

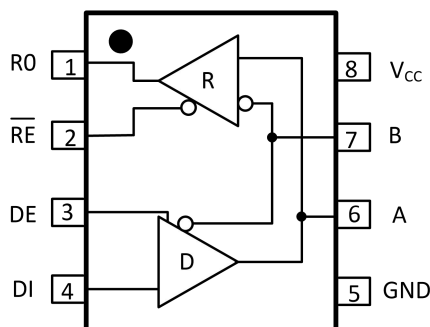
3.3V, 12Mbps, RS-485/RS-422 Transceiver

Features

- Operate from a Single +3.3V Supply
- Half-duplex Transceiver
- Data Rate Up to 12Mbps
- Allow Up to 256 Transceivers on the Bus
- Low Quiescent Current: $I_{cc}=0.5\text{mA}$, Typ
- Low Shutdown Current: $I_{cc}=3\mu\text{A}$, Typ
- -7V to 12V Bus Common Mode Input Range
- Fail-safe Functions
- Over Temperature Protection
- ESD Protection for RS-485 I/O Pins
 - ±15kV—Human Body Model
 - ±8kV—IEC 1000-4-2, Contact Discharge
 - ±15kV—IEC 1000-4-2, Air-Gap Discharge
- Small Packaging: SOP8/MSOP8/DFN8

Applications

- Power Inverters
- Motor Control
- Industrial Automation
- Battery-Powered Applications



Pin Diagram

General Description

The COSMAX3485E is an +3.3V powered differential bus/line transceiver designed for multipoint data transmission standard RS485 applications with extended common mode range: -7V to 12V. It also meets the requirements of RS422.

The driver and receiver feature three-state outputs, with the driver outputs maintaining high impedance over the entire common mode range. Excessive power dissipation caused by bus contention or faults is prevented by a thermal shutdown circuit which forces the driver outputs into a high impedance state.

The receiver has a fail-safe feature which guarantees a high output state when the inputs are left open or shorted. Power-on reset circuits keep the outputs in a high impedance state until the supply voltage has stabilized.

The COSMAX3485 offers significant power saving without sacrificing ruggedness against overload or ESD damage. It is available in 8-lead plastic SOP8, MSOP8, and DFN3x3-8, and is specified for operation from -40°C to +125°C ambient temperature.

Rev1.1

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1. Pin Configuration and Functions

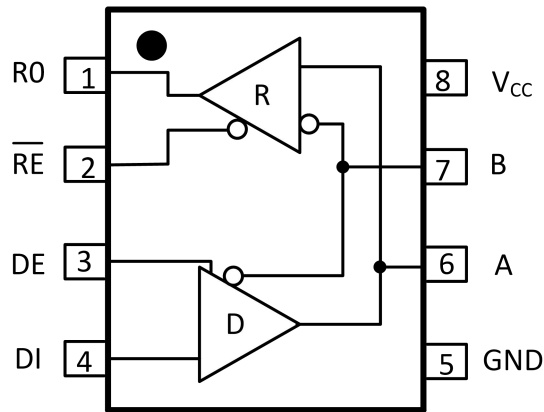


Figure 1 Pin Diagram

Pin Description

Pin	Name	Description
1	RO	Receiver output. If the receiver output is enabled (RE low), then if $A > B$ by 200mV, RO will be high. If $A < B$ by 200mV, then RO will be low.
2	$\overline{RE}$	Receiver output enable. A low enables the receiver output, RO. A high input forces the receiver output into a high impedance state.
3	DE	Driver output enable. A high on DE enables the driver outputs, A and B, and the chip will function as a line driver. A low input will force the driver outputs into a high impedance state and the chip will function as a line receiver.
4	DI	Driver input. If the driver outputs are enabled (DE high), then a low on DI forces the outputs A low and B high. A high on DI with the driver outputs enabled will force A high and B low.
5	GND	Ground
6	A	Non-inverting receiver input and non-inverting driver output
7	B	Inverting receiver input and inverting driver output
8	Vcc	Power Supply

Driver Truth Table

Inputs		Outputs		Function
DE	DI	A	B	
H	H	H	L	Actively drive bus High
H	L	L	H	Actively drive bus Low
L	X	Z	Z	Driver disabled
OPEN	X	Z	Z	Driver disabled by default
H	OPEN	H	L	Actively drive bus high by default

Note: X = Don't care; Z = High impedance

Receiver Truth Table

Inputs		Outputs	Function
$\overline{\text{RE}}$	A-B	R0	
L	$\geq +0.2\text{V}$	H	Receiver valid bus High
L	$\leq -0.2\text{V}$	L	Receiver valid bus Low
L	$\geq -0.2\text{V}$ $\leq +0.2\text{V}$	?	Indeterminate bus state
H	X	Z	Receiver disabled
OPEN	X	Z	Receiver disabled by default
L	Open-circuit bus	H	Fail-safe high output
L	Short-circuit bus	H	Fail-safe high output
L	Idle bus	H	Fail-safe high output

Note: DE = L or OPEN

2. Product Specification

2.1 Absolute Maximum Ratings ⁽¹⁾

Parameter	Min	Max	Unit
DC supply voltage Vcc		6	V
Control input voltages	-0.5	Vcc + 0.5	V
Driver input voltages	-0.5	Vcc + 0.5	V
Driver output voltage at A or B		±14	V
Receiver input voltage		±14	V
Receiver output voltage	-0.5	Vcc + 0.5	V
Operating junction temperature	-40	+135	°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.

2.2 Thermal Data

Parameter	Rating	Unit
Package Thermal Resistance	150 (SOP8) 206 (MSOP8) 57 (DFN8,3x3)	°C/W

2.3 Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Unit
DC supply voltage	3.0	3.3	3.6	V
Input voltage at any bus terminal	-7		12	V
Differential input voltage	-12		12	V
Differential load resistance	54	60		Ω
Data rate	0		12	Mbps
Operating ambient temperature	-40		+85	°C
Operating junction temperature	-40		+125	°C

2.4 Electrical Characteristics

(Typical values are tested at $T_A=25\text{ }^{\circ}\text{C}$, $V_{CC}=3.3\text{V}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Driver Electrical Characteristics						
Differential driver output (no load)	V_{OD1}	$I_O = 0$	2.0		V_{CC}	V
Differential driver output (with load)	V_{OD2}	$R_L = 50\ \Omega$ (RS422) $R_L = 27\ \Omega$ (RS485), (See Figure 2)	2.0 1.5	2.5 2.0		V
Change in magnitude of driver differential output voltage for complementary output states	ΔV_{OD}	$R_L = 27\ \Omega$ or $50\ \Omega$	-0.2	0	0.2	V
Driver common-mode output voltage	V_{OC}	$R_L = 27\ \Omega$ or $50\ \Omega$		$V_{CC}/2$	3	V
Change in magnitude of driver common-mode output voltage for complementary output states	ΔV_{OC}	$R_L = 27\ \Omega$ or $50\ \Omega$			0.2	V
Driver short-circuit current	I_{OS}	$V_O = -7\text{V to } 12\text{V}$	-250		250	mA
Logic Input high voltage	V_{IH}	RE, DE, DI	2.0			V
Logic Input low voltage	V_{IL}	RE, DE, DI			0.8	V
Logic Input current	I_{IN1}	RE, DE, DI			± 5	μA
Receiver Electrical Characteristics						
Receiver differential threshold voltage	V_{TH}	$V_{CM} = -7\text{V to } 12\text{V}$	-200	-125	-50	mV
Receiver input hysteresis	ΔV_{TH}	$V_{CM} = 0\text{V}$		30		mV
Receiver input resistance	R_{IN}	$V_{CM} = -7\text{V to } 12\text{V}$	96			k Ω
Input current (A, B)	I_{IN}	$V_{CC} = 0\text{V or } 3.3\text{V}$, $V_{DE} = 0\text{V}$ $V_{IN} = 12\text{V}$ $V_{IN} = -7\text{V}$			+200 -200	μA
Receiver output high voltage	V_{OH}	$I_O = -4\text{mA}$	V_{CC} -0.4	V_{CC} -0.2		V

Receiver output low voltage	V_{OL}	$I_O = -8mA, V_{ID} = 200mV$		0.2	0.4	V
Receiver short-circuit current	I_{OSR}	$V_O = 0V \text{ to } V_{CC}$	7		30	mA
Tristate output leakage current	I_{OZR}	$V_O = 0.4 \text{ to } 2.4V$	-1		+1	μA
Supply Current and Power Dissipation Characteristics						
Supply current	I_{CC}	No Load, $V_{RE} = 0V$ or V_{CC} Outputs Enabled, $V_{DE}=V_{CC}$ Outputs Disabled, $V_{DE}=0$		0.52 0.33	0.8 0.5	mA mA
Average power dissipation	P_{AVG}	Data rate=10Mbps, 50% duty cycle, $R_L = 27\Omega$			90	mW
Shutdown current	I_{SHDN}			3	10	μA
Thermal shut-down junction temperature	T_{SD}		150	170		$^{\circ}C$
Thermal shutdown hysteresis	T_{HYS}			30		$^{\circ}C$
Driver Switching Characteristics						
Propagation delay input to output	t_{PLH}	$R_{DIFF} = 54\Omega,$ $C_{L1} = C_{L2} = 100pF$ (See Figure 4 and Figure 6)	3	5	10	ns
Propagation delay input to output	t_{PHL}		3	5	10	ns
Output to output skew	t_{SK}			2	5	ns
Rise or fall time	t_r, t_f		3	6	10	ns
Enable to output high	t_{PZH}	$C_L = 100pF, S2 = \text{Closed}$ (See Figure 5 and Figure 7)		5	10	ns
Enable to output low	t_{PZL}	$C_L = 100pF, S1 = \text{Closed}$ (See Figure 5 and Figure 7)		5	10	ns
Disable time from low	t_{PLZ}	$C_L = 15pF, S1 = \text{Closed}$ (See Figure 5 and Figure 7)		8	15	ns
Disable time from high	t_{PHZ}	$C_L = 15pF, S2 = \text{Closed}$ (See Figure 5 and Figure 7)		8	15	ns
Receiver Switching Characteristics						
Propagation delay input to output	t_{PLH}	$R_{DIFF} = 54\Omega,$ $C_{L1} = C_{L2} = 100pF$ (See Figure 4 and Figure 8)	30	105	150	ns
Propagation delay input to output	t_{PHL}		30	105	150	ns
Output to output skew	t_{SK}				10	ns
Enable to output high	t_{PZH}	$C_{RL} = 15pF, S1 = \text{Closed}$ (See Figure 2 and Figure 9)		50	70	ns

Enable to output low	t_{PZL}	$C_{RL} = 15\text{pF}$, S2 = Closed (See Figure 2 and Figure 9)		50	70	ns
Disable time from low	t_{PLZ}	$C_{RL} = 15\text{pF}$, S1 = Closed (See Figure 2 and Figure 9)		50	70	ns
Disable time from high	t_{PHZ}	$C_{RL} = 15\text{pF}$, S2 = Closed (See Figure 2 and Figure 9)		50	70	ns
Maximum data rate	f_{MAX}		12	15		Mbps

3. Test Circuits

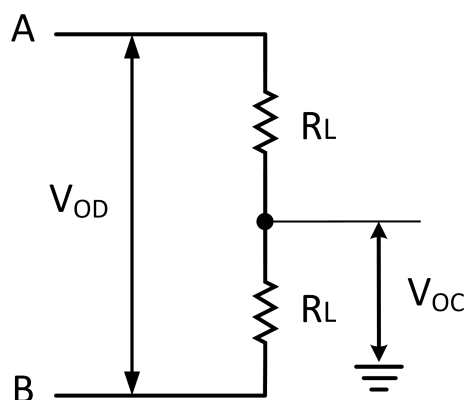


Figure 2. Driver DC test load

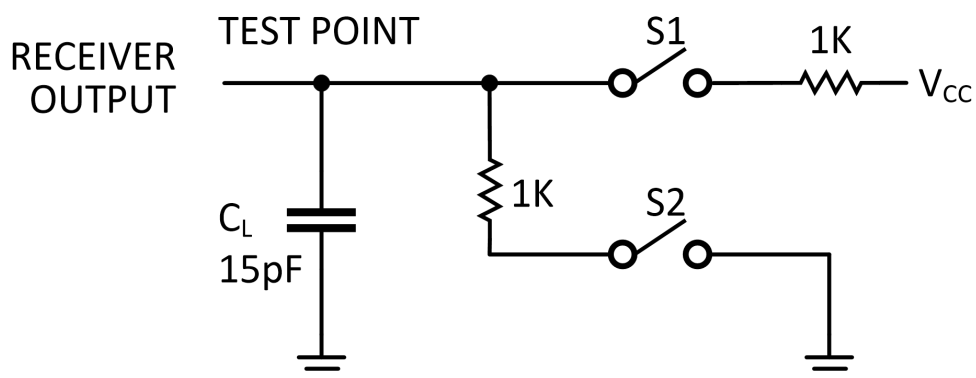


Figure 3. Receiver timing test load

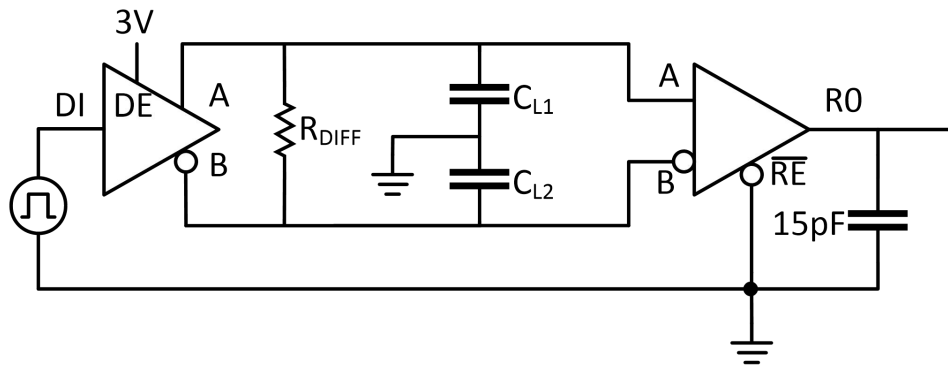


Figure 4. Driver/Receiver timing test circuit

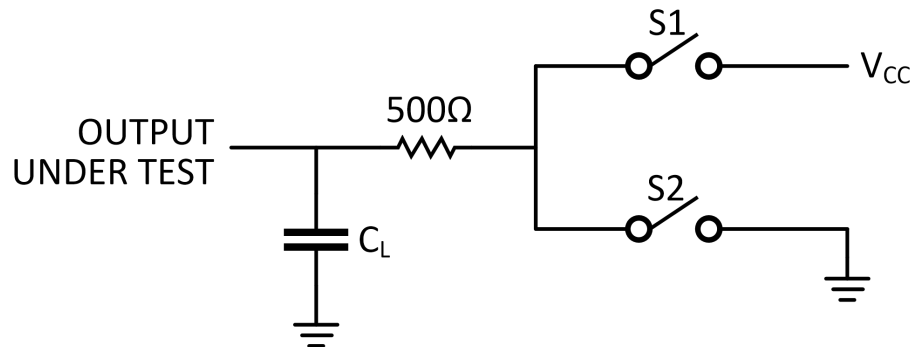


Figure 5. Driver timing test load

4. Switching Time Waveforms

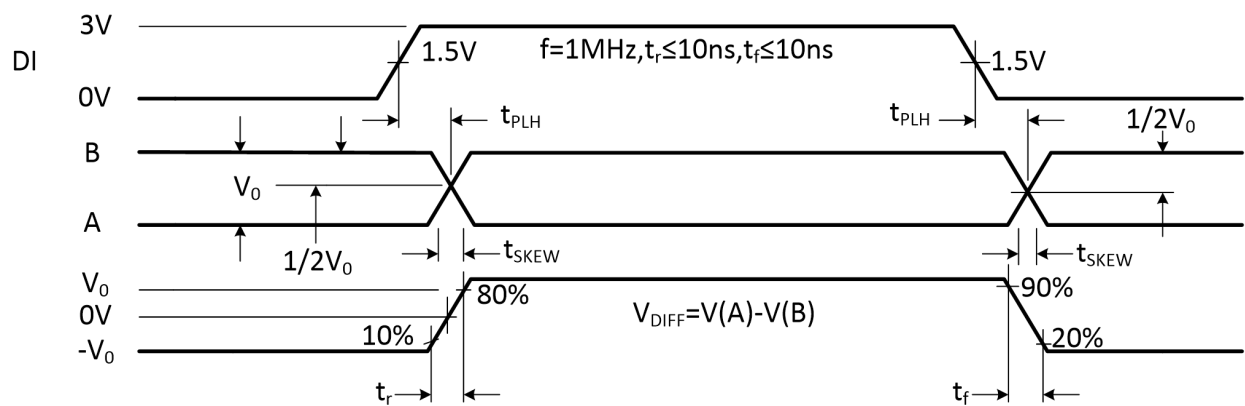


Figure 6. Driver Propagation Delays

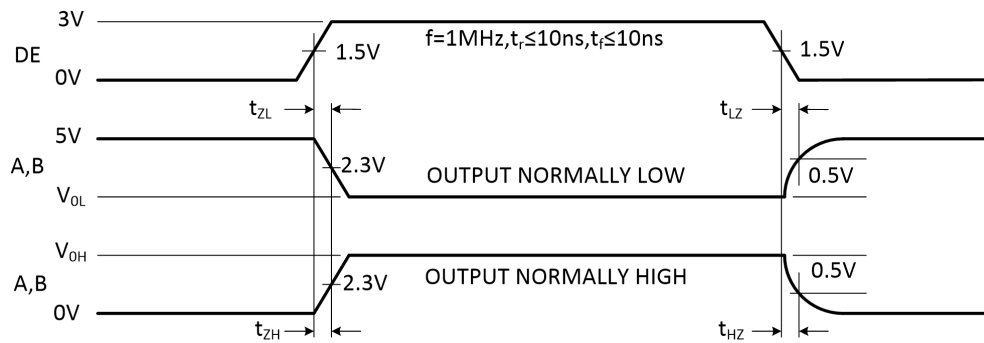


Figure 7. Driver Enable and Disable Times

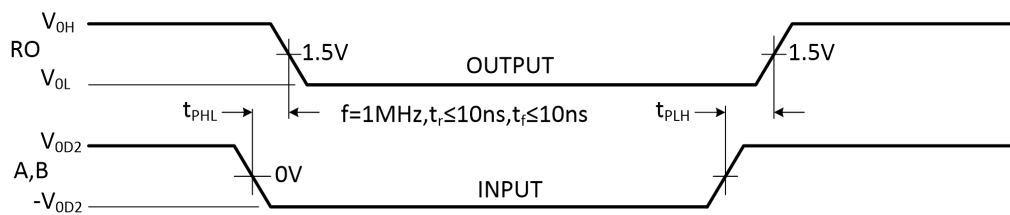


Figure 8. Receiver Propagation Delays

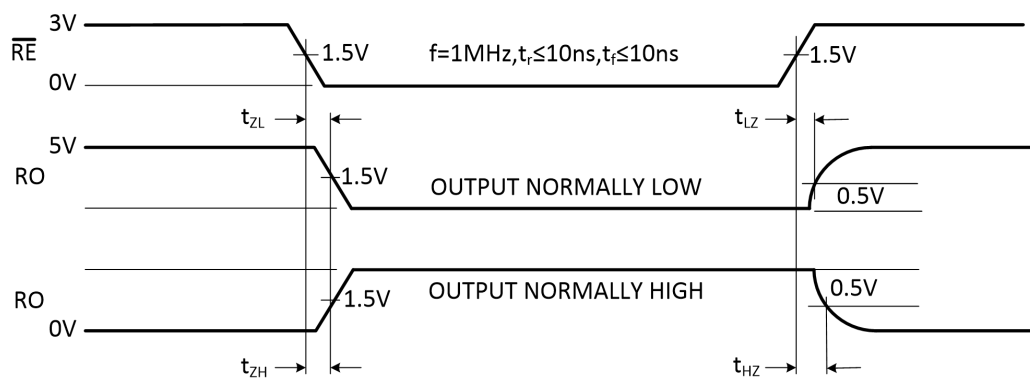


Figure 9. Receiver Enable and Disable Times

5. Typical Application

The COSP485 device is a half-duplex RS-485 transceiver suitable for data transmission at rates up to 10 Mbps over controlled-impedance transmission media (such as twisted-pair cabling). Up to 256 units of the COSP485 device can share a common RS-485 bus due to the low bus-input currents of the device. A typical application showing a multi-point transmission network is illustrated in Figure 10. Only one driver can transmit at a particular time, but multiple receivers may be enabled simultaneously. As with any transmission line, it is important that reflections are minimized. This can be achieved by terminating the extreme ends of the line using resistors equal to the characteristic impedance of the line. Stub lengths off the main line must also be kept as short as possible. A properly terminated transmission line appears purely resistive to the driver.

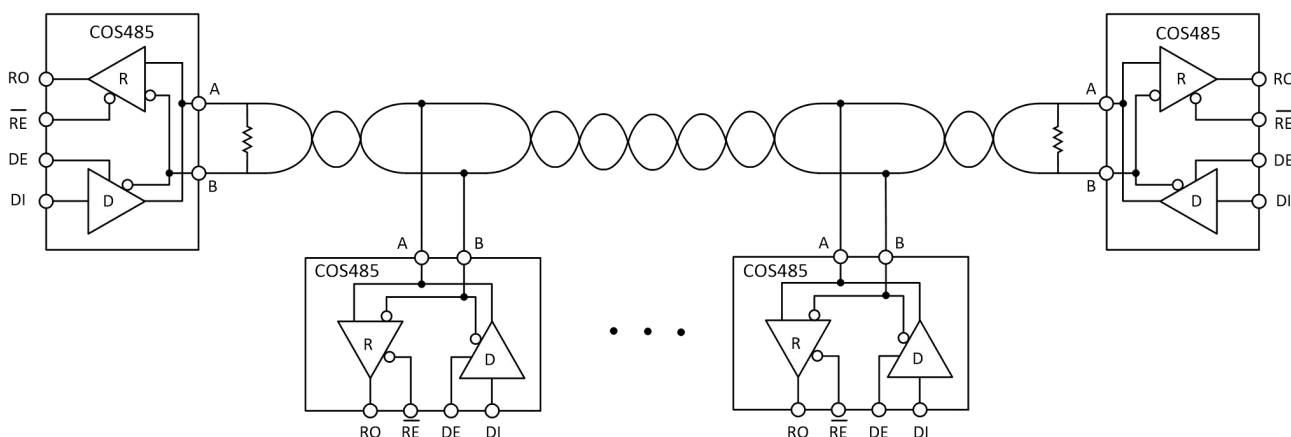


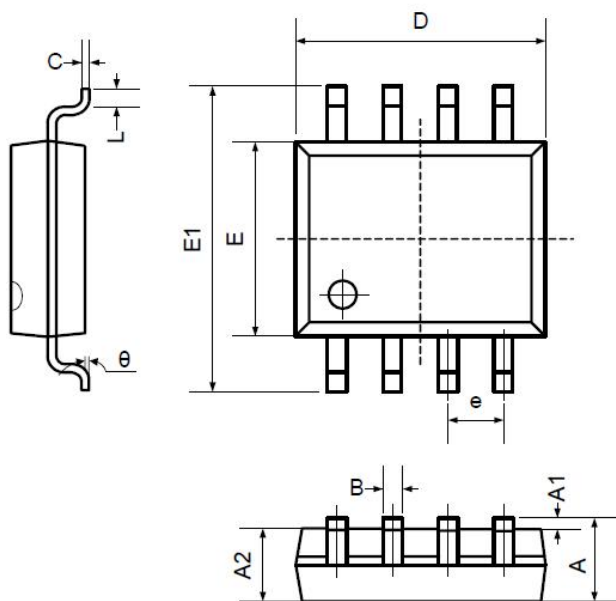
Figure 10. Multi-point Transmission Networks

6. Ordering Information

Model	Order Number	Package	Package Option	Marking Information
COSMAX3485E	COSMAX3485ESA	SOP-8	Tape and Reel, 4000	COS3485E
	COSMAX3485ERM	MSOP-8	Tape and Reel, 3000	COS3485E
	COSMAX3485ERF	DFN3x3-8	Tape and Reel, 4000	COS3485E

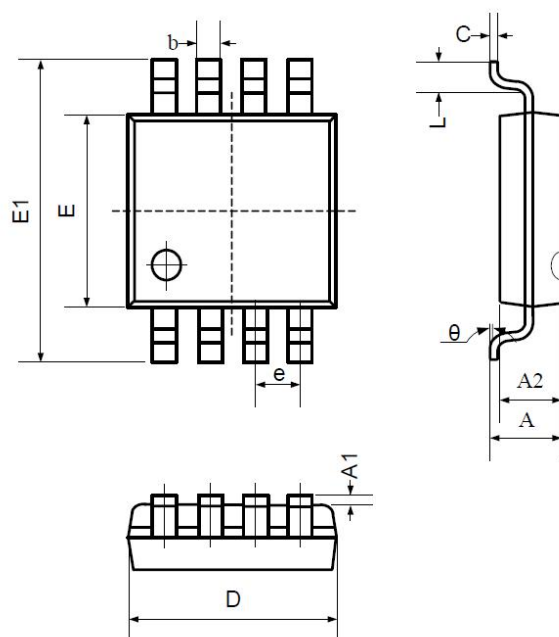
7. Package Information

7.1 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°

7.2 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°