# *36V, 3.5MHz, 15V/µs Precision Rail-to-Rail Input & OutputOperational Amplifiers*

## Description

The HT127X series amplifiers are newest high supply voltage amplifiers with low offset, low power and stable high frequency response. They incorporate HTCSEMI proprietary and patented design techniques to achieve very good AC performance with 3.5MHz bandwidth, 15V/µs slew rate and low distortion while drawing only typical 700µA of quiescent current per amplifier. The input common-mode voltage range extends to V–, and the outputs swing rail-to-rail. The HT127X family can be used as plug-in replacements for many commercially available op-amps to reduce power and improve input/output range and performance.The combination of features makes the HT127X ideal choices for industrial control, motor control and portable audio amplification, sound ports, and other consumer audio.

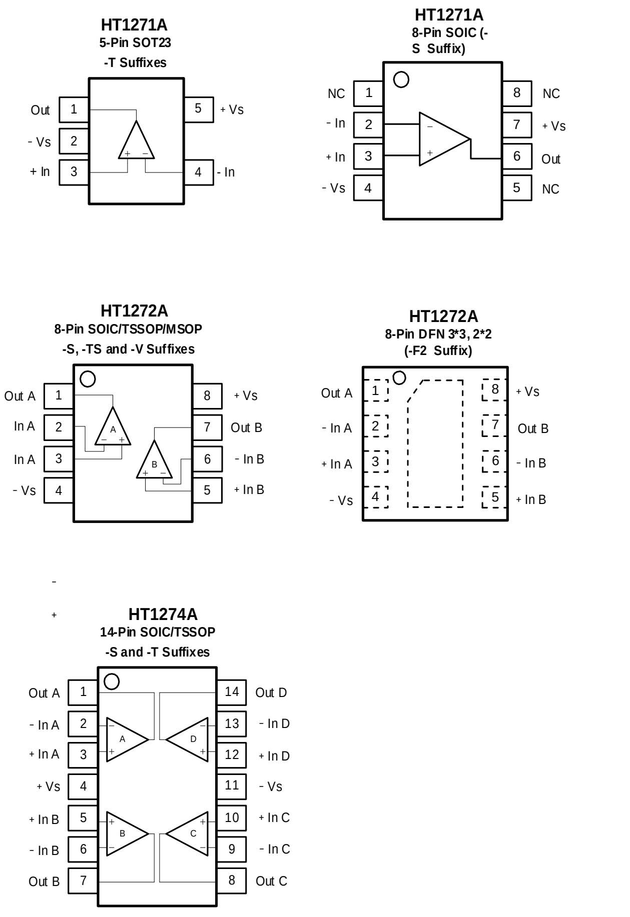
## Features

- Supply Voltage: 3V to 36V
- Low Supply Current: Maximum 1000µA per channel
- Differential Input Voltage Range to Supply Rail, can Work as Comparator
- Input Rail to $-V_S$, Rail to Rail Output
- Fast Response: 3.5 MHz Bandwidth, 15V/µs Slew Rate, 100ns Overload Recovery
- Low Offset Voltage:
  - ±2mV Maximum at 25°C,
  - ±2.5mV Maximum at -40°C to 85°C
  - ±3mV Maximum at -40°C to 125°C
- Very Low THD+N: 0.0005% at Gain = 1, 1kHz
- Excellent EMIRR: 60dB at 900MHz
- 2KV HBM, 1KV CDM, 150mA Latch Up
- –40°C to 125°C Operation Temperature Range

## Applications

- Sensor Interface
- Motor Control
- Industrial Control
- Audio

## Pin Configuration



## Electrical Characteristics

**All test condition is $V_S$ = 30V, $T_A$ = 25°C, $R_L$ = 10kΩ to $V_S$/2, unless otherwise noted.**

| Symbol | Parameter | Conditions | $T_A$ | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Power Supply | | | | | | | |
| $V_S$ | Supply Voltage Range | | | 3 | | 36 | V |
| $I_Q$ | Quiescent Current per Amplifier | $V_S$ = 30V, HT1271 | | | 1000 | 1500 | µA |
| | | | -40°C to 125°C | | | 1700 | µA |
| | | $V_S$ = 5V, HT1271 | | | 850 | 1300 | µA |
| | | | -40°C to 125°C | | | 1500 | µA |
| | | $V_S$ = 30V, HT1272/HT1274 | | | 700 | 1000 | µA |
| | | | -40°C to 125°C | | | 1200 | uA |
| | | $V_S$ = 5V, HT1272/HT1274 | | | 600 | 850 | µA |
| | | | -40°C to 125°C | | | 1000 | µA |
| PSRR | Power Supply Rejection Ratio | $V_S$ = 3V to 36V | | 95 | 120 | | dB |
| | | | -40°C to 125°C | 90 | | | dB |
| Input Characteristics | | | | | | | |
| $V_{OS}$ | Input Offset Voltage | $V_S$ = 30V, $V_{CM}$ = 0V to 28V | | -2 | 0.1 | 2 | mV |
| | | | -40°C to 85°C | -2.5 | | 2.5 | mV |
| | | | -40°C to 125°C | -3 | | 3 | mV |
| | | $V_S$ = 30V, $V_{CM}$ = 28.5V | | -3 | | 3 | mV |
| | | | -40°C to 125°C | -4 | | 4 | mV |
| | | $V_S$ = 5V, $V_{CM}$ = 2.5V | | -2 | 0.1 | 2 | mV |
| | | | -40°C to 125°C | -3 | | 3 | mV |
| $V_{OS}$ TC | Input Offset Voltage Drift | | -40°C to 125°C | | 2 | | µV/°C |
| $I_B$ | Input Bias Current | | | | 25 | | pA |
| | | | -40°C to 85°C | | 80 | | pA |
| | | | -40°C to 125°C | | 1000 | | pA |
| $I_{OS}$ | Input Offset Current | | | | 25 | | pA |
| $I_{IN}$ | Different Input Current | $V_S$ = 36V, $V_{ID}$ = 36V | | | 10 | | nA |
| | | | -40°C to 125°C | | 100 | | nA |
| $C_{IN}$ | Input Capacitance | Differential Mode | | | 5 | | pF |
| | | Common Mode | | | 2.5 | | pF |
| Av | Open-loop Voltage Gain | | | 105 | 120 | | dB |
| | | | -40°C to 125°C | 100 | | | dB |
| $V_{CMR}$ | Common-mode Input Voltage Range | | | (V-) | | (V+) – 1.5 | V |
| CMRR | Common Mode Rejection Ratio | $V_{CM}$ = 0V to 28V | | 105 | 130 | | dB |
| | | | -40°C to 125°C | 100 | | | dB |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Output Characteristics | | | | | | | |
| $V_{OH}$ | Output Swing from Positive Rail | $R_{LOAD}$ = 10kΩ to $V_S$/2 | | | 200 | 300 | mV |
| | | | -40°C to 125°C | | | 450 | mV |
| | | $R_{LOAD}$ = 2kΩ to $V_S$/2 | | | 1.1 | 1.4 | V |
| | | | -40°C to 125°C | | | 2 | V |
| $V_{OL}$ | Output Swing from Negative Rail | $R_{LOAD}$ = 10kΩ to $V_S$/2 | | | 200 | 300 | mV |
| | | | -40°C to 125°C | | | 450 | mV |
| | | $R_{LOAD}$ = 2kΩ to $V_S$/2 | | | 0.8 | 1 | V |
| | | | -40°C to 125°C | | | 1.6 | V |
| $I_{SC}$ | Output Short-Circuit Current | | | 25 | 32 | | mA |
| | | | -40°C to85°C | 20 | | | mA |
| | | | -40°C to 125°C | 15 | | | mA |
| AC Specifications | | | | | | | |
| GBW | Gain-Bandwidth Product | | | | 3.5 | | MHz |
| SR | Slew Rate | G = 1, 10V step | | | 15 | | V/μs |
| | | Open Loop | | 9 | 15 | | V/μs |
| | | | -40°C to85°C | 7 | | | V/μs |
| | | | -40°C to 125°C | 6 | | | V/μs |
| $t_{OR}$ | Overload Recovery | | | | 100 | | ns |
| $t_S$ | Settling Time, 0.1% | G = -1, 10V step | | | 0.8 | | μs |
| | Settling Time, 0.01% | | | | 1 | | μs |
| PM | Phase Margin | $V_S$ = 36V, $R_L$=10K, $C_L$=100pF | | | 60 | | ° |
| GM | Gain Margin | $V_S$ = 36V, $R_L$=10K, $C_L$=100pF | | | 15 | | dB |
| Noise Performance | | | | | | | |
| $E_N$ | Input Voltage Noise | f = 0.1Hz to 10Hz | | | 1.7 | | μ$V_{RMS}$ |
| $e_N$ | Input Voltage Noise Density | f = 1kHz | | | 30 | | nV/ √Hz |
| $i_N$ | Input Current Noise | f = 1kHz | | | 2 | | fA/√Hz |
| THD+N | Total Harmonic Distortion and Noise | f = 1kHz, G =1, $R_L$ = 10kΩ, $V_{OUT}$ = 6$V_{RMS}$ | | | 0.0005 | | % |

## Typical Performance Characteristics

**$V_S$ = ±15V, $V_{CM}$ = 0V, $R_L$ = 10kΩ, unless otherwise specified.**

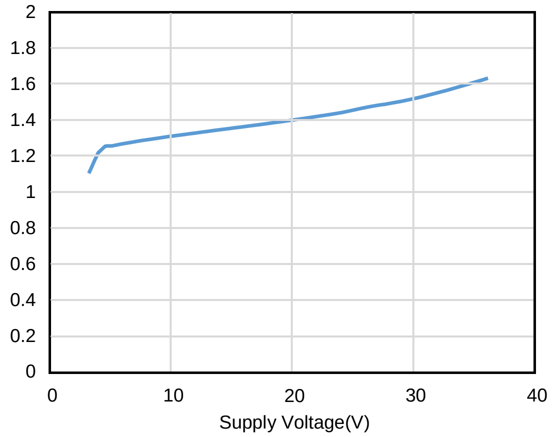



Figure 1. Quiescent Current vs. Supply Voltage, 2ch TP2262

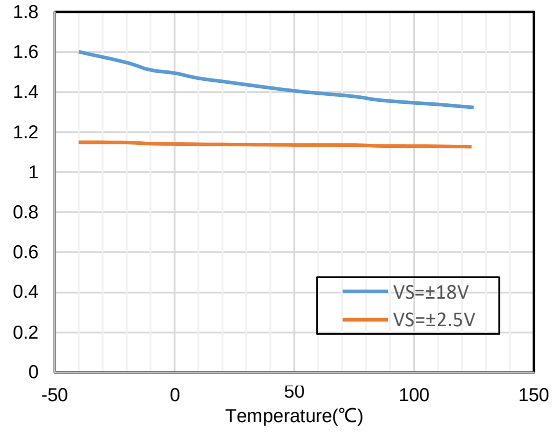



Figure 2. Quiescent Current vs. Temperature, 2ch TP2262

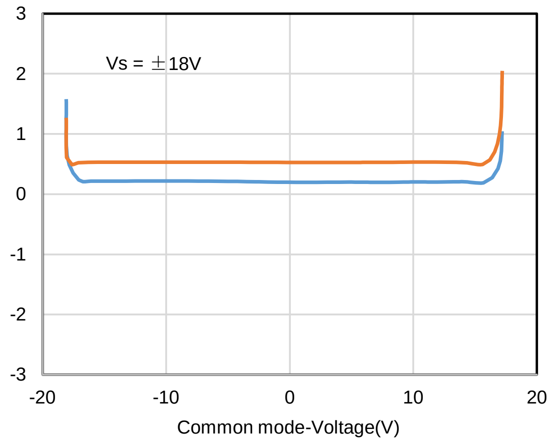



Figure 3. Offset Voltage vs. Common Mode Voltage

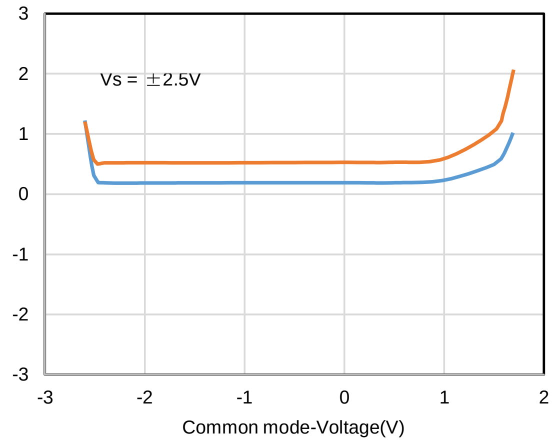



Figure 4. Offset Voltage vs. Common Mode Voltage

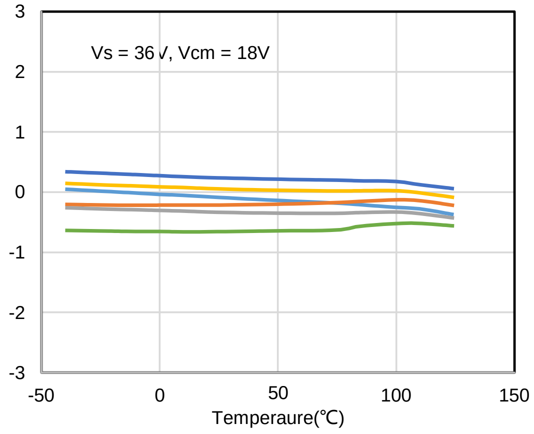



Figure 5. $V_{OS}$ vs. Temperature

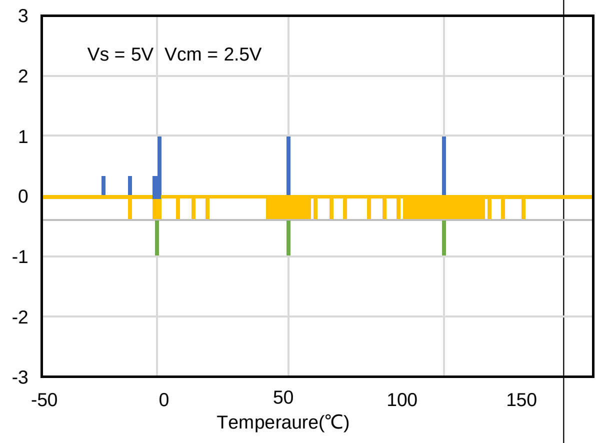



Figure 6. $V_{OS}$ vs. Temperature

**$V_S$ = ±15V, $V_{CM}$ = 0V, $R_L$ = 10kΩ, unless otherwise specified.**

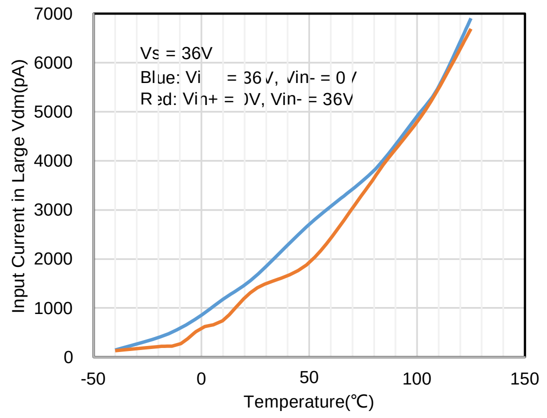



Figure 7. Input Current in Large Vdm vs. Temperature

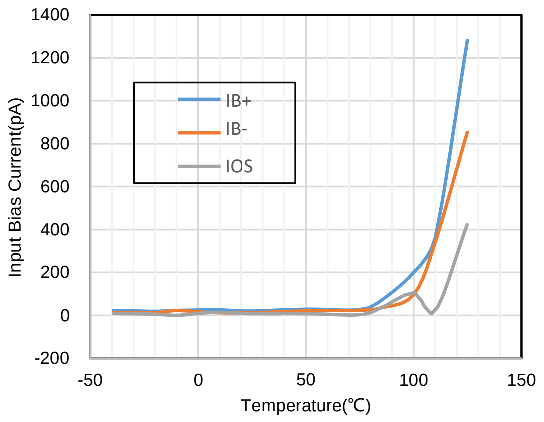



Figure 8. $I_B$ vs. Temperature

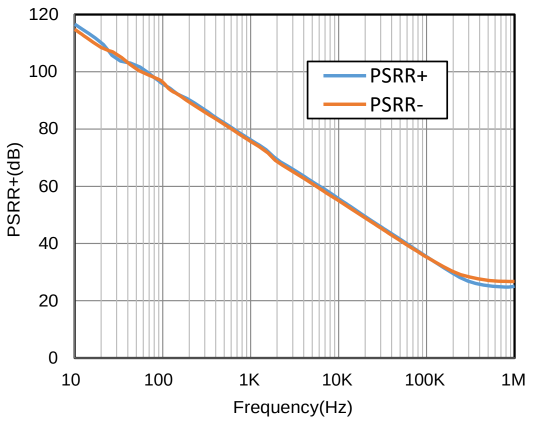



Figure 9. PSRR vs. Frequency

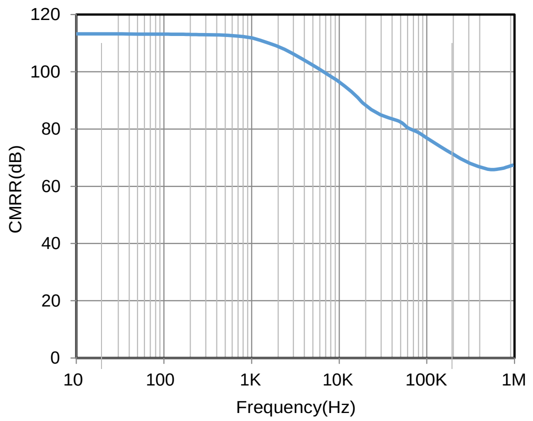



Figure 10. CMRR vs. Frequency

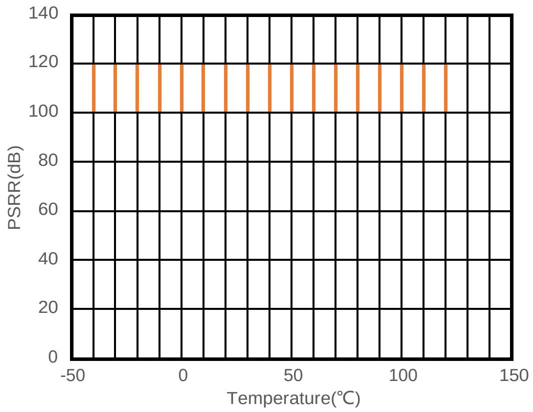



Figure 11. PSRR vs. Temperature

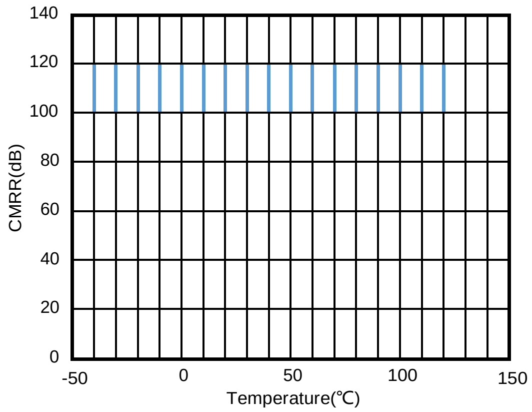



Figure 12. CMRR vs. Temperature

**$V_S$ = ±15V, $V_{CM}$ = 0V, $R_L$ = 10kΩ, unless otherwise specified.**

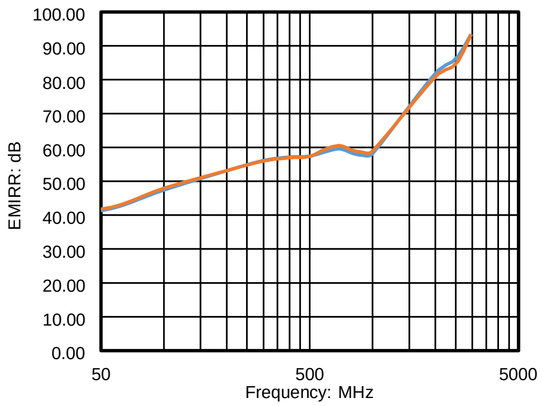



Figure 13. EMIRR+- vs. Frequency

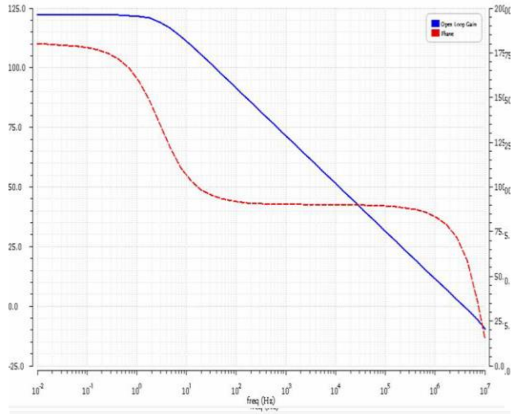


Figure 14. Open Loop Gain and Phase vs. Frequency

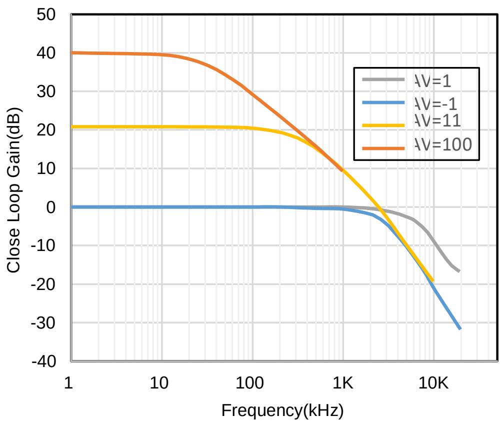
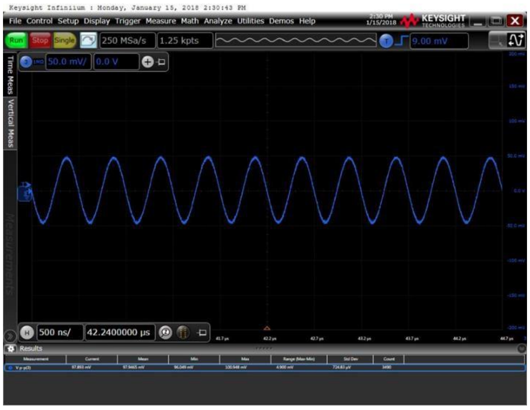



Figure 15. Close Loop Gain and Phase vs. Frequency



$V_S$ =±1.5V, $V_{IN}$=100m$V_{PP}$, $R_L$=10K, $C_L$=100pF, G=1

Figure 16. Waveform under 3V Supply Voltage

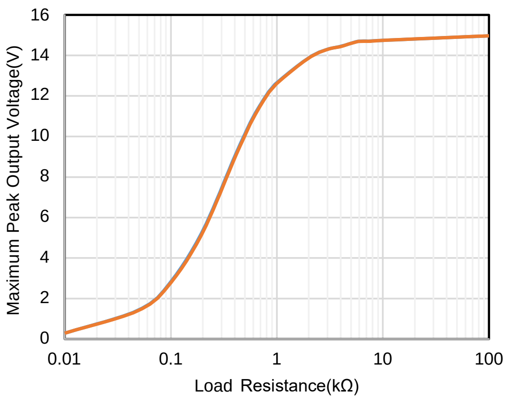



Figure 17. Maximum Peak Output Voltage vs. Load Resistance

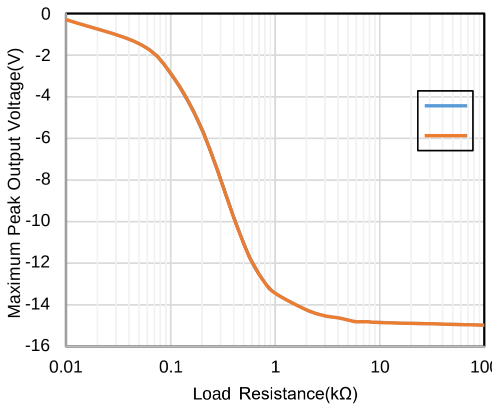



Figure 18. Maximum Peak Output Voltage vs. Load Resistance

**$V_S$ = ±15V, $V_{CM}$ = 0V, $R_L$ = 10kΩ, unless otherwise specified.**

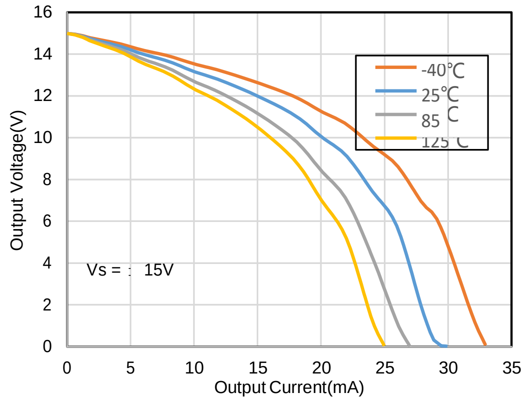


Figure 19. Positive Output Voltage vs. Output Current

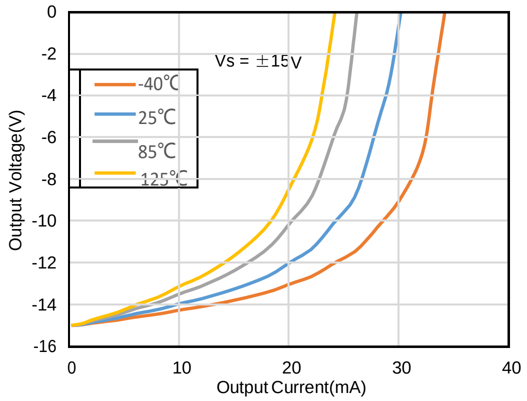


Figure 20. Negative Output Voltage vs. Output Current

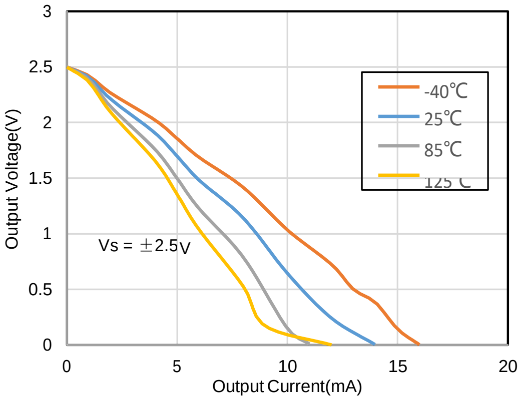


Figure 21. Positive Output Voltage vs. Output Current

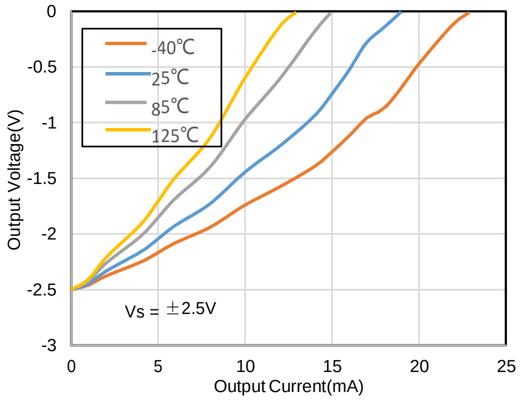


Figure 22. Negative Output Voltage vs. Output Current


Voltage: 1V/div, Time: 200ns/div

$V_S$ =5V, $V_{IN}$ = 2V, $R_L$=Open, G=3

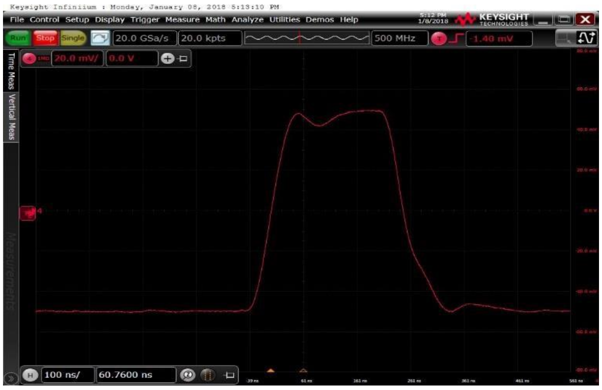
Figure 23. Positive Overload Recovery


Voltage: 1V/div, Time: 200ns/div

$V_S$ =5V, $V_{IN}$ = 2V, $R_L$=Open, G=3

Figure 24. Negative Overload Recovery

**$V_S$ = ±15V, $V_{CM}$ = 0V, $R_L$ = 10kΩ, unless otherwise specified.**



Voltage: 20mV/div, Time: 100ns/div

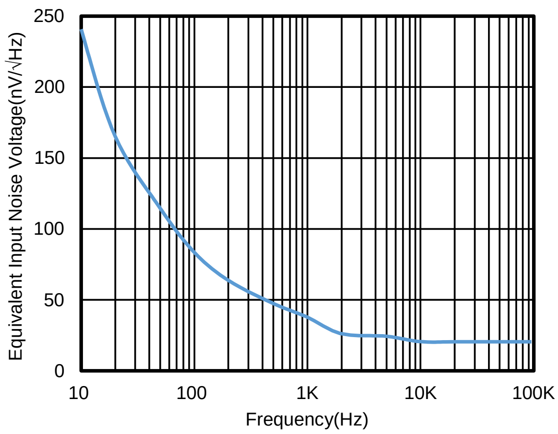
$V_S$ =±15V, $R_L$=2K, $C_L$=100pF, G=1

Figure 25. 100mV Signal Step Response

Voltage: 2V/div, Time: 1μs/div

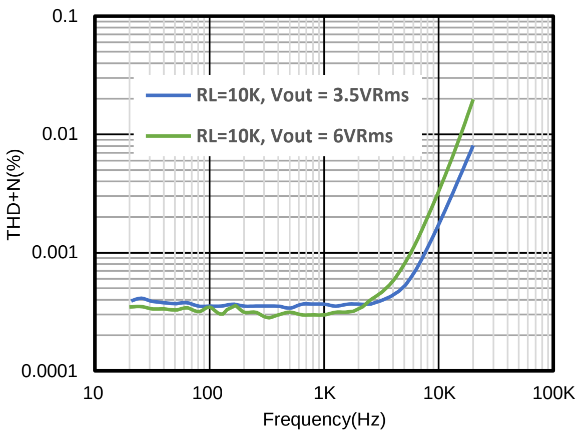
$V_S$ =±15V, $R_L$=2K, $C_L$=100pF, G=1

Figure 26. 10V Signal Step Response



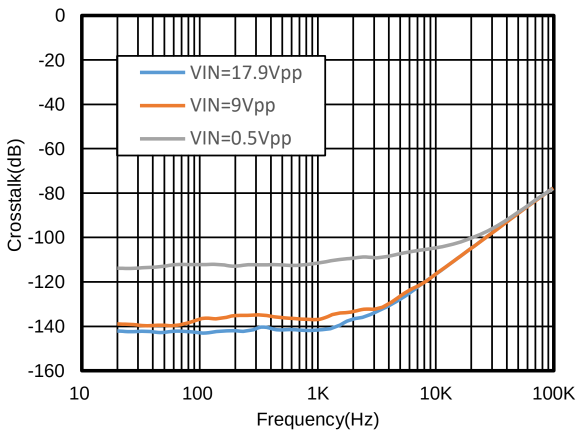

$V_S$ =±15V, $V_{CM}$=0V

Figure 27. Voltage Noise Spectral Density vs. Frequency




$V_S$ =±15V, $V_{CM}$=0V, G=1

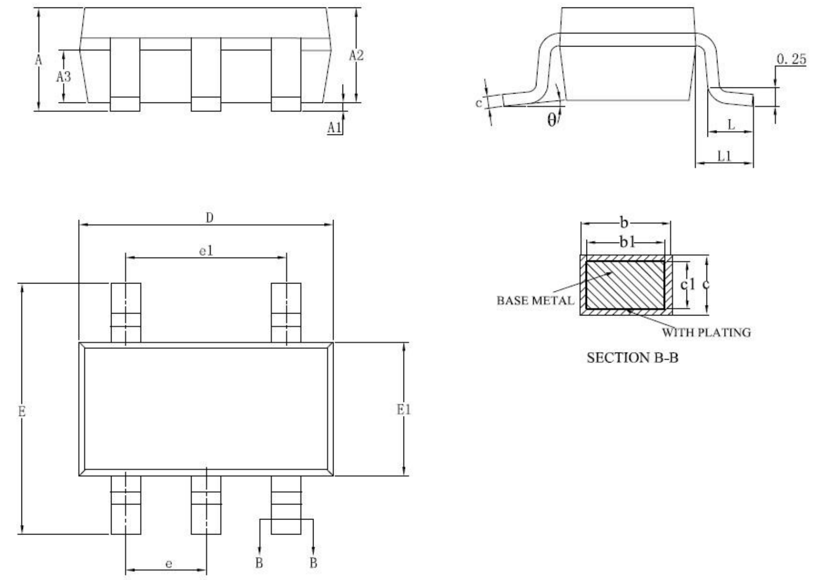
Figure 28. THD+N vs. Frequency




$V_S$ =±15V, $V_{CM}$=0V

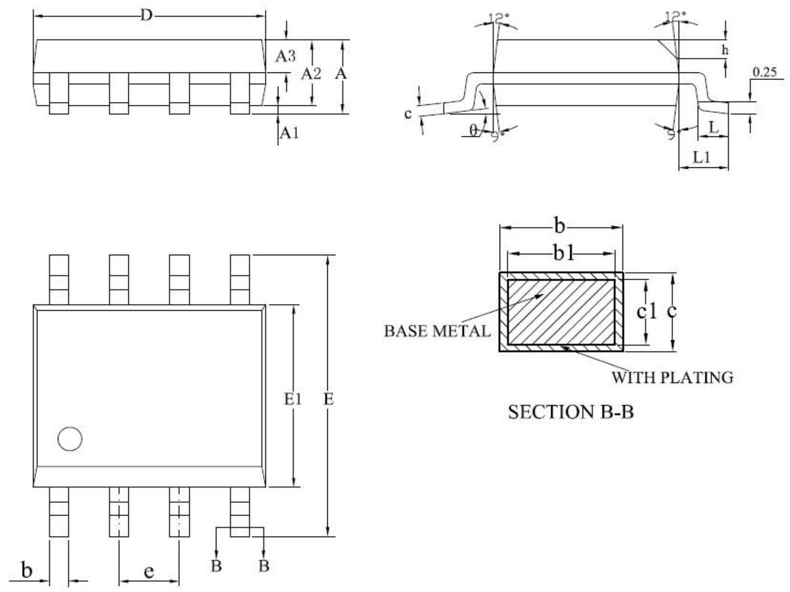
Figure 29. Crosstalk vs. Frequency

**SOT23-5**



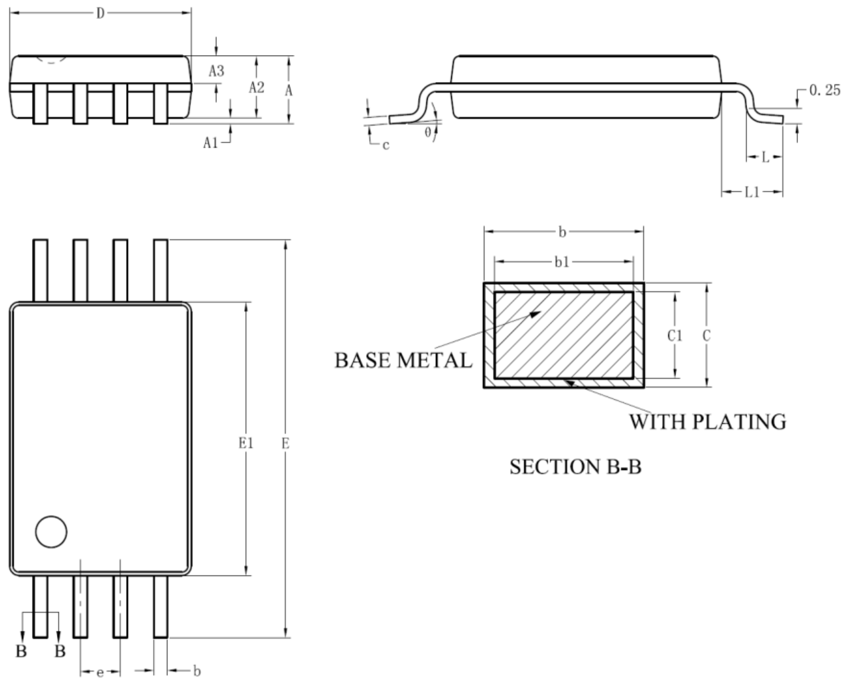

| SYMBOL | MILLIMETER | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | — | — | 1.25 |
| A1 | 0.04 | — | 0.10 |
| A2 | 1.00 | 1.10 | 1.20 |
| A3 | 0.60 | 0.65 | 0.70 |
| b | 0.33 | — | 0.41 |
| b1 | 0.32 | 0.35 | 0.38 |
| c | 0.15 | — | 0.19 |
| c1 | 0.14 | 0.15 | 0.16 |
| D | 2.82 | 2.92 | 3.02 |
| E | 2.60 | 2.80 | 3.00 |
| E1 | 1.50 | 1.60 | 1.70 |
| e | 0.95BSC | | |
| e1 | 1.90BSC | | |
| L | 0.30 | — | 0.60 |
| L1 | 0.60REF | | |
| θ | 0 | — | 8° |

**SOIC-8**



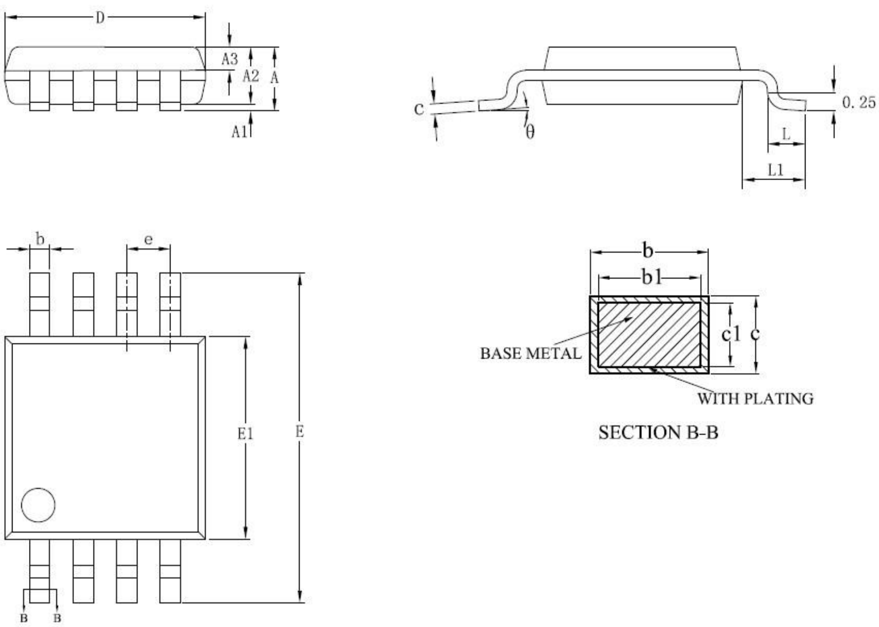

| SYMBOL | MILLIMETER | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | — | — | 1.75 |
| A1 | 0.10 | — | 0.225 |
| A2 | 1.30 | 1.40 | 1.50 |
| A3 | 0.60 | 0.65 | 0.70 |
| b | 0.39 | — | 0.47 |
| b1 | 0.38 | 0.41 | 0.44 |
| c | 0.20 | — | 0.24 |
| c1 | 0.19 | 0.20 | 0.21 |
| D | 4.80 | 4.90 | 5.00 |
| E | 5.80 | 6.00 | 6.20 |
| E1 | 3.80 | 3.90 | 4.00 |
| e | 1.27BSC | | |
| h | 0.25 | — | 0.50 |
| L | 0.50 | — | 0.80 |
| L1 | 1.05REF | | |
| θ | 0 | — | 8° |

## TSSOP-8



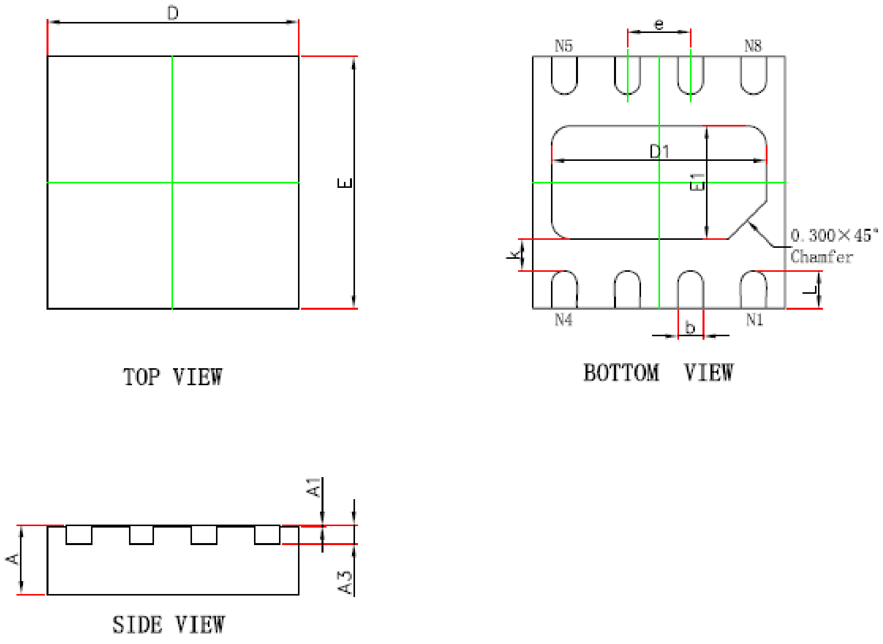

| SYMBOL | MILLIMETER | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | __ | __ | 1.20 |
| A1 | 0.05 | — | 0.15 |
| A2 | 0.90 | 1.00 | 1.05 |
| A3 | 0.39 | 0.44 | 0.49 |
| b | 0.20 | __ | 0.28 |
| b1 | 0.19 | 0.22 | 0.25 |
| c | 0.13 | __ | 0.17 |
| c1 | 0.12 | 0.13 | 0.14 |
| D | 2.90 | 3.00 | 3.10 |
| E1 | 4.30 | 4.40 | 4.50 |
| E | 6.20 | 6.40 | 6.60 |
| e | 0.65BSC | | |
| L | 0.45 | — | 0.75 |
| L1 | 1.00REF | | |
| θ | 0 | __ | 8° |

## MSOP-8



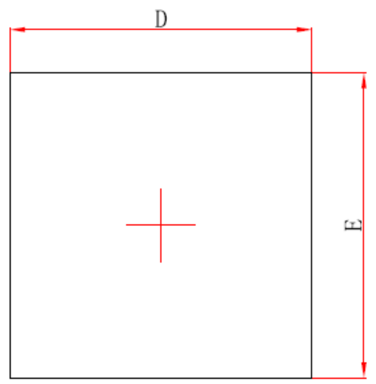

| SYMBOL | MILLIMETER | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | __ | __ | 1.10 |
| A1 | 0.05 | __ | 0.15 |
| A2 | 0.75 | 0.85 | 0.95 |
| A3 | 0.30 | 0.35 | 0.40 |
| b | 0.28 | __ | 0.36 |
| b1 | 0.27 | 0.30 | 0.33 |
| c | 0.15 | __ | 0.19 |
| c1 | 0.14 | 0.15 | 0.16 |
| D | 2.90 | 3.00 | 3.10 |
| E | 4.70 | 4.90 | 5.10 |
| E1 | 2.90 | 3.00 | 3.10 |
| e | 0.65BSC | | |
| L | 0.40 | __ | 0.70 |
| L1 | 0.95REF | | |
| θ | 0 | __ | 8° |

## DFN8 2*2

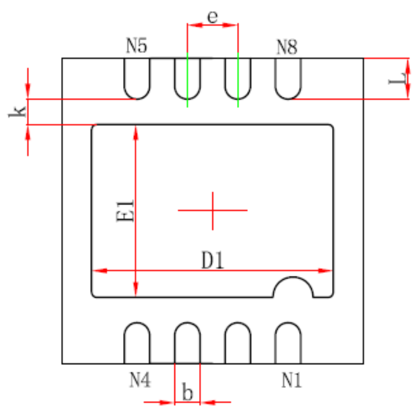



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Norm. | | Norm. | |
| A | 0.550+/-0.050 | | 0.022+/-0.002 | |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A3 | 0.152REF. | | 0.006REF. | |
| D | 2.000+/-0.100 | | 0.079+/-0.004 | |
| E | 2.000+/-0.100 | | 0.079+/-0.004 | |
| D1 | 1.700+/-0.100 | | 0.067+/-0.004 | |
| E1 | 0.900+/-0.100 | | 0.035+/-0.004 | |
| k | 0.200MIN. | | 0.008MIN. | |
| b | 0.200+/-0.050 | | 0.008+/-0.002 | |
| e | 0.500TYP. | | 0.020TYP. | |
| L | 0.300+/-0.050 | | 0.012+/-0.002 | |

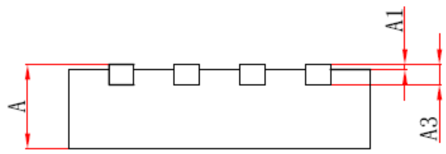
**DFN8 3*3**




**Top View**



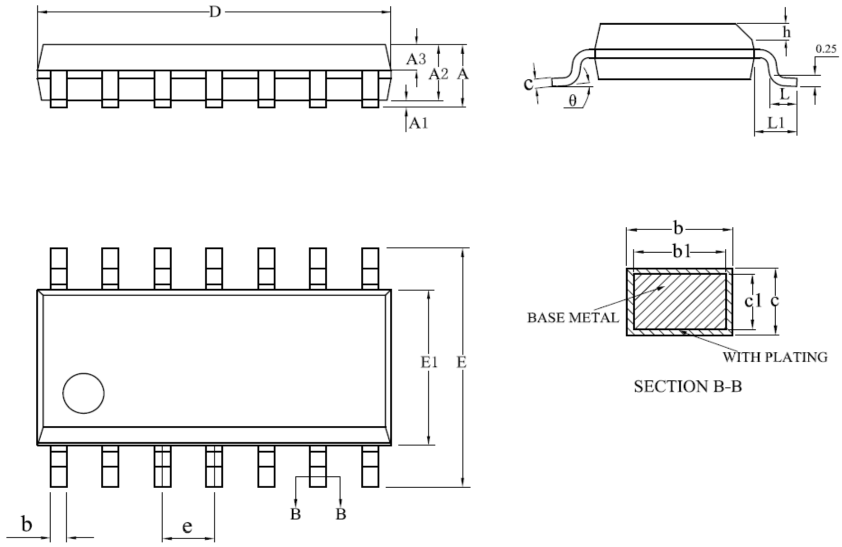

**Bottom View**




**Side View**

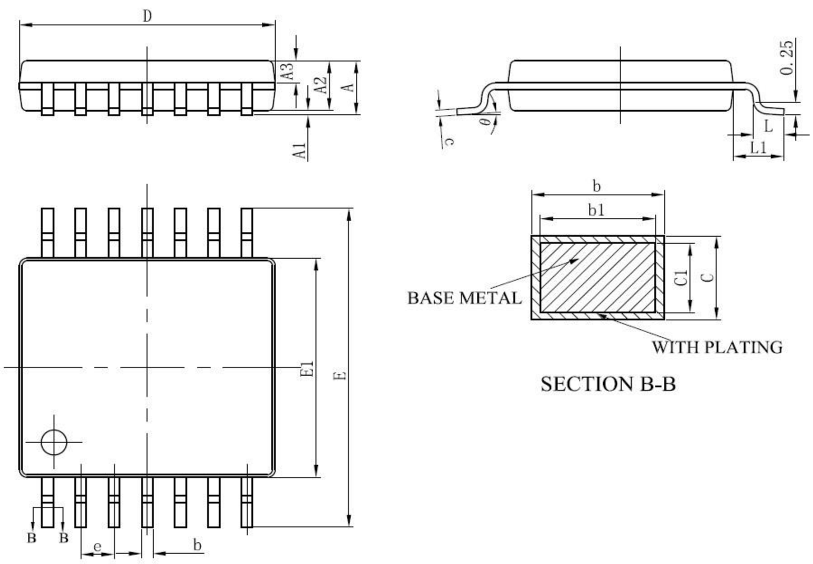
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 0.700/0.800 | 0.800/0.900 | 0.028/0.031 | 0.031/0.035 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A3 | 0.203REF. | | 0.008REF. | |
| D | 2.924 | 3.076 | 0.115 | 0.121 |
| E | 2.924 | 3.076 | 0.115 | 0.121 |
| D1 | 2.300 | 2.500 | 0.091 | 0.098 |
| E1 | 1.600 | 1.800 | 0.063 | 0.071 |
| k | 0.200MIN. | | 0.008MIN. | |
| b | 0.200 | 0.300 | 0.008 | 0.012 |
| e | 0.500TYP. | | 0.020TYP. | |
| L | 0.324 | 0.476 | 0.013 | 0.019 |

## SOIC-14




| SYMBOL | MILLIMETER | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | — | — | 1.75 |
| A1 | 0.05 | — | 0.225 |
| A2 | 1.30 | 1.40 | 1.50 |
| A3 | 0.60 | 0.65 | 0.70 |
| b | 0.39 | — | 0.47 |
| b1 | 0.38 | 0.41 | 0.44 |
| c | 0.20 | — | 0.24 |
| c1 | 0.19 | 0.20 | 0.21 |
| D | 8.55 | 8.65 | 8.75 |
| E | 5.80 | 6.00 | 6.20 |
| E1 | 3.80 | 3.90 | 4.00 |
| e | 1.27BSC | | |
| h | 0.25 | — | 0.50 |
| L | 0.50 | — | 0.80 |
| L1 | 1.05REF | | |
| θ | 0 | — | 8° |

## TSSOP-14




| SYMBOL | MILLIMETER | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | — | — | 1.20 |
| A1 | 0.05 | — | 0.15 |
| A2 | 0.90 | 1.00 | 1.05 |
| A3 | 0.39 | 0.44 | 0.49 |
| b | 0.20 | — | 0.28 |
| b1 | 0.19 | 0.22 | 0.25 |
| c | 0.13 | — | 0.17 |
| c1 | 0.12 | 0.13 | 0.14 |
| D | 4.90 | 5.00 | 5.10 |
| E1 | 4.30 | 4.40 | 4.50 |
| E | 6.20 | 6.40 | 6.60 |
| e | 0.65BSC | | |
| L | 0.45 | 0.60 | 0.75 |
| L1 | 1.00BSC | | |
| θ | 0 | — | 8° |