



**THE DATASHEET OF
AS358MTR-E1**



Description

The AS358/358A/358B consists of two independent, high gain and internally frequency compensated operational amplifiers, they are specifically designed to operate from a single power supply. Operation from split power supply is also possible and the low power supply current drain is independent of the magnitude of the power supply voltages. Typical applications include transducer amplifiers, DC gain blocks and most conventional operational amplifier circuits.

The AS358/358A/358B series is compatible with industry standard 358. The AS358A has more stringent input offset voltage than the AS358.

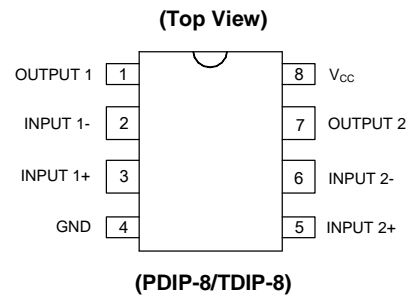
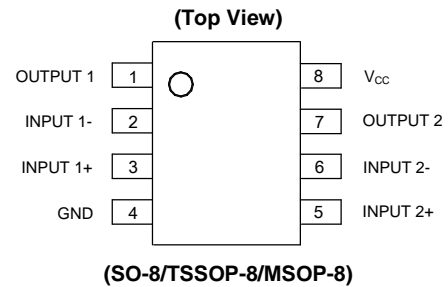
The AS358 is available in PDIP-8, TDIP-8, SO-8, TSSOP-8 and MSOP-8 packages, the AS358A is available in PDIP-8 and SO-8 packages and AS358B is available in TSSOP-8 package.

Features

- Internally Frequency Compensated for Unity Gain
- Large Voltage Gain: 100dB (Typical)
- Low Input Bias Current: 20nA (Typical)
- Low Input Offset Voltage: 2mV (Typical)
- Low Supply Current: 0.5mA (Typical)
- Wide Power Supply Voltage:
 - Single Supply: 3V to 36V
 - Dual Supplies: $\pm 1.5V$ to $\pm 18V$
- Input Common Mode Voltage Range Includes Ground
- Large Output Voltage Swing: 0V to $V_{CC} - 1.5V$
- Lead-Free Packages: SO-8, PDIP-8 and TSSOP-8
 - **Totally Lead-Free; RoHS Compliant (Notes 1 & 2)**
- Lead-Free Packages, Available in "Green" Molding Compound: SO-8, PDIP-8, TDIP-8, TSSOP-8 and MSOP-8
 - **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
 - **Halogen and Antimony Free. "Green" Device (Note 3)**

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
 2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
 3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

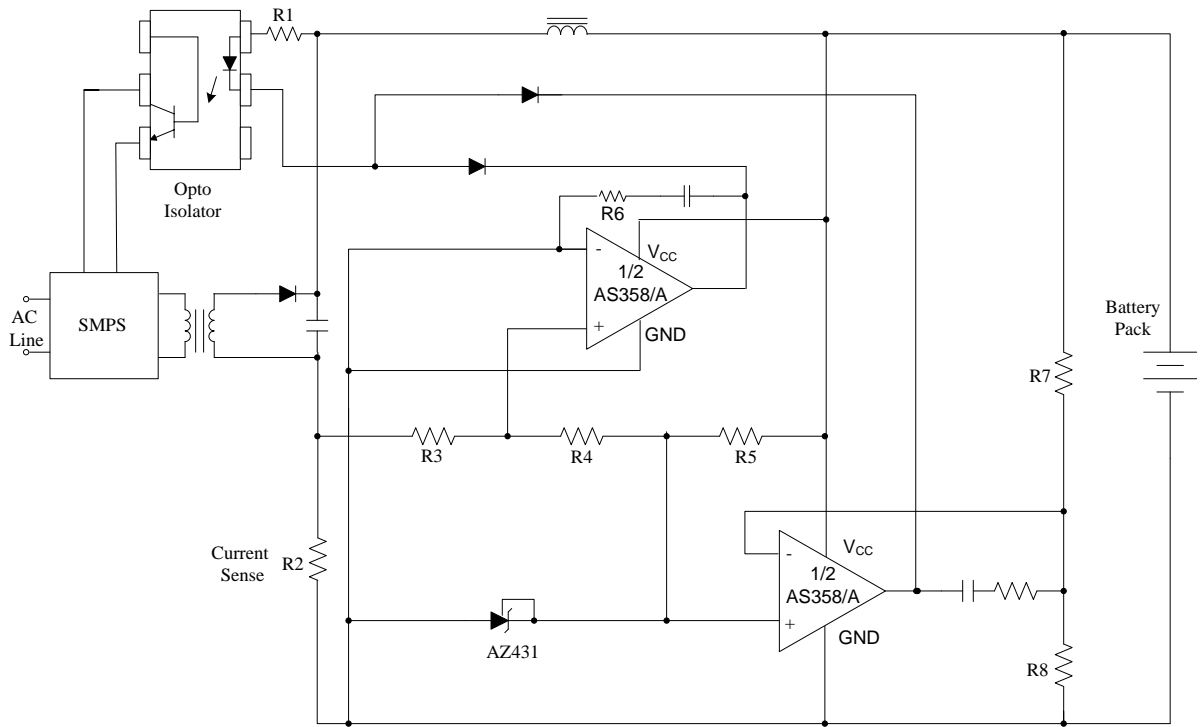
Pin Assignments



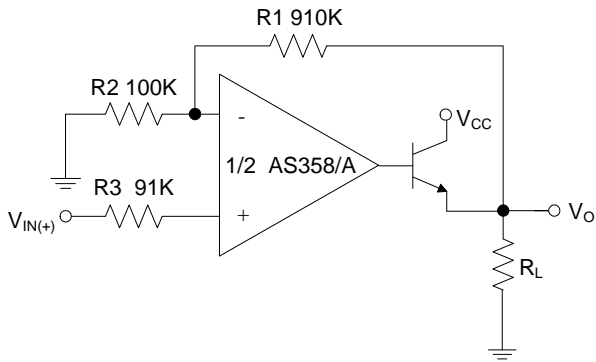
Applications

- Battery Charger
- Cordless Telephone
- Switching Power Supply

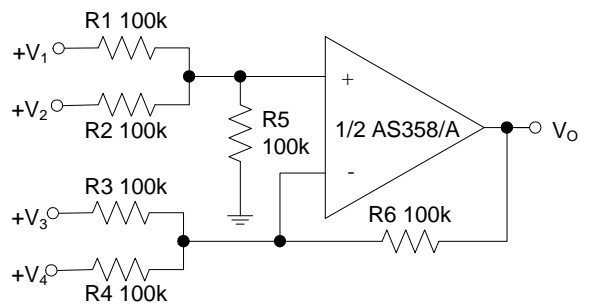
Typical Applications Circuit



Battery Charger

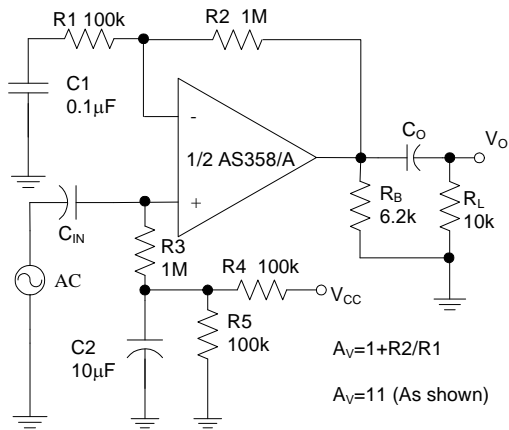


Power Amplifier

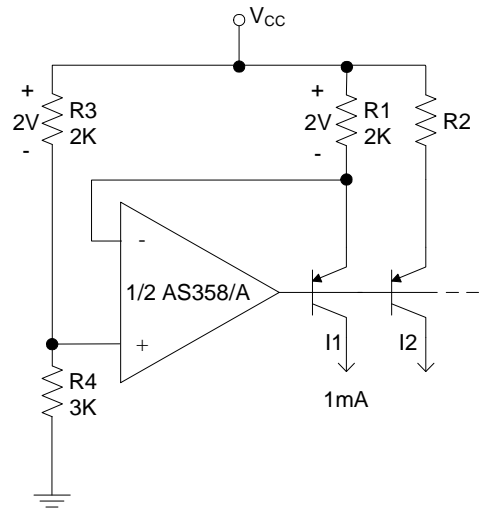


DC Summing Amplifier

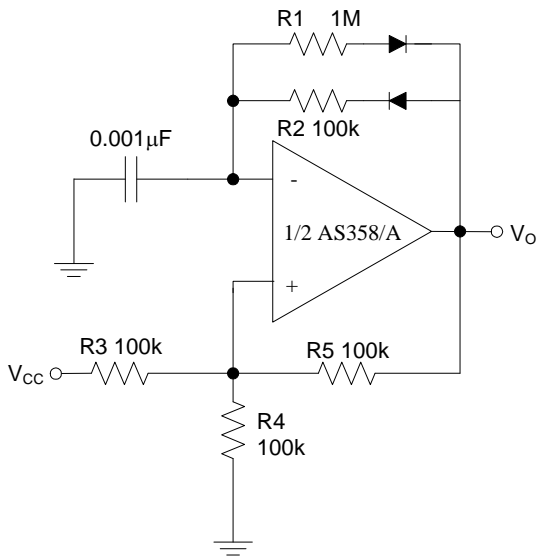
Typical Applications Circuit (Cont.)



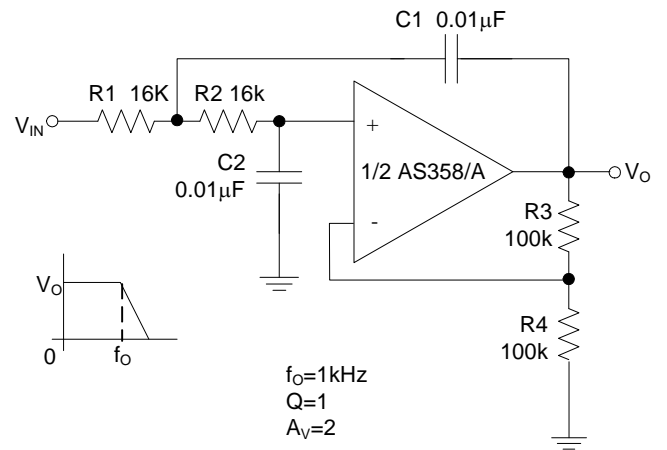
AC Coupled Non-Inverting Amplifier



Fixed Current Sources

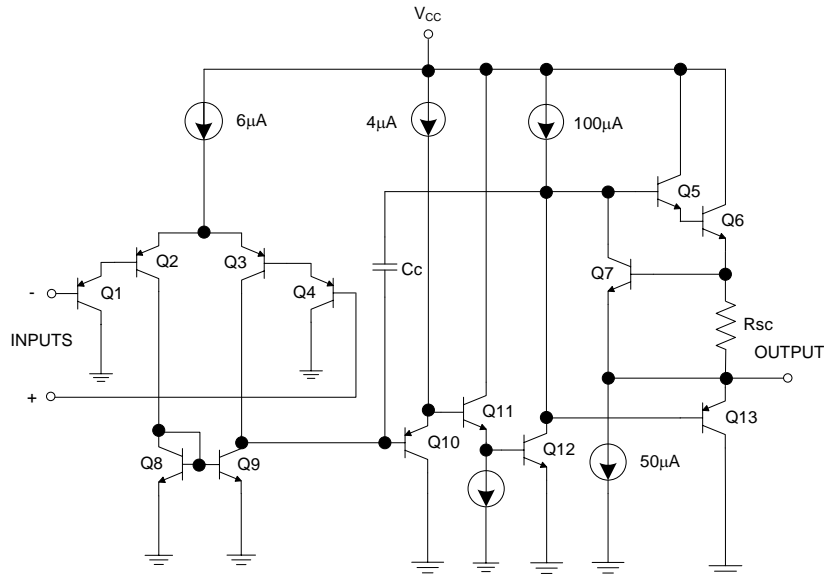


Pulse Generator



DC Coupled Low-Pass Active Filter

Functional Block Diagram



Absolute Maximum Ratings (Notes 4 & 5)

| Symbol | Parameter | Rating | | Unit |
|-------------------|--------------------------------------------|-------------|-----|------|
| V _{CC} | Power Supply Voltage | 40 | | V |
| V _{ID} | Differential Input Voltage | 40 | | V |
| V _{IC} | Input Voltage | -0.3 to 40 | | V |
| P _D | Power Dissipation (T _A = +25°C) | PDIP-8 | 830 | mW |
| | | SO-8 | 550 | |
| | | TSSOP-8 | 500 | |
| | | MSOP-8 | 470 | |
| T _J | Operating Junction Temperature | +150 | | °C |
| T _{STG} | Storage Temperature Range | -65 to +150 | | °C |
| T _{LEAD} | Lead Temperature (Soldering, 10 Seconds) | +260 | | °C |

Notes: 4. Stresses greater than 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 under “Recommended Operating Conditions” is not implied. Exposure to “Absolute Maximum Ratings” for extended periods may affect device reliability.

5. ESD sensitivity.

Recommended Operating Conditions

| Symbol | Parameter | Min | Max | Unit |
|-----------------|-------------------------------------|-----|-----|------|
| V _{CC} | Supply Voltage | 3 | 36 | V |
| T _A | Ambient Operating Temperature Range | -40 | +85 | °C |

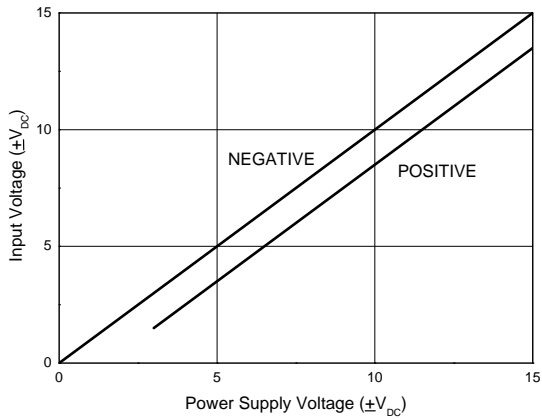
Electrical Characteristics (Limits in standard typeface are for $T_A = +25^\circ\text{C}$, **bold** typeface applies over -40°C to $+85^\circ\text{C}$ (Note 6), $V_{CC} = 5\text{V}$, $\text{GND} = 0\text{V}$, unless otherwise specified.)

| Symbol | Parameter | | Conditions | Min | Typ | Max | Unit | |
|--------------------------|---------------------------------------------------------|--------|------------------------------------------------------------------------------------------------|-----------|------|----------------|------------------------------|----|
| V_{IO} | Input Offset Voltage | | $V_O = 1.4\text{V}$, $R_S = 0\Omega$, $V_{CC} = 5\text{V to } 30\text{V}$ | AS358 | — | 2 | 5 | mV |
| | | | | | — | — | 7 | |
| | | | | AS358A | — | 2 | 3 | |
| | | | | | — | — | 5 | |
| | | | AS358B | — | — | 2 | | |
| | | | | — | — | 4 | | |
| $\Delta V_{IO}/\Delta T$ | Average Temperature Coefficient of Input Offset Voltage | | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | — | 7 | — | $\mu\text{V}/^\circ\text{C}$ | |
| I_{BIAS} | Input Bias Current | | I_{IN+} or I_{IN-} , $V_{CM} = 0\text{V}$ | — | 20 | 200 | nA | |
| | | | | — | — | 200 | | |
| I_{IO} | Input Offset Current | | $I_{IN+} - I_{IN-}$, $V_{CM} = 0\text{V}$ | — | 5 | 30 | nA | |
| | | | | — | — | 100 | | |
| V_{IR} | Input Common Mode Voltage Range (Note 7) | | $V_{CC} = 30\text{V}$ | 0 | — | $V_{CC} - 1.5$ | V | |
| I_{CC} | Supply Current | | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$, $R_L = \infty$, $V_{CC} = 30\text{V}$ | — | 0.7 | 2 | mA | |
| | | | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$, $R_L = \infty$, $V_{CC} = 5\text{V}$ | — | 0.5 | 1.2 | | |
| G_V | Large Signal Voltage Gain | | $V_{CC} = 15\text{V}$, $V_O = 1\text{V to } 11\text{V}$, $R_L \geq 2\text{k}\Omega$ | 85 | 100 | — | dB | |
| | | | | 80 | — | — | | |
| CMRR | Common Mode Rejection Ratio | | DC, $V_{CM} = 0\text{V to } (V_{CC} - 1.5)\text{V}$ | 60 | 70 | — | dB | |
| | | | | 60 | — | — | | |
| PSRR | Power Supply Rejection Ratio | | $V_{CC} = 5\text{V to } 30\text{V}$ | 70 | 100 | — | dB | |
| | | | | 60 | — | — | | |
| CS | Channel Separation | | $f = 1\text{kHz to } 20\text{kHz}$ | — | -120 | — | dB | |
| I_{SOURCE} | Output Current | Source | $V_{IN+} = 1\text{V}$, $V_{IN-} = 0\text{V}$, $V_{CC} = 15\text{V}$, $V_O = 2\text{V}$ | 20 | 40 | — | mA | |
| | | | | 20 | — | — | | |
| I_{SINK} | Output Current | Sink | $V_{IN+} = 0\text{V}$, $V_{IN-} = 1\text{V}$, $V_{CC} = 15\text{V}$, $V_O = 2\text{V}$ | 10 | 15 | — | mA | |
| | | | $V_{IN+} = 0\text{V}$, $V_{IN-} = 1\text{V}$, $V_{CC} = 15\text{V}$, $V_O = 0.2\text{V}$ | 5 | — | — | | |
| | | | | 12 | 50 | — | μA | |
| I_{SC} | Output Short Circuit Current to Ground | | $V_{CC} = 15\text{V}$ | — | 40 | 60 | mA | |
| V_{OH} | Output Voltage Swing | | $V_{CC} = 30\text{V}$, $R_L = 2\text{k}\Omega$ | 26 | — | — | V | |
| | | | | 26 | — | — | | |
| | | | $V_{CC} = 30\text{V}$, $R_L = 10\text{k}\Omega$ | 27 | 28 | — | | |
| | | | | 27 | — | — | | |
| V_{OL} | | | $V_{CC} = 5\text{V}$, $R_L = 10\text{k}\Omega$ | — | 5 | 20 | mV | |
| | | | | — | — | 30 | | |
| θ_{JC} | Thermal Resistance (Junction to Case) | | SO-8 | — | 17 | — | $^\circ\text{C}/\text{W}$ | |
| | | | TSSOP-8 | — | 47 | — | | |
| | | | MSOP-8 | — | 22 | — | | |
| θ_{JA} | Thermal Resistance (Junction to Ambient) | | SO-8 | — | 115 | — | $^\circ\text{C}/\text{W}$ | |
| | | | TSSOP-8 | — | 209 | — | | |
| | | | MSOP-8 | — | 160 | — | | |

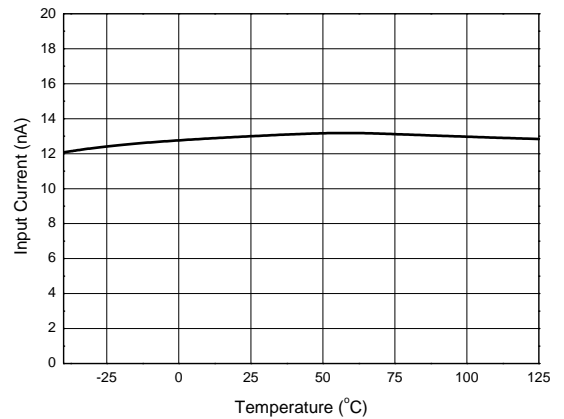
Notes: 6. Limits over the full temperature are guaranteed by design, but not tested in production.
7. The input common-mode voltage of either input signal voltage should not be allowed to go negatively by more than 0.3V (at $+25^\circ\text{C}$). The upper end of the common-mode voltage range is $V_{CC} - 1.5\text{V}$ (at $+25^\circ\text{C}$), but either or both inputs can go to $+36\text{V}$ without damages, independent of the magnitude of the V_{CC} .

Performance Characteristics

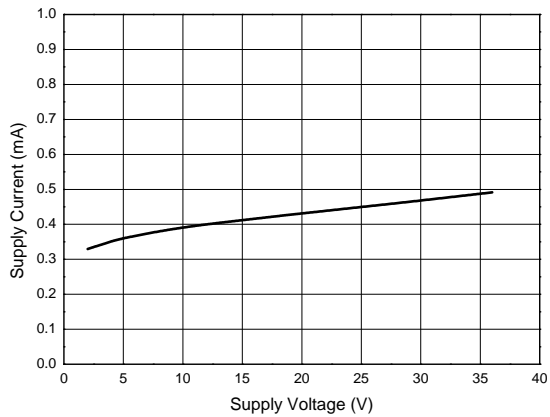
Input Voltage Range



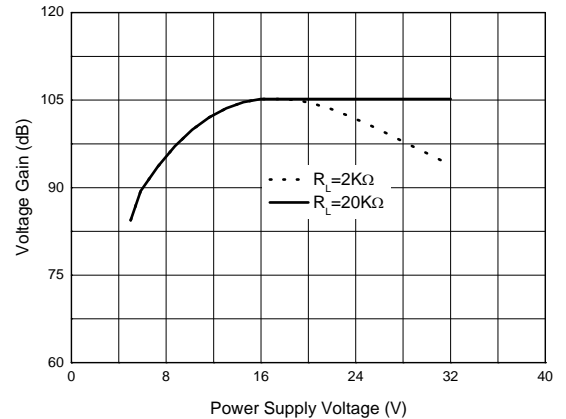
Input Current



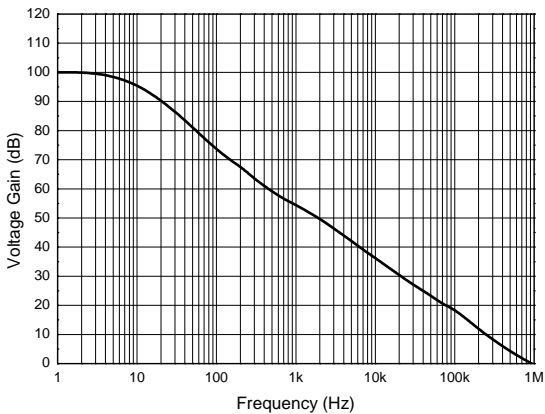
Supply Current



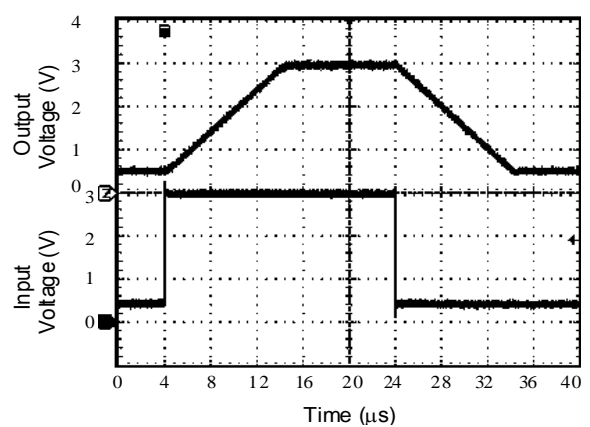
Voltage Gain



Open Loop Frequency Response

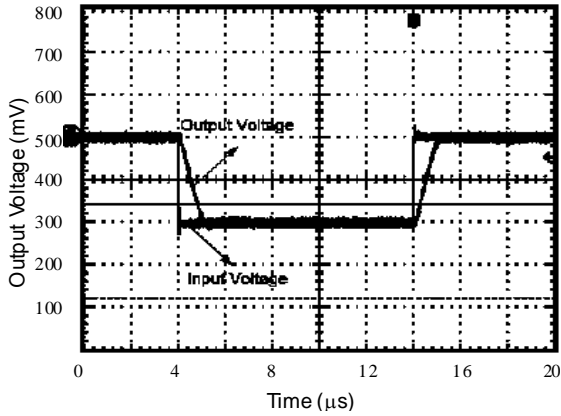


Voltage Follower Pulse Response

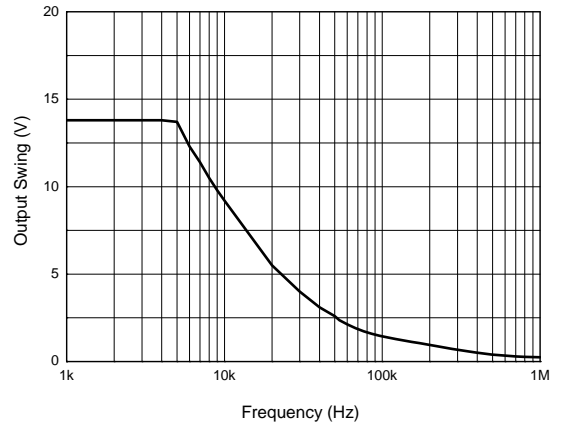


Performance Characteristics (Cont.)

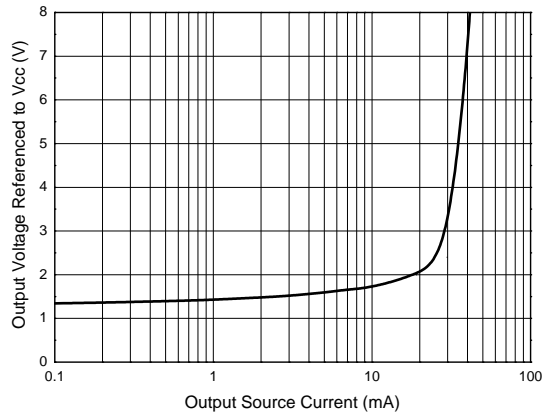
Voltage Follower Pulse Response (Small Signal)



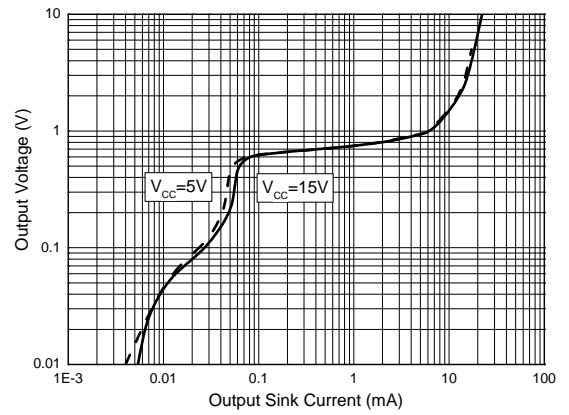
Large Signal Frequency Response



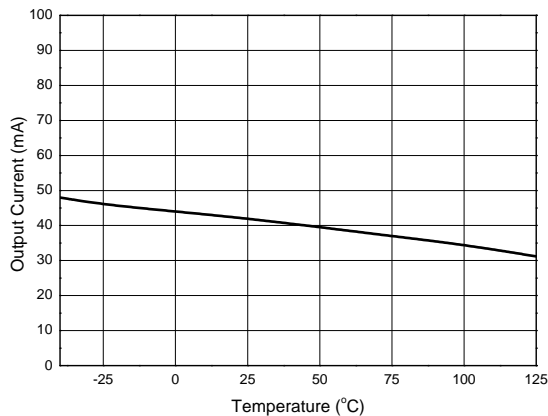
Output Characteristics: Current Sourcing

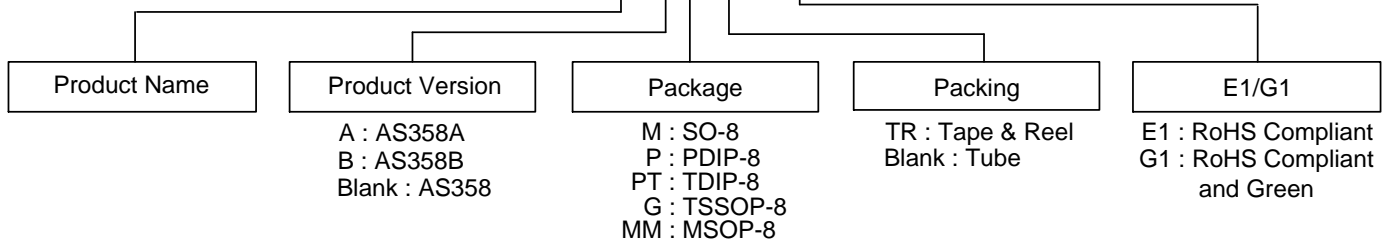


Output Characteristics: Current Sinking



Current Limiting



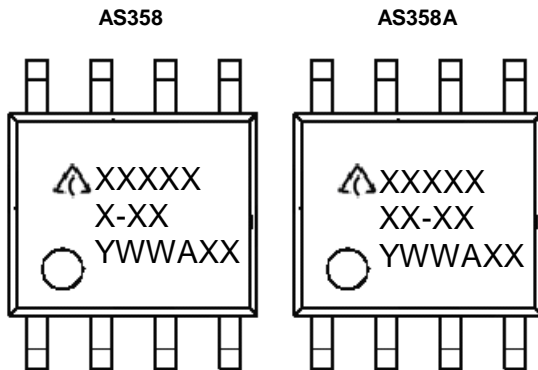
Ordering Information
AS358X XX XX - XX


| Part Number | Package (Note 9) | Temperature Range | RoHS Compliant Lead Free / Green | Marking ID | Packing | Status (Note 8) | Alternative |
|--------------|------------------|-------------------|----------------------------------|-------------|------------------|-----------------|--------------|
| AS358M-E1 | SO-8 | -40°C to +85°C | Lead Free | AS358M-E1 | 100/Tube | End of Life | AS358MTR-G1 |
| AS358M-G1 | | | Green | AS358M-G1 | | | |
| AS358MTR-E1 | | | Lead Free | AS358M-E1 | 4000/Tape & Reel | NRND | AS358MTR-G1 |
| AS358MTR-G1 | | | Green | AS358M-G1 | | In Production | — |
| AS358AM-E1 | | | 100/Tube | End of Life | Lead Free | AS358AM-E1 | AS358AMTR-G1 |
| AS358AM-G1 | | | | | Green | AS358AM-G1 | |
| AS358AMTR-E1 | | | 4000/Tape & Reel | NRND | Lead Free | AS358AM-E1 | AS358AMTR-G1 |
| AS358AMTR-G1 | | | | | Green | AS358AM-G1 | |
| AS358P-E1 | PDIP-8 | -40°C to +85°C | Lead Free | AS358P-E1 | 50/Tube | In Production | — |
| AS358P-G1 | | | Green | AS358P-G1 | | | |
| AS358AP-E1 | | | Lead Free | AS358AP-E1 | | | |
| AS358AP-G1 | | | Green | AS358AP-G1 | | | |
| AS358PT-G1 | TDIP-8 | -40°C to +85°C | Green | AS358PT-G1 | 50/Tube | In Production | — |
| AS358GTR-E1 | TSSOP-8 | -40°C to +85°C | Lead Free | EG3A | 4000/Tape & Reel | NRND | AS358GTR-G1 |
| AS358GTR-G1 | | | Green | GG3A | | In Production | — |
| AS358BGTR-G1 | | | Green | GG3F | | In Production | — |
| AS358MMTR-E1 | MSOP-8 | -40°C to +85°C | Lead Free | AS358MM-E1 | 3000/Tape & Reel | End of Life | AS358MMTR-G1 |
| AS358MMTR-G1 | | | Green | AS358MM-G1 | | In Production | — |

Notes: 8. NRND: Not Recommended for New Design
 9. For packaging details, go to our website at: <https://www.diodes.com/design/support/packaging/diodes-packaging/>.

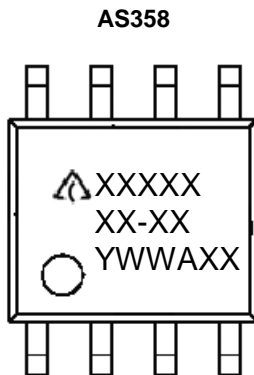
Marking Information

(1) SO-8



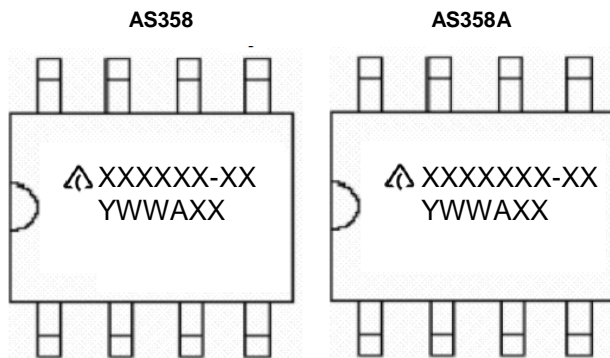
First and Second Lines: Logo and Marking ID
 Third Line: Date Code
 Y: Year
 WW: Work Week of Molding
 A: Assembly House Code
 XX: Internal Code

(2) MSOP-8



First and Second Lines: Logo and Marking ID
 Third Line: Date Code
 Y: Year
 WW: Work Week of Molding
 A: Assembly House Code
 XX: Internal Code

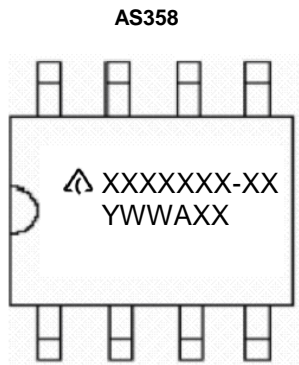
(3) PDIP-8



First Line: Logo and Marking ID
 Second Line: Date Code
 Y: Year
 WW: Work Week of Molding
 A: Assembly House Code
 XX: Internal Code

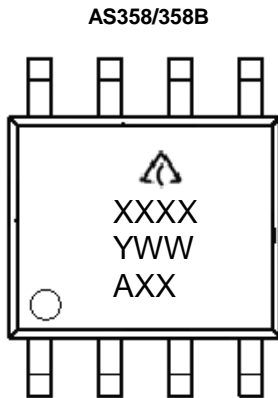
Marking Information (Cont.)

(4) TDIP-8



First Line: Logo and Marking ID
 Second Line: Date Code
 Y: Year
 WW: Work Week of Molding
 A: Assembly House Code
 XX: Internal Code

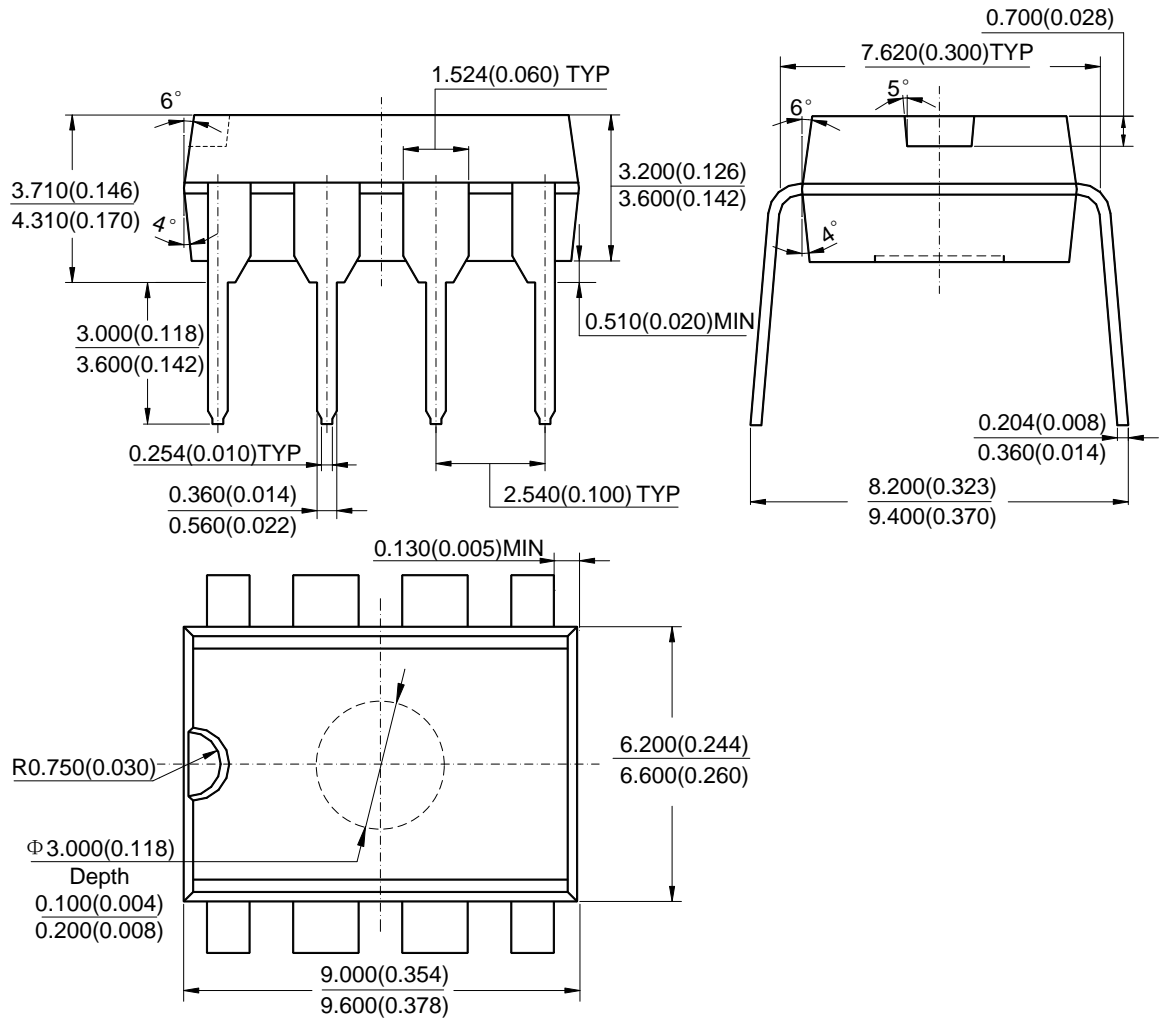
(5) TSSOP-8



First Line: Logo
 Second Line: Marking ID
 Third and Fourth Lines: Date Code
 Y: Year
 WW: Work Week of Molding
 A: Assembly House Code
 XX: Internal Code

Package Outline Dimensions (All dimensions in mm(inch).)

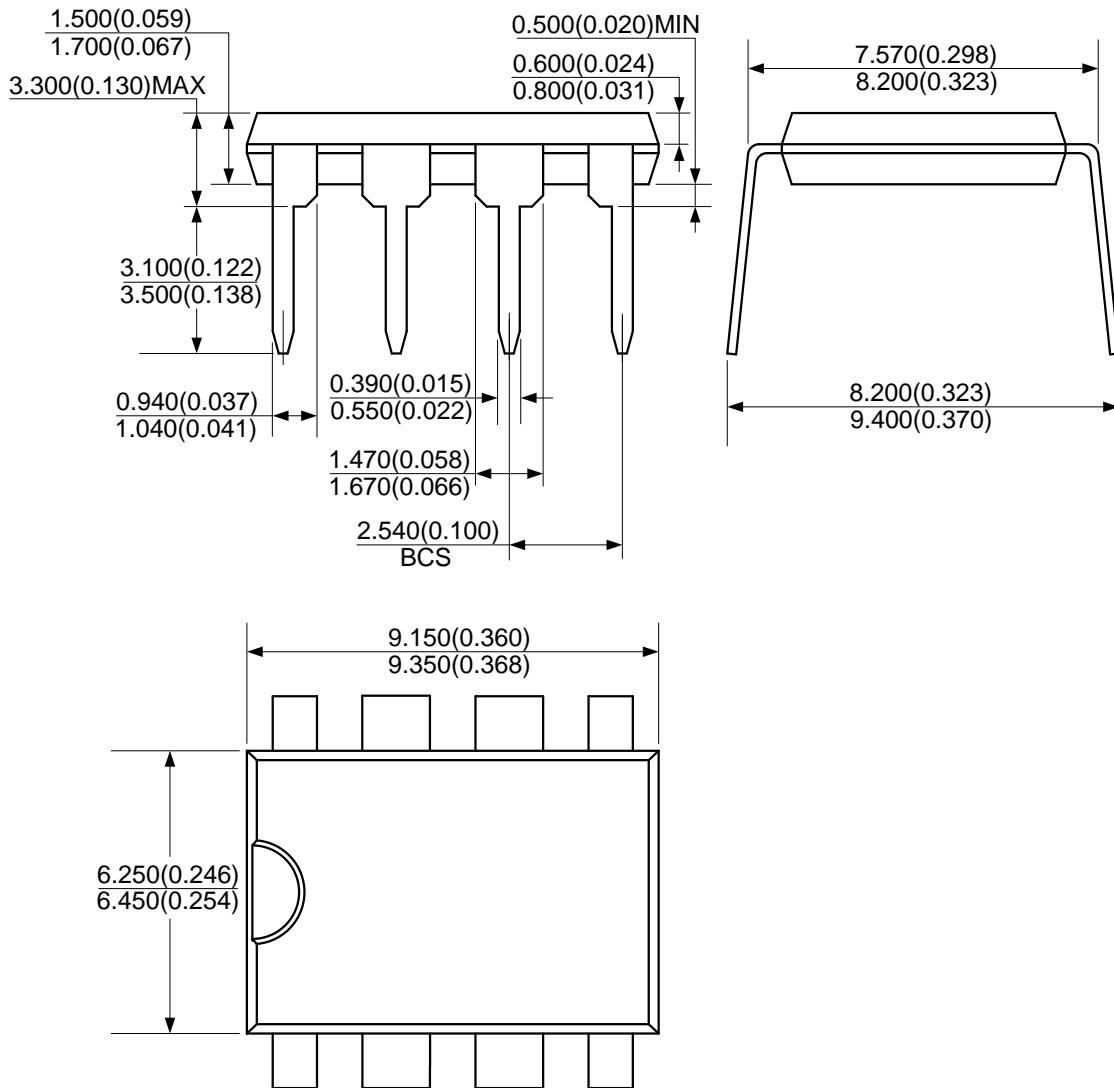
(1) Package Type: PDIP-8



Note: Eject hole, oriented hole and mold mark is optional.

Package Outline Dimensions (Cont. All dimensions in mm(inch).)

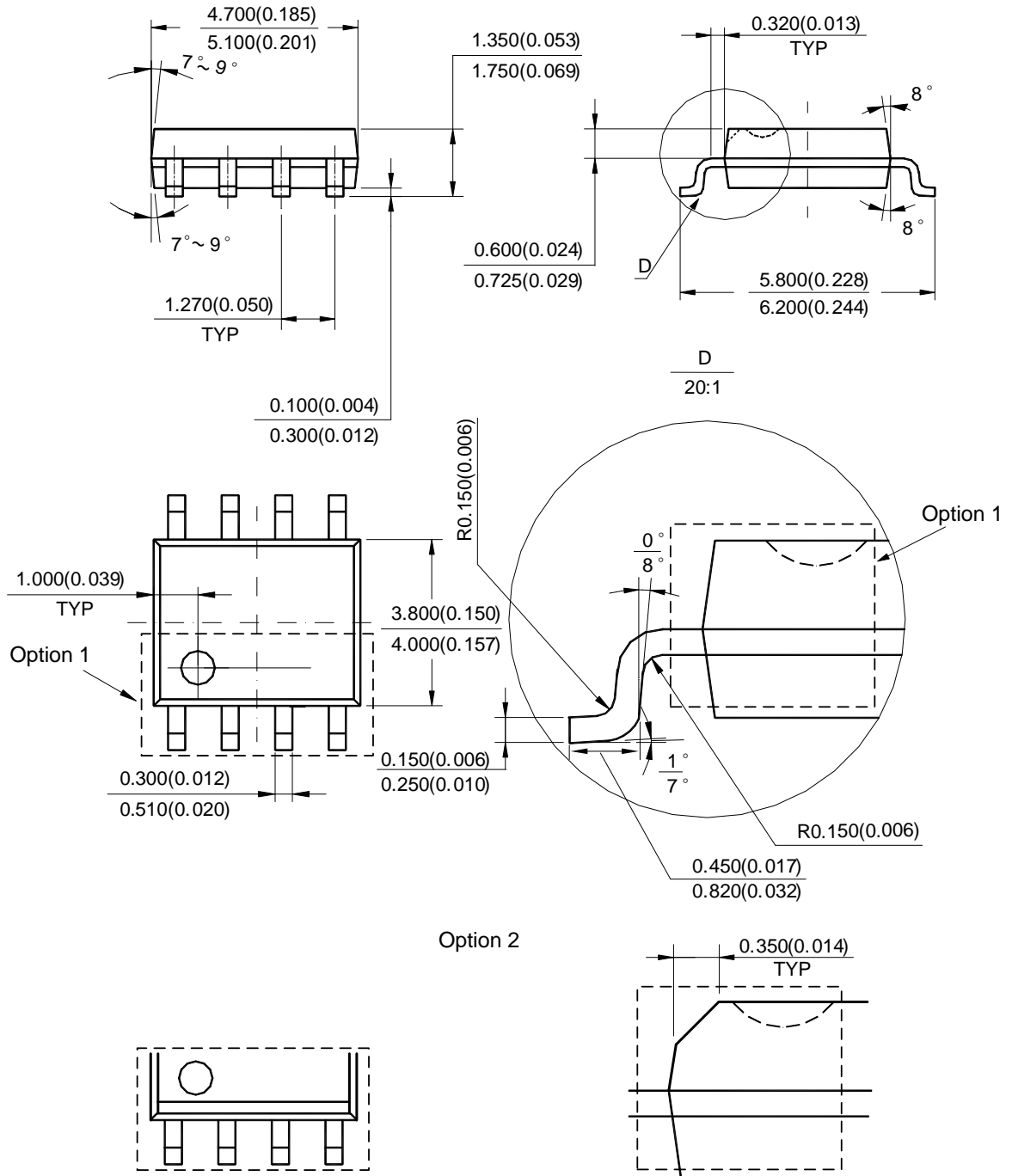
(2) Package Type: TDIP-8



Note: Eject hole, oriented hole and mold mark is optional.

Package Outline Dimensions (Cont. All dimensions in mm(inch).)

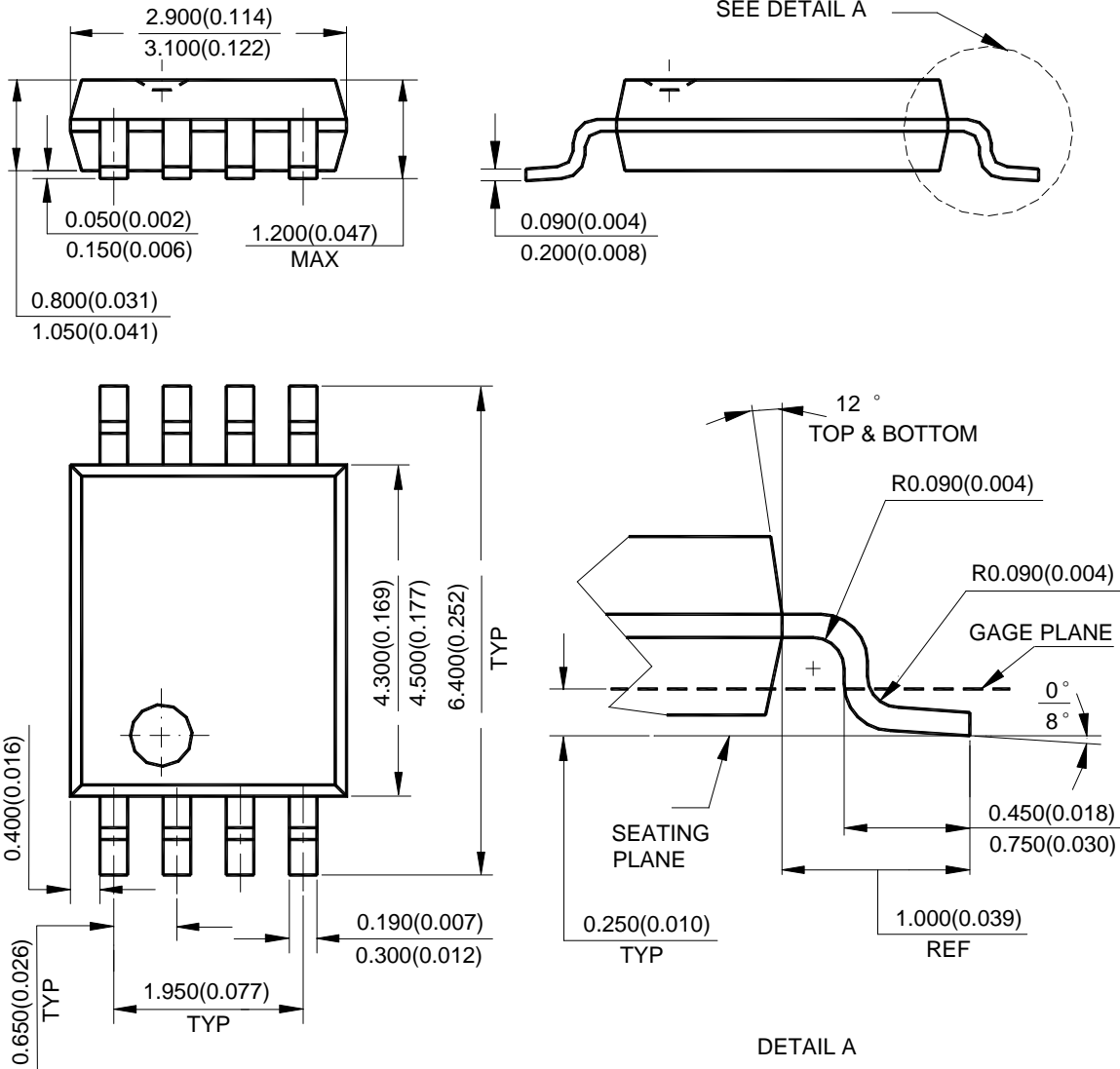
(3) Package Type: SO-8



Note: Eject hole, oriented hole and mold mark is optional.

Package Outline Dimensions (Cont. All dimensions in mm(inch).)

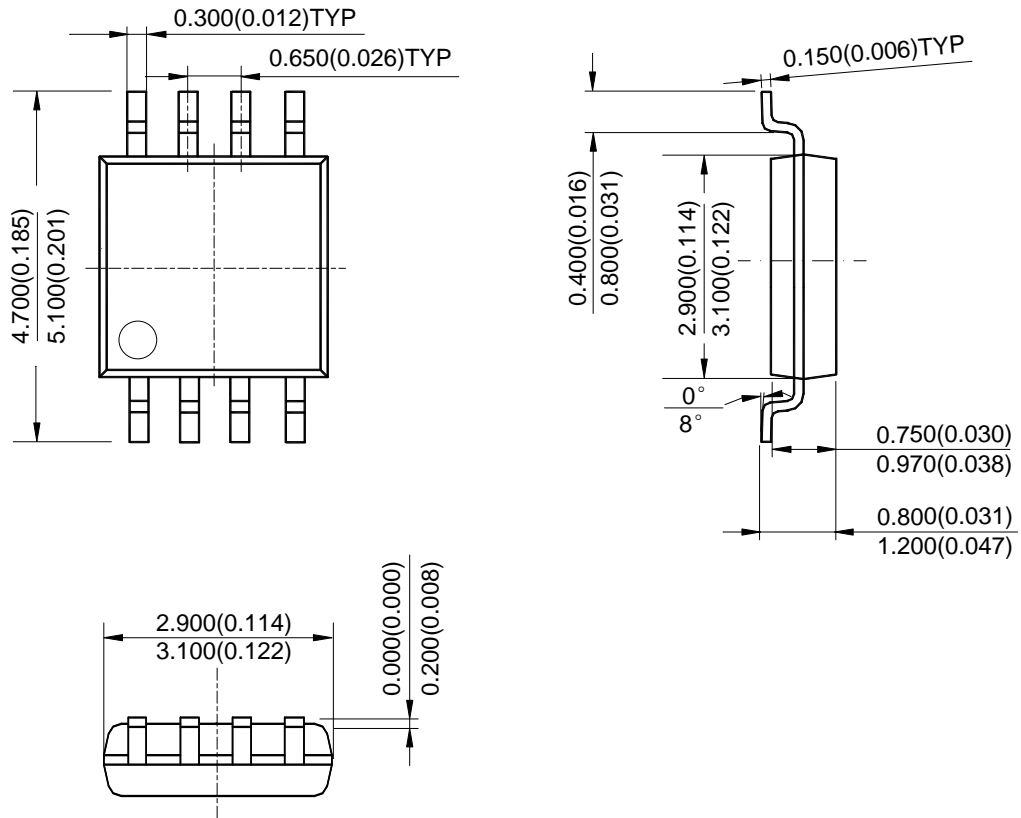
(4) Package Type: TSSOP-8



Note: Eject hole, oriented hole and mold mark is optional.

Package Outline Dimensions (Cont. All dimensions in mm(inch).)

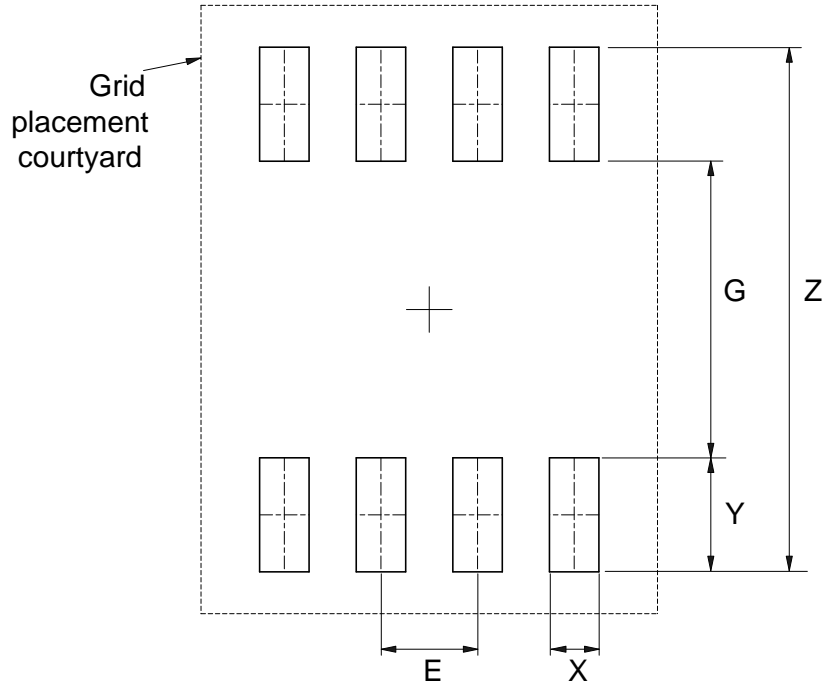
(5) Package Type: MSOP-8



Note: Eject hole, oriented hole and mold mark is optional.

Suggested Pad Layout

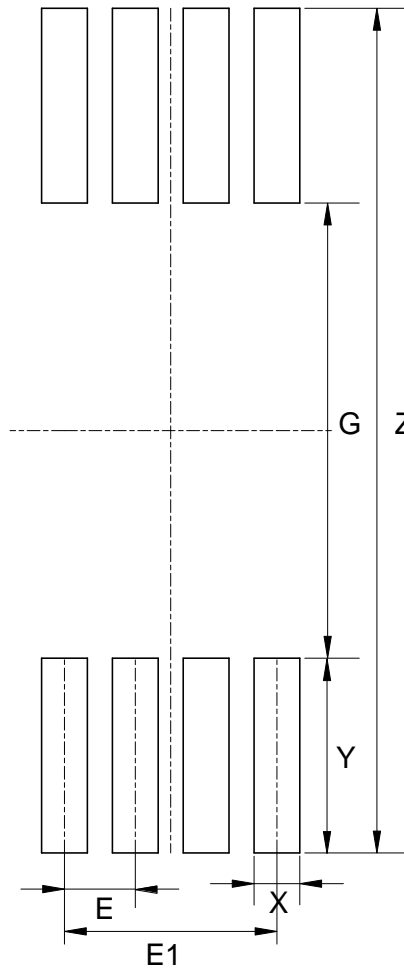
(1) Package Type: SO-8



| Dimensions | Z (mm)/(inch) | G (mm)/(inch) | X (mm)/(inch) | Y (mm)/(inch) | E (mm)/(inch) |
|------------|------------------|------------------|------------------|------------------|------------------|
| Value | 6.900/0.272 | 3.900/0.154 | 0.650/0.026 | 1.500/0.059 | 1.270/0.050 |

Suggested Pad Layout (Cont.)

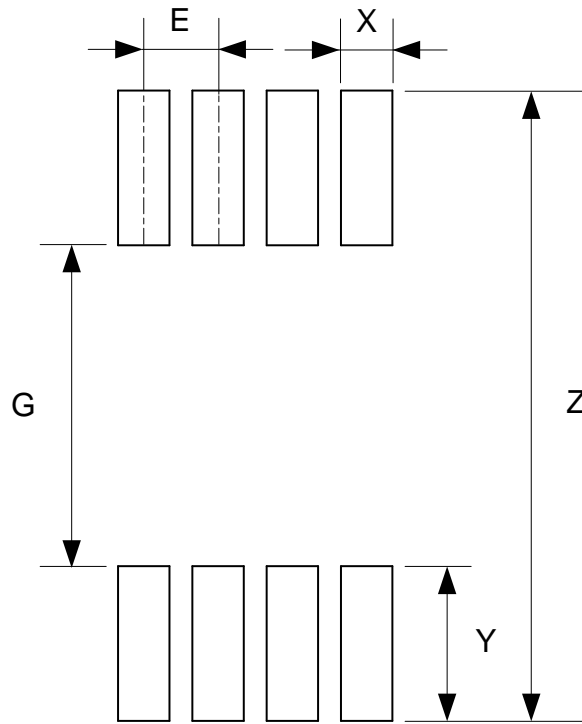
(2) Package Type: TSSOP-8



| Dimensions | Z (mm)/(inch) | G (mm)/(inch) | X (mm)/(inch) | Y (mm)/(inch) | E (mm)/(inch) | E1 (mm)/(inch) |
|------------|------------------|------------------|------------------|------------------|------------------|-------------------|
| Value | 7.720/0.304 | 4.160/0.164 | 0.420/0.017 | 1.780/0.070 | 0.650/0.026 | 1.950/0.077 |

Suggested Pad Layout (Cont.)

(3) Package Type: MSOP-8



| Dimensions | Z (mm)/(inch) | G (mm)/(inch) | X (mm)/(inch) | Y (mm)/(inch) | E (mm)/(inch) |
|------------|------------------|------------------|------------------|------------------|------------------|
| Value | 5.500/0.217 | 2.800/0.110 | 0.450/0.018 | 1.350/0.053 | 0.650/0.026 |

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 - 2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.
- B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

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