

Features

- Wide Single-Supply Voltage Range or Dual Supplies: +2.5 V to +36 V or ± 1.25 V to ± 18 V
- Low Input Bias Current: 1 nA maximum
- Low Offset Voltage: ± 7.0 mV maximum
- Input Common-Mode Voltage Range Includes Ground
- Internal Differential Input Voltage Range Equal to the Supply Voltage
- -40°C to 125°C Operation Range
- ESD Rating: HBM 3 kV, CDM 1 kV
- Qualified for Automotive Applications with AEC-Q100 Reliability Test

Applications

- High-Speed Line or Digital Line Receivers
- High-Speed Sampling Circuits
- Peak and Zero-crossing Detectors
- HEV/EV

Description

The devices in this series consist of dual/quad-independent single or dual supply voltage 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. The current drain is independent of the supply voltage. The outputs can be connected to other open-collector outputs to achieve wired-AND relationships.

All devices are specified for the temperature range of -40°C to 125°C .

Typical Application Circuit

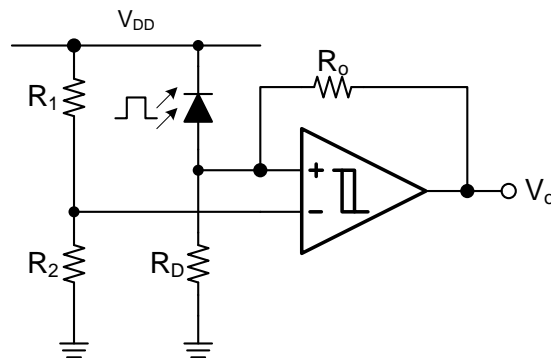


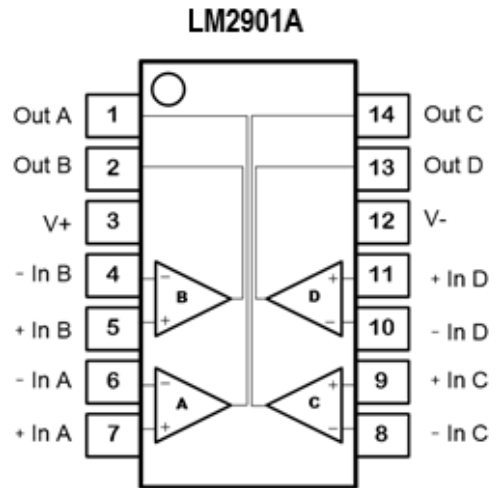
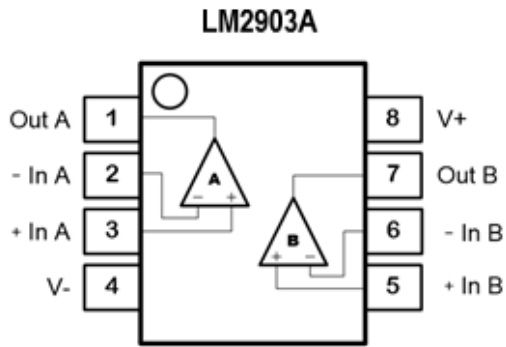
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Revision History

Date	Revision	Notes
2023-02-04	Rev.A.0	Initial version.
2023-05-29	Rev.A.1	The following updates are all about the new datasheet formats or typo, the actual product remains unchanged. Updated symbol of Figure 3 in Typical Performance Characteristics. Updated address of web site. Updated tape and reel information. Updated status of LM2903A-TS1R-S and LM2903A-VS1R-S, the Q100 test is finished.

Pin Configuration



Specifications

Absolute Maximum Ratings ⁽¹⁾

Parameter		Min	Max	Unit
	Supply Voltage: $V^+ - V^-$		40	V
	Input Voltage	$V^- - 0.3$	$V^+ + 0.3$	V
	Input Current: +IN, -IN ⁽²⁾	-10	+10	mA
	Output Current: OUT	-10	+10	mA
	Output Short-Circuit Duration ⁽³⁾		Infinite	
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 are protected by ESD protection diodes to each power supply. If the input extends more than 500 mV beyond the power supply, the input current should be limited to less than 10 mA.

(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, Electrostatic Discharge Protection

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	AEC-Q100-002	3	kV
CDM	Charged Device Model ESD	AEC-Q100-011	1	kV

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOP8	158	43	°C/W
TSSOP8	191	44	°C/W
MSOP8	210	45	°C/W
SOP14	97	47	°C/W
TSSOP14	108	43	°C/W

Electrical Characteristics

All test conditions: $V_{CC} = 5\text{ V}$, $R_{PU} = 10\text{ k}\Omega$, $C_L = 15\text{ pF}$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	Supply Voltage	$T_A = -40^\circ\text{C}$ to 125°C	2.5		36	V
V_{OS}	Input Offset Voltage	$V_{CC} = 5\text{ V}$ to 30 V , $V_{CM} = 0\text{ V}$, $V_O = 1.4\text{ V}$, $T_A = -40^\circ\text{C}$ to 125°C	-7	± 0.6	+7	mV
I_B	Input Bias Current ⁽¹⁾	$V_{DM} = 0\text{ V}$, $V_{CM} = 0\text{ V}$		0.1	1	nA
		$V_{DM} = 0\text{ V}$, $V_{CM} = 0\text{ V}$, $T_A = -40^\circ\text{C}$ to 125°C		1	10	nA
I_{OS}	Input Offset Current ⁽¹⁾	$V_{DM} = 0\text{ V}$, $V_{CM} = 0\text{ V}$		0.1	1	nA
		$V_{DM} = 0\text{ V}$, $V_{CM} = 0\text{ V}$, $T_A = -40^\circ\text{C}$ to 125°C		1	10	nA
I_{Dif}	Input Differential Current	$V_{CC} = 36\text{ V}$, $V_{DM} = 36\text{ V}$		50		nA
C_{IN}	Input Capacitance	$T_A = 25^\circ\text{C}$	Differential		2.5	pF
			Common Mode		5	
V_{CM}	Common-Mode Input Voltage Range		0		$V_{CC} - 1.5$	V
		$T_A = -40^\circ\text{C}$ to 125°C	0		$V_{CC} - 2$	V
A_{VD}	Large-signal Differential-voltage Amplification	$V_{CC} = 15\text{ V}$, $V_O = 1.4\text{ V}$ to 11.4 V , $R_L \geq 15\text{ k}\Omega$ to V_{CC}	50	400		V/mV
I_{OH}	High-Level Output Current	$V_{OH} = 5\text{ V}$, $V_{ID} = 1\text{ V}$		25	500	nA
		$V_{CC} = 36\text{ V}$, $V_{OH} = 36\text{ V}$, $V_{ID} = 1\text{ V}$, $T_A = -40^\circ\text{C}$ to 125°C			5	μA
V_{OL}	Low-Level Output Voltage	$I_{OL} = 4\text{ mA}$, $V_{ID} = -1\text{ V}$		250	400	mV
		$I_{OL} = 4\text{ mA}$, $V_{ID} = -1\text{ V}$, $T_A = -40^\circ\text{C}$ to 125°C			600	mV
I_{OL}	Low-Level Output Current	$V_{OL} = 1.5\text{ V}$, $V_{ID} = -1\text{ V}$	10			mA
I_Q	Quiescent Current per Comparator	$V_{CC} = 5\text{ V}$, $T_A = -40^\circ\text{C}$ to 125°C		100	300	μA
		$V_{CC} = 36\text{ V}$, $T_A = -40^\circ\text{C}$ to 125°C		100	300	μA
t_{RT}	Response Time	R_L connected to 5 V through $5.1\text{ k}\Omega$, $C_L = 15\text{ pF}$	100-mV input step with 5-mV overdrive		2	μs
			TTL-level input step		0.5	

(1) Provided by bench test and design simulation

Typical Performance Characteristics

All test conditions: $V_S = 5\text{ V}$, $V_{CM} = 0\text{ V}$, $R_L = \text{Open}$, unless otherwise noted.

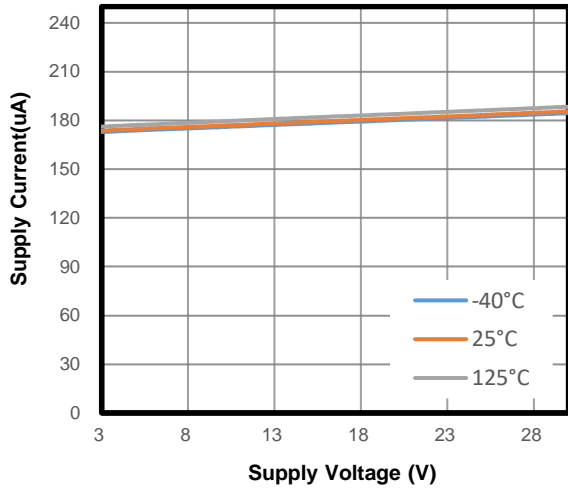


Figure 1. Supply Current vs. Supply Voltage (Dual Channel)

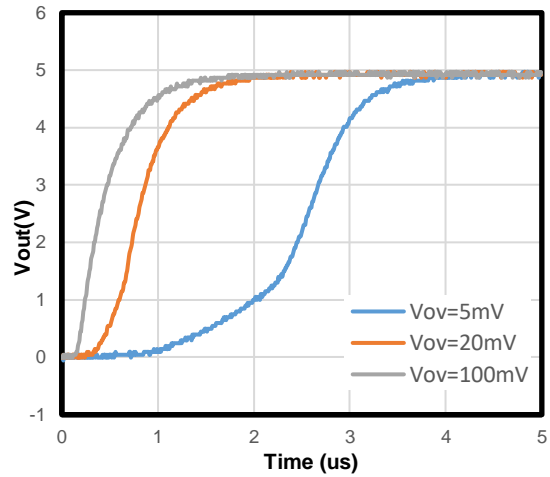


Figure 2. Response Time for Various Input Overdrives: Positive Transition

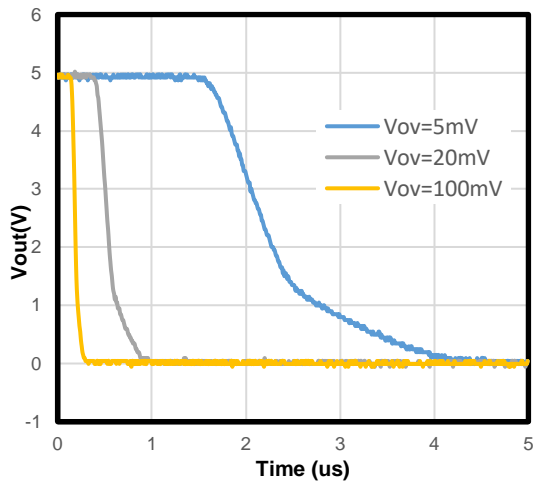


Figure 3. Response Time for Various Input Overdrives: Negative Transition

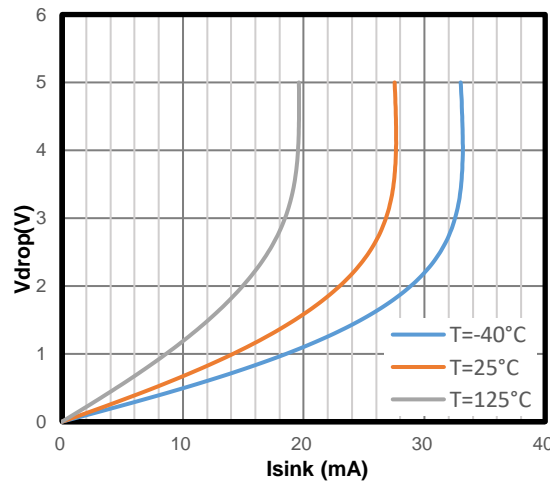


Figure 4 Negative Output Swing vs. Sink Current

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 LM2903A/2901A family's power supply pin is supposed to have a local bypass capacitor (i.e., 0.01 μF to 0.1 μF) within 2 mm for good high-frequency performance. It can also use a bulk capacitor (i.e., 1 μF or larger) within 100 mm 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 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 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 device is an ideal candidate to be used as an infrared receiver shown in Figure 5. The infrared photo diode creates a current relative to the amount of infrared light present. The current creates a voltage across R_D . When this voltage level crosses the voltage applied by the voltage divider to the inverting input, the output transitions. Optional R_o provides additional hysteresis for noise immunity.

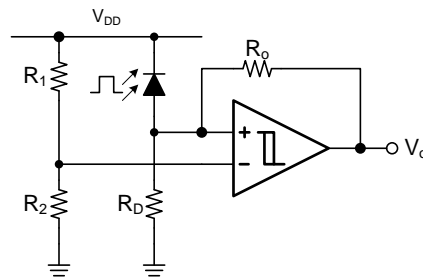
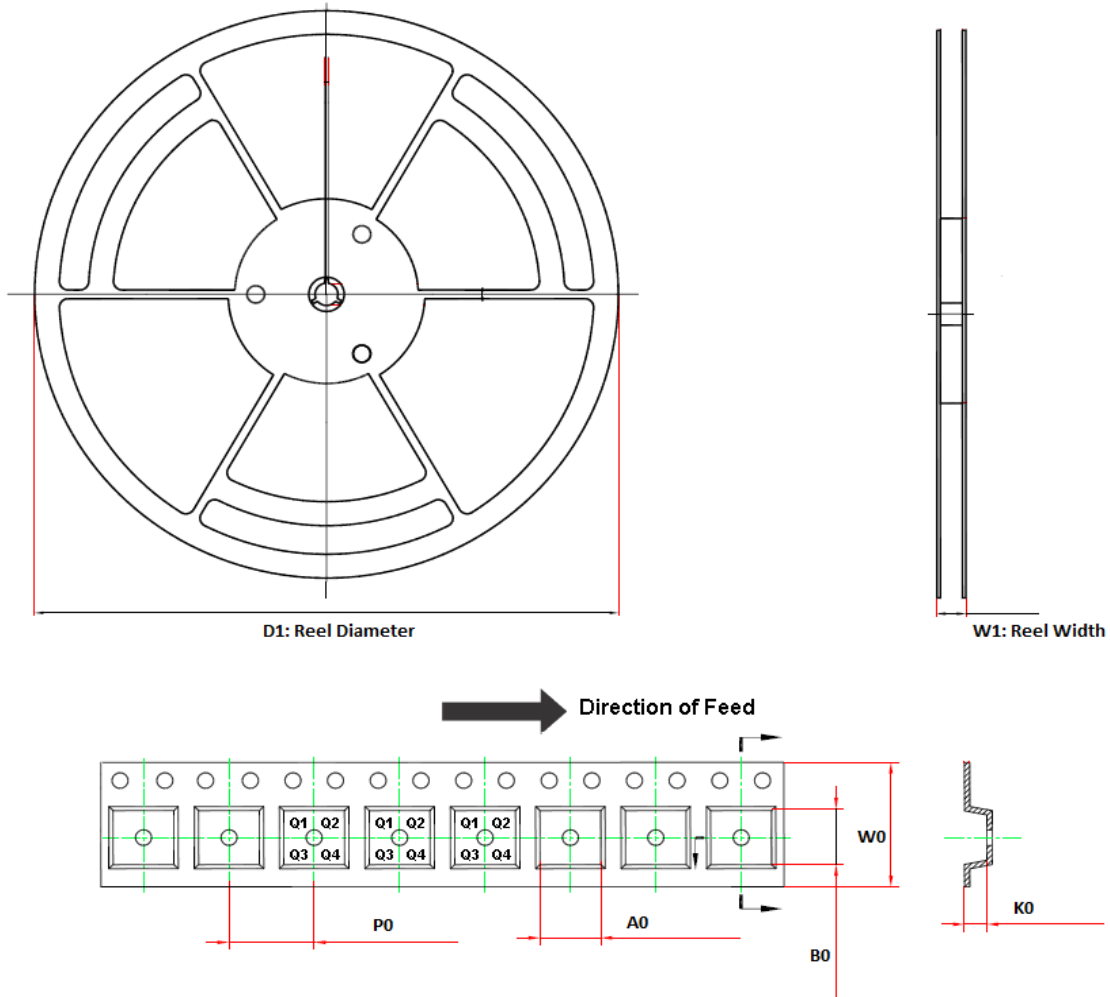


Figure 5. IR Receiver

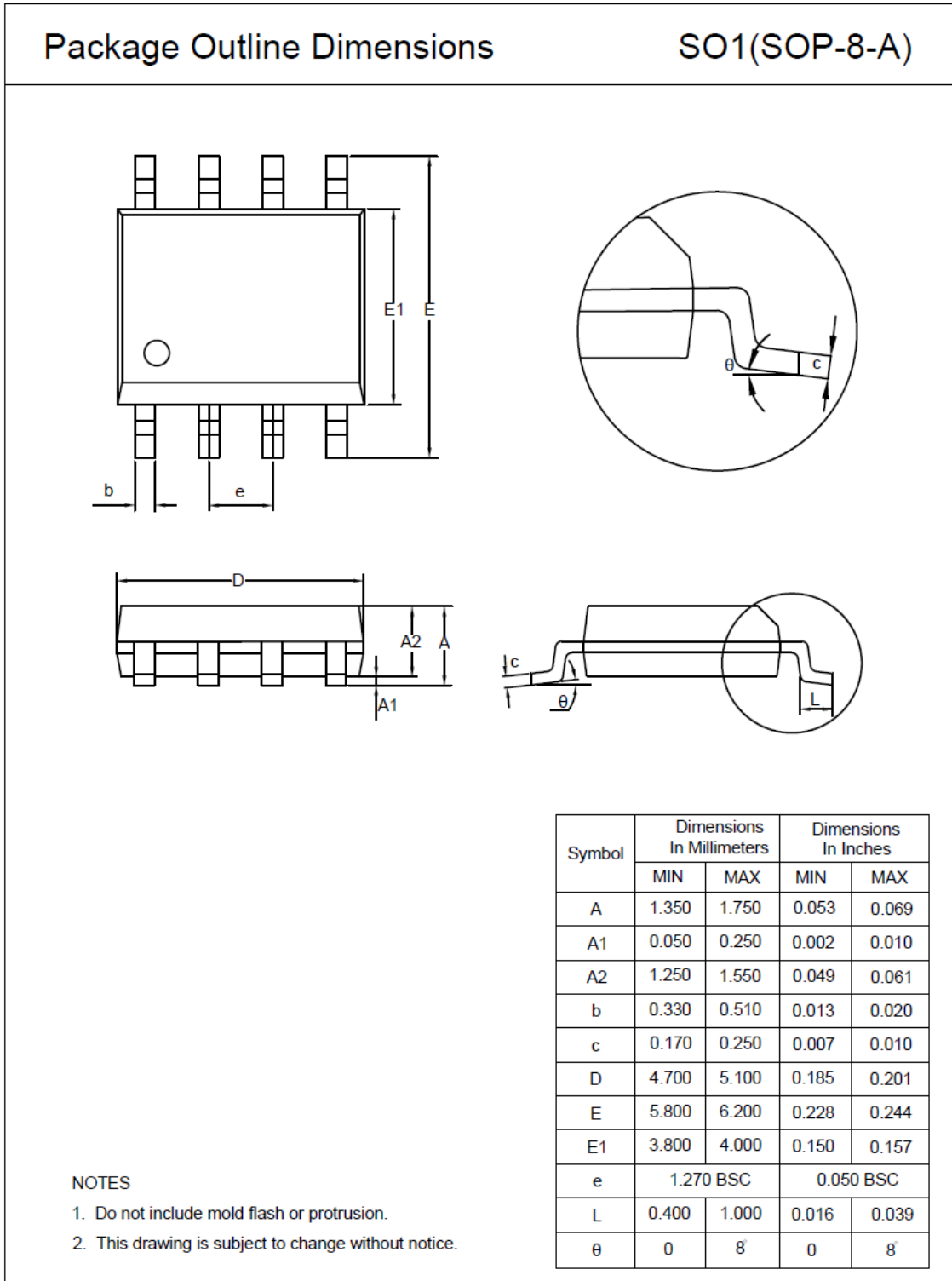
Tape and Reel Information

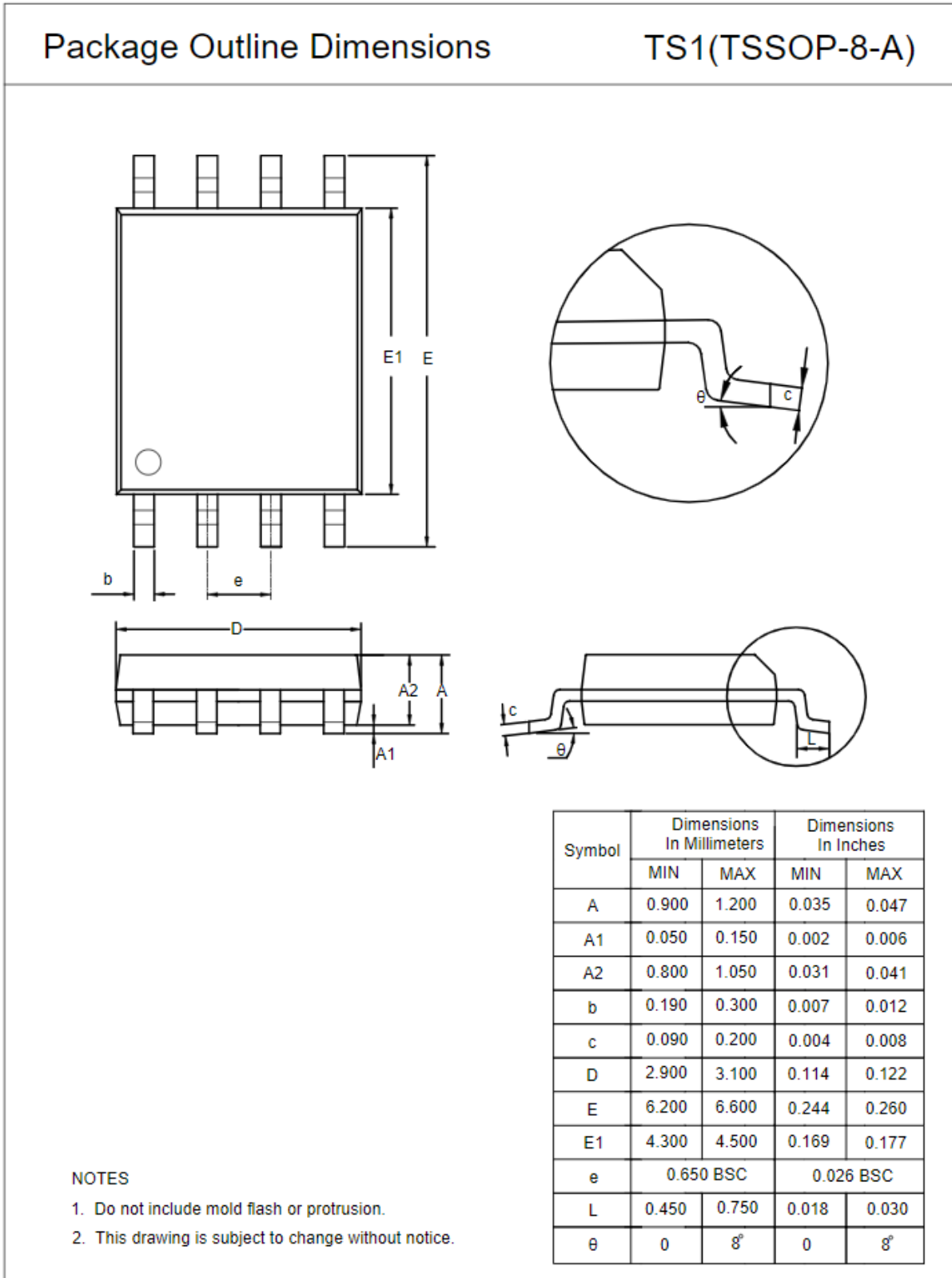


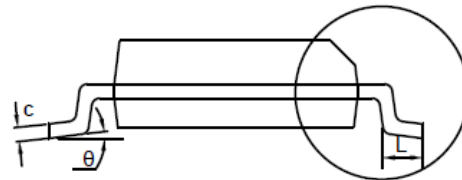
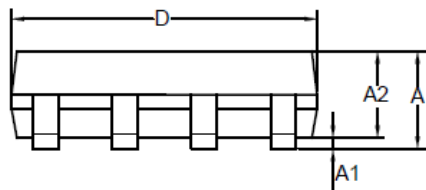
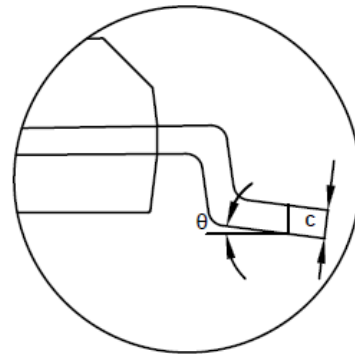
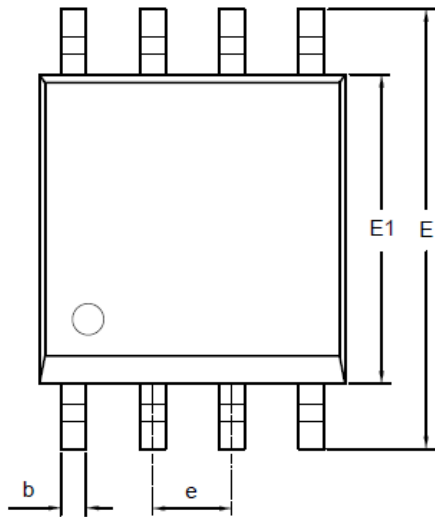
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
LM2903A-SO1R-S	SOP8	330.0	17.6	6.5	5.4	2.0	8.0	12.0	Q1
LM2903A-TS1R-S	TSSOP8	330.0	17.6	6.8	3.3	1.7	8.0	12.0	Q1
LM2903A-VS1R-S	MSOP8	330.0	17.6	5.2	3.3	1.5	8.0	12.0	Q1
LM2901A-SO2R-S	SOP14	330.0	21.6	6.5	9.1	1.8	8.0	16.0	Q1
LM2901A-TS2R-S	TSSOP14	330.0	17.6	6.8	5.5	1.7	8.0	12.0	Q1

Package Outline Dimensions

SOP8



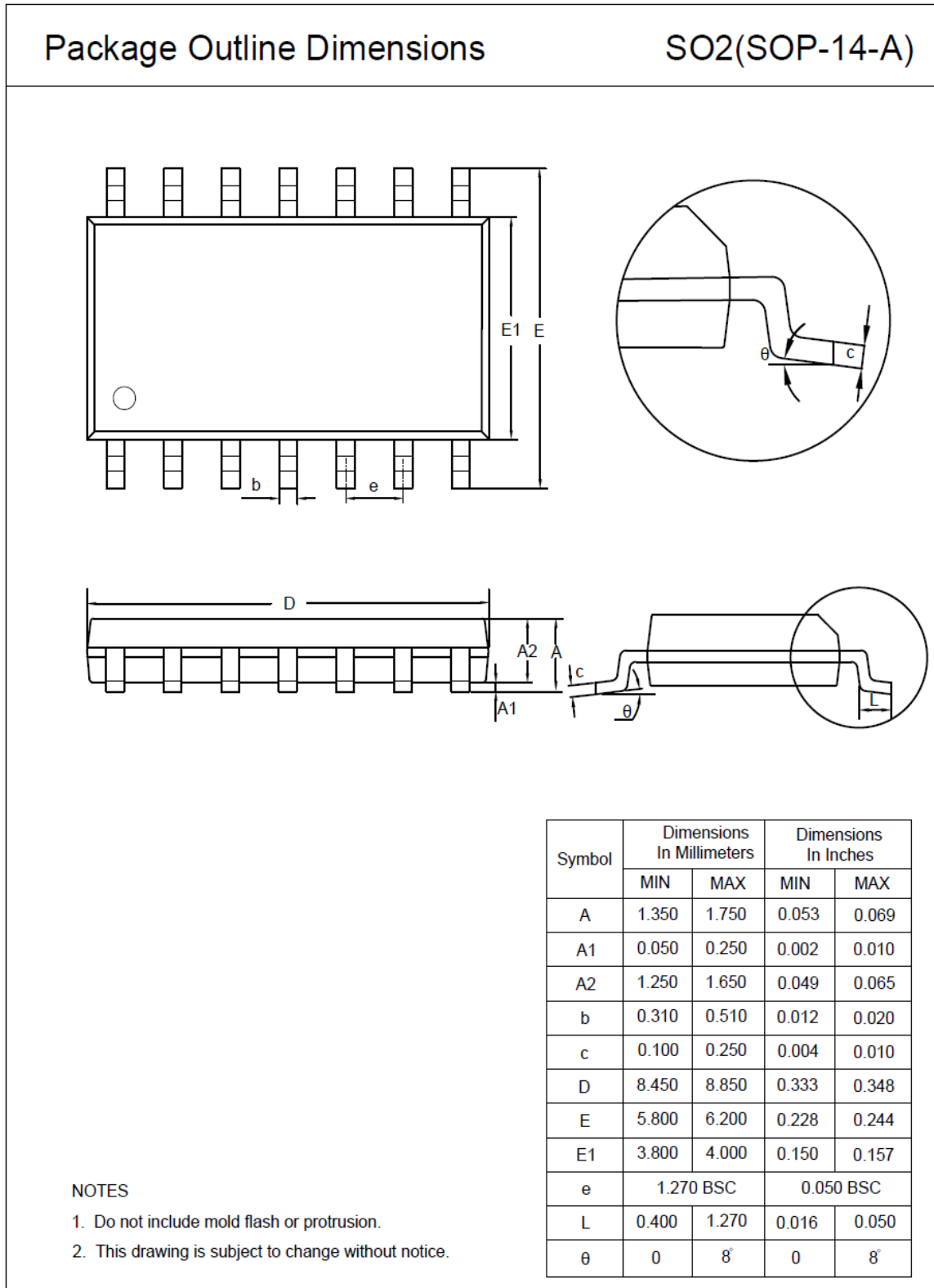
TSSOP8


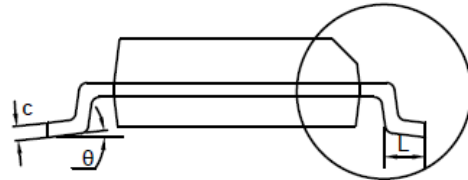
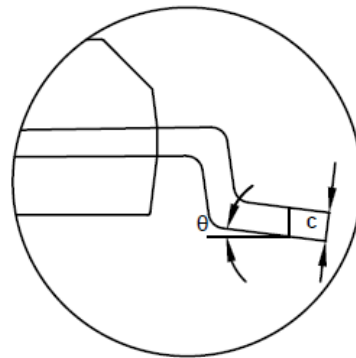
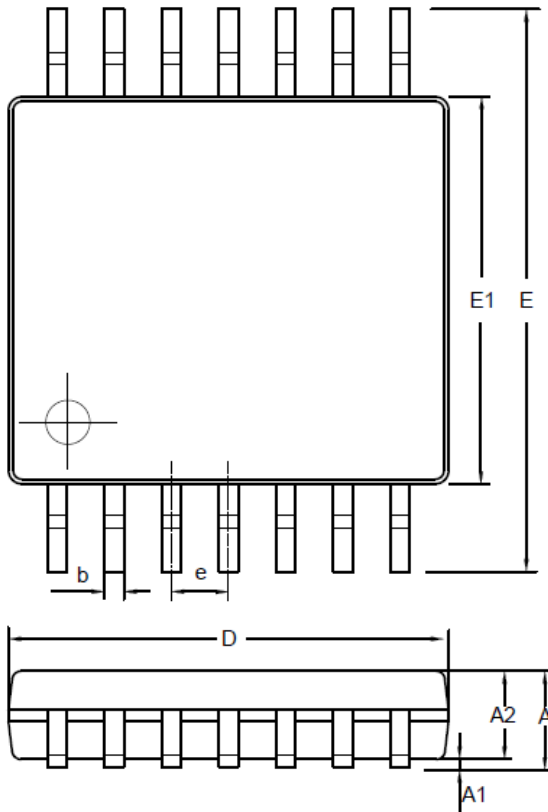
MSOP8
Package Outline Dimensions
VS1(MSOP-8-A)


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.

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
LM2903A-SO1R-S	-40 to 125°C	SOP8	2903S	3	Tape and Reel, 4000	Green
LM2903A-TS1R-S	-40 to 125°C	TSSOP8	2903S	3	Tape and Reel, 3000	Green
LM2903A-VS1R-S	-40 to 125°C	MSOP8	2903S	3	Tape and Reel, 3000	Green
LM2901A-SO2R-S	-40 to 125°C	SOP14	2901S	3	Tape and Reel, 2500	Green
LM2901A-TS2R-S	-40 to 125°C	TSSOP14	2901S	3	Tape and Reel, 3000	Green

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

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