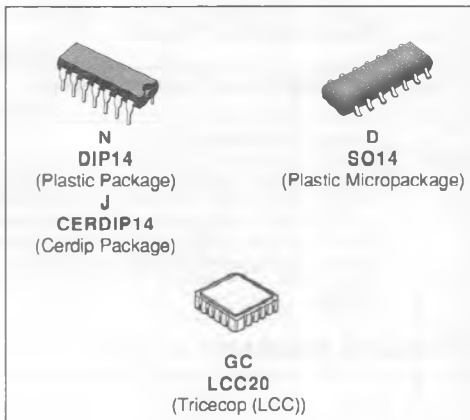


## LOW POWER LOW OFFSET VOLTAGE QUAD COMPARATORS

- WIDE SINGLE SUPPLY VOLTAGE RANGE OR DUAL SUPPLIES FOR ALL DEVICES : +2 V TO +36 V OR  $\pm 1$  V TO  $\pm 18$  V
- VERY LOW SUPPLY CURRENT DRAIN (0.8 mA) INDEPENDENT OF SUPPLY VOLTAGE (1 mW/comparator at +5 V)
- LOW INPUT BIAS CURRENT : 25 nA TYP
- LOW INPUT OFFSET CURRENT :  $\pm 5$  nA TYP
- LOW INPUT OFFSET VOLTAGE :  $\pm 1$  mV TYP
- INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GROUND
- LOW OUTPUT SATURATION VOLTAGE : 250 mV TYP. ( $I_o = 4$  mA)
- DIFFERENTIAL INPUT VOLTAGE RANGE TO THE SUPPLY VOLTAGE
- TTL COMPATIBLE OUTPUTS



### DESCRIPTION

These devices consist of four independent precision voltage comparators with an offset voltage specifications as low as 2 mV 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.

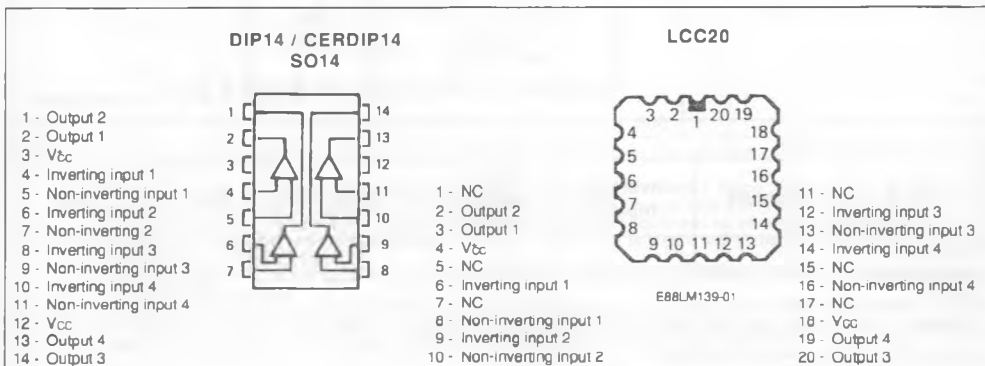
These comparators also have a unique characteristic in that the input common-mode voltage range includes ground even through operated from a single power supply voltage.

### ORDER CODES

Part Number	Temperature Range	Package			
		N	J	GC	D
LM139,A	- 55 to + 125 °C	•	•		
LM239,A	- 40 to + 105 °C	•	•		•
LM339,A	0 to + 70 °C	•	•	•	•
LM2901	- 40 to + 105 °C	•	•	•	•
MC3302	- 40 to + 105 °C	•	•		•

**Note** : Hi-Rel Versions Available  
**Examples** : LM139GC, LM139AN, LM2901D

### PIN CONNECTIONS (top views)

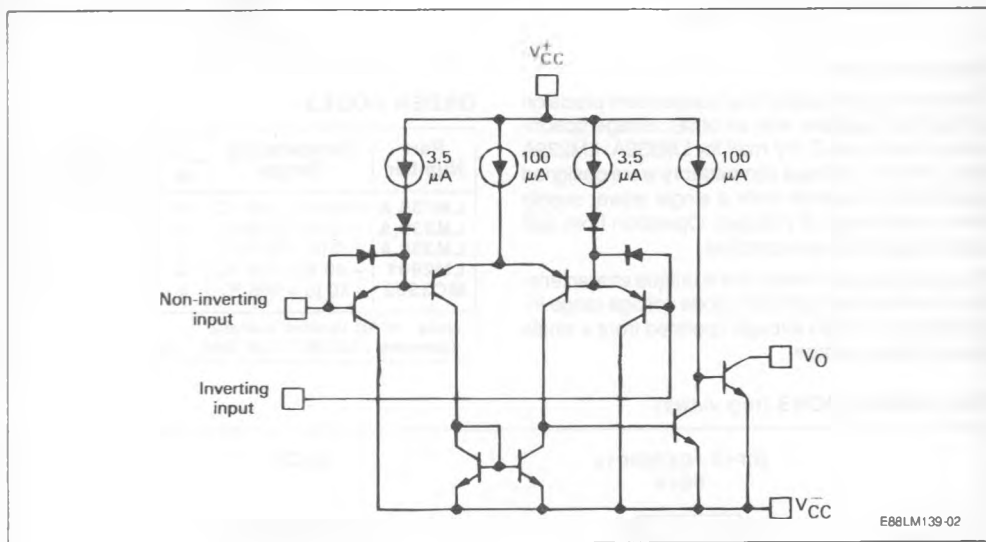


**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	LM139, A LM239, A	LM339, A	LM2901 MC3302	Unit
$V_{CC}$	Supply Voltage	$\pm 18$ to 36	$\pm 18$ to 36	$\pm 18$ to 36	V
$V_{ID}$	Differential Input Voltage	36	36	36	V
$V_i$	Input Voltage	- 0.3 to + 36	- 0.3 to + 36	- 0.3 to + 36	V
	Output Short-circuit to Ground – (note 2)	Continuous	Continuous	Continuous	
$P_{tot}$	Power Dissipation – (note 1)	570 665	570	570	mW
	LM139GC				
$T_{oper}$	Operating Free-air Temperature Range	- 55 to + 125 - 40 to + 105	0 to + 70	- 40 to + 105	$^{\circ}C$
	LM239, A				
$T_{stg}$	Storage Temperature Range	- 65 to + 150	- 65 to + 150	- 65 to + 150	$^{\circ}C$

**Notes :** 1. Short-circuit 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. For operating at high temperatures, the LM139, LM139A, LM2901 and MC3302 must be derated based on a + 125  $^{\circ}C$  max junction temperature and a thermal resistance of 175  $^{\circ}C/W$  which applies for the device soldered on a printed circuit board, operating in a still air ambient. The LM139 and LM139A must be derated based on a + 150  $^{\circ}C$  max junction temperature.  
 $R_{th(j-c)}$  = 250  $^{\circ}C/W$  Devices bonded on a 6 x 3 x 0.15 cm glass-epoxy substrate with 30 mm<sup>2</sup> of 35  $\mu m$  thick copper.

**SCHEMATIC DIAGRAM (1/4 LM139)**



Case	Outputs	Inverting Inputs	Non-inverting Inputs	$V_{CC}$	$V_{CC}$	N.C.
DIP14 CERDIP14 SO14	1, 2, 13, 14	4, 6, 8, 10	5, 7, 9, 11	12	3	
LCC20	2, 3, 19, 20	6, 9, 12, 14	8, 10, 13, 16	18	4	*

\* LCC20 : Other pins are not connected.

## ELECTRICAL CHARACTERISTICS

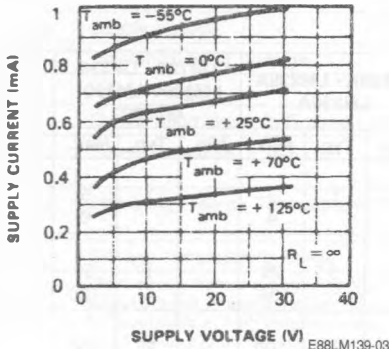
LM139, A : -55 °C < T<sub>amb</sub> < +125 °C  
 LM239, A, LM2901, MC3302 : -40 °C < T<sub>amb</sub> < +105 °C  
 LM339, A : 0 °C < T<sub>amb</sub> < +70 °C  
 (unless otherwise specified) V<sub>CC</sub> = +5 V ; V<sub>CC</sub> = GND

Symbol	Parameter	LM139A - LM239A LM339A			LM139 - LM239 LM339 - LM2901 MC3302			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
V <sub>IO</sub>	Input Offset Voltage – (note 3) T <sub>amb</sub> = +25 °C T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>		1	2 4		1	5 9	mV
I <sub>IO</sub>	Input Offset Current T <sub>amb</sub> = +25 °C T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>		3	25 100		5	50 150	nA
I <sub>IB</sub>	Input Bias Current (I <sub>I+</sub> or I <sub>I-</sub> ) T <sub>amb</sub> = +25 °C – (note 4) T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>		25	100 300		25	250 400	nA
A <sub>VD</sub>	Large Signal Voltage Gain V <sub>CC</sub> = +15 V, T <sub>amb</sub> = +25 °C, R <sub>L</sub> ≥ 15 kΩ	50	200		25	200		V/mV
I <sub>CC</sub>	Supply Current, R <sub>L</sub> = ∞, T <sub>amb</sub> = +25 °C (all comparators)		0.8	2		0.8	2	mA
V <sub>I</sub>	Input Common-mode Voltage Range (note 5) T <sub>amb</sub> = +25 °C T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>	0 0		V <sub>CC</sub> - 1.5 V <sub>CC</sub> - 2	0 0		V <sub>CC</sub> - 1.5 V <sub>CC</sub> - 2	V
V <sub>ID</sub>	Differential Input Voltage (V <sub>I+</sub> = 0, or V <sub>I-</sub> = 0, if used) (note 7)			V <sub>CC</sub>			V <sub>CC</sub>	V
V <sub>OL</sub>	Low Level Output Voltage (V <sub>I</sub> ≥ 1 V, V <sub>I</sub> = 0 V, I <sub>sink</sub> ≤ 4 mA) T <sub>amb</sub> = +25 °C T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>		250	400 700		250	400 700	mV
I <sub>OH</sub>	High Level Output Current (V <sub>I</sub> ≥ 1 V, V <sub>I</sub> = 0 V) T <sub>amb</sub> = +25 °C, V <sub>O</sub> = +5 V T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub> , V <sub>O</sub> = +30 V		0.1	1		0.1	1	nA μA
I <sub>O(sink)</sub>	Output Sink Current (V <sub>I</sub> ≥ 1 V, T <sub>amb</sub> = +25 °C, V <sub>I</sub> = 0 V, V <sub>O</sub> ≤ +1.5 V)	6	16		6	16		mA
t <sub>re</sub>	Response Time – (note 6) (V <sub>L</sub> = +5 V, R <sub>L</sub> = 5100 Ω, V <sub>(ref)</sub> = +1.4 V, T <sub>amb</sub> = +25 °C)		1.3			1.3		μs
t <sub>rel</sub>	Large Signal Response Time (V <sub>L</sub> = 5 V, e <sub>I</sub> = TTL, V <sub>(ref)</sub> = +1.4 V, T <sub>amb</sub> = +25 °C)		300			300		ns

Notes : 3 At output switch point, V<sub>O</sub> = 1.4 V, R<sub>S</sub> = 0 with V<sub>CC</sub> = 5 V, and over the full input common-mode range (0 V to V<sub>CC</sub> - 1.5 V).

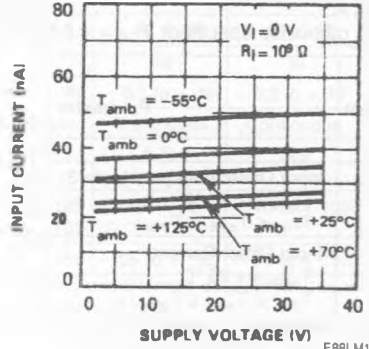
- The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output, so no loading charge exists on the reference input lines.
- The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is V<sub>CC</sub> - 1.5 V, but either or both inputs can go to +30 V without damage.
- The response time specified is for a 100 mV input step with 5 mV overdrive. For larger overdrive signals 300 ns can be obtained.
- 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).

SUPPLY CURRENT



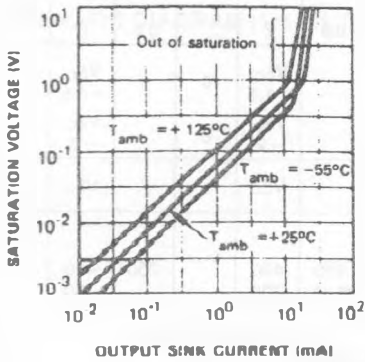
E88LM139-03

INPUT CURRENT



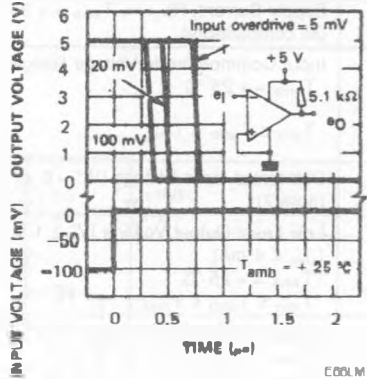
E88LM139-04

OUTPUT SATURATION VOLTAGE



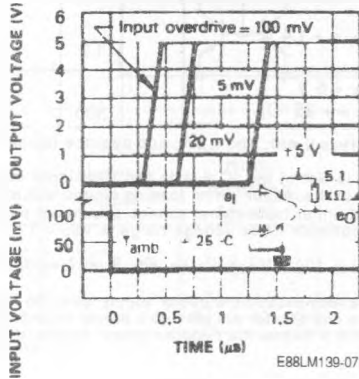
E88LM139-05

RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - NEGATIVE TRANSITION



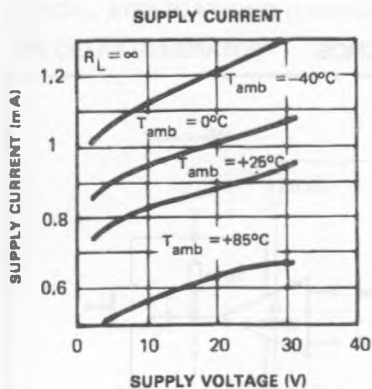
E88LM139-06

RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - POSITIVE TRANSITION

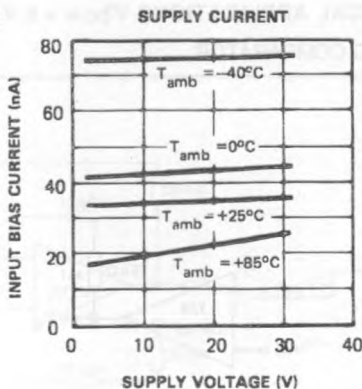


E88LM139-07

LM239,A  
LM2901-MC3302

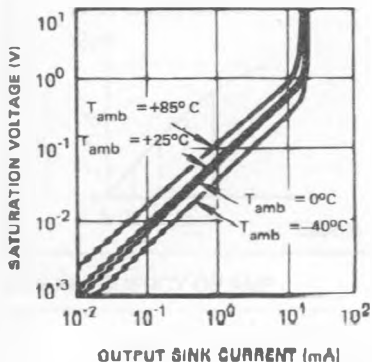


E88LM139-08



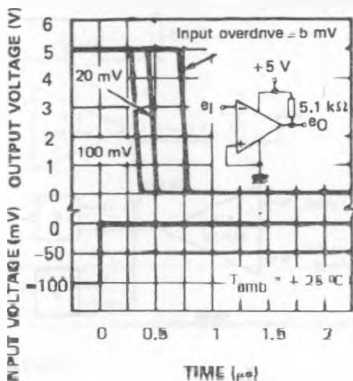
E88LM139-09

**OUTPUT SATURATION VOLTAGE**



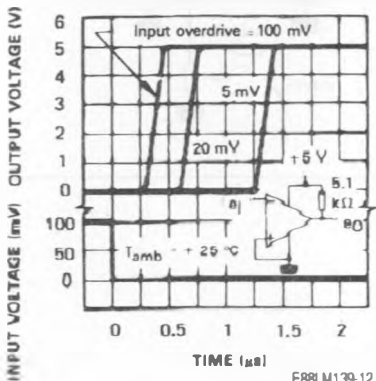
E88LM139-10

**RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - NEGATIVE TRANSITION**



E88LM139-11

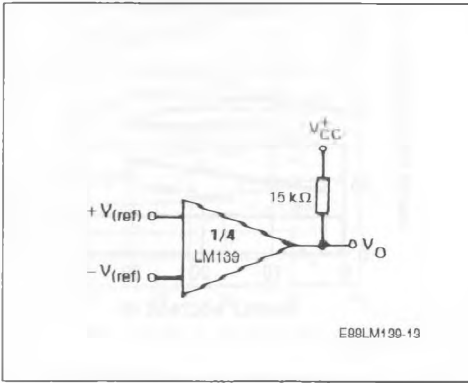
**RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES POSITIVE TRANSITION**



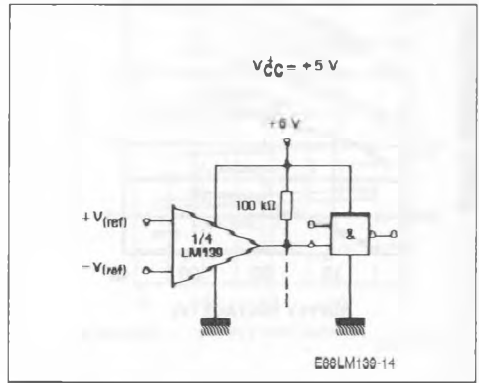
E88LM139-12

TYPICAL APPLICATIONS  $V_{CC} = +5\text{ V}$

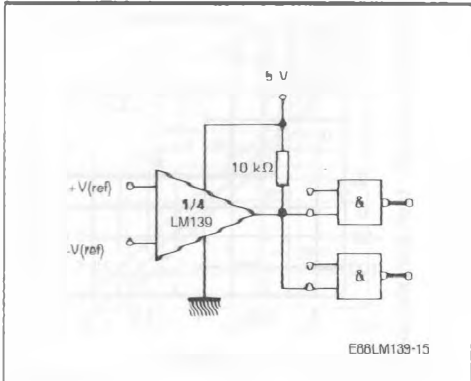
BASIC COMPARATOR



DRIVING CMOS

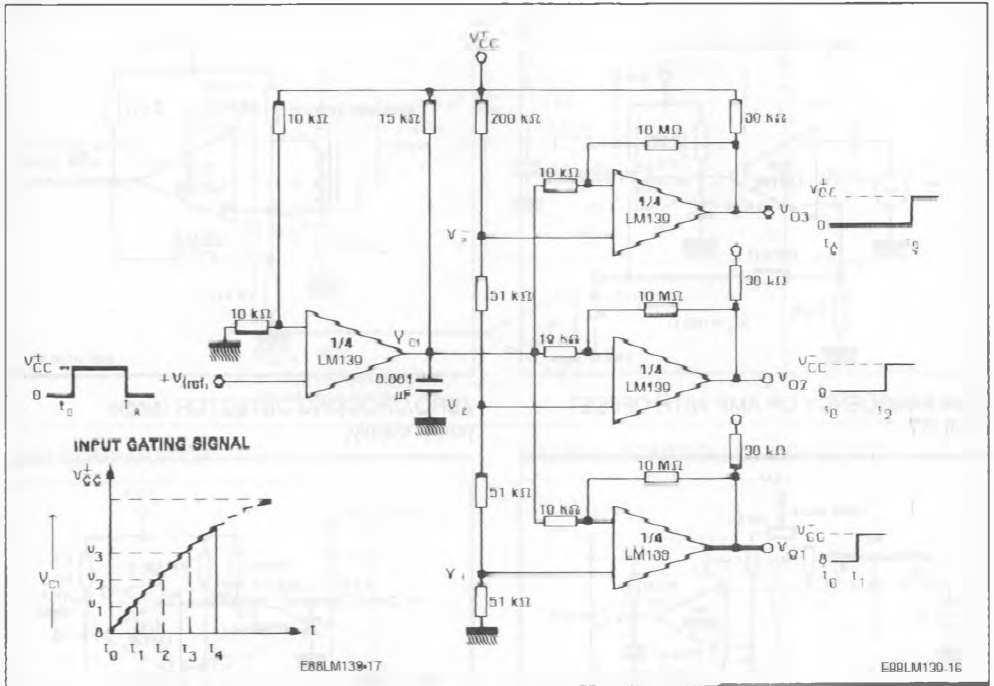


DRIVING TTL

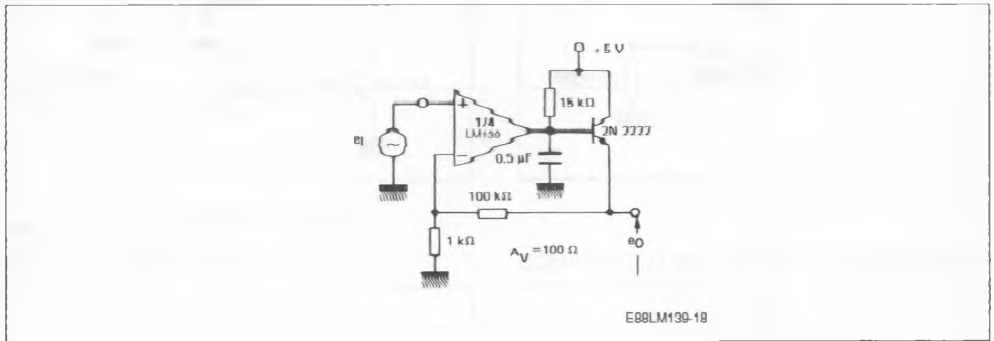


TYPICAL APPLICATIONS (continued)

TIME DELAY GENERATOR

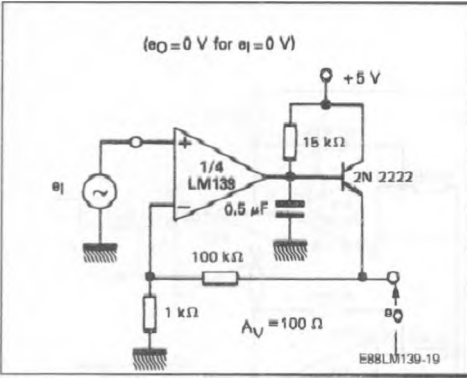


LOW FREQUENCY OP AMP

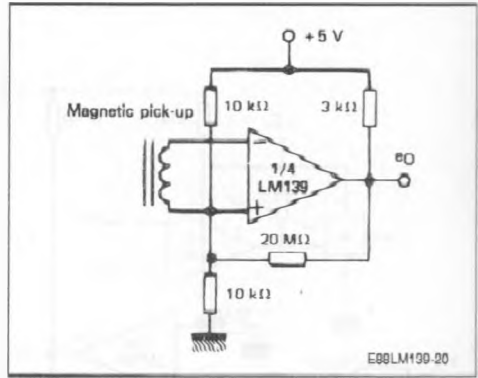


TYPICAL APPLICATIONS (continued)

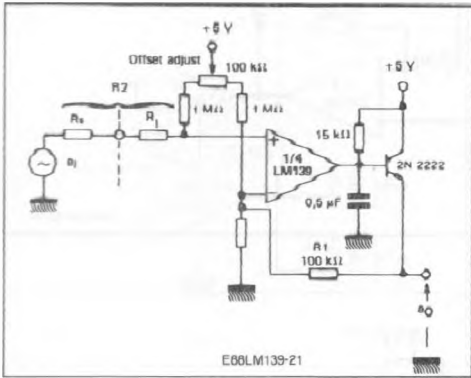
LOW FREQUENCY OP AMP



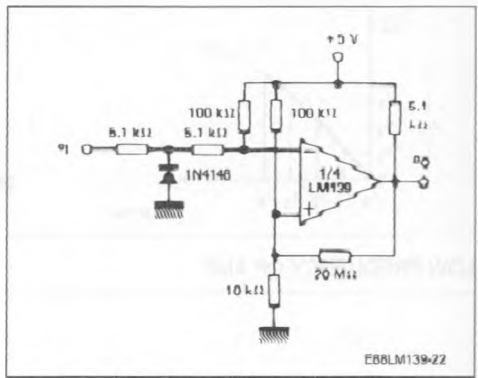
TRANSDUCER AMPLIFIER



LOW FREQUENCY OP AMP WITH OFFSET ADJUST



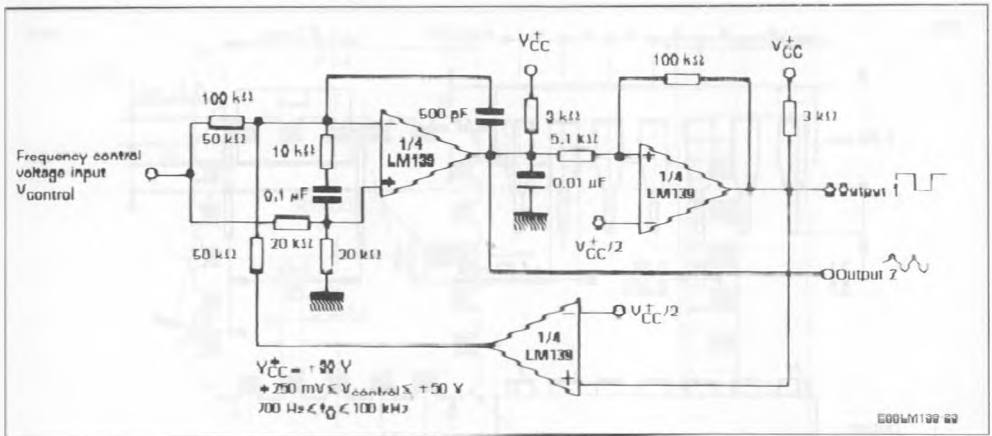
ZERO CROSSING DETECTOR (single power supply)



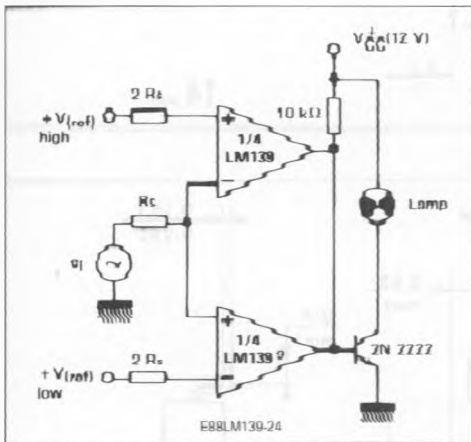


TYPICAL APPLICATIONS (continued)

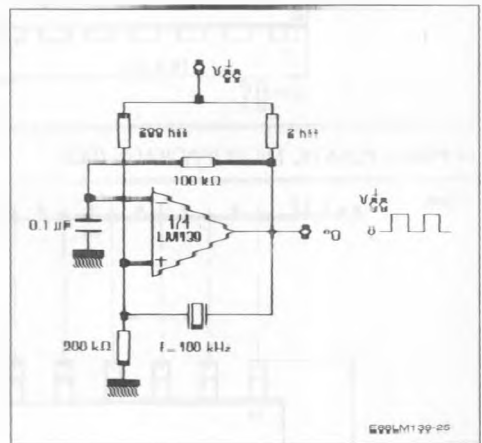
TWO-DECADE HIGH-FREQUENCY VCO



LIMIT COMPARATOR

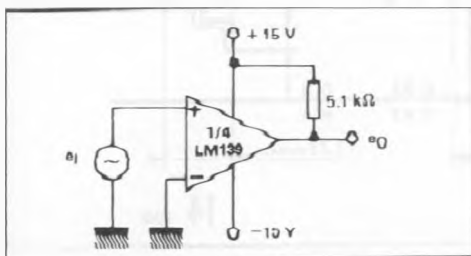


CRYSTAL CONTROLLED OSCILLATOR

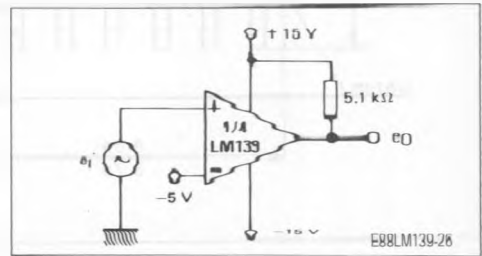


SPLIT-SUPPLY APPLICATIONS

ZERO CROSSING DETECTOR

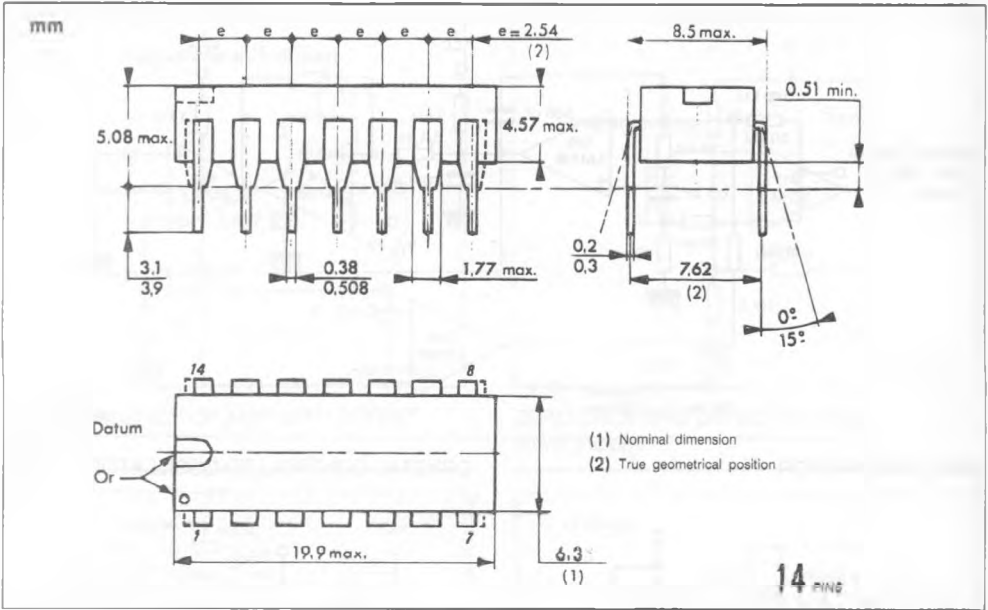


COMPARATOR WITH A NEGATIVE REFERENCE

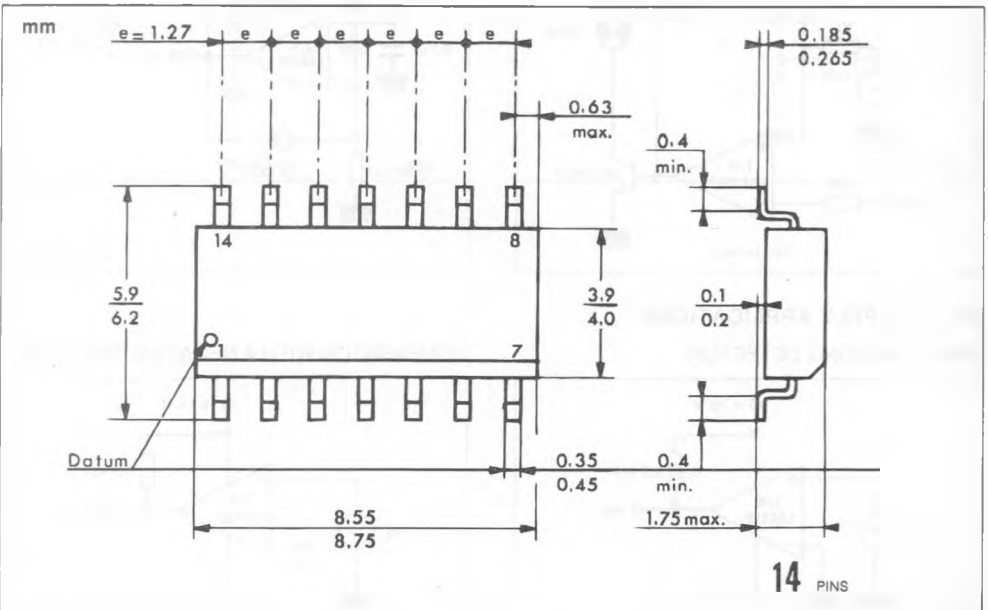


PACKAGE MECHANICAL DATA

14 PINS – PLASTIC DIP OR CERDIP



14 PINS – PLASTIC MICROPACKAGE (SO)



## PACKAGE MECHANICAL DATA (continued)

20 PINS – TRICECOP (LCC)

