# 1. FEATURES

- Low Offset Voltage: 10μV (max)
- Zero-Drift: 0.08μV/°C
- Low Noise: 13nV/$\sqrt{Hz}$
  - 0.1Hz to 10Hz Noise: 0.2$\mu V_{PP}$
- Excellent DC Precision:
  - PSRR: 148dB
  - CMRR: 150dB
  - Open-Loop Gain: 136dB
- Gain Bandwidth: 2.5MHz
- Quiescent Current: 600μA (typ)
- Wide Supply Range: ±2.25V to ±20V
- Rail-to-Rail Output
- Input Includes Negative Rail
- RFI Filtered Inputs
- 1/2 Channel

# 2. APPLICATIONS

- Bridge Amplifiers
- Strain Gauges
- Transducer Applications
- Temperature Measurement
- Electronic Scales
- Medical Instrumentation
- Resistance Temperature Detectors

# 3. DESCRIPTION

The OPZ30x is a high-performance, general-purpose operational amplifiers that supports 4.5 - 40V supply range. With extremely low input offset voltage of 10μV (maximum) and a high CMRR of 150dB, the OPZ30x operational amplifiers provide excellent initial accuracy and rail-to-rail output. The devices work well with both single-supply convenient portable equipment and differential output scenarios.

The OPZ30x family provides up to 2.5MHz bandwidth,3V/us slew rate and outstanding DC performance, which is rather suitable for active filter circuits.

The OPZ30x operational amplifiers are offered in the SOT23-5, SOIC-8, and MSOP-8 packages. All versions are specified from –40°C to 125°C. See Table 1 for the order information.

Bridge Amplifier

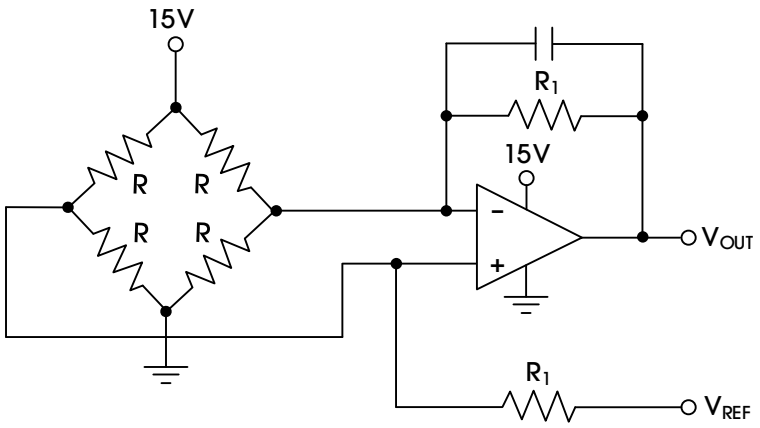


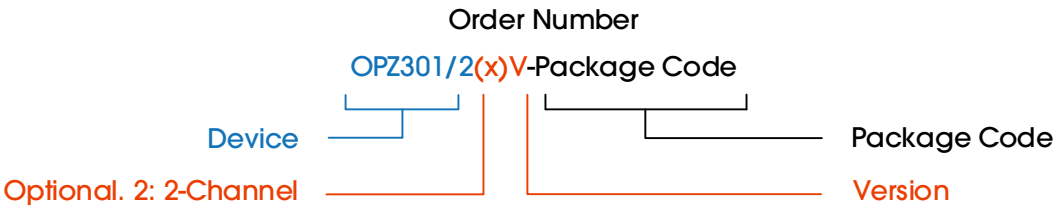
Table 1 lists the order information.

## Table 1. Order Information

| ORDER NUMBER[1] | PART NUMBER | CH (#) | PACKAGE | MARKING | $I_Q$ PER CH (TYP) (μA) | GBW (MHz) | SLEW RATE (TYP) | OP TEMP (°C) | PKG OPTION |
|---|---|---|---|---|---|---|---|---|---|
| OPZ302ASOIC8 | OPZ302 | 1 | SOIC-8 | OPZ302/AVWWW | 450 | 2.5 | 3 | -40 - 125 | T/R-4000 |
| OPZ302ASOT235 | OPZ302 | 1 | SOT23-5 | OPZ302/AVWWW | 450 | 2.5 | 3 | -40 - 125 | T/R-4000 |
| OPZ302AMSOP8 | OPZ302 | 1 | MSOP-8 | OPZ302/AVWWW | 450 | 2.5 | 3 | -40 - 125 | T/R-4000 |
| OPZ3022ASOIC8 | OPZ3022 | 2 | SOIC-8 | OPZ3022/AVWWW | 450 | 2.5 | 3 | -40 - 125 | T/R-4000 |
| OPZ3022AMSOP-8 | OPZ3022 | 2 | SOIC-8 | OPZ3022/AVWWW | 450 | 2.5 | 3 | -40 - 125 | T/R-4000 |

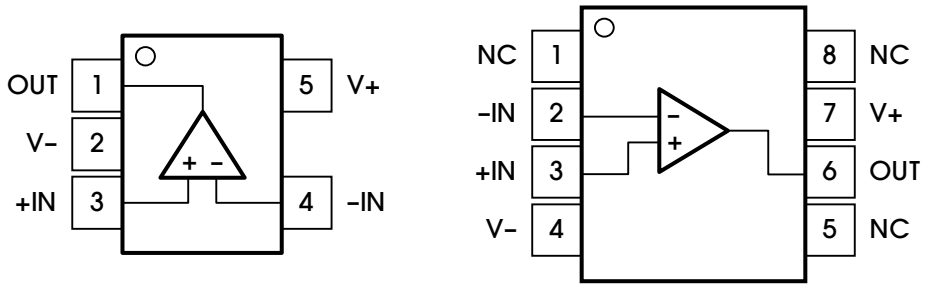
Devices can be ordered via the following two ways:
1. Place orders directly on our website (www.analogysemi.com), or;
2. Contact our sales team by mailing to sales@analogysemi.com.

Note:



# 4. PIN CONFIGURATION AND FUNCTIONS

Figure 1 illustrates the pin configuration (1 CH Devices).




SOT23-5 Package
(1 CH)

SOIC-8/MSOP-8 Package
(1 CH)

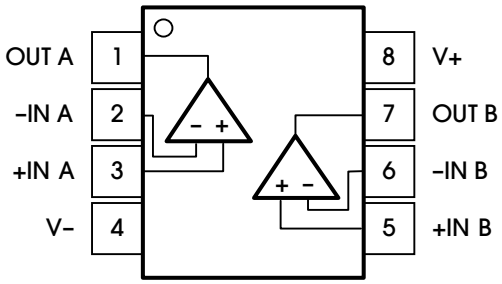
Figure 1. Pin Configuration (1 CH Devices)

Table 2 lists the pin functions (1 CH Devices).

Table 2. Pin Functions (1 CH Devices)

| POSITION | | NAME | TYPE | DESCRIPTION |
|---|---|---|---|---|
| SOT23-5 | SOIC-8 | | | |
| 1 | 6 | OUT | Output | Output |
| 2 | 4 | V– | Power | Negative (lowest) power supply |
| 3 | 3 | +IN | Input | Positive (non-inverting) input |
| 4 | 2 | –IN | Input | Negative (inverting) input |
| 5 | 7 | V+ | Power | Positive (highest) power supply |
| — | 1, 5, 8 | NC | I/O | No internal connection (can be left floating) |

Figure 2 illustrates the pin configuration (2 CH Devices).




SOIC-8/MSOP-8
Package
(2 CH)

Figure 2. Pin Configuration (2 CH Devices)

Table 3 lists the pin functions (2 CH Devices).

Table 3. Pin Functions (2 CH Devices)

| POSITION | NAME | TYPE | DESCRIPTION |
|---|---|---|---|
| 1 | OUT A | Ouput | Output, channel A |
| 2 | –IN A | Input | Inverting input, channel A |
| 3 | +IN A | Input | Non-inverting input, channel A |
| 4 | V– | Power | Negative (lowest) power supply |
| 5 | +IN B | Input | Non-inverting input, channel B |
| 6 | –IN B | Input | Inverting input, channel B |
| 7 | OUT B | Output | Output, channel B |
| 8 | V+ | Power | Positive (highest) power supply |

# 5. SPECIFICATIONS

## 5.1 ABSOLUTE MAXIMUM RATINGS

Table 5 lists the absolute maximum ratings of the OPZ30x. Over operating free-air temperature range, unless otherwise noted.

Table 4. Absolute Maximum Ratings

| PARAMETER | DESCRIPTION | | MIN | MAX | UNITS |
|---|---|---|---|---|---|
| Voltage | Supply | Split | ±2.25 | ±20 | V |
| | | Single | 4.5 | 40 | |
| | Signal input pins(2) | Common-mode | (V–) – 0.5 | (V+) + 0.5 | |
| | | Differential | | ±0.7 | |
| Current | Signal input pins | | | ±10 | mA |
| | Output short-circuit(3) | | Continuous | | |
| Temperature | Operating, $T_A$(4) | | –55 | 150 | °C |
| | Junction, $T_J$ | | | 150 | |
| | Storage, $T_{stg}$ | | –65 | 150 | |

Note 1: Stresses beyond those listed under Table 5 may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Table 7. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
Note 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.
Note 3: Short-circuit to ground, V–, or V+.
Note 4: Provided device does not exceed maximum junction temperature ($T_J$) at any time.

## 5.2 ESD RATINGS

Table 6 lists the ESD ratings of the OPZ30x.

Table 5. ESD Ratings

| PARAMETER | SYMBOL | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|---|
| Electrostatic Discharge | $V_{(ESD)}$ | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1) | TBD | V |
| | | Charged-device model (CDM), per JEDEC specification JESD22-C101(2) | TBD | |

Note 1: The JEDEC document JEP155 indicates that 500V HBM allows safe manufacturing with a standard ESD control process.
Note 2: The JEDEC document JEP157 indicates that 250V CDM allows safe manufacturing with a standard ESD control process.

## 5.3 RECOMMENDED OPERATING CONDITIONS

Table 7 lists the recommended operating conditions for the OPZ30x. Over operating free-air temperature range, unless otherwise noted.

Table 6. Recommended Operating Conditions

| PARAMETER | DESCRIPTION | MIN | NOM | MAX | UNITS |
|---|---|---|---|---|---|
| Operating Voltage Range | Split supply | ±2.25 | | ±20 | V |
| | Single supply | 4.5 | | 40 | V |
| Specified Temperature Range | | –40 | | 125 | °C |

## 5.4 THERMAL INFORMATION

Table 8 lists the thermal information for the OPZ30x.

Table 7. Thermal Information

| PARAMETER | SYMBOL | SOT23-5 | SOIC-8 | UNITS |
|---|---|---|---|---|
| Junction-to-Ambient Thermal Resistance | $R_{\theta JA}$ | 168 | 150 | °C/W |
| Junction-to-Case (Top) Thermal Resistance | $R_{\theta JC(top)}$ | 103 | 54 | °C/W |
| Junction-to-Board Thermal Resistance | $R_{\theta JB}$ | 39 | 90 | °C/W |
| Junction-to-Top Characterization Parameter | $\psi_{JT}$ | 10 | 3 | °C/W |
| Junction-to-Board Characterization Parameter | $\psi_{JB}$ | 36 | 86 | °C/W |
| Junction-to-Case (Bottom) Thermal Resistance | $R_{\theta JC(bot)}$ | 66 | 90 | °C/W |

# 5.5 ELECTRICAL CHARACTERISTICS (OPZ30X)

## 5.5.1 HIGH-VOLTAGE OPERATION

Table 9 lists the electrical characteristics of the OPZ30X for high-voltage operation. $T_A$ = 25°C, $V_S$ = ±4V to ±20V ($V_S$ = 8V to 40V), $R_L$ = 10kΩ connected to $V_S$ / 2, and $V_{CM}$ = $V_{OUT}$ = $V_S$ / 2, unless otherwise noted.

Table 8. Electrical Characteristics (High-Voltage Operation)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| OFFSET VOLTAGE | | | | | | |
| Input Offset Voltage | $V_{OS}$ | | | ±1 | ±10 | μV |
| | | $T_A$ = –40°C to 125°C | | ±0.01 | ±0.08 | μV/°C |
| Power-Supply Rejection Ratio | PSRR | $V_S$ = 4V to 40V, $T_A$ = –40°C to 125°C | | ±0.04 | ±0.36 | μV/V |
| Long-Term Stability(2) | | | | 4 | | μV |
| INPUT BIAS CURRENT | | | | | | |
| Input Bias Current | $I_B$ | $V_{CM}$ = $V_S$ / 2 | | ±300 | ±1000 | pA |
| | | $T_A$ = –40°C to 125°C | | | ±10 | nA |
| Input Offset Current | $I_{OS}$ | | | ±400 | ±2000 | pA |
| | | $T_A$ = –40°C to 125°C | | | ±6 | nA |
| NOISE | | | | | | |
| Input Voltage Noise | $e_n$ | f = 0.1Hz to 10Hz | | 200 | | $nV_{P-P}$ |
| | | f = 0.1Hz to 10Hz | | 30 | | nVrms |
| Input Voltage Noise Density | | f = 1kHz | | 13 | | $nV/\sqrt{Hz}$ |
| Input Current Noise Density | $i_n$ | f = 1kHz | | 7 | | $fA/\sqrt{Hz}$ |
| INPUT VOLTAGE RANGE | | | | | | |
| Common-Mode Voltage Range | $V_{CM}$ | $T_A$ = –40°C to 125°C | V– | | (V+) – 1.5 | V |
| Common-Mode Rejection Ratio | CMRR | (V–) < $V_{CM}$ < (V+) – 1.5V | TBD | 145 | | dB |
| | | (V–) + 0.5V < $V_{CM}$ < (V+) – 1.5V, $V_S$ = ±20V | TBD | 150 | | dB |
| | | (V–) + 0.5V < $V_{CM}$ < (V+) – 1.5V, $V_S$ = ±20V, $T_A$ = –40°C to 125°C | TBD | 150 | | dB |
| INPUT IMPEDANCE | | | | | | |
| Differential | $Z_{ID}$ | | | 100 \|\| 6 | | MΩ \|\| pF |
| Common-Mode | $Z_{IC}$ | | | 6 \|\| 9.5 | | $10^{12}$Ω \|\| pF |
| OPEN-LOOP GAIN | | | | | | |
| Open-Loop Voltage Gain | $A_{OL}$ | (V–) + 0.5V < $V_O$ < (V+) – 0.5V | TBD | 136 | | dB |
| | | (V–) + 0.5V < $V_O$ < (V+) – 0.5V, $T_A$ = –40°C to 125°C | TBD | 126 | | dB |
| FREQUENCY RESPONSE | | | | | | |
| Gain-Bandwidth Product | GBW | OPZ302 | | 2.5 | | MHz |
| Slew Rate | SR | G = 1, OPZ302 | | 3 | | V/μs |
| Settling Time 0.1% | $t_S$ | $V_S$ = ±20V, G = 1, 10V step | | 20 | | μs |
| Settling Time 0.01% | | $V_S$ = ±20V, G = 1, 10V step | | 27 | | μs |
| Overload Recovery Time | $t_{OR}$ | $V_{IN}$ × G = $V_S$ | | 1 | | μs |
| Total Harmonic Distortion + Noise | THD+N | 1kHz, G = 1, $V_{OUT}$ = 1Vrms | | 0.0001% | | |

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| OUTPUT | | | | | | |
| Voltage Output Swing from Rail | | No load | | 6 | 15 | mV |
| | | $R_L$ = 10kΩ | | 100 | 150 | mV |
| | | $T_A$ = –40°C to 125°C | | TBD | 200 | mV |
| Short-Circuit Current | $I_{SC}$ | Sinking | | –20 | | mA |
| | | Sourcing | | 29 | | mA |
| Open-Loop Output Resistance | $R_O$ | f = 1MHz, $I_O$ = 0 | | 120 | | Ω |
| Capacitive Load Drive | $C_{LOAD}$ | | | 2 | | nF |
| POWER SUPPLY | | | | | | |
| | | $V_S$ = ±4V to $V_S$ = ±20V | | 600 | TBD | |
| | | $I_O$ = 0mA, $T_A$ = –40°C to 125°C | | | TBD | µA |

Note 1: $V_S$ / 2 = mid-supply.
Note 2: 1000-hour life test at 125°C demonstrated randomly distributed variation in the range of measurement limits—approximately 4µV.

## 5.5.2 LOW VOLTAGE OPERATION

Table 10 lists the electrical characteristics of the OPZ30X for low-voltage operation. $T_A$ = 25°C, $V_S$ = ±2.25V to < ±4V ($V_S$ = 4.5V to < 8V), $R_L$ = 10kΩ connected to $V_S$ / 2, and $V_{CM}$ = $V_{OUT}$ = $V_S$ / 2, unless otherwise noted.

Table 9. Electrical Characteristics (Low-Voltage Operation)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| OFFSET VOLTAGE | | | | | | |
| Input Offset Voltage | $V_{OS}$ | | | ±1 | ±10 | μV |
| | | $T_A$ = –40°C to 125°C | | ±0.01 | ±0.08 | μV/°C |
| Power-Supply Rejection Ratio | PSRR | $V_S$ = 4.5V to 40V, $T_A$ = –40°C to 125°C | | ±0.04 | ±0.36 | μV/V |
| Long-Term Stability(2) | | | | 4 | | μV |
| INPUT BIAS CURRENT | | | | | | |
| Input Bias Current | $I_B$ | | | ±300 | ±1000 | pA |
| | | $T_A$ = –40°C to 125°C | | | ±10 | nA |
| Input Offset Current | $I_{OS}$ | | | ±400 | ±2000 | pA |
| | | $T_A$ = –40°C to 125°C | | | ±6 | nA |
| NOISE | | | | | | |
| Input Voltage Noise | $e_n$ | f = 0.1Hz to 10Hz | | 200 | | $nV_{P-P}$ |
| | | f = 0.1Hz to 10Hz | | 30 | | nVrms |
| Input Voltage Noise Density | | f = 1kHz | | 13 | | $nV/\sqrt{Hz}$ |
| Input Current Noise Density | $i_n$ | f = 1kHz | | 7 | | $fA/\sqrt{Hz}$ |
| INPUT VOLTAGE RANGE | | | | | | |
| Common-Mode Voltage Range | $V_{CM}$ | $T_A$ = –40°C to 125°C | V– | | (V+) – 1.5 | V |
| Common-Mode Rejection Ratio | CMRR | (V–) < $V_{CM}$ < (V+) – 1.5V | TBD | 125 | | dB |
| | | (V–) + 0.5V < $V_{CM}$ < (V+) – 1.5V, $V_S$ = ±2V | TBD | 130 | | dB |
| | | (V–) + 0.5V < $V_{CM}$ < (V+) – 1.5V, $V_S$ = ±2V, $T_A$ = –40°C to 125°C | TBD | 130 | | dB |
| INPUT IMPEDANCE | | | | | | |
| Differential | $Z_{ID}$ | | | 100 \|\| 6 | | MΩ \|\| pF |
| Common-Mode | $Z_{IC}$ | | | 6 \|\| 9.5 | | $10^{12}$Ω \|\| pF |
| OPEN-LOOP GAIN | | | | | | |
| Open-Loop Voltage Gain | $A_{OL}$ | (V–) + 0.5V < $V_O$ < (V+) – 0.5V, $R_L$ = 5kΩ | TBD | 120 | | dB |
| | | (V–) + 0.5V < $V_O$ < (V+) – 0.5V | TBD | 130 | | dB |
| | | (V–) + 0.5V < $V_O$ < (V+) – 0.5V, $T_A$ = –40°C to 125°C | TBD | 120 | | dB |
| FREQUENCY RESPONSE | | | | | | |
| Gain-Bandwidth Product | GBW | OPZ302 | | 2.5 | | MHz |
| Slew Rate | SR | G = 1, OPZ302 | | 3 | | V/μs |
| Overload Recovery Time | $t_{OR}$ | $V_{IN}$ × G = $V_S$ | | 1 | | μs |
| Total Harmonic Distortion + Noise | THD+N | 1kHz, G = 1, $V_{OUT}$ = 1Vrms | | 0.0001% | | |

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| OUTPUT | | | | | | |
| Voltage Output Swing from Rail | | No load | | 6 | 15 | mV |
| | | $R_L$ = 10kΩ | | 100 | 150 | mV |
| | | $T_A$ = –40°C to 125°C | | TBD | 200 | mV |
| Short-Circuit Current | $I_{SC}$ | Sinking | | –20 | | mA |
| | | Sourcing | | 29 | | mA |
| Open-Loop Output Resistance | $R_O$ | f = 1MHz, $I_O$ = 0 | | 120 | | Ω |
| Capacitive Load Drive | $C_{LOAD}$ | | | 2 | | nF |
| POWER SUPPLY | | | | | | |
| | | $V_S$ = ±2.25V to $V_S$ = ±4V | | 595 | TBD | |
| | | $I_O$ = 0mA, $T_A$ = –40°C to 125°C | | | TBD | μA |

Note 1: $V_S$ / 2 = mid-supply.
Note 2: 1000-hour life test at 125°C demonstrated randomly distributed variation in the range of measurement limits—approximately 4μV.

# 6. PACKAGE INFORMATION

The OPZ30x family is available in the SOT23-5, SOIC-8, MSOP-8, and TSSOP-14 packages.

## 6.1 SOT23-5 PACKAGE

Figure 55 shows the SOT23-5 package view.

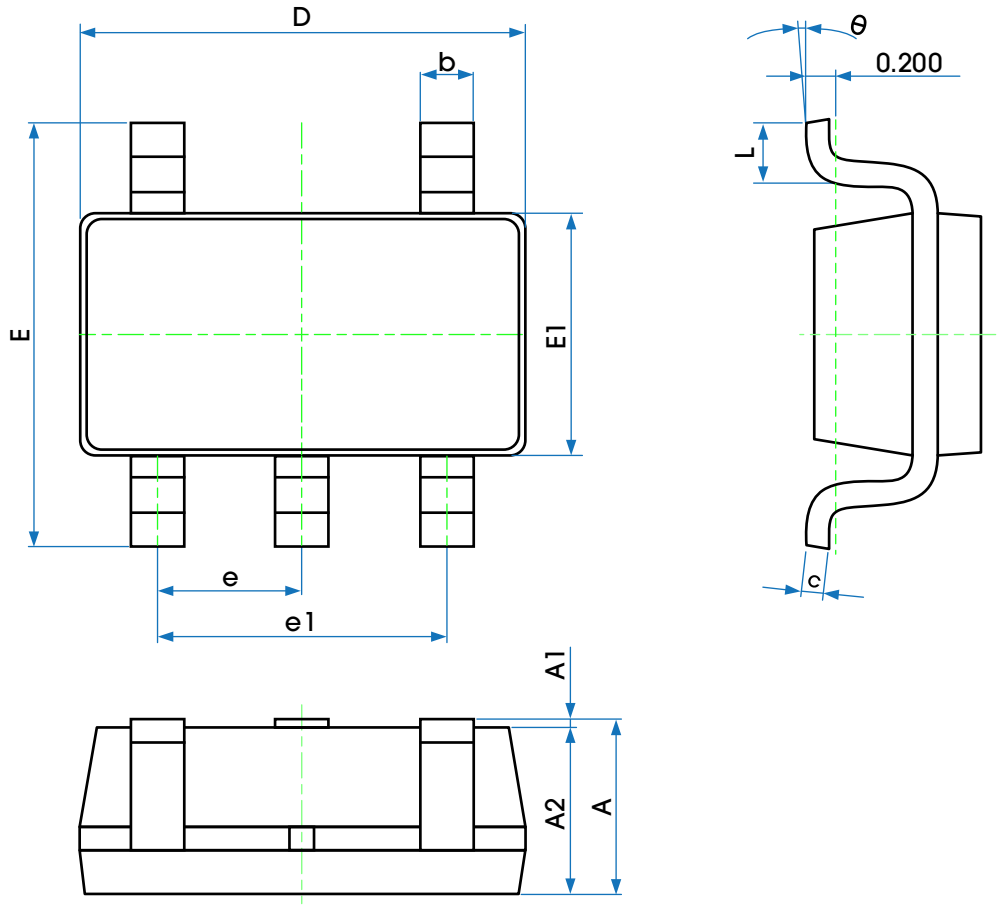



Figure 3. SOT23-5 Package View

Table 13 provides detailed information about the dimensions of the SOT23-5 package.

Table 10. Dimensions of the SOT23-5 Package

| SYMBOL | DIMENSIONS IN MILLIMETERS | | DIMENSIONS IN 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 | 2.650 | 2.950 | 0.104 | 0.116 |
| E1 | 1.500 | 1.700 | 0.059 | 0.067 |
| 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° |

## 6.2 SOIC-8 PACKAGE

Figure 56 shows the SOIC-8 package view.

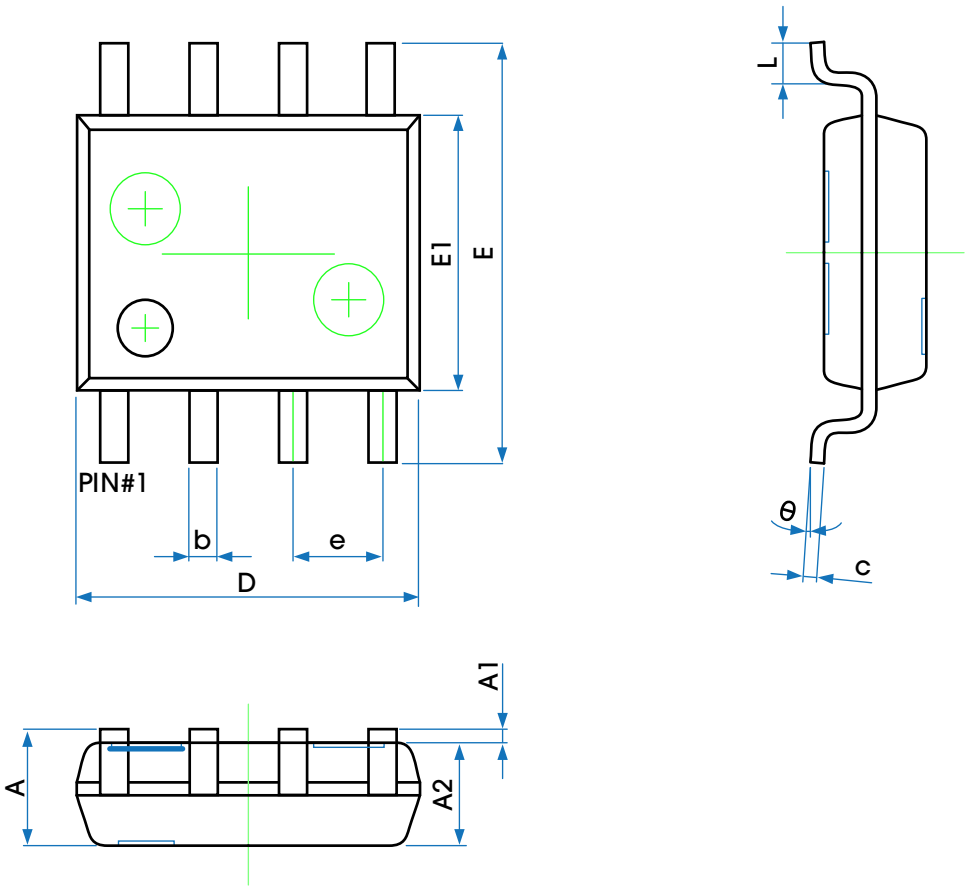



Figure 4. SOIC-8 Package View

Table 14 provides detailed information about the dimensions of the SOIC-8 package.

Table 11. Dimensions of the SOIC-8 Package

| SYMBOL | DIMENSIONS IN MILLIMETERS | | DIMENSIONS IN 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 | 4.700 | 5.100 | 0.185 | 0.201 |
| 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° |

## TAPE AND REEL INFORMATION

TBD

# REVISION HISTORY

| REVISION | DATE | DESCRIPTION |
|---|---|---|
| Rel 0.1 | 15 January 2021 | DRAFT. |
| Rel 0.5.1 | 21 December 2021 | 1. Updated the paragraph after the Order Information table.<br>2. Added the THERMAL INFORMATION section.<br>3. Added the TYPICAL CHARACTERISTICS section.<br>4. Added the DETAILED DESCRIPTION section.<br>5. Added the APPLICATION AND IMPLEMENTATION section.<br>6. Added the POWER SUPPLY RECOMMENTDATIONS section.<br>7. Added the LAYOUT section. |
| Rel 0.5.2 | 27 January 2022 | 1. Removed information about the 4-channel.<br>2. Updated Table 5.<br>3. Updated Section 5.5.<br>4. Updated Section 7.2.<br>5. Updated the first paragraph in Section 8.<br>6. Updated “18V” and “36V” to “20V” and “40V”.<br>7. Updated the Order Information table. |
| Rel 0.8 | 27 June 2022 | 1. Update key specifications in Section 5 |
| Rel 0.8.1 | 6 July 2022 | 1. Update key specifications in Section 5, ESD and delete OPZ301 info |