钍地半导体
Tudi Semiconductor

Product Specification

TUDI-LM2901-Q1/LM2901B-Q1

汽车类四路比较器

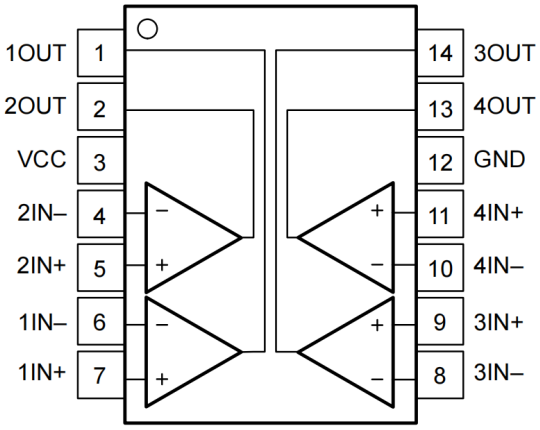
网址 www.sztdbdt.com

用芯智造·卓越品质

semiconductor device manufacturer

- Design
- research and development
- production
- and sales

特性



D, PW and DYY Packages
14-Pin SOIC, TSSOP and SOT-23

- 符合汽车应用要求
- 具有符合 AEC-Q100 标准的下列特性：
  - 器件温度等级 1：–40°C 至 125°C 环境工作温度范围
  - 器件 HBM ESD 分类等级：
- “ AV ”版本为 1C 级
- 所有其他版本为 2 级
  - 器件 CDM ESD 分类等级 C3
- 改进了“ B ”器件的 2kV HBM ESD
- 单电源或双电源
- 独立于电源电压的

低电源电流：

每个比较器 200uA（典型值）（“ B ”版本）

- 低输入偏置电流：3.5nA（典型值）（“ B ”器件）？低输入偏置电流：0.5nA（典型值）（“ B ”器件）
- 低输入偏移电压：±0.37mV（典型值）（“ B ”器 件）
- 共模输入电压范围包括接地
- 差动输入电压范围等于最大额定电源电压：±36V
- 输出与 TTL、MOS 和 CMOS 兼容
- 有关采用 SOT 封装的单通道版本，请参阅 TL331- Q1 (SLVS969)
- 有关采用多种封装的双通道版本，请参阅 LM2903x-Q1 (SLCS141)
- 功能安全型
  - 可提供用于功能安全系统设计的文档

应用

- 汽车
  - HEV/EV 和动力总成
  - 信息娱乐系统与仪表组
  - 车身控制模块
- 工业
- 电器

说明

LM2901B-Q1 器件是业界通用 LM2901x-Q1 比较器系 列的下一代版本。下一代系列产品为成本敏感型应用提 供卓越的价值，其特性包括更低的偏移电压和更高的电 源电压能力。此外，具有更低的电源电流、更低的输入 偏置电流、更低的传播延迟以及更高的 2kV ESD 性能，提供即插即用替代的便利性。

所有器件都包含四个独立的电压比较器，这些比较器可 在宽电压范围内运行。如果两个电源的电压差处于 2V 至 36V 范围内且 VCC 比输入共模电压至少高 1.5V， 那么也可以使用双电源。输出可以连接到其他集电极开 路输出。

“ V ”版本的工作电压高达 32V，“ B ”版本的工作电 压高达 36V。所有这些器件均符合 -40°C 至 +125 °C 的 AEC-Q100 1 级温度范围。

表 **4-1. Pin Functions**

PIN				I/O	DESCRIPTION
NAME(1)	SOIC, TSSOP, DYY	X2QFN	WQFN		
OUT1 (1)	1	14	16	Output	Output pin of the comparator 2
OUT2 (1)	2	1	15	Output	Output pin of the comparator 1
V_{CC}	3	2	1	—	Positive supply
IN2 – (1)	4	3	5	Input	Negative input pin of the comparator 1
IN2+ (1)	5	4	6	Input	Positive input pin of the comparator 1
IN1 – (1)	6	5	2	Input	Negative input pin of the comparator 2
IN1+ (1)	7	6	4	Input	Positive input pin of the comparator 2
IN3 –	8	7	7	Input	Negative input pin of the comparator 3
IN3+	9	8	8	Input	Positive input pin of the comparator 3
IN4 –	10	9	9	Input	Negative input pin of the comparator 4
IN4+	11	10	11	Input	Positive input pin of the comparator 4
GND	12	11	12	—	Negative supply
OUT4	13	12	13	Output	Output pin of the comparator 4
OUT3	14	13	14	Output	Output pin of the comparator 3
NC	—	—	3	—	No Internal Connection - Leave floating or GND
NC	—	—	10	—	No Internal Connection - Leave floating or GND
Thermal Pad	—	—	PAD	—	Connect directly to GND pin

(1) Some manufacturers transpose the names of channels 1 & 2. Electrically the pinouts are identical, just a difference in channel naming convention.

5 Specifications

5.1 Absolute Maximum Ratings for LM2901B-Q1

over operating free-air temperature range (unless otherwise noted)(1)

	MIN	MAX	UNIT
Supply voltage: V_S = (V+) – (V –)	-0.3	38	V
Differential input voltage : V_{ID} (2)		±38	V
Input pins (IN+, IN –)	-0.3	38	V
Current into input pins (IN+, IN –)		-50	mA
Output pin (OUT)	-0.3	38	V
Output sink current		25	mA
Output short-circuit duration(3)		Unlimited	s
Junction temperature, T_J		150	°C
Storage temperature, T_{stg}	-65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* can cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods can affect device reliability.
(2) Differential voltages are at IN+ with respect to IN-
(3) Short circuits from outputs to V+ can cause excessive heating and eventual destruction.

5.2 Absolute Maximum Ratings for LM2901x-Q1

over operating free-air temperature range (unless otherwise noted)(1)

	MIN	MAX	UNIT
Supply voltage, V_{CC} (2)		36	V
Differential input voltage, V_{ID} (3)		±36	
Input voltage range, V_I (either input)	– 0.3	36	
Output voltage, V_O		36	
Output current, I_O		20	mA
Duration of output short circuit to ground(4)	Unlimited		
Operating virtual junction temperature, T_J		150	°C
Storage temperature, T_{stg}	– 65	150	°C

(1) Operation outside the Absolute Maximum Ratings can cause permanent device damage. Absolute Maximum Ratings do not imply functional operation of the device at these or any other conditions beyond those listed under Recommended Operating Conditions. If used outside the Recommended Operating Conditions but within the Absolute Maximum Ratings, the device may not be fully functional, and this can affect device reliability, functionality, performance, and shorten the device lifetime.
(2) All voltage values, except differential voltages, are with respect to network ground.
(3) Differential voltages are at IN+ with respect to IN−.
(4) Short circuits from outputs to V_{CC} can cause excessive heating and eventual destruction.

5.3 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per AEC Q100-002(1)	±2000	V
		Charged-device model (CDM), per AEC Q100-011(1)	±1000	

(1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

5.4 Recommended Operating Conditions for LM2901B-Q1

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

	MIN	MAX	UNIT
Supply voltage: V_S = (V+) − (V−)	2	36	V
Ambient temperature, T_A, LM2901B-Q1	−40	125	°C
Input Voltage Range, V_{IVR}	(V−) − 0.1	(V+) − 2.0	V

5.5 Recommended Operating Conditions for LM2901x-Q1

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage	LM2901-Q1	2	30	V
		LM2901V-Q1, LM2901AV-Q1	2	32	
T_A	Ambient temperature		−40	125	°C
I_O	Output current (per comparator)		0	4	mA

5.6 Thermal Information

THERMAL METRIC(1)		All Devices					UNIT
		D (SOIC)	PW (TSSOP)	DDY (SOT-23)	RTE (WQFN)	RUC (X2QFN)	
		14 PINS	14 PINS	14 PINS	16 PINS	14 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	111.2	136.6		67.6		°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	66.9	66.6		72.3		
$R_{\theta JB}$	Junction-to-board thermal resistance	67.8	79.8		43.1		
ψ_{JT}	Junction-to-top characterization parameter	28.0	17.8		6.3		
ψ_{JB}	Junction-to-board characterization parameter	67.4	79.3		42.8		
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	-	-	-	26.4	-	

(1) For more information about traditional and new thermal metrics, see the Semicondctor and IC Package Thermal Metrics report, SPRA953.

5.7 Electrical Characteristics for LM2901B-Q1

V_S = 5V, V_{CM} = (V－) ; T_A = 25°C (unless otherwise noted).

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	V_S = 5 to 36V	－3.5	±0.37	3.5	mV
		V_S = 5 to 36V, T_A = －40°C to +125°C	－5.5		5.5	
I_B	Input bias current			－3.5	－25	nA
		T_A = －40°C to +125°C			－50	nA
I_{OS}	Input offset current		－25	±0.5	25	nA
		T_A = －40°C to +125°C	－50		50	nA
V_{CM}	Common mode range (1)	V_S = 3 to 36V	(V－)		(V+) － 1.5	V
		V_S = 3 to 36V, T_A = －40°C to +125°C	(V－)		(V+) － 2.0	V
A_{VD}	Large signal differential voltage amplification	V_S = 15V, V_O = 1.4V to 11.4V; R_L ⩾ 15k to (V+)	50	200		V/mV
V_{OL}	Low level output Voltage {swing from (V－)}	I_{SINK} ⩽ 4mA, V_{ID} = -1V		110	400	mV
		I_{SINK} ⩽ 4mA, V_{ID} = -1V T_A = －40°C to +125°C			550	mV
I_{OH-LKG}	High-level output leakage current	(V+) = V_O = 5V; V_{ID} = 1V		0.1	50	nA
		(V+) = V_O = 36V; V_{ID} = 1V			100	nA
I_{OL}	Low level output current	V_{OL} = 1.5V; V_{ID} = -1V; V_S = 5V	6	21		mA
I_Q	Quiescent current (all comparators)	V_S = 5V, no load		0.8	1.2	mA
		V_S = 36V, no load, T_A = －40°C to +125°C		1	1.6	mA

(1) When the voltage at either input goes negative by more than 0.3V, the output can be incorrect and excessive input current can flow. The upper end of the common-mode voltage range is limited by V_{CC} － 2V. However only one input needs to be in the valid common mode range, the other input can go up the maximum V_{CC} level and the comparator provides a proper output state. Either or both inputs can go to maximum V_{CC} level without damage.

5.8 Switching Characteristics for LM2901B-Q1

V_S = 5V, V_{O_PULLUP} = 5V, V_{CM} = V_S/2, C_L = 15pF, R_L = 5.1kOhm, T_A = 25°C (unless otherwise noted).

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{response}$	Propagation delay time, high-to-low; Small scale input signal (1)	Input overdrive = 5mV, Input step = 100mV		1000		ns
$t_{response}$	Propagation delay time, high-to-low; TTL input signal (1)	TTL input with V_{ref} = 1.4V		300		ns

(1) High-to-low and low-to-high refers to the transition at the input.

5.9 Electrical Characteristics for LM2901x-Q1

V_{CC} = 5V, at specified free-air temperature (unless otherwise noted)

PARAMETER		TEST CONDITIONS(1)		T_A (2)	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	$V_{IC} = V_{ICR(min)}$, V_O = 1.4V, V_{CC} = 5V to MAX(3)	Non A devices	25°C		2	7	mV
				Full range			15	
			A suffix devices	25°C		1	2	
				Full range			4	
I_{IO}	Input offset current	V_O = 1.4V		25°C		5	50	nA
				Full range			200	
I_{IB}	Input bias current	V_O = 1.4V		25°C		− 25	− 250	nA
				Full range			− 500	
V_{ICR}	Common-mode input-voltage range(4)			25°C	0		V_{CC} − 1.5	V
				Full range	0		V_{CC} − 2	
A_{VD}	Large-signal differential-voltage amplification	V_{CC} = 15V, V_O = 1.4V to 11.4V, $R_L \geqslant 15k\Omega$ to V_{CC}		25°C	25	100		V/mV
I_{OH}	High-level output current	V_{ID} = 1V	V_{OH} = 5V	25°C		0.1	50	nA
			V_{OH} = V_{CC} MAX(3)	Full range			1	μA
V_{OL}	Low-level output voltage	V_{ID} = − 1V	I_{OL} = 4mA	25°C		150	400	mV
				Full range			700	
I_{OL}	Low-level output current	V_{ID} = − 1V	V_{OL} = 1.5V	25°C	6	16		mA
I_{CC}	Supply current (four comparators)	V_O = 2.5V, No load	V_{CC} = 5V	25°C		0.8	2	
			V_{CC} = MAX(3)			1	2.5	

(1) All characteristics are measured with zero common-mode input voltage, unless otherwise specified.
(2) Full range (MIN to MAX) is −40°C to 125°C. All characteristics are measured with zero common-mode input voltage, unless otherwise specified.
(3) V_{CC} MAX = 30V for non-V devices and 32V for V-suffix devices.
(4) The voltage at either the input or common mode can not be allowed to negative by more that 0.3V. The upper end of the common-mode voltage range is V_{CC+} − 1.5V; however, one input can exceed V_{CC}, and the comparator can provide a proper output state as long as the other input remains in the common-mode range. Either or both inputs can go to 30V without damage.

5.10 Switching Characteristics for LM2901x-Q1

V_{CC} = 5V, T_A = 25°C

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Response time(2)	R_L connected to 5V through 5.1kΩ, C_L = 15pF(1)	100mV input step with 5mV overdrive		1.3		μs
		TTL-level input step		0.3		

(1) C_L includes probe and jig capacitance.
(2) The response time specified is the interval between the input step function and the instant when the output crosses 1.4V.

6 Detailed Description

6.1 Overview

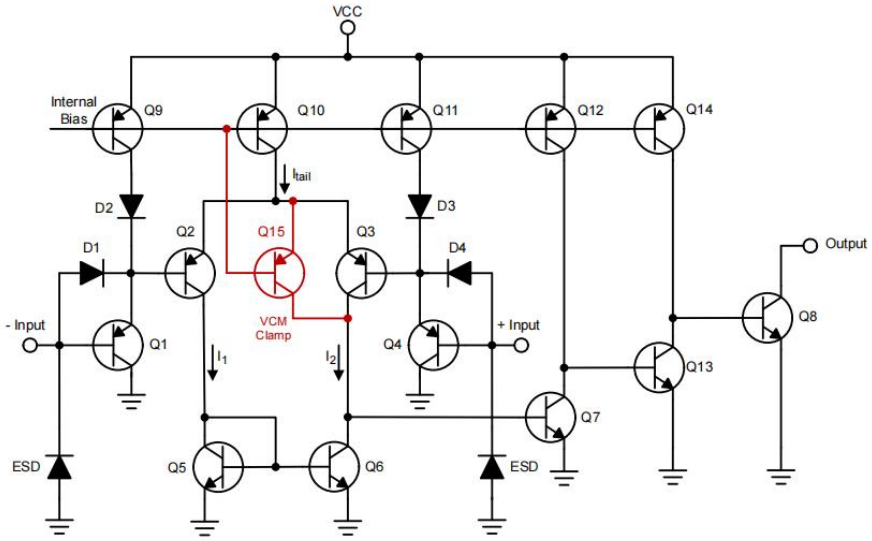
The LM2901-Q1 family is a quad comparator with the ability to operate up to 36V on the supply pin. This standard device has proven ubiquity and versatility across a wide range of applications. This is due to it's very wide supply voltages range (2V to 36V), low Iq and fast response.

This device is AEC-Q100 qualified and can operate over a wide temperature range of －40°C to 125°C .

The open-drain output allows the user to configure the output's logic low voltage (V_{OL}) and can be utilized to enable the comparator to be used in AND functionality.

The "B" versions add dedicated ESD protections on all the pins for improved ESD performance as well as improved negative input voltage handling. Please see Application Note SNOAA35 for more information

6.2 Functional Block Diagram Schematic (Each Comparator)



6.3 Feature Description

The comparator consists of a PNP darlington pair input, allowing the device to operate with very high gain and fast response with minimal input bias current. The input Darlington pair creates a limit on the input common mode voltage capability, allowing the comparator to accurately function from ground to V_{CC}－ 2V over temperature. On the non-B devices, a clamp was added around Q3 to mimic the both inputs above input voltage range behavior of the original classic silicon.

The output consists of an open drain NPN (pull-down or low side) transistor. The output NPN sinks current when the negative input voltage is higher than the positive input voltage and the offset voltage. The V_{OL} is resistive and scales with the output current. Please see the "Output Low Voltage vs. Output Sinking Current" graphs for V_{OL} values with respect to the output current.

6.4 Device Functional Modes

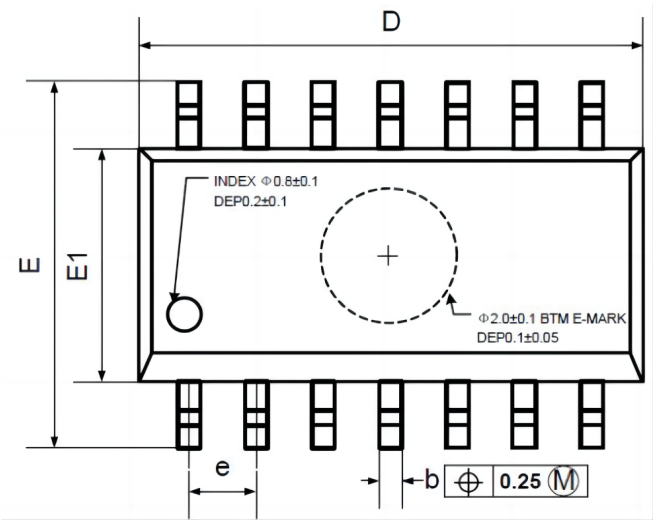
6.4.1 Voltage Comparison

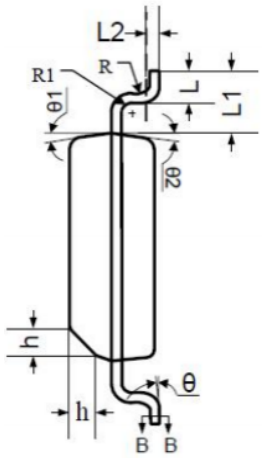
The LM2901-Q1 family of devices operates solely as a voltage comparator, comparing the differential voltage between the positive and negative pins and outputs a logic low or high impedance (logic high with pullup) based on the input differential polarity.

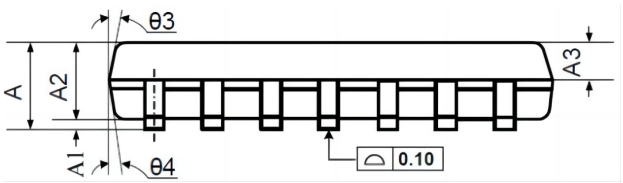
ORDERING INFORMATION

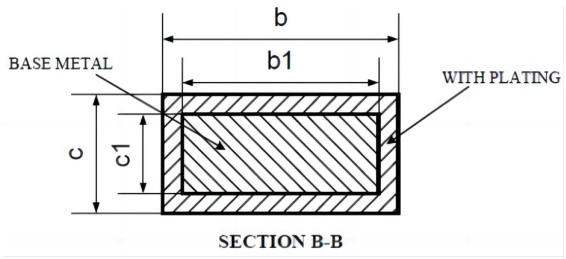
Order Number	Package	Package Quantity	MarkingOn The park
LM2901AVQDRG4Q1-TUDI	SOP14	Tape,Reel,2500	2901AVQ
LM2901AVQDRQ1-TUDI	SOP14	Tape,Reel,2500	2901AVQ
LM2901AVQPWRG4Q1-TUDI	TSSOP14	Tape,Reel,2500	2901AVQ
LM2901AVQPWRQ1-TUDI	TSSOP14	Tape,Reel,2500	2901AVQ
LM2901BQDRQ1-TUDI	SOP14	Tape,Reel,2500	LM2901BQ
LM2901BQPWRQ1-TUDI	TSSOP14	Tape,Reel,2500	2901BQ
LM2901QDRG4Q1-TUDI	SOP14	Tape,Reel,2500	2901Q1
LM2901QDRQ1-TUDI	SOP14	Tape,Reel,2500	2901Q1
LM2901QPWRG4Q1-TUDI	TSSOP14	Tape,Reel,2500	2901Q1
LM2901QPWRQ1-TUDI	TSSOP14	Tape,Reel,2500	2901Q1
LM2901VQDRG4Q1-TUDI	SOP14	Tape,Reel,2500	2901VQ1
LM2901VQDRQ1-TUDI	SOP14	Tape,Reel,2500	2901VQ1
LM2901VQPWRG4Q1-TUDI	TSSOP14	Tape,Reel,2500	2901Q1
LM2901VQPWRQ1-TUDI	TSSOP14	Tape,Reel,2500	2901VQ

Package SOP14



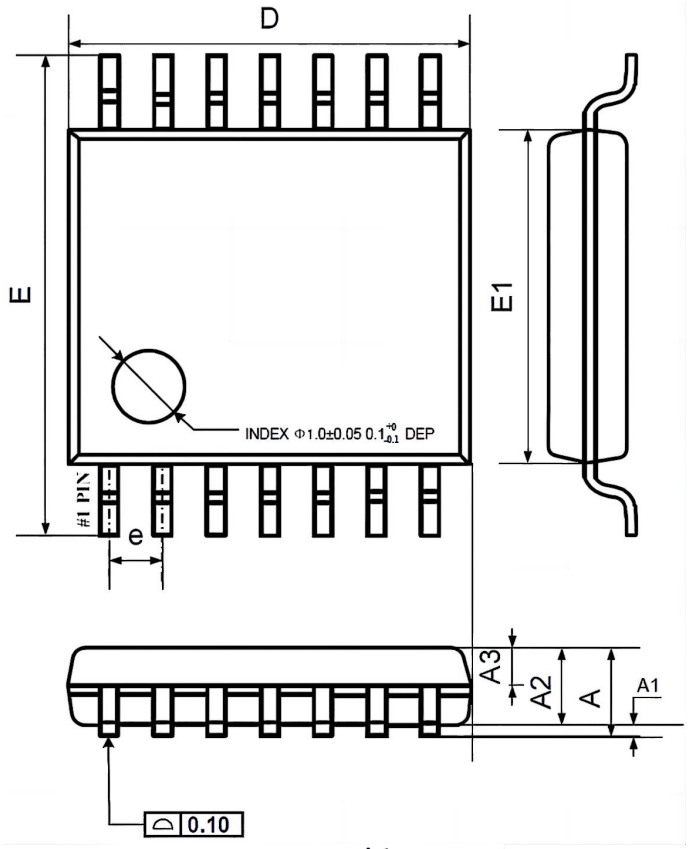


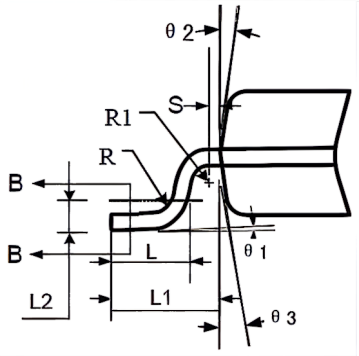


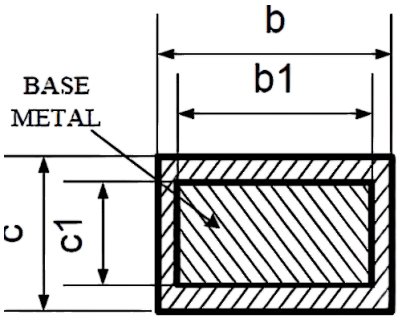


Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	1.35	1.60	1.75
A1	0.10	0.15	0.25
A2	1.25	1.45	1.65
A3	0.55	0.65	0.75
b	0.36		0.49
b1	0.35	0.40	0.45
C	0.16		0.25
c1	0.15	0.20	0.25
D	8.53	8.63	8.73
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.45	0.60	0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07		
R1	0.07		
h	0.30	0.40	0.50
θ	0°		8°
θ1	6°	8°	10°
θ2	6°	8°	10°
θ3	5°	7°	9°
θ4	5°	7°	9°

Package TSSOP14







Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.90	1.00	1.05
A3	0.34	0.44	0.54
b	0.20	—	0.28
b1	0.20	0.22	0.24
C	0.10	—	0.19
c1	0.10	0.13	0.15
D	4.86	4.96	5.06
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65 BSC		
L	0.45	0.60	0.75
L1	1.00 REF		
L2	0.25 BSC		
R	0.09	—	—
R1	0.09	—	—
S	0.20	—	—
θ1	0°	—	8°
θ2	10°	12°	14°
θ3	10°	12°	14°

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