

Features

- Supply Voltage: 3V to 36V
- Offset Voltage: $\pm 2\text{mV}$ Maximum
- Differential Input Voltage Range to Supply Rail, can Work as Comparator
- Bandwidth: 1.5MHz, Slew Rate: $0.5\text{V}/\mu\text{s}$
- Input Rail to $-V_s$, No Internal ESD Diode to $+V_s$
- Low 1/f Noise: $50\text{ nV}/\sqrt{\text{Hz}}$ at 10Hz
- High PSRR+: 60dB at 100KHz
- No significant output glitch when power on and off
- -40°C to 125°C Operation Temperature Range

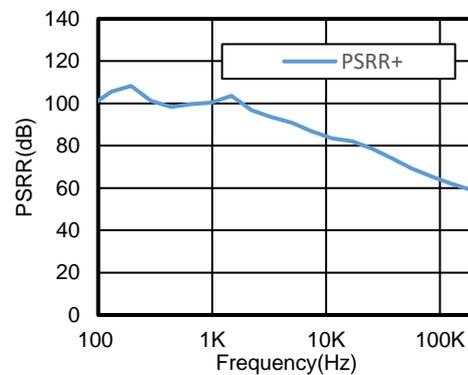
Description

The TPA264X series amplifiers are newest high supply voltage amplifiers with 2mV offset, low noise and immunity to high frequency noise from power supply. They incorporate 3PEAK's proprietary and patented design techniques to achieve very good AC performance with 1.5MHz bandwidth, $0.5\text{V}/\mu\text{s}$ slew rate and low distortion while drawing only $550\mu\text{A}$ of quiescent current per amplifier.

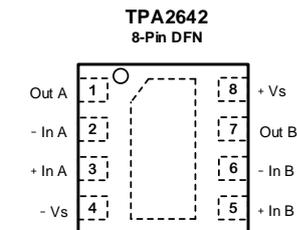
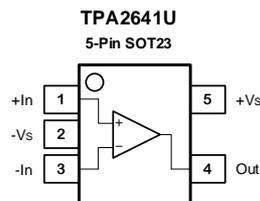
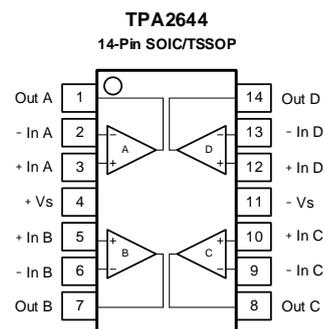
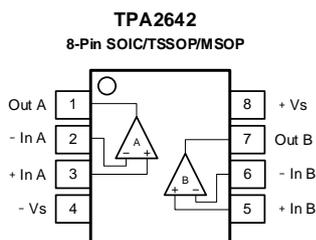
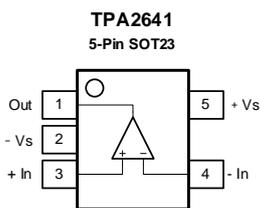
The input common-mode voltage range extends to $-V_s$, and no internal ESD diode between input and $+V_s$, This feature can block the current path from input to $+V_s$ when power down but the signal still in input pin, it's usual in battery related application.

Applications

- Instrumentation
- Sensor Interface
- Motor Control
- Industrial Control



Pin Configuration



The thermal pad of DFN package is recommended to be left float or connected to $-V_s$

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Revision History

| Date | Revision | Notes |
|-----------|----------|---|
| 2020/4/26 | Rev.A.0 | Initial version |
| 2023/4/9 | Rev.A.1 | The following updates are all about the new datasheet formats or typo, the actual product remains unchanged. Updated Package Outline Dimensions. |
| 2023/11/5 | Rev.A.2 | The following updates are all about the new datasheet formats or typo, the actual product remains unchanged. Updated Input Voltage Noise in Electrical Characteristics: 1uVRMS -> 1.6uVPP. |

Order Information

| Order Number | Operating Temperature Range | Package | Marking Information | MSL | Transport Media, Quantity |
|--------------------------------|-----------------------------|---------------|---------------------|-----|---------------------------|
| TPA2641-S5TR | -40 to 125°C | 5-Pin SOT23 | 641 | 3 | Tape and Reel, 3000 |
| TPA2641U-S5TR | -40 to 125°C | 5-Pin SOT23 | 64U | 3 | Tape and Reel, 3000 |
| TPA2642-SO1R | -40 to 125°C | 8-Pin SOIC | A2642 | 3 | Tape and Reel, 4000 |
| TPA2642-DF4R ^{Note 1} | -40 to 125°C | 8-Pin DFN 2*2 | 642 | 3 | Tape and Reel, 3000 |
| TPA2642-TS1R ^{Note 1} | -40 to 125°C | 8-Pin TSSOP | A2642 | 3 | Tape and Reel, 3000 |
| TPA2642-VS1R | -40 to 125°C | 8-Pin MSOP | A2642 | 3 | Tape and Reel, 3000 |
| TPA2644-SO2R | -40 to 125°C | 14-Pin SOIC | A2644 | 3 | Tape and Reel, 2500 |
| TPA2644-TS2R | -40 to 125°C | 14-Pin TSSOP | A2644 | 3 | Tape and Reel, 3000 |

Note 1: For future product, contact the 3PEAK factory for more information and samples.

Absolute Maximum Ratings ^{Note 1}

| Parameters | Rating |
|--|--|
| Supply Voltage, (+V _S)– (-V _S) | 40 V |
| Input Voltage | (-V _S) – 0.3 to 40V |
| Input Current: +IN, –IN ^{Note 2} | ±10mA |
| Output Voltage | (-V _S) – 0.3 to (+V _S) + 0.3 |
| Output Short-Circuit Duration ^{Note 3} | Infinite |
| Maximum Junction Temperature | 150°C |
| Operating Temperature Range | –40 to 125°C |
| Storage Temperature Range | –65 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 inputs are protected by ESD protection diodes to negative power supply. If the input extends more than 300mV beyond the negative power supply, the input current should be limited to less than 10mA.

Note 3: 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 and Latch Up Rating

| Symbol | Parameter | Condition | Minimum Level | Unit |
|--------|--------------------------|------------------------|---------------|------|
| HBM | Human Body Model ESD | ANSI/ESDA/JEDEC JS-001 | 2 | kV |
| CDM | Charged Device Model ESD | ANSI/ESDA/JEDEC JS-002 | 1 | kV |

Thermal Information

| Package Type | θ_{JA} | θ_{JC} | Unit |
|---------------|---------------|---------------|------|
| 5-Pin SOT23 | 250 | 81 | °C/W |
| 8-Pin SOIC | 158 | 43 | °C/W |
| 8-Pin MSOP | 210 | 45 | °C/W |
| 8-Pin TSSOP | 191 | 44 | °C/W |
| 8-Pin DFN 2*2 | 100 | 60 | °C/W |
| 14-Pin SOIC | 120 | 36 | °C/W |
| 14-Pin TSSOP | 180 | 35 | °C/W |

Electrical Characteristics

All test condition is at $T_A = 25^\circ\text{C}$, $R_L = 10\text{k}\Omega$, $C_L = 100\text{pF}$, 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 | $V_S = 5\text{V to } 36\text{V}$ | | | 350 | 550 | μA |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | | | 650 | μA |
| PSRR | Power Supply Rejection Ratio | $V_S = 5\text{V to } 36\text{V}$ | | 100 | 120 | | dB |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | 95 | | | dB |
| Input Characteristics | | | | | | | |
| V_{OS} | Input Offset Voltage | $V_S = 36\text{V}, V_{CM} = 0\text{V to } 28\text{V}$ | | -2 | 0.1 | 2 | mV |
| | | | $-40^\circ\text{C to } 85^\circ\text{C}$ | -3 | | 3 | mV |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | -3.5 | | 3.5 | mV |
| | | $V_S = 5\text{V}, V_{CM} = 2.5\text{V}$ | | -2 | 0.1 | 2 | mV |
| | | | $-40^\circ\text{C to } 85^\circ\text{C}$ | -3 | | 3 | |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | -3.5 | | 3.5 | mV |
| $V_{OS\ TC}$ | Input Offset Voltage Drift | | $-40^\circ\text{C to } 125^\circ\text{C}$ | | 5 | | $\mu\text{V}/^\circ\text{C}$ |
| I_B | Input Bias Current | $V_S = 36\text{V}, V_{CM} = 18\text{V}$ | | | 15 | 30 | nA |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | | | 50 | nA |
| I_{OS} | Input Offset Current | $V_S = 36\text{V}, V_{CM} = 18\text{V}$ | | | 1 | 10 | nA |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | | | 30 | nA |
| I_B | Input Bias Current | $V_S = 36\text{V}, V_{CM} = 0\text{V}$ | | | 20 | 50 | nA |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | | | 100 | nA |
| I_{OS} | Input Offset Current | $V_S = 36\text{V}, V_{CM} = 0\text{V}$ | | | 1 | 30 | nA |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | | | 50 | nA |
| I_{IN} | Different Input Current | $V_S = 36\text{V}, V_{ID} = 36\text{V}$ | | -300 | 50 | 300 | nA |
| | | $V_S = 36\text{V}, V_{ID} = 36\text{V}$ | $-40^\circ\text{C to } 125^\circ\text{C}$ | -500 | | 500 | nA |
| C_{IN} | Input Capacitance | Differential Mode | | | 5 | | pF |
| | | Common Mode | | | 5 | | pF |
| A_V | Open-loop Voltage Gain | | | 110 | 130 | | dB |
| | | $-40^\circ\text{C to } 125^\circ\text{C}$ | | 100 | | | dB |
| V_{CMR} | Common-mode Input Voltage Range | | $-40^\circ\text{C to } 125^\circ\text{C}$ | $(-V_S)$ | | $(+V_S)-2$ | V |
| CMRR | Common Mode Rejection Ratio | $V_{CM} = 0\text{V to } 28\text{V}$ | | 85 | 110 | | dB |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | 80 | | | dB |
| Output Characteristics | | | | | | | |
| | Output Voltage Swing from Positive Rail | $I_{LOAD} = 50\mu\text{A to } V_S/2$ | | | 1.1 | 1.2 | V |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | | | 1.4 | V |
| | | $I_{LOAD} = 1\text{mA to } V_S/2$ | | | 1.3 | 1.5 | V |
| | | | $-40^\circ\text{C to } 125^\circ\text{C}$ | | | 1.7 | V |

| | | | | | | | |
|---|------------------------------|---|----------------|--|-----|-----|----|
| | | $I_{LOAD} = 5mA \text{ to } V_S/2$ | | | 1.9 | 2.4 | V |
| | | | -40°C to 125°C | | | 2.5 | V |
| Output Voltage Swing from Negative Rail | | $I_{LOAD} = 50\mu A \text{ to } V_S/2$ | | | 70 | 100 | mV |
| | | | -40°C to 125°C | | | 150 | mV |
| | | $I_{LOAD} = 1mA \text{ to } V_S/2$ | | | 0.9 | 1 | V |
| | | | -40°C to 125°C | | | 1.1 | V |
| | | $I_{LOAD} = 5mA \text{ to } V_S/2$ | | | 1.2 | 1.5 | V |
| | | | -40°C to 125°C | | | 1.6 | V |
| I_{SC} | Output Short-Circuit Current | $V_S = 5V, R_{LOAD} = 10k\Omega \text{ to } 0V$ | | | 5 | 10 | mV |
| | | | -40°C to 125°C | | | 15 | mV |
| I_{SC} | Output Short-Circuit Current | | | | 50 | | mA |
| | | | -40°C to 125°C | | 30 | | mA |

| AC Specifications | | | | | | | |
|-------------------|-------------------------------------|--|--|--|------|--|-----------------|
| GBW | Gain-Bandwidth Product | | | | 1.5 | | MHz |
| SR | Slew Rate | $G = 1, 2V \text{ step}$ | | | 0.5 | | V/ μs |
| t_{OR} | Overload Recovery | From positive rail | | | 1.5 | | μs |
| | | From negative rail | | | 8 | | μs |
| t_s | Settling Time, 0.1% | $G = 1, 2V \text{ step}$ | | | 3 | | μs |
| | Settling Time, 0.01% | | | | 4 | | μs |
| PM | Phase Margin | $R_L = 10K, C_L = 100pF$ | | | 60 | | ° |
| GM | Gain Margin | $R_L = 10K, C_L = 100pF$ | | | 15 | | dB |
| | Channel Separation | $f = 100 \text{ kHz}$ | | | 120 | | dB |
| Noise Performance | | | | | | | |
| E_N | Input Voltage Noise | $f = 0.1Hz \text{ to } 10Hz$ | | | 1.6 | | μV_{PP} |
| e_N | Input Voltage Noise Density | $f = 1kHz$ | | | 50 | | nV/ \sqrt{Hz} |
| i_N | Input Current Noise | $f = 1kHz$ | | | 200 | | fA/ \sqrt{Hz} |
| THD+N | Total Harmonic Distortion and Noise | $f = 1kHz, G = 1, R_L = 10k\Omega, V_{OUT} = 6V_{RMS}$ | | | 0.01 | | % |

Typical Performance Characteristics

$V_S = \pm 15V$, $V_{CM} = 0V$, $R_L = 10k\Omega$, unless otherwise specified.

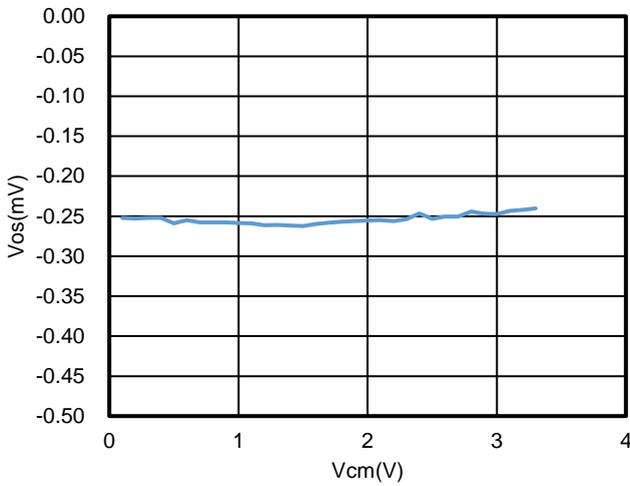


Figure 1. Offset Voltage vs. Common Mode Voltage, $V_S = 5V$

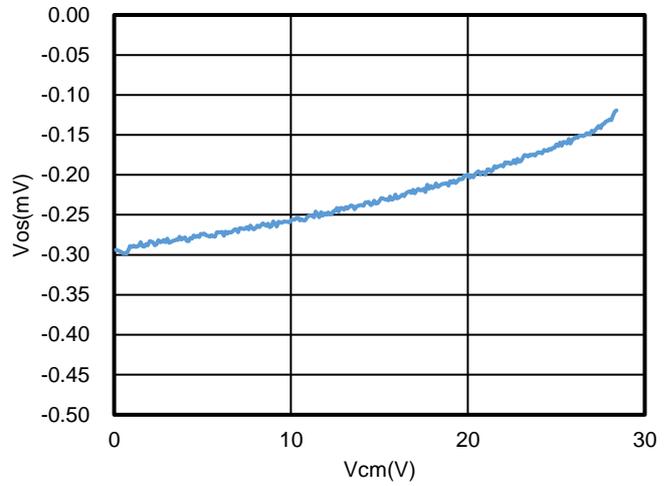


Figure 2. Offset Voltage vs. Common Mode Voltage, $V_S = 30V$

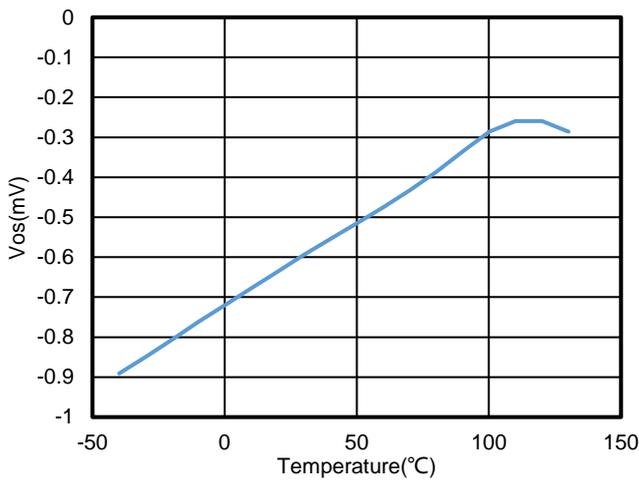


Figure 3. Offset Voltage vs. Temperature, $V_S = 30V$, $V_{CM} = 15V$

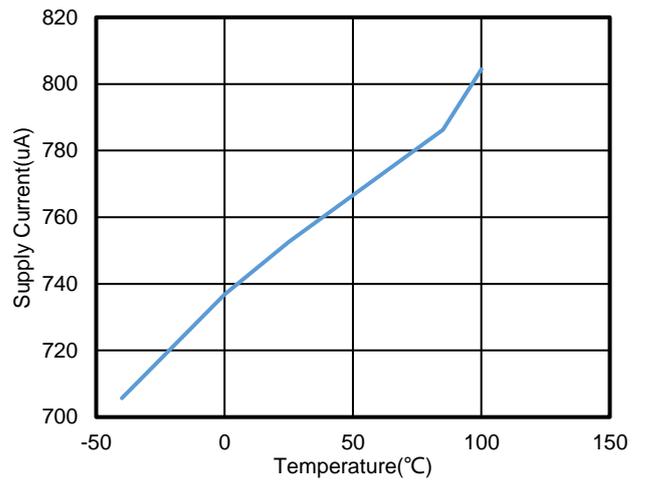


Figure 4. I_q vs. Temperature, $\pm 15V$ Supply, TPA2642

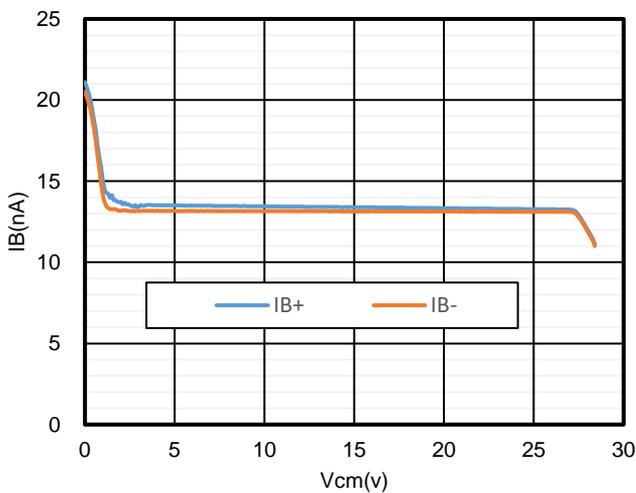


Figure 5. I_B vs. Common Mode Voltage, $V_S = 30V$

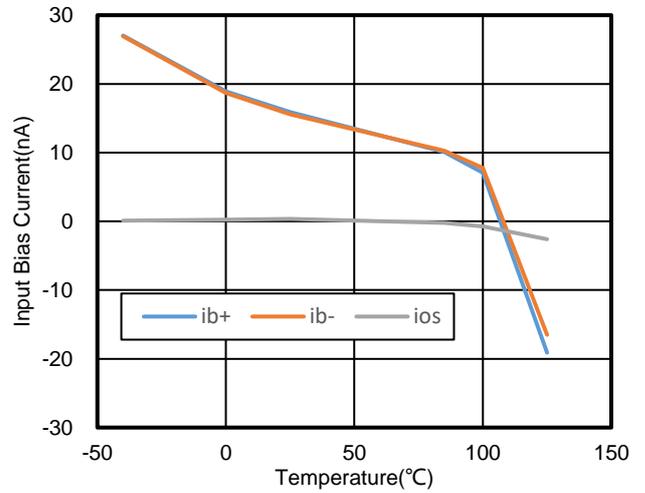


Figure 6. I_B and I_{OS} vs. Temperature, $V_S = 30V$, $V_{CM} = 15V$



Figure 7. -3dB Bandwidth, G = 1, Vs = 30V

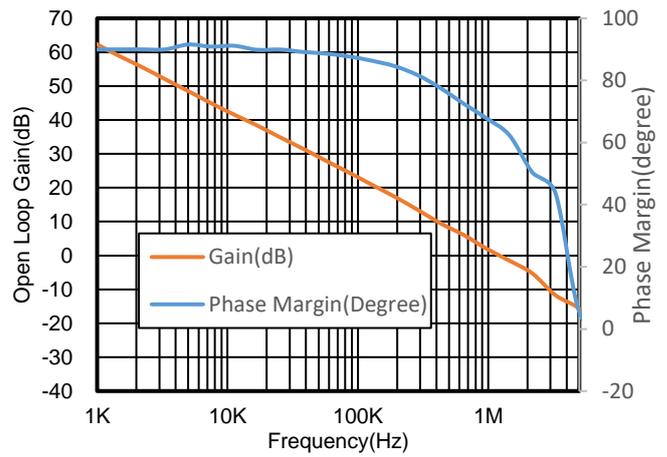


Figure 8. Open Loop Gain and Phase vs. Frequency

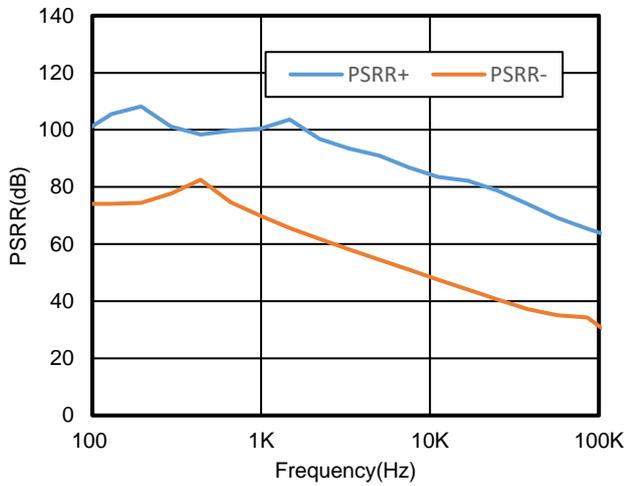


Figure 9. PSRR vs. Frequency

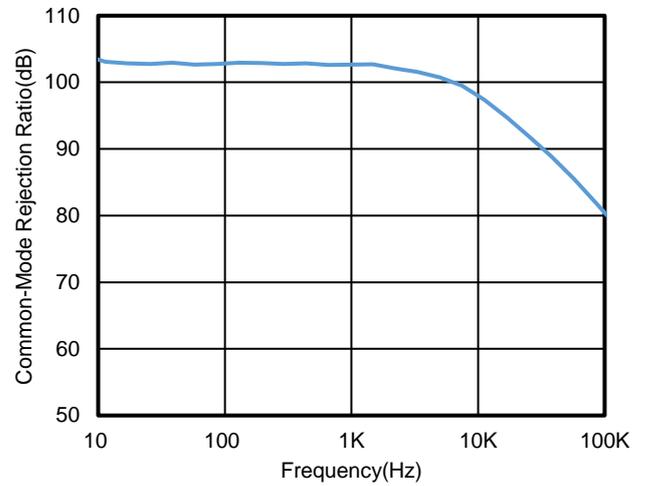


Figure 10. CMRR vs. Frequency



Time: 10μs/div, Measure Time: 1.4μs, G=11

Figure 11. Positive Overload Recovery



Time: 10μs/div, Measure Time: 7.8μs, G=11

Figure 12. Negative Overload Recovery



Voltage: 200mV/div, Time: 5μs/div
 $R_L=100K, C_L=1nF, G=1$
 Figure 13. 1V Signal Step Response



Voltage: 2mV/div, Time: 5μs/div
 $C_L=50pF, G=1$
 Figure 14. 10mV Signal Step Response

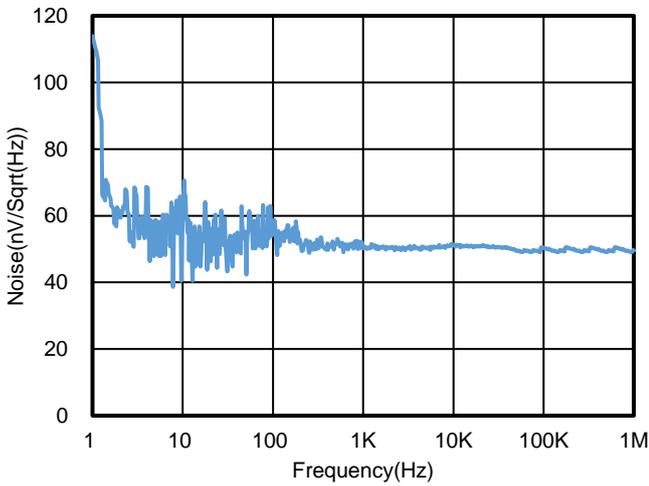


Figure 15. Voltage Noise Density vs. Frequency

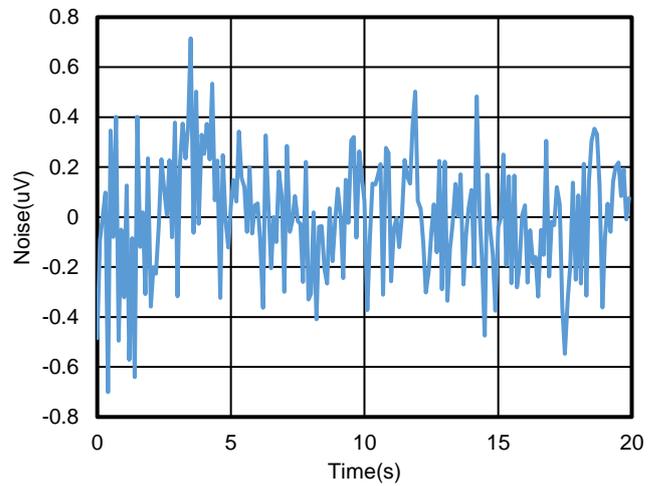


Figure 16. 0.1 to 10Hz Voltage Noise

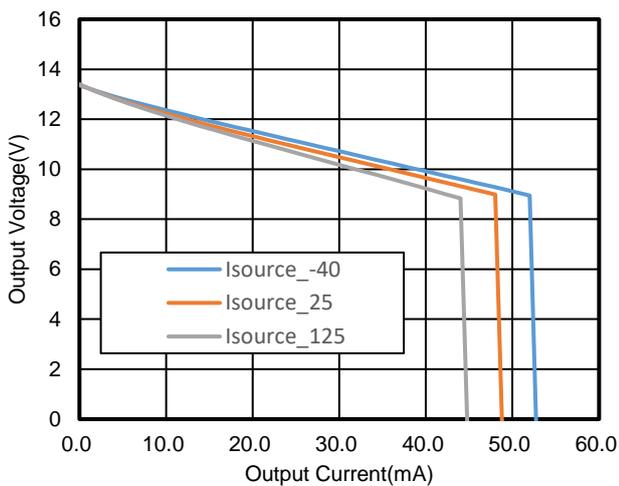


Figure 17. V_{OUT} vs. I_{OUT} , Source

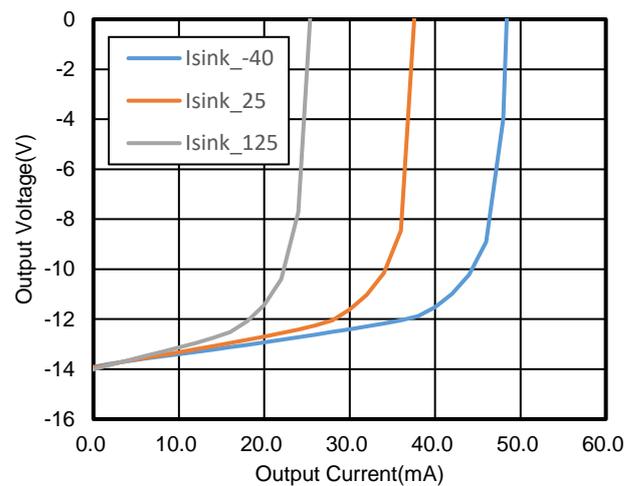


Figure 18. V_{OUT} vs. I_{OUT} , Sink

Power On and Off Behavior, 36V Single Supply, G = 1, Input = $V_s / 2$, Yellow: V_s , Green: Output



Figure 19. 2ms Power On and Off Time



Figure 20. 10ms Power On and Off Time



Figure 21. 100ms Power On and Off Time



Figure 22. 1s Power On and Off Time

Power On and Off Behavior, +18V and -18V Dual Supply, G = 1, Input = Ground, Green: +Vs, Red: -Vs, Yellow: Output.



Figure 23. 1ms Power On and Off Time



Figure 24. 10ms Power On and Off Time



Figure 25. 100ms Power On and Off Time

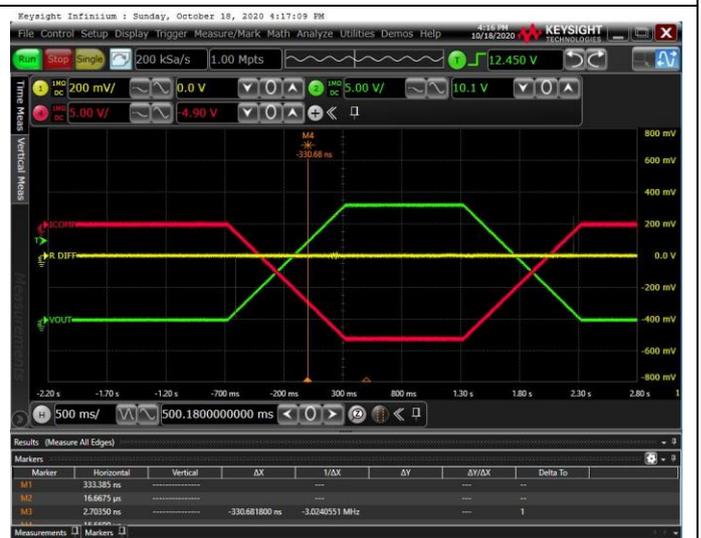
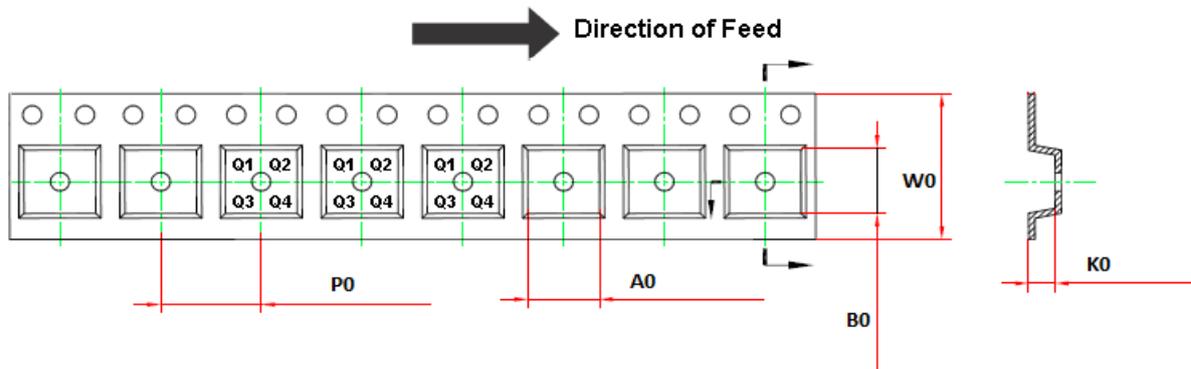
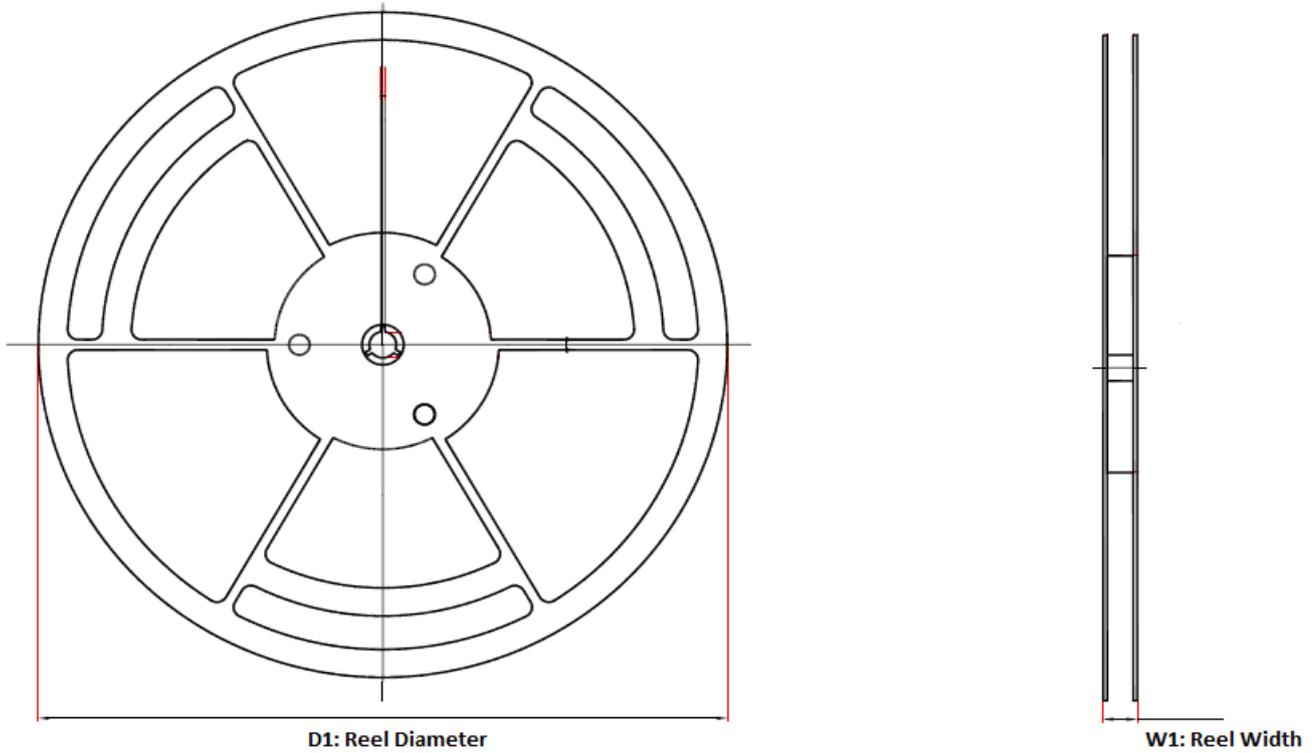


Figure 26. 1s Power On and Off Time

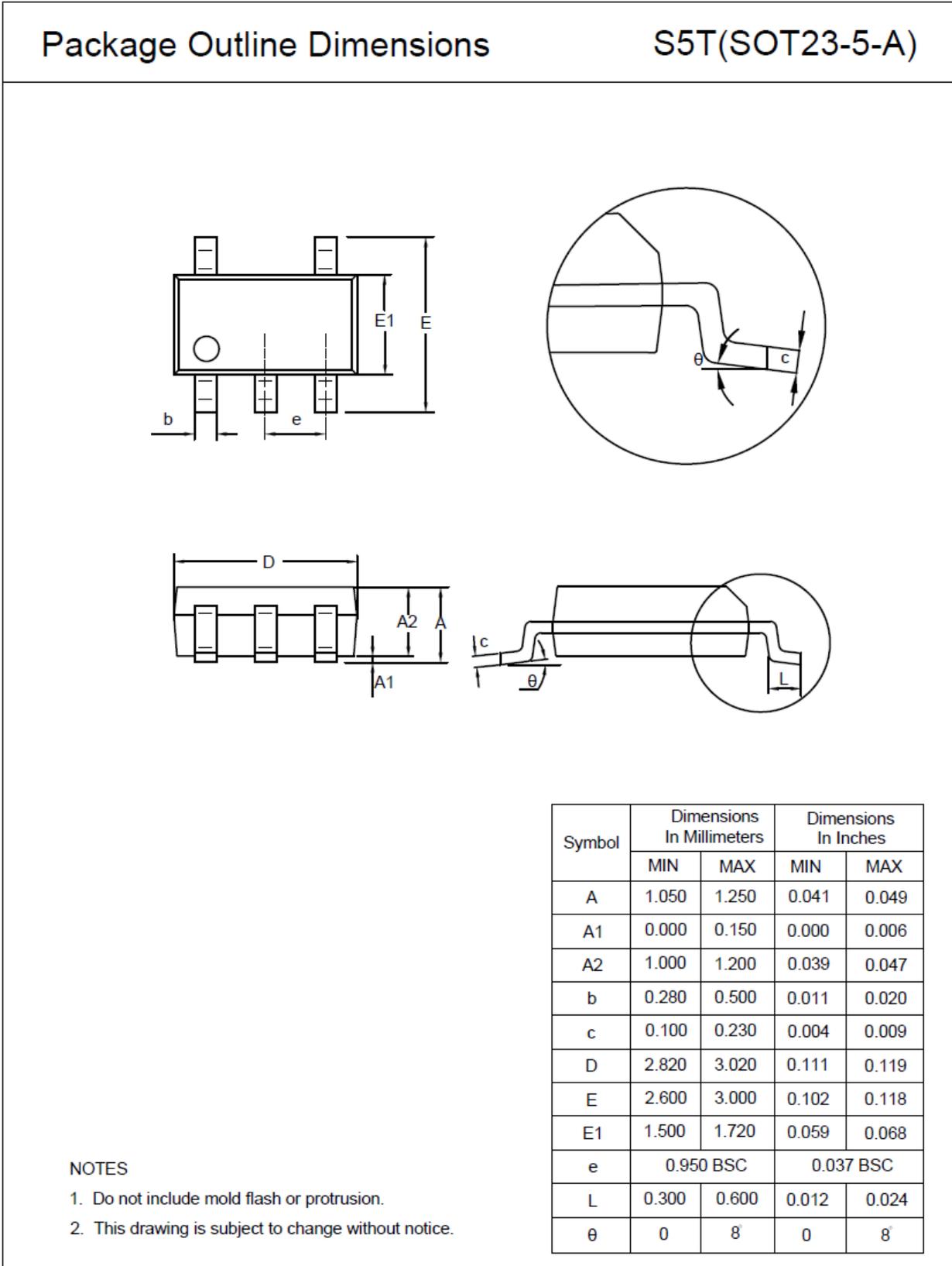
Tape and Reel Information



| Order Number | Package | D1 | W1 | A0 | B0 | K0 | P0 | W0 | Pin1 Quadrant |
|---------------|--------------|-------|------|-----|-----|-----|-----|------|------------------|
| TPA2641-S5TR | 5-Pin SOT23 | 180.0 | 13.1 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPA2641U-S5TR | 5-Pin SOT23 | 180.0 | 13.1 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPA2642-SO1R | 8-Pin SOIC | 330.0 | 17.6 | 6.4 | 5.4 | 2.1 | 8.0 | 12.0 | Q1 |
| TPA2642-DF4R | 8-Pin DFN2*2 | 180.0 | 13.1 | 2.3 | 2.3 | 1.1 | 4.0 | 8.0 | Q1 |
| TPA2642-TS1R | 8-Pin TSSOP | 330.0 | 17.6 | 6.8 | 3.3 | 1.2 | 8.0 | 12.0 | Q1 |
| TPA2642-VS1R | 8-Pin MSOP | 330.0 | 17.6 | 5.2 | 3.3 | 1.5 | 8.0 | 12.0 | Q1 |
| TPA2644-SO2R | 14-Pin SOIC | 330.0 | 21.6 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| TPA2644-TS2R | 14-Pin TSSOP | 330.0 | 17.6 | 6.8 | 5.4 | 1.2 | 8.0 | 12.0 | Q1 |

Package Outline Dimensions

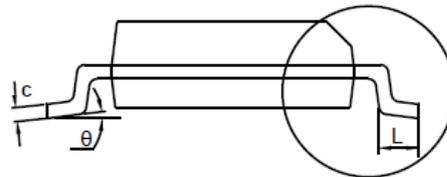
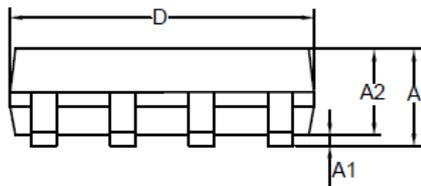
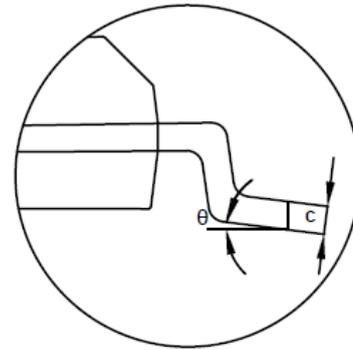
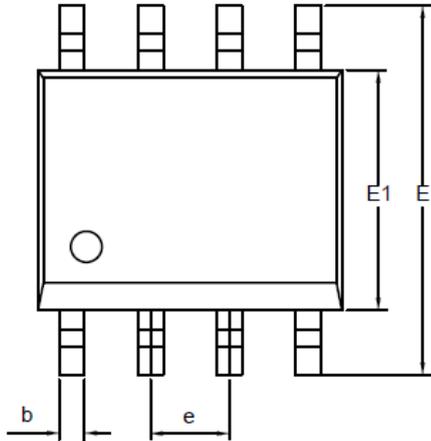
SOT23-5



SOP8

Package Outline Dimensions

SO1(SOP-8-A)



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.050 | 0.250 | 0.002 | 0.010 |
| A2 | 1.250 | 1.550 | 0.049 | 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 | 1.000 | 0.016 | 0.039 |
| theta | 0 | 8° | 0 | 8° |

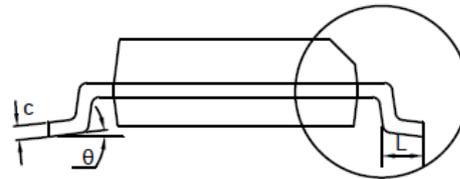
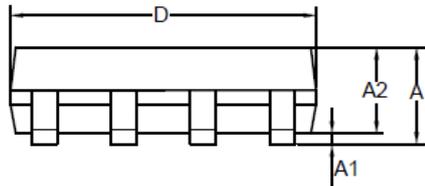
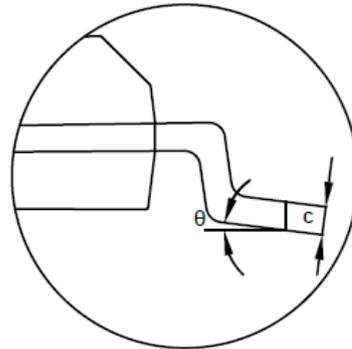
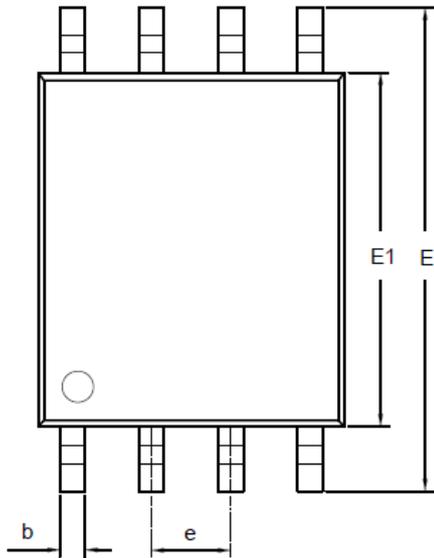
NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

TSSOP8

Package Outline Dimensions

TS1(TSSOP-8-A)



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.900 | 1.200 | 0.035 | 0.047 |
| A1 | 0.050 | 0.150 | 0.002 | 0.006 |
| A2 | 0.800 | 1.050 | 0.031 | 0.041 |
| b | 0.190 | 0.300 | 0.007 | 0.012 |
| c | 0.090 | 0.200 | 0.004 | 0.008 |
| D | 2.900 | 3.100 | 0.114 | 0.122 |
| E | 6.200 | 6.600 | 0.244 | 0.260 |
| E1 | 4.300 | 4.500 | 0.169 | 0.177 |
| e | 0.650 BSC | | 0.026 BSC | |
| L | 0.450 | 0.750 | 0.018 | 0.030 |
| θ | 0 | 8° | 0 | 8° |

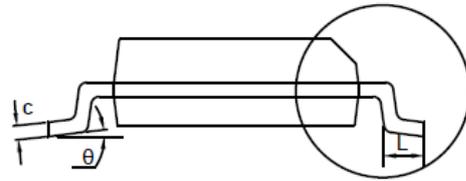
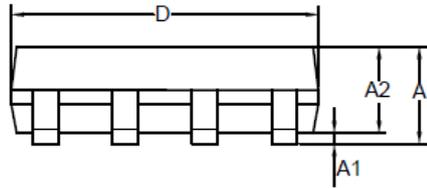
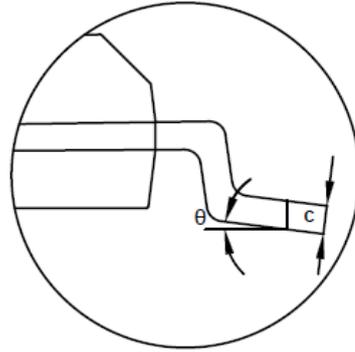
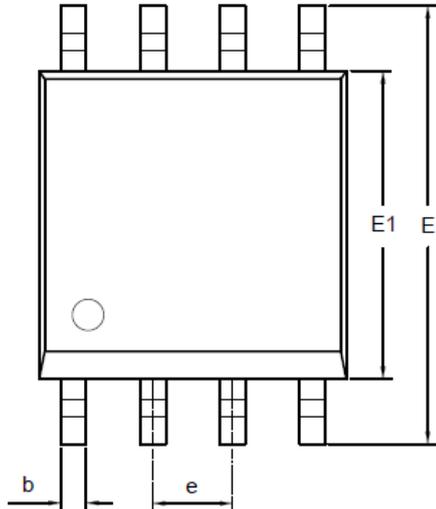
NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

MSOP8

Package Outline Dimensions

VS1(MSOP-8-A)

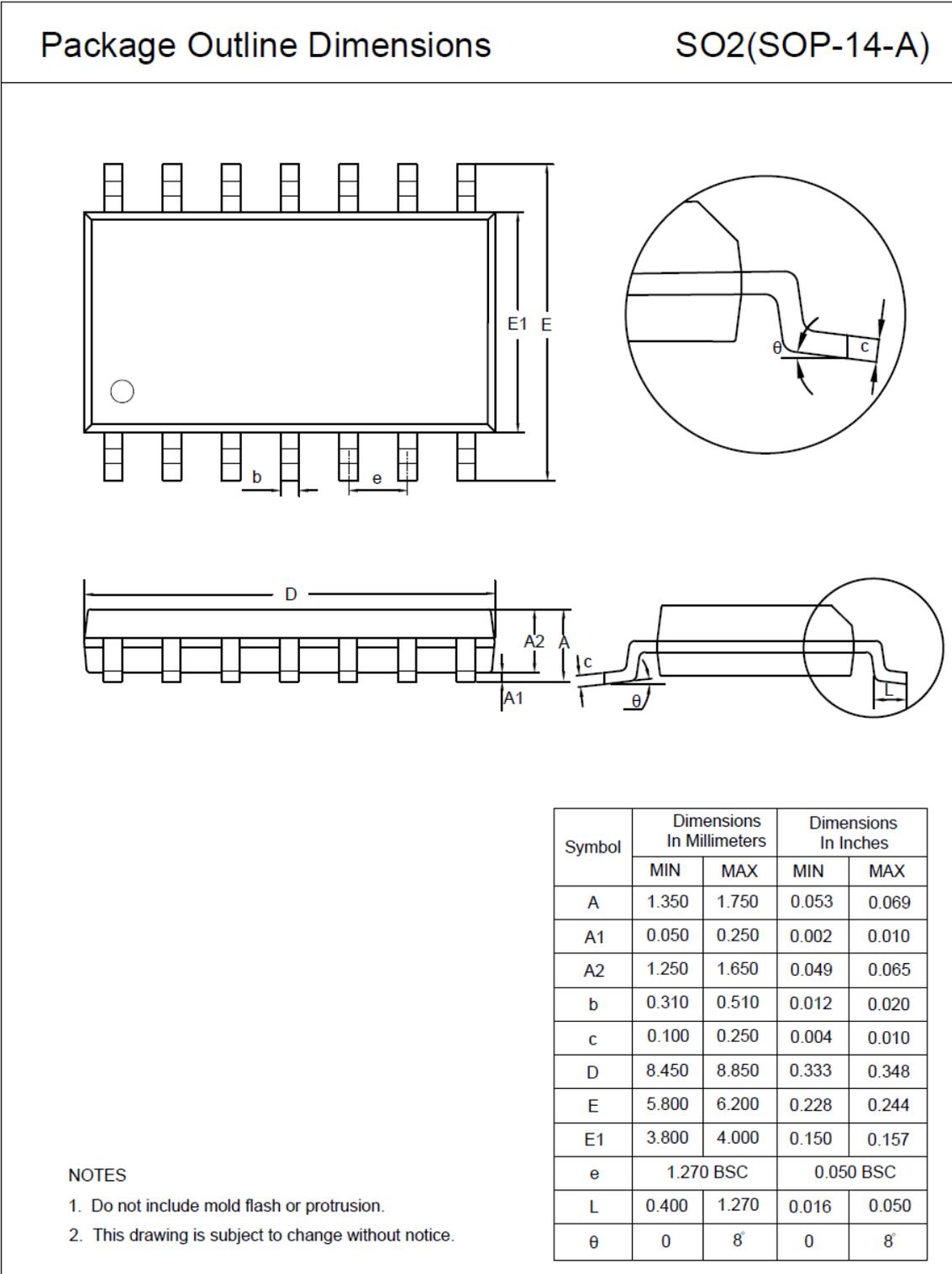


| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|----------|---------------------------|-------|----------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.800 | 1.100 | 0.031 | 0.043 |
| A1 | 0.050 | 0.150 | 0.002 | 0.006 |
| A2 | 0.750 | 0.950 | 0.030 | 0.037 |
| b | 0.250 | 0.380 | 0.010 | 0.015 |
| c | 0.090 | 0.230 | 0.004 | 0.009 |
| D | 2.900 | 3.100 | 0.114 | 0.122 |
| E | 4.700 | 5.100 | 0.185 | 0.201 |
| E1 | 2.900 | 3.100 | 0.114 | 0.122 |
| e | 0.650 BSC | | 0.026 BSC | |
| L | 0.400 | 0.800 | 0.016 | 0.031 |
| θ | 0 | 8° | 0 | 8° |

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

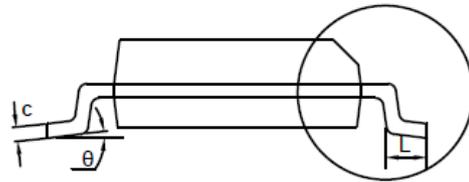
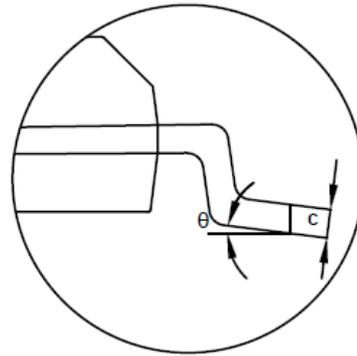
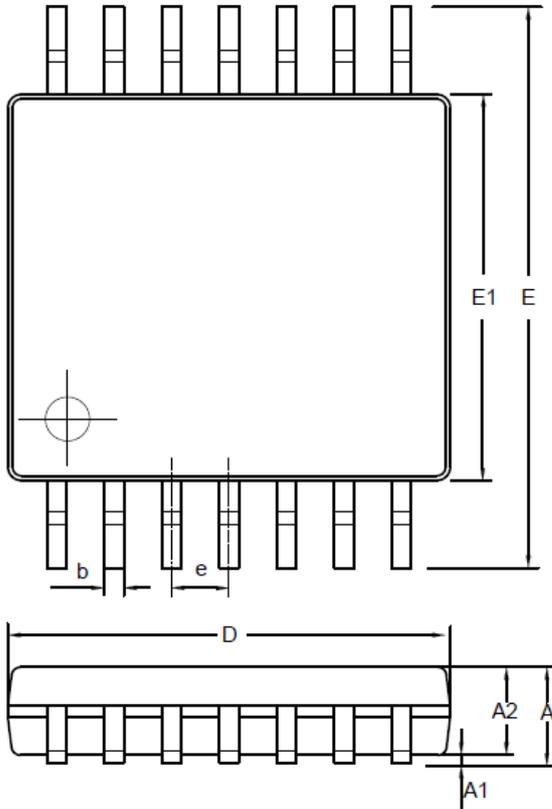
SOP14



TSSOP14

Package Outline Dimensions

TS2(TSSOP-14-A)



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|----------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.900 | 1.200 | 0.035 | 0.047 |
| A1 | 0.050 | 0.150 | 0.002 | 0.006 |
| A2 | 0.800 | 1.050 | 0.031 | 0.041 |
| b | 0.190 | 0.300 | 0.007 | 0.012 |
| c | 0.090 | 0.200 | 0.004 | 0.008 |
| D | 4.900 | 5.100 | 0.193 | 0.201 |
| E | 6.200 | 6.600 | 0.244 | 0.260 |
| E1 | 4.300 | 4.500 | 0.169 | 0.177 |
| e | 0.650 BSC | | 0.026 BSC | |
| L | 0.450 | 0.750 | 0.018 | 0.030 |
| θ | 0 | 8° | 0 | 8° |

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

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