钍地半导体
Tudi Semiconductor

Product Specification

TUDI-LM2901MX

Precision Voltage-to Frequency Converters

网址 www.sztdbdt.com

用芯智造·卓越品质

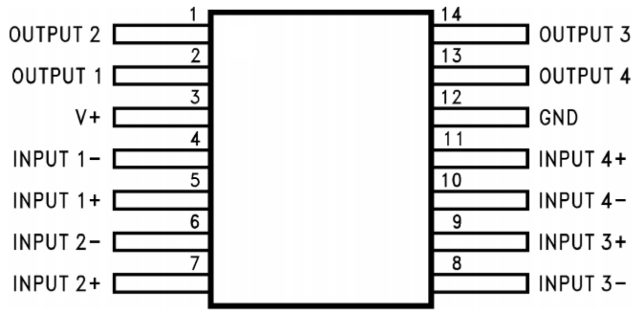
semiconductor device manufacturer

- Design
- research and development
- production
- and sales

Features

- WideSupplyVoltageRange
- LM139/139ASeries2to36V_{DC}or±1to±18V_{DC}
- LM2901-N:2to36V_{DC}or±1to±18V_{DC}
- LM3302-N:2to28V_{DC}or±1to±14V_{DC}
- VeryLowSupplyCurrentDrain(0.8mA)—
- IndependentofSupplyVoltage
- LowInputBiasingCurrent:25nA
- LowInputOffsetCurrent:±5nA
- OffsetVoltage:±3mV
- InputCommon-ModeVoltageRangeIncludes GND
- DifferentialInputVoltageRangeEqualtothe PowerSupplyVoltage
- LowOutputSaturationVoltage:250mVat4mA
- OutputVoltageCompatibleWithTTL,DTL,ECL, MOS,andCMOSLogicSystems
- Advantages:

– High-PrecisionComparators
– ReducedV_{OS}DriftOvertemperature
– EliminatesNeedforDualSupplies
– AllowsSensingNearGND
– CompatibleWithAllFormsofLogic
– PowerDrainSuitableforBatteryOperation



14-Pin CLGA Package

Applications

- LimitComparators
- SimpleAnalog-to-DigitalConverters(ADCs)
- Pulse,Squarewave,andTimeDelayGenerators
- WideRangeVCO;MOSClockTimers
- MultivibratorsandHigh-VoltageDigitalLogic Gates

Description

The LMx39-N series consists of four independent precision voltage comparators with an offset voltage specification as low as 2 mV maximum for all four comparators. These comparators were designed specifically to operate 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. These comparators also have a unique characteristic in that the input common-mode voltage range includes ground, even though they are operated from a single power supply voltage.

The LMx39-N series was designed to directly interface with TTL and CMOS. When operated from both plus and minus power supplies, the devices directly interface with MOS logic— where the low power drain of the LM339 is a distinct advantage over standard comparators.

Pin Functions

PIN		I/O	DESCRIPTION
NO.	NAME		
1	OUTPUT2	O	Output, Channel 2
2	OUTPUT1	O	Output, Channel 1
3	V+	P	Positive Supply
4	INPUT1-	I	Inverting Input, Channel 1
5	INPUT1+	I	Noninverting Input, Channel 1
6	INPUT2-	I	Inverting Input, Channel 2
7	INPUT2+	I	Noninverting Input, Channel 2
8	INPUT3-	I	Inverting Input, Channel 3
9	INPUT3+	I	Noninverting Input, Channel 3
10	INPUT4-	I	Inverting Input, Channel 4
11	INPUT4+	I	Noninverting Input, Channel 4
12	GND	P	Ground
13	OUTPUT4	O	Output, Channel 4
14	OUTPUT3	O	Output, Channel 3

6 Specifications

6.1 Absolute Maximum Ratings[1]

			MIN	MAX	UNIT
Supply Voltage, V^+	LM139N, LM239N, LM339N, LM2901N			36	V_{DC}
	LM3302N			28	
Differential Input Voltage	LM139N, LM239N, LM339N, LM2901N [2]			36	
	LM3302N[2]			28	
Input Voltage	LM139N, LM239N, LM339N, LM2901N		−0.3	36	
	LM3302		–0.3	28	
Input Current (V_{IN}<−0.3 V_{DC})[3]				50	mA
Power Dissipation[4]	PDIP			1050	mW
	Cavity DIP			1190	
	SOIC Package			760	
Output Short-Circuit to GND[5]				Continuous	
Lead Temperature (Soldering, 10 seconds)				260	°C
Soldering Information	PDIP Package (10 seconds)			260	
	SOIC Package	Vapor Phase (60 seconds)		215	
		Infrared (15 seconds)		220	
Storage temperature, T_{stg}			−65	150	

(1) Refer to RETS139AX for LM139A military specifications and to RETS139X for LM139 military specifications.
(2) Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator will provide a proper output state. The low input voltage state must not be less than −0.3 V_{DC} (or 0.3 V_{DC} below the magnitude of the negative power supply, if used) (at 25°C).
(3) This input current will only exist when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistors becoming forward biased and thereby acting as input diode clamps. In addition to this diode action, there is also lateral NPN parasitic transistor action on the IC chip. This transistor action can cause the output voltages of the comparators to go to the V^+ voltage level (or to ground for a large overdrive) for the time duration that an input is driven negative. This is not destructive and normal output states will re-establish when the input voltage, which was negative, again returns to a value greater than −0.3 V_{DC} (at 25°C).
(4) For operating at high temperatures, the LM339/LM339A, LM2901, LM3302 must be derated based on a 125°C maximum junction temperature and a thermal resistance of 95°C/W which applies for the device soldered in a printed circuit board, operating in a still air ambient. The LM239-N and LM139-N must be derated based on a 150°C maximum junction temperature. The low bias dissipation and the "ON-OFF" characteristic of the outputs keeps the chip dissipation very small (P_D≤100 mW), provided the output transistors are allowed to saturate.
(5) Short circuits from the output to V^+ can cause excessive heating and eventual destruction. When considering short circuits to ground, the maximum output current is approximately 20 mA independent of the magnitude of V^+.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001[1]	±600	V

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

6.3 Recommended Operating Conditions

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

			MIN	MAX	UNIT
Supply Voltage	Single Supply	LM139N, LM239N, LM339N, LM2901N	2	36	V
		LM3302N	2	28	
	Dual Supply	LM139N, LM239N, LM339N, LM2901N	±1	±18	
		LM3302N	±1	±14	
Operating Temperature	LM139/LM139A		−55	125	°C
	LM2901/LM3302		−40	85	
	LM239/LM239A		−25	85	
	LM339/LM339A		0	70	

6.4 Thermal Information

THERMAL METRIC(1)		LM139-N, LM239-N, LM339-N	LM2901-N, LM339-N	LM2901-N, LM339-N	UNIT
		J	D	NFF	
		14 PINS			
$R_{\theta JA}$	Junction-to-ambient thermal resistance	95	95	95	°C/W

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

6.5 Electrical Characteristics: LM139A, LM239A, LM339A, LM139

(V^+=5 V_{DC}, T_A = 25°C[1] unless otherwise stated)

PARAMETER	TEST CONDITIONS	LM139A			LM239A, LM339A			LM139			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage	See[2]		1.0	2.0		1.0	2.0		2.0	5.0	mV_{DC}
Input Bias Current	$I_{IN(+)}$ or $I_{IN(-)}$ with Output in Linear Range[3], V_{CM}=0 V		25	100		25	250		25	100	nA_{DC}
Input Offset Current	$I_{IN(+)} - I_{IN(-)}$, V_{CM}= 0 V		3.0	25		5.0	50		3.0	25	nA_{DC}
Input Common-Mode Voltage Range	V^+=30 V_{DC} (LM3302, V^+ = 28 V_{DC})[4]	0		V^+−1.5	0		V^+−1.5	0		V^+−1.5	V_{DC}
Supply Current	(LM3302, V^+ = 28 V_{DC}), R_L = ∞ on all Comparators		0.8	2.0		0.8	2.0		0.8	2.0	mA_{DC}
	(LM3302, V^+ = 28 V_{DC}), R_L = ∞, V^+ = 36 V					1.0	2.5		1.0	2.5	mA_{DC}
Voltage Gain	R_L≥15 kΩ, V^+ = 15 V_{DC} V_O = 1 V_{DC} to 11 V_{DC}	50	200		50	200		50	200		V/mV
Large Signal Response Time	V_{IN} = TTL Logic Swing, V_{REF} = 1.4 V_{DC}, V_{RL} = 5 V_{DC}, R_L = 5.1 kΩ		300			300			300		ns
Response Time	V_{RL} = 5 V_{DC}, R_L = 5.1 kΩ[5]		1.3			1.3			1.3		μs
Output Sink Current	$V_{IN(-)}$ = 1 V_{DC}, $V_{IN(+)}$ = 0, V_O ≤ 1.5 V_{DC}	6.0	16		6.0	16		6.0	16		mA_{DC}
Saturation Voltage	$V_{IN(-)}$ = 1 V_{DC}, $V_{IN(+)}$ = 0, I_{SINK} ≤ 4 mA		250	400		250	400		250	400	mV_{DC}
Output Leakage Current	$V_{IN(+)}$ = 1 V_{DC}, $V_{IN(-)}$ = 0, V_O = 5 V_{DC}		0.1			0.1			0.1		nA_{DC}
Input Offset Voltage	See[2]			4.0			4.0			9.0	mV_{DC}
Input Offset Current	$I_{IN(+)}-I_{IN(-)}$, V_{CM} = 0 V			100			150			100	nA_{DC}
Input Bias Current	$I_{IN(+)}$ or $I_{IN(-)}$ with Output in			300			400			300	nA_{DC}
	Linear Range, V_{CM} = 0 V[3]										
Input Common-Mode	V^+=30 V_{DC} (LM3302),	0		V^+−2.0	0		V^+−2.0	0		V^+−2.0	V_{DC}
Voltage Range	V^+ = 28 V_{DC})[4]										
Saturation Voltage	$V_{IN(-)}$=1 V_{DC}, $V_{IN(+)}$ = 0, I_{SINK} ≤ 4 mA			700			700			700	mV_{DC}
Output Leakage Current	$V_{IN(+)}$ = 1 V_{DC}, $V_{IN(-)}$ = 0, V_O = 30 V_{DC}, (LM3302, V_O = 28 V_{DC})			1.0			1.0			1.0	μA_{DC}
Differential Input Voltage	Keep all V_{IN}'s ≥ 0 V_{DC} (or V^-, if used)[6]			36			36			36	V_{DC}

(1) These specifications are limited to −55°C ≤ T_A ≤ 125°C, for the LM139/LM139A. With the LM239/LM239A, all temperature specifications are limited to −25°C ≤ T_A ≤ 85°C, the LM339/LM339A temperature specifications are limited to 0°C ≤ T_A ≤ 70°C, and the LM2901, LM3302 temperature range is −40°C ≤ T_A ≤ 85°C.
(2) At output switch point, V_O≃1.4 V_{DC}, R_S = 0 Ω with V^+ from 5 V_{DC} to 30 V_{DC}; and over the full input common-mode range (0 V_{DC} to V^+ −1.5 V_{DC}), at 25°C. For LM3302, V^+ from 5 V_{DC} to 28 V_{DC}.
(3) The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the reference or input lines.
(4) The input common-mode voltage or either input signal voltage should not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is V^+ −1.5V at 25°C, but either or both inputs can go to 30 V_{DC} without damage (25V for LM3302), independent of the magnitude of V^+.
(5) The response time specified is a 100-mV input step with 5-mV overdrive. For larger overdrive signals 300 ns can be obtained, see typical performance characteristics section.
(6) Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator will provide a proper output state. The low input voltage state must not be less than −0.3 V_{DC} (or 0.3 V_{DC}below the magnitude of the negative power supply, if used) (at 25°C).

6.6 Electrical Characteristics: LM239, LM339, LM2901, LM3302

($V^+ = 5\ V_{DC}$, $T_A = 25°C$[1] unless otherwise stated)

PARAMETER	TEST CONDITIONS	LM239, LM339			LM2901			LM3302			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage	See[2]		2.0	5.0		2.0	7.0		3	20	mV_{DC}
Input Bias Current	$I_{IN(+)}$ or $I_{IN(-)}$ with Output in Linear Range[3], V_{CM}=0 V		25	250		25	250		25	500	nA_{DC}
Input Offset Current	$I_{IN(+)}-I_{IN(-)}$, V_{CM} = 0 V		5.0	50		5	50		3	100	nA_{DC}
Input Common-Mode Voltage Range	V^+ = 30 V_{DC} (LM3302, V^+ = 28 V_{DC})[4]	0		V^+−1.5	0		V^+−1.5	0		V^+−1.5	V_{DC}
Supply Current	(LM3302, V^+ = 28 V_{DC}) R_L = ∞ on all Comparators		0.8	2.0		0.8	2.0		0.8	2.0	mA_{DC}
	(LM3302, V^+ = 28 V_{DC}) R_L = ∞, V^+ = 36 V		1.0	2.5		1.0	2.5		1.0	2.5	mA_{DC}
Voltage Gain	R_L ≥ 15 kΩ, V^+ = 15 V_{DC} V_O = 1 V_{DC} to 11 V_{DC}	50	200		25	100		2	30		V/mV
Large Signal Response Time	V_{IN} = TTL Logic Swing, V_{REF} = 1.4 V_{DC}, V_{RL} = 5 V_{DC}, R_L = 5.1 kΩ,		300			300			300		ns
Response Time	V_{RL} = 5 V_{DC}, R_L = 5.1 kΩ[5]		1.3			1.3			1.3		μs
Output Sink Current	$V_{IN(-)}$= 1 V_{DC}, $V_{IN(+)}$ = 0, V_O ≤ 1.5 V_{DC}	6.0	16		6.0	16		6.0	16		mA_{DC}
Saturation Voltage	$V_{IN(-)}$ = 1 V_{DC}, $V_{IN(+)}$ = 0, I_{SINK} ≤ 4 mA		250	400		250	400		250	500	mV_{DC}
Output Leakage Current	$V_{IN(+)}$ = 1 V_{DC},$V_{IN(-)}$ = 0, V_O = 5 V_{DC}		0.1			0.1			0.1		nA_{DC}
Input Offset Voltage	See[2]			9.0		9	15			40	mV_{DC}
Input Offset Current	$I_{IN(+)}-I_{IN(-)}$, V_{CM} = 0 V			150		50	200			300	nA_{DC}
Input Bias Current	$I_{IN(+)}$ or $I_{IN(-)}$ with Output in			400		200	500			1000	nA_{DC}
	Linear Range, V_{CM} = 0V[3]										
Input Common-Mode	V^+ = 30 V_{DC} (LM3302, V^+ = 28 V_{DC})			V^+−2.0	0		V^+−2.0	0		V^+−2.0	V_{DC}
Voltage Range	See[4]										
Saturation Voltage	$V_{IN(-)}$ = 1 V_{DC}, $V_{IN(+)}$ = 0, I_{SINK} ≤ 4 mA			700		400	700			700	mV_{DC}
Output Leakage Current	$V_{IN(+)}$ = 1 V_{DC}, $V_{IN(-)}$ = 0, V_O = 30 V_{DC}, (LM3302, V_O = 28 V_{DC})			1.0			1.0			1.0	μA_{DC}
Differential Input Voltage	Keep all V_{IN}'s ≥ 0 V_{DC} (or V^-, if used)[6]			36			36			28	V_{DC}

(1) These specifications are limited to −55°C ≤ T_A ≤ 125°C, for the LM139/LM139A. With the LM239/LM239A, all temperature specifications are limited to −25°C ≤ T_A ≤ 85°C, the LM339/LM339A temperature specifications are limited to 0°C ≤ T_A ≤ 70°C, and the LM2901, LM3302 temperature range is −40°C ≤ T_A ≤ 85°C.

(2) At output switch point, V_O≃1.4 V_{DC}, R_S = 0 Ω with V^+ from 5 V_{DC} to 30 V_{DC}; and over the full input common-mode range (0 V_{DC} to V^+ −1.5 V_{DC}), at 25°C. For LM3302, V^+ from 5 V_{DC} to 28 V_{DC}.

(3) The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the reference or input lines.

(4) The input common-mode voltage or either input signal voltage should not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is V^+ −1.5V at 25°C, but either or both inputs can go to 30 V_{DC} without damage (25V for LM3302), independent of the magnitude of V^+.

(5) The response time specified is a 100-mV input step with 5-mV overdrive. For larger overdrive signals 300 ns can be obtained, see typical performance characteristics section.

(6) Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator will provide a proper output state. The low input voltage state must not be less than −0.3 V_{DC} (or 0.3 V_{DC}below the magnitude of the negative power supply, if used) (at 25°C).

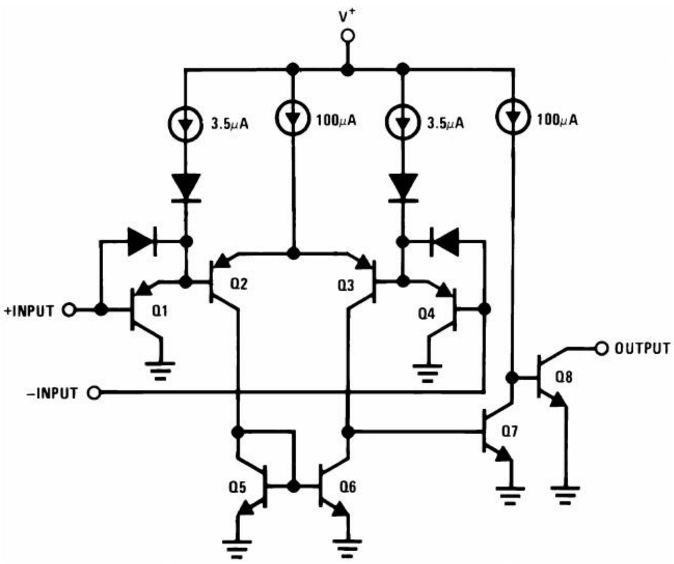
7 Detailed Description

7.1 Overview

The LM139/LM239/LM339 family of devices is a monolithic quad of independently functioning comparators designed to meet the needs for a medium-speed, TTL compatible comparator for industrial applications. Since no antisaturation clamps are used on the output such as a Baker clamp or other active circuitry, the output leakage current in the OFF state is typically 0.1 nA. This makes the device ideal for system applications where it is desired to switch a node to ground while leaving it totally unaffected in the OFF state. Other features include single supply, low voltage operation with an input common mode range from ground up to approximately one volt below V_{CC} . The output is an uncommitted collector so it may be used with a pullup resistor and a separate output supply to give switching levels from any voltage up to 36V down to a V CE SAT above ground (approximately 100 mV), sinking currents up to 16 mA. The open collector output configuration allows the device to be used in wired-OR configurations, such as a window comparators.

In addition it may be used as a single pole switch to ground, leaving the switched node unaffected while in the OFF state. Power dissipation with all four comparators in the OFF state is typically 4 mW from a single 5-V supply (1 mW/comparator).

7.2 Functional Block Diagram



7.3 Feature Description

The LMx39-N series are high-gain, wide bandwidth devices which, like most comparators, can easily oscillate if the output lead is inadvertently allowed to capacitively couple to the inputs through stray capacitance. This shows up only during the output voltage transition intervals as the comparator changes states. Reducing the input resistors to < 10 kΩ reduces the feedback signal levels and finally, adding even a small amount (1 to 10 mV) of positive feedback (hysteresis) causes such a rapid transition that oscillations due to stray feedback are not possible. Simply socketing the IC and attaching resistors to the pins will cause input-output oscillations during the small transition intervals unless hysteresis is used. If the input signal is a pulse waveform, with relatively fast rise and fall times, hysteresis is not required.

The differential input voltage may be larger than V^+ without damaging the device. Protection should be provided to prevent the input voltages from going negative more than −0.3 V_{DC} (at 25°C). An input clamp diode can be used as shown in the applications section.

The output of the LMx39-N series is the uncommitted collector of a grounded-emitter NPN output transistor. Many collectors can be tied together to provide an output OR'ing function. An output pullup resistor can be connected to any available power supply voltage within the permitted supply voltage range and there is no restriction on this voltage due to the magnitude of the voltage which is applied to the V^+ terminal of the LM139A package. The output can also be used as a simple SPST switch to ground (when a pullup resistor is not used).

Feature Description (continued)

The amount of current which the output device can sink is limited by the drive available (which is independent of V^+) and the β of this device. When the maximum current limit is reached (approximately 16 mA), the output transistor will come out of saturation and the output voltage will rise very rapidly. The output saturation voltage is limited by the approximately 60-Ω R_{SAT} of the output transistor. The low offset voltage of the output transistor (4 mV) allows the output to clamp essentially to ground level for small load currents.

7.4 Device Functional Modes

A basic comparator circuit is used for converting analog signals to a digital output. The output is HIGH when the voltage on the non-inverting (+IN) input is greater than the inverting (-IN) input. The output is LOW when the voltage on the noninverting (+IN) input is less than the inverting (-IN) input. The inverting input (-IN) is also commonly referred to as the "reference" or "VREF" input.

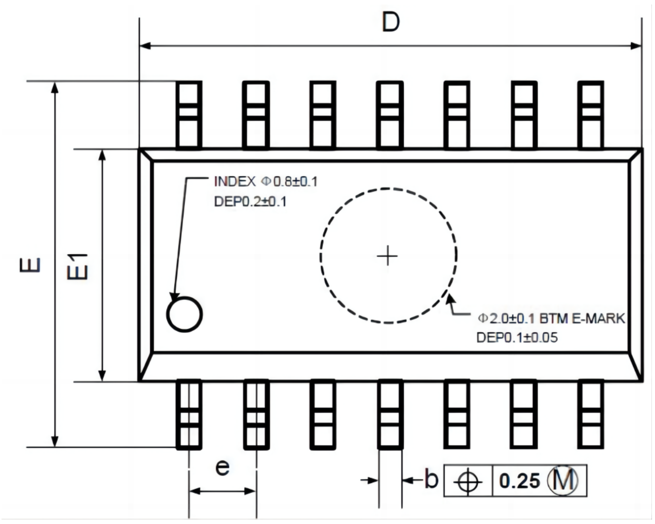
All pins of any unused comparators should be tied to the negative supply.

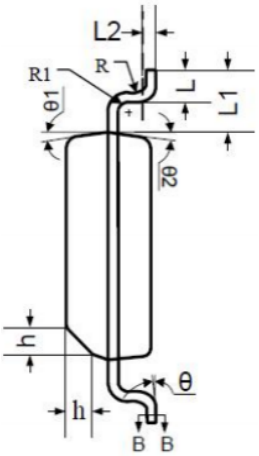
The bias network of the LMx39-N series establishes a drain current which is independent of the magnitude of the power supply voltage over the range of from 2 V_{DC} to 30 V_{DC}.

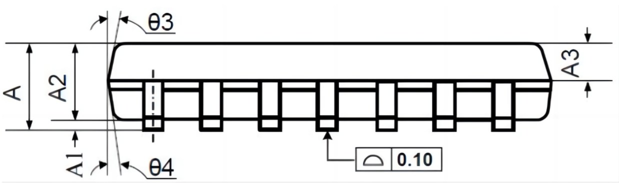
ORDERING INFORMATION

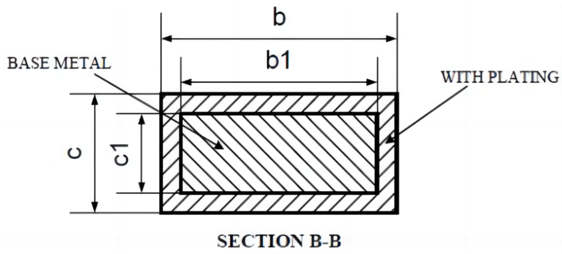
Order Number	Package	Package Quantity	MarkingOn The park
LM2901MX/NOPB-TUDI	SOP14	Tape,Reel,2500	LM2901M
LM2901N/NOPB-TUDI	DIP14	Tube,25,A box of 1000	LM2901N
LM339AMX/NOPB-TUDI	SOP14	Tape,Reel,2500	LM339AM
LM339AN/NOPB-TUDI	DIP14	Tube,25,A box of 1000	LM339AN
LM339MX/NOPB-TUDI	SOP14	Tape,Reel,2500	LM339M
LM339N/NOPB-TUDI	DIP14	Tube,25,A box of 1000	LM339N

Package SOP14



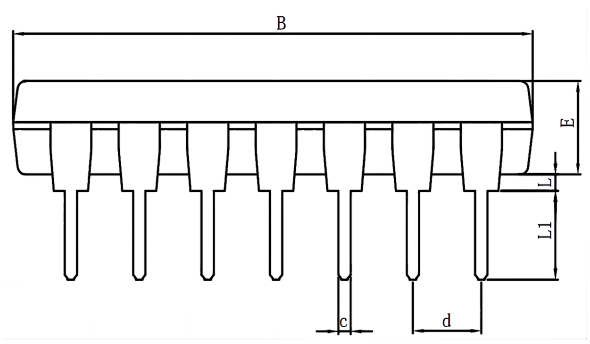


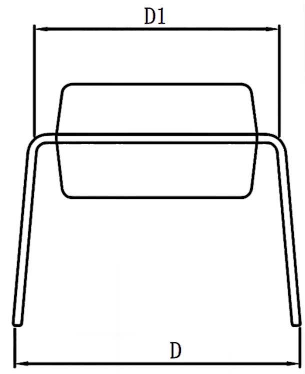


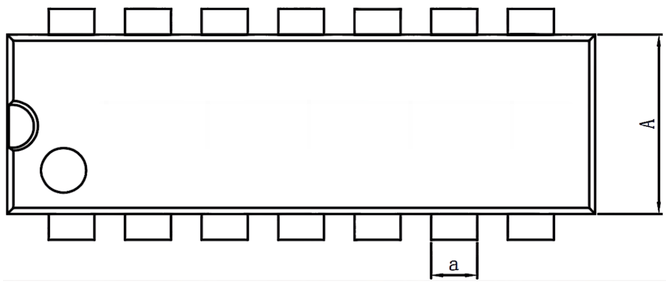


Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	1.35	1.60	1.75
A1	0.10	0.15	0.25
A2	1.25	1.45	1.65
A3	0.55	0.65	0.75
b	0.36		0.49
b1	0.35	0.40	0.45
C	0.16		0.25
c1	0.15	0.20	0.25
D	8.53	8.63	8.73
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.45	0.60	0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07		
R1	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 DIP14







DIM.	MIN	TYP	MAX	DIM.	MIN	TYP	MAX
A	6.100	6.300	6.680	a	1.504	1.524	1.544
B	18.940	19.200	19.560	C	0.437	0.457	0.477
D	8.200	8.700	9.200	d	2.530	2.540	2.550
D1	7.42	7.62	7.82	L	0.500	—	0.800
E	3.100	3.300	3.550	L1	3.000	3.200	3.600

Important statement:

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