

GENERAL DESCRIPTION

The SGM8048 operates with a single-supply voltage as low as 1.4V, while drawing 690nA (TYP) of quiescent current per amplifier. 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 SGM8048 has a gain-bandwidth product of 100kHz (TYP) and is stable for gains ≥ 10 . The combination of characteristics makes the SGM8048 ideal for low frequency applications, such as battery current monitoring and sensor conditioning.

The SGM8048 operational amplifier is offered in quad configuration and it is specified over the -40°C to $+85^{\circ}\text{C}$ temperature range. The SGM8048 is available in Green SOIC-14 and TSSOP-14 packages.

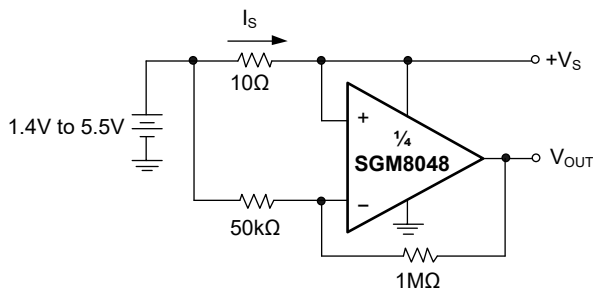
FEATURES

- **Low Quiescent Current: 690nA/Amplifier (TYP)**
- **Rail-to-Rail Input and Output**
- **Gain-Bandwidth Product: 100kHz (TYP)**
- **Stable for Gains ≥ 10**
- **Wide Supply Voltage Range: 1.4V to 5.5V**
- **-40°C to $+85^{\circ}\text{C}$ Operating Temperature Range**
- **Available in Green SOIC-14 and TSSOP-14 Packages**

APPLICATIONS

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

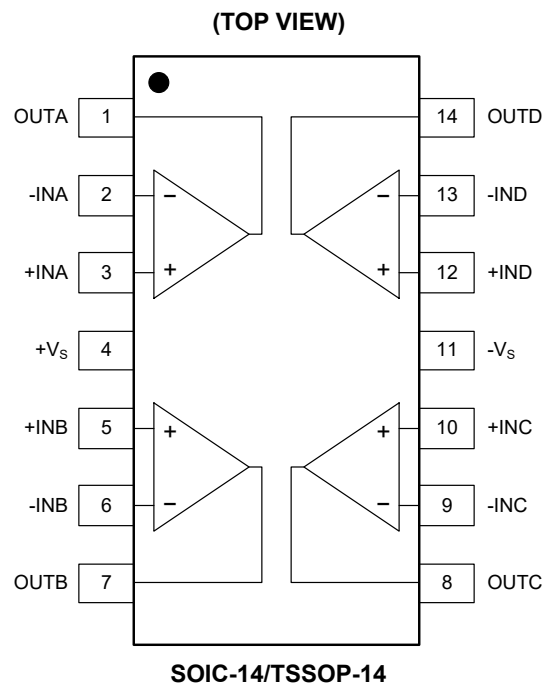
TYPICAL APPLICATION



$$I_s = \frac{+V_s - V_{OUT}}{(20V/V) \cdot (10\Omega)}$$

High-side Battery Current Sensor

PIN CONFIGURATIONS



PACKAGE/ORDERING INFORMATION

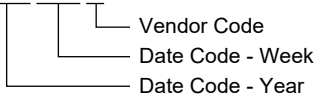
| MODEL | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER | PACKAGE MARKING | PACKING OPTION |
|---------|---------------------|-----------------------------|------------------|---------------------------|---------------------|
| SGM8048 | SOIC-14 | -40°C to +85°C | SGM8048YS14G/TR | SGM8048YS14 XXXXX | Tape and Reel, 2500 |
| | TSSOP-14 | -40°C to +85°C | SGM8048YTS14G/TR | SGM8048 YTS14 XXXXX | Tape and Reel, 3000 |

MARKING INFORMATION

NOTE: XXXXX = Date Code and Vendor Code.

SOIC-14/TSSOP-14

XXXXX



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
- Analog Inputs (+IN, -IN) (-V_S) - 0.1V to (+V_S) + 0.1V
- Differential Input Voltage |(-V_S) - (+V_S)|
- Junction Temperature +150°C
- Storage Temperature Range -65°C to +150°C
- Lead Temperature (Soldering, 10s) +260°C
- ESD Susceptibility
- HBM 4000V
- MM 400V

RECOMMENDED OPERATING CONDITIONS

- Operating Temperature Range -40°C to +85°C

OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods

may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

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, or specifications without prior notice.

ELECTRICAL CHARACTERISTICS

(At $T_A = +25^\circ\text{C}$, $+V_S = 1.4\text{V}$ to 5.0V , $-V_S = \text{GND}$, $A_V = 10$, $V_{\text{CM}} = +V_S/2$, $V_{\text{OUT}} \approx +V_S/2$ and $R_L = 1\text{M}\Omega$ to $+V_S/2$ ⁽¹⁾, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|--------------------------------------|---------------------------------|---|----------------|-------|----------------|------------------------------|
| DC Electrical Characteristics | | | | | | |
| Input Offset Voltage | V_{OS} | $V_{\text{CM}} = +V_S/2$ | | 0.8 | 2.5 | mV |
| Input Offset Voltage Drift | $\Delta V_{\text{OS}}/\Delta T$ | $V_{\text{CM}} = +V_S/2$, $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$ | | 2.5 | | $\mu\text{V}/^\circ\text{C}$ |
| Power Supply Rejection Ratio | PSRR | $+V_S = 1.4\text{V}$ to 5.5V | 74 | 80 | | dB |
| Input Common Mode Voltage Range | V_{CMR} | | $(-V_S) - 0.1$ | | $(+V_S) + 0.1$ | V |
| Common Mode Rejection Ratio | CMRR | $+V_S = 5.0\text{V}$, $V_{\text{CM}} = -0.1\text{V}$ to 5.1V | 68 | 83 | | dB |
| | | $+V_S = 5.0\text{V}$, $V_{\text{CM}} = 2.5\text{V}$ to 5.1V | 65 | 81 | | |
| | | $+V_S = 5.0\text{V}$, $V_{\text{CM}} = -0.1\text{V}$ to 2.5V | 70 | 79 | | |
| Large-Signal Voltage Gain | A_{VO} | $+V_S = 1.4\text{V}$, $R_L = 50\text{k}\Omega$, $V_{\text{OUT}} = (+V_S) - 0.1\text{V}$ | 70 | 79 | | dB |
| | | $+V_S = 2.5\text{V}$, $R_L = 50\text{k}\Omega$, $V_{\text{OUT}} = (+V_S) - 0.1\text{V}$ | | 88 | | |
| | | $+V_S = 5.0\text{V}$, $R_L = 50\text{k}\Omega$, $V_{\text{OUT}} = (+V_S) - 0.1\text{V}$ | 83 | 92 | | |
| Input Bias Current | I_{B} | | | 1 | | pA |
| Input Offset Current | I_{OS} | | | 1 | | pA |
| Maximum Output Voltage Swing | V_{OH} | $+V_S = 1.4\text{V}$, $R_L = 50\text{k}\Omega$ | 1.390 | 1.395 | | V |
| | | $+V_S = 2.5\text{V}$, $R_L = 50\text{k}\Omega$ | | 2.497 | | |
| | | $+V_S = 5.0\text{V}$, $R_L = 50\text{k}\Omega$ | 4.990 | 4.996 | | |
| | V_{OL} | $+V_S = 1.4\text{V}$, $R_L = 50\text{k}\Omega$ | | 5.4 | 10 | mV |
| | | $+V_S = 2.5\text{V}$, $R_L = 50\text{k}\Omega$ | | 3.4 | | |
| | | $+V_S = 5.0\text{V}$, $R_L = 50\text{k}\Omega$ | | 3.7 | 10 | |
| Output Short-Circuit Current | I_{SC} | $+V_S = 2.5\text{V}$ | | 5.3 | | mA |
| | | $+V_S = 5.0\text{V}$ | 22 | 23 | | |
| Supply Voltage | V_{CC} | | 1.4 | | 5.5 | V |
| Quiescent Current/Amplifier | I_{Q} | $+V_S = 1.4\text{V}$ | | 550 | | nA |
| | | $+V_S = 2.5\text{V}$ | | 680 | | |
| | | $+V_S = 5.0\text{V}$ | | 690 | 1500 | |

ELECTRICAL CHARACTERISTICS (continued)

(At $T_A = +25^\circ\text{C}$, $+V_S = 1.4\text{V}$ to 5.0V , $-V_S = \text{GND}$, $A_V = 10$, $V_{CM} = +V_S/2$, $V_{OUT} \approx +V_S/2$ and $R_L = 1\text{M}\Omega$ to $+V_S/2$, $C_L = 60\text{pF}$ ⁽¹⁾, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|--------------------------------------|--------------------|--|-----|------|-----|------------------------------|
| AC Electrical Characteristics | | | | | | |
| Gain-Bandwidth Product | GBP | | | 100 | | kHz |
| Slew Rate | SR | $+V_S = 1.4\text{V}$, $V_{OUT} = 1\text{V}$ Step | | 8 | | V/ms |
| | | $+V_S = 2.5\text{V}$, $V_{OUT} = 1\text{V}$ Step | | 13.5 | | |
| | | $+V_S = 5.0\text{V}$, $V_{OUT} = 2\text{V}$ Step | | 14.5 | | |
| Phase Margin | PM | $+V_S = 1.4\text{V}$ to 5.5V | | 60 | | ° |
| Input Voltage Noise | $e_{n\text{ p-p}}$ | $+V_S = 1.4\text{V}$, $f = 0.1\text{Hz}$ to 10Hz | | 3.7 | | $\mu\text{V}_{\text{P-P}}$ |
| | | $+V_S = 2.5\text{V}$, $f = 0.1\text{Hz}$ to 10Hz | | 3.7 | | |
| | | $+V_S = 5.0\text{V}$, $f = 0.1\text{Hz}$ to 10Hz | | 3.5 | | |
| Input Voltage Noise Density | e_n | $+V_S = 1.4\text{V}$, $f = 1\text{kHz}$ | | 240 | | $\text{nV}/\sqrt{\text{Hz}}$ |
| | | $+V_S = 2.5\text{V}$, $f = 1\text{kHz}$ | | 190 | | |
| | | $+V_S = 5.0\text{V}$, $f = 1\text{kHz}$ | | 205 | | |

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. The bypass capacitors are laid out according to the rules discussed in "Supply Bypass".

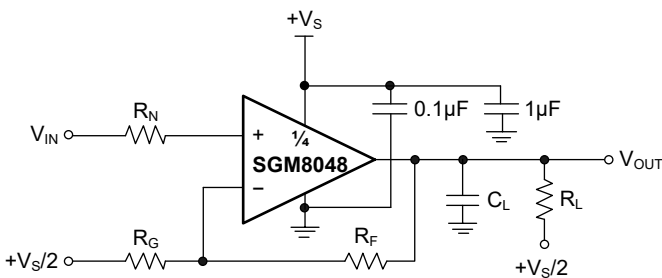


Figure 1. AC and DC Test Circuit for Most Non-Inverting Gain Conditions

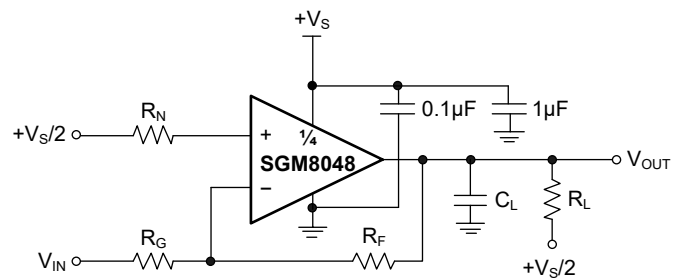
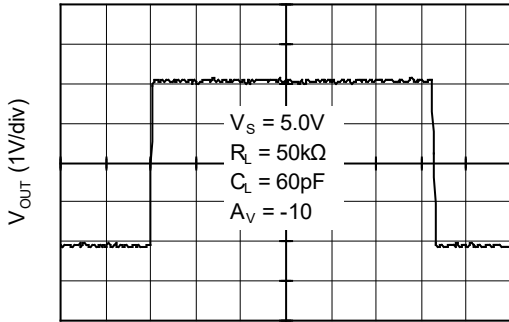


Figure 2. AC and DC Test Circuit for Most Inverting Gain Conditions

TYPICAL PERFORMANCE CHARACTERISTICS

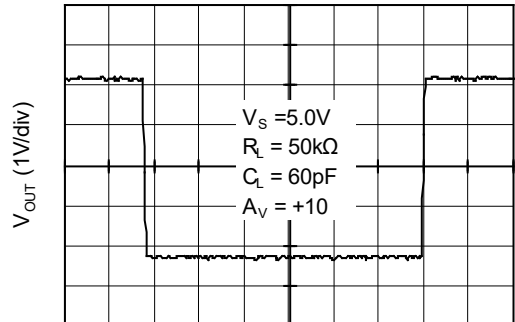
At $T_A = +25^\circ\text{C}$, $+V_S = 1.4\text{V}$ to 5.0V , $-V_S = \text{GND}$, $A_V = 10$, $V_{CM} = +V_S/2$, $V_{OUT} \approx +V_S/2$ and $R_L = 1\text{M}\Omega$ to $+V_S/2$, $C_L = 60\text{pF}$, unless otherwise noted.

Large Signal Inverting Pulse Response



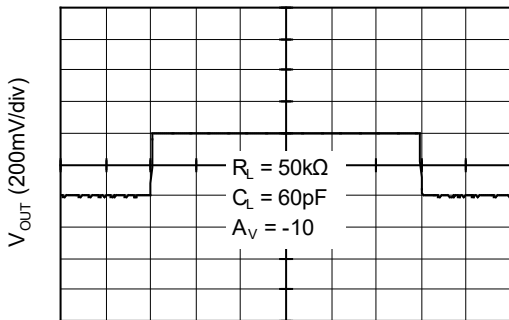
Time (5ms/div)

Large Signal Non-Inverting Pulse Response



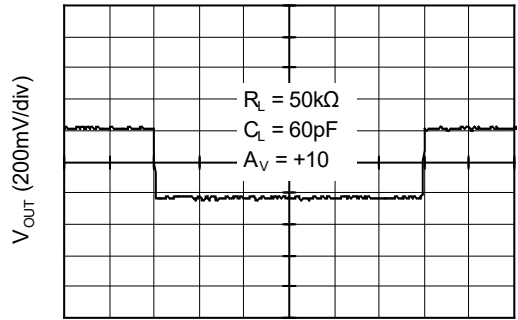
Time (5ms/div)

Small Signal Inverting Pulse Response



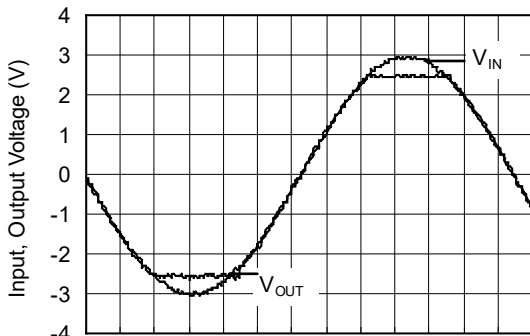
Time (5ms/div)

Small Signal Non-Inverting Pulse Response



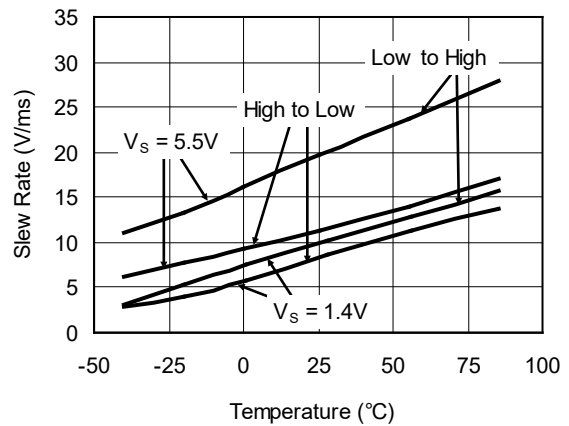
Time (5ms/div)

No Phase Reversal



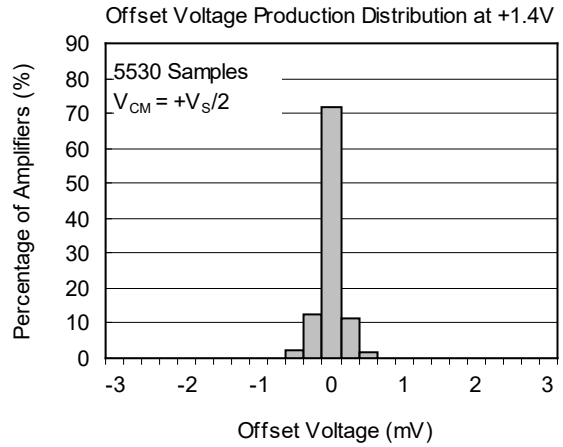
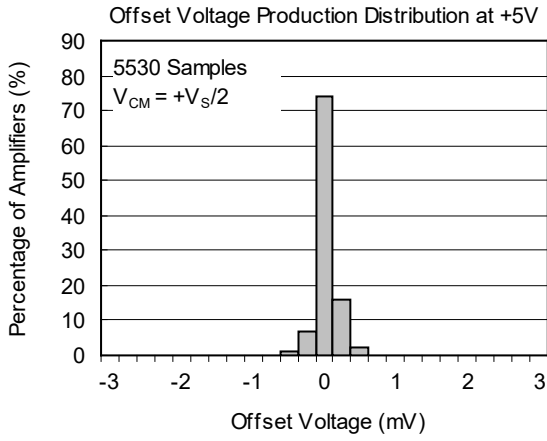
Time (5ms/div)

Slew Rate vs. Temperature



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At $T_A = +25^\circ\text{C}$, $+V_S = 1.4\text{V to } 5.0\text{V}$, $-V_S = \text{GND}$, $A_V = 10$, $V_{CM} = +V_S/2$, $V_{OUT} \approx +V_S/2$ and $R_L = 1\text{M}\Omega$ to $+V_S/2$, $C_L = 60\text{pF}$, unless otherwise noted.



REVISION HISTORY

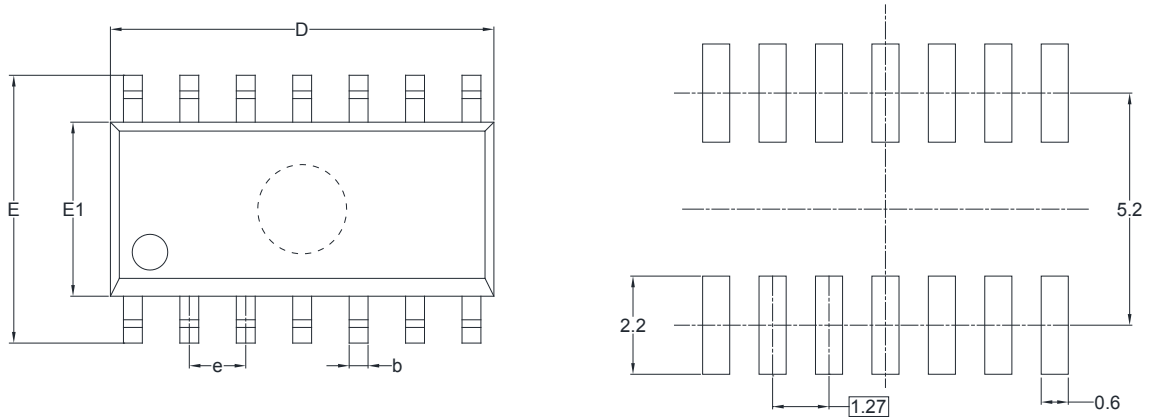
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| | Page |
|--|------|
| JANUARY 2013 – REV.A.1 to REV.A.2 | |
| Added Tape and Reel Information section..... | 9~10 |
| MAY 2011 – REV.A to REV.A.1 | |
| Updated Package Description | All |
| Changes from Original (JUNE 2010) to REV.A | |
| Changed from product preview to production data..... | All |

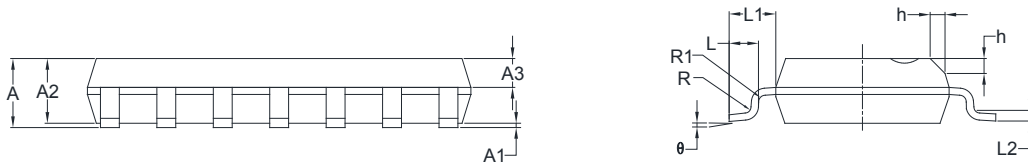
PACKAGE INFORMATION

PACKAGE OUTLINE DIMENSIONS

SOIC-14



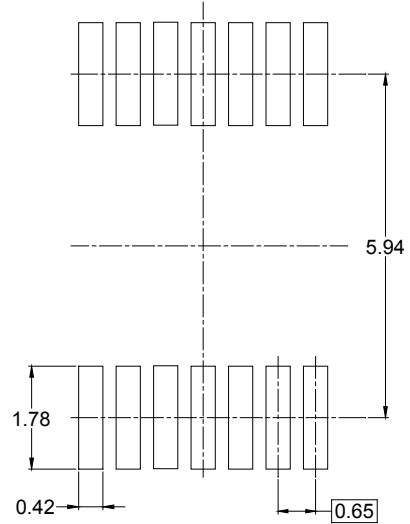
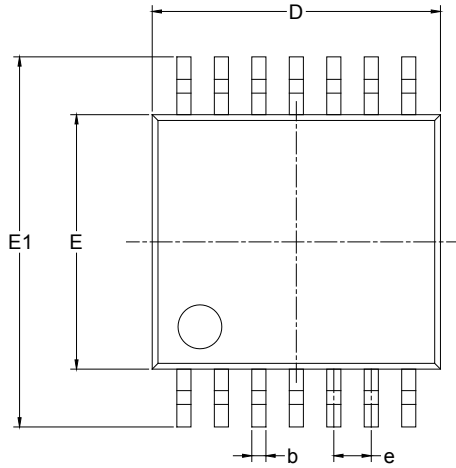
RECOMMENDED LAND PATTERN (Unit: mm)



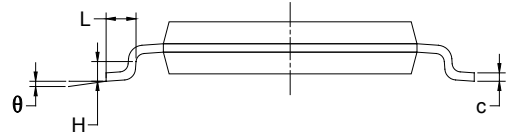
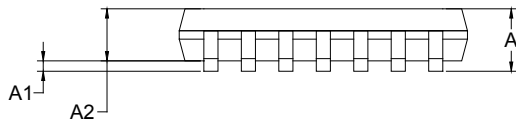
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|------------------------------|------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.35 | 1.75 | 0.053 | 0.069 |
| A1 | 0.10 | 0.25 | 0.004 | 0.010 |
| A2 | 1.25 | 1.65 | 0.049 | 0.065 |
| A3 | 0.55 | 0.75 | 0.022 | 0.030 |
| b | 0.36 | 0.49 | 0.014 | 0.019 |
| D | 8.53 | 8.73 | 0.336 | 0.344 |
| E | 5.80 | 6.20 | 0.228 | 0.244 |
| E1 | 3.80 | 4.00 | 0.150 | 0.157 |
| e | 1.27 BSC | | 0.050 BSC | |
| L | 0.45 | 0.80 | 0.018 | 0.032 |
| L1 | 1.04 REF | | 0.040 REF | |
| L2 | 0.25 BSC | | 0.01 BSC | |
| R | 0.07 | | 0.003 | |
| R1 | 0.07 | | 0.003 | |
| h | 0.30 | 0.50 | 0.012 | 0.020 |
| θ | 0° | 8° | 0° | 8° |

PACKAGE OUTLINE DIMENSIONS

TSSOP-14



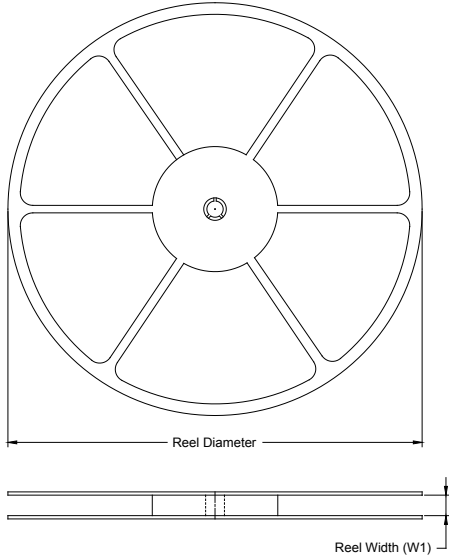
RECOMMENDED LAND PATTERN (Unit: mm)



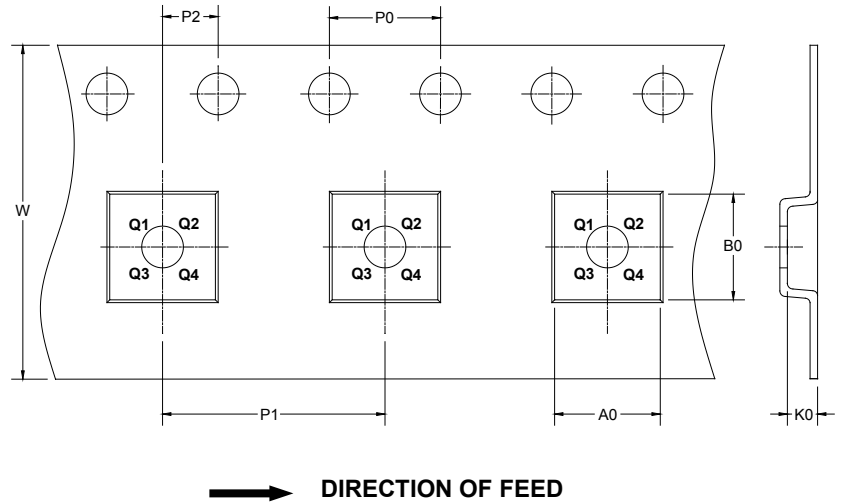
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|----------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | | 1.200 | | 0.047 |
| A1 | 0.050 | 0.150 | 0.002 | 0.006 |
| A2 | 0.800 | 1.050 | 0.031 | 0.041 |
| b | 0.190 | 0.300 | 0.007 | 0.012 |
| c | 0.090 | 0.200 | 0.004 | 0.008 |
| D | 4.860 | 5.100 | 0.191 | 0.201 |
| E | 4.300 | 4.500 | 0.169 | 0.177 |
| E1 | 6.250 | 6.550 | 0.246 | 0.258 |
| e | 0.650 BSC | | 0.026 BSC | |
| L | 0.500 | 0.700 | 0.02 | 0.028 |
| H | 0.25 TYP | | 0.01 TYP | |
| θ | 1° | 7° | 1° | 7° |

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 |
|--------------|---------------|--------------------|---------|---------|---------|---------|---------|---------|--------|---------------|
| SOIC-14 | 13" | 16.4 | 6.60 | 9.30 | 2.10 | 4.0 | 8.0 | 2.0 | 16.0 | Q1 |
| TSSOP-14 | 13" | 12.4 | 6.95 | 5.60 | 1.20 | 4.0 | 8.0 | 2.0 | 12.0 | Q1 |

DD0001

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

DD0002