

THOMSON SEMICONDUCTORS

LM139,A
LM239,A
LM339,A
LM2901
MC3302

78C 05164 D

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

7-73-53 LOW POWER LOW OFFSET VOLTAGE QUAD COMPARATORS

2

CASES

CB-2
(TO-116)



DP SUFFIX
PLASTIC PACKAGE
DG SUFFIX
CERDIP PACKAGE

CB-511
(SO-14)



FP SUFFIX
PLASTIC MICROPACKAGE

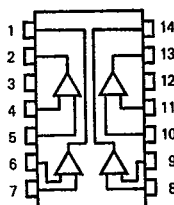
CB-705



GC SUFFIX
TRICOP (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

CB-705



- 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

- 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

Ref. 00345

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THOMSON COMPONENTS

LM139,A•LM239,A•LM339,A•LM2901•MC3302

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T-73-53

MAXIMUM RATINGS

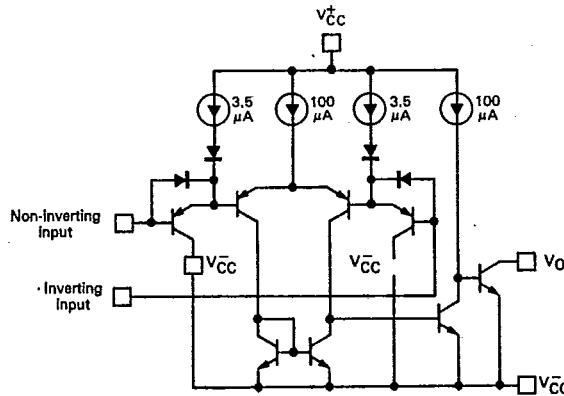
Rating	Symbol	LM139,A LM239,A	LM339,A	LM2901 MC3302	
Supply voltage MC3302	V _{CC}	±18 to 36 —	±18 to 36	±18 to 36 ±14 to 28	V
Differential Input voltage	V _{ID}	36	36	36	V
Input voltage MC3302	V _I	-0.3 to +36 —	-0.3 to +36	-0.3 to +36 -0.3 to +28	V
Output short-circuit to ground - (Note 2)	—	Continuous	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

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T-73-53

ELECTRICAL CHARACTERISTICS

LM139,A : $-55^{\circ}\text{C} \leq T_{\text{amb}} \leq +125^{\circ}\text{C}$, $V_{\text{CC}}^{+} = +5\text{V}$
 LM239,A : $-25^{\circ}\text{C} \leq T_{\text{amb}} \leq +85^{\circ}\text{C}$, $V_{\text{CC}}^{+} = +6\text{V}$
 LM339,A : $0^{\circ}\text{C} \leq T_{\text{amb}} \leq +70^{\circ}\text{C}$, $V_{\text{CC}}^{+} = +5\text{V}$
 (Unless otherwise specified)

Characteristic	Symbol	LM139,A/LM239,A			LM339,A			Unit
		Min	Typ	Max	Min	Typ	Max	
Input offset voltage - (Note 3) $T_{\text{amb}} = +25^{\circ}\text{C}$	V_{IO}	—	± 2	± 5	—	± 2	± 5	mV
LM139A, LM239A LM339A		—	± 1	± 2	—	—	—	
$T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$	LM139A, LM239A LM339A	—	—	9	—	—	9	
		—	—	4	—	—	4	
Input offset current $T_{\text{amb}} = +25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$	I_{IO}	—	± 3	± 25 ± 100	—	± 5	± 50 ± 150	nA
Input bias current (I_{I}^{+} or I_{I}^{-}) $T_{\text{amb}} = +25^{\circ}\text{C}$ - (Note 4) $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$	I_{IB}	—	25	100 300	—	25	250 400	nA
Large signal voltage gain $V_{\text{CC}}^{+} = +15\text{V}$, $T_{\text{amb}} = +25^{\circ}\text{C}$, $R_{\text{L}} \geq 15\text{ k}\Omega$	A_{VD}	—	200	—	—	200	—	V/mV
LM139A, LM239A LM339A		50	200	—	50	200	—	
Supply current, $R_{\text{L}} = \infty$, $T_{\text{amb}} = +25^{\circ}\text{C}$ (all comparators)	I_{CC}	—	0.8	2	—	0.8	2	mA
Input common-mode voltage range $T_{\text{amb}} = +25^{\circ}\text{C}$ - (Note 5)	V_{I}	0	—	V_{CC}^{+} -1.5	0	—	V_{CC}^{+} -1.5	V
$T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$		0	—	V_{CC}^{+} -2	—	—	V_{CC}^{+} -2	
Differential input voltage ($V_{\text{I}}^{+} = 0$ or $V_{\text{I}}^{-} = 0$, if used) - Note 7 LM139A, LM239A LM339A	V_{ID}	—	—	36 V_{CC}^{+}	—	—	36 V_{CC}^{+}	V
Low level output voltage ($V_{\text{I}}^{-} \geq 1\text{V}$, $V_{\text{I}}^{+} = 0\text{V}$, $I_{\text{sink}} \leq 4\text{mA}$) $T_{\text{amb}} = +25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$	V_{OL}	—	250	—	—	250	400	mV
		—	—	700	—	—	700	
High level output current ($V_{\text{I}}^{+} \geq 1\text{V}$, $V_{\text{I}}^{-} = 0\text{V}$) $T_{\text{amb}} = +25^{\circ}\text{C}$, $V_{\text{O}} = +5\text{V}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$, $V_{\text{O}} = +30\text{V}$	I_{OH}	—	0.1	—	—	0.1	—	nA μA
Output sink current ($V_{\text{I}}^{-} \geq 1\text{V}$, $T_{\text{amb}} = +25^{\circ}\text{C}$, $V_{\text{I}}^{+} = 0\text{V}$, $V_{\text{O}} \leq +1.5\text{V}$)	$I_{\text{O(sink)}}$	6	16	—	6	16	—	mA
Response time - (Note 6) ($V_{\text{L}} = +5\text{V}$, $R_{\text{L}} = 5100\ \Omega$, $V_{\text{(ref)}} = +1.4\text{V}$, $T_{\text{amb}} = +25^{\circ}\text{C}$)	t_{re}	—	1.3	—	—	1.3	—	μs
Large signal response time ($V_{\text{L}} = 5\text{V}$, $e_{\text{I}} = \text{TTL}$, $R_{\text{L}} = 5100\ \Omega$, $V_{\text{(ref)}} = +1.4\text{V}$, $T_{\text{amb}} = +25^{\circ}\text{C}$)	t_{ref}	—	300	—	—	300	—	ns

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LM139,A•LM239,A•LM339,A•LM2901•MC3302

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ELECTRICAL CHARACTERISTICS

LM2901, MC3302: $-40^{\circ}\text{C} \leq T_{\text{amb}} \leq +85^{\circ}\text{C}$, $V_{\text{CC}} = +5\text{ V}$
(Unless otherwise specified)

T-73-53

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

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

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 $V_{\text{CC}}^+ - 1.5\text{ V}$, 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.

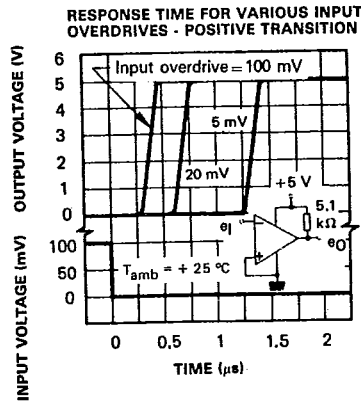
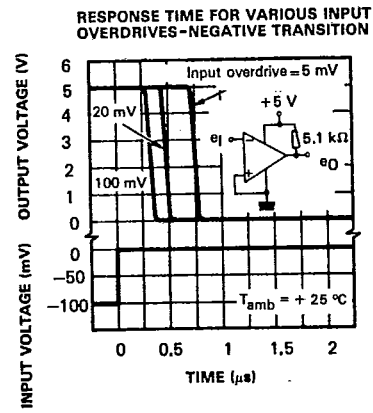
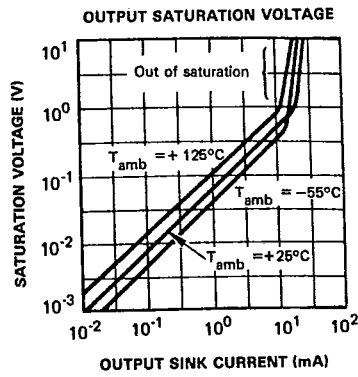
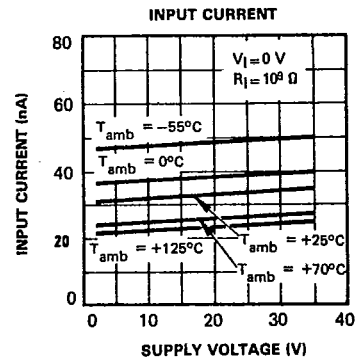
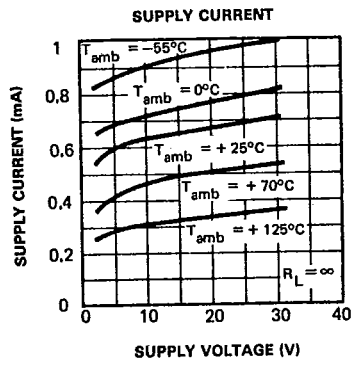
Note 7: Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator will provide a proper output state. The low input voltage state must not be less than -0.3 V (or 0.3 V below the negative power supply, if used).

LM139,A•LM239,A•LM339,A•LM2901•MC3302

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LM139,A - LM339,A
MC3302

T-73-53

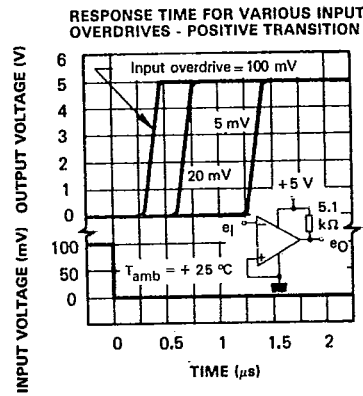
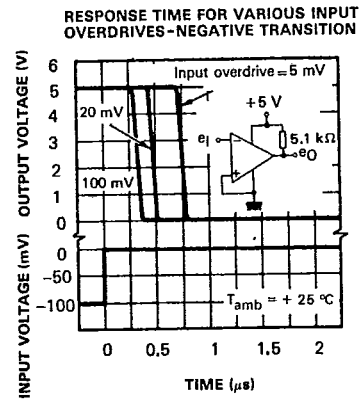
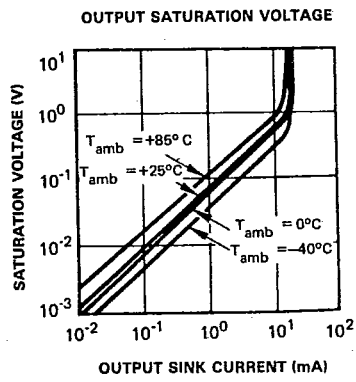
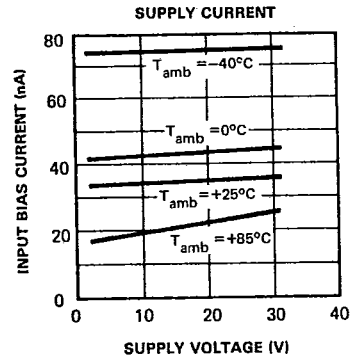
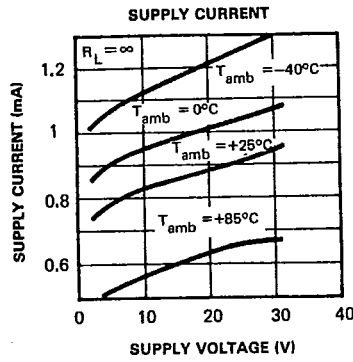


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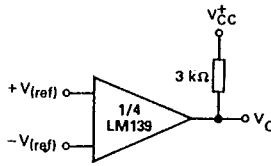
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LM2901

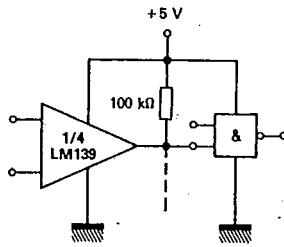


TYPICAL APPLICATIONS

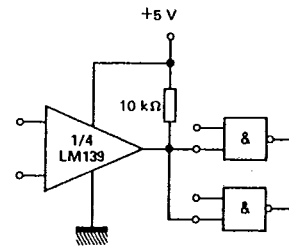
V_{CC}⁺ = +5 V



BASIC COMPARATOR



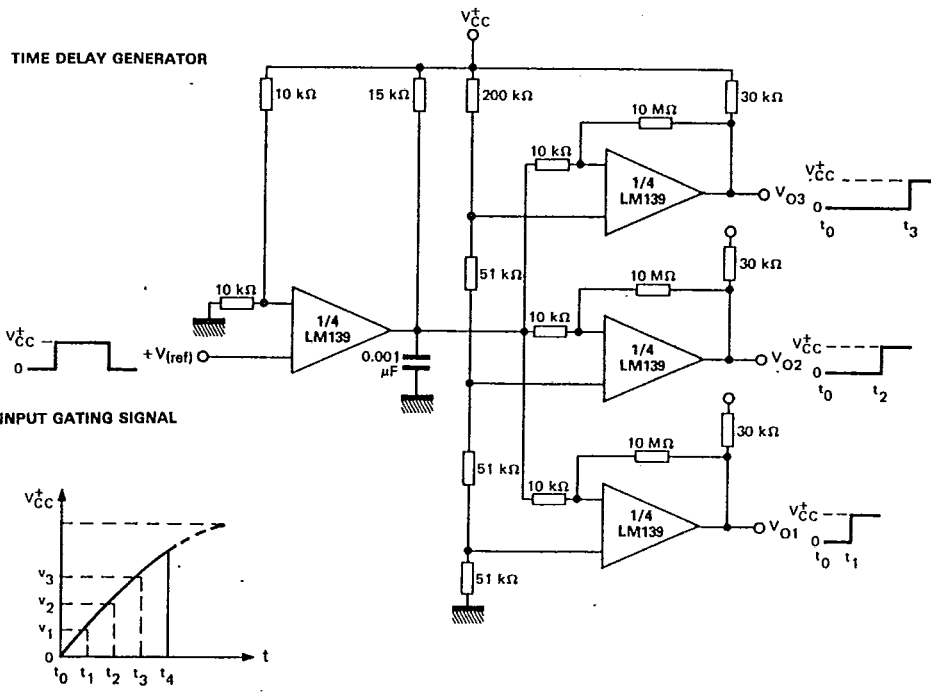
DRIVING CMOS



DRIVING TTL

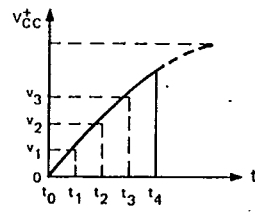
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TYPICAL APPLICATION



TIME DELAY GENERATOR

INPUT GATING SIGNAL



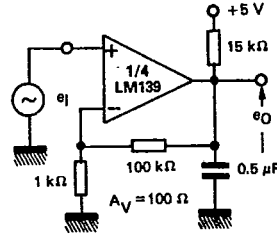
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T-73-53

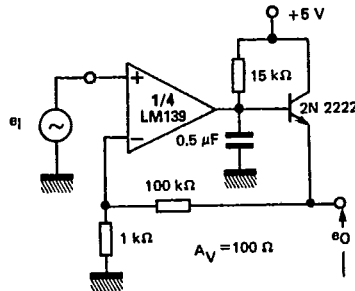
TYPICAL APPLICATIONS (continued)

LOW FREQUENCY OP AMP

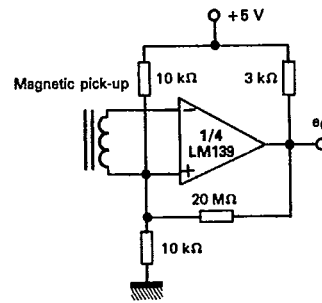


LOW FREQUENCY OP AMP

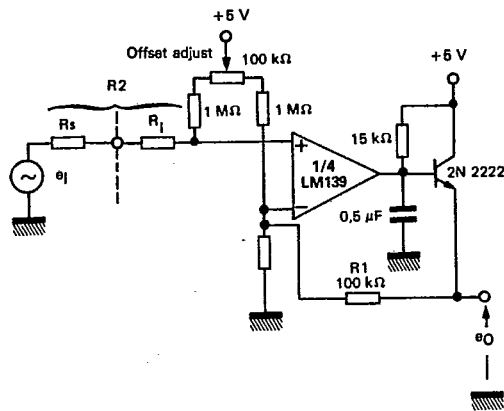
($e_0 = 0$ V for $e_1 = 0$ V)



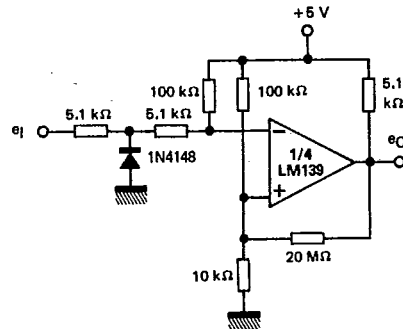
TRANSDUCER AMPLIFIER



LOW FREQUENCY OP AMP WITH OFFSET ADJUST



ZERO CROSSING DETECTOR (SINGLE POWER SUPPLY)



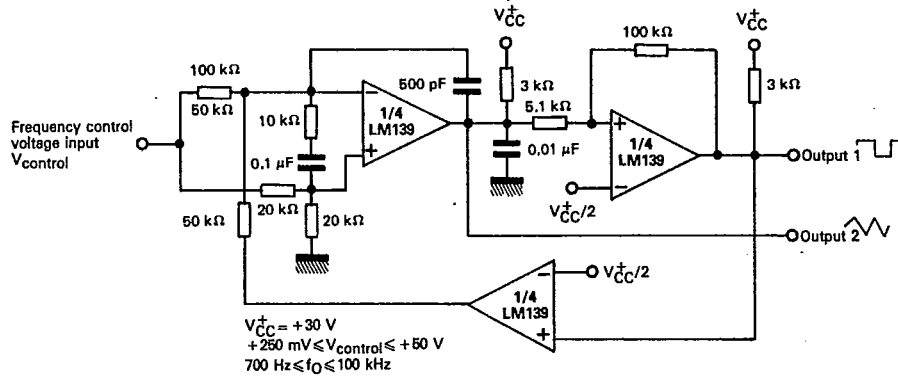
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T-73-53

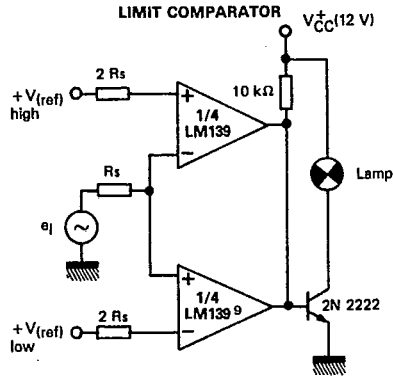
TYPICAL APPLICATIONS (continued)

TWO-DECADE HIGH-FREQUENCY VCO

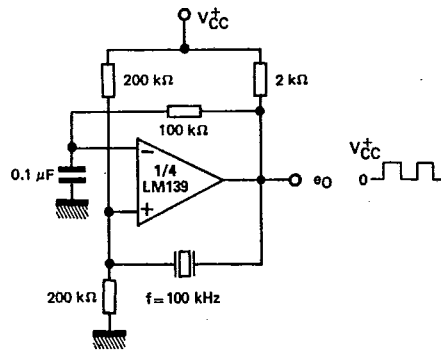


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LIMIT COMPARATOR

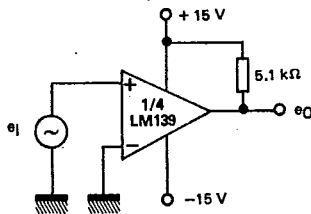


CRYSTAL CONTROLLED OSCILLATOR

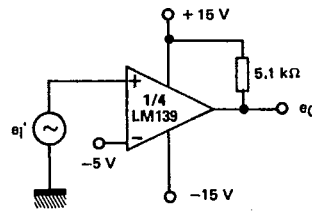


SPLIT-SUPPLY APPLICATIONS

ZERO CROSSING DETECTOR

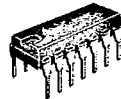
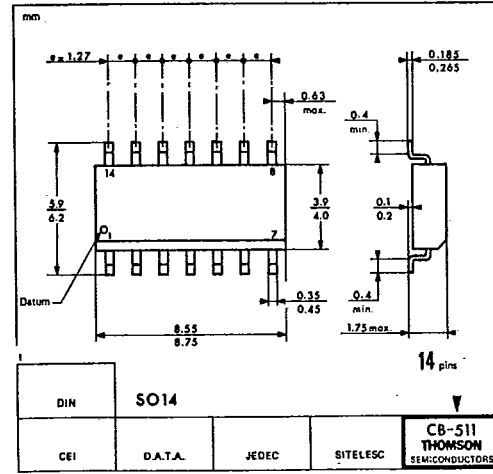
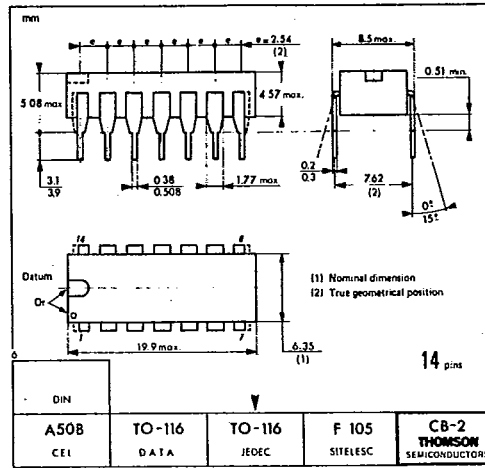


COMPARATOR WITH A NEGATIVE REFERENCE



LM139,A•LM239,A•LM339,A•LM2901•MC3302

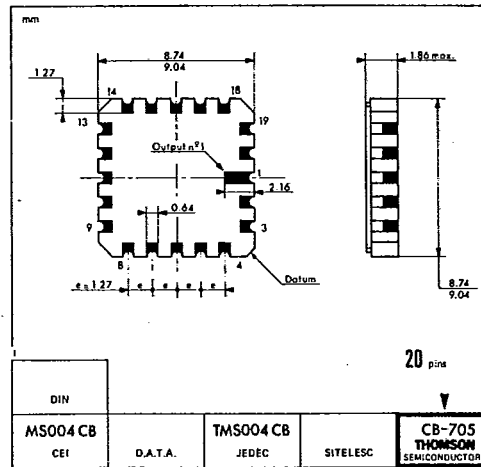
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CB-2
DP SUFFIX
PLASTIC PACKAGE
DG SUFFIX
CERDIP PACKAGE



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.