



SGM8041

710nA, Single Rail-to-Rail I/O Operational Amplifier

PRODUCT DESCRIPTION

The SGM8041 is guaranteed to operate with a single supply voltage as low as 1.4V, while drawing less than 710nA (TYP) of quiescent current. This device is also designed to support rail-to-rail input and output operation. This combination of features supports battery-powered and portable applications.

The SGM8041 has a gain-bandwidth product of 14.5kHz (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 SGM8041 is offered in single configuration. It is specified for the extended industrial (-40°C to +85°C) temperature range. The SGM8041 is available in the Green SOT-23-5, SOIC-8 and MSOP-8 packages.

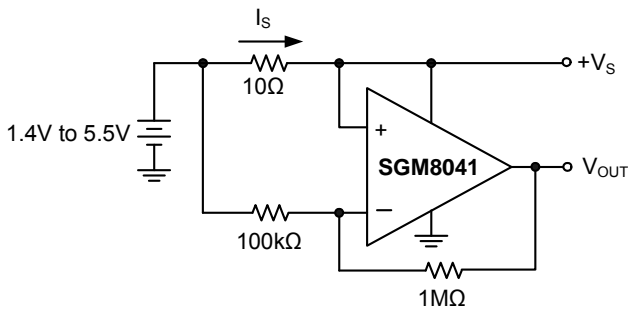
FEATURES

- **Low Quiescent Current: 710nA (TYP)**
- **Rail-to-Rail Input and Output**
- **Gain-Bandwidth Product: 14.5kHz at $V_S = 5V$ (TYP)**
- **Wide Supply Voltage Range: 1.4V to 5.5V**
- **Unity Gain Stable**
- **-40°C to +85°C Operating Temperature Range**
- **Available in Green SOT-23-5, SOIC-8 and MSOP-8 Packages**

APPLICATIONS

- Toll Booth Tags
- Wearable Products
- Temperature Measurement
- Battery Powered System

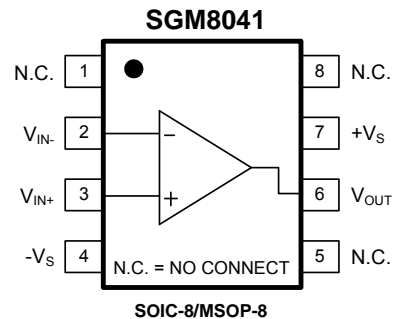
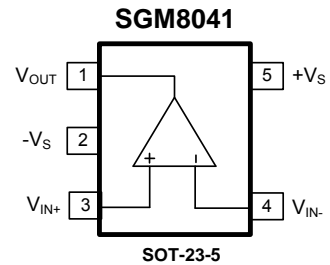
TYPICAL APPLICATION



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

High Side Battery Current Sensor

PIN CONFIGURATIONS (TOP VIEW)

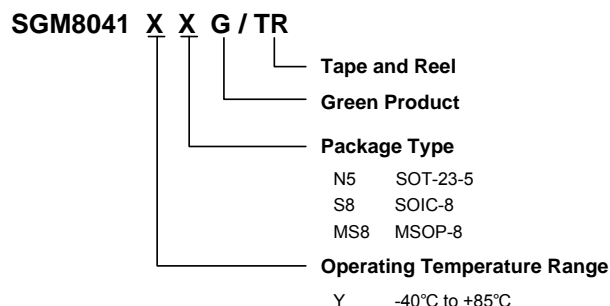


PACKAGE/ORDERING INFORMATION

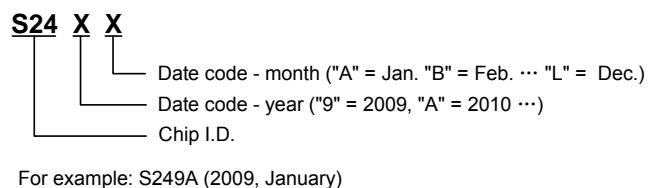
| MODEL | ORDER NUMBER | PACKAGE DESCRIPTION | PACKAGE OPTION | MARKING INFORMATION |
|---------|-----------------|---------------------|---------------------|---------------------|
| SGM8041 | SGM8041YN5G/TR | SOT-23-5 | Tape and Reel, 3000 | S24XX |
| | SGM8041YS8G/TR | SOIC-8 | Tape and Reel, 2500 | SGM8041YS8 |
| | SGM8041YMS8G/TR | MSOP-8 | Tape and Reel, 3000 | SGM8041YMS8 |

NOTE: Order number and package marking are defined as the follow:

ORDER NUMBER



MARKING INFORMATION



ABSOLUTE MAXIMUM RATINGS

| | |
|--|--|
| Supply Voltage | 6V |
| Analog Inputs (V _{IN+} , V _{IN-}) | (-V _S) - 0.1V to (+V _S) + 0.1V |
| Differential Input Voltage | (-V _S) - (+V _S) |
| Storage Temperature Range | -65°C to +150°C |
| Junction Temperature | 150°C |
| Operating Temperature Range | -40°C to +85°C |
| Lead Temperature (Soldering 10sec) | 260°C |
| ESD Susceptibility | |
| HBM | 3000V |
| MM | 300V |

NOTE:

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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.

SGMICRO reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact SGMICRO sales office to get the latest datasheet.

ELECTRICAL CHARACTERISTICS

$+V_S = +1.4V$ to $+5.0V$, $-V_S = GND$, $T_A = +25^\circ C$, $V_{CM} = +V_S/2$, $V_{OUT} \approx +V_S/2$ and $R_L = 1M\Omega$ to $+V_S/2$ ⁽¹⁾, unless otherwise noted.

| PARAMETER | | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|----------|---|--------------|-------|--------------|------------------|
| DC ELECTRICAL CHARACTERISTICS | | | | | | |
| Input Offset Voltage (V_{OS}) | | $V_{CM} = +V_S/2$ | | 0.4 | 2.5 | mV |
| Input Offset Voltage Drift ($\Delta V_{OS}/\Delta T$) | | $V_{CM} = +V_S/2$, $-40^\circ C \leq T_A \leq +85^\circ C$ | | 2.5 | | $\mu V/^\circ C$ |
| Power Supply Rejection Ratio (PSRR) | | $+V_S = 1.4V$ to $5.5V$ | 74 | 80 | | dB |
| Common Mode Input Range (V_{CMR}) | | | $-V_S - 0.1$ | | $+V_S + 0.1$ | V |
| Common Mode Rejection Ratio (CMRR) | | $+V_S = 5.0V$, $V_{CM} = -0.1V$ to $5.1V$ | 67 | 84 | | dB |
| | | $+V_S = 5.0V$, $V_{CM} = 2.5V$ to $5.1V$ | 70 | 83 | | |
| | | $+V_S = 5.0V$, $V_{CM} = -0.1V$ to $2.5V$ | 66 | 78 | | |
| Large Signal Voltage Gain (A_{VO}) | | $+V_S = 1.4V$, $R_L = 50k\Omega$, $V_{OUT} = +V_S - 0.1V$ | 72 | 80 | | dB |
| | | $+V_S = 2.5V$, $R_L = 50k\Omega$, $V_{OUT} = +V_S - 0.1V$ | | 88 | | |
| | | $+V_S = 5.0V$, $R_L = 50k\Omega$, $V_{OUT} = +V_S - 0.1V$ | 76 | 93 | | |
| Input Bias Current (I_B) | | | | 1 | | pA |
| Input Offset Current (I_{OS}) | | | | 1 | | pA |
| Maximum Output Voltage Swing | V_{OH} | $+V_S = 1.4V$, $R_L = 50k\Omega$ | 1.390 | 1.395 | | V |
| | | $+V_S = 2.5V$, $R_L = 50k\Omega$ | | 2.497 | | |
| | | $+V_S = 5.0V$, $R_L = 50k\Omega$ | 4.990 | 4.997 | | |
| | V_{OL} | $+V_S = 1.4V$, $R_L = 50k\Omega$ | | 4.5 | 10 | mV |
| | | $+V_S = 2.5V$, $R_L = 50k\Omega$ | | 3.1 | | |
| | | $+V_S = 5.0V$, $R_L = 50k\Omega$ | | 3.5 | 10 | |
| Output Short Circuit Current (I_{SC}) | | $+V_S = 2.5V$ | | 5.5 | | mA |
| | | $+V_S = 5.0V$ | 22 | 24 | | |
| Supply Voltage | | | 1.4 | | 5.5 | V |
| Quiescent Current (I_Q) | | $+V_S = 1.4V$ | | 600 | | nA |
| | | $+V_S = 2.5V$ | | 660 | | |
| | | $+V_S = 5.0V$ | | 710 | 1500 | |

ELECTRICAL CHARACTERISTICS

+V_S = +1.4V to +5.0V, -V_S = GND, T_A = +25°C, V_{CM} = +V_S/2, V_{OUT} ≈ +V_S/2 and R_L = 1MΩ to +V_S/2, C_L = 60pF ⁽¹⁾, unless otherwise noted.

| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|--|-----|------|-----|-------------------|
| AC ELECTRICAL CHARACTERISTICS | | | | | |
| Gain-Bandwidth Product (GBP) | +V _S = 1.4V | | 13.5 | | kHz |
| | +V _S = 2.5V | | 14.3 | | |
| | +V _S = 5.0V | | 14.5 | | |
| Slew Rate (SR) | +V _S = 1.4V, V _{OUT} = 1V Step | | 3.0 | | V/ms |
| | +V _S = 2.5V, V _{OUT} = 1V Step | | 3.0 | | |
| | +V _S = 5.0V, V _{OUT} = 2V Step | | 3.3 | | |
| Phase Margin (PM) | +V _S = 1.4V to 5.5V | | 60 | | ° |
| Input Voltage Noise (e _n p-p) | +V _S = 1.4V, f = 0.1Hz to 10Hz | | 3.7 | | μV _{P-P} |
| | +V _S = 2.5V, f = 0.1Hz to 10Hz | | 3.5 | | |
| | +V _S = 5.0V, f = 0.1Hz to 10Hz | | 3.4 | | |
| Input Voltage Noise Density (e _n) | +V _S = 1.4V, f = 1kHz | | 143 | | nV/√Hz |
| | +V _S = 2.5V, f = 1kHz | | 144 | | |
| | +V _S = 5.0V, f = 1kHz | | 135 | | |

NOTE1: 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. The bypass capacitors are laid out according to the rules discussed in “Supply Bypass”.

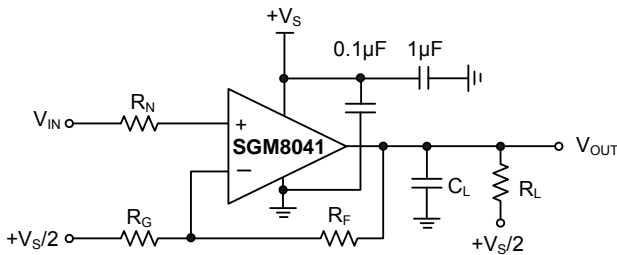


Figure 1. AC and DC Test Circuit for Most Non-Inverting Gain Conditions.

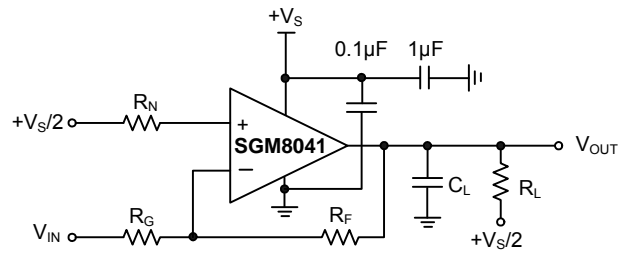
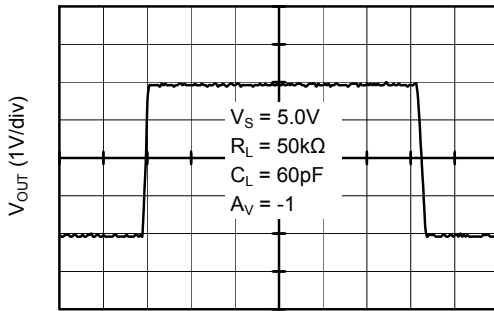


Figure 2. AC and DC Test Circuit for Most Inverting Gain Conditions.

TYPICAL PERFORMANCE CHARACTERISTICS

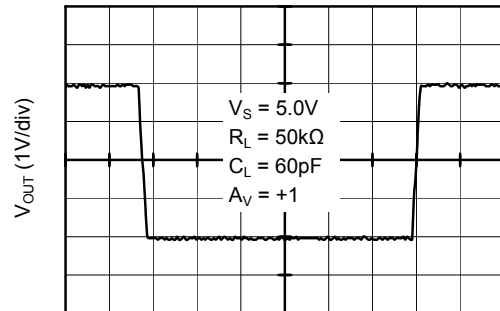
$T_A = +25^\circ\text{C}$, $+V_S = +1.4\text{V}$ to $+5.0\text{V}$, $-V_S = \text{GND}$, $V_{\text{CM}} = +V_S/2$, $V_{\text{OUT}} \approx +V_S/2$ and $R_L = 1\text{M}\Omega$ to $+V_S/2$, $C_L = 60\text{pF}$, unless otherwise noted.

Large Signal Inverting Pulse Response



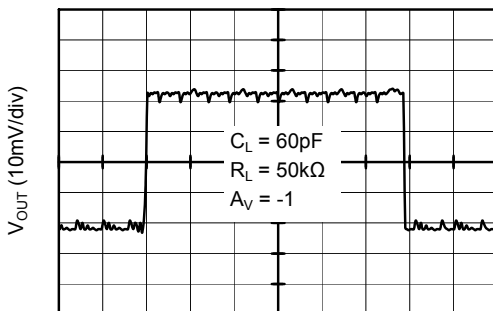
Time (5ms/div)

Large Signal Non-Inverting Pulse Response



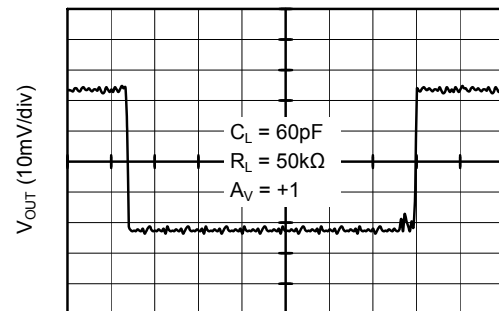
Time (5ms/div)

Small Signal Inverting Pulse Response



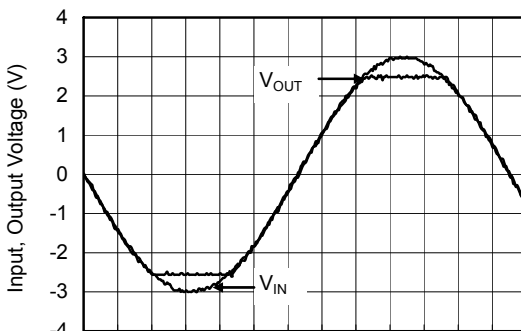
Time (5ms/div)

Small Signal Non-Inverting Pulse Response



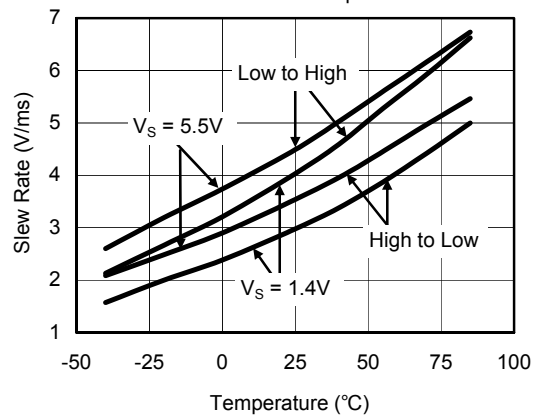
Time (5ms/div)

No Phase Reversal



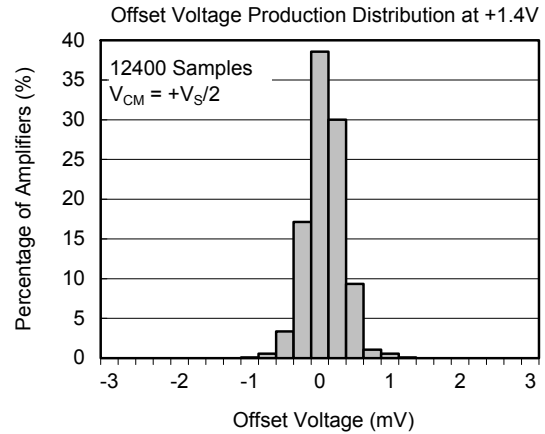
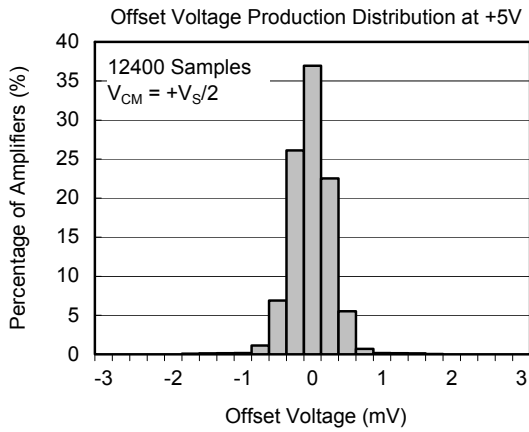
Time (5ms/div)

Slew Rate vs. Temperature



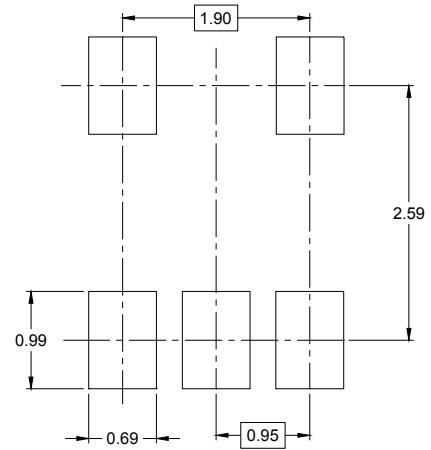
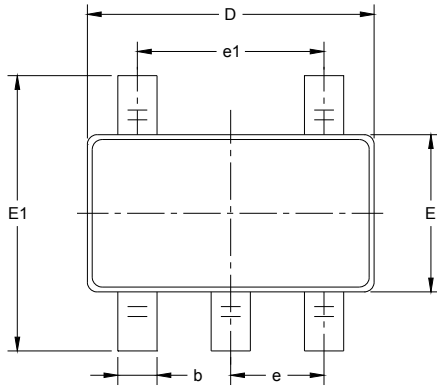
TYPICAL PERFORMANCE CHARACTERISTICS

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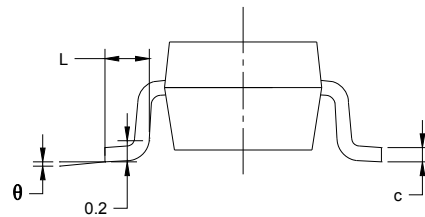
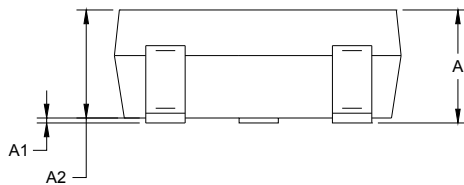


PACKAGE OUTLINE DIMENSIONS

SOT-23-5



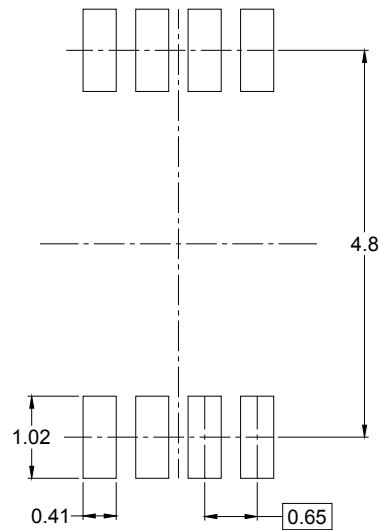
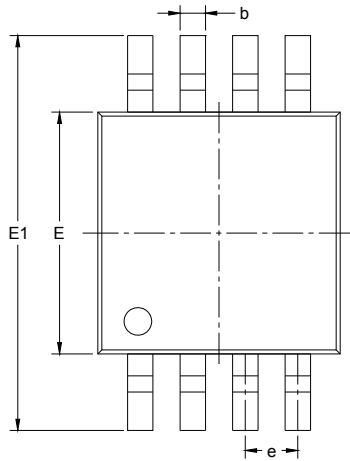
RECOMMENDED LAND PATTERN (Unit: mm)



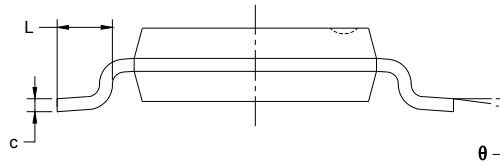
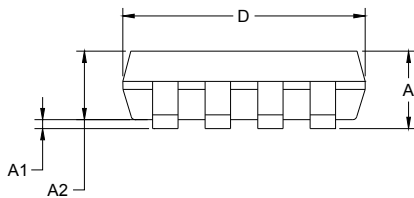
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 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° |

PACKAGE OUTLINE DIMENSIONS

MSOP-8



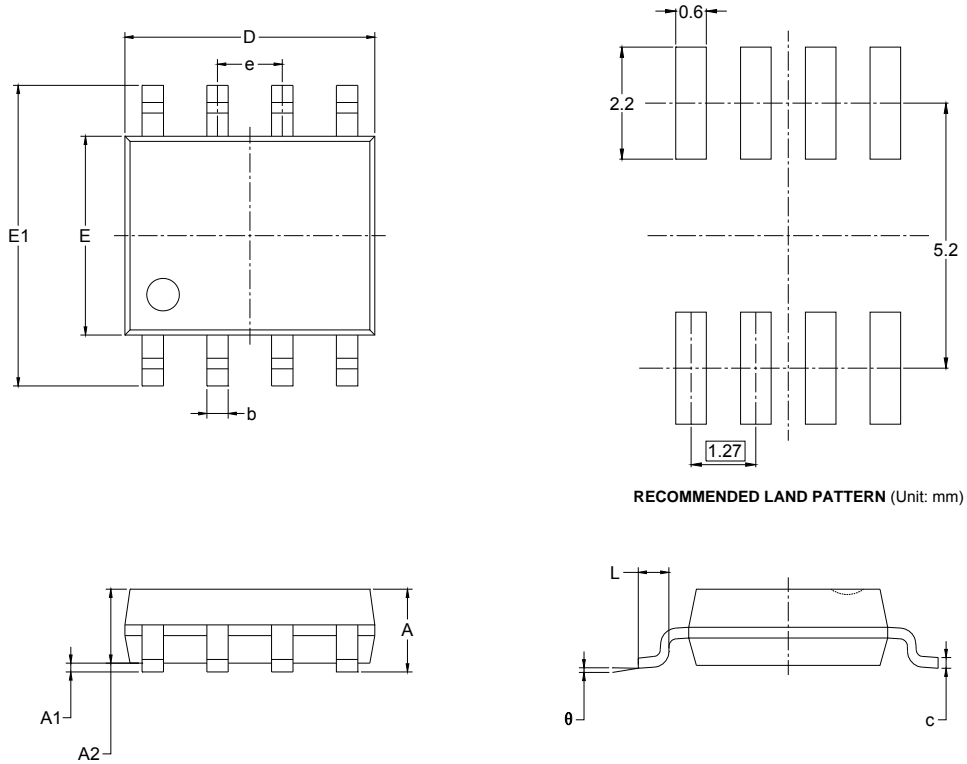
RECOMMENDED LAND PATTERN (Unit: mm)



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.820 | 1.100 | 0.032 | 0.043 |
| A1 | 0.020 | 0.150 | 0.001 | 0.006 |
| A2 | 0.750 | 0.950 | 0.030 | 0.037 |
| b | 0.250 | 0.380 | 0.010 | 0.015 |
| c | 0.090 | 0.230 | 0.004 | 0.009 |
| D | 2.900 | 3.100 | 0.114 | 0.122 |
| E | 2.900 | 3.100 | 0.114 | 0.122 |
| E1 | 4.750 | 5.050 | 0.187 | 0.199 |
| e | 0.650 BSC | | 0.026 BSC | |
| L | 0.400 | 0.800 | 0.016 | 0.031 |
| θ | 0° | 6° | 0° | 6° |

PACKAGE OUTLINE DIMENSIONS

SOIC-8

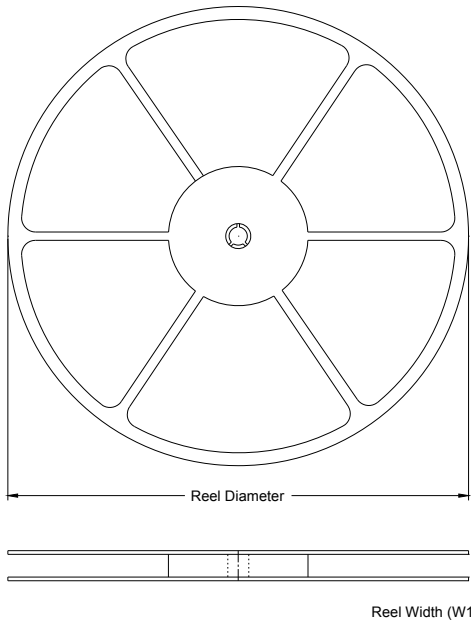


RECOMMENDED LAND PATTERN (Unit: mm)

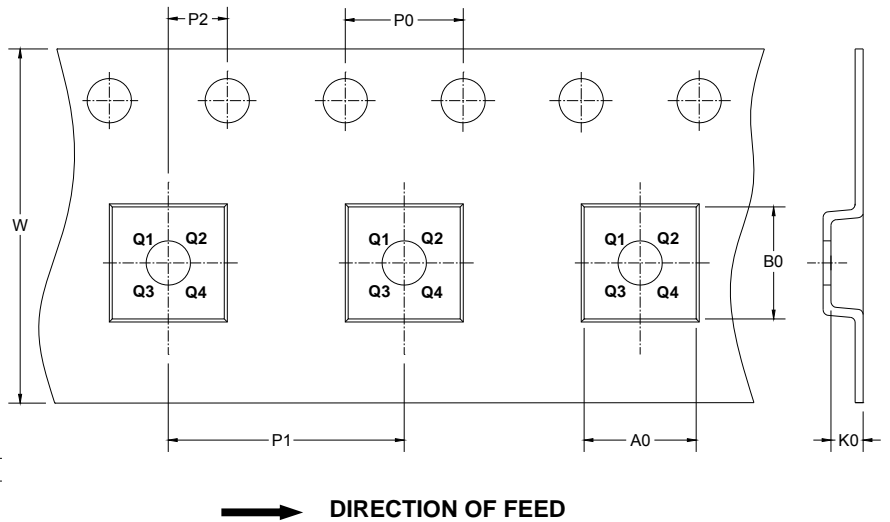
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|----------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| b | 0.330 | 0.510 | 0.013 | 0.020 |
| c | 0.170 | 0.250 | 0.006 | 0.010 |
| D | 4.700 | 5.100 | 0.185 | 0.200 |
| E | 3.800 | 4.000 | 0.150 | 0.157 |
| E1 | 5.800 | 6.200 | 0.228 | 0.244 |
| e | 1.27 BSC | | 0.050 BSC | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS

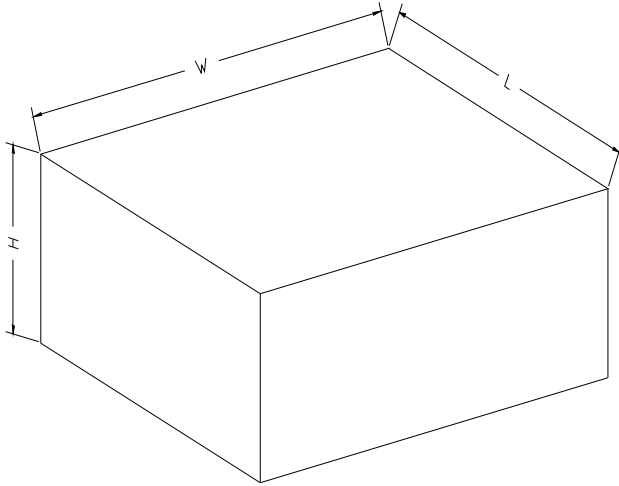


NOTE: The picture is only for reference. Please make the object as the standard.

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 |
|--------------|---------------|--------------------|---------|---------|---------|---------|---------|---------|--------|---------------|
| SOT-23-5 | 7" | 9.5 | 3.2 | 3.2 | 1.4 | 4.0 | 4.0 | 2.0 | 8.0 | Q3 |
| SOIC-8 | 13" | 12.4 | 6.4 | 5.4 | 2.1 | 4.0 | 8.0 | 2.0 | 12.0 | Q1 |
| MSOP-8 | 13" | 12.4 | 5.2 | 3.3 | 1.5 | 4.0 | 8.0 | 2.0 | 12.0 | Q1 |

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 |
| 13" | 386 | 280 | 370 | 5 |