40-V High-Power Comparators with Open-Drain Output

Features

- Wide Single-supply Voltage Range or Dual Supplies: +2 V to +40 V or ±1 V to ±20 V
- Low Supply Current: 460 μA per Channel (Typ)
- Propagation Delay: 1 μs
- Low Offset Voltage: ±4 mV (Max, −40°C to 125°C)
- Low Input Bias Current: 60 nA (Typ)
- Input Common-mode Voltage Range Includes Ground
- Internal Differential Input Voltage Range Equal to The Supply Voltage
- Open-Drain Output for Maximum Flexibility
- Low Output Saturation
- −40°C to 125°C Operation Range
- LM2903-SO1R-S, LM2903-VS1R-S, LM2901-SO2R-S and LM2901-TS2R-S are Qualified for Automotive Applications with the AEC- Q100 Reliability Test

Applications

- Peak and Zero-Crossing Detectors
- Threshold Detectors/Discriminators
- Sensing at the Ground or Supply Line
- Logic Level Shifting or Translation
- Window Comparators
- IR Receivers

Description

The devices in this series consist of single, dual, or quad independent 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 are 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.

The operating temperature range of the devices is from −40°C to +125°C.

Typical Application Circuit

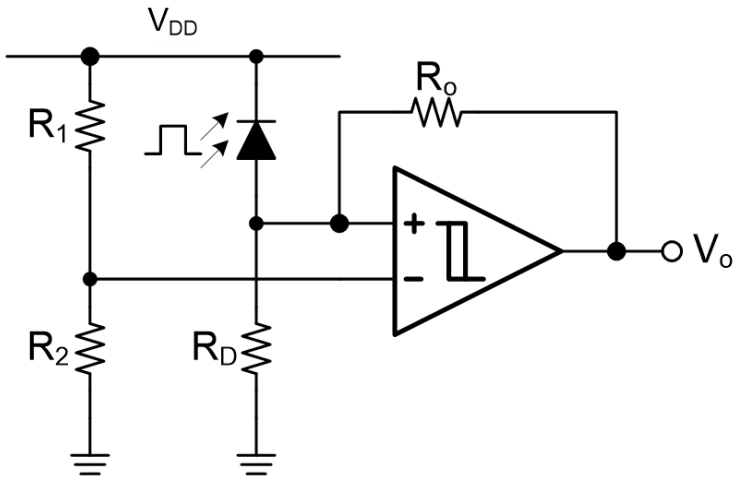


Table of Contents

Features 1
Applications 1
Description 1
Typical Application Circuit 1
Revision History 3
Pin Configuration and Functions 5
Specifications 8
Absolute Maximum Ratings (1) 8
ESD, Electrostatic Discharge Protection 8
Recommended Operating Conditions 8
Thermal Information 9
Electrical Characteristics 10
Typical Performance Characteristics 13
Detailed Description 15
Overview 15
Functional Block Diagram 15
Application and Implementation 16
Application Information 16
Typical Application 17
Tape and Reel Information 18
Package Outline Dimensions 20
SOT23-5 20
SOT353-5 21
SOP8 22
MSOP8 23
TSSOP8 24
SOP14 25
TSSOP14 26
Order Information 27
IMPORTANT NOTICE AND DISCLAIMER 28

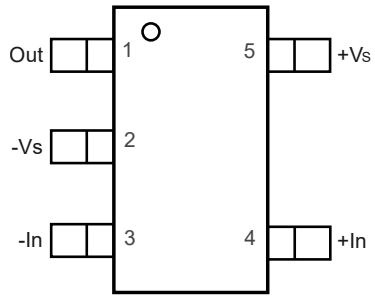
Revision History

Date	Revision	Notes
2025-04-25	Rev.A.0	Initial version.
2025-06-10	Rev.A.1	Updated the note of Absolute Maximum Ratings from "The inputs are protected by ESD protection diodes to each power supply" to "The inputs are protected by ESD protection diodes to the negative power supply". Corrected handwriting errors of part number.
2025-08-20	Rev.A.2	Added new part numbers with AEC-Q100 qualified. Added new part number TL391S-S5TR. Updated Electrical Characteristics: • I_Q, V_S = 5 V, No Load, Output Low, V_{INP} = 0 V, V_{INN} = 1 V, T_A = −40°C to 125°C, TL391 / TL331 / LM2903: changed max value from 1 mA to 1.1 mA • I_Q, V_S = 40 V, No Load, Output Low, V_{INP} = 1 V, V_{INN} = 0 V, T_A = −40°C to 125°C, TL391 / TL331 / LM2903: changed max value from 1.3 mA to 1.45 mA • Added TS391S V_{OS}: V_S = 40 V, V = 0 V and 38 V: typ value 1 mV and max value 1.5 mV V_S = 40 V, V_{CM} = 0 V and 38 V, T_A = −40°C to 125°C: max value 2 mV • Removed I_{OS} limit for T_A = −40°C to 125°C • I_{OL}, V_S = 5 V, V_{OL} = 1.5 V, V_{ID} = −1 V, T_A = −40°C to 125°C: changed min value from 10 mA to 9 mA • V_{OL}, V_S = 5 V, I_{OL} = 4 mA, V_{ID} = −1 V, T_A = −40°C to 125°C : changed max value from 100 mV to 150 mV and provided by bench tests and design simulation.
2026-02-05	Rev.A.3	The following updates are all about the new datasheet formats or typos, and the actual product remains unchanged. Updated Electrical Characteristics: • Changed TS391S to TL391S for Vos conditions. • Added Vos min value -1.5 mV for V_S = 40 V, V_{CM} = 0 V and 38 V, TL391S • Removed Vos typ value 1 mV for V_S = 40 V, V_{CM} = 0 V and 38 V, TL391S • Added Vos min value -2 mV for V_S = 40 V, V_{CM} = 0 V and 38 V, T_A = −40°C to 125°C, TL391S • changed I_Q condition from "V_S = 5 V, No Load, Output Low, V_{INP} = 0 V, V_{INN} = 1 V, T_A = −40°C to 125°C, TL391 / TL331 / LM2903" to "V_S = 5 V, No Load, Output High, V_{INP} = 1 V, V_{INN} = 0 V, T_A = −40°C to 125°C, TL391 / TL331 / LM2903" • Added LM2901 I_Q — V_S = 5 V, No Load, Output High, V_{INP} = 1 V, V_{INN} = 0 V, LM2901: typ value 1.15 mA and max value 1.3 mA — V_S = 5 V, No Load, Output High, V_{INP} = 1 V, V_{INN} = 0 V, T_A = −40°C to 125°C, LM2901: max value 1.5 mA — V_S = 40 V, No Load, Output High, V_{INP}= 1 V, V_{INN} = 0 V, LM2901: typ value 1.4 mA and max value 1.6 mA — V_S = 40 V, No Load, Output High, V_{INP} = 1 V, V_{INN} = 0 V, T_A = −40°C to 125°C, LM2901: max value 1.8 mA
2026-07-24	Rev.A.4	Updated Order Information: Removed "(2) For future products, contact the factory for more information and samples. "

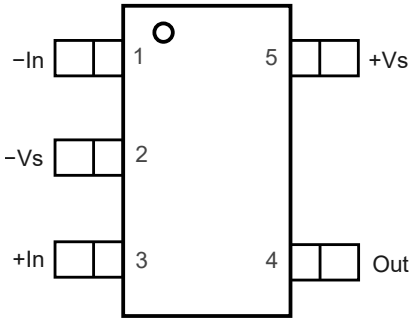
Date	Revision	Notes
		Added new part number TL331U-SC5R.

Pin Configuration and Functions

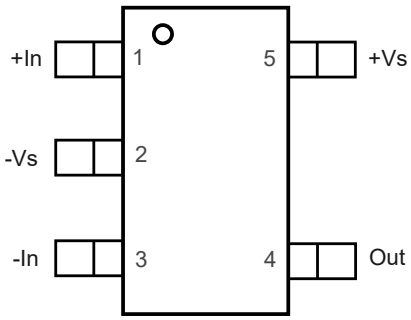
TL391-S5TR, TL391S-S5TR
SOT23-5
Top View



TL331-S5TR
SOT23-5
Top View



TL331U-S5TR
SOT23-5
Top View



TL331U-SC5R
SOT353-5
Top View

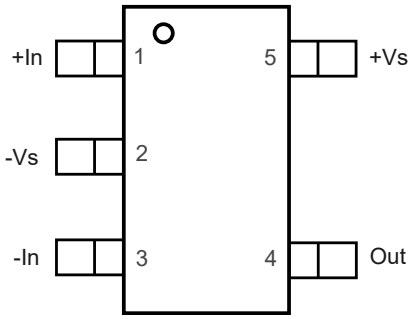
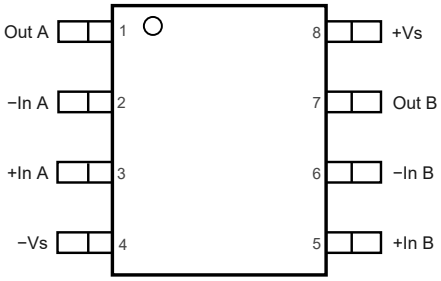


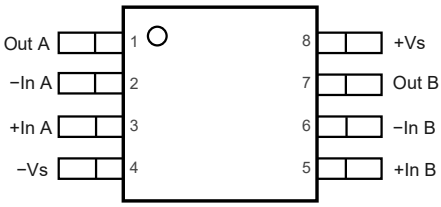
Table 1. Pin Functions: TL391-S5TR/TL331-S5TR/TL331U-S5TR/TL331U-SC5R

Pin No.			Name	I/O	Description
TL391-S5TR	TL331-S5TR	TL331U-S5TR/ TL331U-SC5R			
3	1	3	−In	I	Inverting input
2	2	2	$-V_S$	−	Negative power supply
4	3	1	+In	I	Non-inverting input
1	4	4	Out	O	Output
5	5	5	$+V_S$	−	Positive power supply

LM2903-SO1R
SOP8
Top View



LM2903-VS1R
MSOP8
Top View



LM2903-TS1R
TSSOP8
Top View

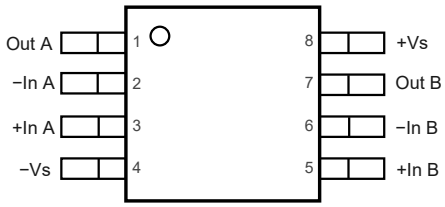
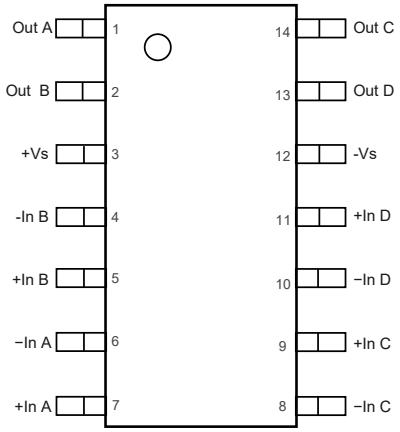


Table 2. Pin Functions: LM2903-SO1R/LM2903-VS1R/LM2903-TS1R

Pin No.			Name	I/O	Description
LM2903-SO1R	LM2903-VS1R	LM2903-TS1R			
1	1	1	Out A	O	Output.
2	2	2	−In A	I	Inverting input.
3	3	3	+In A	I	Non-inverting input.
4	4	4	$-V_S$	−	Negative power supply.
5	5	5	+In B	I	Non-inverting input.
6	6	6	−In B	I	Inverting input.
7	7	7	Out B	O	Output.
8	8	8	$+V_S$	−	Positive power supply.

LM2901-SO2R
SOP14 Package
Top View



LM2901-TS2R
TSSOP14 Package
Top View

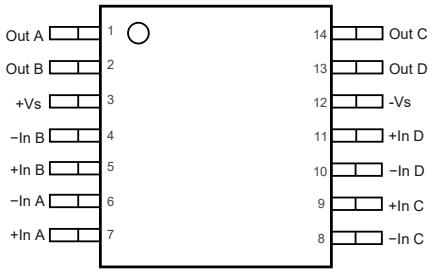


Table 3. Pin Functions: LM2901-SO2R/LM2901-TS2R

Pin No.		Name	I/O	Description
LM2901-SO2R	LM2901-TS2R			
1	1	Out A	O	Output
2	2	Out B	O	Output
3	3	$+V_S$	−	Positive power supply
4	4	−In B	I	Inverting input
5	5	+In B	I	Non-inverting input
6	6	−In A	I	Inverting input
7	7	+In A	I	Non-inverting input
8	8	−In C	I	Inverting input
9	9	+In C	I	Non-inverting input
10	10	−In D	I	Inverting input
11	11	+In D	I	Noninverting input
12	12	$-V_S$	−	Negative power supply
13	13	Out D	O	Output
14	14	Out C	O	Output

Specifications

Absolute Maximum Ratings (1)

Parameter		Min	Max	Unit
	Supply Voltage, $(+V_S) – (-V_S)$	−0.3	42	V
	Input Voltage	$(-V_S) – 0.3$	42	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 the negative power supply. If the input extends more than 500 mV beyond the negative 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 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.

ESD, Electrostatic Discharge Protection

Parameter		Condition	Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001 (1)	3.5	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 (2)	1.5	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

Parameter		Min	Typ	Max	Unit
V_S	Supply Voltage, $(+V_S) – (-V_S)$	2		40	V

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOT23-5	250	81	°C/W
SOT353-5	400	150	°C/W
SOP8	158	43	°C/W
MSOP8	210	45	°C/W
TSSOP8	191	44	°C/W
SOP14	97	47	°C/W
TSSOP14	108	43	°C/W

Electrical Characteristics

All test conditions: V_S = 5 V, $R_{PULL-UP}$ = 5.1 k, T_A = 25°C, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power Supply						
I_Q	Quiescent Current	V_S = 5 V, No Load, Output High, V_{INP} = 1 V, V_{INN} = 0 V, TL391 / TL331 / LM2903		0.74	1	mA
		V_S = 5 V, No Load, Output High, V_{INP} = 1 V, V_{INN} = 0 V, T_A = −40°C to 125°C, TL391 / TL331 / LM2903			1.1	mA
		V_S = 40 V, No Load, Output High, V_{INP}= 1 V, V_{INN} = 0 V, TL391 / TL331 / LM2903		0.92	1.3	mA
		V_S = 40 V, No Load, Output High, V_{INP} = 1 V, V_{INN} = 0 V, T_A = −40°C to 125°C, TL391 / TL331 / LM2903			1.45	mA
		V_S = 5 V, No Load, Output High, V_{INP} = 1 V, V_{INN} = 0 V, LM2901		1.15	1.3	mA
		V_S = 5 V, No Load, Output High, V_{INP} = 1 V, V_{INN} = 0 V, T_A = −40°C to 125°C, LM2901			1.5	mA
		V_S = 40 V, No Load, Output High, V_{INP}= 1 V, V_{INN} = 0 V, LM2901		1.4	1.6	mA
		V_S = 40 V, No Load, Output High, V_{INP} = 1 V, V_{INN} = 0 V, T_A = −40°C to 125°C, LM2901			1.8	mA
Input Characteristics						
V_{OS}	Input Offset Voltage (1)	V_S = 40 V, V_{CM} = 0 V and 38 V, TL391S	-1.5		1.5	mV
		V_S = 40 V, V_{CM} = 0 V and 38 V, T_A = −40°C to 125°C, TL391S	-2		2	mV
V_{OS}	Input Offset Voltage (1)	V_S = 5 V, V_{CM} = 0 V	−2		2	mV
		V_S = 5 V, V_{CM} = 0 V, T_A = −40°C to 125°C	−3		3	mV
V_{OS} TC	Input Offset Voltage Drift (2)	V_S = 5 V, V_{CM} = 0 V, T_A = −40°C to 125°C		2		µV/°C
V_{OS}	Input Offset Voltage (1)	V_S = 5 V, V_{CM} = 3 V	−2		2	mV
		V_S = 5 V, V_{CM} = 3 V, T_A = −40°C to 125°C	−3		3	mV
V_{OS} TC	Input Offset Voltage Drift (2)	V_S = 5 V, V_{CM} = 3 V, T_A = −40°C to 125°C		2		µV/°C
V_{OS}	Input Offset Voltage (1)	V_S = 5 V, V_{CM} = 3.5 V	−3		3	mV
V_{OS}	Input Offset Voltage (1)	V_S = 40 V, V_{CM} = 0 V	−3		3	mV

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		V_S = 40 V, V_{CM} = 0 V, T_A = −40°C to 125°C	−3.5		3.5	mV
V_{OS} TC	Input Offset Voltage Drift (2)	V_S = 40 V, V_{CM} = 0 V, T_A = −40°C to 125°C		2		µV/°C
V_{OS}	Input Offset Voltage (1)	V_S = 40 V, V_{CM} = 38 V	−3		3	mV
		V_S = 40 V, V_{CM} = 38 V, T_A = −40°C to 125°C	−4		4	mV
V_{OS} TC	Input Offset Voltage Drift (2)	V_S = 40 V, V_{CM} = 38 V, T_A = −40°C to 125°C		2		µV/°C
V_{OS}	Input Offset Voltage (1)	V_S = 40 V, V_{CM} = 38.5 V	−4		4	mV
I_B	Input Bias Current	V_S = 40 V, V_{CM} = 0 V	−100	-60	0	nA
		V_S = 40 V, V_{CM} = 0 V, T_A = −40°C to 125°C	−150			nA
I_{OS}	Input Offset Current	V_S = 40 V, V_{CM} = 0 V	−30	0	30	nA
I_{OS} TC	Input Offset Current Drift (2)	V_S = 40 V, V_{CM} = 0 V, T_A = −40°C to 125°C		10		pA/°C
I_B	Input Bias Current	V_S = 40V, V_{CM} = 38V	−100	-30	0	nA
		V_S = 40V, V_{CM} = 38V, T_A = −40°C to 125°C	−150			nA
I_{OS}	Input Offset Current	V_S = 40 V, V_{CM} = 38 V	−30	0	30	nA
I_{OS} TC	Input Offset Current Drift (2)	V_S = 40 V, V_{CM} = 38 V, T_A = −40°C to 125°C		10		pA/°C
A_V	Large-signal Differential-voltage Amplification (4)	V_S = 15 V, V_O = 1.4 V to 11.4 V, RL ≥ 15 kΩ to V_{CC}	50	500		V/mV
		V_S = 15 V, V_O = 1.4 V to 11.4 V, RL ≥ 15 kΩ to V_{CC}, T_A = −40°C to 125°C	5			V/mV
V_{CM}	Common-mode Input Voltage Range	V_S = 40 V	0		38.5	V
		V_S = 40 V, T_A = −40°C to 125°C	0		38	V
Output						
I_{OH}	High-level Output Current	V_S = 5 V, V_{OH} = 5 V, V_{ID} = 1 V		8	25	nA
		V_S = 5 V, V_{OH} = 5 V, V_{ID} = 1 V, T_A = −40°C to 125°C			2000	nA
		V_S = 5 V, V_{OH} = 40 V, V_{ID} = 1 V		35	100	nA
		V_S = 5 V, V_{OH} = 40 V, V_{ID} = 1 V, T_A = −40°C to 125°C			4000	nA
I_{OL}	Low-level Output Current	V_S = 5 V, V_{OL} = 1.5 V, V_{ID} = −1 V	10	17		mA
		V_S = 5 V, V_{OL} = 1.5 V, V_{ID} = −1 V, T_A = −40°C to 125°C	9			mA
V_{OL}	Output Voltage Low	V_S = 5 V, I_{OL} = 4 mA, V_{ID} = −1 V		40	100	mV

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		V_S = 5 V, I_{OL} = 4 mA, V_{ID} = −1 V, T_A = −40°C to 125°C (2)			150	mV
Switching Characteristics (3)						
t_{RT}	Response Time	V_S = 5 V, R_L connected to 5 V through 5.1 kΩ, C_L= 15 pF,100-mV input step with 5-mV overdrive (2)		1		µs
		V_S = 5 V, R_L connected to 5 V through 5.1 kΩ, C_L= 15 pF, TTL-level input step (2)		0.3		µs

(1) The input offset voltage is the average of the input-referred trip points.
(2) Provided by bench tests and design simulation.
(3) Delay time is measured from the mid-point of the input to the mid-point of the output.
(4) Provided by design simulation.

Typical Performance Characteristics

All test conditions: V_S = 5 V, V_{CM} = 2.5 V, $R_{PULL-UP}$ = 5.1 k, unless otherwise noted.

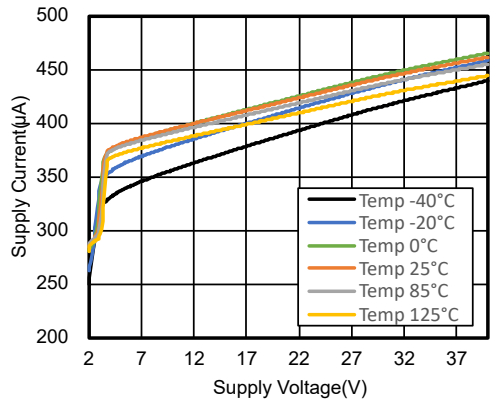


Figure 1. Supply Current vs. Supply Voltage, Output High, per Comparator for LM2903

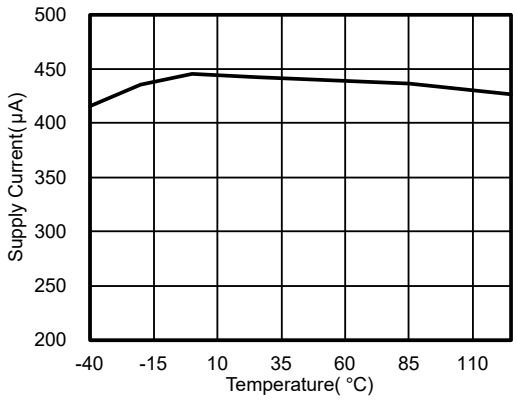


Figure 2. Supply Current vs. Temperature, per Comparator for LM2903

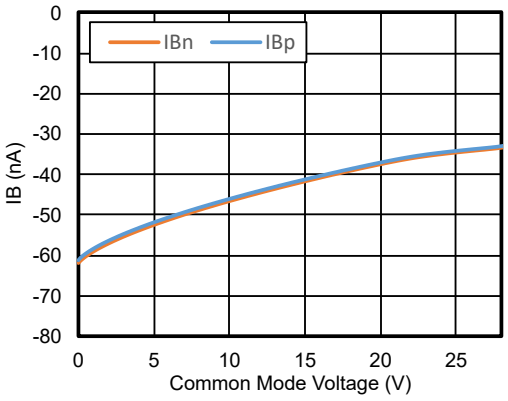


Figure 3. IB vs. Common-Mode Voltage

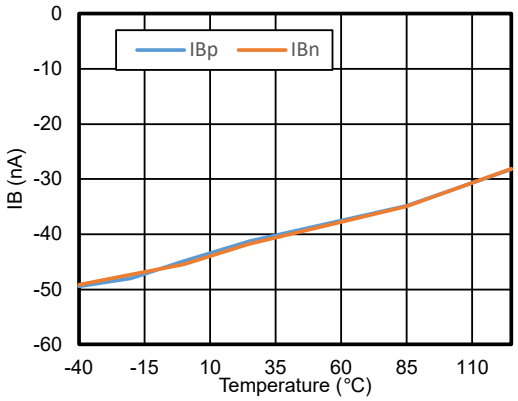


Figure 4. IB vs. Temperature

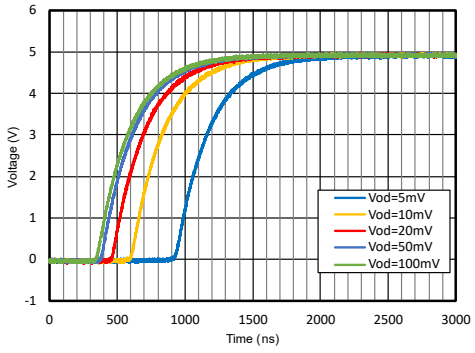


Figure 5. Propagation Delay, Low to High, 5 V

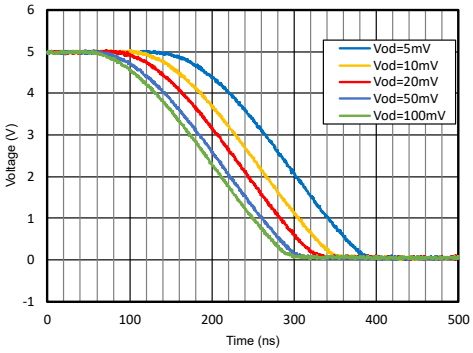


Figure 6. Propagation Delay, High to Low, 5 V

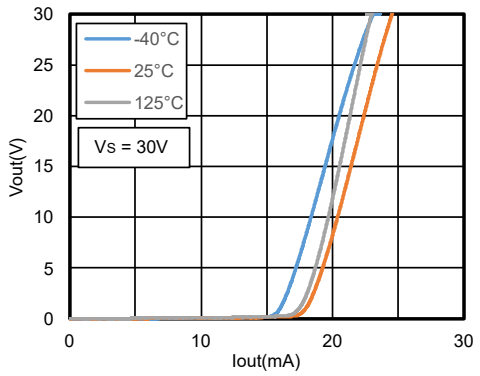


Figure 7. Output Voltage vs. Output Sinking Current, 5 V

Detailed Description

Overview

The devices in this series consist of single/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.

Functional Block Diagram

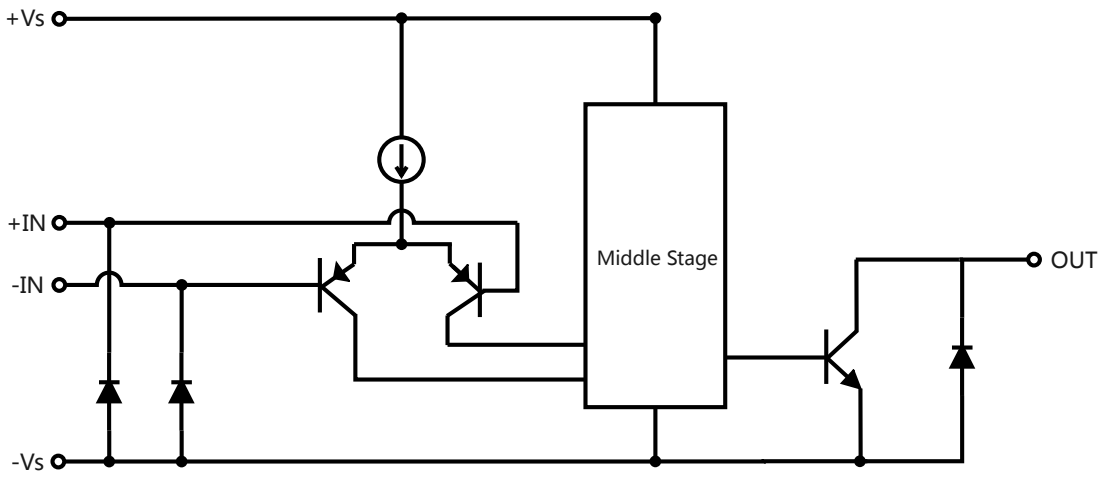


Figure 8. Functional Block Diagram

Application and Implementation

Note

Information in the following application 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 power supply pins of TL331, TL391, LM2903, and LM2901 families should have local bypass capacitors (i.e., 0.01 μF to 0.1 μF) within 2 mm for high-frequency performance. They can also use a bulk capacitor (i.e., 1 μF or larger) within 100 mm to provide large and slow currents. This bulk capacitor can be shared with other analog parts.

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

Operation Outside of the Common Input Voltage Range

A list of input voltage situations and the corresponding outcomes are as follows:

1. When both −IN and +IN are within the common-mode range:
   a. If the voltage at the −IN pin is higher than the voltage at the +IN pin and the offset voltage, the output is low, and the output MOSFET is sinking current.
   b. If the voltage at the −IN pin is lower than the voltage at the +IN pin and the offset voltage, the output is high impedance.
2. When the voltage at the −IN pin is higher than the common-mode voltage range and the voltage at the +IN pin is within the common-mode voltage range, the output is low, and the output MOSFET is sinking current.
3. When the voltage at the +IN pin is higher than the common-mode voltage range and the voltage at the −IN pin is within the common-mode voltage range, the output is high impedance.
4. When the voltages at the −IN and +IN pins are both higher than the common-mode voltage 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 9. 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.

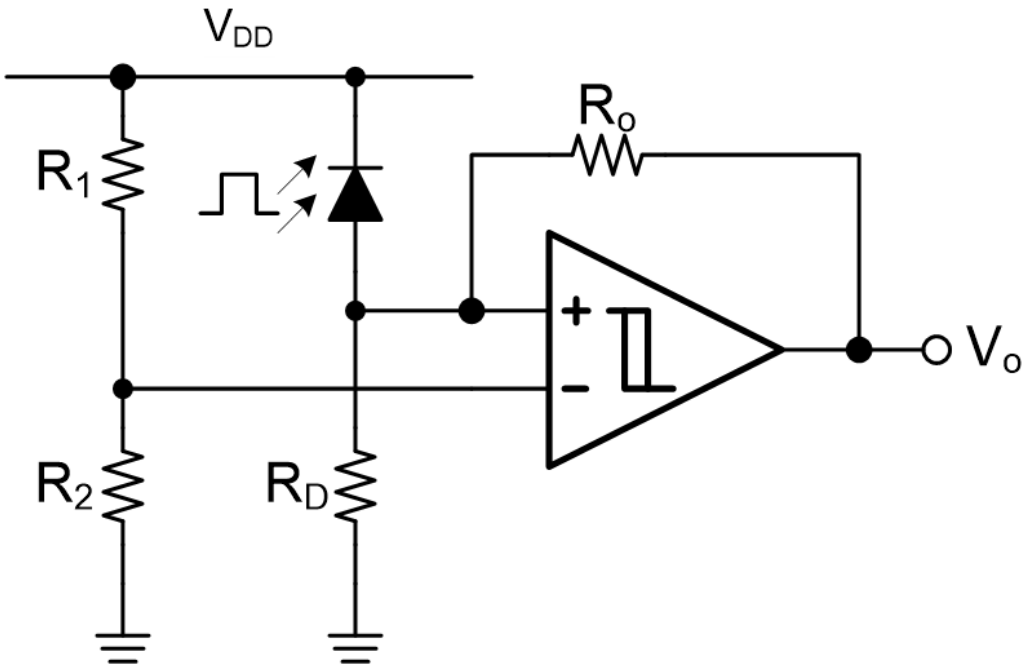
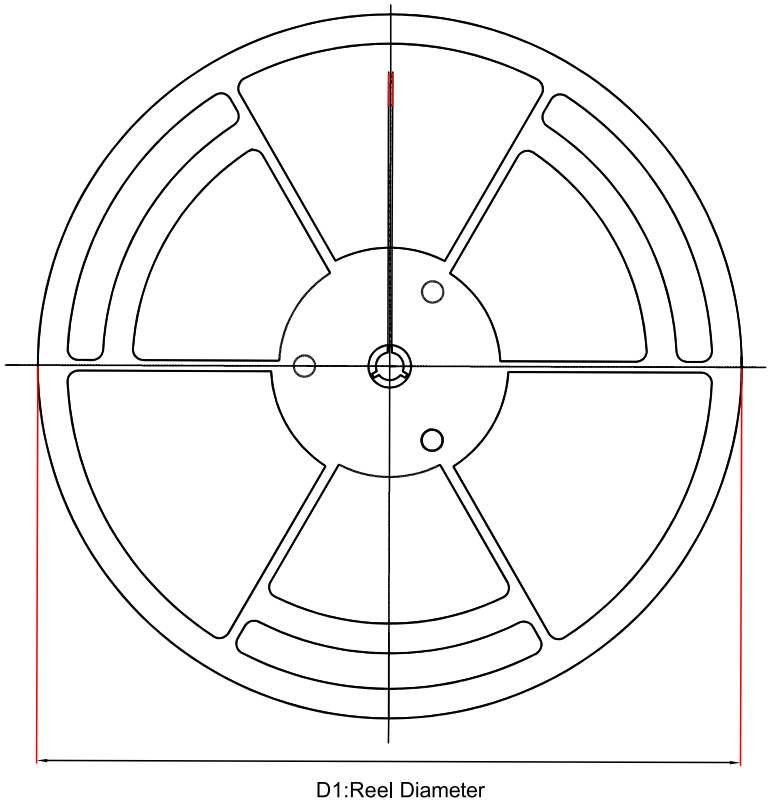
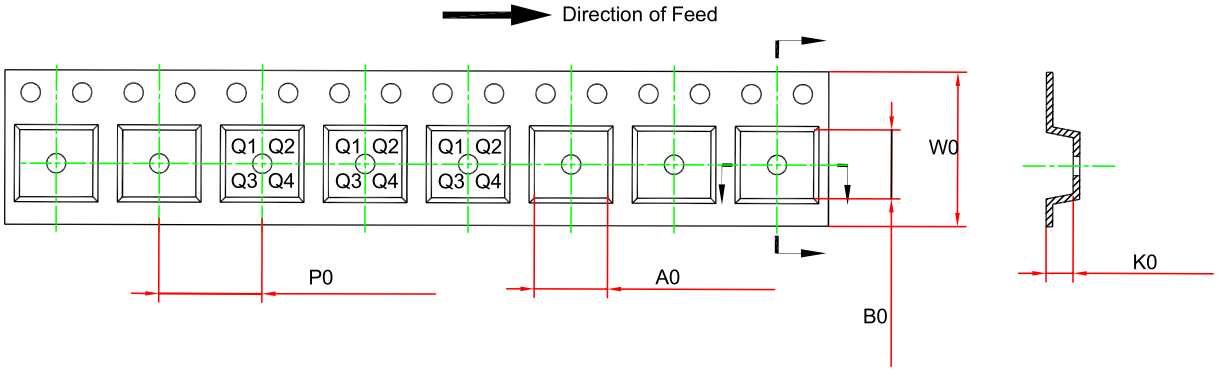


Figure 9. Typical Application Circuit

Tape and Reel Information





Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm) (1)	B0 (mm) (1)	K0 (mm) (1)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TL391-S5TR	SOT23-5	180	12	3.3	3.25	1.4	4	8	Q3
TL391S-S5TR	SOT23-5	180	12	3.3	3.25	1.4	4	8	Q3
TL331-S5TR	SOT23-5	180	12	3.3	3.25	1.4	4	8	Q3
TL331U-S5TR	SOT23-5	180	12	3.3	3.25	1.4	4	8	Q3
TL331U-SC5R	SOT353	178	12.1	2.4	2.5	1.2	4	8	Q3

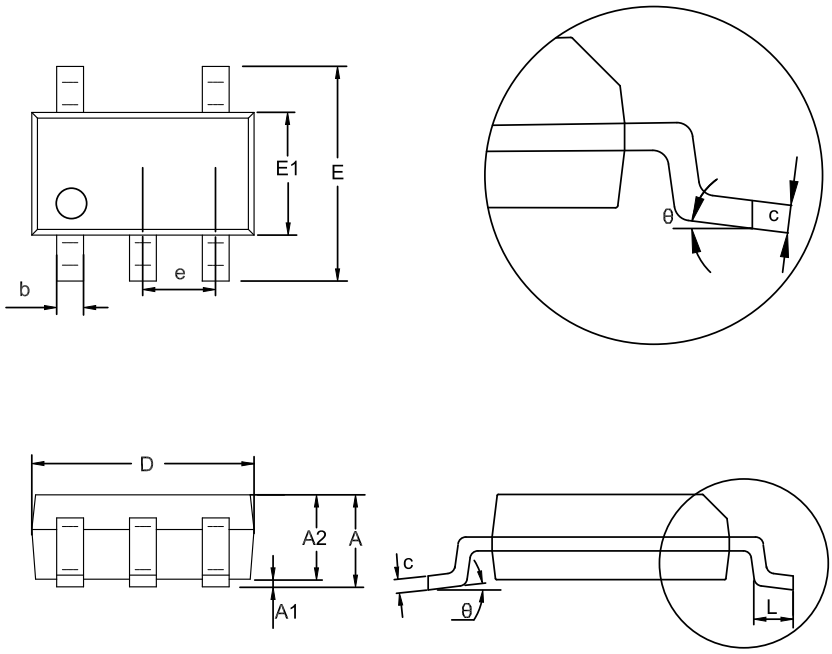
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm) (1)	B0 (mm) (1)	K0 (mm) (1)	P0 (mm)	W0 (mm)	Pin1 Quadrant
LM2903-SO1R	SOP8	330	17.6	6.5	5.4	2	8	12	Q1
LM2903-SO1R-S	SOP8	330	17.6	6.5	5.4	2	8	12	Q1
LM2903-VS1R	MSOP8	330	17.6	5.3	3.4	1.3	8	12	Q1
LM2903-VS1R-S	MSOP8	330	17.6	5.3	3.4	1.3	8	12	Q1
LM2903-TS1R	TSSOP8	330	17.6	6.8	3.4	1.2	8	12	Q1
LM2901-SO2R	SOP14	330	21.6	6.5	9.3	2.1	8	16	Q1
LM2901-SO2R-S	SOP14	330	21.6	6.5	9.3	2.1	8	16	Q1
LM2901-TS2R	TSSOP14	330	17.6	6.8	5.5	1.5	8	12	Q1
LM2901-TS2R-S	TSSOP14	330	17.6	6.8	5.5	1.5	8	12	Q1

(1) The value is for reference only. Contact the factory for more information.

Package Outline Dimensions

SOT23-5

Package Outline Dimensions S5T(SOT23-5-A)



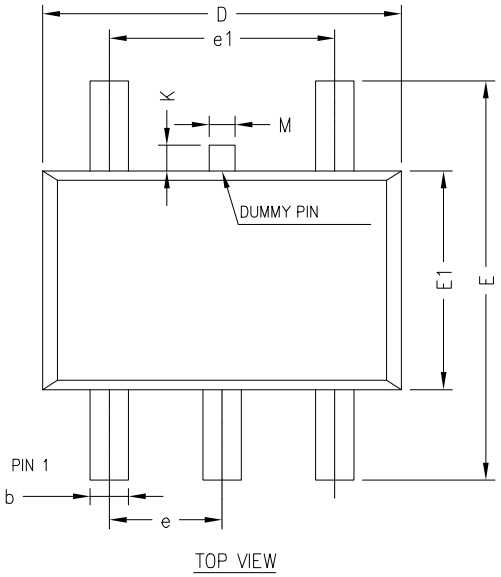
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.150	0.000	0.006
A2	1.000	1.200	0.039	0.047
b	0.280	0.500	0.011	0.020
c	0.100	0.230	0.004	0.009
D	2.820	3.020	0.111	0.119
E	2.600	3.000	0.102	0.118
E1	1.500	1.720	0.059	0.068
e	0.950 BSC		0.037 BSC	
L	0.300	0.600	0.012	0.024
θ	0	8°	0	8°

NOTES

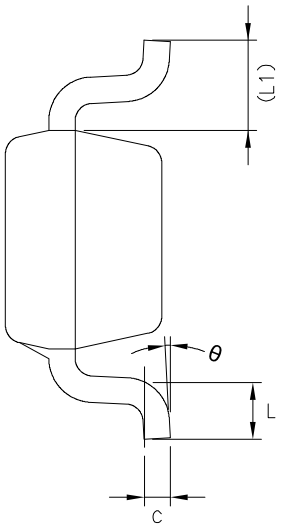
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

SOT353-5

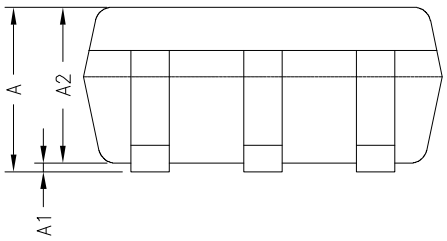
Package Outline Dimensions SC5(SOT353-5-B)



TOP VIEW



SIDE VIEW



SIDE VIEW

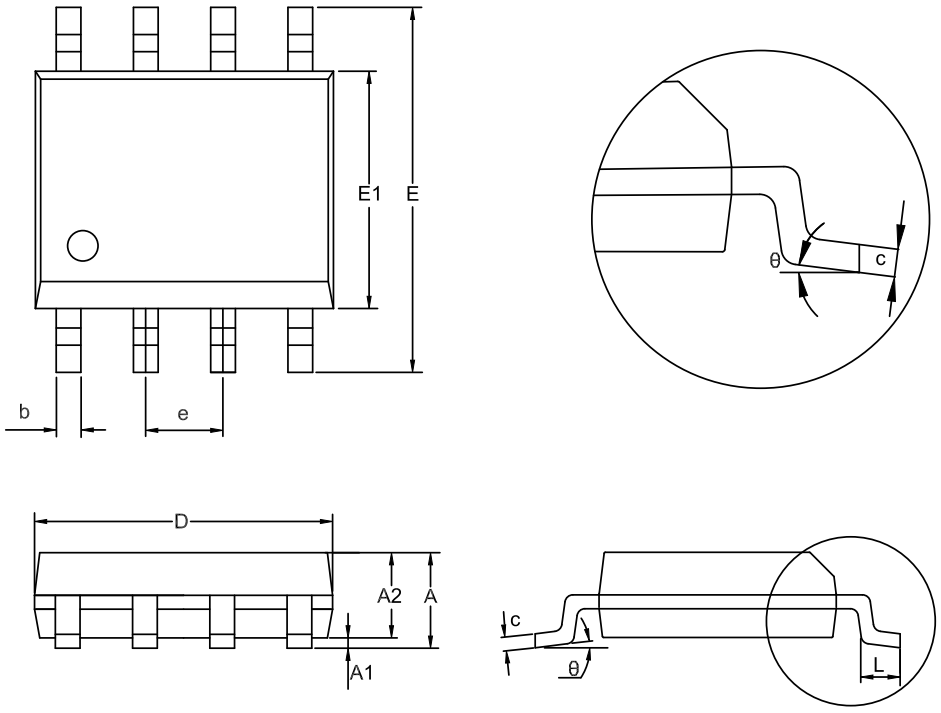
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	1.100	0.031	0.043
A1	0.000	0.100	0.000	0.004
A2	0.800	1.000	0.031	0.039
b	0.150	0.350	0.006	0.014
c	0.110	0.230	0.004	0.009
D	2.020	2.120	0.080	0.083
E	2.150	2.450	0.085	0.096
E1	1.210	1.310	0.048	0.052
e	0.650 BSC		0.026 BSC	
e1	1.200	1.400	0.047	0.055
L	0.260	0.460	0.010	0.018
L1	0.520 REF		0.020 REF	
K	0.000	0.200	0.000	0.008
M	0.100	0.200	0.004	0.008
θ	0	8°	0	8°

NOTES

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

SOP8

Package Outline Dimensions SO1(SOP-8-A)



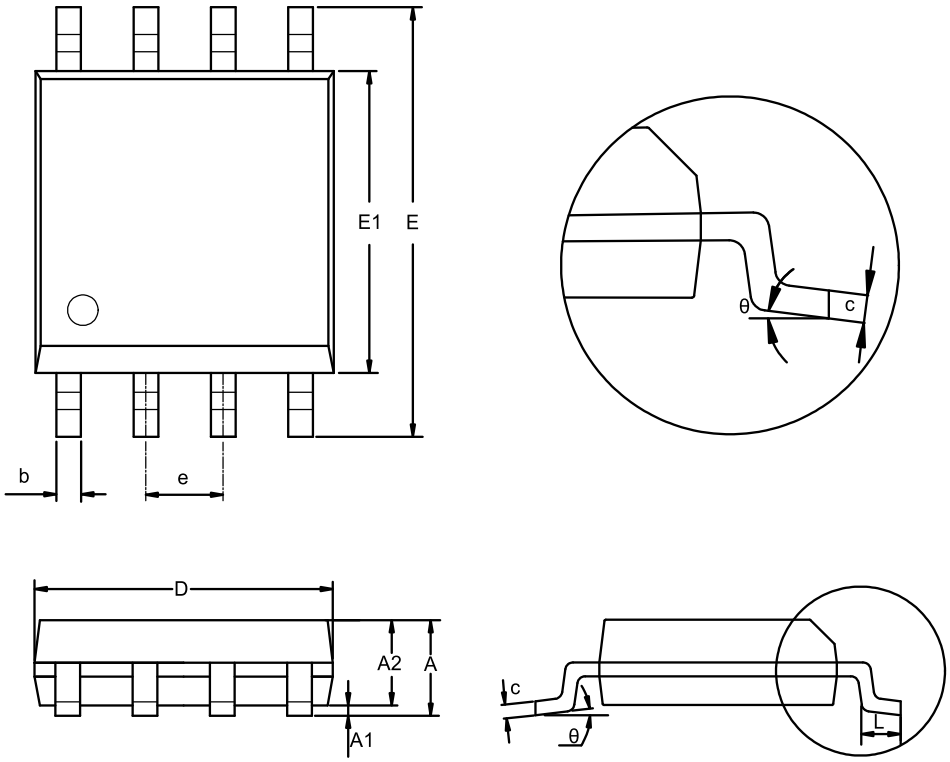
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.550	0.049	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050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



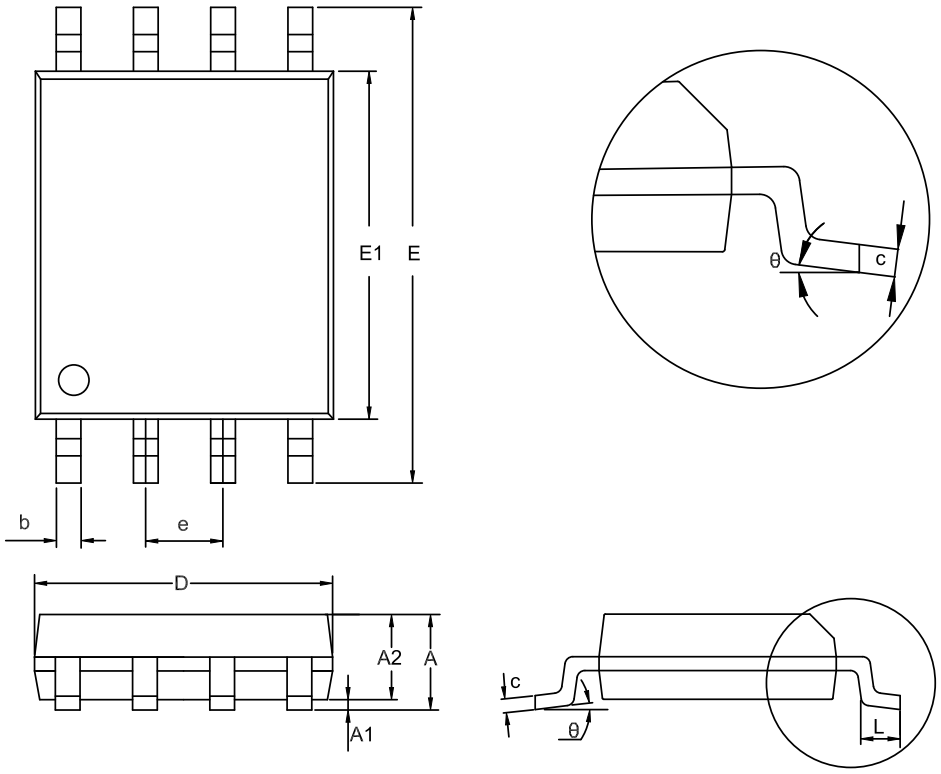
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	1.100	0.031	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	4.700	5.100	0.185	0.201
E1	2.900	3.100	0.114	0.122
e	0.650 BSC		0.026 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.

TSSOP8

Package Outline Dimensions TS1(TSSOP-8-A)



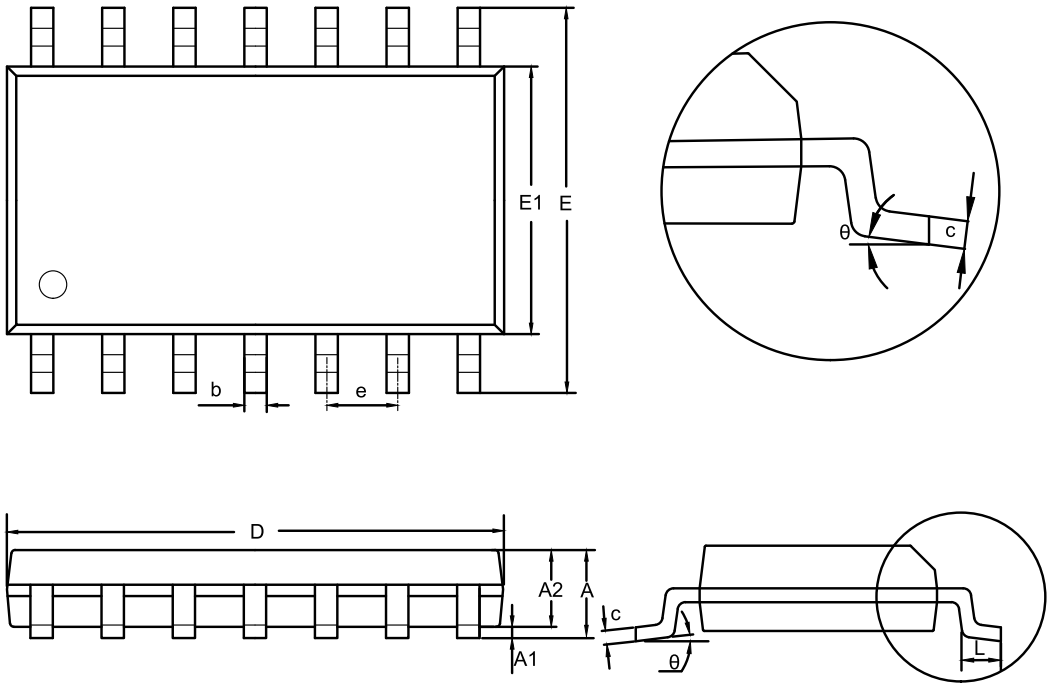
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.200	0.035	0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	2.900	3.100	0.114	0.122
E	6.200	6.600	0.244	0.260
E1	4.300	4.500	0.169	0.177
e	0.650 BSC		0.026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

SOP14

Package Outline Dimensions SO2(SOP-14-A)



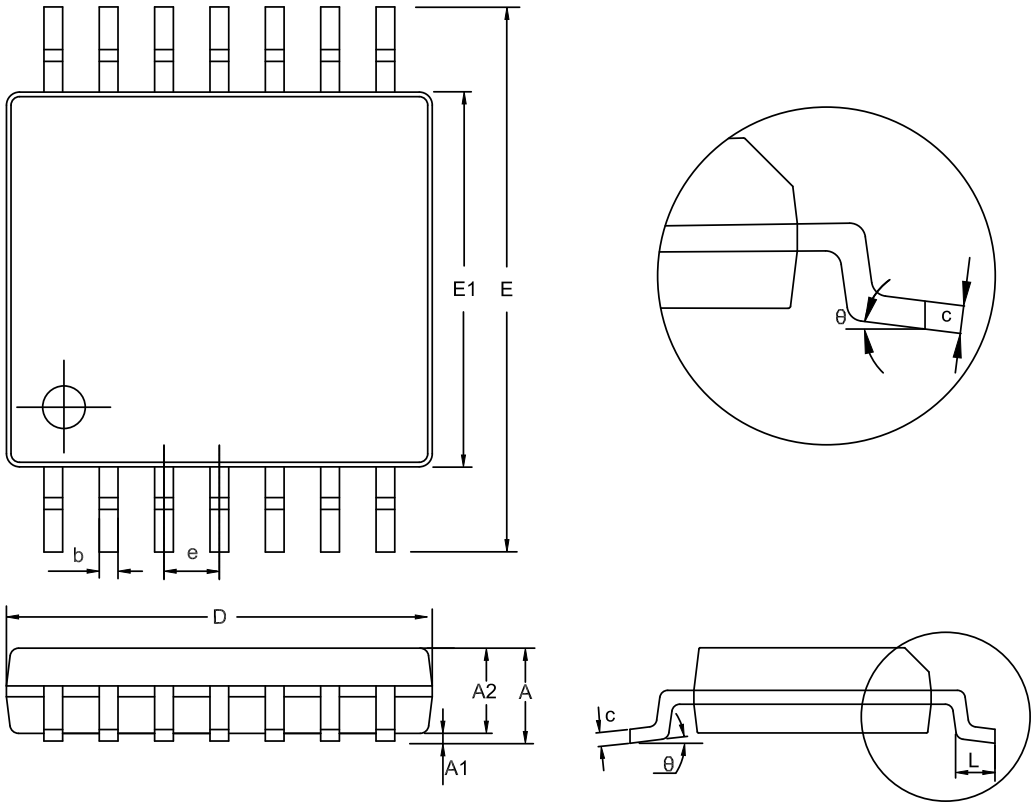
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.650	0.049	0.065
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0	8°	0	8°

NOTES

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

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
TL391-S5TR	−40 to 125°C	SOT23-5	A9C	3	Tape and Reel, 3000	Green
TL391S-S5TR	−40 to 125°C	SOT23-5	A9C	3	Tape and Reel, 3000	Green
TL331-S5TR	−40 to 125°C	SOT23-5	A9B	3	Tape and Reel, 3000	Green
TL331U-S5TR	−40 to 125°C	SOT23-5	A99	3	Tape and Reel, 3000	Green
TL331U-SC5R	−40 to 125°C	SOT353-5	A9A	3	Tape and Reel, 3000	Green
LM2903-SO1R	−40 to 125°C	SOP8	L2903	3	Tape and Reel, 4000	Green
LM2903-SO1R-S (1)	−40 to 125°C	SOP8	L2903	3	Tape and Reel, 4000	Green
LM2903-VS1R	−40 to 125°C	MSOP8	L2903	3	Tape and Reel, 3000	Green
LM2903-VS1R-S (1)	−40 to 125°C	MSOP8	L2903	3	Tape and Reel, 3000	Green
LM2903-TS1R	−40 to 125°C	TSSOP8	L2903	3	Tape and Reel, 3000	Green
LM2901-SO2R	−40 to 125°C	SOP14	L2901	3	Tape and Reel, 2500	Green
LM2901-SO2R-S (1)	−40 to 125°C	SOP14	L2901	3	Tape and Reel, 2500	Green
LM2901-TS2R	−40 to 125°C	TSSOP14	L2901	3	Tape and Reel, 3000	Green
LM2901-TS2R-S (1)	−40 to 125°C	TSSOP14	L2901	3	Tape and Reel, 3000	Green

(1) Passed AEC-Q100 Reliability Test.

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

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