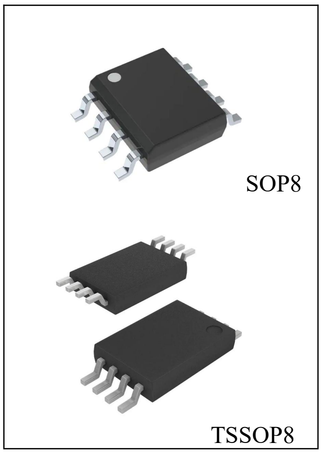
# S358

## General Purpose Low Voltage Rail-to-Rail Output Amplifiers

## General Description




The S358(dual) is rail-to-rail input and output voltage feedback amplifiers offering low cost. They have a wide input common-mode voltage range and output voltage swing, and take the minimum operating supply voltage down to 2.1V and the maximum recommended supply voltage is 5.5 V. All are specified over the extended – 45°C to +85°C temperature range.

The S358 provide 1MHz bandwidth at a low current consumption of 60µA per amplifier. Very low input bias currents of 10pA, enable S358 to be used for integrators, photodiode amplifiers, and piezoelectric sensors. Rail-to-rail inputs and outputs are useful to designers buffering ASIC in single-supply systems.

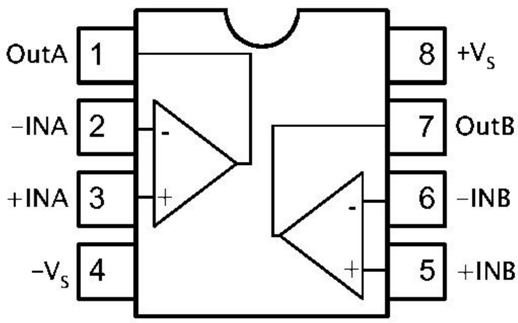
Applications for the series amplifiers include safety monitor, portable equipment, battery and power supply control, and signal conditioning and interfacing for transducers in very low power systems

The S358 is available in SOP8 and TSSOP8 package.

## Features

- Low Cost
- Rail-to-Rail Input and Output: 0.8mV Typical Vos
- Unity Gain Stable
- Gain Bandwidth Product: 1MHz
- Very Low Input Bias Currents: 10pA
- Operates on 2.1 V to 5.5 V Supplies
- Input Voltage Range: -0.1 V to +5.6 V with $V_S = 5.5$ V
- Low Supply Current: 60µA/Amplifier

## Block Diagram and Pin Configuration




**S358(SOP8/TSSOP8)**

## Package Information

| Part NO. | Package Description | Package Marking | Package Option |
|---|---|---|---|
| S358F | SOP8 | CHMC<br>S358F<br>SXXXX | 100/Tube<br>4000/Reel |
| S358 | TSSOP8 | CHMC<br>S358<br>SXXXX | 100/Tube<br>4000/Reel |

CHMC:Trademark S358/S358F:Part NO. SXXXX:Lot NO.

## Recommended Operating Conditions

| Characteristic | Min. | Max. | Unit |
|---|---|---|---|
| Operating Temperature Rangge | -40 | +85 | °C |
| Power Supply Operating Range | 2.1 | 5.5 | V |

## Absolute Maximum Ratings

| Characteristic | Min. | Max. | Unit |
|---|---|---|---|
| Power Supply Voltage | 0 | +7.5 | V |
| Maximum Junction Temperature | | +160 | °C |
| Input Voltage Range | -Vs-0.5 | +Vs+0.5 | V |
| Operating Temperature Range | -45 | +85 | °C |
| Storage Temperature Range | -65 | +150 | °C |
| Lead Temperature, 10 seconds | | +260 | °C |

## Electrical Characteristics (Vs=+5V, $R_L$=10kΩ to Vs/2, $V_{Out}$=Vs/2; unless otherwise noted)

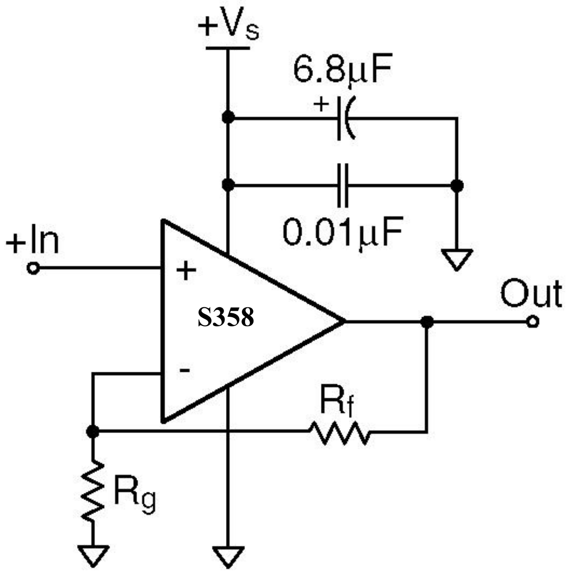
| Characteristics | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| **AC Performance** | | | | | |
| Gain bandwidth product | $C_L$=100pF | | 1.0 | | MHz |
| Phase margin | | | 52 | | Deg |
| Gain margin | | | 17 | | dB |
| Slew rate | Vo=1Vpp | | 0.52 | | V/µs |
| Input voltage noise | >50kHz | | 36 | | nV/Hz |
| **DC Performance** | | | | | |
| Input offset voltage | | | ±0.8 | ±5 | mV |
| Input bias current | | | 10 | | pA |
| Input offset current | | | 10 | | pA |
| Power supply rejection ratio | Vs=+2.5V～+5.5V | 60 | 82 | | dB |
| Supply current | | | 120 | 240 | µA |
| **Input characteristics** | | | | | |
| Input common mode voltage range | Vs=5.5V | -0.1 | | 5.6 | V |
| Common mode rejection ratio | Vs=5.5V<br>Vo=0.1～4.9V | 56 | 68 | | dB |
| **Output characteristics** | | | | | |
| Output voltage Swing from Rail | $R_L$=100kΩ | | 0.008 | | V |
| Output current | $R_L$=100kΩ | 20 | 23 | | mA |

# Application Summary

**Data Sheet**

The S358 family are single supply, general purpose, voltage-feedback amplifiers that are pin-for-pin compatible and drop in replacements with other industry standard S358 amplifier. The S358 is fabricated on a CMOS process, features a rail-to-rail output, and is unity gain stable.

The typical non-inverting circuit schematic is shown in Figure below:



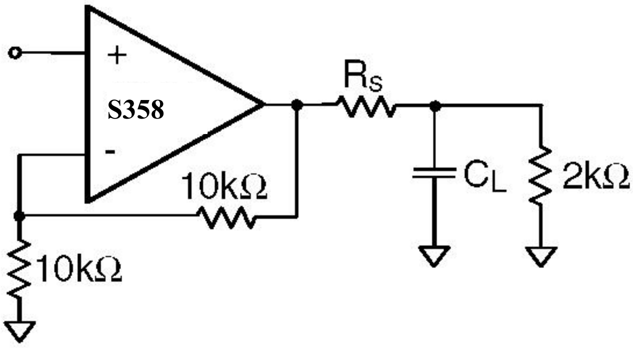

Typical Non-inverting configuration

**Power Dissipation**

The maximum internal power dissipation allowed is directly related to the maximum junction temperature. If the maximum junction temperature exceeds 150°C, some performance degradation will occur. If the maximum junction temperature exceeds 175°C for an extended time, device failure may occur.

**Driving Capacitive Loads**

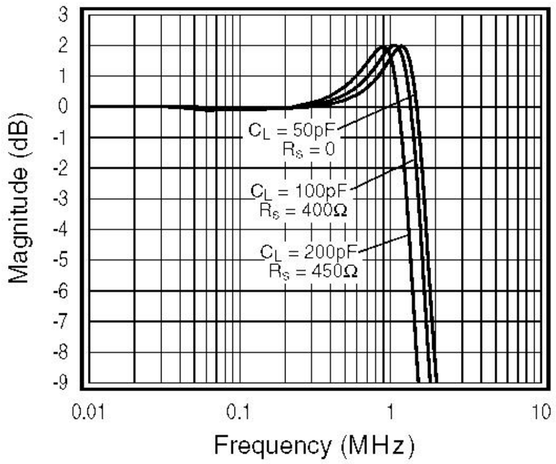
The Frequency Response vs CL plot illustrates the response of the S358 . A small series resistance (Rs) at the output of the amplifier, illustrated in Figure below, will improve stability and settling performance. Rs values in the Frequency Response vs CL plot were chosen to achieve maximum bandwidth



with less than 1dB of peaking. For maximum flatness, use a larger Rs. As the plot indicates, the S358 family can easily drive a 200pF capacitive load without a series resistance.

Driving a capacitive load introduces phase-lag into the output signal, which reduces phase margin in the amplifier. The unity gain follower is the most sensitive configuration.

The response is illustrated in Figure below:




Frequency Response vs $C_L$ for unity gain configuration

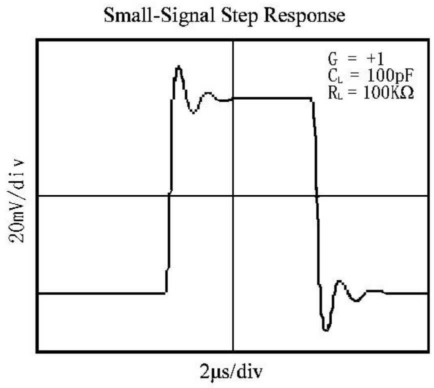
**Layout Considerations**

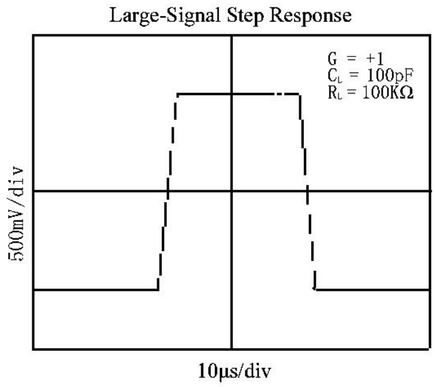
General layout and supply bypassing play major roles in high frequency performance. Follow the steps below as a basis for high frequency layout:

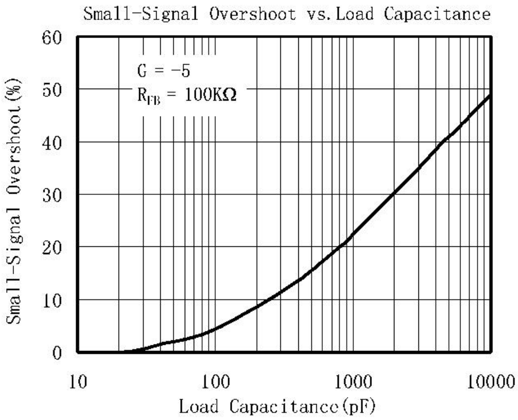
- Include 6.8µF and 0.01µF ceramic capacitors
- Place the 6.8µF capacitor within 0.75 inches of the power pin
- Place the 0.01µF capacitor within 0.1 inches of the power pin
- Remove the ground plane under and around the part, especially near the input and output pins to reduce parasitic capacitance
- Minimize all trace lengths to reduce series inductances

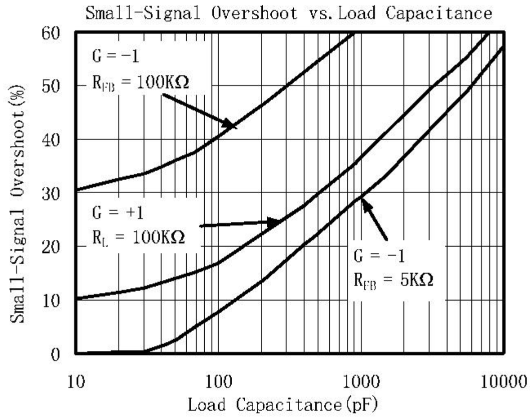
## Characteristics Curve

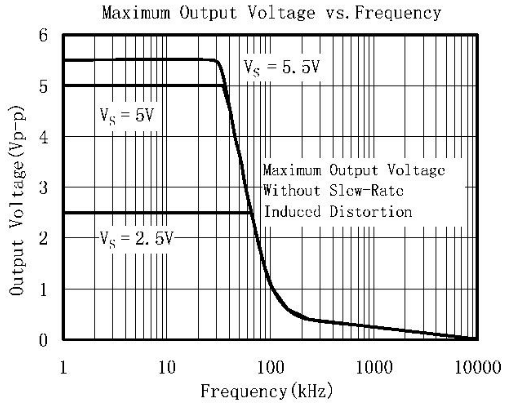
(Ta=+25℃, Vs=+5V, RL=100kΩ connected to Vs/2)

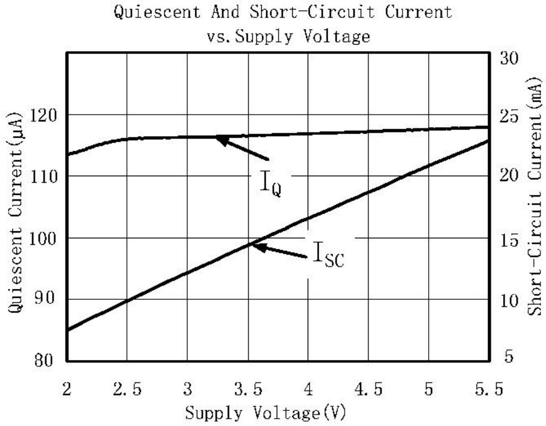


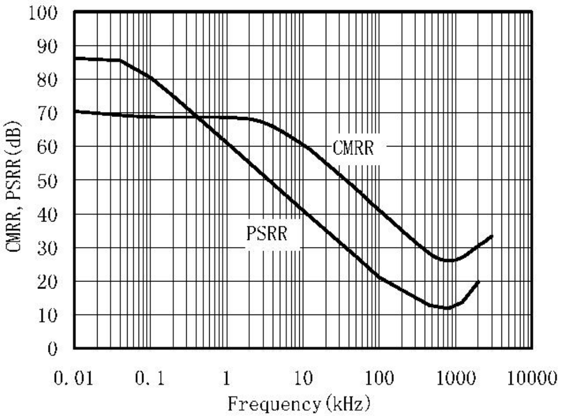



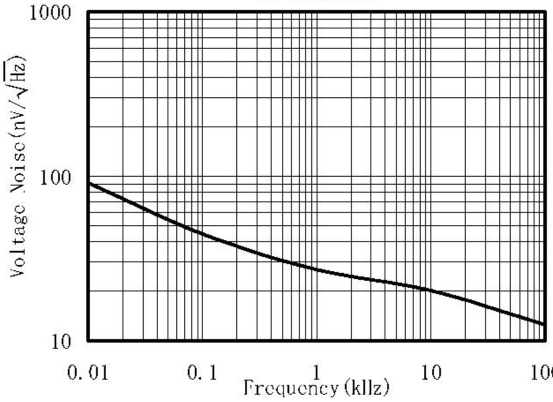



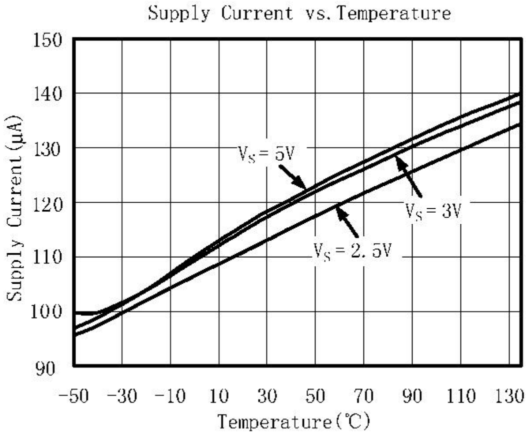
CMRR And PSRR vs. Frequency



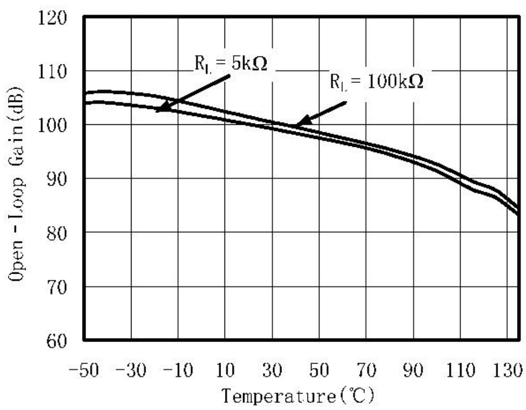

Input Voltage Noise Spectral Density vs. Frequency



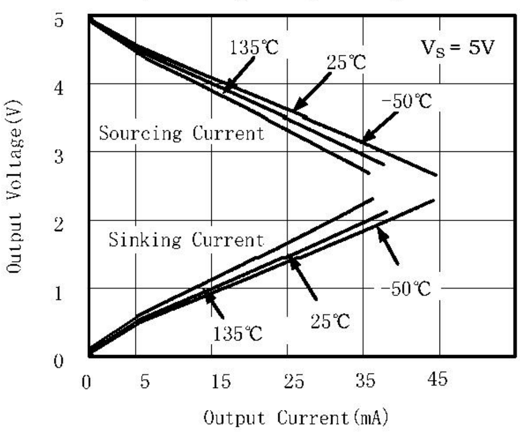

Supply Current vs. Temperature



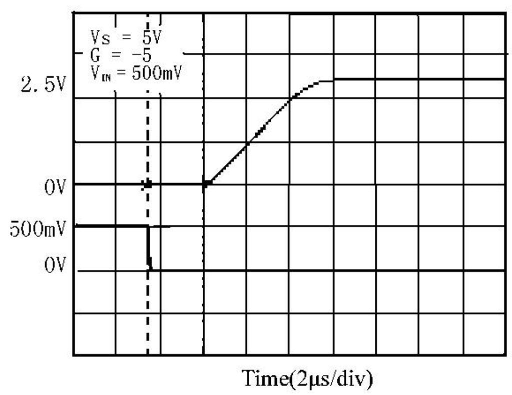

Open-Loop Gain vs. Temperature

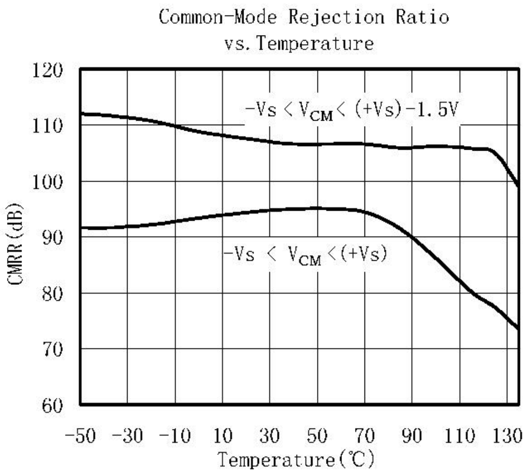


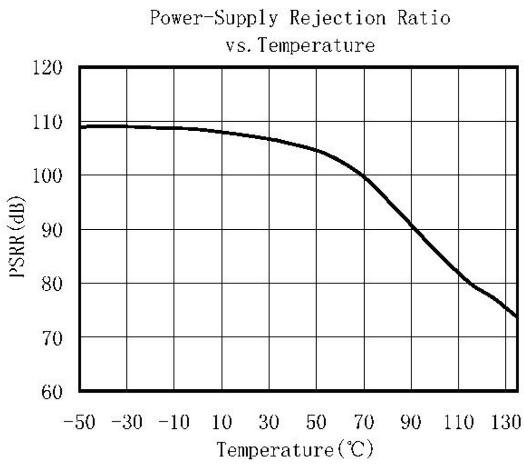

Output Voltage Swing vs. Output Current




Overload Recovery Time

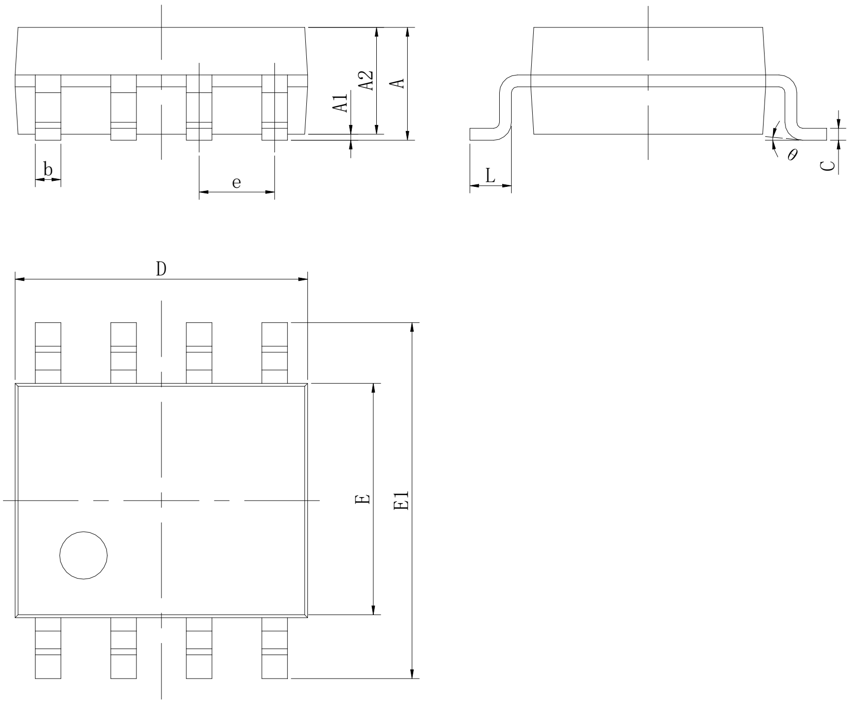



Common-Mode Rejection Ratio
vs. Temperature
CMRR (dB)
120
110
100
90
80
70
60
-Vs < VCM < (+Vs)-1.5V
-Vs < VCM < (+Vs)
-50 -30 -10 10 30 50 70 90 110 130
Temperature (℃)


Power-Supply Rejection Ratio
vs. Temperature
PSRR (dB)
120
110
100
90
80
70
60
-50 -30 -10 10 30 50 70 90 110 130
Temperature (℃)

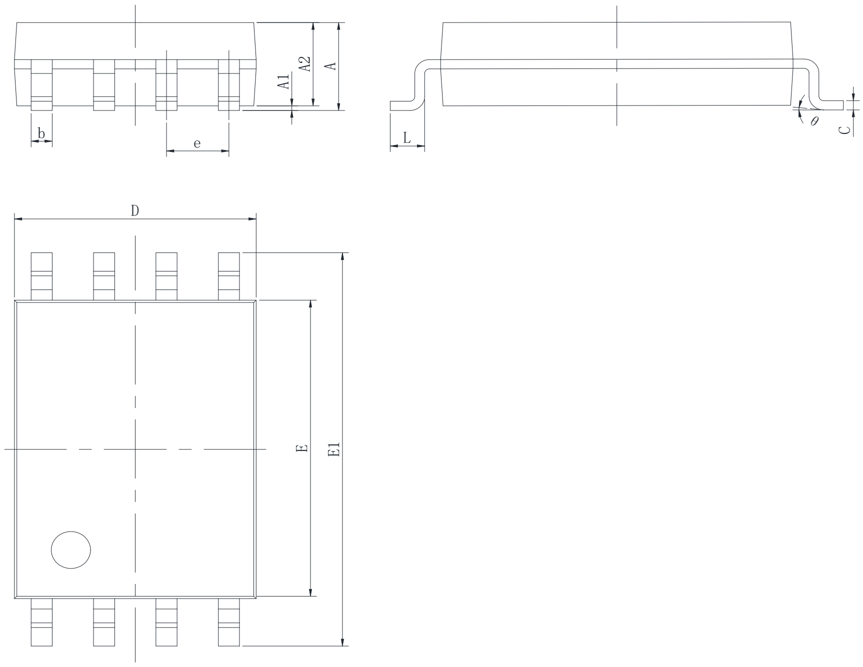
## Outline Dimensions

**SOP8** Unit: mm




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.350 | 1.800 | 0.053 | 0.071 |
| A1 | 0.000 | 0.250 | 0.000 | 0.010 |
| A2 | 1.250 | 1.550 | 0.053 | 0.061 |
| b | 0.300 | 0.510 | 0.011 | 0.020 |
| c | 0.170 | 0.250 | 0.006 | 0.010 |
| D | 4.700 | 5.100 | 0.185 | 0.201 |
| E | 3.800 | 4.000 | 0.150 | 0.157 |
| E1 | 5.800 | 6.300 | 0.228 | 0.244 |
| e | 1.270(BSC) | | 0.050(BSC) | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |

**TSSOP8** Unit: mm




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | | 1.100 | | 0.043 |
| A1 | 0.020 | 0.150 | 0.001 | 0.006 |
| A2 | 0.800 | 1.000 | 0.031 | 0.039 |
| 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 |
| θ | 0° | 8° | 0° | 8° |

## Statements

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