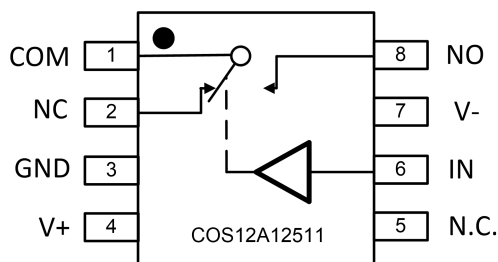


High Voltage, Single and Dual Supply SPDT Analog Switch

Features

- Single and Dual Supply Operation
 - $\pm 3\text{V}$ to $\pm 8\text{V}$ (COS12A12511)
 - $+3\text{V}$ to $+16\text{V}$ (COS12A12511S)
- Low ON-State Resistance:
 - 2.8Ω with 16V Supply
 - 3.6Ω with 12V Supply
 - 11Ω with 5V Supply
- Low Leakage Currents
 - 1 nA Off-Leakage at 25°C
 - 1 nA On-Leakage at 25°C
- Fast Switching Speed
 - $t_{\text{ON}}=70\text{ns}$, $t_{\text{OFF}}=50\text{ns}$ (12V Supply)
- Break-Before-Make Operation
- Rail-to-Rail Operation
- TTL/CMOS Logic Compatible
- Packaging: MSOP8 and SOP8



Pin Diagram

Rev1.3

Copyright©2018 Cosine Nanoelectronics Inc. All rights reserved.
The information provided here is believed to be accurate and reliable. Cosine Nanoelectronics assumes no liability for inaccuracies and omissions. Specifications described and contained here are subjected to change without notice on the purpose of improving the design and performance. All of this information described herein should not be implied or granted for any third party.

General Description

The COS12A12511 is a high voltage single channel, bidirectional, single-pole double-throw (SPDT) CMOS analog switch. The device can pass signals with swings of 0 to 16 V or -8V to $+8\text{V}$. This switch conducts equally well in both directions when it is on.

The COS12A12511 can operate continuously with a single supply between 3V and 16V (COS12A12511S) or dual supply between $\pm 3\text{V}$ to $\pm 8\text{V}$ (COS12A12511). It can handle rail-to-rail analog signals. The OFF/ON leakage current maximum is only 1nA at 25°C or 10nA at 85°C . The digital inputs have 0.8V to 2.4V logic thresholds, ensuring TTL/CMOS logic compatibility when using a $+5\text{V}$ supply.

Applications

- Power routing applications
- Audio and video signal switching
- Precision automatic test equipment
- Relay replacement
- Automotive applications
- Sample and hold systems
- Telecom signal switching
- Battery power systems

1 Pin Configuration and Functions

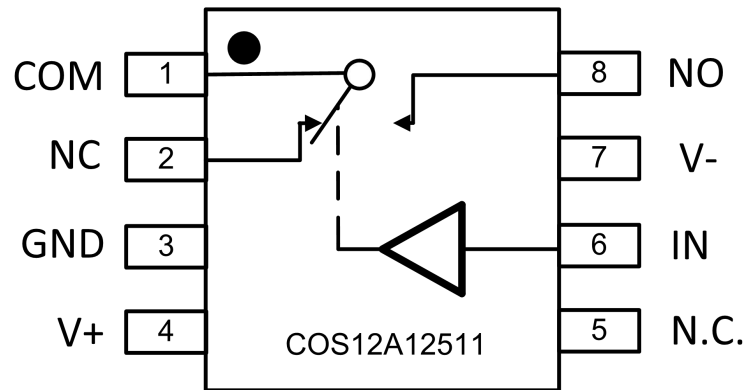


Figure 1 Pin Diagram

Truth Table

| IN Logic | NC to COM, COM to NC | NO to COM, COM to NO |
|----------|----------------------|----------------------|
| L | On | Off |
| H | Off | On |

Pin Description

| PIN | | | FUNCTION |
|-----|------|-----|---|
| NO. | NAME | I/O | |
| 1 | COM | I/O | Common terminal. Can be an input or output |
| 2 | NC | I/O | Normally closed terminal. Can be an input or output |
| 3 | GND | - | Ground. 0V reference |
| 4 | V+ | I | Most positive power supply |
| 5 | N.C. | - | No connect. Not internally connected |
| 6 | IN | I | Logic control input |
| 7 | V- | I | Most negative power supply. This pin is only used in dual-supply applications and should be tied to ground in single-supply applications. |
| 8 | NO | I/O | Normally open terminal. Can be an input or output |

2 Package and Ordering Information

| Supply Mode | Order Number | Package | Package Option | Marking Information |
|---------------|--------------|---------|---------------------|---------------------|
| Dual Supply | COS12A12511 | MSOP8 | Tape and Reel, 3000 | COS12A12511 |
| Single Supply | COS12A12511S | MSOP8 | Tape and Reel, 3000 | COS12A12511S |

3 Product Specification

3.1 Absolute Maximum Ratings ⁽¹⁾

| Parameter | Min | Max | Unit |
|--|---------|----------|------|
| V+ to V- | 0 | 17 | V |
| V+ to GND | -0.3 | 17 | V |
| V- to GND | -8.5 | 0.3 | V |
| Analog voltage range (V_{NC} , V_{NO} , V_{COM}) | V- -0.5 | V+ + 0.5 | V |
| Continuous current into any terminal | | ± 20 | mA |
| Peak current into any terminal | | ± 50 | mA |
| Continuous power dissipation | | 560 | mW |
| Operating junction temperature | -40 | +125 | °C |
| Storage temperature | -55 | +150 | °C |

(1) Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

3.2 Thermal Data

| Parameter | Rating | Unit |
|----------------------------|---------------------------|------|
| Package Thermal Resistance | 206 (MSOP8) 155 (SOP8) | °C/W |

3.3 Recommended Operating Conditions

| Parameter | Rating | Unit |
|-----------|----------|------|
| V+ | 3 ~ 16 | V |
| V- | -8 ~ 0 | V |
| $V_{I/O}$ | V- to V+ | V |
| V_{IN} | 0 ~ V+ | V |

3.4 Electrical Characteristics for $\pm 8V$ Dual Supply

(Typical values are tested at $T_A=25^\circ C$, $V_+=8V\pm 10\%$, $V_-=-8V\pm 10\%$, unless otherwise noted)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|--|----------------------------|---|-------|------|-------|----------|
| Analog Switch | | | | | | |
| Analog signal range | V_{COM}, V_{NO}, V_{NC} | | V_- | | V_+ | V |
| On-state resistance | R_{ON} | V_{NC} or $V_{NO} = -4.5V$ to $+4.5V$, $I_{COM} = -10mA$ | | 3.2 | 6 | Ω |
| On-state resistance flatness | R_{ON} | V_{NC} or $V_{NO} = -3.3V$ to $+3.3V$, $I_{COM} = -10mA$ | | 1.0 | 3 | Ω |
| OFF leakage current (NO, NC) | $I_{NO(OFF)}, I_{NC(OFF)}$ | V_{NC} or $V_{NO} = -4.5V$ to $+4.5V$, $V_{COM} = -4.5V$ to $+4.5V$ | | | 50 | nA |
| ON leakage current (NO, NC) | $I_{NO(ON)}, I_{NC(ON)}$ | V_{NC} or $V_{NO} = -4.5V$ to $+4.5V$, $V_{COM} = open$ | | | 50 | nA |
| Digital Control Input (IN) | | | | | | |
| Input logic high | V_{IH} | | 5 | | V_+ | V |
| Input logic low | V_{IL} | | 0 | | 0.8 | V |
| Input leakage current | I_{IH}, I_{IL} | $V_{IN} = 0$ or V_+ | | | 0.05 | μA |
| Switch Dynamic Characteristics | | | | | | |
| Turn-on time | t_{ON} | V_{NO} or $V_{NC}=3.3V$, $R_L=300\Omega$, $C_L = 35pF$, Figure 1 | | 70 | 130 | ns |
| Turn-off time | t_{OFF} | V_{NO} or $V_{NC}=3.3V$, $R_L=300\Omega$, $C_L = 35pF$, Figure 1 | | 50 | 75 | ns |
| Break-Before-Make Delay (COS4561 only) | t_{BBM} | V_{NO} or $V_{NC}=3.3V$, $R_L=300\Omega$, $C_L = 35pF$, Figure 2 | 5 | 40 | | ns |
| Charge Injection | Q | $V_{NO}=V_{NC}=0V$, $R_{GEN}=0$, $C_L = 1.0nF$, Figure 3 | | -110 | | pC |
| NO or NC off capacitance | C_{OFF} | $V_{NC}=V_{NO} = 0$, $f = 1MHz$, | | 15 | | pF |
| COM off-capacitance (COS4514/COS4515 only) | C_{COM} | $V_{COM} = 0$, $f = 1MHz$, | | 65 | | pF |
| COM On-Capacitance | C_{COM} | $V_{COM} = V_{NO}, V_{NC} = 0$, $f = 1MHz$, | | 65 | | pF |
| Off-Isolation | V_{ISO} | $R_L = 50\Omega$, $C_L = 15pF$, $V_{NC} = 1V_{RMS}$, $f = 100kHz$ | | -85 | | dB |
| Bandwidth | BW | $R_L = 50\Omega$, $C_L = 15pF$, $V_{NC} = 1V_{RMS}$, $f = 100kHz$ | | 100 | | MHz |
| Power Supply | | | | | | |
| V_+ supply current | I_+ | $V_{IN} = 0$ or V_+ | | | 0.1 | μA |

3.5 Electrical Characteristics for 12V Single Supply

(Typical values are tested at $T_A=25\text{ }^{\circ}\text{C}$, $V_+=11.4\text{V}$ to 12.6V , $V_{INH}=5\text{V}$, $V_{INL}=0.8$, unless otherwise noted)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|--|----------------------------|---|------|------|-------|---------------|
| Analog Switch | | | | | | |
| Analog signal range | V_{COM}, V_{NO}, V_{NC} | | 0 | | V_+ | V |
| On-state resistance | R_{ON} | V_{NC} or $V_{NO} = 0\text{V}$ to 10.8V , $I_{COM} = -10\text{mA}$ | | 4.0 | 7.4 | Ω |
| On-state resistance flatness | R_{ON} | V_{NC} or $V_{NO} = 3.3\text{V}$ to $+7\text{V}$, $I_{COM} = -10\text{mA}$ | | 1.5 | 3 | Ω |
| OFF leakage current (NO, NC) | $I_{NO(OFF)}, I_{NC(OFF)}$ | V_{NC} or $V_{NO} = 0\text{V}$ to 10.8V , $V_{COM} = 0\text{V}$ to 10.8V | | | 50 | nA |
| ON leakage current (NO, NC) | $I_{NO(ON)}, I_{NC(ON)}$ | V_{NC} or $V_{NO} = 0\text{V}$ to 10.8V , $V_{COM} = \text{open}$ | | | 50 | nA |
| Digital Control Input (IN) | | | | | | |
| Input logic high | V_{IH} | | 5 | | V_+ | V |
| Input logic low | V_{IL} | | 0 | | 0.8 | V |
| Input leakage current | I_{IH}, I_{IL} | $V_{IN} = 0$ or V_+ | | | 0.01 | μA |
| Switch Dynamic Characteristics | | | | | | |
| Turn-on time | t_{ON} | V_{NO} or $V_{NC}=10\text{V}$, $R_L=300\Omega$, $C_L = 35\text{pF}$, Figure 1 | | 70 | 130 | ns |
| Turn-off time | t_{OFF} | V_{NO} or $V_{NC}=10\text{V}$, $R_L=300\Omega$, $C_L = 35\text{pF}$, Figure 1 | | 50 | 75 | ns |
| Break-Before-Make Delay (COS4561 only) | t_{BBM} | V_{NO} or $V_{NC}=10\text{V}$, $R_L=300\Omega$, $C_L = 35\text{pF}$, Figure 2 | 5 | 40 | | ns |
| Charge Injection | Q | $V_{GEN}=5\text{V}$, $R_{GEN}=0$, $C_L = 1.0\text{nF}$, Figure 3 | | -110 | | pC |
| NO or NC off capacitance | C_{OFF} | $V_{NC}=V_{NO} = 0$, $f = 1\text{MHz}$, | | 15 | | pF |
| COM off-capacitance (COS4514/COS4515 only) | C_{COM} | $V_{COM} = 0$, $f = 1\text{MHz}$, | | 65 | | pF |
| COM On-Capacitance | C_{COM} | $V_{COM} = V_{NO}, V_{NC} = 0$, $f = 1\text{MHz}$, | | 65 | | pF |
| Off-Isolation | V_{ISO} | $R_L = 50\Omega$, $C_L = 15\text{pF}$, $V_{NC} = 1V_{RMS}$, $f = 100\text{kHz}$ | | -85 | | dB |
| Bandwidth | BW | $R_L = 50\Omega$, $C_L = 15\text{pF}$, $V_{NC} = 1V_{RMS}$, $f = 100\text{kHz}$ | | 90 | | MHz |
| Power Supply | | | | | | |
| V_+ supply current | I_+ | $V_{IN} = 0$ or V_+ | | | 0.1 | μA |

3.6 Electrical Characteristics for 5V Single Supply

(Typical values are tested at $T_A=25\text{ }^{\circ}\text{C}$, $V_+=4.5\text{V}$ to 5.5V , $V_{INH}=2.4\text{V}$, $V_{INL}=0.8$, unless otherwise noted)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|--|----------------------------|---|------|------|-------|---------------|
| Analog Switch | | | | | | |
| Analog signal range | V_{COM}, V_{NO}, V_{NC} | | 0 | | V_+ | V |
| On-state resistance | R_{ON} | V_{NC} or $V_{NO} = 0\text{V}$ to 4.5V , $I_{COM} = -10\text{mA}$ | | 11 | 32 | Ω |
| OFF leakage current (NO, NC) | $I_{NO(OFF)}, I_{NC(OFF)}$ | $V_{COM}=0\text{V}$ to 4.5V , V_{NO} or $V_{NC}=0\text{V}$ to 4.5V | | | 50 | nA |
| ON leakage current (NO, NC) | $I_{NO(ON)}, I_{NC(ON)}$ | $V_{COM}=\text{open}$, V_{NO} or $V_{NC}=0\text{V}$ to 4.5V | | | 50 | nA |
| Digital Control Input (IN) | | | | | | |
| Input logic high | V_{IH} | | 2.4 | | V_+ | V |
| Input logic low | V_{IL} | | 0 | | 0.8 | V |
| Input leakage current | I_{IH}, I_{IL} | $V_{IN} = 0$ or V_+ | | | 0.01 | μA |
| Switch Dynamic Characteristics | | | | | | |
| Turn-on time | t_{ON} | V_{NO} or $V_{NC}=3\text{V}$, $R_L=300\Omega$, $C_L = 35\text{pF}$, Figure 1 | | 75 | 130 | ns |
| Turn-off time | t_{OFF} | V_{NO} or $V_{NC}=3\text{V}$, $R_L=300\Omega$, $C_L = 35\text{pF}$, Figure 1 | | 45 | 70 | ns |
| Break-Before-Make Delay (COS4561 only) | t_{BBM} | V_{NO} or $V_{NC}=3\text{V}$, $R_L=300\Omega$, $C_L = 35\text{pF}$, Figure 2 | 5 | 40 | | ns |
| Charge Injection | Q | $V_{GEN}=2\text{V}$, $R_{GEN}=0$, $C_L = 1.0\text{nF}$, Figure 3 | | -40 | | pC |
| NO or NC Off Capacitance | C_{OFF} | $V_{NC}=V_{NO} = 0$, $f = 1\text{MHz}$, | | 15 | | pF |
| COM Off-Capacitance (COS4514/COS4515 only) | C_{COM} | $V_{COM} = 0$, $f = 1\text{MHz}$, | | 65 | | pF |
| COM On-Capacitance | C_{COM} | $V_{COM} = V_{NO}, V_{NC} = 0$, $f = 1\text{MHz}$, | | 65 | | pF |
| Off-Isolation | V_{ISO} | $R_L = 50\Omega$, $C_L = 15\text{pF}$, $V_{NC} = 1V_{RMS}$, $f = 100\text{kHz}$ | | -85 | | dB |
| Bandwidth | BW | $R_L = 50\Omega$, $C_L = 15\text{pF}$, $V_{NC} = 1V_{RMS}$, $f = 100\text{kHz}$ | | 60 | | MHz |
| Power Supply | | | | | | |
| V_+ supply current | I_+ | $V_{IN} = 0$ or V_+ | | | 0.1 | μA |

4 Test Circuits and Timing Diagrams

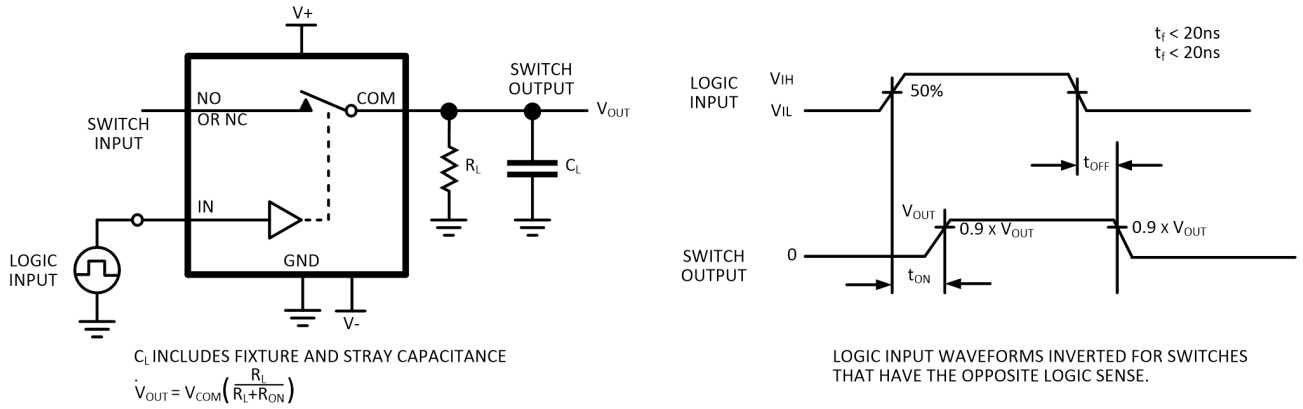


Figure 1. Switching Time

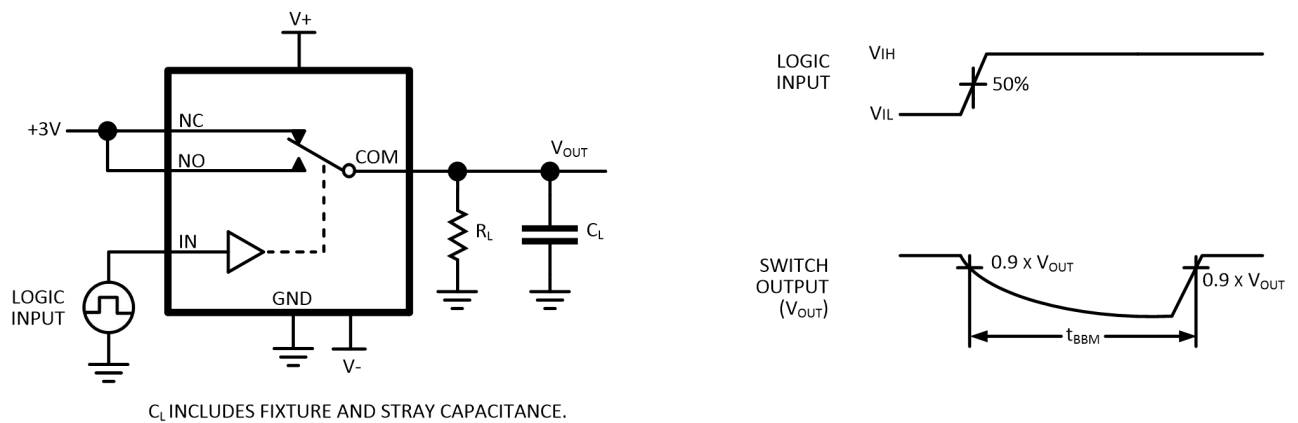


Figure 2. Break-Before-Make Interval

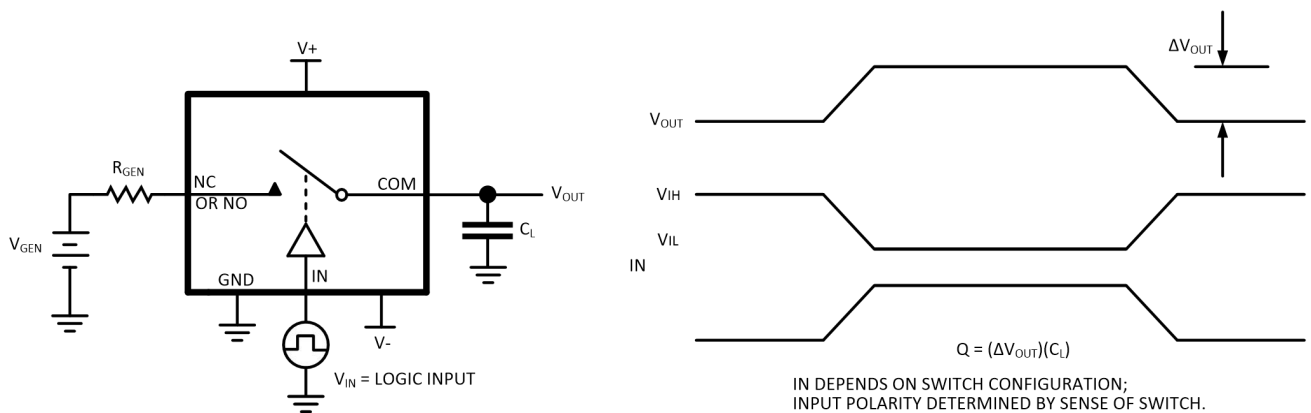
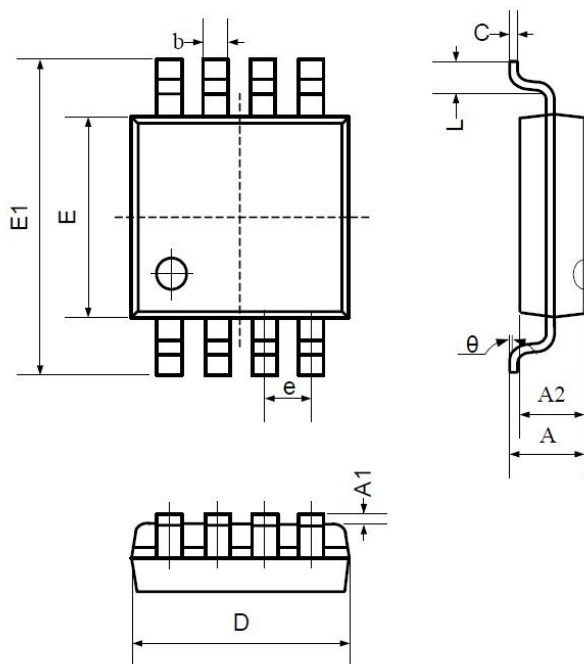


Figure 3. Charge Injection

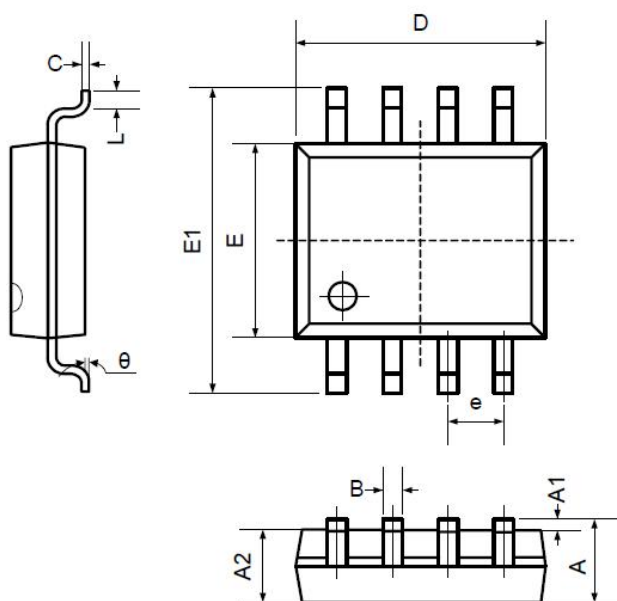
5 Package Information

5.1 MSOP8 (Package Outline Dimensions)



| 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 TYP | |
| E | 2.900 | 3.100 | 0.114 | 0.122 |
| E1 | 4.700 | 5.100 | 0.185 | 0.201 |
| L | 0.410 | 0.650 | 0.016 | 0.026 |
| θ | 0° | 6° | 0° | 6° |

5.2 SOP8 (Package Outline Dimensions)



| 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 | 0.190 | 0.250 | 0.007 | 0.010 |
| D | 4.780 | 5.000 | 0.188 | 0.197 |
| E | 3.800 | 4.000 | 0.150 | 0.157 |
| E1 | 5.800 | 6.300 | 0.228 | 0.248 |
| e | 1.270TYP | | 0.050TYP | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |