钍地半导体
Tudi Semiconductor

Product Specification

TUDI-LM2902

Low-power quad operational amplifier

网址 www.sztdbdt.com

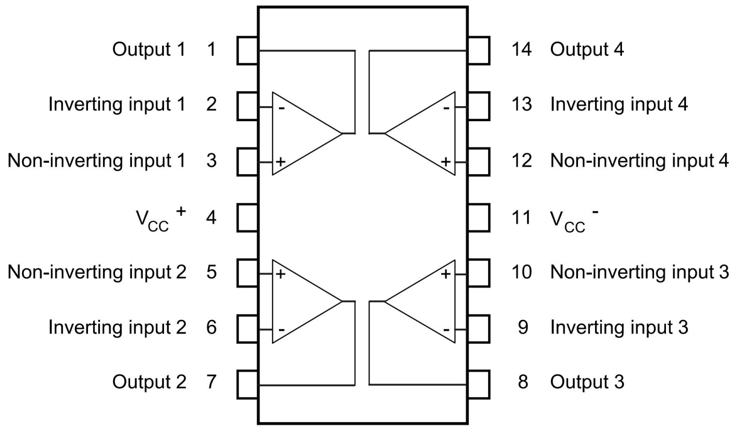
用芯智造·卓越品质

semiconductor device manufacturer

- Design
- research and development
- production
- and sales

Features

- Wide gain bandwidth: 1.3 MHz
- Input common-mode voltage range includes negative rail
- Large voltage gain: 100 dB
- Very low supply current per amplifier: 375 μA
- Low input bias current: 20 nA
- Low input offset current: 2 nA
- ESD internal protection: 800 V
- Wide power supply range
- Single supply: 3 V to 30 V
- Dual supplies: ±1.5 V to ±15 V



SO14 and TSSOP14 pin connections

Description

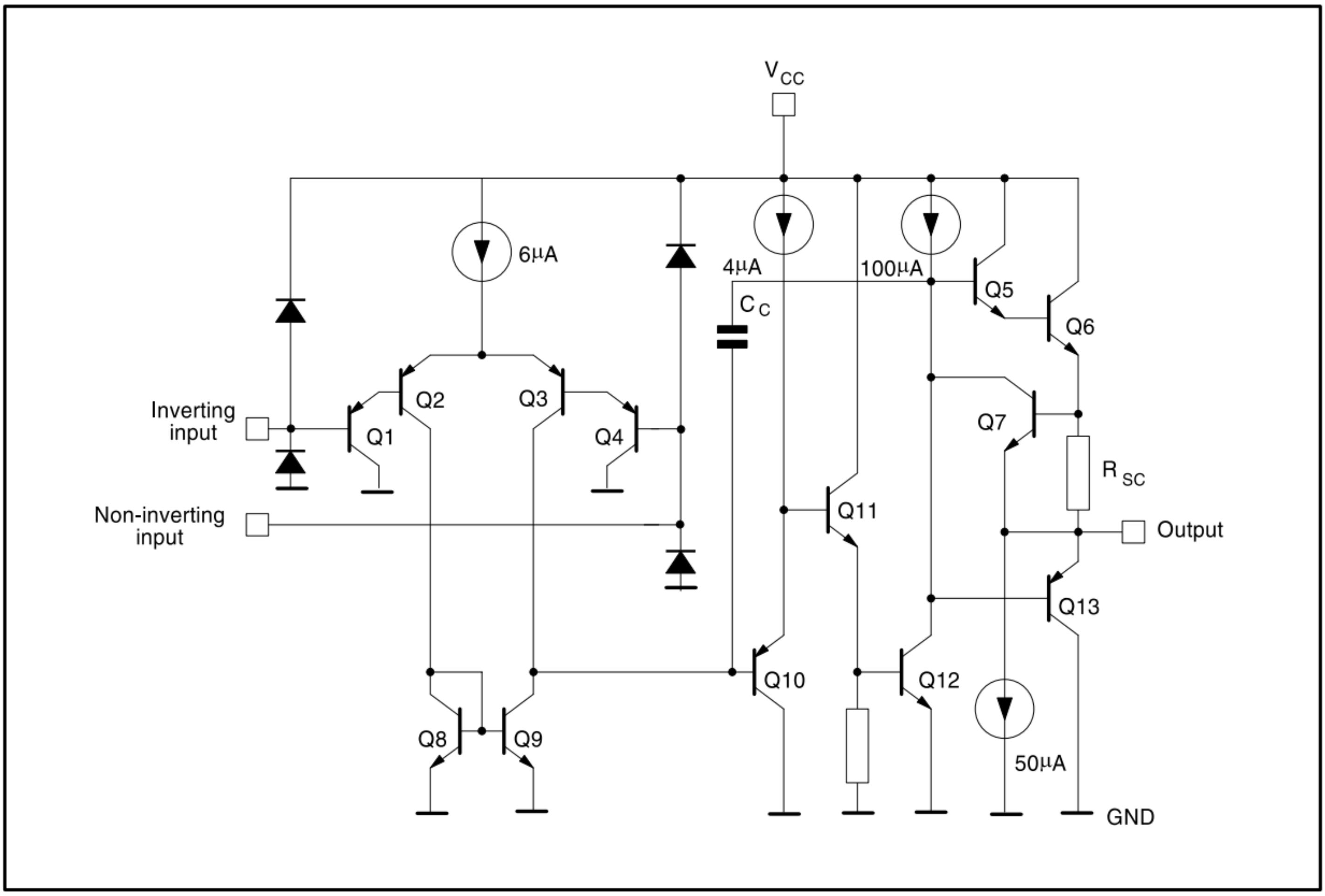
This circuit consists of four independent, high-gain operational amplifiers which have frequency compensation implemented internally and are designed especially for automotive and industrial control systems.

The device operates from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

All the pins are protected against electrostatic discharges up to 800 V.

Schematic diagram

Figure 1: Schematic diagram (1/4 LM2902W)



Absolute maximum ratings and operating conditions

Table 1: Absolute maximum ratings

Symbol	Parameter		Value	Unit
V_{CC}	Supply voltage		±16 to 32	V
V_{id}	Differential input voltage		32	V
V_i	Input voltage		-0.3 to (V_{CC}^+) + 0.3	V
	Output short-circuit to ground (1)		Infinite	
I_{in}	Input current (2)		50	mA
T_{stg}	Storage temperature range		-65 to 150	°C
R_{thja}	Thermal resistance junction to ambient (3)	SO14	105	°C/W
		TSSOP14	100	
R_{thjc}	Thermal resistance junction to case (3)	SO14	31	
		TSSOP14	32	
ESD	HBM: human body model (4)		800	V
	MM: machine model (5)		100	
	CDM: charged device model (6)		1500	

Notes:

(1)Short-circuits from the output to V_{CC}^+ can cause excessive heating and potential destruction. The maximum output current is approximately 20 mA, independent of the magnitude of V_{CC}^+

(2)This input current only exists when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistor becoming forward biased and thereby acting as an input diode clamp. In addition to this diode action, there is also NPN parasitic action on the IC chip. This transistor action can cause the output voltages of the op amps to go to the V_{CC} voltage level (or to ground for a large overdrive) for the time during which an input is driven negative. This is not destructive and normal output is restored for input voltages higher than -0.3 V.

(3)$R_{thja/c}$ are typical values.

(4)Human body model: a 100 pF capacitor is charged to the specified voltage, then discharged through a 1.5 kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are floating.

(5)Machine model: a 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω). This is done for all couples of connected pin combinations while the other pins are floating.

(6)Charged device model: all pins and the package are charged together to the specified voltage and then discharged directly to the ground through only one pin. This is done for all pins.

Table 2: Operating conditions

Symbol	Parameter		Value	Unit
V_{CC}	Supply voltage		3 to 30	V
V_{icm}	Common mode input voltage range		(V_{CC}^-) to (V_{CC}^+) - 1.5	V
		$T_{min} \leq T_{amb} \leq T_{max}$	(V_{CC}^-) to (V_{CC}^+) - 2	
T_{oper}	Operating free-air temperature range		-40 to 125	°C

Electrical characteristics

Table 3: VCC+ = 5 V, VCC- = ground, VO = 1.4 V, Tamb = 25 °C (unless otherwise stated)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage [(1)]	LM2902W		2	7	mV
		LM2902AW			2	
		$T_{min} \le T_{amb} \le T_{max}$, LM2902W			9	
		$T_{min} \le T_{amb} \le T_{max}$, LM2902AW			4	
$\Delta V_{io}/\Delta T$	Input offset voltage drift			7	30	μV/°C
I_{io}	Input offset current	T_{amb} = 25 °C		2	30	nA
		$T_{min} \le T_{amb} \le T_{max}$			40	
DI_{io}	Input offset current drift			10	200	pA/°C
I_{ib}	Input bias current [(2)]	T_{amb} = 25 °C		20	150	nA
		$T_{min} \le T_{amb} \le T_{max}$			300	
A_{vd}	Large signal voltage gain	V_{CC}^+ = 15 V, R_L = 2 kΩ, V_o = 1.4 V to 11.4 V, T_{amb} = 25 °C	50	100		V/mV
		V_{CC}^+ = 15 V, R_L = 2 kΩ, V_o = 1.4 V to 11.4 V, $T_{min} \le T_{amb} \le T_{max}$	25			
SVR	Supply voltage rejection ratio	$R_S \le$ 10 kΩ, T_{amb} = 25 °C	65	110		dB
		$R_S \le$ 10 kΩ, $T_{min} \le T_{amb} \le T_{max}$	65			
I_{CC}	Supply current (all op amps, no load)	T_{amb} = 25 °C, V_{CC}^+ = 5 V		0.7	1.2	mA
		T_{amb} = 25 °C, V_{CC}^+ = 30 V		1.5	3	
		$T_{min} \le T_{amb} \le T_{max}$, V_{CC}^+ = 5 V		0.9	1.2	
		$T_{min} \le T_{amb} \le T_{max}$, V_{CC}^+ = 30 V		1.5	3	
CMR	Common-mode rejection ratio	$R_S \le$ 10 kΩ, T_{amb} = 25 °C	70	80		dB
		$R_S \le$ 10 kΩ, $T_{min} \le T_{amb} \le T_{max}$	60			
I_o	Output short-circuit current	V_{id} = 1 V, V_{CC}^+ = 15 V, V_o = 2 V	20	40	70	mA
I_{sink}	Output sink current	V_{id} = -1 V, V_{CC}^+ = 15 V, V_o = 2 V	10	20		
		V_{id} = -1 V, V_{CC}^+ = 15 V, V_o = 0.2 V	12	50		μA
V_{OH}	High-level output voltage	V_{CC}^+ = 30 V, R_L = 2 kΩ, T_{amb} = 25 °C	26	27		V
		V_{CC}^+ = 30 V, R_L = 2 kΩ, T_{min} = T_{amb} = T_{max}	26			
		V_{CC}^+ = 30 V, R_L = 10 kΩ, T_{amb} = 25 °C	27	28		
		V_{CC}^+ = 30 V, R_L = 10 kΩ, T_{min} = T_{amb} = T_{max}	27			
		V_{CC}^+ = 5 V, R_L = 2 kΩ, T_{amb} = 25 °C	3.5			
		V_{CC}^+ = 5 V, R_L = 2 kΩ, T_{min} = T_{amb} = T_{max}	3			
V_{OL}	Low level output voltage	R_L = 10 kΩ, T_{amb} = 25 °C		5	20	mV
		R_L = 10 kΩ, T_{min} = T_{amb} = T_{max}			20	
SR	Slew rate	V_{CC}^+ = 15 V, V_{in} = 0.5 to 3 V, R_L = 2 kΩ, C_L = 100 pF, unity gain	0.24	0.4		V/μs

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
SR	Slew rate	V_{CC}^{+} = 15 V, V_{in} = 0.5 to 3 V, R_L = 2 kΩ, C_L = 100 pF, unity gain, $T_{min} \leq T_{amb} \leq T_{max}$	0.14			V/μs
GBP	Gain bandwidth product	V_{CC}^{+} = 30 V, V_{in} = 10 mV, R_L = 2 kΩ, C_L = 100 pF		1.3		MHz
THD	Total harmonic distortion	f = 1 kHz, A_V = 20 dB, R_L = 2 kΩ, V_o = 2 V_{pp}, C_L = 100 pF, V_{CC}^{+} = 30 V		0.015		%
e_n	Equivalent input noise voltage	f = 1 kHz, R_S = 100 Ω, V_{CC}^{+} = 30 V		40		nV/√Hz
V_{O1}/V_{O2}	Channel separation [3]	1 kHz ≤ f ≤ 20 kHz		120		dB

Notes:

[1] V_O = 1.4 V, R_S = 0 Ω, 5 V < V_{CC}^{+} < 30 V, 0 V < V_{ic} < (V_{CC}^{+}) - 1.5 V.

[2] The direction of the input current is out of the IC. This current is essentially constant, independent of the state of the output, so there is no change in the load on the input lines.

[3] Due to the proximity of external components, ensure that stray capacitance does not cause coupling between these external parts. Typically, this can be detected as this type of capacitance increases at higher frequencies.

Typical single-supply applications

Figure 2: AC coupled inverting amplifier

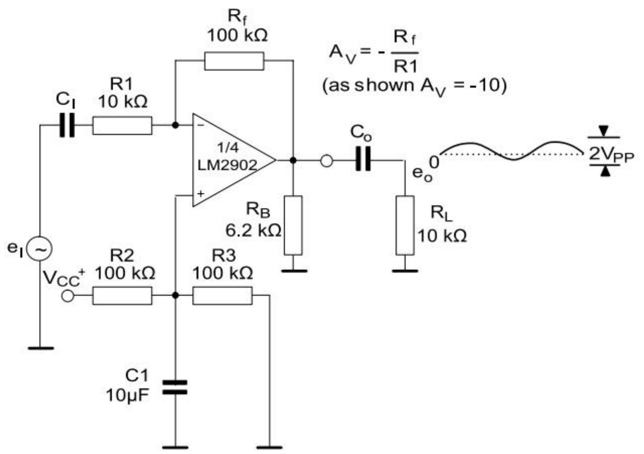


Figure 3: AC coupled non-inverting amplifier

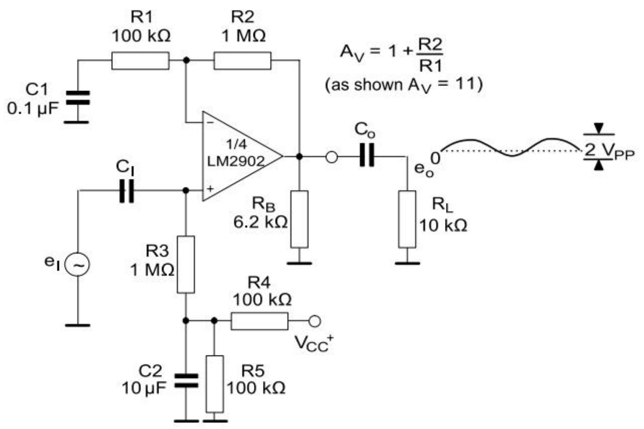


Figure 4: Non-inverting DC gain

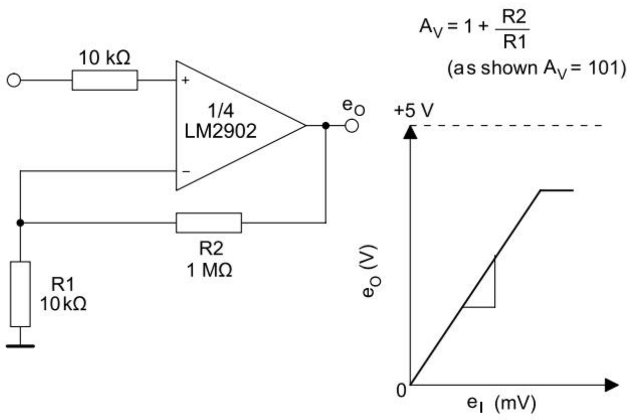
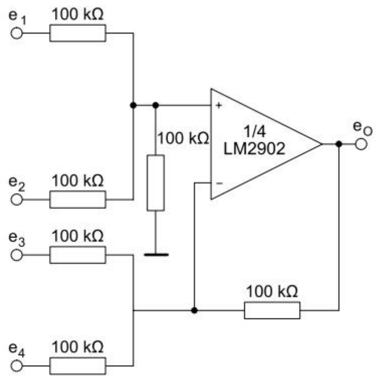
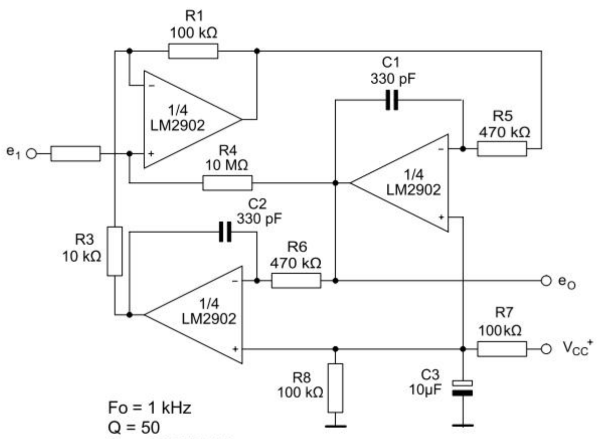


Figure 5: DC summing amplifier



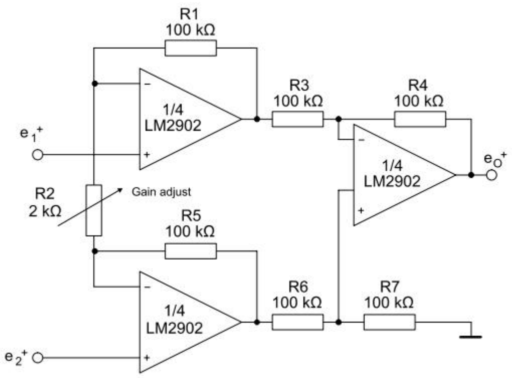
eo = e1 + e2 - e3 - e4
where (e1 + e2) ≥ (e3 + e4)
to keep eo ≥ 0 V

Figure 6: Active bandpass filter



Fo = 1 kHz
Q = 50
Av = 100 (40 dB)

Figure 7: High input Z adjustable gain DC instrumentation amplifier



If R1 = R5 and R3 = R4 = R6 = R7
$eo = [\, 1 + \frac{2R1}{R2} \,]\,(e2 - e1)$
As shown eo = 101 (e2 - e1)

Figure 8: High input Z, DC differential amplifier

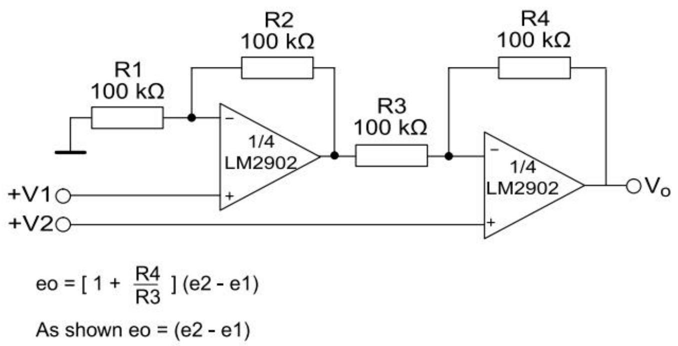
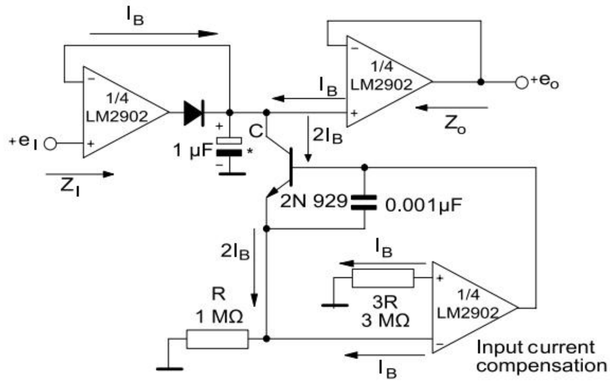
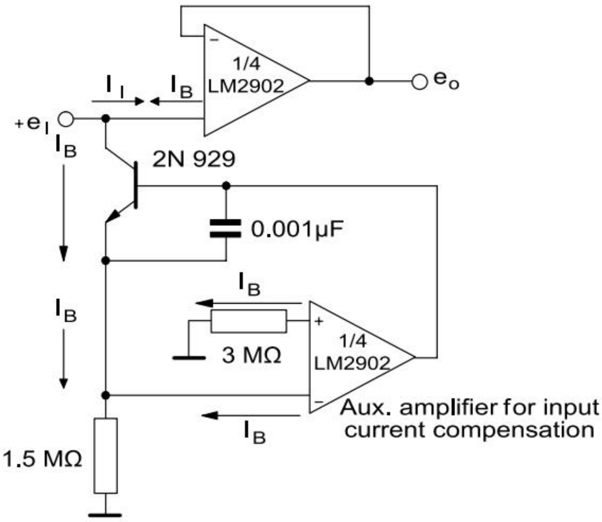


Figure 9: Low drift peak detector



* Polycarbonate or polyethylene

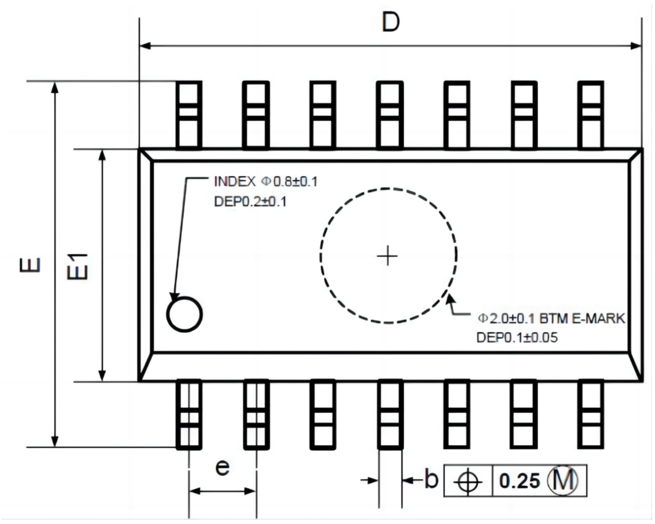
Figure 10: Using symmetrical amplifiers to reduce input current (general concept)

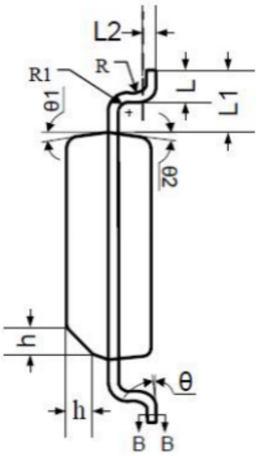


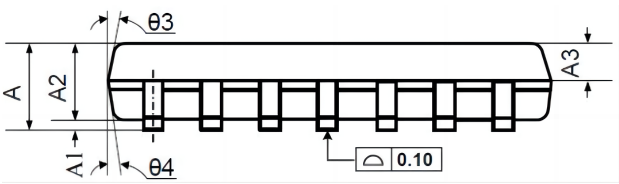
ORDERING INFORMATION

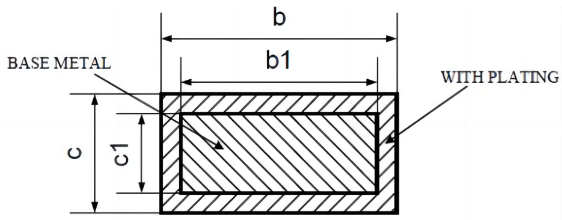
Order Number	Package	Package Quantity	Marking On The park
LM2902WDT-TUDI	SOP14	Tape,Reel,2500	2902W
LM2902WYDT-TUDI	SOP14	Tape,Reel,2500	2902WY
LM2902AWYDT-TUDI	SOP14	Tape,Reel,2500	2902AWY
LM2902WPT-TUDI	TSSOP14	Tape,Reel,2500	2902W
LM2902WYPT-TUDI	TSSOP14	Tape,Reel,2500	2902WY
LM2902AWYPT-TUDI	TSSOP14	Tape,Reel,2500	2902AWY

Package SOP14





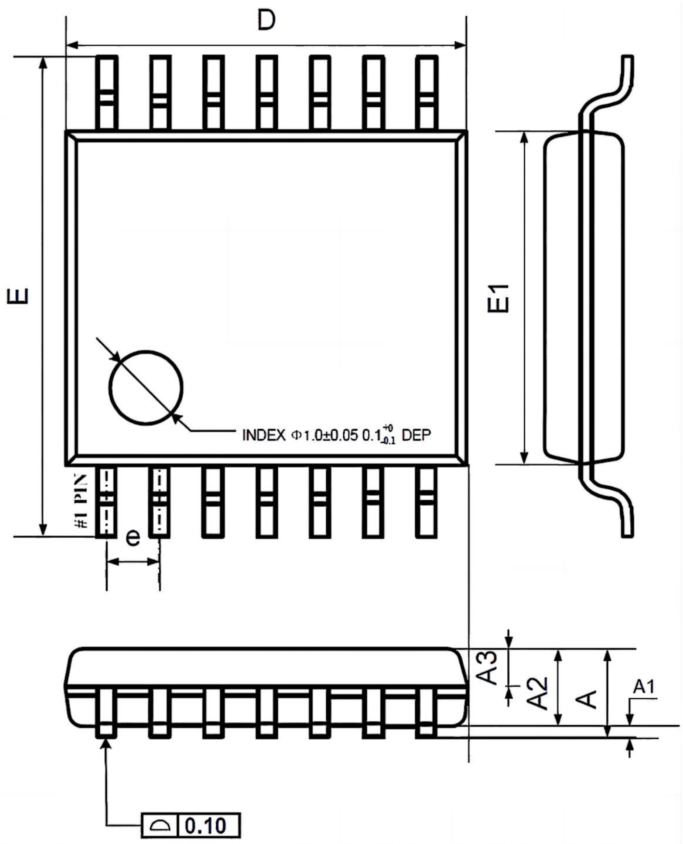


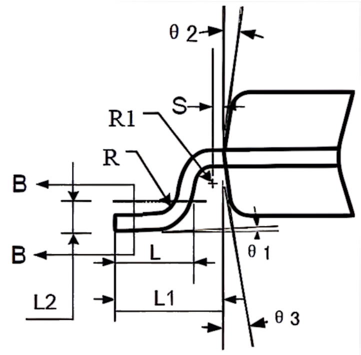


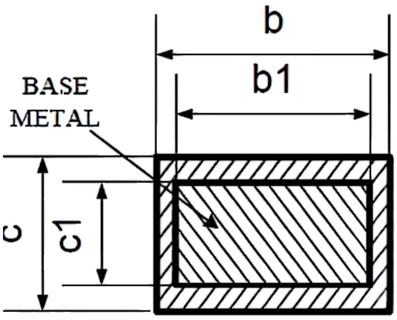
SECTION B-B

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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