

DATA SHEET

**LM139/239/239A/339/339A/
LM2901/MC3302**
Quad voltage comparator

Product data
Supersedes data of 2001 Aug 03
File under Integrated Circuits, IC11 Handbook

2002 Jan 22

Quad voltage comparator

LM139/239/239A/339/339A/
LM2901/MC3302

ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNIT
V_{CC}	V_{CC} supply voltage	36 or ± 18	V_{DC}
V_{DIFF}	Differential input voltage	36	V_{DC}
V_{IN}	Input voltage	-0.3 to +36	V_{DC}
P_D	Maximum power dissipation, $T_{amb} = 25\text{ }^\circ\text{C}$ (still-air) ¹		
	N package	1420	mW
	D package	1040	mW
	LM339DH package	762	mW
	Output short-circuit to ground ²	Continuous	
I_{IN}	Input current ($V_{IN} < -0.3 V_{DC}$) ³	50	mA
T_{amb}	Operating temperature range		
	LM139	-55 to +125	$^\circ\text{C}$
	LM239/239A	-25 to +85	$^\circ\text{C}$
	LM339/339A	0 to +70	$^\circ\text{C}$
	LM2901	-40 to +125	$^\circ\text{C}$
MC3302	-40 to +85	$^\circ\text{C}$	
T_{stg}	Storage temperature range	-65 to +150	$^\circ\text{C}$
T_{sld}	Lead soldering temperature (10 sec max)	230	$^\circ\text{C}$

NOTES:

- Derate above 25 $^\circ\text{C}$, at the following rates:
 N Package at 11.4 mW/ $^\circ\text{C}$
 D Package at 8.3 mW/ $^\circ\text{C}$
 DH Package at 6.1 mW/ $^\circ\text{C}$
- Short circuits from the output to V_+ can cause excessive heating and eventual destruction. The maximum output current is approximately 20 mA independent of the magnitude of V_+ .
- 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 reestablish when the input voltage, which was negative, again returns to a value greater than $-0.3 V_{DC}$.

Quad voltage comparator

LM139/239/239A/339/339A/
LM2901/MC3302**DC AND AC ELECTRICAL CHARACTERISTICS**

$V_+ = 5 V_{DC}$; LM139: $-55\text{ °C} \leq T_{amb} \leq +125\text{ °C}$; LM239/239A: $-25\text{ °C} \leq T_{amb} \leq +85\text{ °C}$; LM339/339A: $0\text{ °C} \leq T_{amb} \leq +70\text{ °C}$;
LM2901: $-40\text{ °C} \leq T_{amb} \leq +125\text{ °C}$; MC3302: $-40\text{ °C} \leq T_{amb} \leq +85\text{ °C}$, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	LM239A/339A			UNIT
			Min	Typ	Max	
V_{OS}	Input offset voltage ²	$T_{amb} = 25\text{ °C}$		± 1.0	± 2.0	mV
		Over temp.			± 4.0	mV
V_{CM}	Input common-mode voltage range ³	$T_{amb} = 25\text{ °C}$	0		$V_+ - 1.5$	V
		Over temp.	0		$V_+ - 2.0$	V
V_{IDR}	Differential input voltage ¹	Keep all $V_{IN} \geq 0 V_{DC}$ (or V_- if needed)			V_+	V
I_{BIAS}	Input bias current ⁴	$I_{IN(+)}$ or $I_{IN(-)}$ with output in linear range $T_{amb} = 25\text{ °C}$ Over temp.		25	250 400	nA nA
I_{OS}	Input offset current	$I_{IN(+)} - I_{IN(-)}$ $T_{amb} = 25\text{ °C}$ Over temp.		± 5.0	± 50 ± 150	nA nA
I_{OL}	Output sink current	$V_{IN(-)} \geq 1 V_{DC}$; $V_{IN(+)} = 0$; $V_O \leq 1.5 V_{DC}$; $T_{amb} = 25\text{ °C}$	6.0	16		mA
	Output leakage current	$V_{IN(+)} \geq 1 V_{DC}$; $V_{IN(-)} = 0$ $V_O = 5 V_{DC}$; $T_{amb} = 25\text{ °C}$ $V_O = 30 V_{DC}$; over temp.		0.1	1.0	nA μA
I_{CC}	Supply current	$R_L = \infty$ on comparators; $V_+ = 30 V$; $T_{amb} = 25\text{ °C}$		0.8	2.0	mA
A_V	Voltage gain	$R_L \geq 15\text{ k}\Omega$; $V_+ = 15 V_{DC}$	50	200		V/mV
V_{OL}	Saturation voltage	$V_{IN(-)} \geq 1 V_{DC}$; $V_{IN(+)} = 0$; $I_{SINK} \leq 4\text{ mA}$ $T_{amb} = 25\text{ °C}$ Over temp.		250	400 700	mV mV
t_{LSR}	Large-signal response time	$V_{IN} = \text{TTL logic swing}$; $V_{REF} = 1.4 V_{DC}$; $V_{RL} = 5 V_{DC}$; $R_L = 5.1\text{ k}\Omega$; $T_{amb} = 25\text{ °C}$		300		ns
t_R	Response time ⁵	$V_{RL} = 5 V_{DC}$; $R_L = 5.1\text{ k}\Omega$; $T_{amb} = 25\text{ °C}$		1.3		μs

See notes at the end of the Electrical Characteristics.

Quad voltage comparator

LM139/239/239A/339/339A/
LM2901/MC3302**DC AND AC ELECTRICAL CHARACTERISTICS** (continued)

$V_+ = 5 V_{DC}$; LM139: $-55\text{ °C} \leq T_{amb} \leq +125\text{ °C}$; LM239/239A: $-25\text{ °C} \leq T_{amb} \leq +85\text{ °C}$; LM339/339A: $0\text{ °C} \leq T_{amb} \leq +70\text{ °C}$;
LM2901: $-40\text{ °C} \leq T_{amb} \leq +125\text{ °C}$; MC3302: $-40\text{ °C} \leq T_{amb} \leq +85\text{ °C}$, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	LM139			LM239/339			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{OS}	Input offset voltage ²	$T_{amb} = 25\text{ °C}$		± 2.0	± 5.0		± 2.0	± 5.0	mV
		Over temp.			± 9.0			± 9.0	mV
V_{CM}	Input common-mode voltage range ³	$T_{amb} = 25\text{ °C}$	0		$V_+ - 1.5$	0		$V_+ - 1.5$	V
		Over temp.	0		$V_+ - 2.0$	0		$V_+ - 2.0$	V
V_{IDR}	Differential input voltage ¹	Keep all $V_{IN} \geq 0 V_{DC}$ (or V_- if needed)			V_+			V_+	V
I_{BIAS}	Input bias current ⁴	$I_{IN(+)}$ or $I_{IN(-)}$ with output in linear range		25	100		25	250	nA
		$T_{amb} = 25\text{ °C}$ Over temp.			300			400	nA
I_{OS}	Input offset current	$I_{IN(+)} - I_{IN(-)}$ $T_{amb} = 25\text{ °C}$ Over temp.		± 3.0	± 25 ± 100		± 5.0	± 50 ± 150	nA nA
I_{OL}	Output sink current	$V_{IN(-)} \geq 1 V_{DC}$; $V_{IN(+)} = 0$; $V_O \leq 1.5 V_{DC}$; $T_{amb} = 25\text{ °C}$	6.0	16		6.0	16		mA
	Output leakage current	$V_{IN(+)} \geq 1 V_{DC}$; $V_{IN(-)} = 0$ $V_O = 5 V_{DC}$; $T_{amb} = 25\text{ °C}$ $V_O = 30 V_{DC}$; Over temp.		0.1	1.0		0.1	1.0	nA μA
I_{CC}	Supply current	$R_L = \infty$ on comparators; $V_+ = 30 V$; $T_{amb} = 25\text{ °C}$		0.8	2.0		0.8	2.0	mA
A_V	Voltage gain	$R_L \geq 15\text{ k}\Omega$; $V_+ = 15 V_{DC}$	50	200		50	200		V/mV
V_{OL}	Saturation voltage	$V_{IN(-)} \geq 1 V_{DC}$; $V_{IN(+)} = 0$; $I_{SINK} \leq 4\text{ mA}$ $T_{amb} = 25\text{ °C}$ Over temp.		250	400 700		250	400 700	mV mV
t_{LSR}	Large-signal response time	$V_{IN} = \text{TTL logic swing}$; $V_{REF} = 1.4 V_{DC}$; $V_{RL} = 5 V_{DC}$; $R_L = 5.1\text{ k}\Omega$; $T_{amb} = 25\text{ °C}$		300			300		ns
t_R	Response time ⁵	$V_{RL} = 5 V_{DC}$; $R_L = 5.1\text{ k}\Omega$; $T_{amb} = 25\text{ °C}$		1.3			1.3		μs

See notes on following page.

Quad voltage comparator

LM139/239/239A/339/339A/
LM2901/MC3302**DC AND AC ELECTRICAL CHARACTERISTICS** (continued)

$V_+ = 5 V_{DC}$; LM139: $-55\text{ °C} \leq T_{amb} \leq +125\text{ °C}$; LM239/239A: $-25\text{ °C} \leq T_{amb} \leq +85\text{ °C}$; LM339/339A: $0\text{ °C} \leq T_{amb} \leq +70\text{ °C}$;
LM2901: $-40\text{ °C} \leq T_{amb} \leq +125\text{ °C}$; MC3302: $-40\text{ °C} \leq T_{amb} \leq +85\text{ °C}$, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	LM2901			MC3302			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{OS}	Input offset voltage ²	$T_{amb} = 25\text{ °C}$		± 2.0	± 7.0		± 3.0	± 20	mV
		Over temp.		± 9	± 15			± 40	mV
V_{CM}	Input common-mode voltage range ³	$T_{amb} = 25\text{ °C}$	0		$V_+ - 1.5$	0		$V_+ - 1.5$	V
		Over temp.	0		$V_+ - 2.0$	0		$V_+ - 2.0$	V
V_{IDR}	Differential input voltage ¹	Keep all $V_{IN} \geq 0 V_{DC}$ (or V_- if needed)			V_+			V_+	V
I_{BIAS}	Input bias current ⁴	$I_{IN(+)}$ or $I_{IN(-)}$ with output in linear range $T_{amb} = 25\text{ °C}$		25	250		25	500	nA
		Over temp.		200	500			1000	nA
I_{OS}	Input offset current	$I_{IN(+)} - I_{IN(-)}$ $T_{amb} = 25\text{ °C}$ Over temp.		± 5 ± 50	± 50 ± 200		± 5	± 100 ± 300	nA nA
I_{OL}	Output sink current	$V_{IN(-)} \geq 1 V_{DC}$; $V_{IN(+)} = 0$; $V_O \leq 1.5 V_{DC}$; $T_{amb} = 25\text{ °C}$	6.0	16		6	16		mA
	Output leakage current	$V_{IN(+)} \geq 1 V_{DC}$; $V_{IN(-)} = 0$ $V_O = 5 V_{DC}$; $T_{amb} = 25\text{ °C}$ $V_O = 30 V_{DC}$; Over temp.		0.1	1.0		0.1	1.0	nA μA
I_{CC}	Supply current	$R_L = \infty$ on all comparators, $T_{amb} = 25\text{ °C}$		0.8	2.0				
		$R_L = \infty$ on all comparators, $V_+ = 30\text{ V}$		1.0	2.5				mA
							0.8	1.8	mA
A_V	Voltage gain	$R_L \geq 15\text{ k}\Omega$; $V_+ = 15 V_{DC}$	25	100		2	100		V/mV
V_{OL}	Saturation voltage	$V_{IN(-)} \geq 1 V_{DC}$; $V_{IN(+)} = 0$; $I_{SINK} \leq 4\text{ mA}$ $T_{amb} = 25\text{ °C}$ Over temp.		400	400 700		150	400 700	mV mV
t_{LSR}	Large-signal response time	$V_{IN} = \text{TTL logic swing}$; $V_{REF} = 1.4 V_{DC}$; $V_{RL} = 5 V_{DC}$; $R_L = 5.1\text{ k}\Omega$; $T_{amb} = 25\text{ °C}$		300			300		ns
t_R	Response time ⁵	$V_{RL} = 5 V_{DC}$; $R_L = 5.1\text{ k}\Omega$; $T_{amb} = 25\text{ °C}$		1.3			1.3		μs

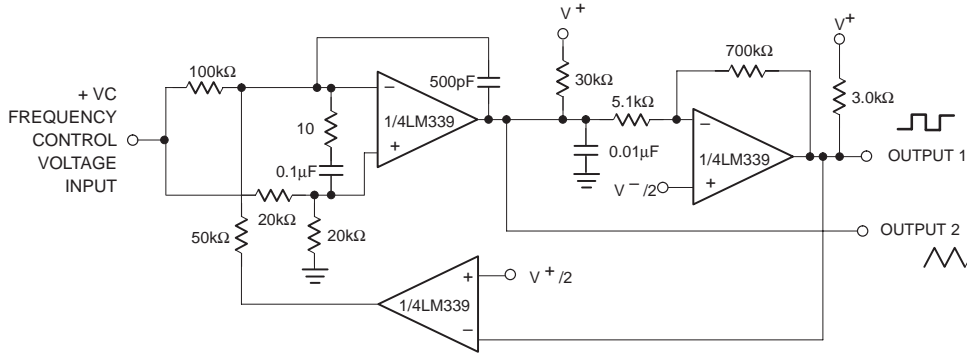
NOTES:

- Positive excursions of input voltage may exceed the power supply level by 17 V. 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 output switch point, $V_O \approx 1.4 V_{DC}$, $R_S = 0\ \Omega$ with V_+ from $5 V_{DC}$ to $30 V_{DC}$; and over the full input common-mode range ($0 V_{DC}$ to $V_+ - 1.5 V_{DC}$). Inputs of unused comparators should be grounded.
- 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 $V_+ - 1.5\text{ V}$, but either or both inputs can go to $30 V_{DC}$ without damage.
- 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.
- The response time specified is for a 100 mV input step with a 5 mV overdrive. For larger overdrive signals, 300 ns can be obtained (see Figure 4, Typical performance characteristics).

Quad voltage comparator

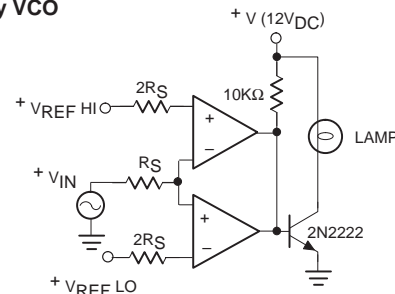
LM139/239/239A/339/339A/ LM2901/MC3302

EQUIVALENT CIRCUIT

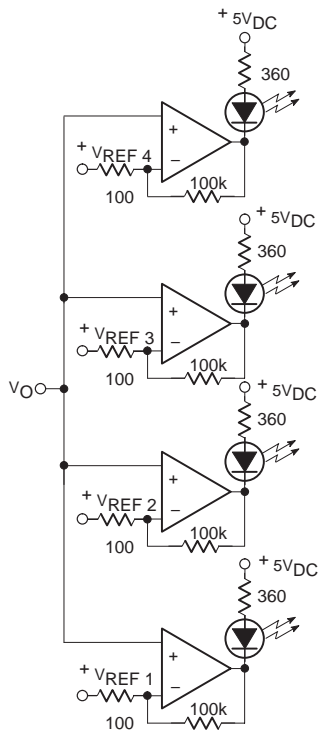


NOTES:
 $V^+ = 30V_{DC}$
 $+250mV_{DC} \leq V_C = 50V_{DC}$
 $700H \leq f_O = 100kHz$

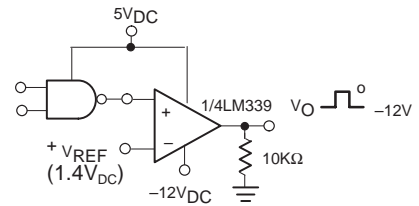
Two-Decade High Frequency VCO



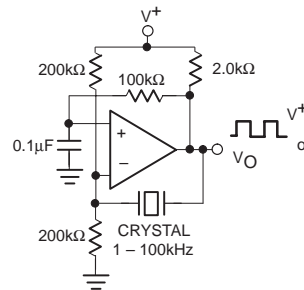
Limit Comparator



Visible Voltage Indicator



TTL-to-MOS Logic Converter



Crystal-Controlled Oscillator

NOTE:
 Input of unused comparators should be grounded.

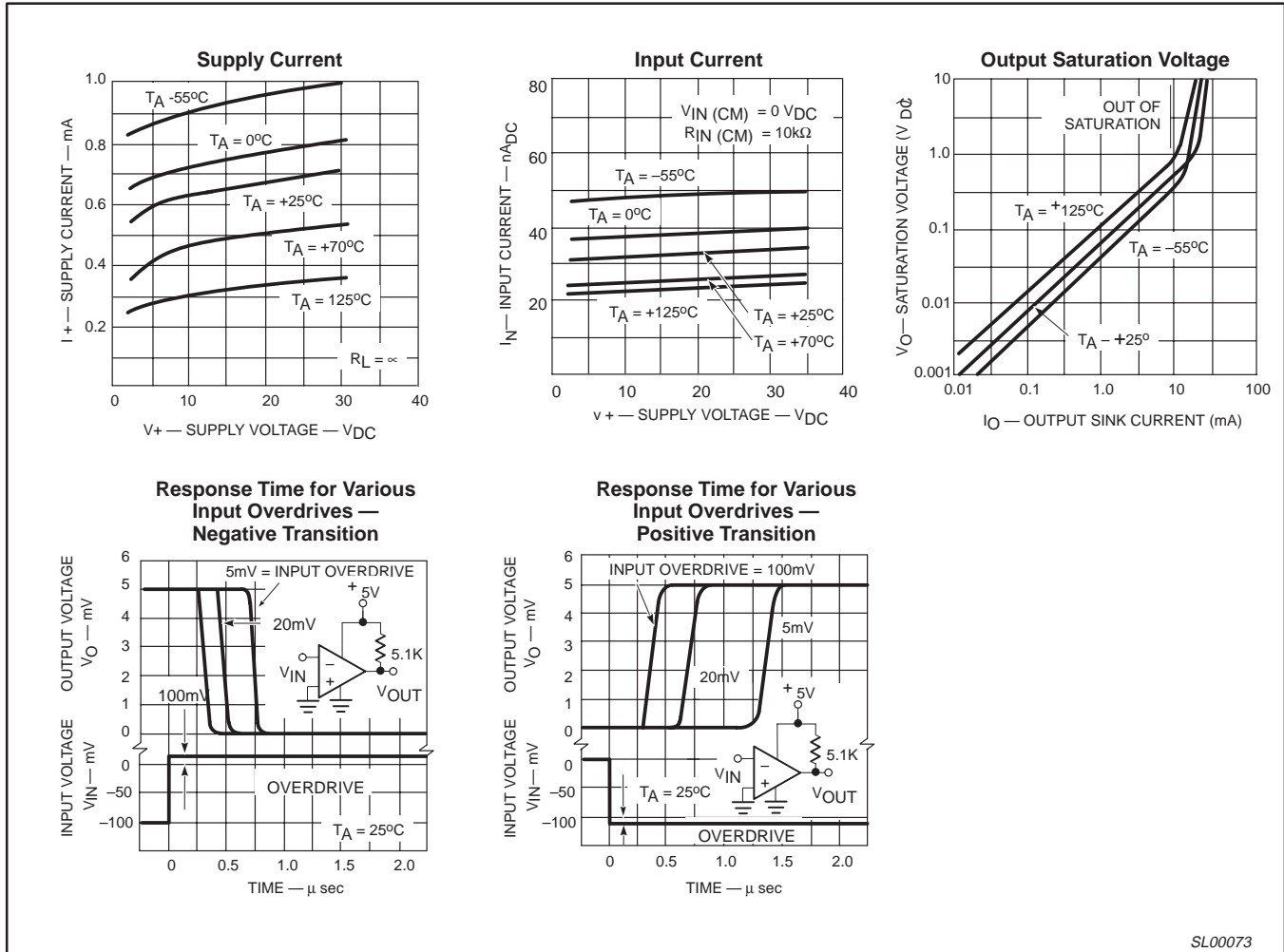
SL00072

Figure 3. Equivalent circuit.

Quad voltage comparator

LM139/239/239A/339/339A/
LM2901/MC3302

TYPICAL PERFORMANCE CHARACTERISTICS



SL00073

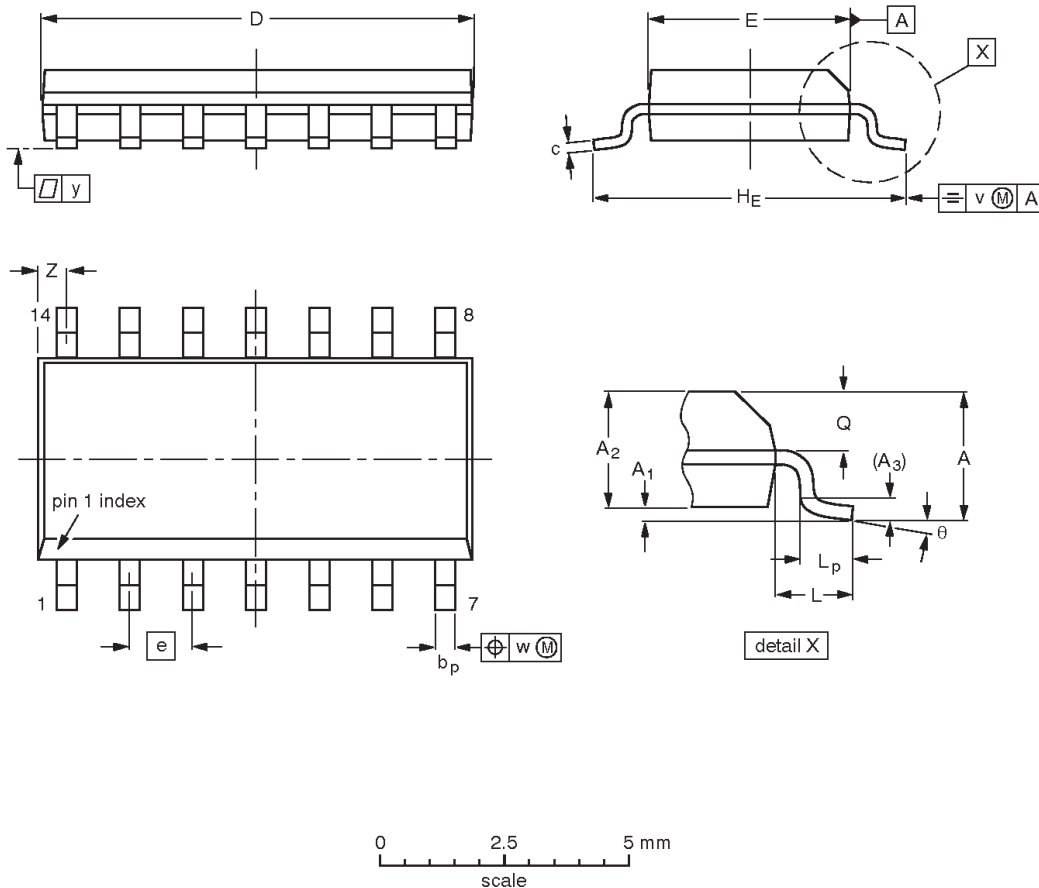
Figure 4. Typical performance characteristics.

Quad voltage comparator

LM139/239/239A/339/339A/
LM2901/MC3302

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	8.75 8.55	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.35 0.34	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

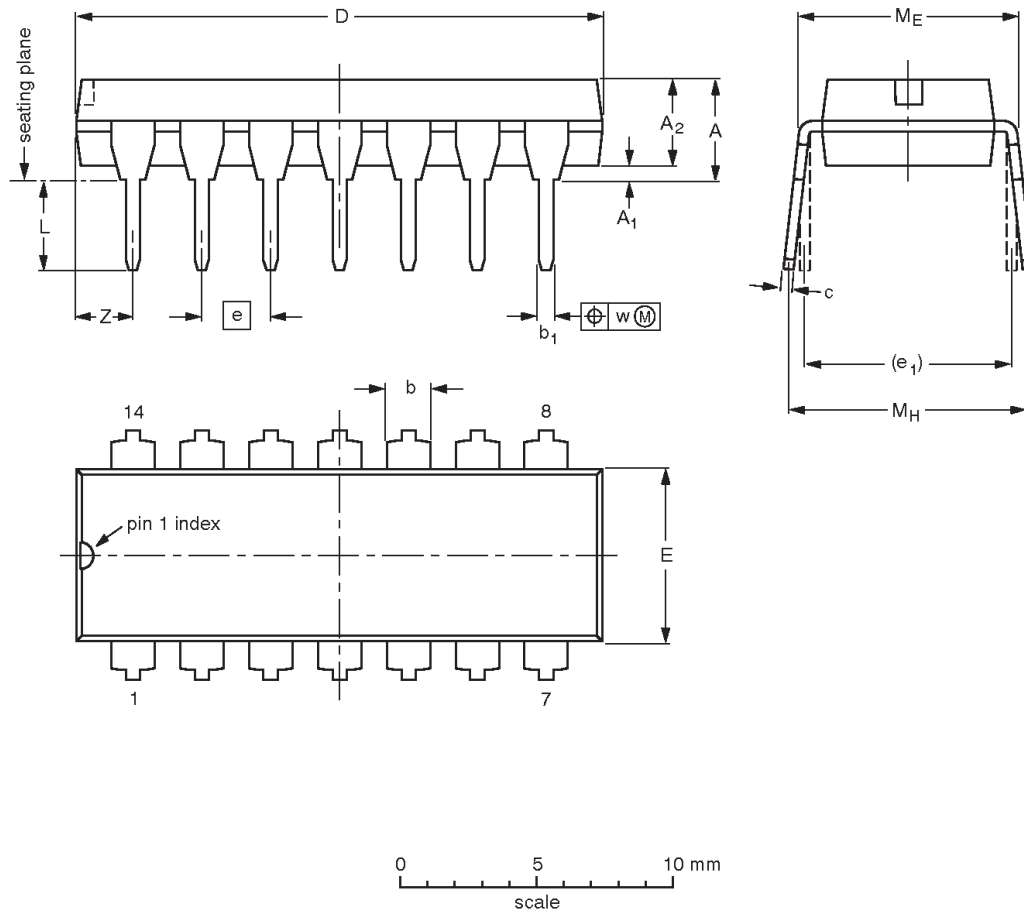
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT108-1	076E06	MS-012				97-05-22 99-12-27

Quad voltage comparator

LM139/239/239A/339/339A/
LM2901/MC3302

DIP14: plastic dual in-line package; 14 leads (300 mil)

SOT27-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A ₁ min.	A ₂ max.	b	b ₁	c	D ⁽¹⁾	E ⁽¹⁾	e	e ₁	L	M _E	M _H	w	Z ⁽¹⁾ max.
mm	4.2	0.51	3.2	1.73 1.13	0.53 0.38	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.2
inches	0.17	0.020	0.13	0.068 0.044	0.021 0.015	0.014 0.009	0.77 0.73	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.087

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

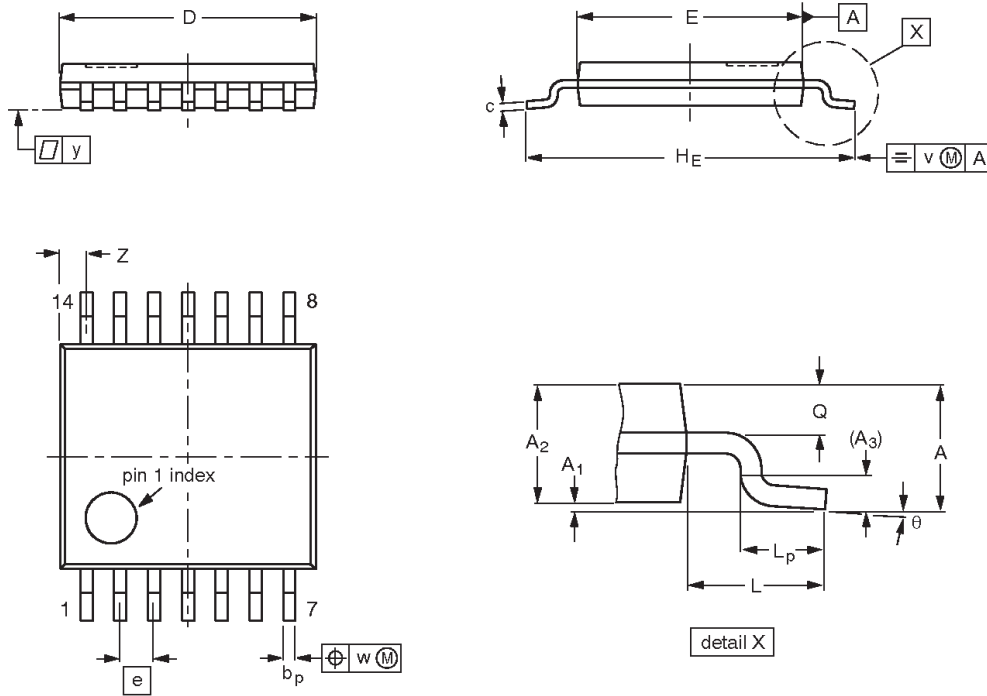
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT27-1	050G04	MO-001	SC-501-14			95-03-11 99-12-27

Quad voltage comparator

LM139/239/239A/339/339A/
LM2901/MC3302

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽²⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	θ
mm	1.10	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.72 0.38	8° 0°

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT402-1		MO-153				-95-04-04 99-12-27

Quad voltage comparator

LM139/239/239A/339/339A/
LM2901/MC3302

Data sheet status

Data sheet status ^[1]	Product status ^[2]	Definitions
Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Changes will be communicated according to the Customer Product/Process Change Notification (CPCN) procedure SNW-SQ-650A.

[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

Definitions

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

Application information — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Disclaimers

Life support — These products are not designed for use in life support appliances, devices or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips Semiconductors customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips Semiconductors for any damages resulting from such application.

Right to make changes — Philips Semiconductors reserves the right to make changes, without notice, in the products, including circuits, standard cells, and/or software, described or contained herein in order to improve design and/or performance. Philips Semiconductors assumes no responsibility or liability for the use of any of these products, conveys no license or title under any patent, copyright, or mask work right to these products, and makes no representations or warranties that these products are free from patent, copyright, or mask work right infringement, unless otherwise specified.

Contact information

For additional information please visit
<http://www.semiconductors.philips.com>. Fax: +31 40 27 24825

© Koninklijke Philips Electronics N.V. 2002
All rights reserved. Printed in U.S.A.

Date of release: 01-02

For sales offices addresses send e-mail to:
sales.addresses@www.semiconductors.philips.com

Document order number:

9397 750 09351

Let's make things better.