LM139, LM239, LM339

Low-power quad voltage comparators

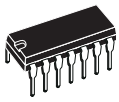
Features

- Wide single supply voltage range or dual supplies for all devices: +2 to +36 V or ±1 V to ±18 V
- Very low supply current (1.1 mA) independent of supply voltage
- Low input bias current: 25 nA typ
- Low input offset current: ±5 nA typ
- Low input offset voltage: ±1 mV typ
- Input common-mode voltage range includes ground
- Low output saturation voltage: 250 mV typ; (I_{SINK} = 4 mA)
- Differential input voltage range equal to the supply voltage
- TTL, DTL, ECL, MOS, CMOS compatible outputs

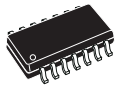
Description

This family of devices consists of four independent precision-voltage comparators with an offset voltage specification as low as 2 mV maximum for LM339A, LM239A and LM139A. Each comparator has been designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible.

These comparators also have a unique characteristic in that the input common mode voltage range includes ground even though operated from a single power supply voltage.



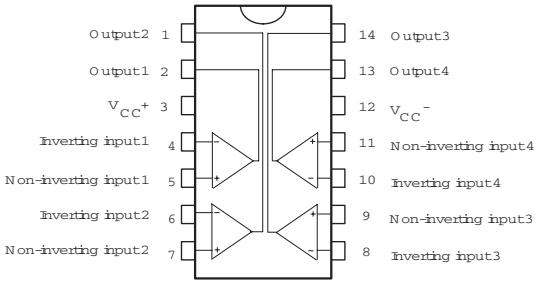
N
DIP14
(Plastic package)



D
SO-14
(Plastic micropackage)

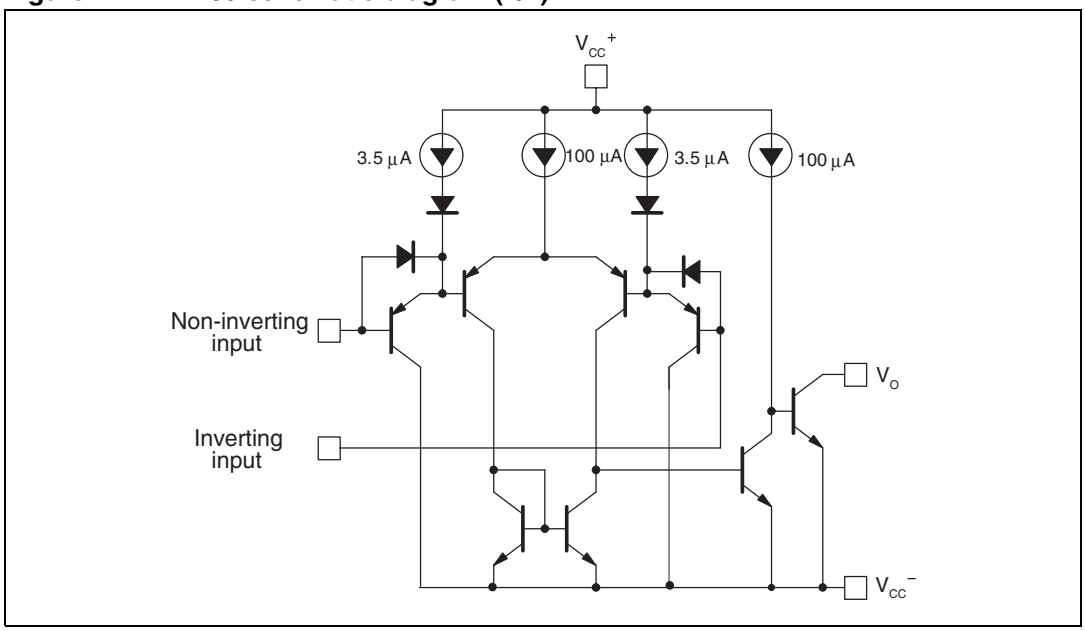
P
TSSOP14
(Thin shrink small outline package)

Pin connections (top view)



1 Schematic diagram

Figure 1. LM139 schematic diagram (1/4)



2 Absolute maximum ratings and operating conditions

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	±18 or 36	V
V_{ID}	Differential input voltage	±36	V
V_{IN}	Input voltage	-0.3 to +36	V
	Output short-circuit to ground (1)	Infinite	
R_{thja}	Thermal resistance junction to ambient(2) DIP14 SO-14 TSSOP14	 80 105 100	°C/W
R_{thjc}	Thermal resistance junction to case (2) DIP14 SO-14 TSSOP14	 33 31 32	°C/W
T_{stg}	Storage temperature range	-65 to +150	°C
T_j	Junction temperature	+150	°C
T_{LEAD}	Lead temperature (soldering 10 seconds)	260	°C
ESD	Human body model (HBM)(3)	500	V
	Machine model (MM)(4)	100	
	Charged device model (CDM)(5)	1500	

1. Short-circuits from the output to V_{CC}^+ can cause excessive heating and eventual destruction. The maximum output current is approximately 20 mA independent of the magnitude of V_{CC}^+.
2. Short-circuits can cause excessive heating. These values are typical.
3. 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.
4. 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.
5. 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 (T_{amb} = 25° C)

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	2 to 32 ±1 to ±16	V
V_{ICM}	Common mode input voltage range	0 to (V_{CC}^+ - 1.5)	V
T_{oper}	Operating free-air temperature range – LM139, LM139A – LM239, LM239A – LM339, LM339A	 -55, +125 -40, +105 0, +70	°C

3 Electrical characteristics

Table 3. Electrical characteristics at V_{CC}^+ = +5 V, V_{CC}^-= GND, T_{amb} = +25° C (unless otherwise specified)

Symbol	Parameter	LM139A - LM239A LM339A			LM139 - LM239 LM339			Unit
		Min.	Typ.	Max.	Min	Typ.	Max.	
V_{IO}	Input offset voltage (1) $T_{min} \le T_{amb} \le T_{max}$		1	2 4		1	5 9	mV
I_{IO}	Input offset current $T_{min} \le T_{amb} \le T_{max}$		3	25 100		5	50 150	nA
I_{IB}	Input bias current (I^+ or I^-) (2) $T_{min} \le T_{amb} \le T_{max}$		25	100 300		25	250 400	nA
A_{VD}	Large signal voltage gain V_{CC} = 15 V, R_L = 15 kΩ, V_o = 1 V to 11 V	50	200		50	200		V/mV
I_{CC}	Supply current (all comparators) V_{CC} = +5 V, no load V_{CC} = +30 V, no load		1.1 1.3	2 2.5		1.1 1.3	2 2.5	mA
V_{ICM}	Input common mode voltage range (3) V_{CC} = 30 V $T_{min} \le T_{amb} \le T_{max}$	0 0		V_{CC}^+ -1.5 V_{CC}^+ -2	0 0		V_{CC}^+ -1.5 V_{CC}^+ -2	V
V_{ID}	Differential input voltage (4)			V_{CC}^+			V_{CC}^+	V
V_{OL}	Low level output voltage V_{ID} = -1 V, I_{SINK} = 4 mA $T_{min} \le T_{amb} \le T_{max}$		250	400 700		250	400 700	mV
I_{OH}	High level output current $V_{CC} = V_o$ = 30 V, V_{ID} = 1 V $T_{min} \le T_{amb} \le T_{max}$		0.1	 1		0.1	 1	nA µA
I_{SINK}	Output sink current V_{ID}= 1 V, V_o = 1.5 V	6	16		6	16		mA
t_{re}	Response time (5) R_L= 5.1 kΩ connected to V_{CC}^+		1.3			1.3		µs

Table 3. Electrical characteristics at V_{CC}^+ = +5 V, V_{CC}^-= GND, T_{amb} = +25° C (unless otherwise specified) (continued)

Symbol	Parameter	LM139A - LM239A LM339A			LM139 - LM239 LM339			Unit
		Min.	Typ.	Max.	Min	Typ.	Max.	
trel	Large signal response time R_L= 5.1 kΩ connected to V_{CC}^+, e_I = TTL, $V_{(ref)}$ = +1.4 V		300			300		ns

1. At output switch point, $V_o \approx$ 1.4 V, V_{CC}^+ from 5 V to 30 V, and over the full common-mode range (0 V to V_{CC}^+ -1.5 V).
2. 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 charge exists on the reference of input lines.
3. The input common-mode voltage of 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_{CC}^+ -1.5 V, but either or both inputs can go to +30 V without damage.
4. 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 (or 0.3 V below the negative power supply, if used).
5. The response time specified is for a 100 mV input step with 5 mV overdrive. For larger overdrive signals, 300 ns can be obtained.

4 Electrical characteristics curves

Figure 2. Supply current vs. supply voltage

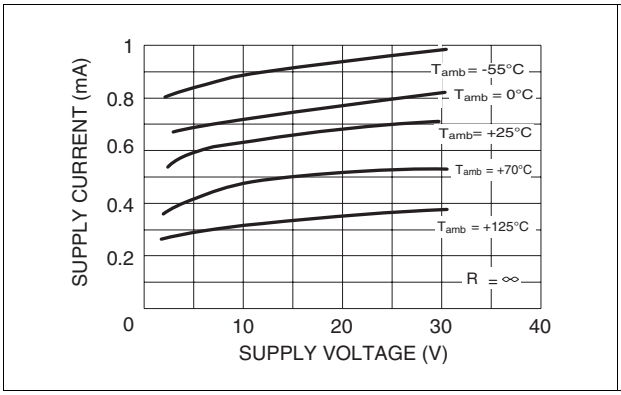


Figure 3. Input current vs. supply voltage

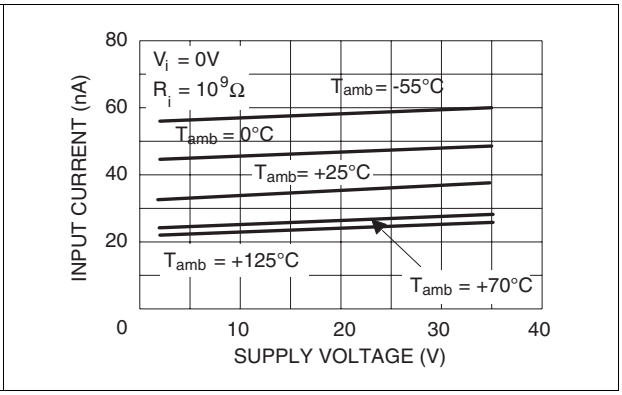


Figure 4. Output saturation voltage vs. output current

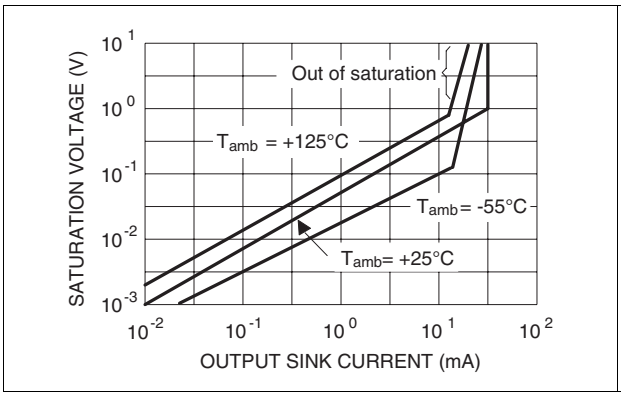


Figure 5. Response time for various input overdrives - negative transition

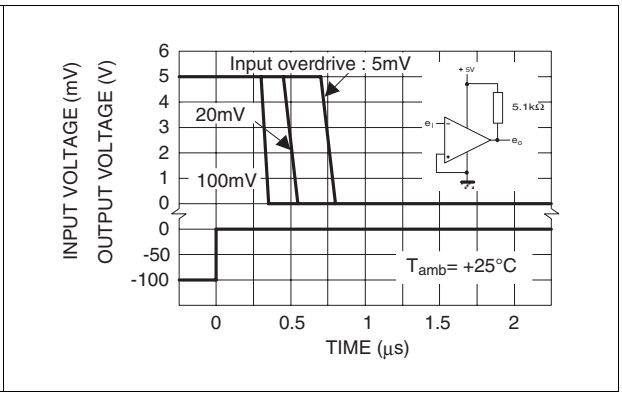
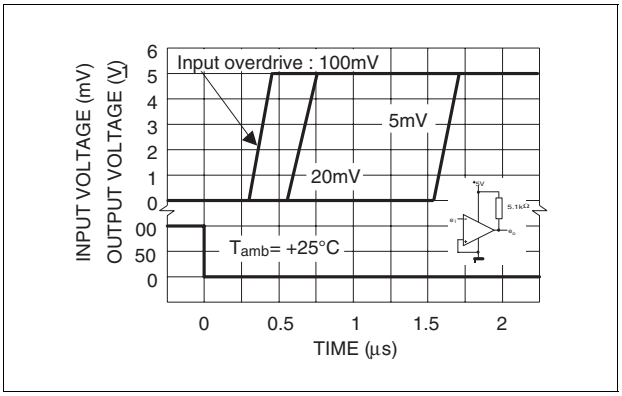


Figure 6. Response time for various input overdrives - positive transition



5 Typical applications

Figure 7. Basic comparator

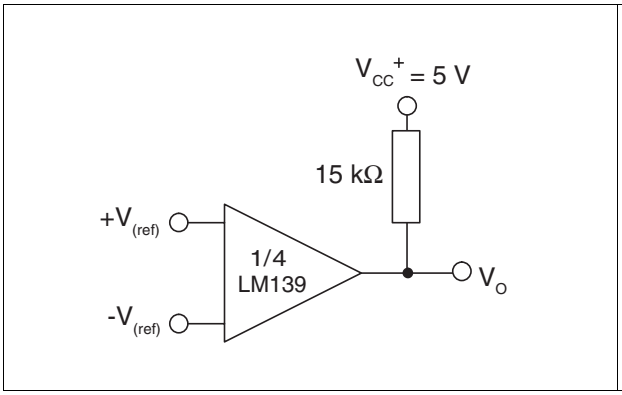


Figure 8. Driving CMOS

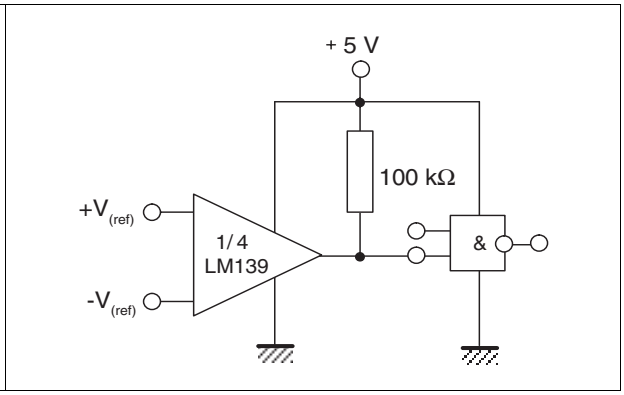


Figure 9. Driving TTL

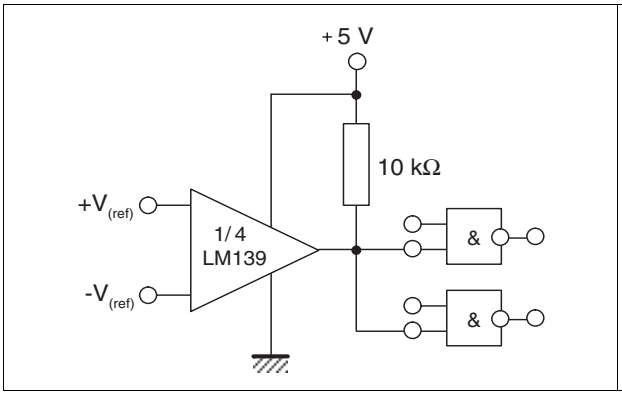


Figure 10. Low frequency op amp

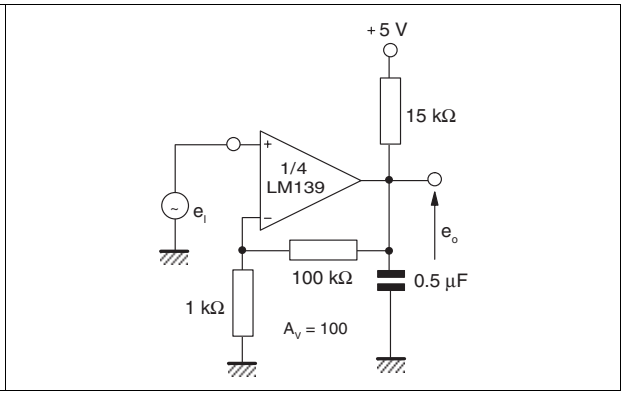


Figure 11. Low frequency op amp

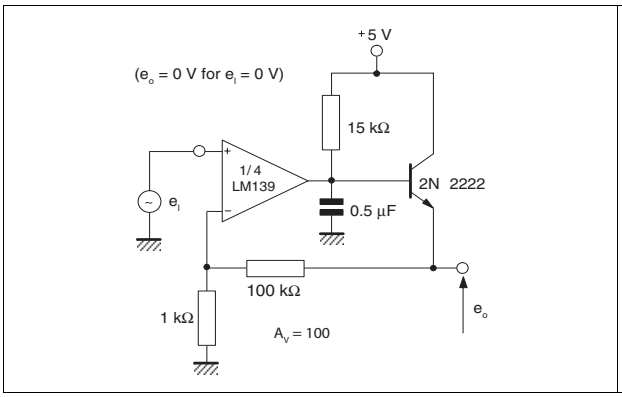


Figure 12. Transducer amplifier

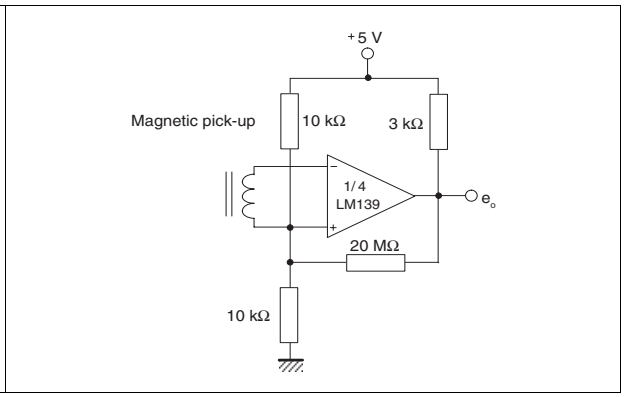


Figure 13. Time delay generator

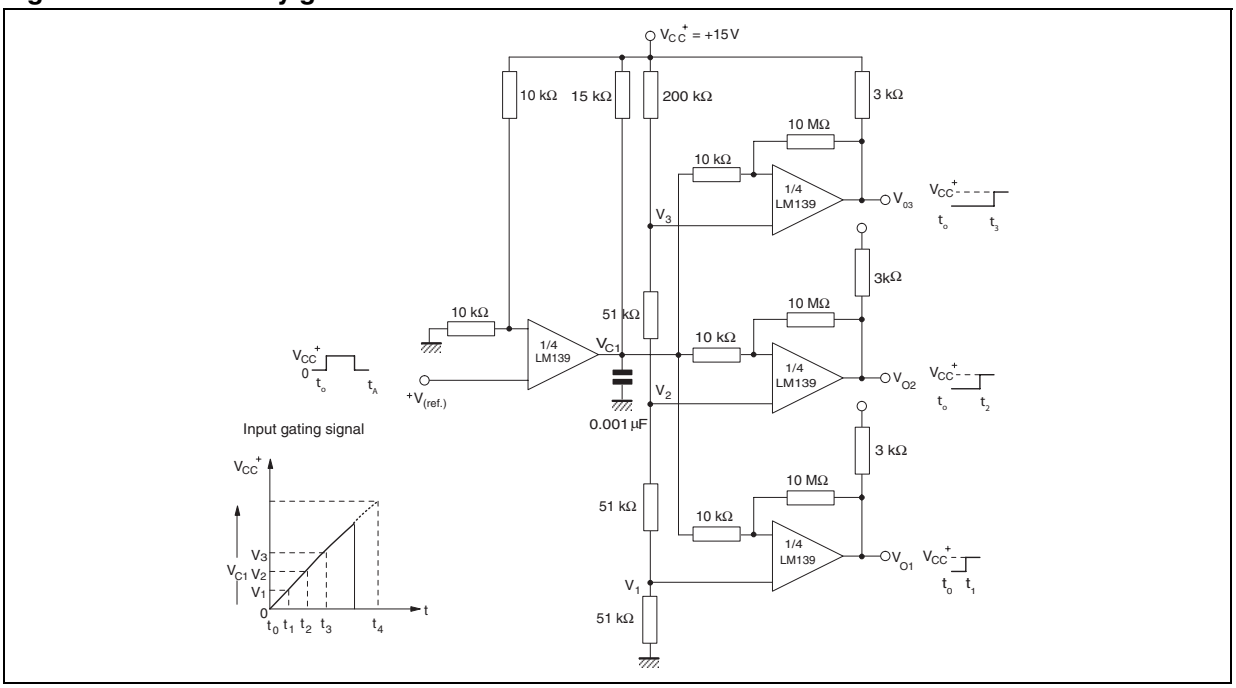


Figure 14. Low frequency op amp with offset adjust

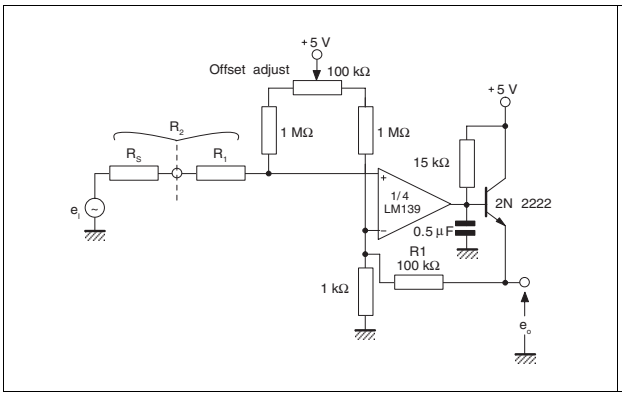


Figure 15. Zero crossing detector (single power supply)

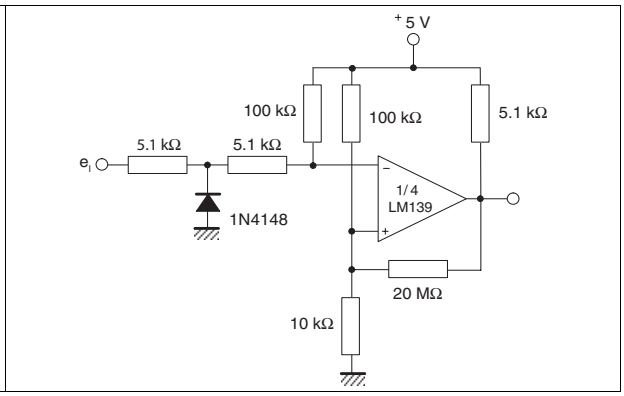


Figure 16. Two-decade high-frequency VCO

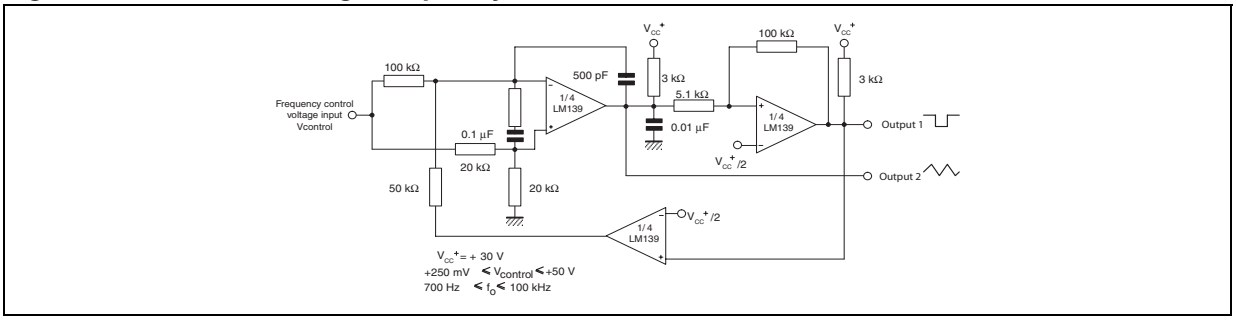


Figure 17. Limit comparator

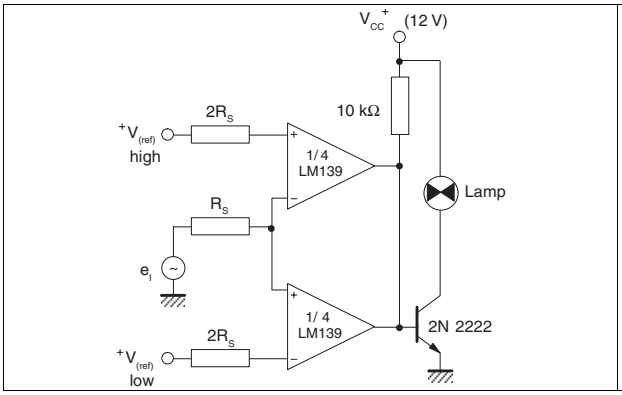


Figure 18. Crystal-controlled oscillator

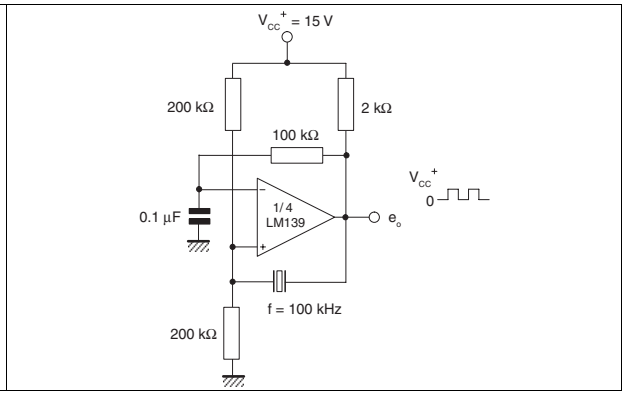


Figure 19. Zero crossing detector

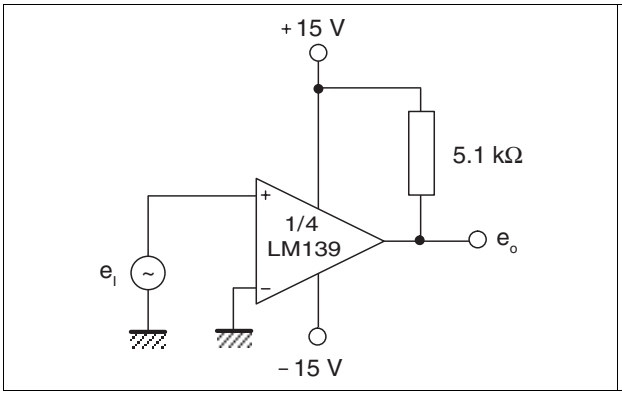
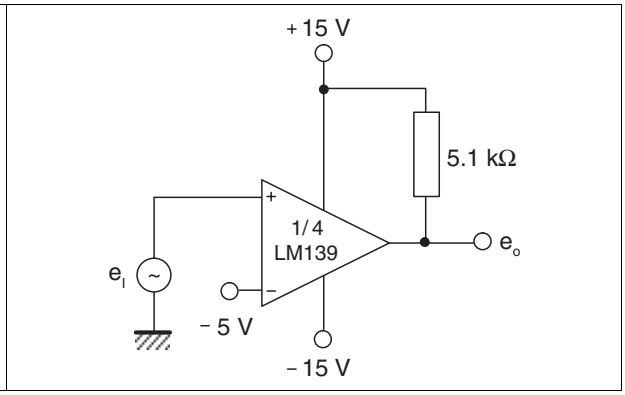


Figure 20. Comparator with a negative reference



6 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

6.1 DIP14 package information

Figure 21. DIP14 package mechanical drawing

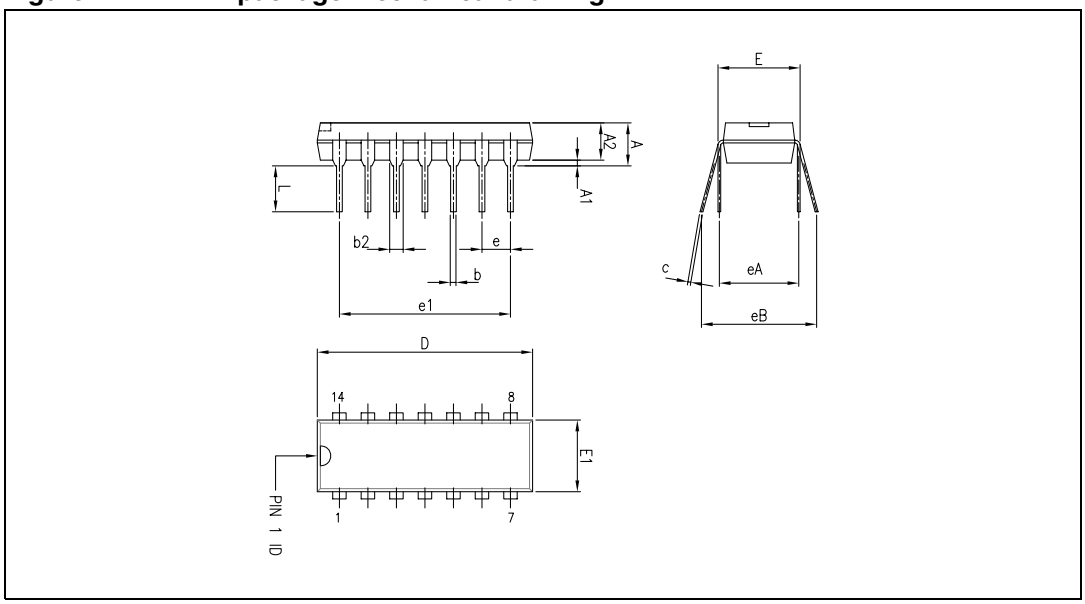


Table 4. DIP14 package mechanical data

Dimensions						
Ref.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			5.33			0.21
A1	0.38			0.015		
A2	2.92	3.30	4.95	0.11	0.13	0.19
b	0.36	0.46	0.56	0.014	0.018	0.022
b2	1.14	1.52	1.78	0.04	0.06	0.07
c	0.20	0.25	0.36	0.007	0.009	0.01
D	18.67	19.05	19.69	0.73	0.75	0.77
E	7.62	7.87	8.26	0.30	0.31	0.32
E1	6.10	6.35	7.11	0.24	0.25	0.28
e		2.54			0.10	
e1		15.24			0.60	
eA		7.62			0.30	
eB			10.92			0.43
L	2.92	3.30	3.81	0.11	0.13	0.15

6.2 SO-14 package information

Figure 22. SO-14 package mechanical drawing

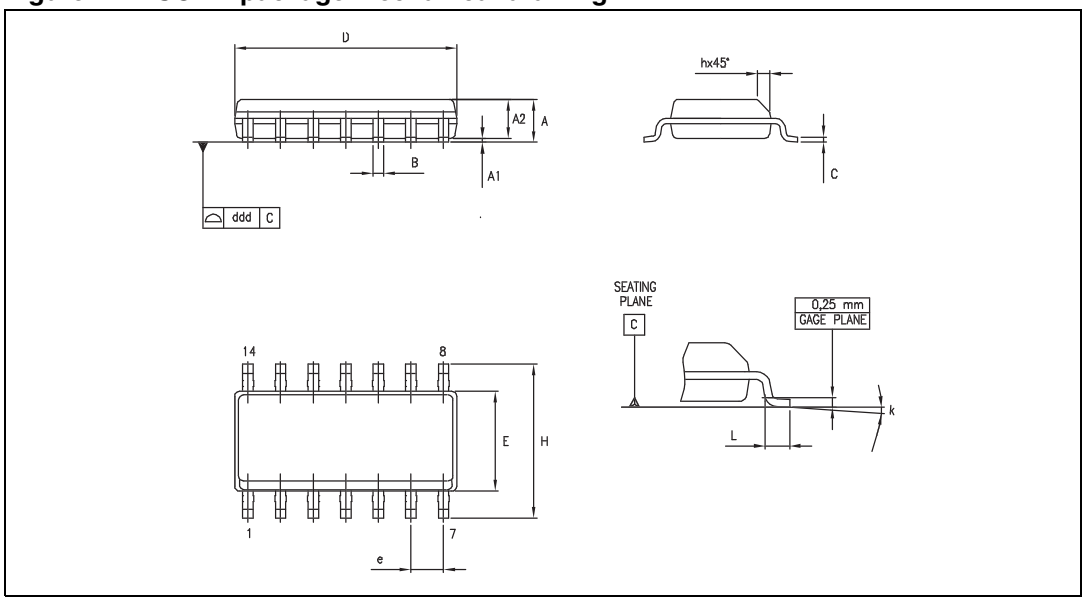


Table 5. SO-14 package mechanical data

Dimensions						
Ref.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.35		1.75	0.05		0.068
A1	0.10		0.25	0.004		0.009
A2	1.10		1.65	0.04		0.06
B	0.33		0.51	0.01		0.02
C	0.19		0.25	0.007		0.009
D	8.55		8.75	0.33		0.34
E	3.80		4.0	0.15		0.15
e		1.27			0.05	
H	5.80		6.20	0.22		0.24
h	0.25		0.50	0.009		0.02
L	0.40		1.27	0.015		0.05
k	8° (max.)					
ddd			0.10			0.004

6.3 TSSOP14 package information

Figure 23. TSSOP14 package mechanical drawing

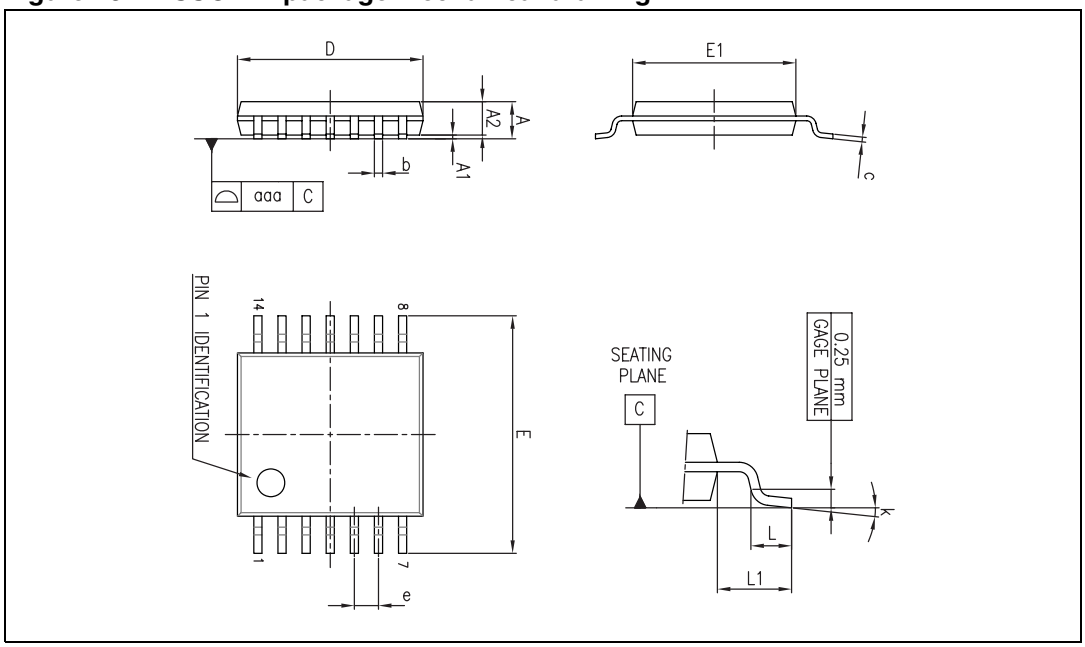


Table 6. TSSOP14 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	4.90	5.00	5.10	0.193	0.197	0.201
E	6.20	6.40	6.60	0.244	0.252	0.260
E1	4.30	4.40	4.50	0.169	0.173	0.176
e		0.65			0.0256	
L	0.45	0.60	0.75	0.018	0.024	0.030
L1		1.00			0.039	
k	0°		8°	0°		8°
aaa			0.10			0.004

7 Ordering information

Table 7. Order codes

Part number	Temperature range	Package	Packing	Marking
LM139N LM139AN	-55° C, +125° C	DIP14	Tube	LM139N LM139AN
LM139D LM139AD		SO-14	Tube	139 139A
LM139DT LM139ADT		SO-14	Tape & reel	139 139A
LM139PT LM139APT		TSSOP14	Tape & reel	139 139A
LM239N LM239AN	-40° C, +105° C	DIP14	Tube	LM239N LM239AN
LM239D LM239AD		SO-14	Tube	239 239A
LM239DT LM239ADT		SO-14	Tape & reel	239 239A
LM239PT LM239APT		TSSOP14	Tape & reel	239 239A
LM339N LM339AN	0° C, +70° C	DIP14	Tube	LM339N LM339AN
LM339D LM339AD		SO-14	Tube	339 339A
LM339DT LM339ADT		SO-14	Tape & reel	339 339A
LM339PT LM339APT		TSSOP14	Tape & reel	339 339A

8 Revision history

Table 8. Document revision history

Date	Revision	Changes
01-Mar-2003	1	Initial release.
28-Apr-2009	2	Updated document format. Removed power dissipation from *Table 1: Absolute maximum ratings*. Added R_{THJA}, $R_{THJC,}$ ESD and T_{LEAD} values to *Table 1*. Updated package information in *Chapter 6*. Added *Table 7: Order codes*.

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