THOMSON SEMICONDUCTORS

LM139,A
LM239,A
LM339,A
LM2901
MC3302

78C 05164   D

T. 73-53

LOW POWER
LOW OFFSET VOLTAGE
QUAD COMPARATORS

LOW POWER LOW OFFSET VOLTAGE QUAD COMPARATORS

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

- Wide single supply voltage range or dual supplies for all devices (excepted MC3302) : +2 V to +36 V or ±1 V to ±18 V
- Very low supply current drain (0.8 mA) independent of supply voltage (2 mW/comparator at +5 V).
- Low input bias current : 25 nA typ.
- Low input offset current : ±5 nA typ.
- Low input offset voltage : ±3 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.

ORDERING INFORMATION

Hi-Rel versions available - See chapter 14

PART NUMBER	TEMPERATURE RANGE	PACKAGE			
		DP	DG	FP	GC
LM139,A	−55°C to +125°C		•		•
LM239,A	−25°C to + 85°C	•	•		
LM339,A	0°C to + 70°C	•	•	•	
LM2901	−40°C to + 85°C	•		•	
MC3302	−40°C to + 85°C	•			

Examples : LM139GC, LM139ADG, LM2901FP

CASES

CB-2
(TO-116)

CB-511
(SO-14)

DP SUFFIX
PLASTIC PACKAGE
DG SUFFIX
CERDIP PACKAGE

FP SUFFIX
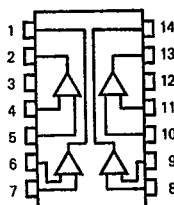PLASTIC MICROPACKAGE

CB-705

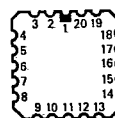**GC SUFFIX**
TRICECOP (LCC)

PIN ASSIGNMENTS
(Top views)

CB-2
CB-511

1 - Output 2
2 - Output 1
3 - V_{CC}^+
4 - Inverting input 1
5 - Non-inverting input 1
6 - Inverting input 2
7 - Non-inverting 2
8 - Inverting input 3
9 - Non-inverting input 3
10 - Inverting input 4
11 - Non-Inverting input 4
12 - V_{CC}^-
13 - Output 4
14 - Output 3

1 - NC
2 - Output 2
3 - Output 1
4 - V_{CC}^+
5 - NC
6 - Inverting input 1
7 - NC
8 - Non-Inverting input 1
9 - Inverting input 2
10 - Non-inverting input 2

CB-705

11 - NC
12 - Inverting input 3
13 - Non-inverting input 3
14 - Inverting input 4
15 - NC
16 - Non-Inverting input 4
17 - NC
18 - V_{CC}^-
19 - Output 4
20 - Output 3

Réf. 00345

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THOMSON
COMPONENTS

LM139,A•LM239,A•LM339,A•LM2901•MC3302

78C 06165   D.

T-73-53

MAXIMUM RATINGS

Rating	Symbol	LM139,A LM239,A	LM339,A	LM2901 MC3302	
Supply voltage MC3302	V_{CC}	±18 to 36 —	±18 to 36 —	±18 to 36 ±14 to 28	V
Differential input voltage	V_{ID}	36	36	36	V
Input voltage MC3302	V_I	−0.3 to +36 —	−0.3 to +36 —	−0.3 to +36 −0.3 to +28	V
Output short-circuit to ground - (Note 2)	—	Continuous	Continuous	Continuous	—
Power dissipation - (Note 1) LM139GC	P_{tot}	570 665	570 —	570 —	mW
Operating free-air temperature range LM239,A	T_{oper}	−55 to +125 −25 to +85	0 to +70 —	−40 to +85 —	°C
Storage temperature range	T_{stg}	−65 to +150	−65 to +150	−65 to +150	°C

Note 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}^+.

Note 2 : For operating at high temperatures, the LM139, LM139A, LM2901 and MC3302 must be derated based on a +125°C max junction temperature and a thermal resistance of 175°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°C max junction temperature.

* $R_{th(j-a)} = 250°C/W$. Devices bonded on a 6 × 3 × 0.15 cm glass-epoxy substrate with 30 mm² of 35 μm thick copper.

SCHEMATIC DIAGRAM (1/4 LM139)
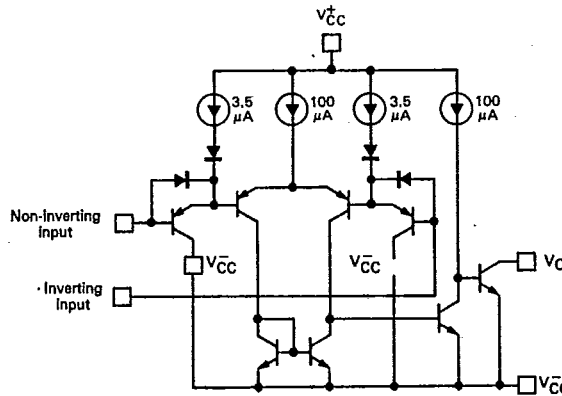
CASE	Outputs	Inverting Inputs	Non-Inverting Inputs	V_{CC}^-	V_{CC}^+	N.C.
CB-2/CB-511	1, 2, 13, 14	4, 6, 8, 10	5, 7, 9, 11	12	3	—
CB-705	2, 3, 19, 20	6, 9, 12, 14	8, 10, 13, 16	18	4	*

* **CB-705** : Other pins are not connected.

LM139,A•LM239,A•LM339,A•LM2901•MC3302

78C 06166   D

T·73·53

ELECTRICAL CHARACTERISTICS
LM139,A : −55°C ⩽ T$_{amb}$ ⩽ +125°C, V$_{CC}^+$ = +5V
LM239,A : −25°C ⩽ T$_{amb}$ ⩽ + 85°C, V$_{CC}^+$ = +5 V
LM339,A :   0°C ⩽ T$_{amb}$ ⩽ + 70°C, V$_{CC}^+$ = +5 V
(Unless otherwise specified)

Characteristic	Symbol	LM139,A/LM239,A			LM339,A			Unit
		Min	Typ	Max	Min	Typ	Max	
Input offset voltage - (Note 3)	V$_{IO}$							mV
T$_{amb}$ = +25°C		−	±2	±5	−	±2	±5	
LM139A, LM239A		−	±1	±2	−	±1	−	
LM339A		−	−	−	−	−	±2	
T$_{min}$ ⩽ T$_{amb}$ ⩽ T$_{max}$		−	−	9	−	−	9	
LM139A, LM239A		−	−	4	−	−	−	
LM339A		−	−	−	−	−	4	
Input offset current	I$_{IO}$							nA
T$_{amb}$ = +25°C		−	±3	±25	−	±5	±50	
T$_{min}$ ⩽ T$_{amb}$ ⩽ T$_{max}$		−	−	±100	−	−	±150	
Input bias current (I$_I^+$ or I$_I^-$)	I$_{IB}$							nA
T$_{amb}$ = +25°C - (Note 4)		−	25	100	−	25	250	
T$_{min}$ ⩽ T$_{amb}$ ⩽ T$_{max}$		−	−	300	−	−	400	
Large signal voltage gain	A$_{VD}$							V/mV
V$_{CC}^+$ = +15 V, T$_{amb}$ = +25°C, R$_L$ ⩾ 15 kΩ		−	200	−	−	200	−	
LM139A, LM239A		50	200	−	−	−	−	
LM339A		−	−	−	50	200	−	
Supply current, R$_L$ = ∞, T$_{amb}$ = +25°C (all comparators)	I$_{CC}$	−	0.8	2	−	0.8	2	mA
Input common-mode voltage range	V$_I$							V
T$_{amb}$ = +25°C - (Note 5)		0	−	V$_{CC}^+$ −1.5	0	−	V$_{CC}^+$ −1.5	
T$_{min}$ ⩽ T$_{amb}$ ⩽ T$_{max}$		0	−	V$_{CC}^+$ −2	−	−	V$_{CC}^+$ −2	
Differential input voltage (V$_I^+$ = 0 or V$_I^-$ = 0, if used) - Note 7	V$_{ID}$	−	−	36	−	−	36	V
LM139A, LM239A		−	−	V$_{CC}^+$	−	−	−	
LM339A		−	−	−	−	−	V$_{CC}^+$	
Low level output voltage (V$_I^-$ ⩾ 1V, V$_I^+$ = 0 V, I$_{sink}$ ⩽ 4 mA)	V$_{OL}$							mV
T$_{amb}$ = +25°C		−	250	−	−	250	400	
T$_{min}$ ⩽ T$_{amb}$ ⩽ T$_{max}$		−	−	700	−	−	700	
High level output current (V$_I^+$ ⩾ 1 V, V$_I^-$ = 0 V)	I$_{OH}$							
T$_{amb}$ = +25°C, V$_O$ = +5 V		−	0.1	−	−	0.1	−	nA
T$_{min}$ ⩽ T$_{amb}$ ⩽ T$_{max}$, V$_O$ = +30 V		−	−	1	−	−	1	µA
Output sink current	I$_{O(sink)}$							mA
(V$_I^-$ ⩾ 1 V, T$_{amb}$ = +25°C, V$_I^+$ = 0 V, V$_O$ ⩽ +1.5 V)		6	16	−	6	16	−	
Response time - (Note 6)	t$_{re}$							µs
(V$_L$ = +5 V, R$_L$ = 5100 Ω, V$_{(ref)}$ = +1.4 V, T$_{amb}$ = +25°C)		−	1.3	−	−	1.3	−	
Large signal response time (V$_L$ = 5 V, e$_I$ = TTL, R$_L$ = 5100 Ω, V$_{(ref)}$ = +1.4 V, T$_{amb}$ = +25°C)	t$_{rel}$	−	300	−	−	300	−	ns

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THOMSON SEMICONDUCTORS
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LM139,A•LM239,A•LM339,A•LM2901•MC3302

T.73-53

ELECTRICAL CHARACTERISTICS
LM2901, MC3302 : $-40°C \leqslant T_{amb} \leqslant +85°C$, $V_{CC} = +5$ V
(Unless otherwise specified)

Characteristic	Symbol	LM2901			MC3302			Unit
		Min	Typ	Max	Min	Typ	Max	
Input offset voltage - (Note 3) $T_{amb} = +25°C$ $T_{min} \leqslant T_{amb} \leqslant T_{max}$	V_{IO}	— —	±2 9	±7 15	— —	±3 —	±20 40	mV
Input offset current $T_{amb} = +25°C$ $T_{min} \leqslant T_{amb} \leqslant T_{max}$	I_{IO}	— —	±5 ±50	±50 ±200	— —	±3 —	±100 ±300	nA
Input bias current (I_I^+ or I_I^-) $T_{amb} = +25°C$ - (Note 4) $T_{min} \leqslant T_{amb} \leqslant T_{max}$	I_{IB}	— —	25 200	250 500	— —	25 —	500 1000	nA
Large signal voltage gain ($V_{CC}^+ = +15$ V, $T_{amb} = +25°C$, $R_L \geqslant 15$ kΩ)	A_{VD}	25	100	—	2	30	—	V/mV
Supply current $R_L = \infty$, $T_{amb} = +25°C$ (all comparators) $R_L = \infty$, $T_{amb} = +25°C$, $V_{CC}^+ = +30$ V	I_{CC}	— —	0.8 1	2 2.5	— —	0.8 —	2 —	mA
Input common-mode voltage range $T_{amb} = +25°C$ - (Note 5) $T_{min} \leqslant T_{amb} \leqslant T_{max}$	V_I	0 0	— —	V_{CC}^+ -1.5 V_{CC}^+ -2	0 0	— —	V_{CC}^+ -1.5 V_{CC}^+ -2	V
Differential input voltage ($V_I^+ = 0$ or $V_I^- = 0$, if used) - Note 7	V_{ID}	—	—	V_{CC}^+	—	—	V_{CC}^+	V
Low level output voltage ($V_I^- \geqslant +1$ V, $V_I^+ = 0$ V, $I_{sink} \leqslant 4$ mA) $T_{amb} = +25°C$ $T_{min} \leqslant T_{amb} \leqslant T_{max}$	V_{OL}	— —	— 400	400 700	— —	250 —	500 700	mV
High level output current ($V_I^+ \geqslant +1$ V, $V_I^- = 0$ V) $T_{amb} = +25°C$, $V_O = +5$ V $T_{min} \leqslant T_{amb} \leqslant T_{max}$, $V_O = +30$ V	I_{OH}	— —	0.1 —	— 1	— —	0.1 —	— 1	nA μA
Output sink current ($V_I^- = +1$ V, $V_I^+ = 0$ V, $T_{amb} = +25°C$, $V_O \leqslant +1.5$ V)	$I_{O(sink)}$	6	16	—	6	16	—	mA
Response time $V_L = +5$ V ($R_L = 5100$ Ω, $T_{amb} = +25°C$) - Note 6	t_{re}	—	1.3	—	—	1.3	—	μs
Large signal response time ($V_L = +5$ V, $e_I = $ TTL, $R_L = 5100$ Ω, $V_{(ref)} = +1.4$ V, $T_{amb} = +25°C$)	t_{rel}	—	300	—	—	300	—	ns

Note 3 : At output switch point, $V_O \cong 1.4$ V, $R_S = 0$ with $V_{CC}^+ = 5$ V, and over the full input common-mode range (0 V to $V_{CC}^+ - 1.5$ V).

Note 4 : 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 or input lines.

Note 5 : 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.

Note 6 : The response time specified is for a 100 mV input step with 5 mV overdrive. For larger overdrive signals 300 ns can be obtained.
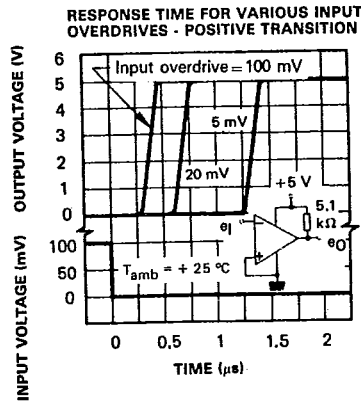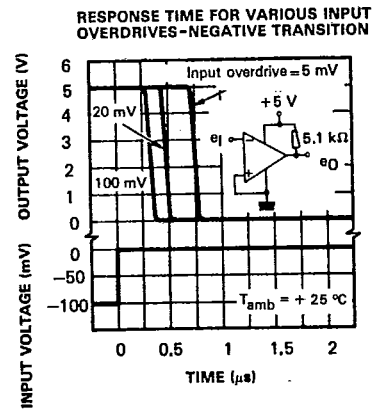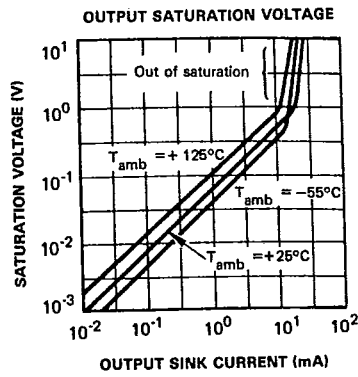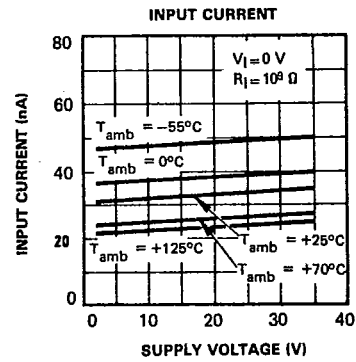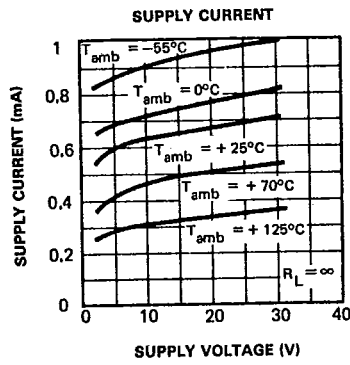
Note 7 : Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator will provide a proper output state. The low input voltage state must not be less than -0.3 V (or 0.3 V bellow the negative power supply, if used).

THOMSON SEMICONDUCTORS

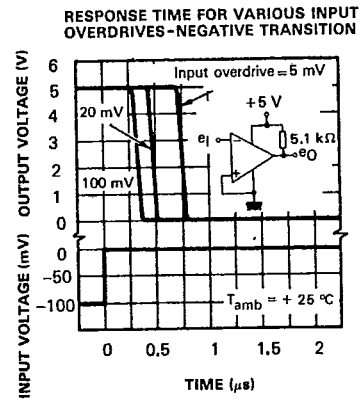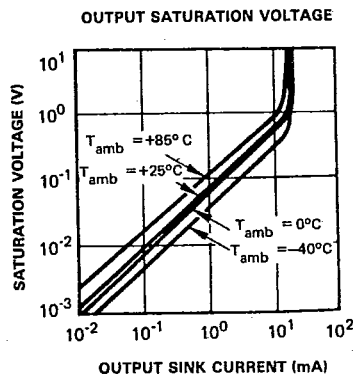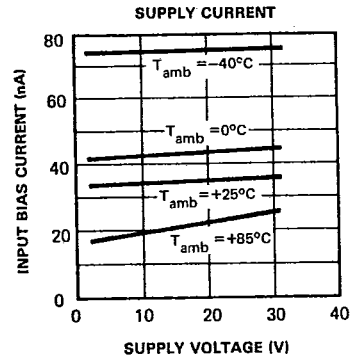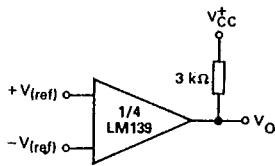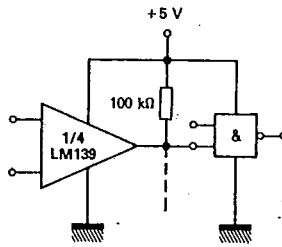LM139,A•LM239,A•LM339,A•LM2901•MC3302

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T-73-53

LM139,A - LM339,A
MC3302

SUPPLY CURRENT

SUPPLY CURRENT (mA)

$T_{amb} = -55°C$

$T_{amb} = 0°C$

$T_{amb} = +25°C$

$T_{amb} = +70°C$

$T_{amb} = +125°C$

$R_L = \infty$

SUPPLY VOLTAGE (V)

INPUT CURRENT

INPUT CURRENT (nA)

$V_I = 0\ V$
$R_I = 10^9\ \Omega$

$T_{amb} = -55°C$

$T_{amb} = 0°C$

$T_{amb} = +125°C$ $T_{amb} = +25°C$

$T_{amb} = +70°C$

SUPPLY VOLTAGE (V)

OUTPUT SATURATION VOLTAGE

SATURATION VOLTAGE (V)

Out of saturation

$T_{amb} = +125°C$

$T_{amb} = -55°C$

$T_{amb} = +25°C$

OUTPUT SINK CURRENT (mA)

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

OUTPUT VOLTAGE (V)

INPUT VOLTAGE (mV)

Input overdrive = 5 mV

20 mV

100 mV

+5 V

e_I 5.1 kΩ

e_O

$T_{amb} = +25°C$

TIME (μs)

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

OUTPUT VOLTAGE (V)

INPUT VOLTAGE (mV)

Input overdrive = 100 mV

5 mV

20 mV

+5 V

5.1 kΩ

e_I e_O

$T_{amb} = +25°C$

TIME (μs)

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THOMSON SEMICONDUCTORS

LM139,A•LM239,A•LM339,A•LM2901•MC3302

LM2901

SUPPLY CURRENT

SUPPLY CURRENT

OUTPUT SATURATION VOLTAGE

RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES-NEGATIVE TRANSITION

RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - POSITIVE TRANSITION

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THOMSON SEMICONDUCTORS
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TYPICAL APPLICATIONS

$V_{CC}^+ = +5 V$

BASIC COMPARATOR

DRIVING CMOS

DRIVING TTL

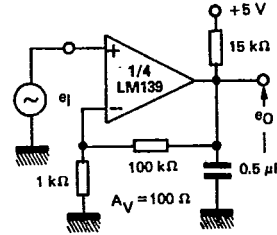**TYPICAL APPLICATION**
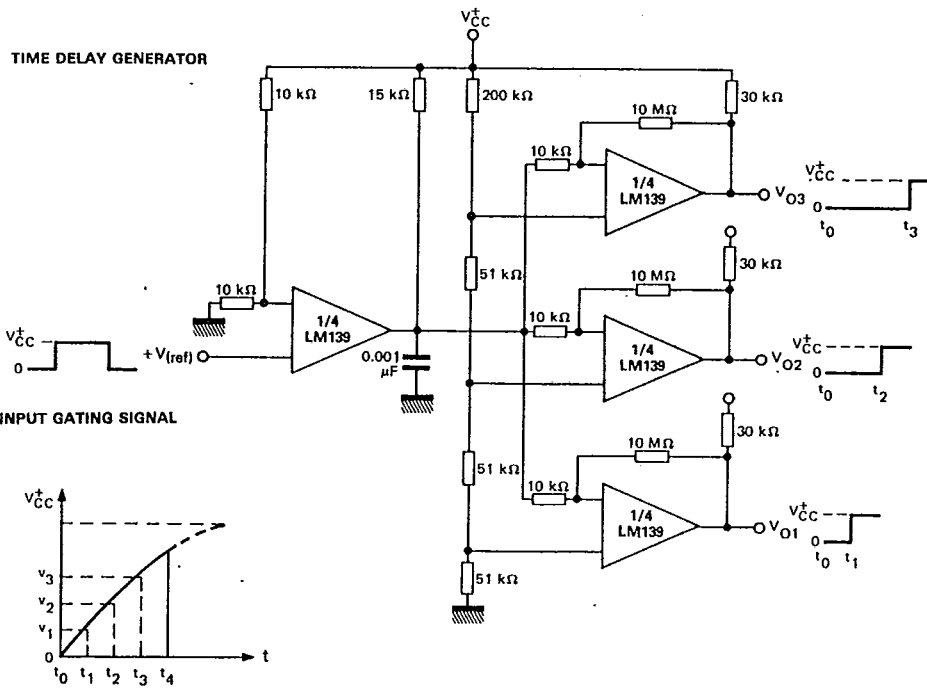
TIME DELAY GENERATOR

INPUT GATING SIGNAL
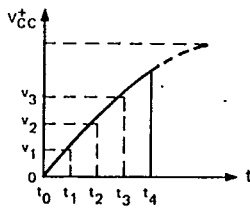
LM139,A•LM239,A•LM339,A•LM2901•MC3302

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TYPICAL APPLICATIONS (continued)

LOW FREQUENCY OP AMP

$A_V = 100\ \Omega$

LOW FREQUENCY OP AMP

($e_O = 0$ V for $e_I = 0$ V)

$A_V = 100\ \Omega$
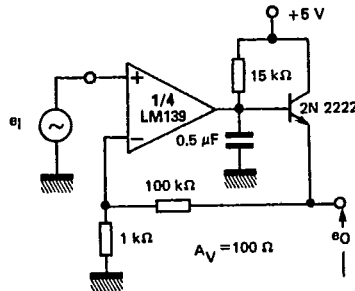
TRANSDUCER AMPLIFIER
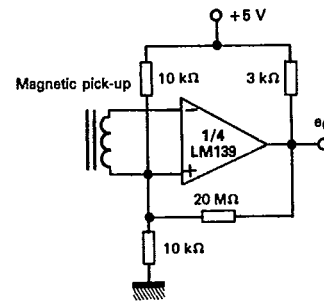
LOW FREQUENCY OP AMP WITH OFFSET ADJUST
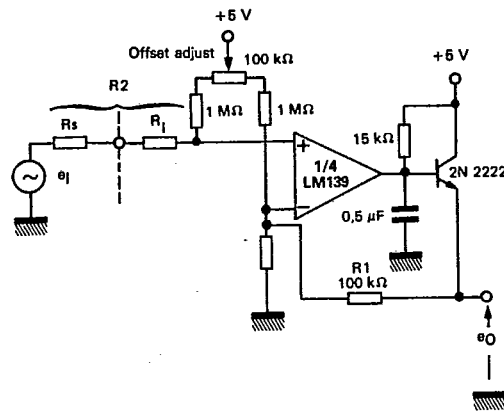
ZERO CROSSING DETECTOR (SINGLE POWER SUPPLY)

THOMSON SEMICONDUCTORS
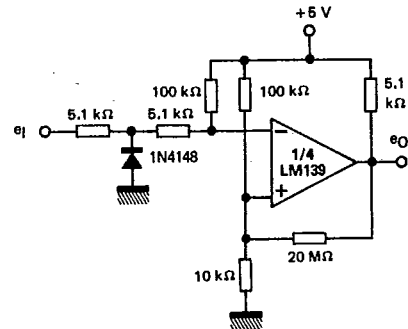
LM139,A•LM239,A•LM339,A•LM2901•MC3302

TYPICAL APPLICATIONS (continued)

TWO-DECADE HIGH-FREQUENCY VCO

Frequency control voltage input $V_{control}$

100 kΩ
50 kΩ
10 kΩ
0.1 µF
50 kΩ
20 kΩ
20 kΩ
1/4 LM139
500 pF
V_{CC}^+
3 kΩ
5.1 kΩ
0.01 µF
100 kΩ
1/4 LM139
V_{CC}^+
3 kΩ
$V_{CC}^+/2$
Output 1
Output 2
1/4 LM139
$V_{CC}^+/2$

$V_{CC}^+ = +30$ V
$+250$ mV $\leqslant V_{control} \leqslant +50$ V
700 Hz $\leqslant f_O \leqslant 100$ kHz

LIMIT COMPARATOR

2 Rs
$+V_{(ref)}$ high
Rs
e_I
2 Rs
$+V_{(ref)}$ low
1/4 LM139
1/4 LM139
V_{CC}^+(12 V)
10 kΩ
Lamp
2N 2222
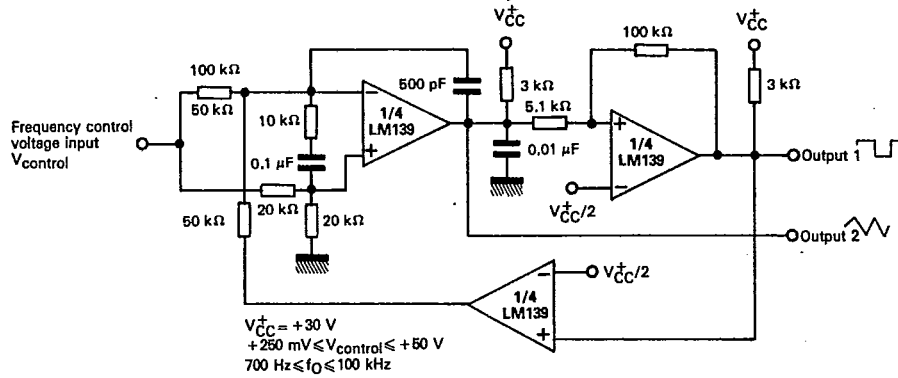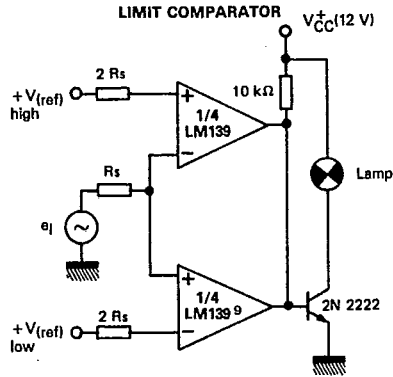
CRYSTAL CONTROLLED OSCILLATOR

V_{CC}^+
200 kΩ
2 kΩ
100 kΩ
0.1 µF
1/4 LM139
V_{CC}^+
e_O
0
200 kΩ
f = 100 kHz
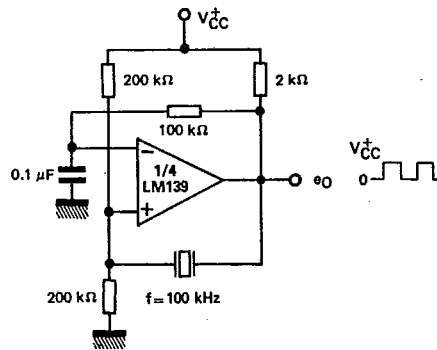
SPLIT-SUPPLY APPLICATIONS

ZERO CROSSING DETECTOR

e_I
+ 15 V
5.1 kΩ
1/4 LM139
e_O
− 15 V
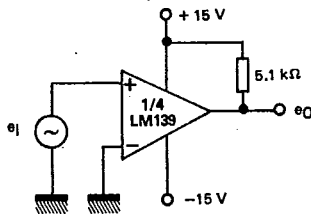
COMPARATOR WITH A NEGATIVE REFERENCE

e_I
+ 15 V
5.1 kΩ
1/4 LM139
e_O
−5 V
− 15 V

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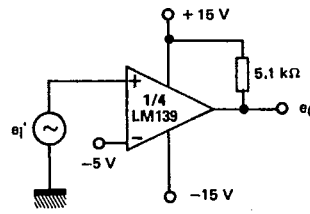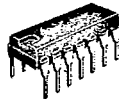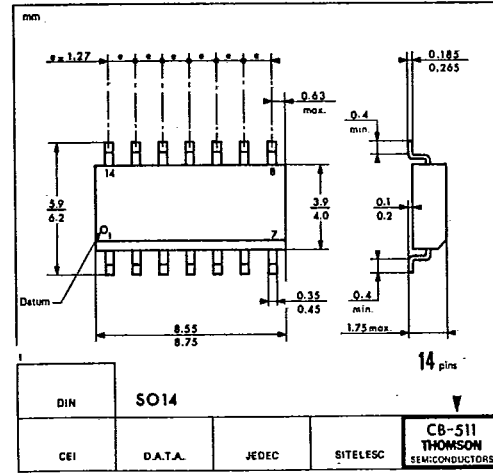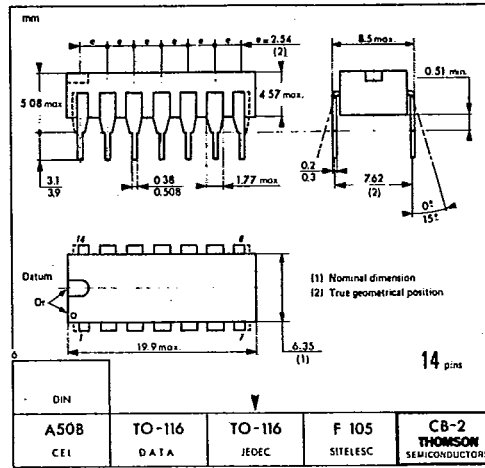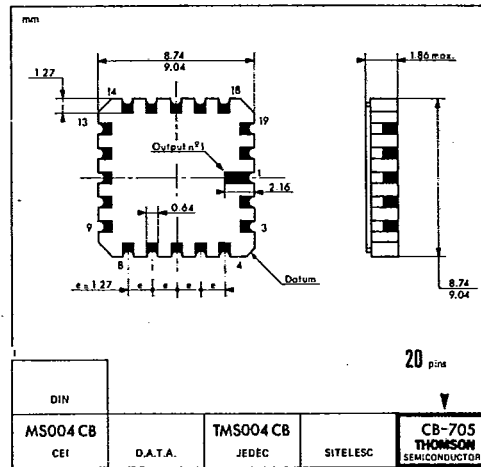
CB-2
DP SUFFIX
PLASTIC PACKAGE
DG SUFFIX
CERDIP PACKAGE

CB-511
FP SUFFIX
PLASTIC MICROPACKAGE

CB-705
GC SUFFIX
TRICECOP (LCC)

These specifications are subject to change without notice.
Please inquire with our sales offices about the availability of the different packages.

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THOMSON SEMICONDUCTORS