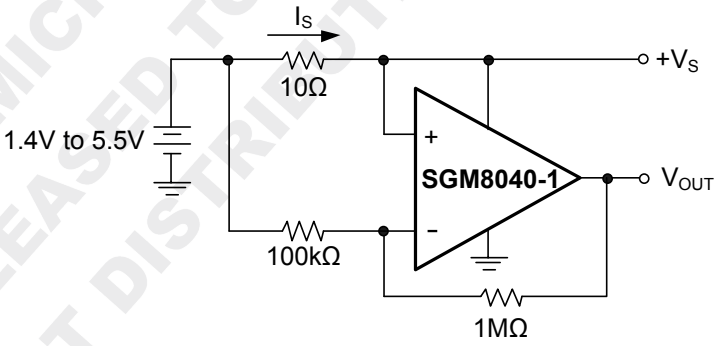
## FEATURES

- **Low Quiescent Current: 600nA (TYP)**
- **Rail-to-Rail Input and Output**
- **Gain-Bandwidth Product: 12kHz at $V_S$ = 5V (TYP)**
- **Wide Supply Voltage Range: 1.4V to 5.5V**
- **Unity Gain Stable**
- **Low Offset Voltage: 80μV (TYP)**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in Green SOT-23-5 Package**

## APPLICATIONS

Toll Booth Tags
Wearable Products
Temperature Measurement
Battery Powered System

## TYPICAL APPLICATION




$$I_S = \frac{+V_S - V_{OUT}}{(10V/V) \cdot (10\Omega)}$$

**High Side Battery Current Sensor**

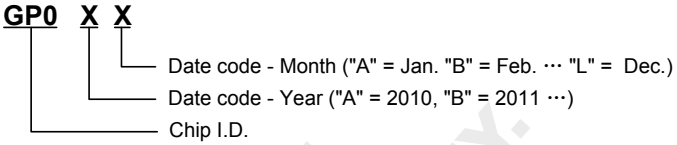
# PACKAGE/ORDERING INFORMATION

| MODEL | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER | PACKAGE MARKING | PACKING OPTION |
|---|---|---|---|---|---|
| SGM8040-1 | SOT-23-5 | -40℃ to +85℃ | SGM8040-1YN5G/TR | GP0XX | Tape and Reel, 3000 |

NOTE: XX = Date 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.

## MARKING INFORMATION




For example: GP0HA (2017, January)

## ABSOLUTE MAXIMUM RATINGS

Supply Voltage ..... 6V
Analog Inputs ($V_{IN+}$, $V_{IN-}$) ..... ($-V_S$) - 0.3V to ($+V_S$) + 0.3V
Differential Input Voltage ..... | ($-V_S$) - ($+V_S$) |
Storage Temperature Range ..... -65℃ to +150℃
Junction Temperature ..... +150℃
Lead Temperature (Soldering 10sec) ..... +260℃

## RECOMMENDED OPERATING CONDITIONS

Operating Temperature Range ..... -40℃ to +85℃

## 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.

## ESD SENSITIVITY CAUTION

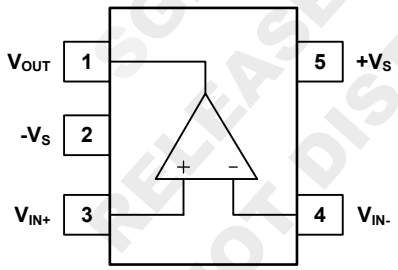
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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

**SGM8040-1 (TOP VIEW)**




**SOT-23-5**

## ELECTRICAL CHARACTERISTICS

($T_A$ = +25℃, $+V_S$ = 1.4V to 5.5V, $-V_S$ = GND, $V_{CM}$ = $+V_S$/2, $V_{OUT}$ = $+V_S$/2 and $R_L$ = 1MΩ (1), unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| **DC ELECTRICAL CHARACTERISTICS** | | | | | | |
| Input Offset Voltage | $V_{OS}$ | | | 80 | | μV |
| Power Supply Rejection Ratio | PSRR | $+V_S$ = 1.4V to 5.5V | | 5 | | μV/V |
| Input Common Mode Voltage Range | $V_{CM}$ | | $(-V_S)$ - 0.1 | | $(+V_S)$ + 0.1 | V |
| Common Mode Rejection Ratio | CMRR | $+V_S$ = 5V, $V_{CM}$ = -0.1V to 5.1V | | 96 | | dB |
| | | $+V_S$ = 5V, $V_{CM}$ = 2.5V to 5.1V | | 92 | | |
| | | $+V_S$ = 5V, $V_{CM}$ = -0.1V to 2.5V | | 110 | | |
| Large Signal Voltage Gain | $A_{VO}$ | $+V_S$ = 1.4V, $(-V_S)$ + 0.1V < $V_{OUT}$ < $(+V_S)$ - 0.1V, $R_L$ = 50kΩ | | 100 | | dB |
| | | $+V_S$ = 2.5V, $(-V_S)$ + 0.1V < $V_{OUT}$ < $(+V_S)$ - 0.1V, $R_L$ = 50kΩ | | 120 | | |
| | | $+V_S$ = 5V, $(-V_S)$ + 0.1V < $V_{OUT}$ < $(+V_S)$ - 0.1V, $R_L$= 50kΩ | | 120 | | |
| Input Bias Current | $I_B$ | | | 5 | | pA |
| Input Offset Current | $I_{OS}$ | | | 5 | | pA |
| Voltage Output Swing from Rail | | $R_L$ = 50kΩ | | 2 | | mV |
| Short-Circuit Current | $I_{SC}$ | $+V_S$ = 1.4V | | 2 | | mA |
| | | $+V_S$ = 5V | | 20 | | |
| Supply Voltage | $V_S$ | | 1.4 | | 5.5 | V |
| Quiescent Current | $I_Q$ | | | 600 | | nA |
| **AC ELECTRICAL CHARACTERISTICS ($C_L$ = 60pF)** | | | | | | |
| Gain-Bandwidth Product | GBP | $+V_S$ = 1.4V | | 11 | | kHz |
| | | $+V_S$ = 2.5V | | 11.5 | | |
| | | $+V_S$ = 5V | | 12 | | |
| Slew Rate | SR | $+V_S$ = 1.4V, $V_{OUT}$ = 1V Step | | 2 | | V/ms |
| | | $+V_S$ = 2.5V, $V_{OUT}$ = 1V Step | | 3.5 | | |
| | | $+V_S$ = 5V, $V_{OUT}$ = 2V Step | | 4 | | |
| Input Voltage Noise | | f = 0.1Hz to 10Hz | | 5 | | $μV_{P-P}$ |
| Input Voltage Noise Density | $e_n$ | f = 1kHz | | 190 | | nV/$\sqrt{HZ}$ |

NOTE: 1. Refer to Figure 1 and Figure 2.

## TEST CIRCUITS

The test circuits used for the DC and AC tests are shown in Figure 1 and Figure 2.

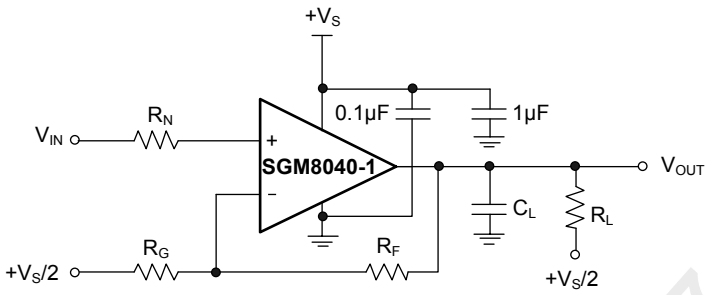



**Figure 1. AC and DC Test Circuit for Most Non-Inverting Gain Configurations**

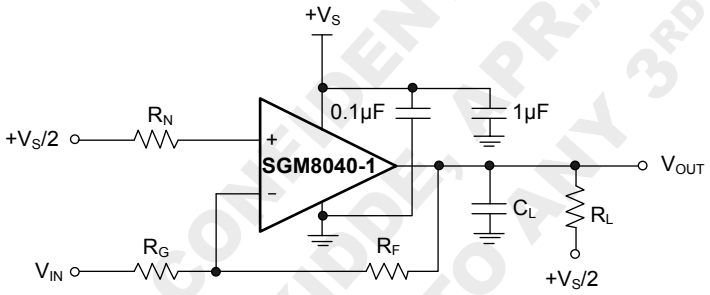
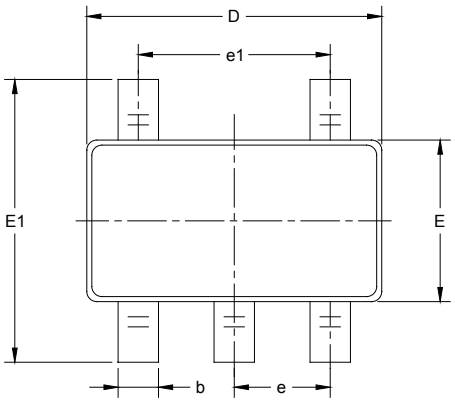
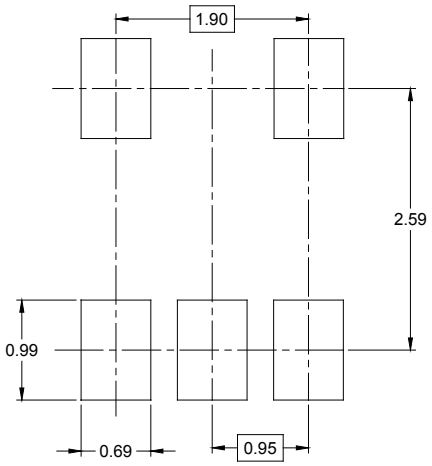



**Figure 2. AC and DC Test Circuit for Most Inverting Gain Configurations**

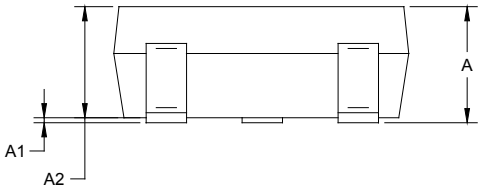
# PACKAGE OUTLINE DIMENSIONS

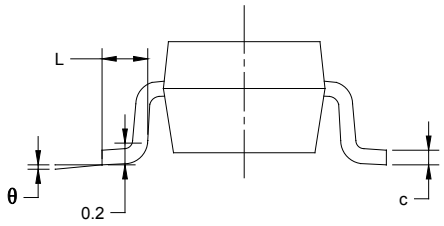
## SOT-23-5




**RECOMMENDED LAND PATTERN** (Unit: mm)

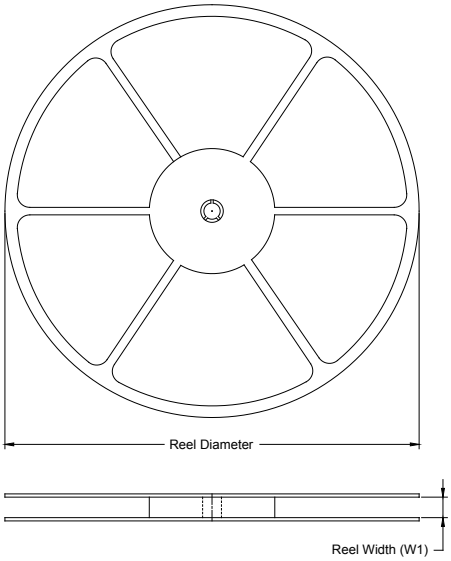


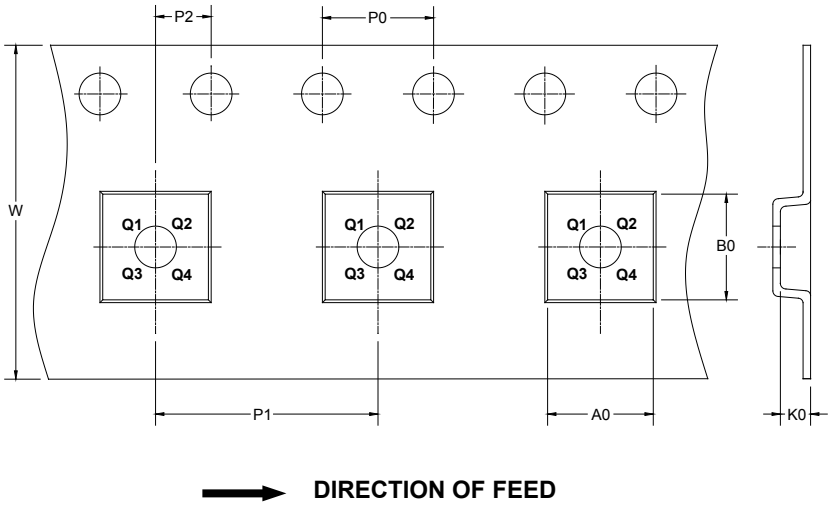

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.500 | 0.012 | 0.020 |
| c | 0.100 | 0.200 | 0.004 | 0.008 |
| D | 2.820 | 3.020 | 0.111 | 0.119 |
| E | 1.500 | 1.700 | 0.059 | 0.067 |
| E1 | 2.650 | 2.950 | 0.104 | 0.116 |
| e | 0.950 BSC | | 0.037 BSC | |
| e1 | 1.900 BSC | | 0.075 BSC | |
| L | 0.300 | 0.600 | 0.012 | 0.024 |
| θ | 0° | 8° | 0° | 8° |

# TAPE AND REEL INFORMATION

### REEL DIMENSIONS




### TAPE DIMENSIONS




DIRECTION OF FEED

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 |
|---|---|---|---|---|---|---|---|---|---|---|
| SOT-23-5 | 7″ | 9.5 | 3.20 | 3.20 | 1.40 | 4.0 | 4.0 | 2.0 | 8.0 | Q3 |

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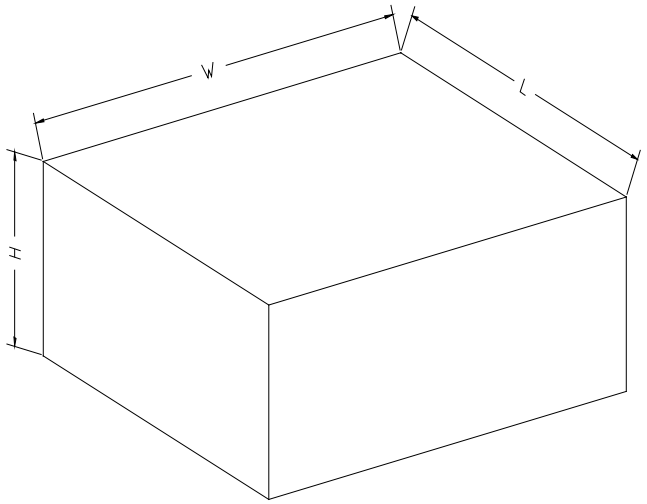
## CARTON BOX DIMENSIONS




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 |

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