# LOW POWER QUAD VOLTAGE COMPARATORS

■ WIDE SINGLE SUPPLY VOLTAGE RANGE OR DUAL SUPPLIES FOR ALL DEVICES : +2V TO +36V OR $\pm$1V TO $\pm$18V
■ VERY LOW SUPPLY CURRENT (1.1mA) INDEPENDENT OF SUPPLY VOLTAGE (1.4mW/comparator at +5V)
■ LOW INPUT BIAS CURRENT : 25nA TYP
■ LOW INPUT OFFSET CURRENT : $\pm$5nA TYP
■ LOW INPUT OFFSET VOLTAGE : $\pm$1mV TYP
■ INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GROUND
■ LOW OUTPUT SATURATION VOLTAGE : 250mV TYP. (I_O = 4mA)
■ DIFFERENTIAL INPUT VOLTAGE RANGE EQUAL TO THE SUPPLY VOLTAGE
■ TTL, DTL, ECL, MOS, CMOS COMPATIBLE OUTPUTS

DESCRIPTION

These devices consist of four independent precision voltage comparators with an offset voltage specifications as low as 2mV max for LM339A, LM239A and LM139A. All 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.

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
SO14
(Plastic Micropackage)
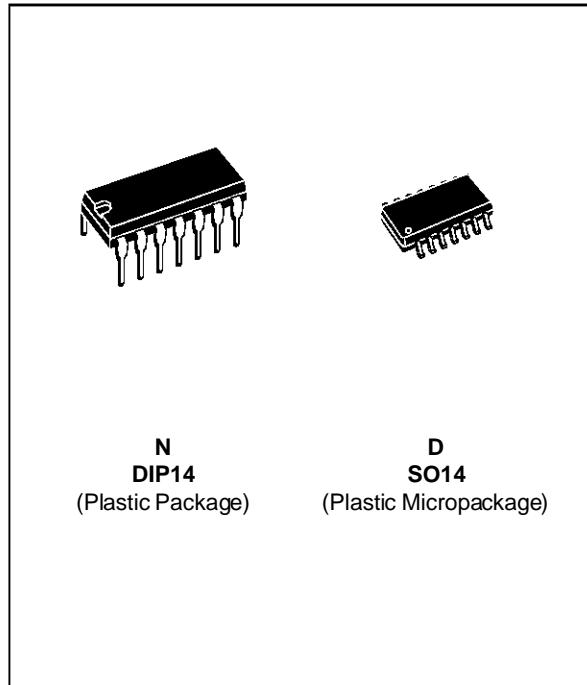
ORDER CODES

Part Number	Temperature Range	Package	
		N	**D**
LM139,A	-55, +125°C	•	•
LM239,A	-40, +105°C	•	•
LM339,A	0, +70°C	•	•
Example : LM139AN			

PIN CONNECTIONS (top view)

Output 2	1		14	Output 3
Output 1	2		13	Output 4
V_{CC}^+	3		12	V_{CC}^-
Inverting input 1	4		11	Non-inverting input 4
Non-inverting input 1	5		10	Inverting input 4
Inverting input 2	6		9	Non-inverting input 3
Non-inverting input 2	7		8	Inverting input 3
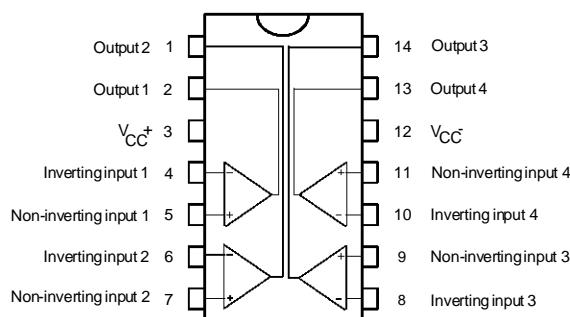
SCHEMATIC DIAGRAM (1/4 LM139)
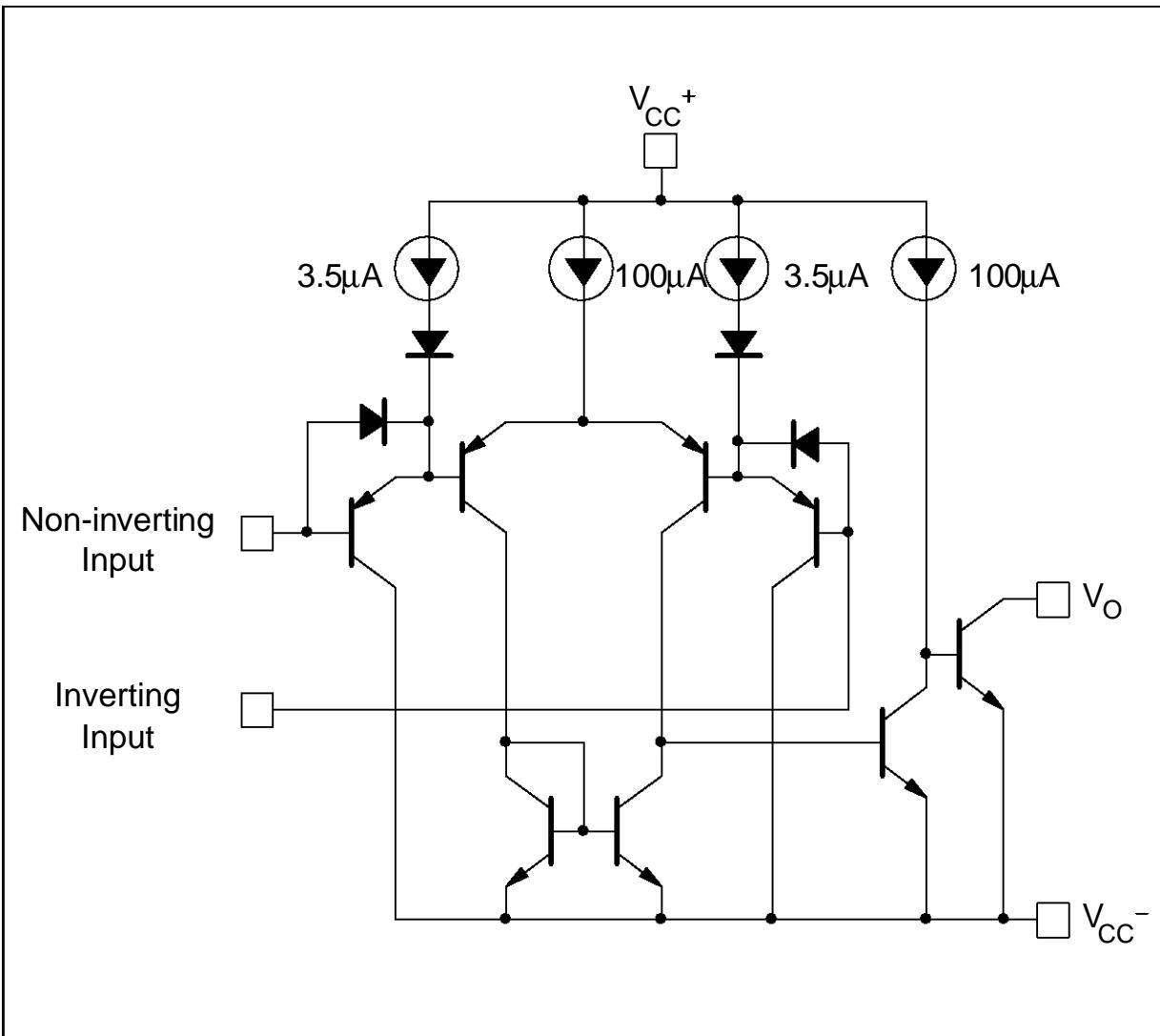
ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	LM139,A LM239,A	LM339,A	Unit
V_{CC}	Supply Voltage	±18 to 36	±18 to 36	V
V_{id}	Differential Input Voltage	±36	±36	V
V_I	Input Voltage	-0.3 to +36	-0.3 to +36	V
	Output Short-circuit to Ground - (note 1)	Infinite		
P_{tot}	Power Dissipation	570	570	mW
T_{oper}	Operating Free-air Temperature Range LM239,A	-55, +125 -40, +105	0, +70	^{o}C
T_{stg}	Storage Temperature Range	-65, +150	-65, +150	^{o}C

Notes : 1. Short-circuit from the output to V_{CC}^{+} can cause excessive heating and eventual destruction. The maximum output current is approximately 20mA, independent of the magnitude of V_{CC}^{+}.

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ELECTRICAL CHARACTERISTICS

V_{CC}^{+} = +5V, 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 – (note 2) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$		1	2 4		1	5 9	mV
I_{io}	Input Offset Current T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$		3	25 100		5	50 150	nA
I_{ib}	Input Bias Current (I_I^{+} or I_I^{-}) - (note 3) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$		25	100 300		25	250 400	nA
A_{vd}	Large Signal Voltage Gain (V_{CC} = 15V, R_L =15kΩ, V_O = 1 to 11V)	50	200		50	200		V/mV
I_{CC}	Supply Current (all comparators) V_{CC} = +5V, no load V_{CC} = +30V, no load		1.1 1.3	2 2.5		1.1 1.3	2 2.5	mA
V_{icm}	Input Common Mode Voltage Range - (note 4) (V_{CC} = 30V) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$	0 0		V_{CC}^{+}-1.5 V_{CC}^{+}-2	0 0		V_{CC}^{+}-1.5 V_{CC}^{+}-2	V
V_{id}	Differential Input Voltage - (note 6)			V_{CC}^{+}			V_{CC}^{+}	V
V_{OL}	Low Level Output Voltage (V_{id} = -1V, I_{sink} = 4mA) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$		250	400 700		250	400 700	mV
I_{OH}	High Level Output Current (V_{id} = 1V) (V_{CC} = V_O = 30V) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$		0.1	1		0.1	1	nA μA
I_{sink}	Output Sink Current (V_{id} = -1V, V_O = 1.5V)	6	16		6	16		mA
t_{re}	Response Time – (note 5) (R_L = 5.1kΩ connected to V_{CC}^{+})		1.3			1.3		μs
t_{rel}	Large Signal Response Time (R_L = 5.1kΩ connected to V_{CC}^{+}, e_I = TTL, $V_{(ref)}$ = +1.4V)		300			300		ns

Notes : 2. At output switch point, $V_O \approx$ 1.4V, R_S = 0 with V_{CC}^{+} from 5V to 30V, and over the full input common-mode range (0V to V_{CC}^{+} −1.5V).

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 charge exists on the reference of input lines.

4. The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is V_{CC}^{+} −1.5V, but either or both inputs can go to +30V without damage.

5. The response time specified is for a 100mV input step with 5mV overdrive. For larger overdrive signals 300ns can be obtained.

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 −0.3V (or 0.3V bellow the negative power supply, if used).

**SUPPLY CURRENT versus
SUPPLY VOLTAGE**
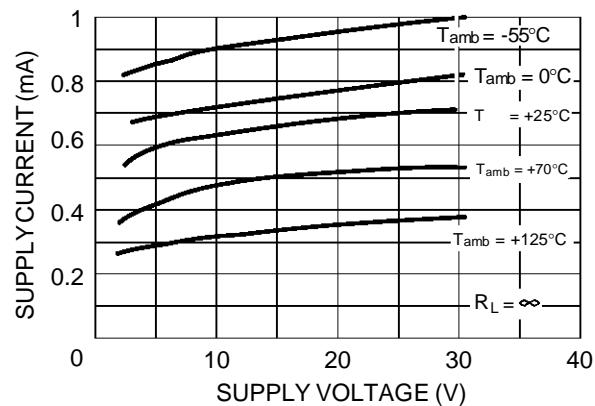
**INPUT CURRENT versus
SUPPLY VOLTAGE**
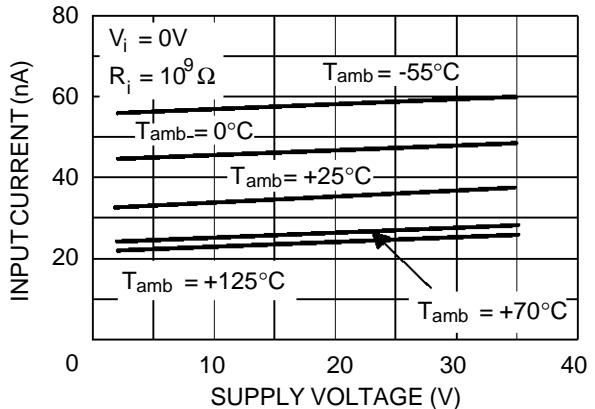
**OUTPUT SATURATION VOLTAGE
versus OUTPUT CURRENT**
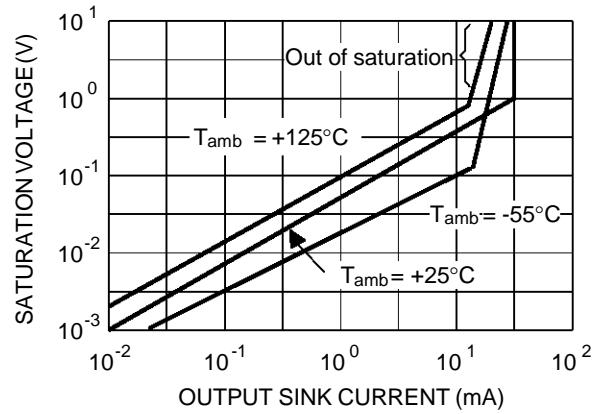
**RESPONSE TIME FOR VARIOUS INPUT
OVERDRIVES - NEGATIVE TRANSITION**
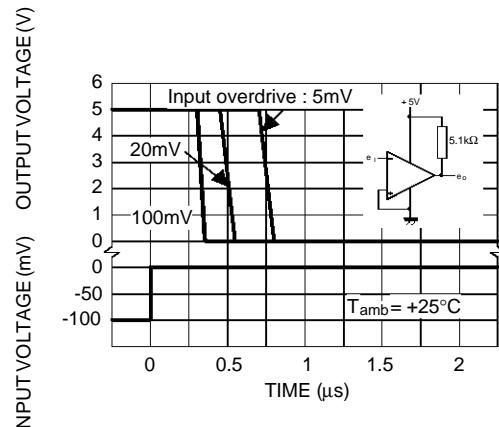
**RESPONSE TIME FOR VARIOUS INPUT
OVERDRIVES - POSITIVE TRANSITION**

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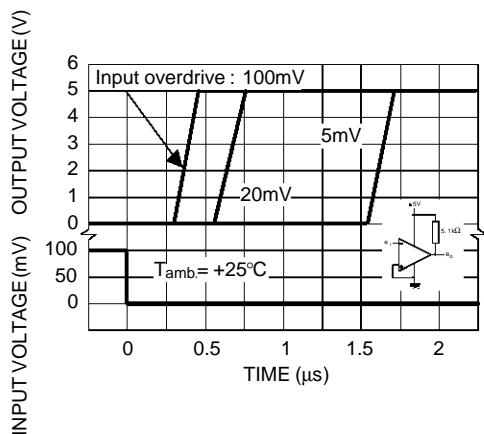
TYPICAL APPLICATIONS

BASIC COMPARATOR
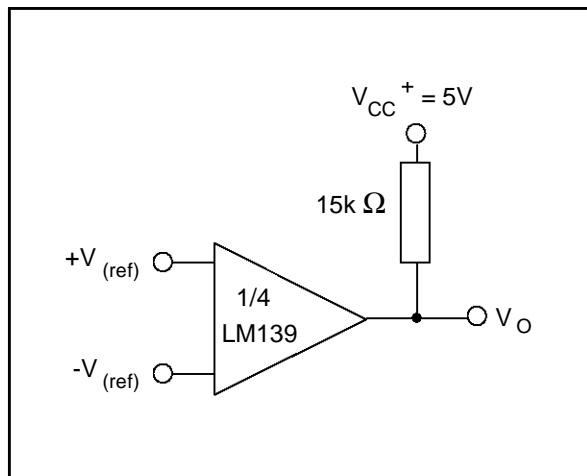
DRIVING CMOS
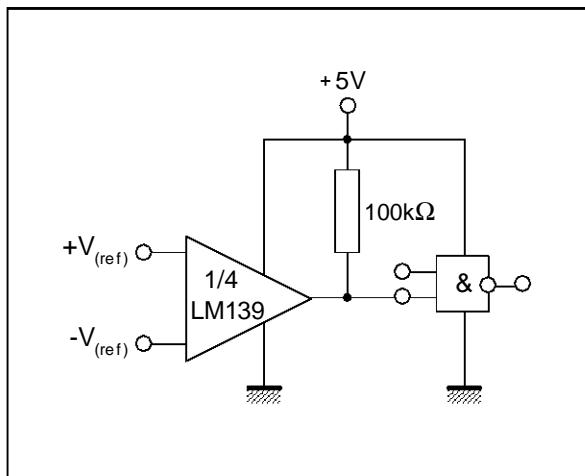
DRIVING TTL
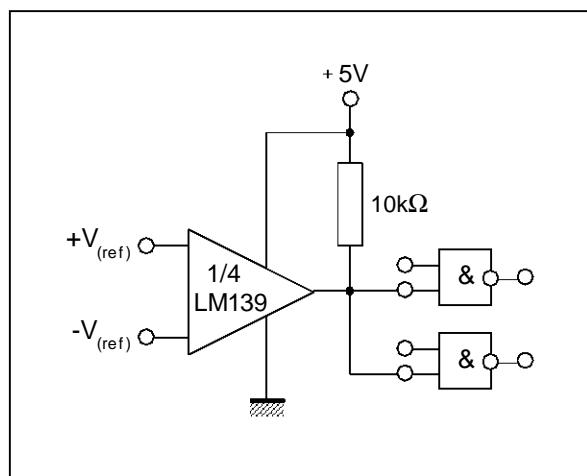
LOW FREQUENCY OP AMP
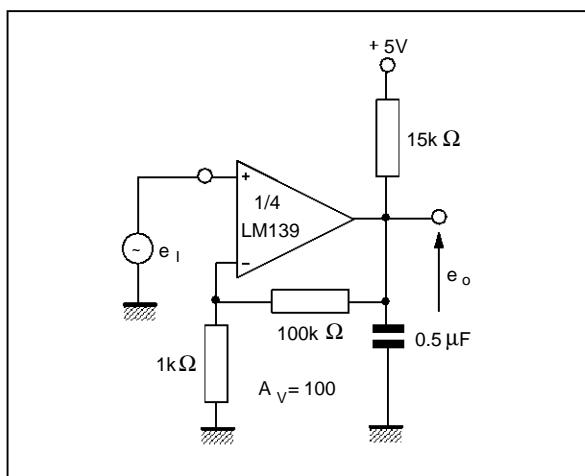
LOW FREQUENCY OP AMP
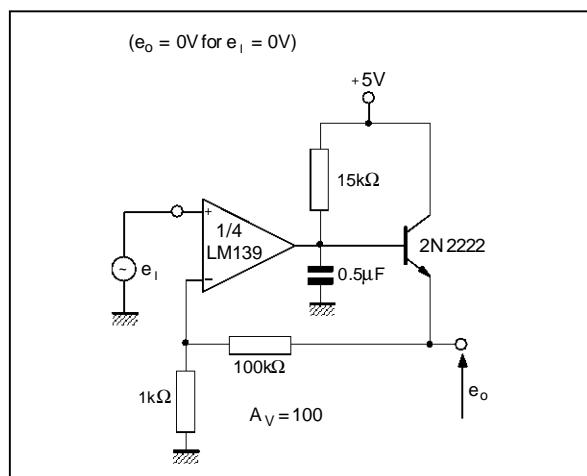
TRANSDUCER AMPLIFIER

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MICROELECTRONICS
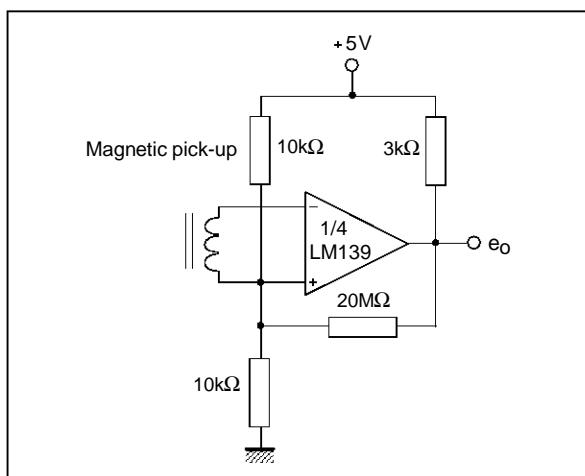
TYPICAL APPLICATIONS (continued)

TIME DELAY GENERATOR
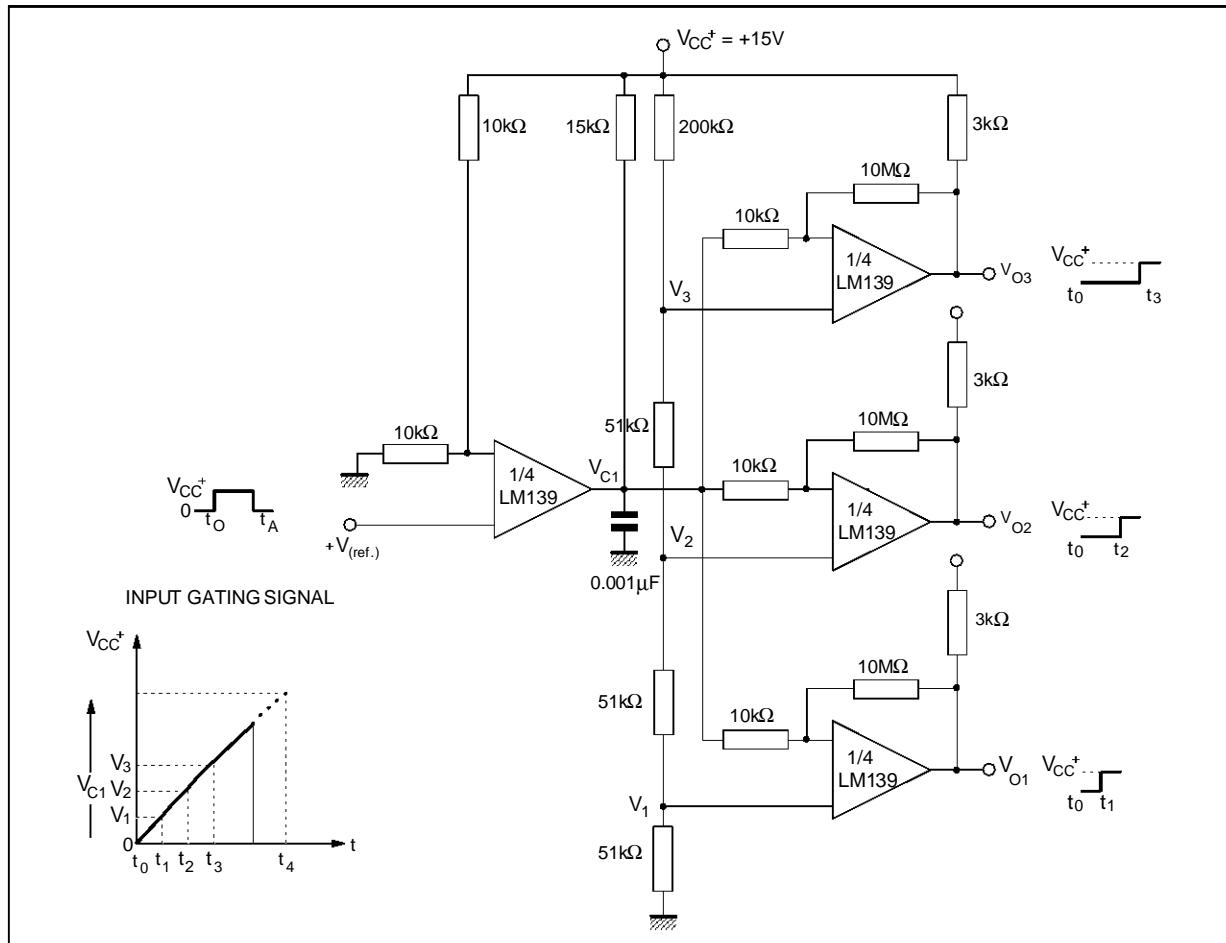
LOW FREQUENCY OP AMP WITH OFFSET ADJUST
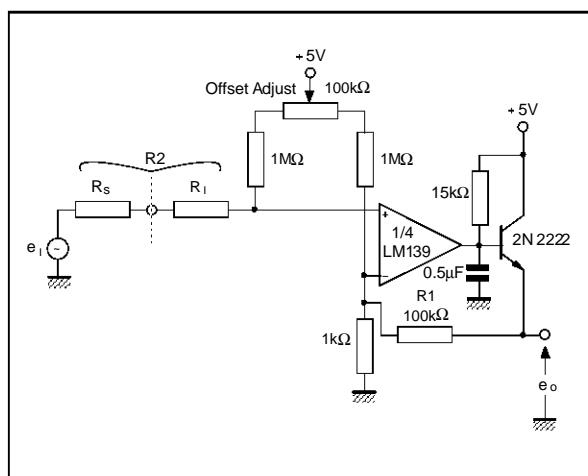
### ZERO CROSSING DETECTOR (single power supply)

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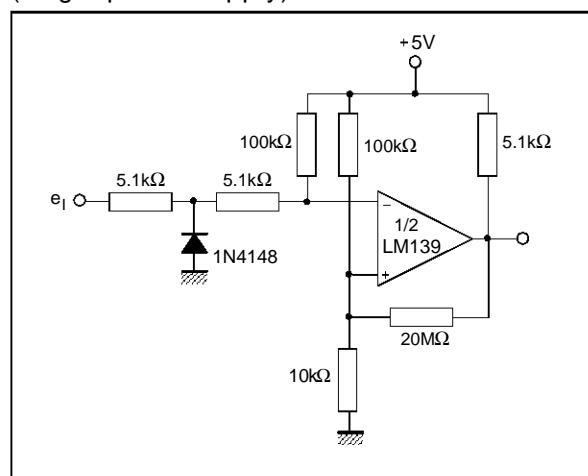
TYPICAL APPLICATIONS (continued)

TWO-DECADE HIGH-FREQUENCY VCO

$V_{CC}^+ = +30V$
$+250mV \leq V_{control} \leq +50V$
$700 Hz \leq f_o \leq 100kHz$
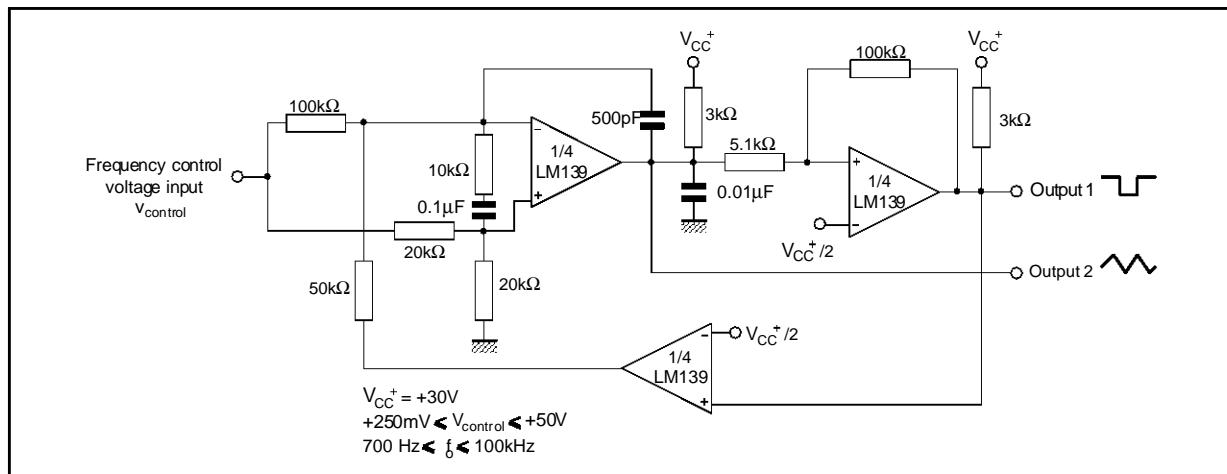
### LIMIT COMPARATOR
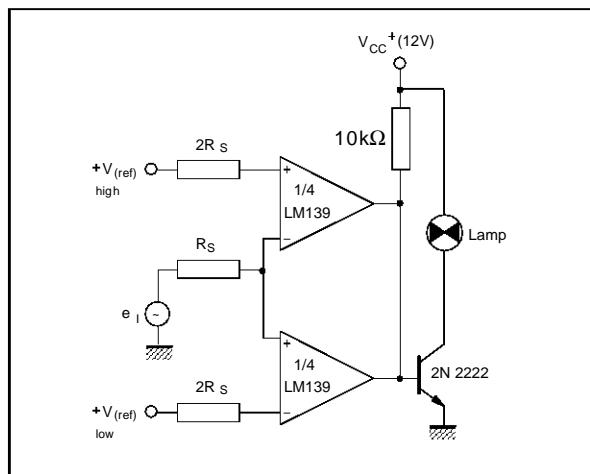
CRYSTAL CONTROLLED OSCILLATOR
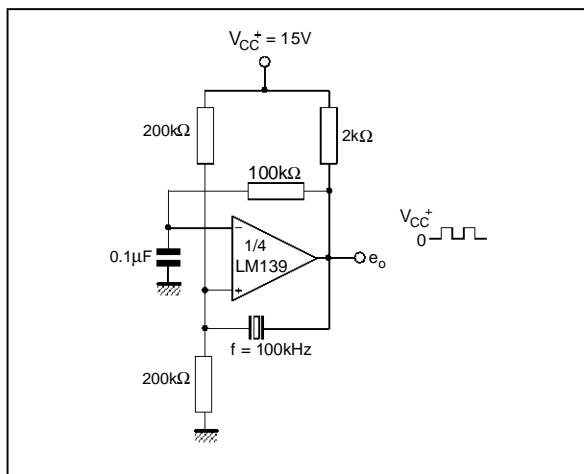
SPLIT-SUPPLY APPLICATIONS

### ZERO CROSSING DETECTOR
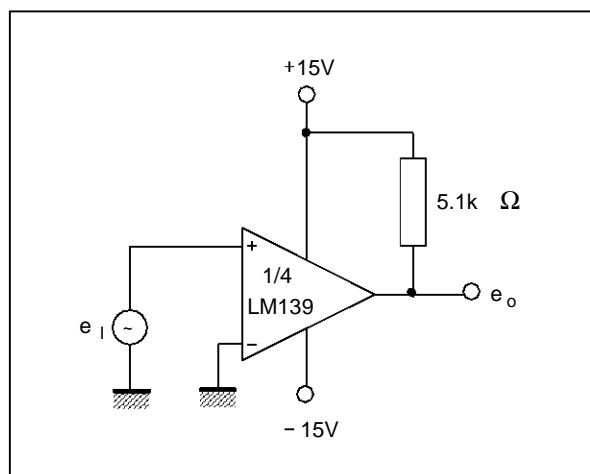
COMPARATOR WITH A NEGATIVE REFERENCE
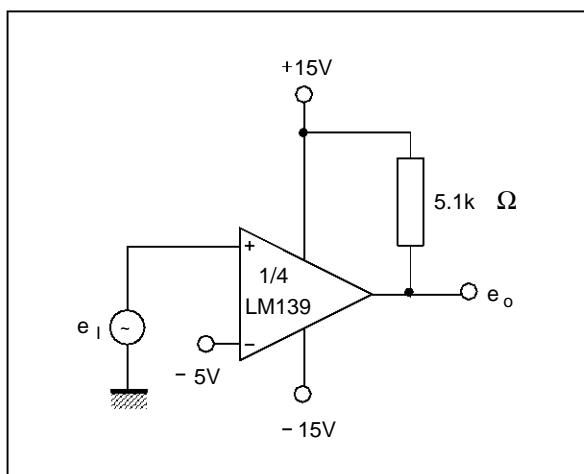
PACKAGE MECHANICAL DATA
14 PINS - PLASTIC DIP
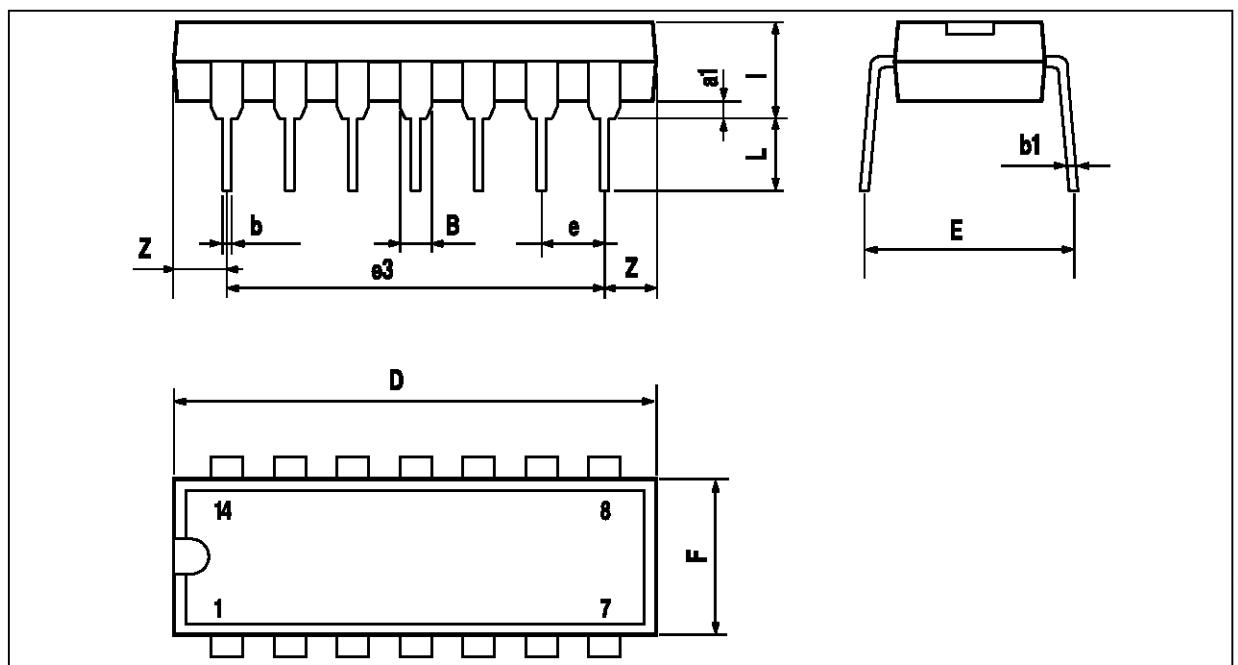
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
i			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100

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PACKAGE MECHANICAL DATA
14 PINS - PLASTIC MICROPACKAGE (SO)
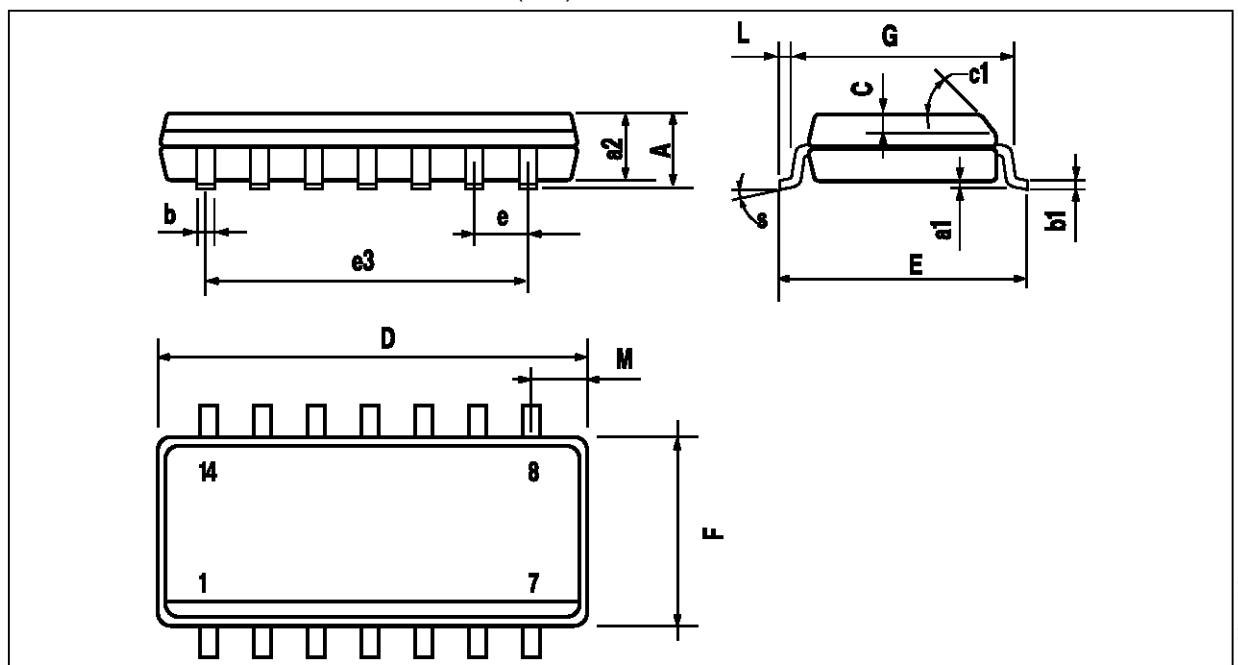
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1			45° (typ.)			
D	8.55		8.75	0.336		0.334
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.150		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.020		0.050
M			0.68			0.027
S			8° (max.)			

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