Features

- Wide Single-supply Voltage Range or Dual Supplies: +3 V to +36 V or ±1.5 V to ±18 V
- Low Supply Current: 1mA
- Low Input Bias Current: 25 nA Typ
- Low Offset Voltage: ±7 mV Max
- Input Common-mode Voltage Range Includes Ground
- Internal Differential Input Voltage Range Equal to The Supply Voltage
- −40°C to 125°C Operation Range

Applications

- High-Speed Sampling Circuits
- Peak and Zero-crossing Detectors
- Threshold Detectors/Discriminators
- Sensing at Ground or Supply Line

Description

The devices in this series consist of dual comparators on a single monolithic substrate. The common-mode input voltage range includes ground even when operated from a single supply, and the low power supply current drain makes these comparators suitable for battery operation. These types were designed to directly interface with TTL and CMOS, Current drain is independent of the supply voltage. The outputs can be connected to other open-collector outputs to achieve wired-AND relationships.

The LM2903D is a dual-channel version available in 8-pin SOP and MSOP packages. All devices are specified for the temperature range of −40°C to +125°C.

Typical Application Circuit

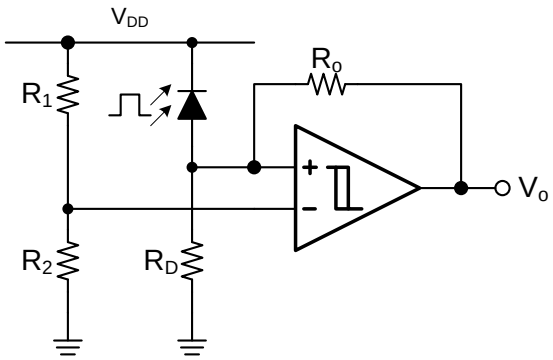
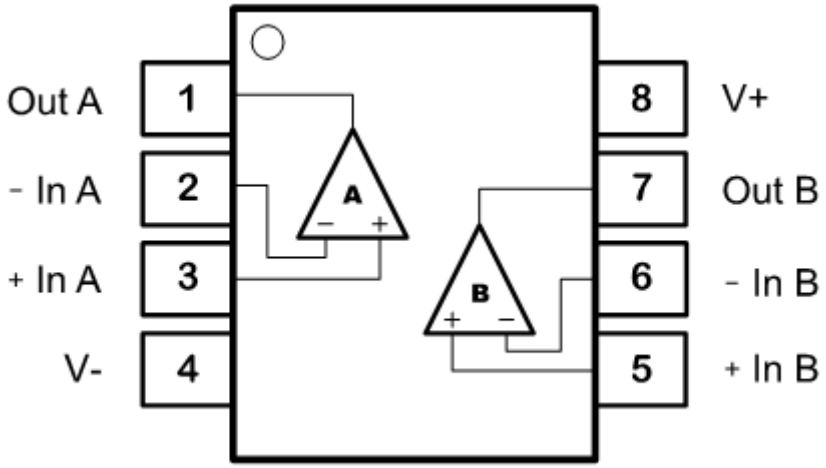


Table of Contents

Revision History

Date	Revision	Notes
2022-06-15	Rev.A.0	Initial Version
2022-06-27	Rev.A.1	Remove min spec of A_{VD} in Electrical Characteristics.

Pin Configuration and Functions



Pin Functions

Pin		I/O	Description
No.	Name		
1	OUT A	O	Output of channel A.
2	−IN A	I	Inverting Input of channel A.
3	+IN A	I	Non-Inverting Input of channel A.
4	V−	I	Negative Power Supply.
5	+IN B	I	Non-Inverting Input of channel B.
6	−IN B	I	Inverting Input of channel B.
7	OUT B	O	Output of channel B.
8	V+	I	Positive Power Supply.

Specifications

Absolute Maximum Ratings(1)

Parameter		Min	Max	Unit
	Supply Voltage: $V^+ - V^-$		40	V
	Input Voltage	$V^- - 0.3$	40	V
	Input Current: +IN, –IN(2)	−10	+10	mA
	Output Current: OUT(2)	−10	+10	mA
	Output Sink Current(3)		50	mA
T_J	Maximum Junction Temperature		150	°C
T_A	Operating Temperature Range	−40	125	°C
T_{STG}	Storage Temperature Range	−65	150	°C
T_L	Lead Temperature (Soldering 10 sec)		260	°C

(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.
(2) The inputs and outputs are protected by ESD protection diodes to negative power supply. If the input or output extends more than 300mV beyond the negative power supply, the current should be limited to less than 10mA.
(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 comparators 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. 125℃

ESD, Electrostatic Discharge Protection

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

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

Parameter		Min	Typ	Max	Unit
V_S	Supply Voltage, $V^+ – V^-$	3		36	V
	Input voltage range	0		$V^+ – 2$	V
T_A	Operating Temperature Range	–40		125	°C

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOP8	158	43	°C/W
MSOP8	210	45	°C/W

Electrical Characteristics

All test condition is at T_A = 25°C, V_S = 5 V, V_{CM} = 0 V, unless otherwise noted.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_S	Supply Voltage			3		36	V
V_{OS}	Input Offset Voltage(1)	V_S = 5 V to 36 V, V_{CM} = 0 V to V^+ – 2 V		−7	1	7	mV
		V_S = 5 V to 36 V, V_{CM} = 0 V to V^+ – 2 V, T_A = –40 to 125°C		-10		10	mV
I_B	Input Bias Current				25	250	nA
		T_A = –40 to 125°C				400	nA
I_{OS}	Input Offset Current				10	50	nA
		T_A = –40 to 125°C				150	nA
V_{CM}	Common-mode Input Voltage Range			0		V^+ −1.5	V
		T_A = −40°C to +125°C		0		V^+ − 2	V
A_{VD}	Large-signal Differential-voltage	V_{CC} = 15 V, R_L ≥ 15 kΩ to V_{CC}			200		V/mV
I_{OH}	High-level Output Current	V_{OH} = 5 V, V_{ID} = 1 V			25	50	nA
		V_{OH} = 36 V, V_{ID} = 1 V, T_A = −40°C to +125°C				200	nA
V_{OL}	Low-Level Output Voltage	I_{OL} = 4 mA, V_{ID} = −1 V			150	350	mV
		I_{OL} = 4 mA, V_{ID} = −1 V, T_A = −40°C to +125°C				400	mV
I_{OL}	Low-level Output Current	V_{OL} = 1.5 V, V_{ID} = −1 V		25	40		mA
		V_{OL} = 1.5 V, V_{ID} = −1 V, T_A = −40°C to +125°C		10			
I_Q	Quiescent Current, 2ch Comparator	V_{CC} = 5 V			0.7	1	mA
		V_{CC} = 36 V, T_A = −40°C to +125°C			0.8	1.2	mA
t_{RT}	Response time	R_L connected to 5 V through 5.1 kΩ, C_L = 15 pF(2)(3)	100-mV input step with 5-mV overdrive		1.6		μs
			TTL-level input step, Low to high		0.6	1	
			TTL-level input step, High to low		0.3	0.5	

(1) The input offset voltage is the average of the input-referred trip points.
(2) C_L includes probe and jig capacitance.
(3) The response time specified is the interval between the input step function and the instant of output:
Output low to high transition: when the output crosses 10% of high-level output voltage.
Output high to low transition: when the output crosses 90% of high-level output voltage.

Typical Performance Characteristics

V_S = +5 V, V_{CM} = 0 V, R_L = Open, unless otherwise specified.

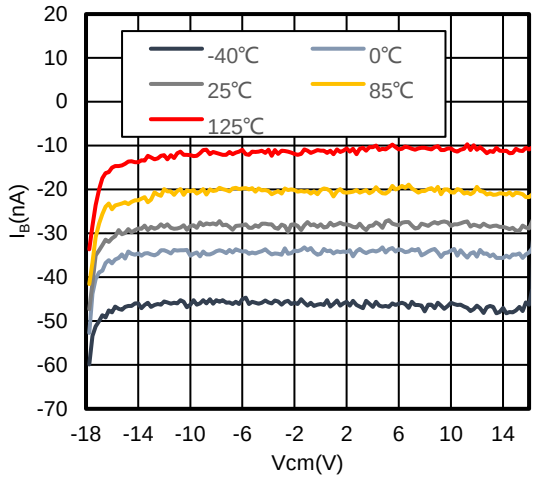


Figure 1. I_B vs. V_{CM}, (V+) = 18 V, (V−) = −18 V

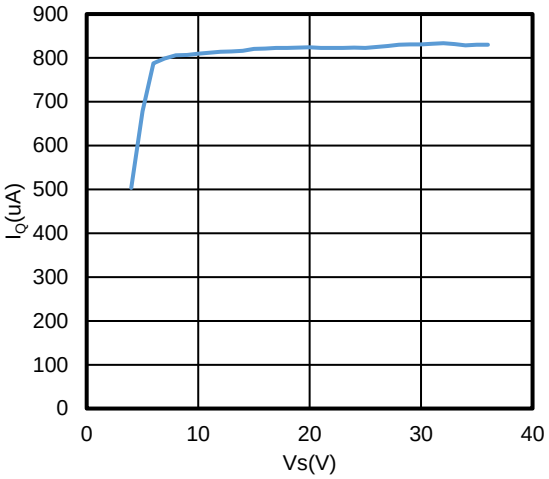


Figure 2. Supply Current vs. Supply Voltage

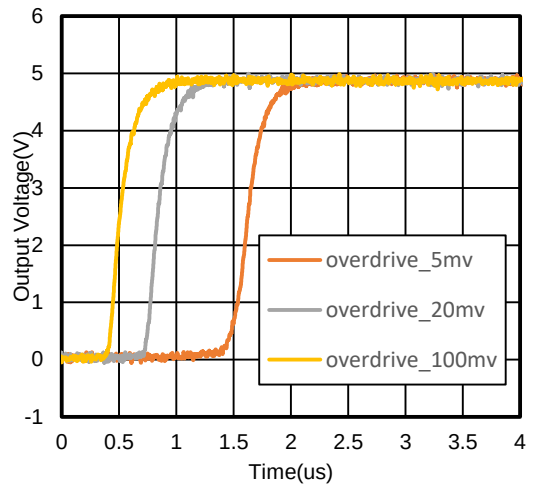


Figure 3. Response Time for Various Input Overdrives, Positive Transition

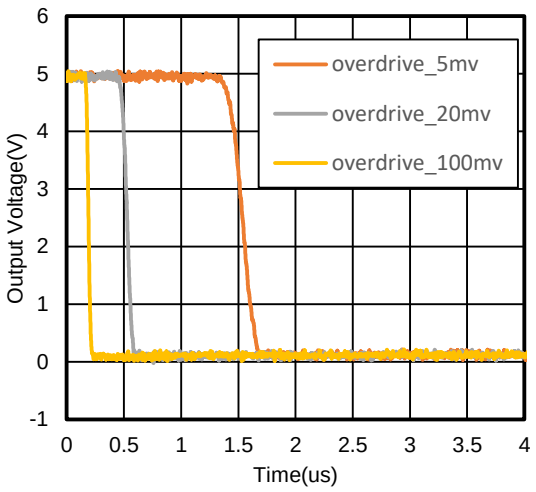


Figure 4. Response Time For Various Input Overdrives, Negative Transition

Detailed Description

Overview

The LM2903D comparator has the ability to operate from 3 V to 36 V on the supply pin, the device also has very low Iq and fast response.

The open-drain output allows the output's logic high voltage (VOH) can be configured, or be used in AND functionality.

Functional Block Diagram

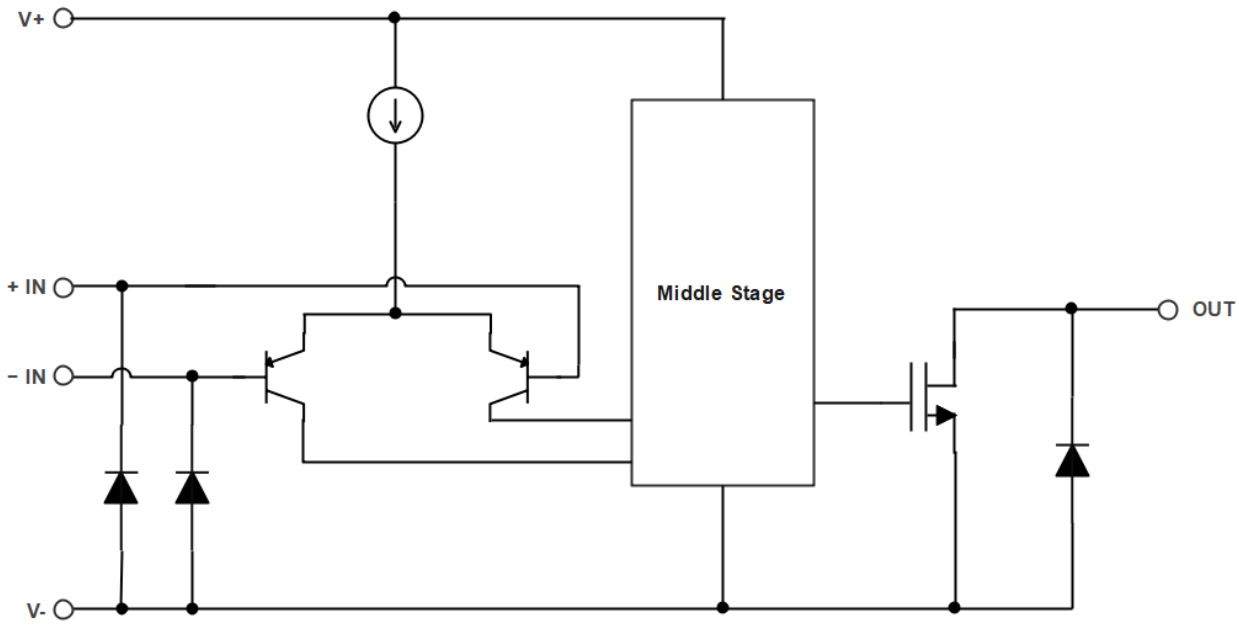


Figure 5. Functional Block Diagram

Application and Implementation

NOTE

Information in the following applications sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

Application Information

Power Supply Layout and Bypass

The LM2903D family's power supply pin should have a local bypass capacitor (i.e., 0.01 μF to 0.1 μF) within 2mm for good high frequency performance. It can also use a bulk capacitor (i.e., 1 μF or larger) within 100mm to provide large, slow currents. This bulk capacitor can be shared with other analog parts.

Good ground layout improves performance by decreasing the amount of stray capacitance and noise at the comparator's inputs and outputs. To decrease the stray capacitance, minimize PCB lengths and resistor leads, and place external components as close to the comparator's pins as possible.

Operation Outside of the Common Input Voltage Range

The following is a list of input voltage situation and their outcomes:

1. When both IN- and IN+ are both within the common-mode range:
   1) If IN- is higher than IN+ and the offset voltage, the output is low and the output MOSFET is sinking Current.
   2) If IN- is lower than IN+ and the offset voltage, the output is high impedance.
2. When IN- is higher than the common-mode range and IN+ is within the common-mode range, the output is low and the output MOSFET is sinking current.
3. When IN+ is higher than the common-mode range and IN- is within the common-mode range, the output is high impedance.
4. When IN- and IN+ are both higher than the common-mode range, the output is in an uncertain state.

Typical Application

IR Receiver

The LM2903D is an ideal candidate to be used as an infrared receiver shown in Figure 6. The infrared photodiode creates a current relative to the amount of infrared light present. The current creates a voltage across RD. When this voltage level cross the voltage applied by the voltage divider to the inverting input, the output transitions. Optional Ro provides additional hysteresis for noise immunity.

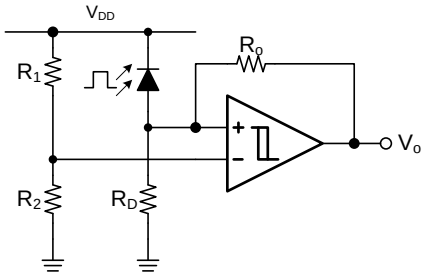
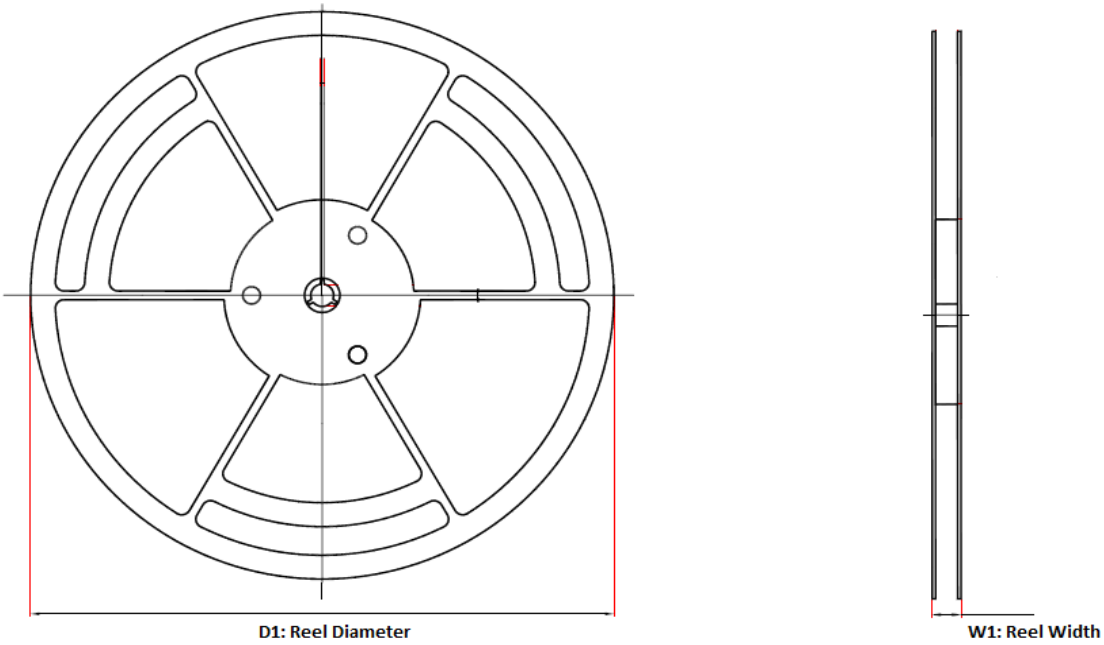


Figure 6. IR Receiver

Tape and Reel Information

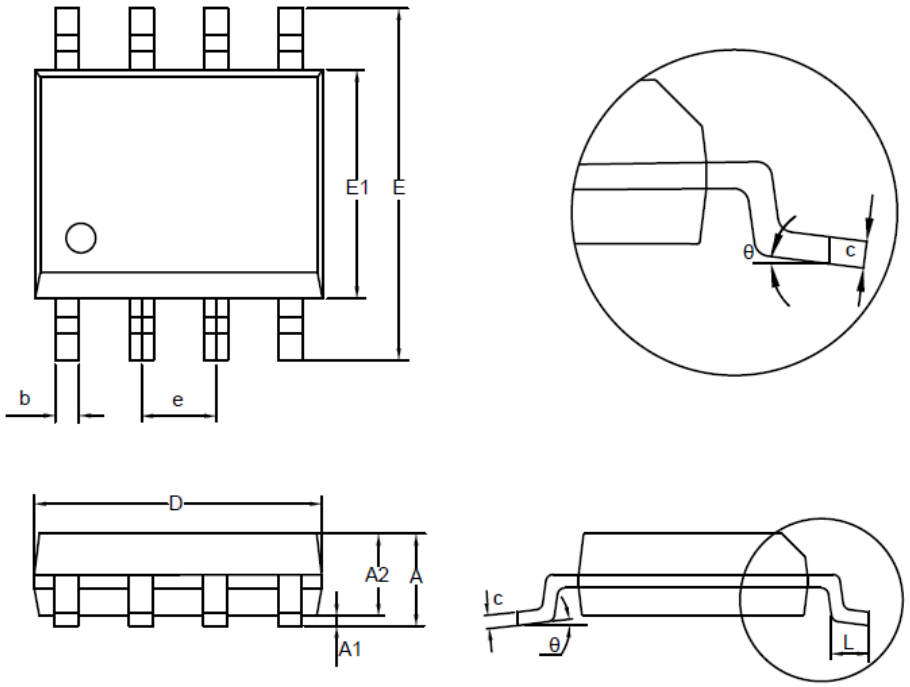


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
LM2903D-SO1R	SOP8	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1
LM2903D-VS1R	MSOP8	330.0	17.6	5.2	3.3	1.5	8.0	12.0	Q1

Package Outline Dimensions

SOP8

Package Outline Dimensions SO1(SOP-8-A)



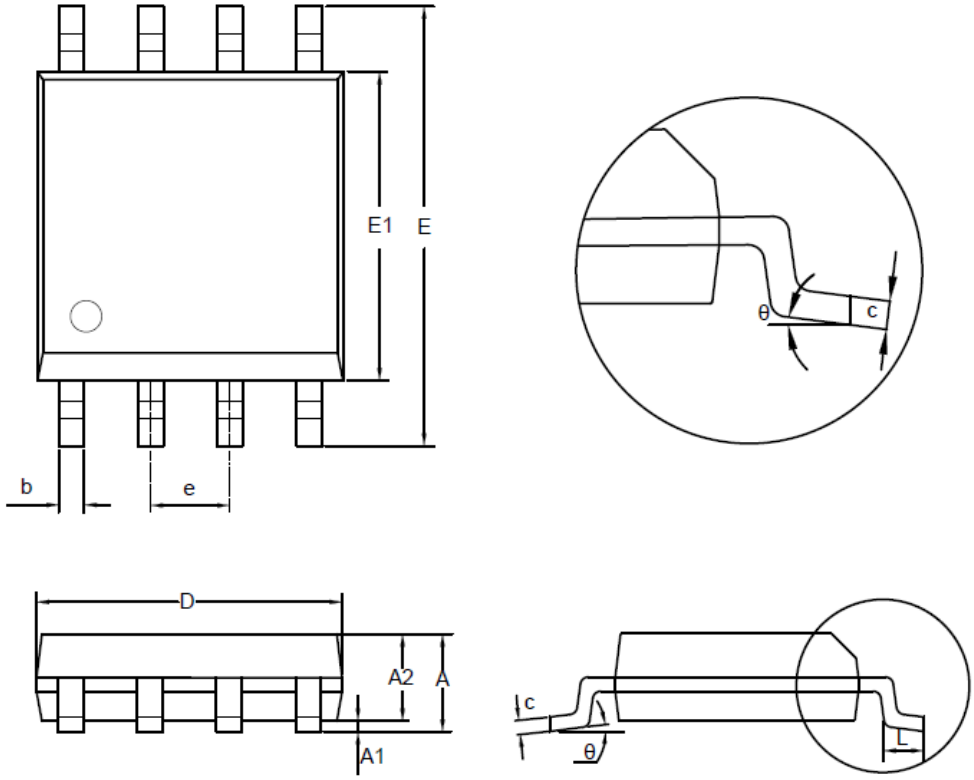
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.550	0.049	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.000	0.016	0.039
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.

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
LM2903D-SO1R	−40 to 125°C	SOP8	LM2903	3	Tape and Reel, 4000	Green
LM2903D-VS1R	−40 to 125°C	MSOP8	LM2903	3	Tape and Reel, 3000	Green

Green: 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.