

Features

- HIGH GAIN BANDWIDTH:1.1MHz
- RAIL-TO-RAIL INPUT AND OUTPUT
0.6mV Typical V_{OS}
- INPUT VOLTAGE RANGE: -0.1V to +5.6V
with $V_S = 5.5V$
- SUPPLY RANGE: +2.5V to +5.5V
- SPECIFIED UP TO +125°C
- MicroSIZE PACKAGES: SOT23-5, SOT23-6

Application

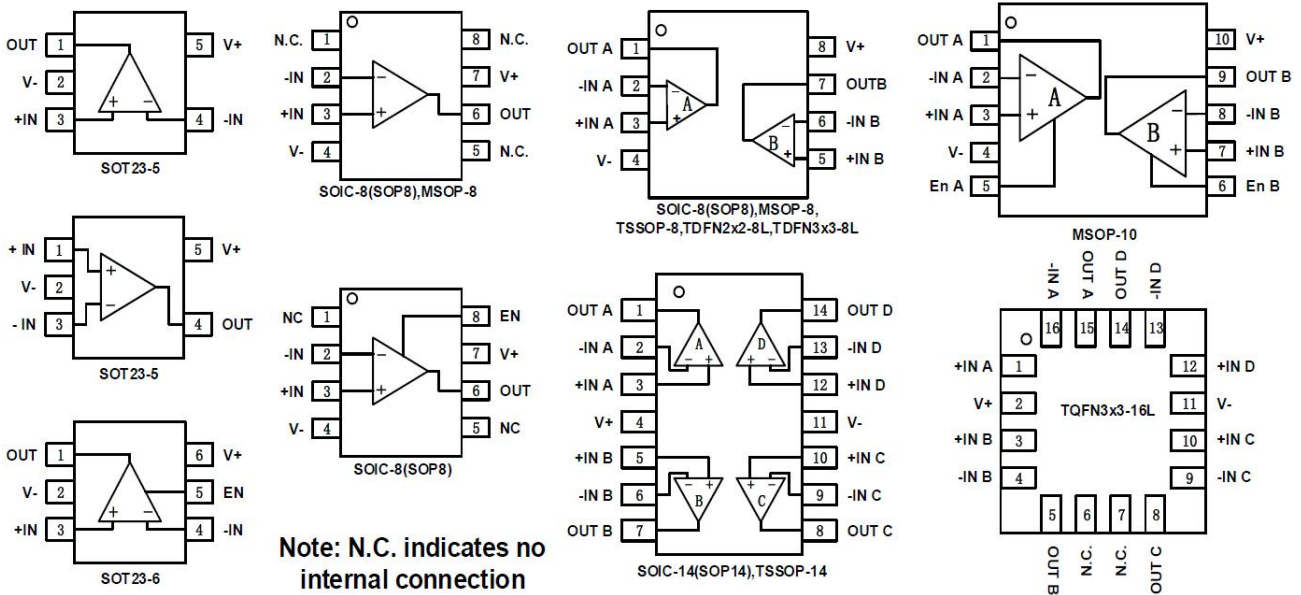
- SENSORS
- PHOTODIODE AMPLIFICATION
- ACTIVE FILTERS
- TEST EQUIPMENT
- DRIVING A/D CONVERTERS

Description

The CBM8541, CBM8542, CBM8544, families of products offer low voltage operation and rail-to-rail input and output, as well as excellent speed/power consumption ratio, providing an excellent bandwidth (1.1MHz) and slew rate of 0.5V/us. The op-amps are unity gain stable and feature an ultra-low input bias current.

The devices are ideal for sensor interfaces, active filters and portable applications. The CBM8541, CBM8542, CBM8544, families of operational amplifiers are specified at the full temperature range of -40°C to +125°C under single or dual power supplies of 2.5V to 5.5V.

PIN CONFIGURATIONS



ABSOLUTE MAXIMUM RATINGS ⁽¹⁾

- Supply Voltage, V+ to V-.....7.0V
- Input Terminals, Voltage ⁽²⁾ - 0.5 to (V+) + 0.5V
Current ⁽²⁾ ±10mA
- Storage Temperature -65°C to +150°C
- Operating Temperature -40°C to +125°C
- Junction Temperature.....150°C
- Package Thermal Resistance @ T_A= +25°C
- SOT23-5, SOT23-6.....200°C/W
- MSOP-10, SOIC-8, TSSOP-8 150°C/W
- SOIC-14, TSSOP-14.....100°C/W
- Lead Temperature (Soldering, 10s)260°C
- ESD Susceptibility
- HBM5000V
- MM400V

1. Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.
2. Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current-limited to 10mA or less.



ESD SENSITIVITY CAUTION

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.

ELECTRICAL CHARACTERISTICS

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

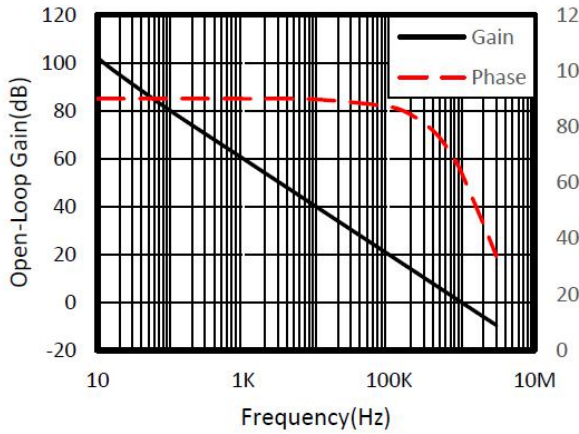
| PARAMETER | CONDITIONS | T_J | CBM8541, CBM8542, CBM8544 | | | UNIT | |
|---------------|------------------------------------|---|---|------|-----|------|------------------------------|
| | | | MIN | TYP | MAX | | |
| | | | POWER SUPPLY | | | | |
| V_S | Operating Voltage Range | | 25°C | 2.5 | | 5.5 | V |
| I_Q | Quiescent Current/Amplifier | | 25°C | | 58 | 80 | μA |
| PSRR | Power-Supply Rejection Ratio | $V_S = 2.5\text{V to } 5.5\text{V}$, $V_{cm} = (V_-) + 0.5\text{V}$ | 25°C | 72 | 90 | | dB |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | 65 | | | |
| INPUT | | | | | | | |
| V_{os} | Input Offset Voltage | | 25°C | | 0.6 | 3 | mV |
| $V_{os\ TC}$ | Input Offset Voltage Average Drift | $-40^\circ\text{C to } 125^\circ\text{C}$ | | | 2 | | $\mu\text{V}/^\circ\text{C}$ |
| I_B | Input Bias Current | | 25°C | | 1 | 10 | pA |
| I_{os} | Input Offset Current | | 25°C | | 1 | 10 | pA |
| V_{cm} | Common-Mode Voltage Range | $V_S = 5.5\text{V}$ | 25°C | -0.1 | | 5.6 | V |
| CMRR | Common-Mode Rejection Ratio | $V_S = 5.5\text{V}$, $V_{cm} = -0.1\text{V to } 4\text{V}$ | 25°C | 71 | 90 | | dB |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | 68 | | | |
| | | $V_S = 5.5\text{V}$, $V_{cm} = -0.1\text{V to } 5.6\text{V}$ | 25°C | 60 | 80 | | |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | 57 | | | |
| OUTPUT | | | | | | | |
| AOL | Open-Loop Voltage Gain | $R_L = 2\text{k}\Omega$, $V_o = 0.15\text{V to } 4.85\text{V}$ | 25°C | 94 | 105 | | dB |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | 85 | | | |
| | | $R_L = 10\text{k}\Omega$, $V_o = 0.05\text{V to } 4.95\text{V}$ | 25°C | 100 | 110 | | |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | 90 | | | |
| | Output Swing From Rail | $R_L = 2\text{k}\Omega$ | 25°C | | 25 | | mV |
| | | $R_L = 10\text{k}\Omega$ | | | 8 | | |
| I_{out} | Output Short-Circuit Current | | 25°C | | 55 | | mA |

| FREQUENCY RESPONSE | | | | | | | |
|----------------------------------|-----------------------------|-------------------------------------|------|---------|-----|-----------|------------------------|
| SR | Slew Rate | | 25°C | | 0.5 | | V/us |
| GBP | Gain-Bandwidth Product | | 25°C | | 1.1 | | MHz |
| PM | Phase Margin | | 25°C | | 64 | | ° |
| ts | Setting Time,0.1% | | | | 1.3 | | us |
| | Overload Recovery Time | $V_{IN} \cdot \text{Gain} \geq V_S$ | | | 2.3 | | us |
| NOISE | | | | | | | |
| en | Input Voltage Noise Density | f = 1KHz | 25°C | | 22 | | nV/ $\sqrt{\text{Hz}}$ |
| | | f = 10KHz | 25°C | | 20 | | nV/ $\sqrt{\text{Hz}}$ |
| ENABLE/SHUTDOWN(CBM8541,CBM8542) | | | | | | | |
| $I_{Q(OFF)}$ | Supply Current in Shutdown | | 25°C | | <1 | | uA |
| t_{OFF} | | | 25°C | | 3 | | us |
| t_{ON} | | | 25°C | | 20 | | us |
| V_L | Shut Down | | 25°C | V- | | (V-) +0.8 | V |
| V_H | Amplifier Is Active | | 25°C | (V-) +2 | | V+ | V |

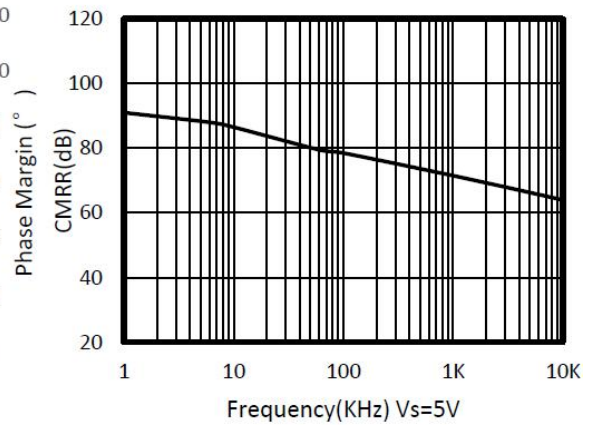
TYPICAL CHARACTERISTICS

At $T_A = +25^\circ\text{C}$, $V_S = 5\text{V}$, $R_L = 10\text{k}\Omega$ connected to $V_S/2$, $V_{OUT} = V_S/2$, unless otherwise noted.

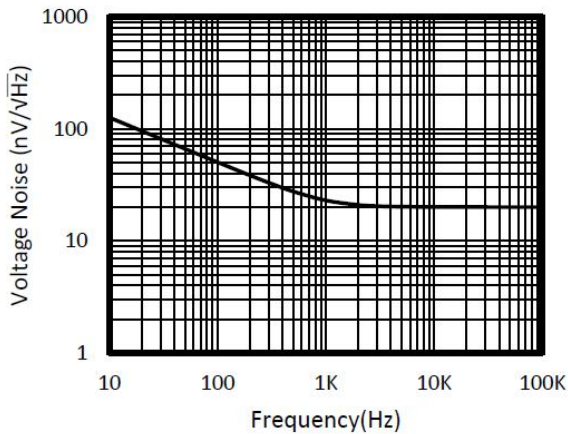
OPEN-LOOP GAIN AND PHASE vs FREQUENCY



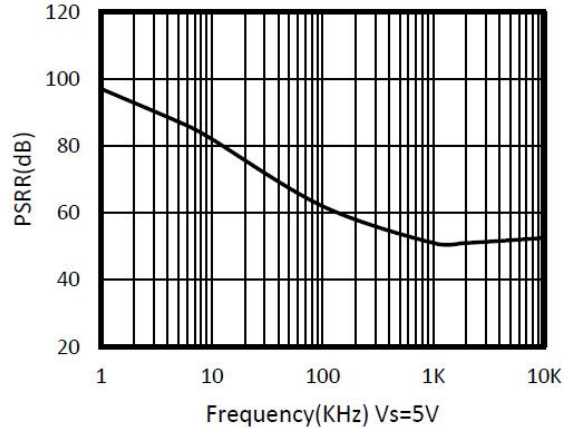
COMMON-MODE REJECTION RATIO vs FREQUENCY



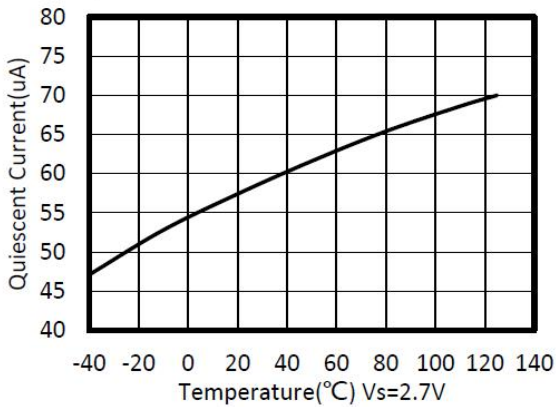
INPUT VOLTAGE NOISE SPECTRAL DENSITY vs FREQUENCY



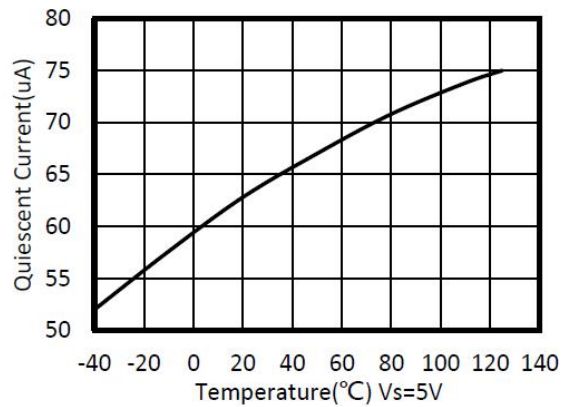
POWER-SUPPLY REJECTION RATIO vs FREQUENCY



QUIESCENT CURRENT vs TEMPERATURE

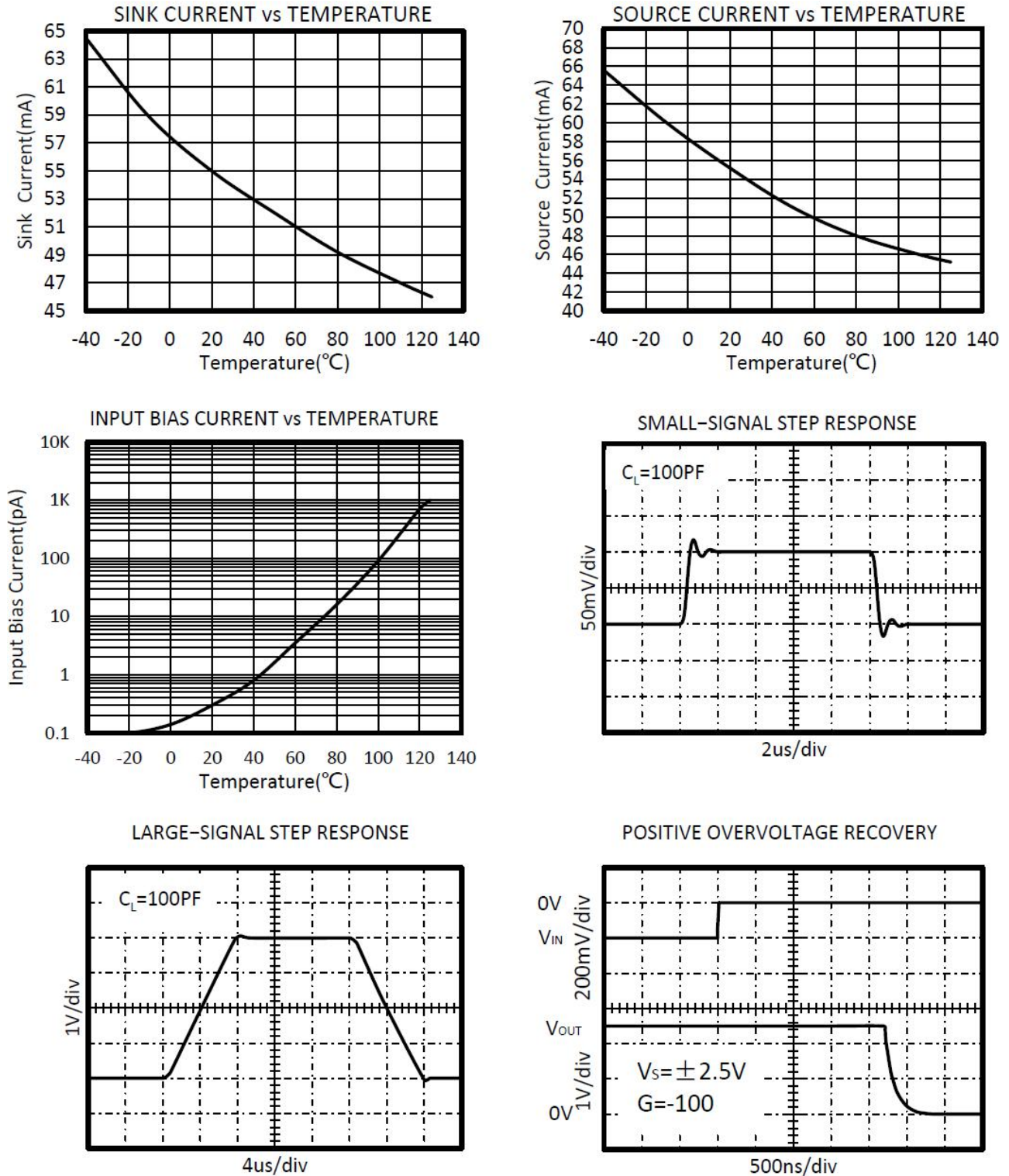


QUIESCENT CURRENT vs TEMPERATURE



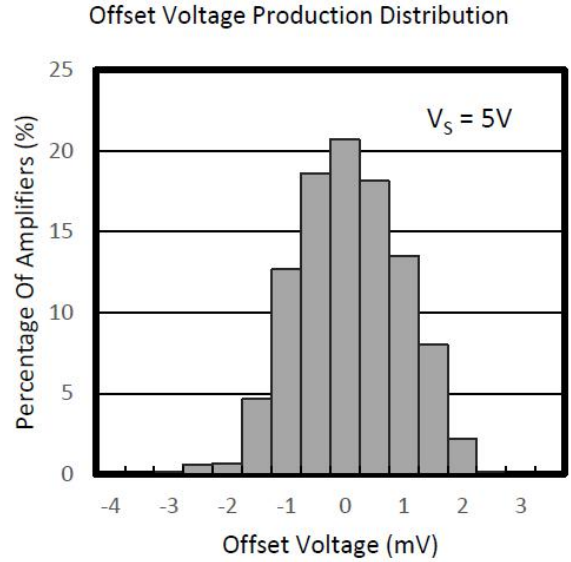
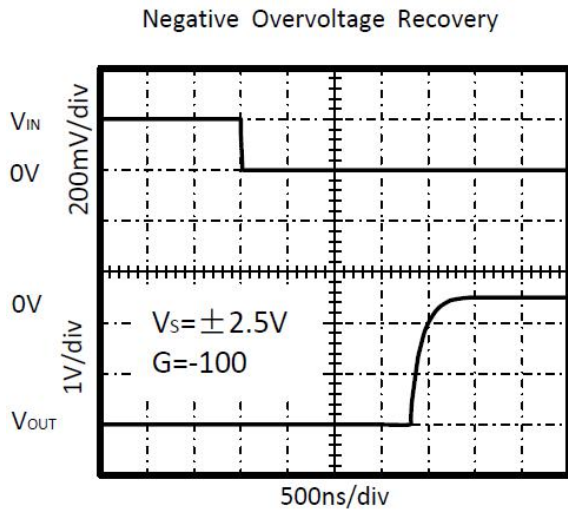
TYPICAL CHARACTERISTICS

At $T_A = +25^\circ\text{C}$, $V_S = 5\text{V}$, $R_L = 10\text{k}\Omega$ connected to $V_S/2$, $V_{OUT} = V_S/2$, unless otherwise noted.



TYPICAL CHARACTERISTICS

At $T_A = +25^\circ\text{C}$, $V_S = 5\text{V}$, $R_L = 10\text{k}\Omega$ connected to $V_S/2$, $V_{OUT} = V_S/2$, unless otherwise noted.



APPLICATION NOTES

The CBM8541, CBM8542, CBM8544 are high precision, rail-to-rail operational amplifiers that can be run from a single-supply voltage 2.5V to 5.5V ($\pm 1.25V$ to $\pm 2.75V$). Supply voltages higher than 7V (absolute maximum) can permanently damage the amplifier.

Rail-to-rail input and output swing significantly increases dynamic range, especially in low-supply applications.

Good layout practice mandates use of a 0.1uF capacitor place closely across the supply pins.

LAYOUT GUIDELINES

Attention to good layout practices is always recommended. Keep traces short. When possible, use a PCB ground plane with surface-mount components placed as close to the device pins as possible. Place a 0.1uF 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 susceptibility.

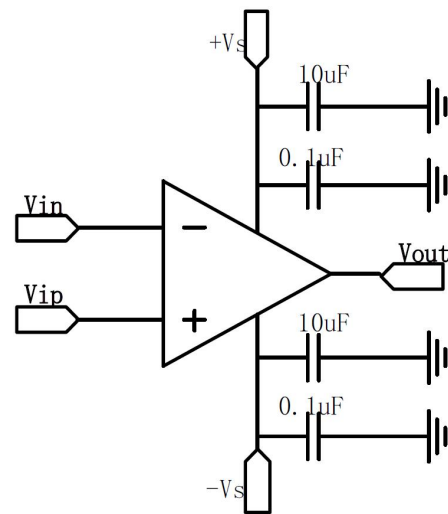


Figure1. Amplifier with Bypass Capacitors

INSTRUMENTATION AMPLIFIER

In the three-op amp, instrumentation amplifier configuration shown in Figure2.

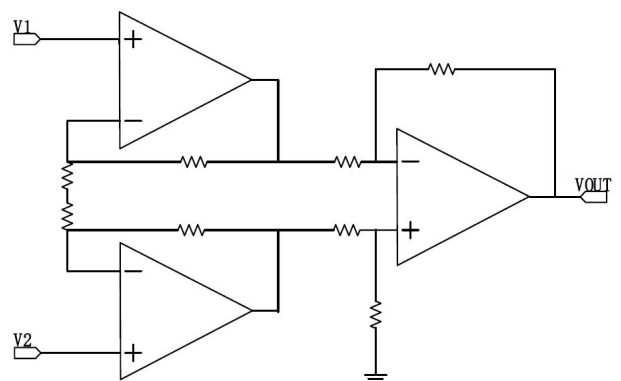
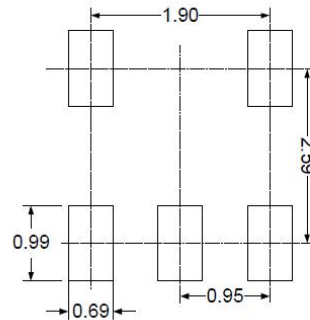
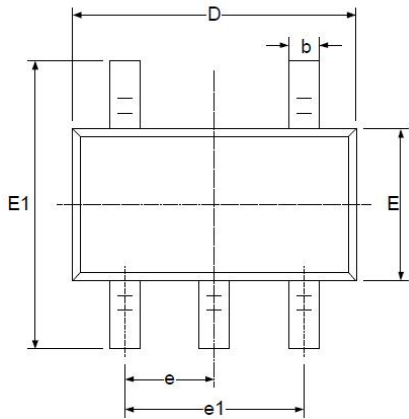


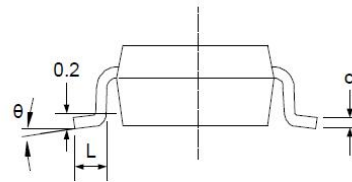
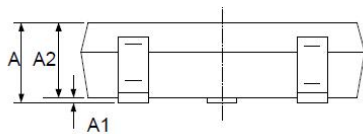
Figure2. Amplifier instrumentation amplifier

PACKAGE OUTLINE DIMENSIONS

SOT23-5

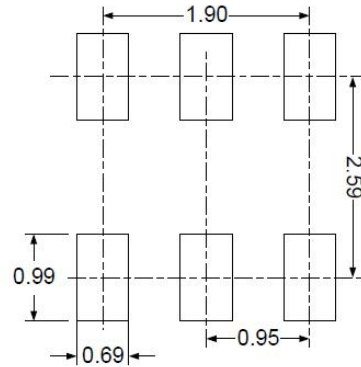
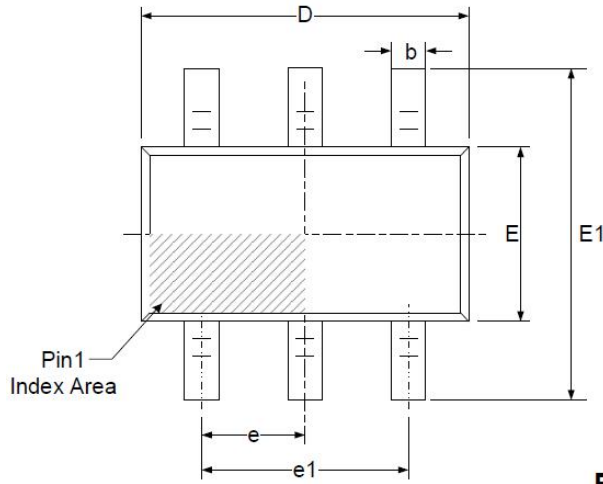


RECOMMENDED LAND PATTERN (Unit: mm)

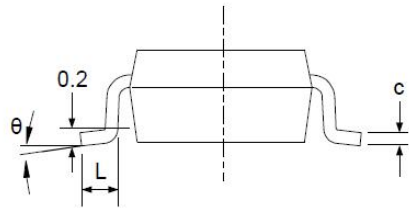
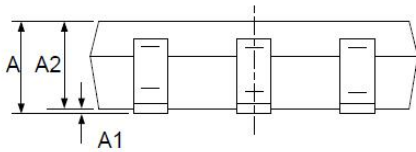


| Symbol | Dimensions In Millimeters | | Dimensions Inches | |
|--------|---------------------------|-------|-------------------|-------|
| | Min | Max | Min | Max |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.500 | 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 | 1.800 | 2.000 | 0.071 | 0.079 |
| L | 0.300 | 0.600 | 0.012 | 0.024 |
| θ | 0° | 8° | 0° | 8° |

SOT23-6

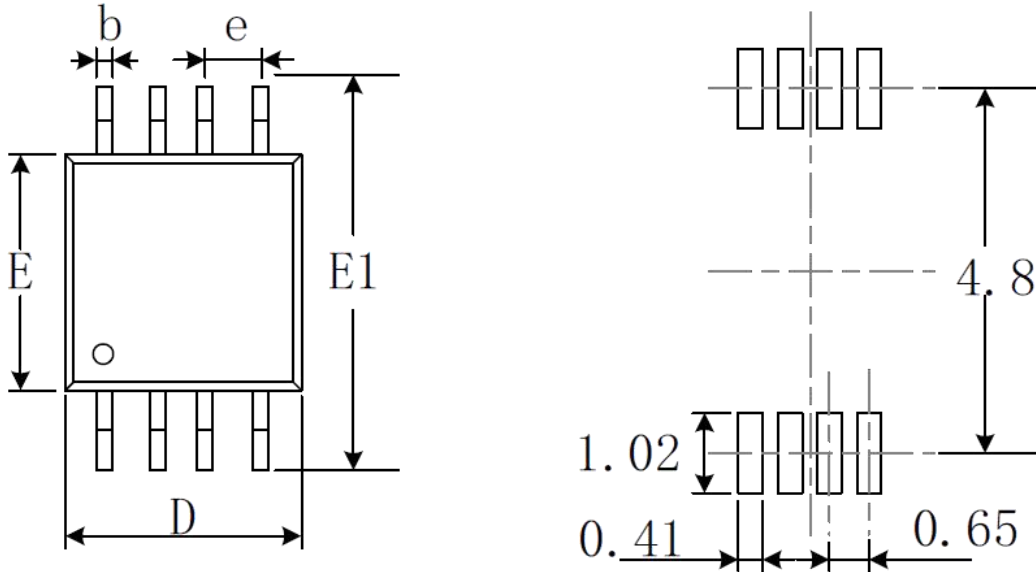


RECOMMENDED LAND PATTERN (Unit: mm)

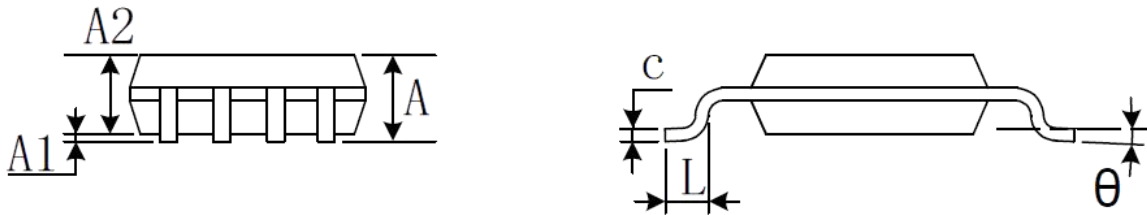


| Symbol | Dimensions In Millimeters | | Dimensions Inches | |
|----------|---------------------------|-------|-------------------|-------|
| | Min | Max | Min | Max |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.500 | 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 | 1.800 | 2.000 | 0.071 | 0.079 |
| L | 0.300 | 0.600 | 0.012 | 0.024 |
| θ | 0° | 8° | 0° | 8° |

MSOP-8

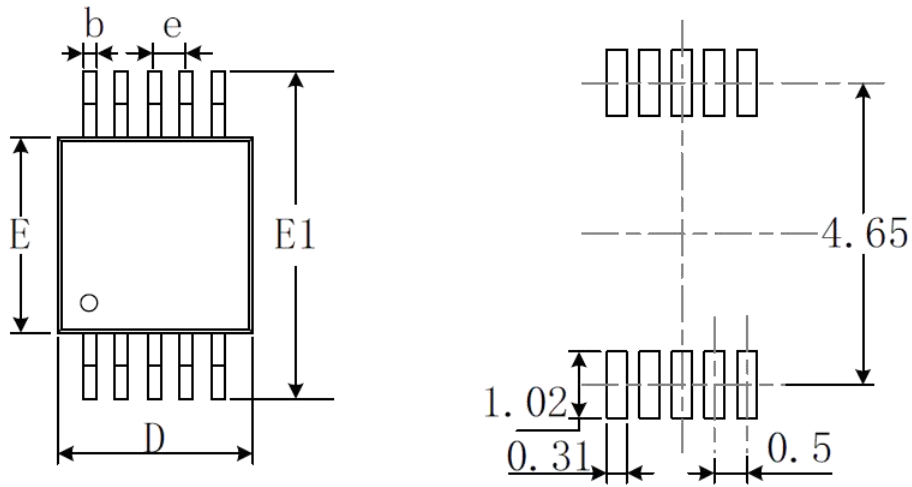


RECOMMENDED LAND PATTERN (Unit: mm)



| Symbol | Dimensions In Millimeters | | Dimensions 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° |

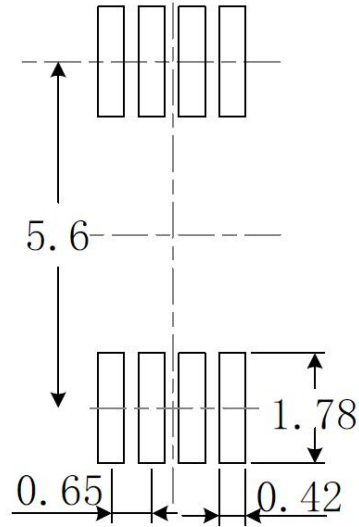
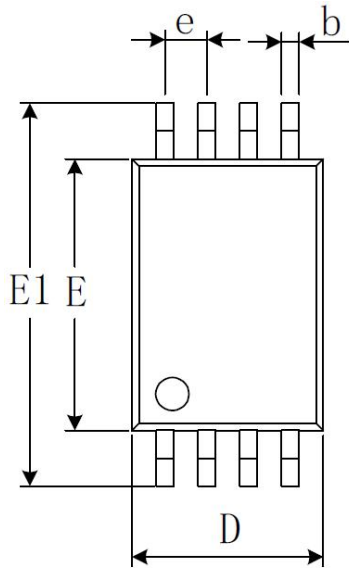
MSOP-10



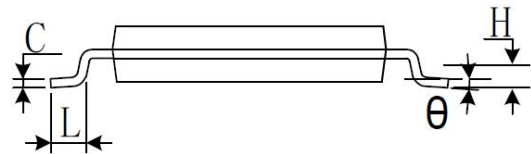
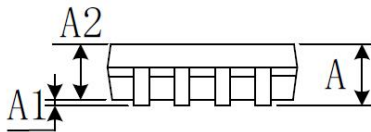
RECOMMENDED LAND PATTERN (Unit: mm)

| Symbol | Dimensions In Millimeters | | Dimensions 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 | 0.180 | 0.280 | 0.007 | 0.011 |
| 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 | 0.50 BSC | | 0.020 BSC | |
| L | 0.400 | 0.800 | 0.016 | 0.031 |
| θ | 0° | 6° | 0° | 6° |

TSSOP-8

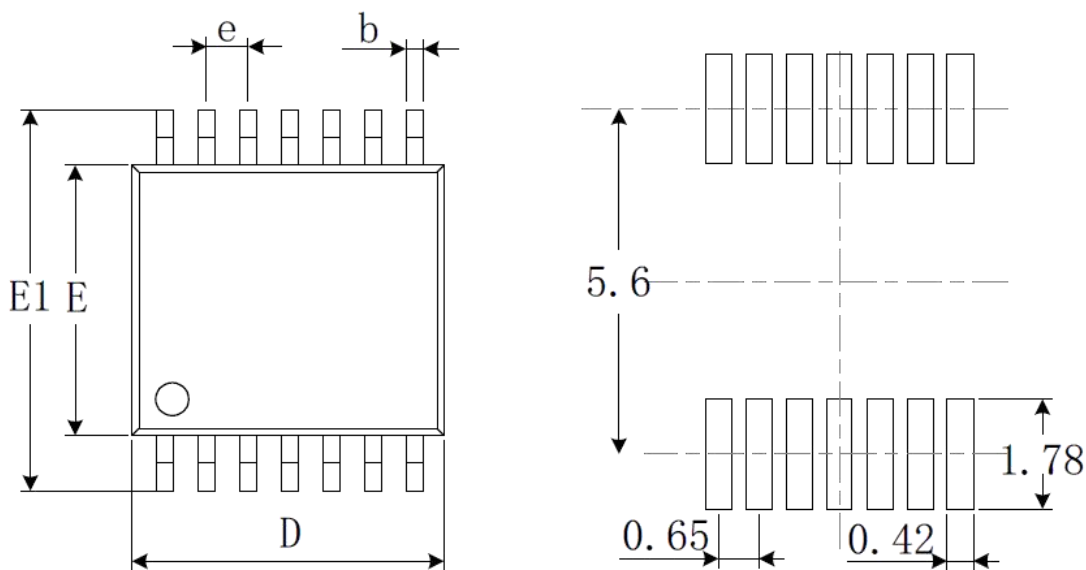


RECOMMENDED LAND PATTERN (Unit: mm)

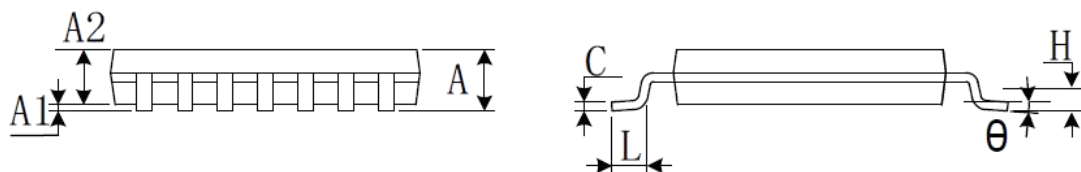


| Symbol | Dimensions In Millimeters | | Dimensions Inches | |
|----------|---------------------------|-------|-------------------|-------|
| | Min | Max | Min | Max |
| A | | 1.200 | | 0.047 |
| A1 | 0.050 | 0.150 | 0.002 | 0.006 |
| A2 | 0.800 | 1.050 | 0.031 | 0.041 |
| b | 0.190 | 0.300 | 0.007 | 0.012 |
| c | 0.090 | 0.200 | 0.004 | 0.008 |
| D | 2.900 | 3.100 | 0.114 | 0.122 |
| 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 | 0.020 | 0.028 |
| H | 0.25 TYP | | 0.01 TYP | |
| θ | 1° | 7° | 1° | 7° |

TSSOP-14

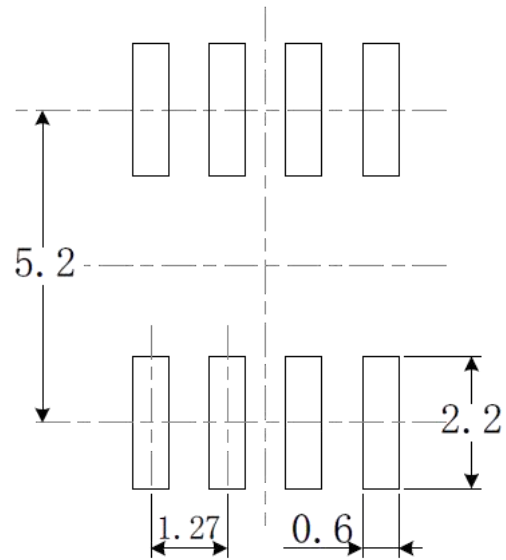
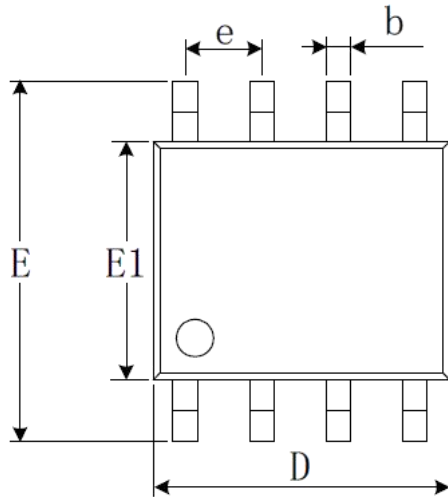


RECOMMENDED LAND PATTERN (Unit: mm)

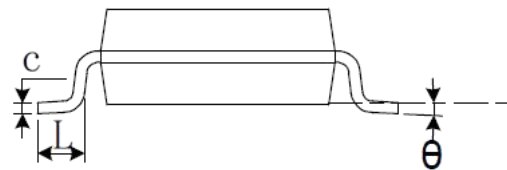
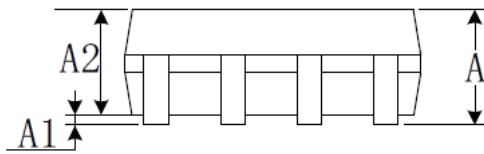


| Symbol | Dimensions In Millimeters | | Dimensions Inches | |
|--------|---------------------------|-------|-------------------|-------|
| | Min | Max | Min | Max |
| A | | 1.200 | | 0.047 |
| A1 | 0.050 | 0.150 | 0.002 | 0.006 |
| A2 | 0.800 | 1.050 | 0.031 | 0.041 |
| b | 0.190 | 0.300 | 0.007 | 0.012 |
| 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 | 0.020 | 0.028 |
| H | 0.25 TYP | | 0.01 TYP | |
| θ | 1° | 7° | 1° | 7° |

SOIC-8(SOP8)

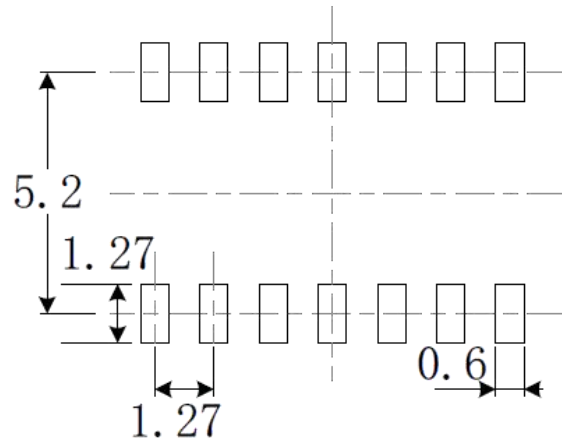
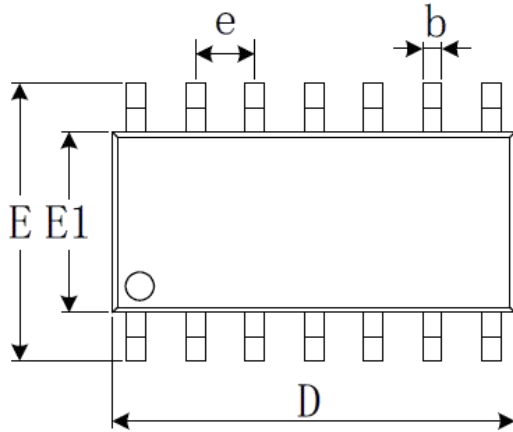


RECOMMENDED LAND PATTERN (Unit: mm)

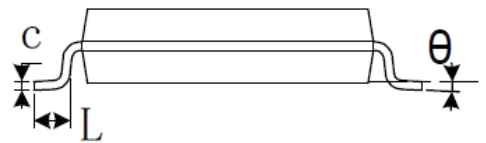
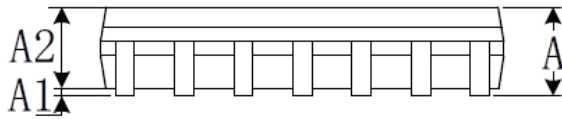


| Symbol | Dimensions In Millimeters | | Dimensions Inches | |
|----------|---------------------------|-------|-------------------|-------|
| | Min | Max | Min | Max |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| b | 0.330 | 0.510 | 0.013 | 0.020 |
| c | 0.170 | 0.250 | 0.007 | 0.010 |
| D | 4.800 | 5.000 | 0.189 | 0.197 |
| E | 5.800 | 6.200 | 0.228 | 0.244 |
| E1 | 3.800 | 4.000 | 0.150 | 0.157 |
| e | 1.270 BSC | | 0.050 BSC | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |

SOIC-14(SOP14)

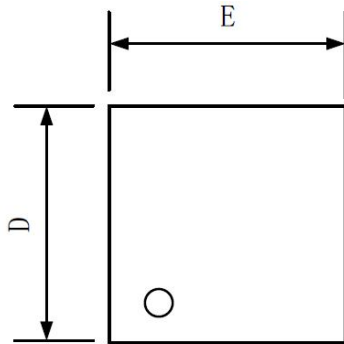


RECOMMENDED LAND PATTERN (Unit: mm)

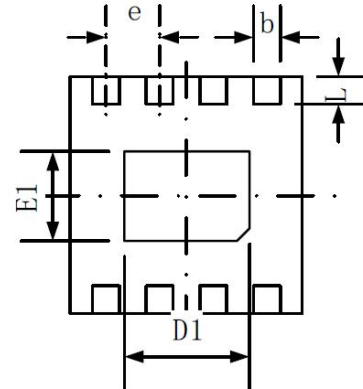


| Symbol | Dimensions In Millimeters | | Dimensions Inches | |
|----------|---------------------------|-------|-------------------|-------|
| | Min | Max | Min | Max |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| b | 0.310 | 0.510 | 0.012 | 0.020 |
| c | 0.100 | 0.250 | 0.004 | 0.010 |
| D | 8.450 | 8.850 | 0.333 | 0.348 |
| E | 5.800 | 6.200 | 0.228 | 0.244 |
| E1 | 3.800 | 4.000 | 0.150 | 0.157 |
| e | 1.270 BSC | | 0.050 BSC | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |

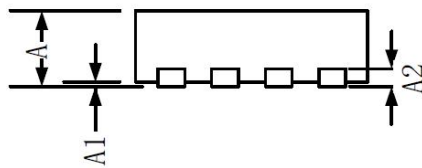
TDFN-2×2-8L



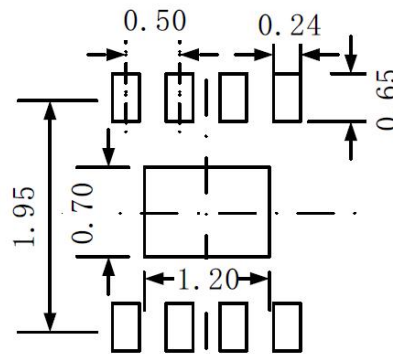
TOP VIEW



BOTTOM VIEW



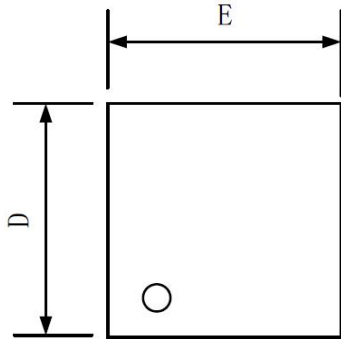
SIDE VIEW



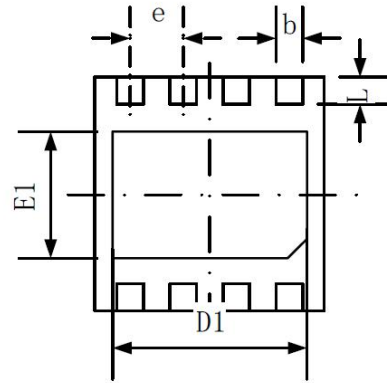
RECOMMENDED LAND PATTERN (Unit: mm)

| Symbol | Dimensions In Millimeters | | Dimensions Inches | |
|--------|---------------------------|-------|-------------------|-------|
| | Min | Max | Min | Max |
| A | 0.700 | 0.800 | 0.028 | 0.031 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A2 | 0.203 TYP | | 0.008 TYP | |
| b | 0.180 | 0.300 | 0.007 | 0.012 |
| D | 1.900 | 2.100 | 0.075 | 0.083 |
| D1 | 1.100 | 1.300 | 0.043 | 0.051 |
| E | 1.900 | 2.100 | 0.075 | 0.083 |
| E1 | 0.600 | 0.800 | 0.024 | 0.031 |
| e | 0.500 TYP | | 0.020 TYP | |
| L | 0.250 | 0.450 | 0.010 | 0.018 |

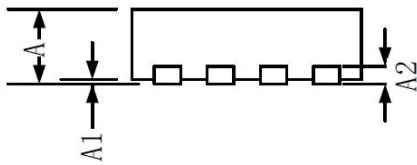
TDFN-3×3-8L



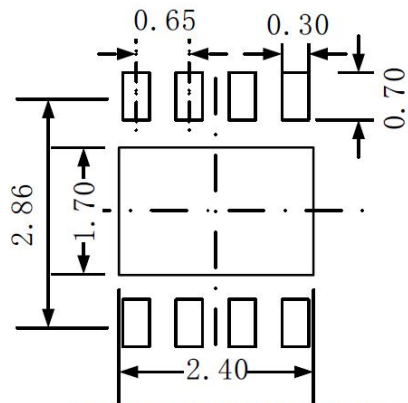
TOP VIEW



BOTTOM VIEW



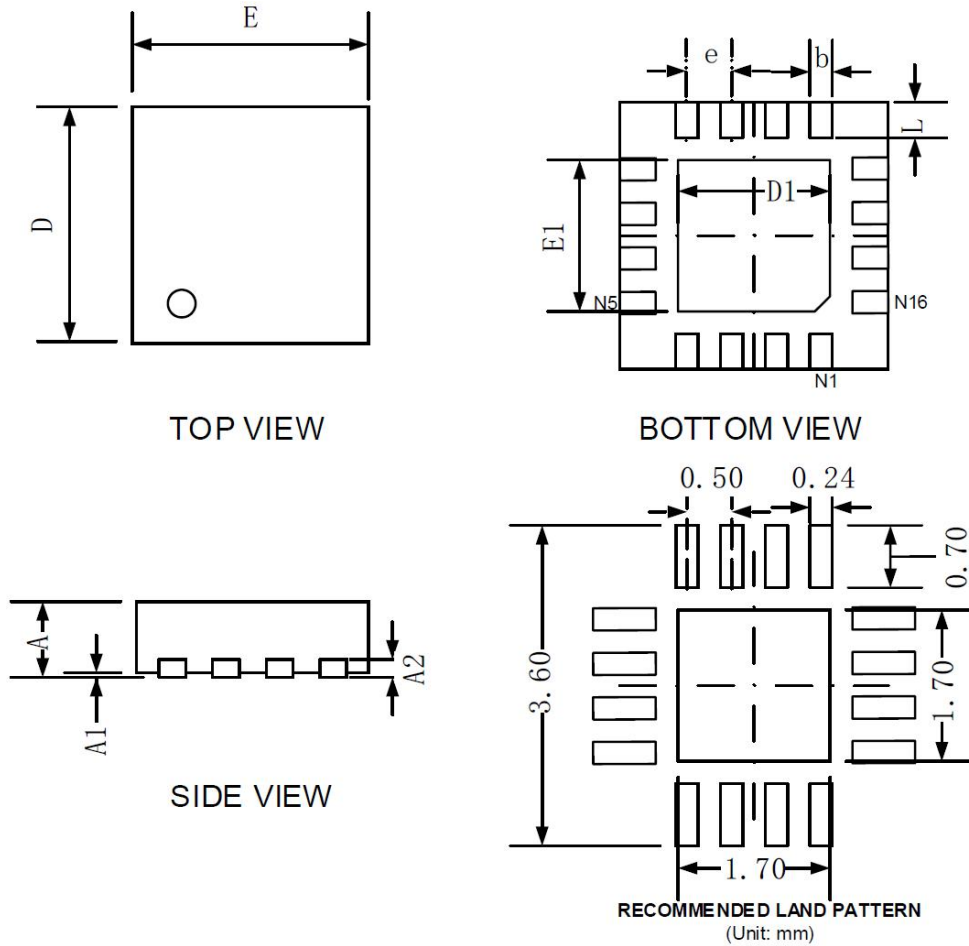
SIDE VIEW



RECOMMENDED LAND PATTERN (Unit: mm)

| Symbol | Dimensions In Millimeters | | Dimensions Inches | |
|--------|---------------------------|-------|-------------------|-------|
| | Min | Max | Min | Max |
| A | 0.700 | 0.800 | 0.028 | 0.031 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A2 | 0.203 TYP | | 0.008 TYP | |
| b | 0.250 | 0.350 | 0.010 | 0.014 |
| D | 2.900 | 3.100 | 0.114 | 0.122 |
| D1 | 2.350 | 2.450 | 0.093 | 0.096 |
| E | 2.900 | 3.100 | 0.114 | 0.122 |
| E1 | 1.650 | 1.750 | 0.065 | 0.069 |
| e | 0.650 TYP | | 0.026 TYP | |
| L | 0.370 | 0.470 | 0.015 | 0.019 |

TQFN-3×3-16L



| Symbol | Dimensions In Millimeters | | Dimensions Inches | |
|--------|---------------------------|-------|-------------------|-------|
| | Min | Max | Min | Max |
| A | 0.700 | 0.800 | 0.028 | 0.031 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A2 | 0.203 TYP | | 0.008 TYP | |
| b | 0.180 | 0.300 | 0.007 | 0.012 |
| D | 2.900 | 3.100 | 0.114 | 0.122 |
| D1 | 1.600 | 1.800 | 0.063 | 0.071 |
| E | 2.900 | 3.100 | 0.114 | 0.122 |
| E1 | 1.600 | 1.800 | 0.063 | 0.071 |
| e | 0.500 TYP | | 0.020 TYP | |
| L | 0.300 | 0.500 | 0.012 | 0.020 |

PACKAGE/ORDERING INFORMATION

| PRODUCT | ORDERING NUMBER | TEMPRANGE | PACKAGE | PAKEAGE MARKING | TRANSPOT MEDIA,QUANTILY |
|----------|-----------------|-------------|-------------|-----------------|-------------------------|
| CBM8541 | CBM88541AST5 | -40°C~125°C | SOT23-5 | 8541 | Reel,3000 |
| | CBM8541ASC7 | -40°C~125°C | SC70-5 | 8541C | Reel,3000 |
| | CBM8541AS8 | -40°C~125°C | SOP-8 | CBM8541A | Reel,2500 |
| CBM8542 | CBM8542AS8 | -40°C~125°C | SOP-8 | CBM8542A | Reel,2500 |
| | CBM8542AMS8 | -40°C~125°C | MSOP-8 | 8542M | Reel,3000 |
| CBM8544 | CBM8544AS14 | -40°C~125°C | SOP-14 | CBM8544AS | Reel,2500 |
| CBM8544Q | CBM8544AST14 | -40°C~125°C | TSSOP-14 | CBM8544AST | Reel,3000 |
| | CBM8544AQ16 | -40°C~125°C | TQFN-3*3-16 | CBM8544AQ | Reel,3000 |