

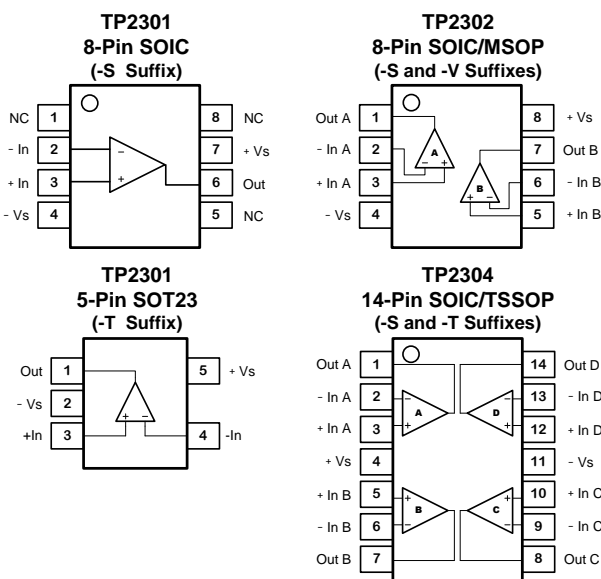
Features

- **Gain-bandwidth Product: 20MHz**
- **Offset Voltage: 50 μ V (max)**
- **Low Noise: 7.3nV/ $\sqrt{\text{Hz}}$ (f= 1kHz)**
- **Slew Rate: 25 V/ μ s**
- **Low THD+N: 0.0005%**
- **Supply Range: 2.2V to 5.5V**
- **Supply Current: 3.5 mA/ch**
- **Low Input Bias Current: 0.3pA Typical**
- **Rail-to-Rail I/O**
- **High Output Current: 70mA (1.0V Drop)**
- **-40°C to 125°C Operation Range**

Applications

- Sensor Signal Conditioning
- Consumer Audio
- Multi-Pole Active Filters
- Control-Loop Amplifiers
- Communications
- Security
- Scanners

Pin Configuration (Top View)



Description

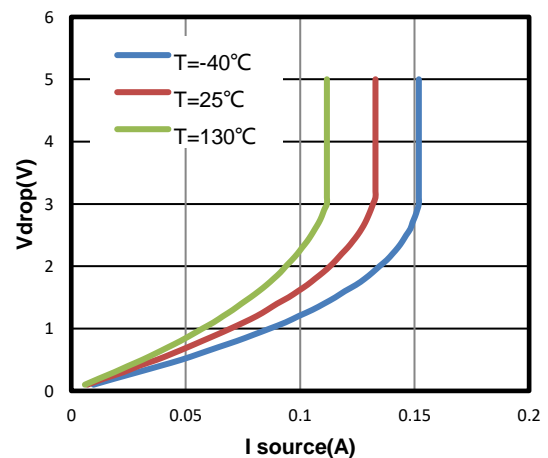
The TP2301 series products are very high precision amplifiers featuring very low noise, low offset voltage, high bandwidth, low input bias current and low temperature drift making them the ideal choice for applications requiring both high DC accuracy and AC performance. The combination of precision, low noise, and high bandwidth provides the user with outstanding value and flexibility relative to similar competitive parts.

Applications for these amplifiers include precision active filters, medical and analytical instrumentation, precision power supply controls, and industrial controls requiring high gains. Featuring low THD+N, the TP2301 series is also excellent for consumer audio applications, particularly for single-supply systems.

The TP2301 is single channel version available in 8-pin SOIC and 5-pin SOT23 packages. The TP2302 is dual channel version available in 8-pin SOIC and MSOP packages. The TP2304 is quad channel version available in 14-pin SOIC and TSSOP packages.

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Positive Output Swing vs. Load Current



TP2301 / TP2302 / TP2304

20MHz Bandwidth, Low Noise High Precision Op-amps

Order Information

| Model Name | Order Number | Package | Transport Media, Quantity | Marking Information |
|------------|-----------------------------|--------------|---------------------------|---------------------|
| TP2301 | TP2301-TR | 5-Pin SOT23 | Tape and Reel, 3,000 | 301 |
| TP2302 | TP2302-SR | 8-Pin SOIC | Tape and Reel, 4,000 | TP2302 |
| | TP2302-VR | 8-Pin MSOP | Tape and Reel, 3,000 | TP2302 |
| TP2304 | TP2304-SR ^{Note 1} | 14-Pin SOIC | Tape and Reel, 2,500 | TP2304 |
| | TP2304-TR ^{Note 1} | 14-Pin TSSOP | Tape and Reel, 3,000 | TP2304 |

Note 1: Future product, contact 3PEAK factory for more information and sample.

Absolute Maximum Ratings ^{Note 1}

Supply Voltage: $V^+ - V^-$ ^{Note 2} 7.0V
 Input Voltage $V^- - 0.3$ to $V^+ + 0.3$
 Input Current: +IN, -IN ^{Note 3} ± 20 mA
 Output Current: OUT ± 160 mA
 Output Short-Circuit Duration ^{Note 4} Infinite

Current at Supply Pins ± 60 mA
 Operating Temperature Range -40°C to 125°C
 Maximum Junction Temperature 150°C
 Storage Temperature Range -65°C to 150°C
 Lead Temperature (Soldering, 10 sec) 260°C

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note 2: The op amp supplies must be established simultaneously, with, or before, the application of any input signals.

Note 3: The inputs are protected by ESD protection diodes to each power supply. If the input extends more than 500mV beyond the power supply, the input current should be limited to less than 10mA.

Note 4: A heat sink may be required to keep the junction temperature below the absolute maximum. This depends on the power supply voltage and how many amplifiers are shorted. Thermal resistance varies with the amount of PC board metal connected to the package. The specified values are for short traces connected to the leads.

ESD, Electrostatic Discharge Protection

| Symbol | Parameter | Condition | Minimum Level | Unit |
|--------|--------------------------|------------------------|---------------|------|
| HBM | Human Body Model ESD | ANSI/ESDA/JEDEC JS-001 | 6 | kV |
| CDM | Charged Device Model ESD | ANSI/ESDA/JEDEC JS-002 | 2 | kV |

Thermal Resistance

| Package Type | θ_{JA} | θ_{JC} | Unit |
|--------------|---------------|---------------|--------------------|
| 5-Pin SOT23 | 250 | 81 | $^\circ\text{C/W}$ |
| 8-Pin SOIC | 158 | 43 | $^\circ\text{C/W}$ |
| 8-Pin MSOP | 210 | 45 | $^\circ\text{C/W}$ |
| 14-Pin SOIC | 120 | 36 | $^\circ\text{C/W}$ |
| 14-Pin TSSOP | 180 | 35 | $^\circ\text{C/W}$ |

Electrical Characteristics

20MHz Bandwidth, Low Noise High Precision Op-amps

The specifications are at $T_A = 27^\circ\text{C}$. $V_S = +2.2\text{ V to }+5.5\text{ V}$, or $\pm 1.1\text{ V to } \pm 2.75\text{ V}$, $R_L = 2\text{ k}\Omega$, $C_L = 100\text{ pF}$. Unless otherwise noted.

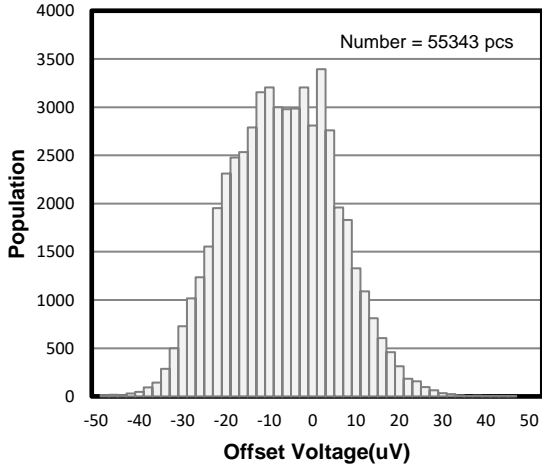
| SYMBOL | PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|---------------------|---|--|---------------|---------|---------------|------------------------------|
| V_{OS} | Input Offset Voltage | $V_{CM} = V_{DD}/2$ | -50 | ± 7 | +50 | μV |
| $V_{OS\ TC}$ | Input Offset Voltage Drift | $-40^\circ\text{C to }125^\circ\text{C}$ | | 1 | 2 | $\mu\text{V}/^\circ\text{C}$ |
| I_B | Input Bias Current | $T_A = 27^\circ\text{C}$ | | 0.3 | | pA |
| | | $T_A = 85^\circ\text{C}$ | | 150 | | pA |
| | | $T_A = 125^\circ\text{C}$ | | 300 | | pA |
| I_{OS} | Input Offset Current | | | 0.001 | | pA |
| V_n | Input Voltage Noise | $f = 0.1\text{Hz to }10\text{Hz}$ | | 2.0 | | μV_{PP} |
| e_n | Input Voltage Noise Density | $f = 1\text{kHz}$ | | 7.3 | | $\text{nV}/\sqrt{\text{Hz}}$ |
| i_n | Input Current Noise | $f = 1\text{kHz}$ | | 2 | | $\text{fA}/\sqrt{\text{Hz}}$ |
| C_{IN} | Input Capacitance | Differential | | 7.76 | | pF |
| | | Common Mode | | 6.87 | | |
| CMRR | Common Mode Rejection Ratio | $V_{CM} = 2\text{V to }3\text{V}$ | 80 | 100 | | dB |
| V_{CM} | Common-mode Input Voltage Range | | $(V^-) - 0.3$ | | $(V^+) + 0.3$ | V |
| PSRR | Power Supply Rejection Ratio | $V_{CM} = 2.5\text{V}$, $V_S = 4\text{V to }5\text{V}$ | 80 | 100 | | dB |
| A_{VOL} | Open-Loop Large Signal Gain | $R_{LOAD} = 2\text{k}\Omega$ | 100 | 130 | | dB |
| V_{OL} , V_{OH} | Output Swing from Supply Rail | $R_{LOAD} = 2\text{k}\Omega$ | | 20 | 50 | mV |
| R_{OUT} | Closed-Loop Output Impedance | $G = 1$, $f = 1\text{MHz}$, $I_{OUT} = 0$ | | 0.043 | | Ω |
| R_o | Open-Loop Output Impedance | $f = 1\text{kHz}$, $I_{OUT} = 0$ | | 125 | | Ω |
| I_{SC} | Output Short-Circuit Current | Sink or source current | 100 | 130 | 200 | mA |
| V_{DD} | Supply Voltage | | 2.2 | | 5.5 | V |
| I_Q | Quiescent Current per Amplifier | TP2301, $V_{DD} = 5\text{V}$ | | 5 | 9 | mA |
| | | TP2302/TP2304, $V_{DD} = 5\text{V}$ | | 3.5 | 5 | mA |
| PM | Phase Margin | $R_{LOAD} = 1\text{k}\Omega$, $C_{LOAD} = 60\text{pF}$ | | 60 | | $^\circ$ |
| GM | Gain Margin | $R_{LOAD} = 1\text{k}\Omega$, $C_{LOAD} = 60\text{pF}$ | | 11 | | dB |
| GBWP | Gain-Bandwidth Product | $f = 1\text{kHz}$ | | 20 | | MHz |
| SR | Slew Rate | $A_V = 1$, $V_{OUT} = 1.5\text{V to }3.5\text{V}$, $C_{LOAD} = 60\text{pF}$, $R_{LOAD} = 1\text{k}\Omega$ | 15 | 25 | | $\text{V}/\mu\text{s}$ |
| FPBW | Full Power Bandwidth ^{Note 1} | | | 5.21 | | MHz |
| t_s | Settling Time, 0.1% Settling Time, 0.01% | $A_V = -1$, 1V Step | | 0.29 | | μs |
| | | | | 0.45 | | |
| THD+N | Total Harmonic Distortion and Noise | $f = 1\text{kHz}$, $A_V = 1$, $R_L = 2\text{k}\Omega$, $V_{OUT} = 1\text{V}_{p-p}$ | | 123 | | dB |
| X_{talk} | Channel Separation | $f = 1\text{kHz}$, $R_L = 2\text{k}\Omega$ | | 110 | | dB |

Note 1: Full power bandwidth is calculated from the slew rate $FPBW = SR/\pi \cdot V_{P-P}$

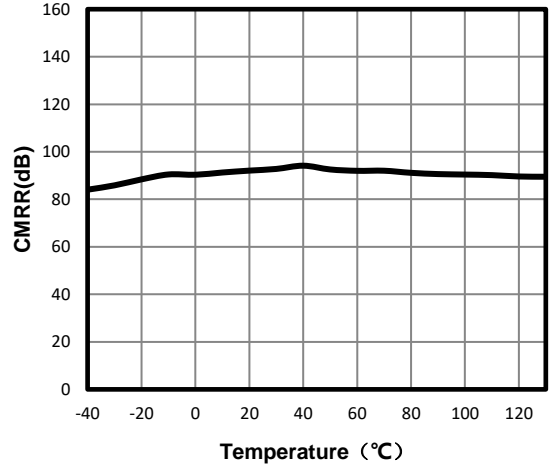
20MHz Bandwidth, Low Noise High Precision Op-amps
Typical Performance Characteristics

$V_S = \pm 2.5V$, $V_{CM} = 0V$, $R_L = \text{Open}$, unless otherwise specified.

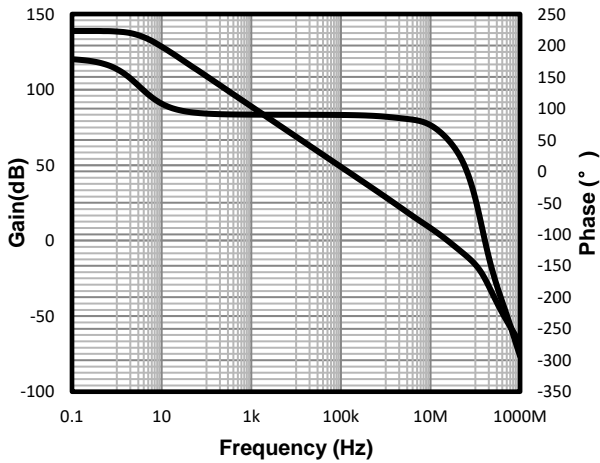
Offset Voltage Production Distribution



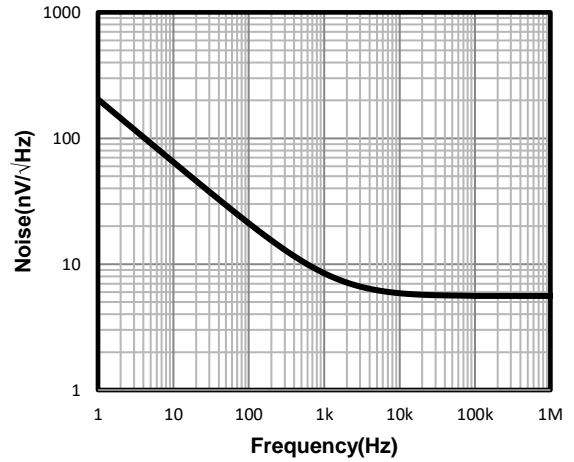
CMRR vs. Temperature



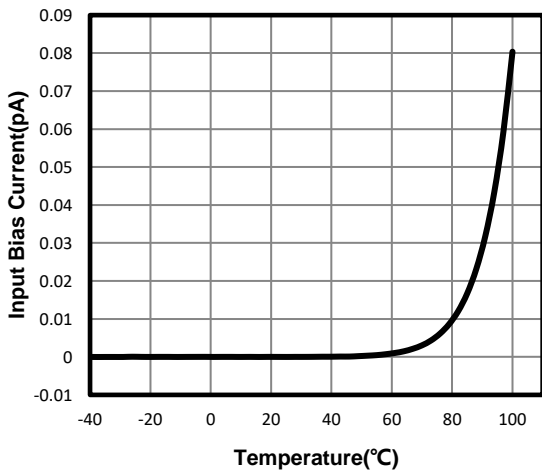
Open-Loop Gain and Phase



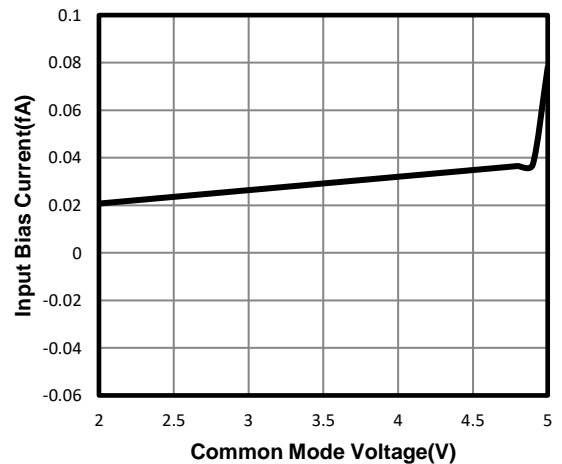
Input Voltage Noise Spectral Density



Input Bias Current vs. Temperature



Input Bias Current vs. Input Common Mode Voltage

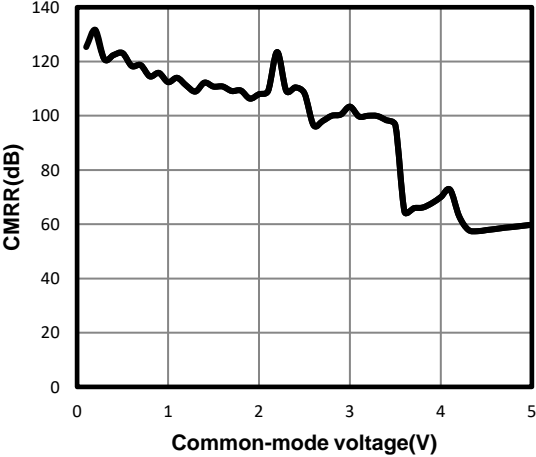


20MHz Bandwidth, Low Noise High Precision Op-amps

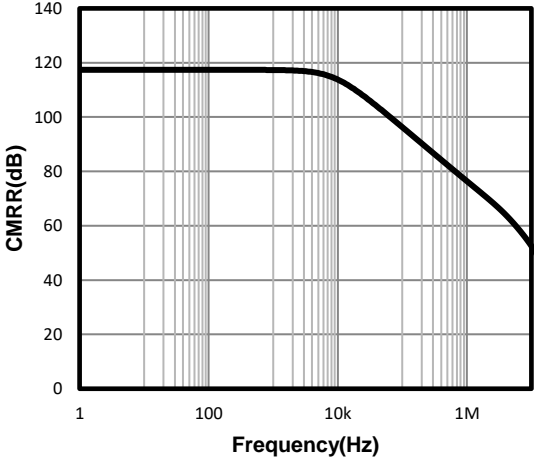
Typical Performance Characteristics

$V_S = \pm 2.5V$, $V_{CM} = 0V$, $R_L = \text{Open}$, unless otherwise specified. (Continued)

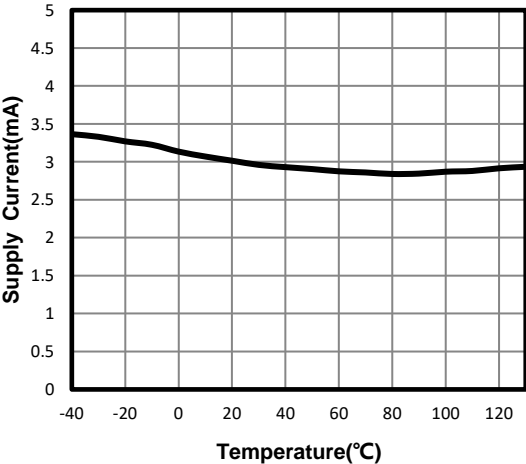
Common Mode Rejection Ratio



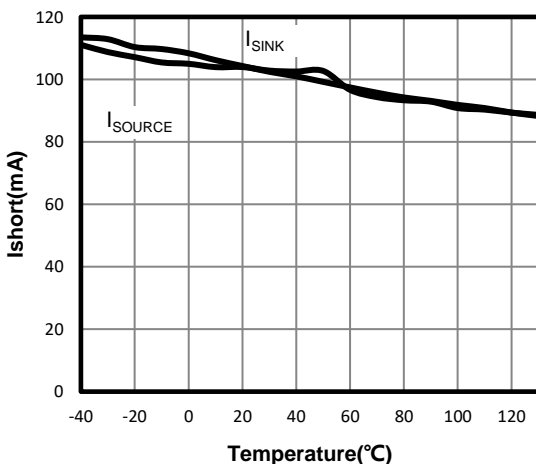
CMRR vs. Frequency



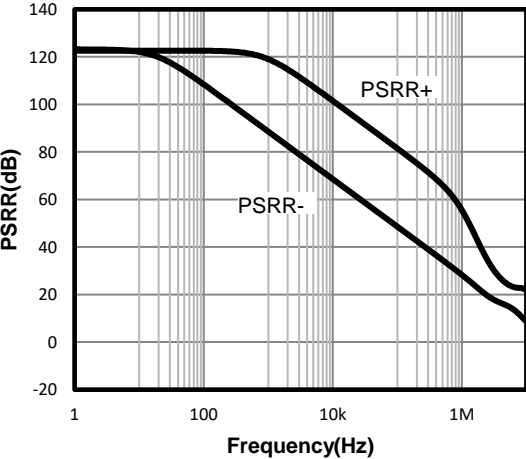
Quiescent Current vs. Temperature



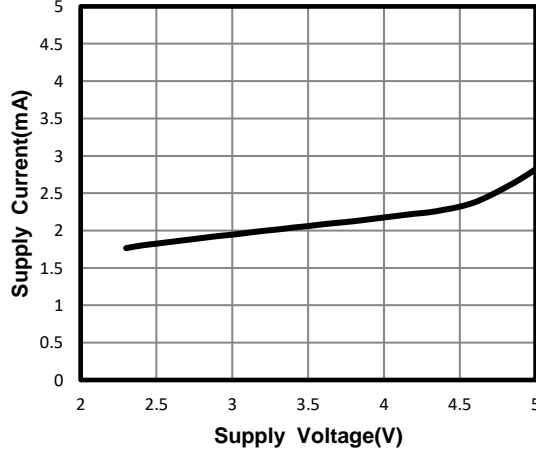
Short Circuit Current vs. Temperature



Power-Supply Rejection Ratio



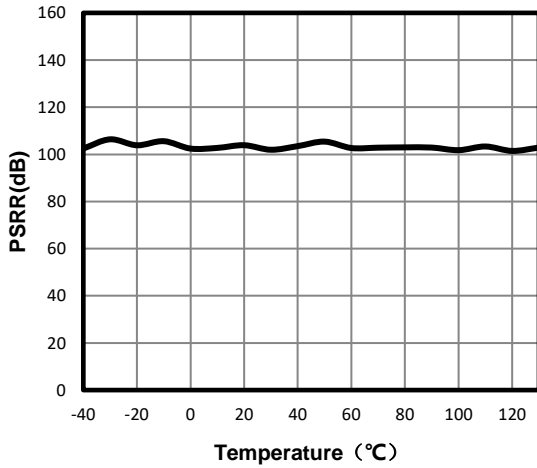
Quiescent Current vs. Supply Voltage



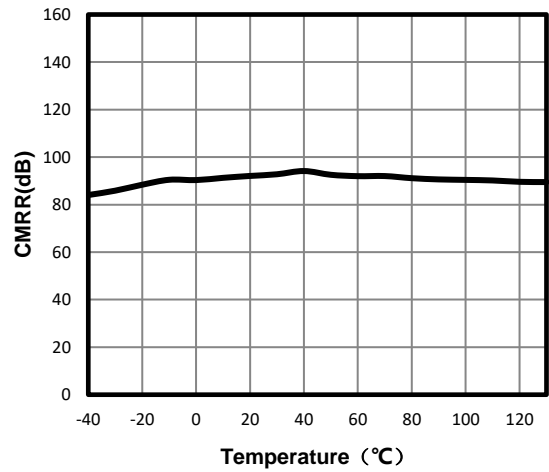
20MHz Bandwidth, Low Noise High Precision Op-amps
Typical Performance Characteristics

$V_S = \pm 2.5V$, $V_{CM} = 0V$, $R_L = \text{Open}$, unless otherwise specified. (Continued)

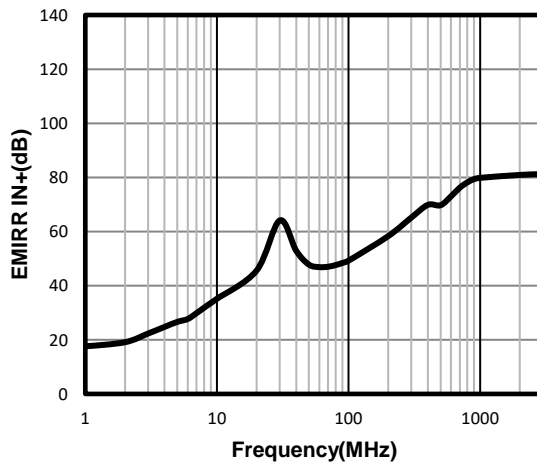
Power-Supply Rejection Ratio vs. Temperature



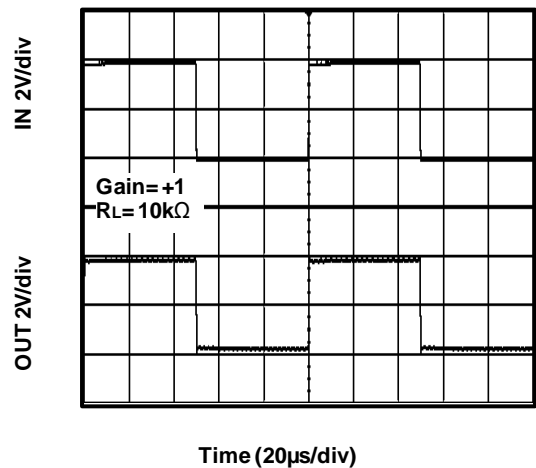
CMRR vs. Temperature



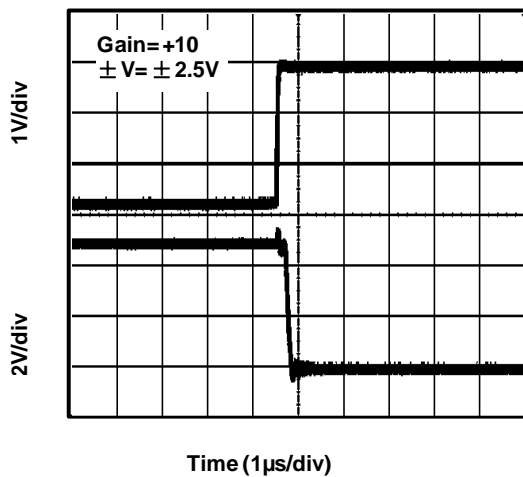
EMIRR IN+ vs. Frequency



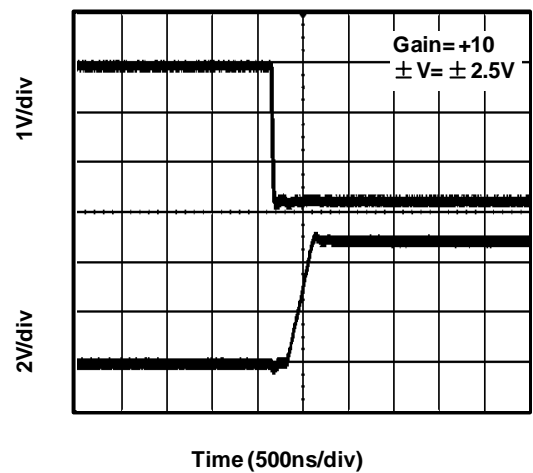
Large-Scale Step Response



Negative Over-Voltage Recovery



Positive Over-Voltage Recovery

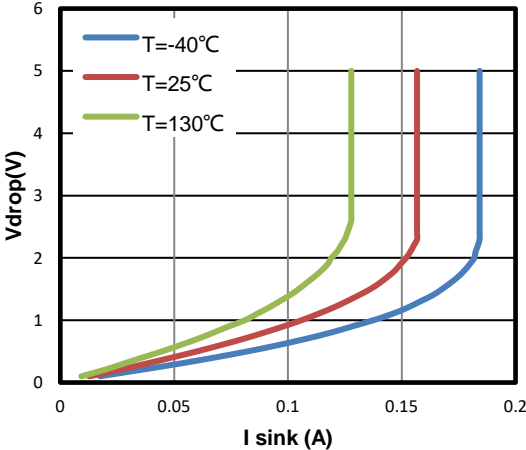


20MHz Bandwidth, Low Noise High Precision Op-amps

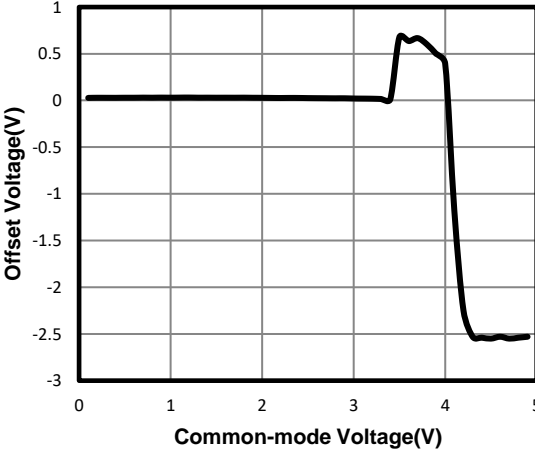
Typical Performance Characteristics

$V_s = \pm 2.5V$, $V_{CM} = 0V$, $R_L = \text{Open}$, unless otherwise specified. (Continued)

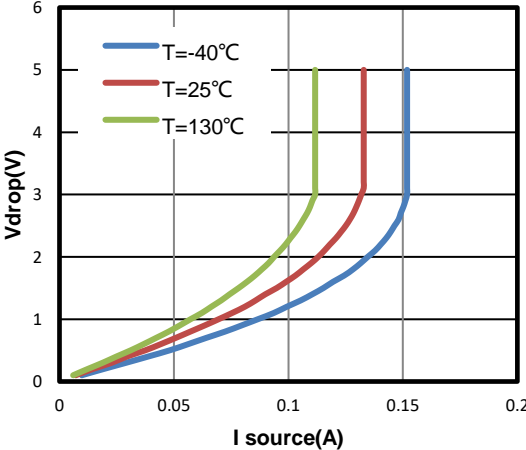
Negative Output Swing vs. Load Current



Offset Voltage vs Common-Mode Voltage



Positive Output Swing vs. Load Current

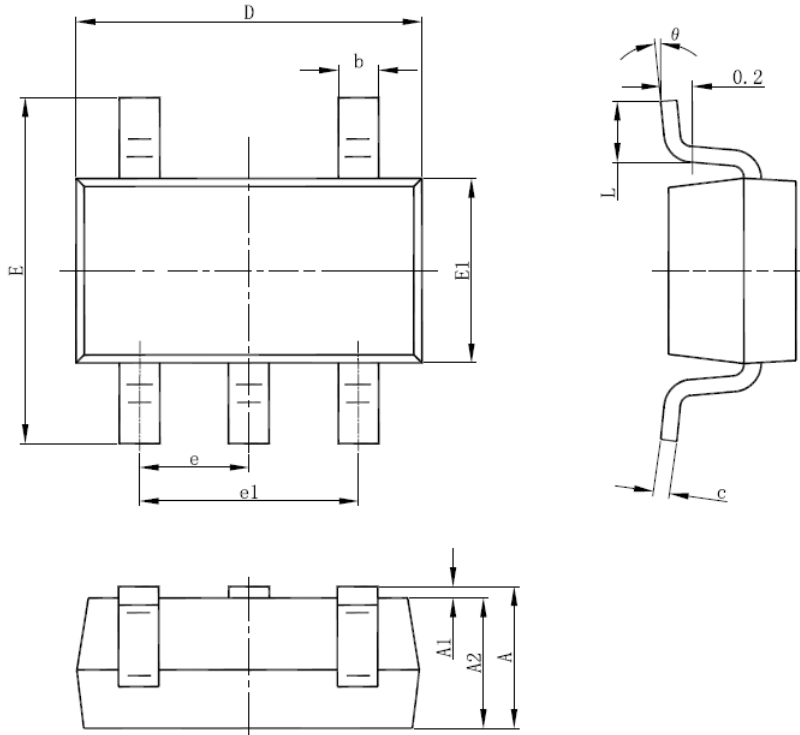


TP2301 / TP2302 / TP2304

20MHz Bandwidth, Low Noise High Precision Op-amps

Package Outline Dimensions

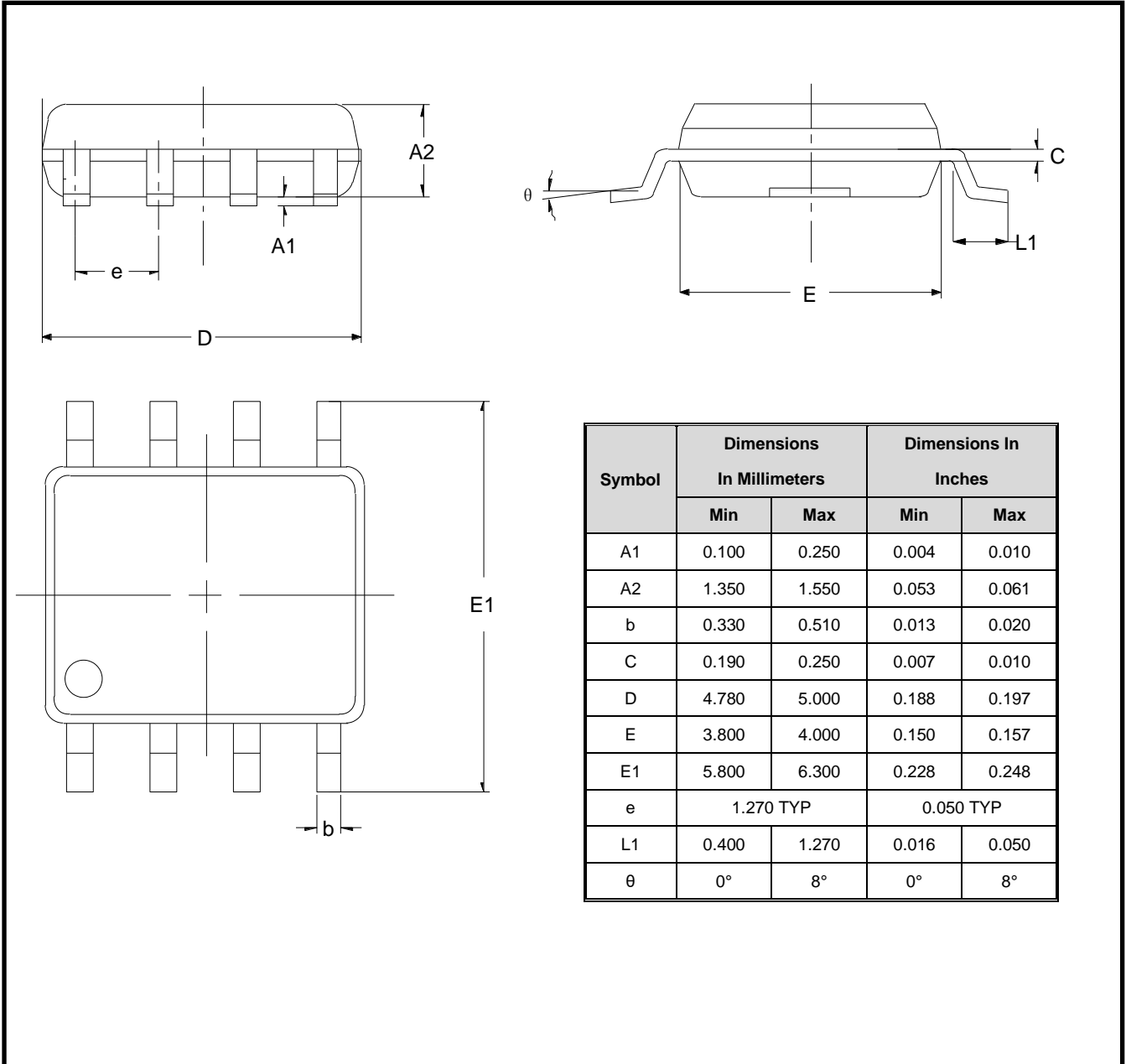
SOT23-5



| 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 |
| E1 | 1.500 | 1.700 | 0.059 | 0.067 |
| E | 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° |

Package Outline Dimensions

SO-8 (SOIC-8)

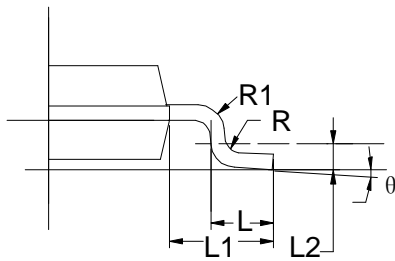
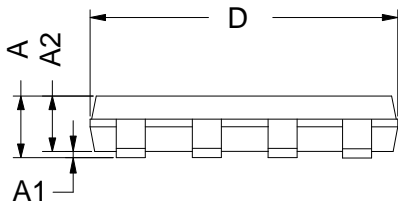
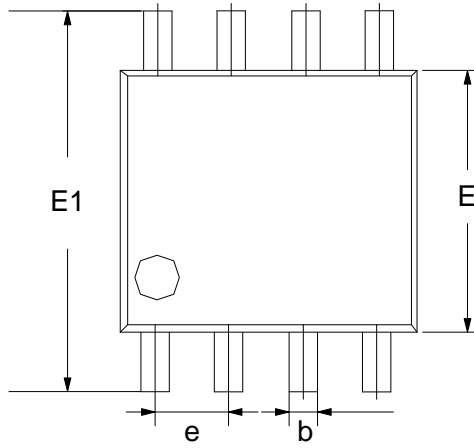


TP2301 / TP2302 / TP2304

20MHz Bandwidth, Low Noise High Precision Op-amps

Package Outline Dimensions

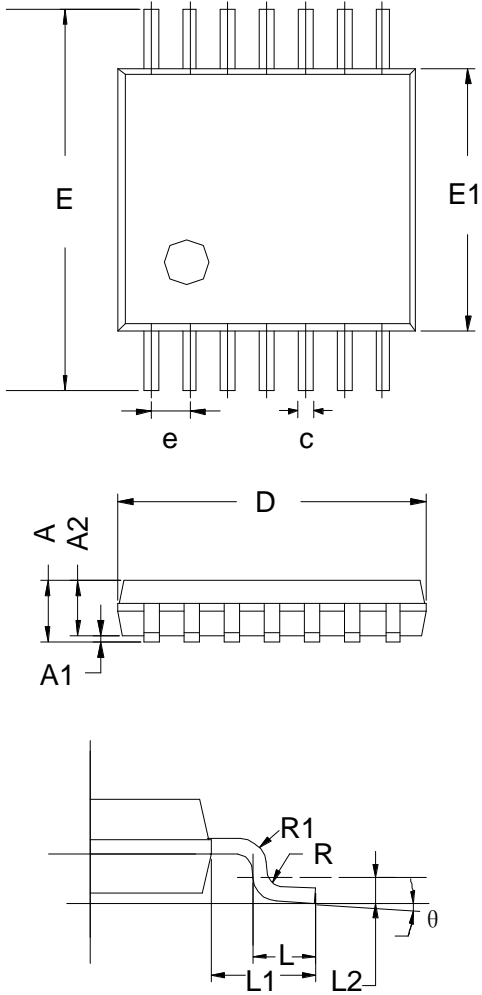
MSOP-8



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|------------------------------|-------|-------------------------|-------|
| | Min | Max | Min | Max |
| A | 0.800 | 1.200 | 0.031 | 0.047 |
| A1 | 0.000 | 0.200 | 0.000 | 0.008 |
| A2 | 0.760 | 0.970 | 0.030 | 0.038 |
| b | 0.30 TYP | | 0.012 TYP | |
| C | 0.15 TYP | | 0.006 TYP | |
| D | 2.900 | 3.100 | 0.114 | 0.122 |
| e | 0.65 TYP | | 0.026 | |
| E | 2.900 | 3.100 | 0.114 | 0.122 |
| E1 | 4.700 | 5.100 | 0.185 | 0.201 |
| L1 | 0.410 | 0.650 | 0.016 | 0.026 |
| θ | 0° | 6° | 0° | 6° |

Package Outline Dimensions

TSSOP-14



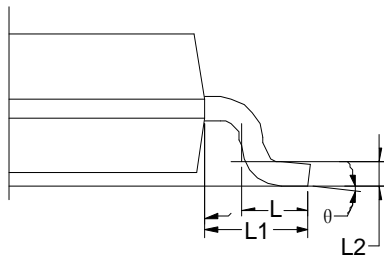
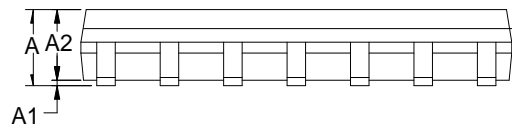
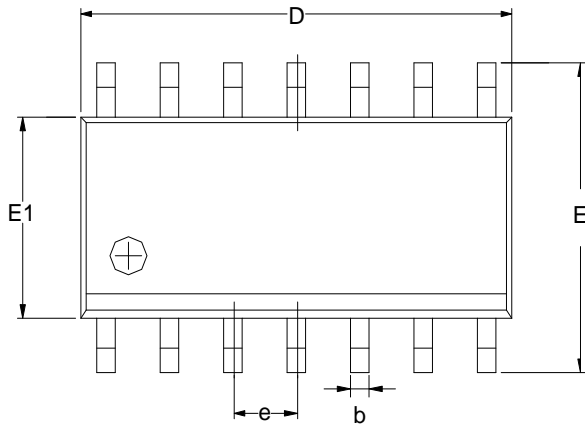
| Symbol | Dimensions In Millimeters | | |
|--------|------------------------------|------|------|
| | MIN | TYP | MAX |
| A | - | - | 1.20 |
| A1 | 0.05 | - | 0.15 |
| A2 | 0.90 | 1.00 | 1.05 |
| b | 0.20 | - | 0.28 |
| c | 0.10 | - | 0.19 |
| D | 4.86 | 4.96 | 5.06 |
| E | 6.20 | 6.40 | 6.60 |
| E1 | 4.30 | 4.40 | 4.50 |
| e | 0.65 BSC | | |
| L | 0.45 | 0.60 | 0.75 |
| L1 | 1.00 REF | | |
| L2 | 0.25 BSC | | |
| R | 0.09 | - | - |
| theta | 0° | - | 8° |

TP2301 / TP2302 / TP2304

20MHz Bandwidth, Low Noise High Precision Op-amps

Package Outline Dimensions

SO-14 (SOIC-14)



| Symbol | Dimensions In Millimeters | | |
|--------|------------------------------|------|------|
| | MIN | TYP | MAX |
| A | 1.35 | 1.60 | 1.75 |
| A1 | 0.10 | 0.15 | 0.25 |
| A2 | 1.25 | 1.45 | 1.65 |
| b | 0.36 | | 0.49 |
| D | 8.53 | 8.63 | 8.73 |
| E | 5.80 | 6.00 | 6.20 |
| E1 | 3.80 | 3.90 | 4.00 |
| e | 1.27 BSC | | |
| L | 0.45 | 0.60 | 0.80 |
| L1 | 1.04 REF | | |
| L2 | 0.25 BSC | | |
| θ | 0° | | 8° |

Revision History

| Date | Revision | Notes |
|-----------|----------|--|
| 2022/4/29 | A.4 | Update order information. Update EC table: VOL/VOH: typ 13mV -> 20mV; max 20mV -> 50mV Iq of TP2301(1ch): typ 5mA, max 9mA Slew Rate: min 18 -> 15 |

单击下面可查看定价，库存，交付和生命周期等信息

[>>3PEAK\(思瑞浦\)](#)