DATA SHEET

**AZV358**

# DUAL LOW VOLTAGE RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

## Description

The AZV358 is dual low voltage (2.7V to 5.5V) operational amplifiers which have rail-to-rail output swing capability. The input common-mode voltage range includes ground. The chip exhibits excellent speed-power ratio, achieving 1MHz of bandwidth and 1V/μs of slew rate with low supply current.

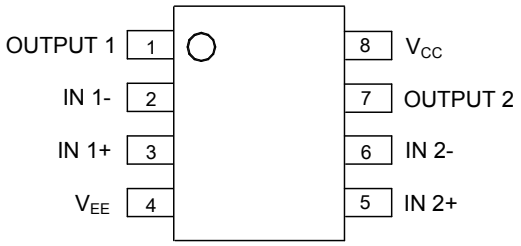
The AZV358 is built with BiCMOS process. It has bipolar input and output stages for improved noise performance, low input offset voltage and higher output current drive.

AZV358 is available in the package of TSSOP-8 and MSOP-8. The small packages save space on pc boards, and enable the design of small portable electronic devices. It also allows the designer to place the device closer to the signal source to reduce noise pickup and increase signal integrity.

AZV358 is also available in standard SOIC-8 package.

## Pin Assignments

M/G/MM Package
(SOIC-8/TSSOP-8/MSOP-8)




## Features

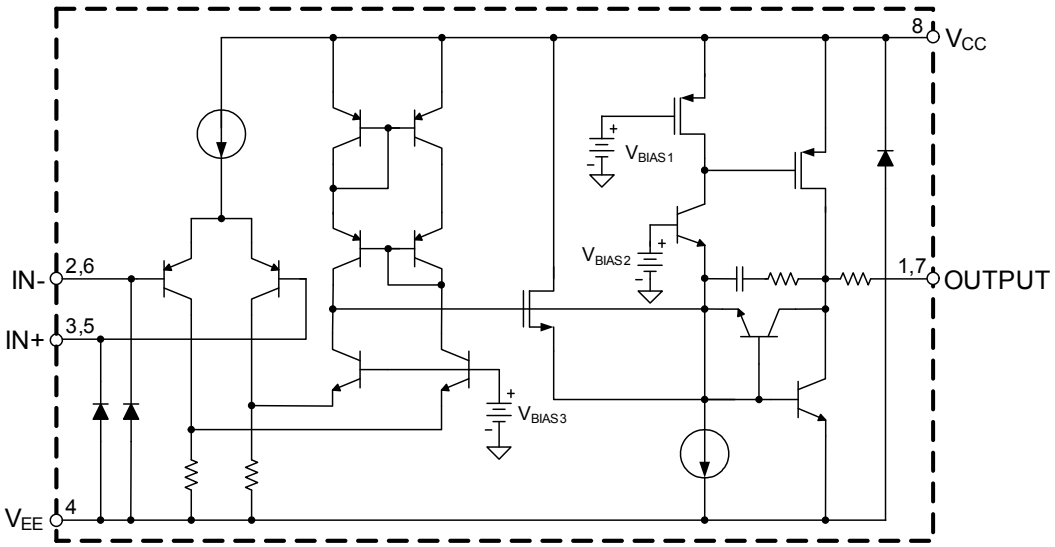
（For $V_{CC}$=5V and $V_{EE}$=0V, typical unless otherwise noted）

- Guaranteed 2.7V to 5.5V Performance
- No Crossover Distortion
- Gain-Bandwidth Product 1MHz
- Industrial Temperature Range: -40°C to +85°C
- Low Supply Current: 210μA
- Rail-to-Rail Output Swing under 10kΩ Load:
  - $V_{OH}$ up to $V_{CC}$ -10mV
  - $V_{OL}$ near to $V_{EE}$ +65mV
- $V_{CM}$: -0.1V to $V_{CC}$-0.8V

## Applications

- Active Filters
- Low Power, Low Voltage Applications
- General Purpose Portable Devices
- Cellular Phone, Cordless Phone
- Battery-Powered Systems

## Functional Block Diagram



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## Absolute Maximum Ratings (@$T_A$=25°C, unless otherwise specified. Note 1)

| Symbol | Parameter | Rating | Unit |
|---|---|---|---|
| $V_{CC}$ | Power Supply Voltage | 6 | V |
| $T_J$ | Operation Junction Temperature | 150 | °C |
| $T_{STG}$ | Storage Temperature Range | -65 to 150 | °C |
| $T_{LEAD}$ | Lead Temperature (Soldering, 10 seconds) | 260 | °C |
| — | ESD (Machine Model) | 200 | V |
| — | ESD (Human Body Model) | 2000 | V |

Note 1: 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.

## Recommended Operating Conditions

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | 2.7 | 5.5 | V |
| $T_A$ | Ambient Operating Temperature Range | -40 | 85 | °C |

## 2.7V Electrical Characteristics (@$T_A$=25°C, **bold** typeface applies over $T_A$=-40°C to 85°C, $V_{CC}$=2.7V, $V_{EE}$=0V, $V_{CM}$=1.0V, $V_O$=$V_{CC}$/2 and $R_L$>1MΩ, unless otherwise specified. Note 2)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IO}$ | Input Offset Voltage | — | — | 1.7 | 7 | mV |
| | | — | — | — | **9** | |
| $I_B$ | Input Bias Current | — | — | 11 | 250 | nA |
| | | — | — | — | **500** | |
| $I_{IO}$ | Input Offset Current | — | — | 5 | 50 | nA |
| | | — | — | — | **150** | |
| $V_{CM}$ | Input Common Mode Voltage Range | for CMRR≥50dB | -0.1 | — | 1.9 | V |
| $I_{CC}$ | Supply Current | $V_O$=$V_{CC}$/2, $A_{VCL}$=1, No load | — | 140 | 340 | μA |
| | | | — | — | **420** | |
| CMRR | Common Mode Rejection Ratio | 0≤$V_{CM}$≤1.7V | 50 | 63 | — | dB |
| PSRR | Power Supply Rejection Ratio | 2.7V≤$V_{CC}$≤5V, $V_O$=1V | 50 | 60 | — | dB |
| $I_{SOURCE}$ | Output Short Circuit Current | $V_O$=0V | 5 | 20 | — | mA |
| $I_{SINK}$ | | $V_O$=2.7V | 10 | 30 | — | mA |
| $V_{OH}$ | Output Voltage Swing | $R_L$=10kΩ to 1.35V | 2.60 | 2.69 | — | V |
| $V_{OL}$ | | | — | 60 | 180 | mV |
| GBWP | Gain Bandwidth Product | $C_L$=200pF | — | 1 | — | MHz |
| $\phi_M$ | Phase Margin | — | — | 60 | — | deg |
| $G_M$ | Gain Margin | — | — | 10 | — | dB |

Note 2: Limits over the full temperature are guaranteed by design, but not tested in production.

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## 5V Electrical Characteristics (@$T_A$=25°C, **bold** typeface applies over $T_A$=-40°C to 85°C, $V_{CC}$=5V, $V_{EE}$=0V, $V_{CM}$=2.0V, $V_O$=$V_{CC}$/2 and $R_L$>1MΩ, unless otherwise specified. Note 2)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IO}$ | Input Offset Voltage | — | — | 1.7 | 7 | mV |
| | | — | — | — | **9** | |
| $I_B$ | Input Bias Current | — | — | 15 | 250 | nA |
| | | — | — | — | **500** | |
| $I_{IO}$ | Input Offset Current | — | — | 5 | 50 | nA |
| | | — | — | — | **150** | |
| $V_{CM}$ | Input Common Mode Voltage Range | for CMRR≥50dB | -0.1 | — | 4.2 | V |
| $I_{CC}$ | Supply Current | $V_O$=$V_{CC}$/2, $A_{VCL}$=1, No load | — | 210 | 440 | μA |
| | | | — | — | **615** | |
| $G_V$ | Large Signal Voltage Gain | $R_L$=2kΩ | 84 | 100 | — | dB |
| | | | **80** | — | — | |
| CMRR | Common Mode Rejection Ratio | 0≤$V_{CM}$≤4V | 50 | 63 | — | dB |
| PSRR | Power Supply Rejection Ratio | 2.7V≤$V_{CC}$≤5V, $V_O$=1V, $V_{CM}$=1V | 50 | 60 | — | dB |
| $I_{SOURCE}$ | Output Short Circuit Current | $V_O$=0V | 5 | 60 | — | mA |
| $I_{SINK}$ | | $V_O$=5V | 10 | 160 | — | mA |
| $V_{OH}$ | Output Voltage Swing | $R_L$=2kΩ to 2.5V | 4.7 | 4.96 | — | V |
| | | | **4.6** | — | — | |
| | | $R_L$=10kΩ to 2.5V | 4.9 | 4.99 | — | |
| | | | **4.8** | — | — | |
| $V_{OL}$ | | $R_L$=2kΩ to 2.5V | — | 120 | 300 | mV |
| | | | — | — | **400** | |
| | | $R_L$=10kΩ to 2.5V | — | 65 | 180 | |
| | | | — | — | **280** | |
| SR | Slew Rate | — | — | 1 | — | V/μs |
| GBWP | Gain Bandwidth Product | $C_L$=200pF | — | 1 | — | MHz |
| $\phi_M$ | Phase Margin | — | — | 60 | — | deg |
| $G_M$ | Gain Margin | — | — | 10 | — | dB |

Note 2: Limits over the full temperature are guaranteed by design, but not tested in production.

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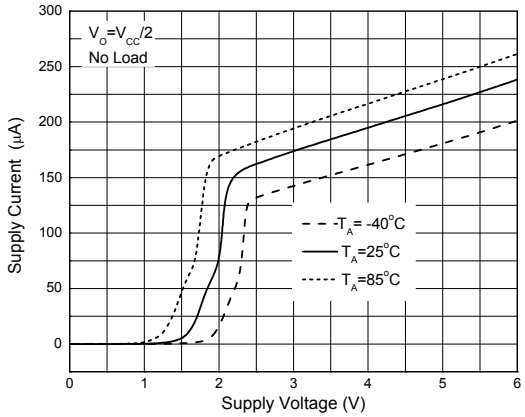
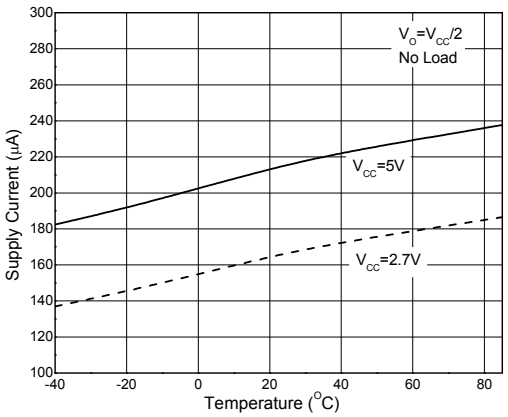
## Performance Characteristics

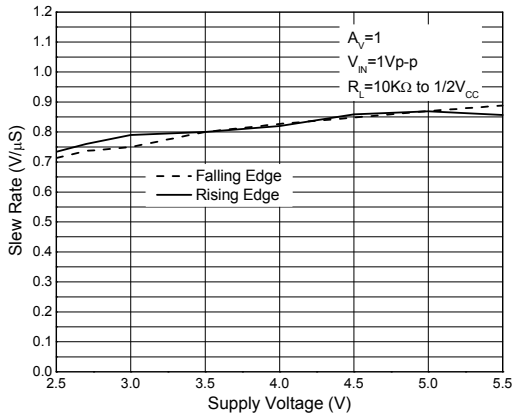
### Supply Current vs. Supply Voltage



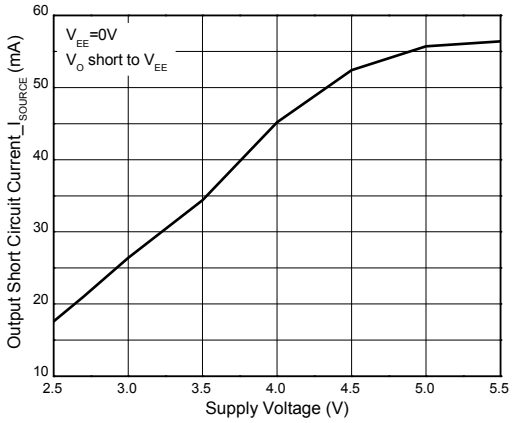

### Supply Current vs. Temperature



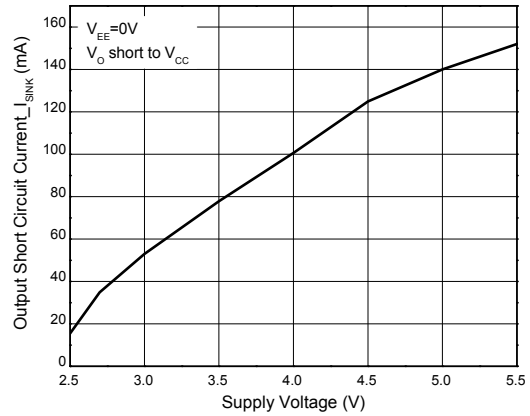

### Slew Rate vs. Supply Voltage



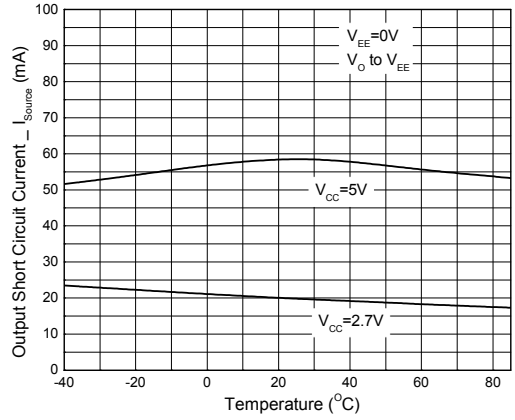

### Output Short Circuit Current vs. Supply Voltage




### Output Short Circuit Current vs. Supply Voltage



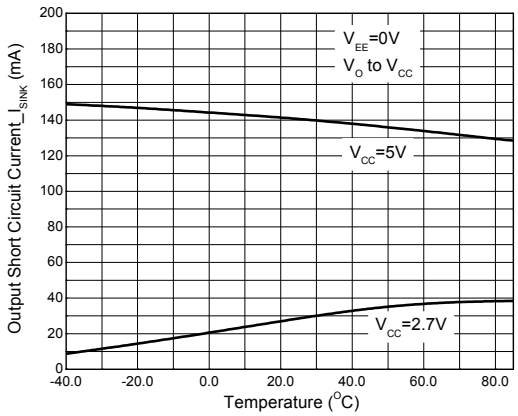

### Output Short Circuit Current vs. Temperature



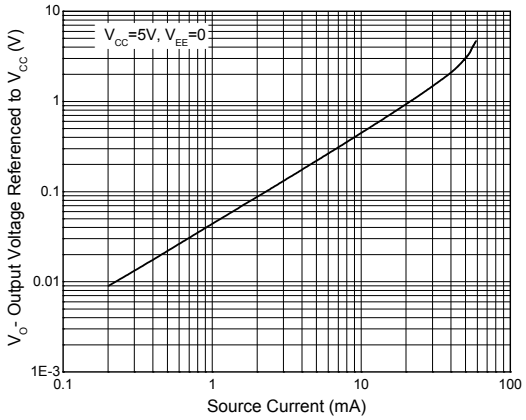
DATA SHEET

## Performance Characteristics (Cont.)

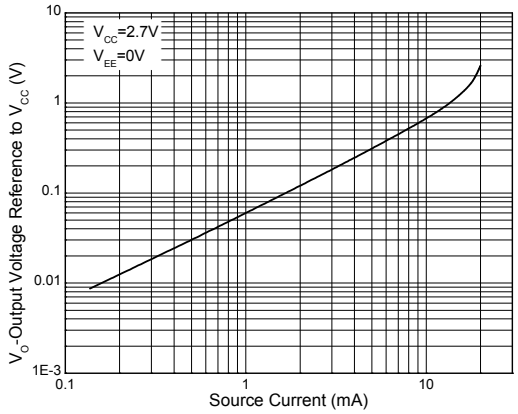
### Output Short Circuit Current vs. Temperature



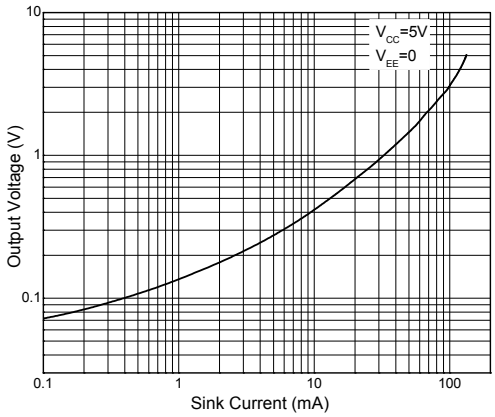

### Output Voltage vs. Output Source Current



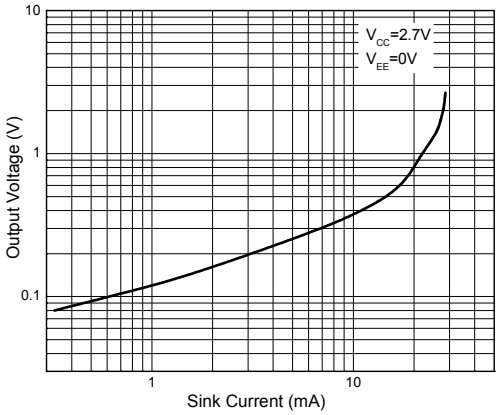

### Output Voltage vs. Output Source Current



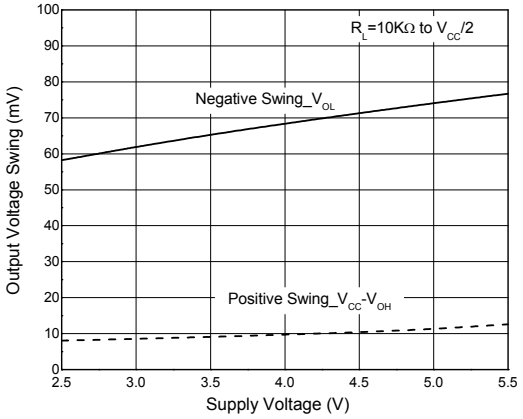

### Output Voltage vs. Output Sink Current




### Output Voltage vs. Output Sink Current



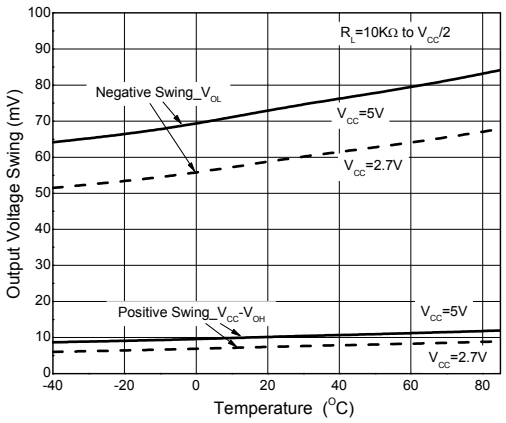

### Output Voltage Swing vs. Supply Voltage



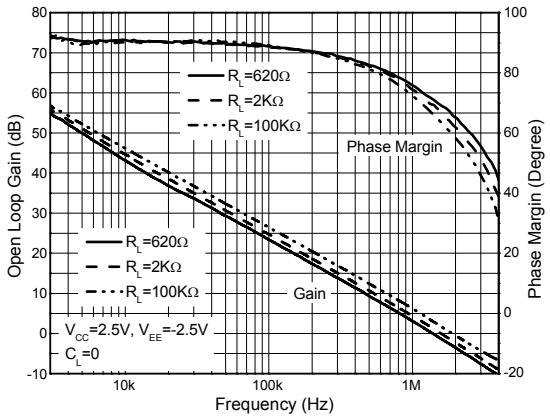
DATA SHEET

## Performance Characteristics (Cont.)

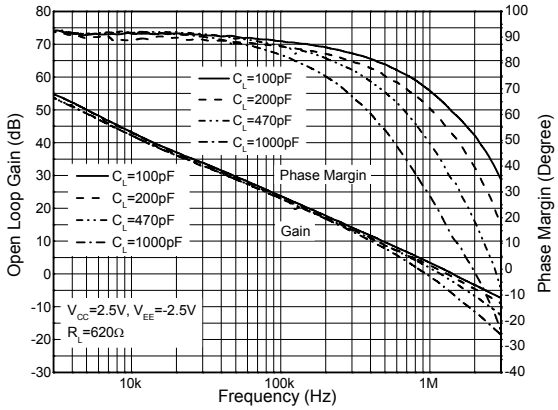
### Output Voltage Swing vs. Temperature



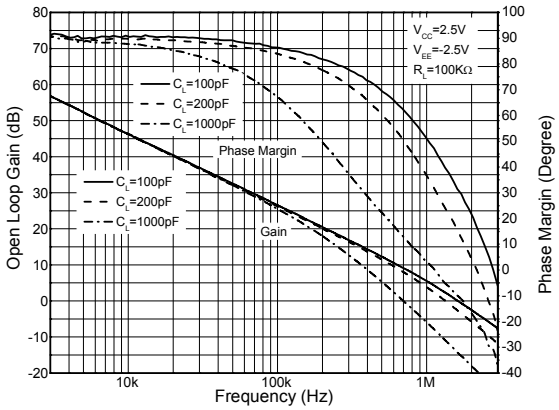

### Gain and Phase vs. Frequency and Resistive Load



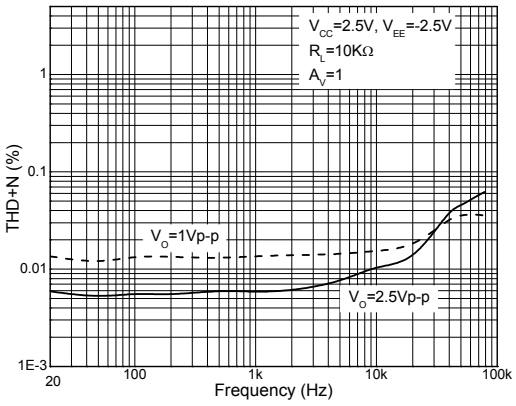

### Gain and Phase vs. Frequency and Capacitive Load



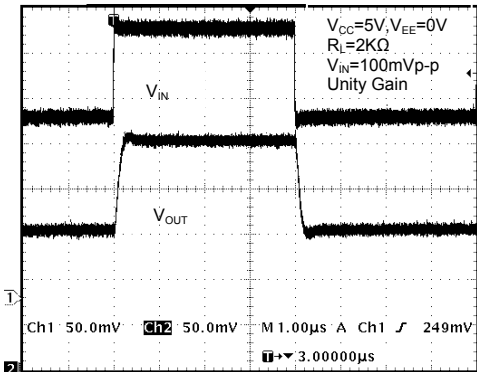

### Gain and Phase vs. Frequency and Capacitive Load




### THD+N vs. Frequency




### Non-Inverting Input Small Signal Pulse Response



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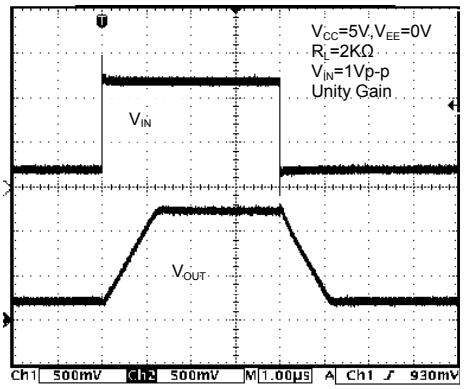
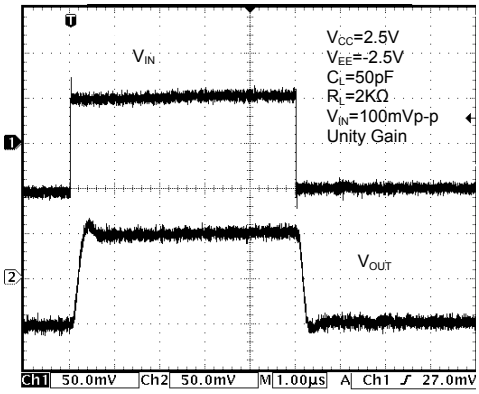
## Performance Characteristics (Cont.)

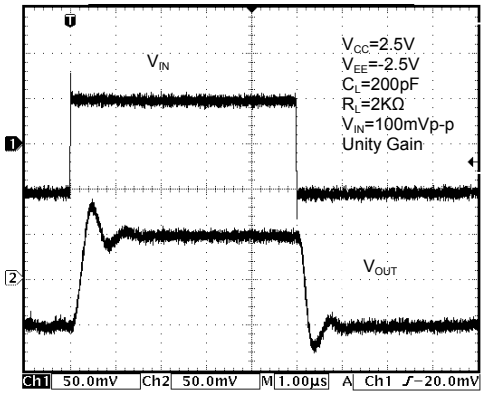
### Non-Inverting Input Large Signal Pulse Response




### Non-Inverting Input Small Signal Response




### Non-Inverting Input Small Signal Response



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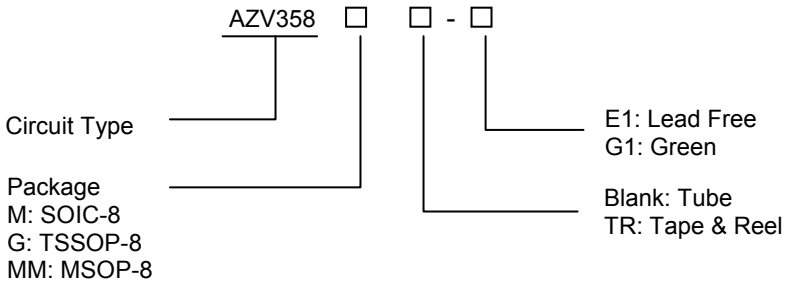
## Ordering Information




| Package | Temperature Range | Part Number | | Marking ID | | Packing Type |
|---|---|---|---|---|---|---|
| | | Lead Free | Green | Lead Free | Green | |
| SOIC-8 | -40 to 85°C | AZV358M-E1 | AZV358M-G1 | AZV358M-E1 | AZV358M-G1 | Tube |
| | | AZV358MTR-E1 | AZV358MTR-G1 | AZV358M-E1 | AZV358M-G1 | Tape & Reel |
| TSSOP-8 | -40 to 85°C | AZV358G-E1 | AZV358G-G1 | EG3E | GG3E | Tube |
| | | AZV358GTR-E1 | AZV358GTR-G1 | EG3E | GG3E | Tape & Reel |
| MSOP-8 | -40 to 85°C | AZV358MM-E1 | AZV358MM-G1 | AZV358MM-E1 | AZV358MM-G1 | Tube |
| | | AZV358MMTR-E1 | AZV358MMTR-G1 | AZV358MM-E1 | AZV358MM-G1 | Tape & Reel |

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant. Products with “G1” suffix are available in green packages.

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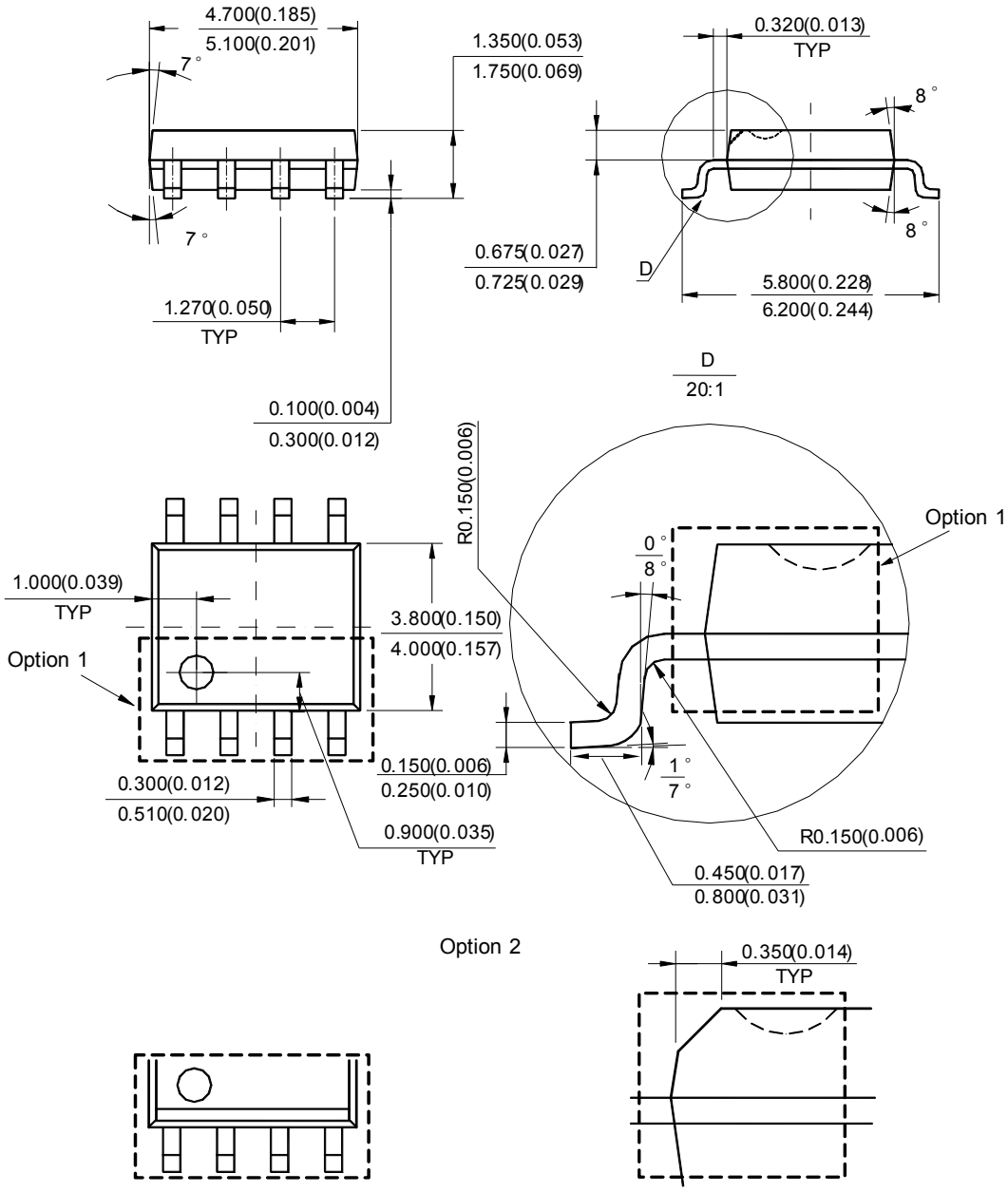
## Package Outline Dimensions (All dimensions in mm(inch).)

### SOIC-8

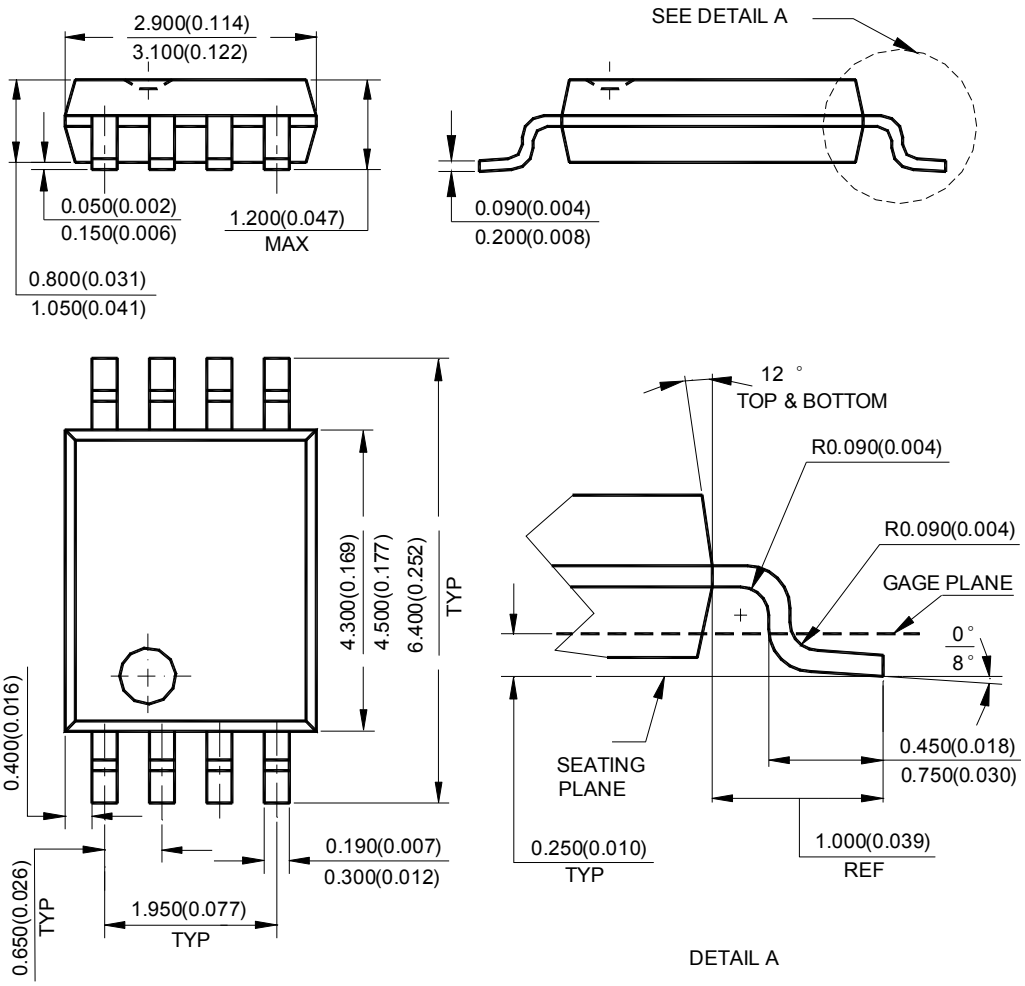



Note: Eject hole, oriented hole and mold mark is optional .

DATA SHEET

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

### TSSOP-8

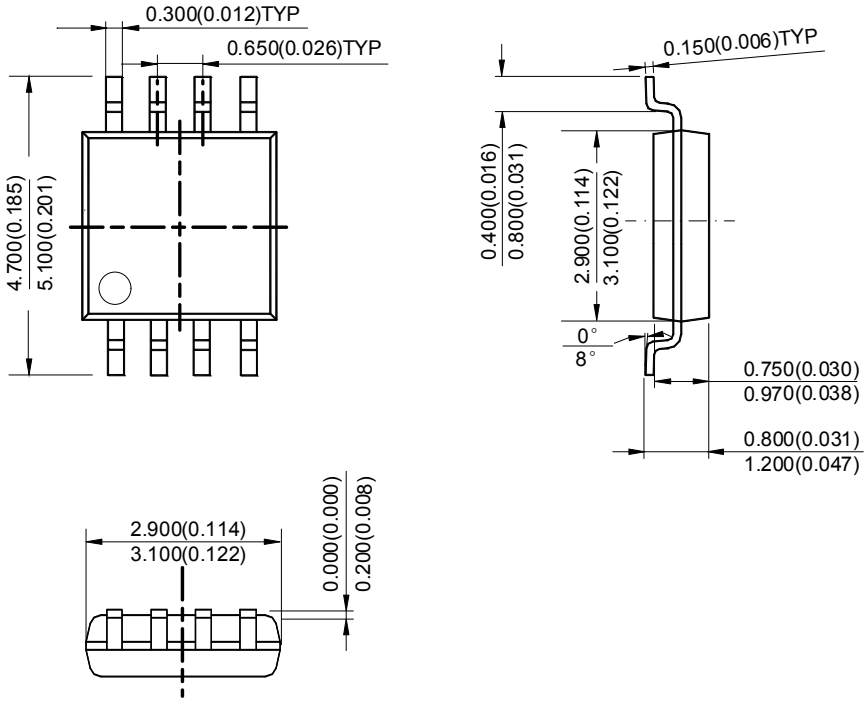



Note: Eject hole, oriented hole and mold mark is optional

DATA SHEET

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

### MSOP-8




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

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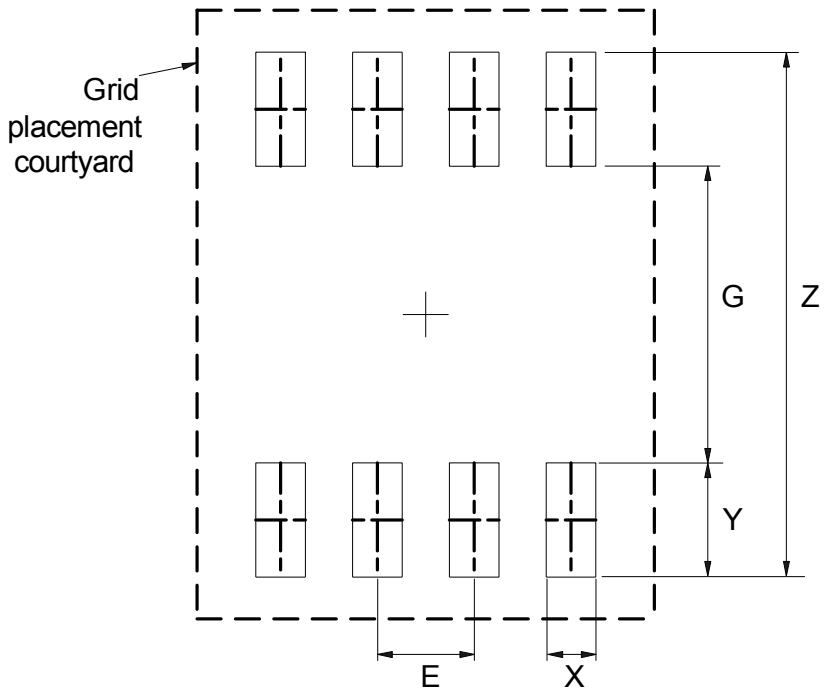
## Suggested Pad Layout

### SOIC-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 |

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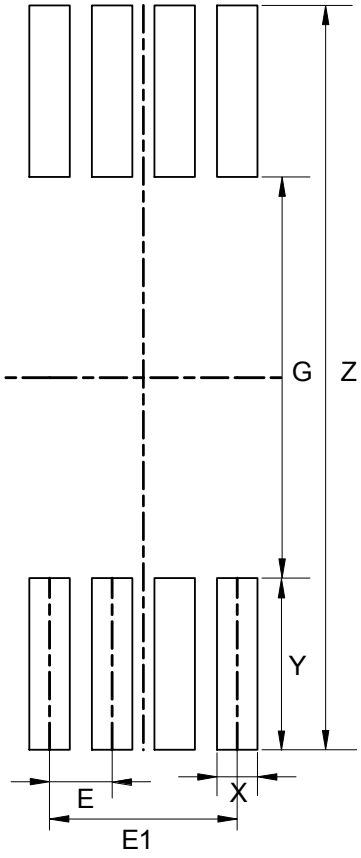
## Suggested Pad Layout (Cont.)

### 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 |

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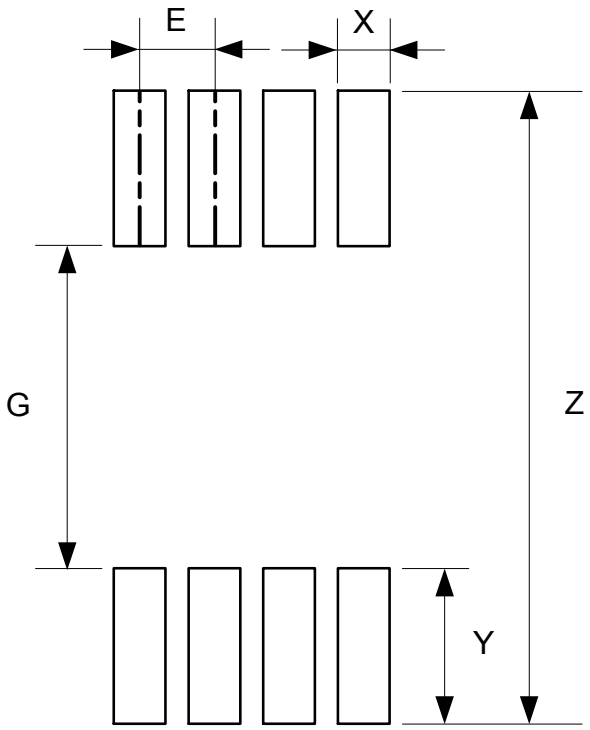
## Suggested Pad Layout (Cont.)

**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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