PRODUCT SPECIFICATIONS

LINEAR INTEGRATED CIRCUITS

Raytheon

Single-Supply Quad Comparators

LM139/139A, 239/239A, 339/339A, 2901 RC3302

Features

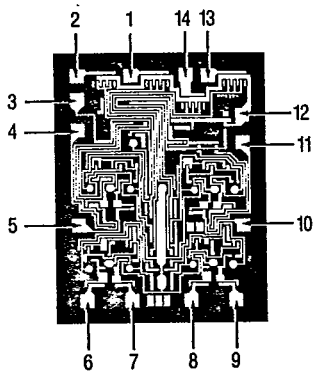
- Input common mode voltage range includes ground
- Wide single supply voltage range — 2V to 36V
- Output compatible with TTL, DTL, ECL, MOS and CMOS logic systems
- Very low supply current drain (0.8mA) independent of supply voltage

Description

These devices offer higher frequency operation and faster switching than can be had from internally compensated quad op amps. Intended for single-supply applications, the Darlington PNP input stage allows them to compare voltages that include ground. The two-stage common-emitter output circuit provides gain and output sink capacity of 3.2mA at an output level of 400mV. The output collector is left open, permitting the designer to drive devices in the range of 2V to 36V.

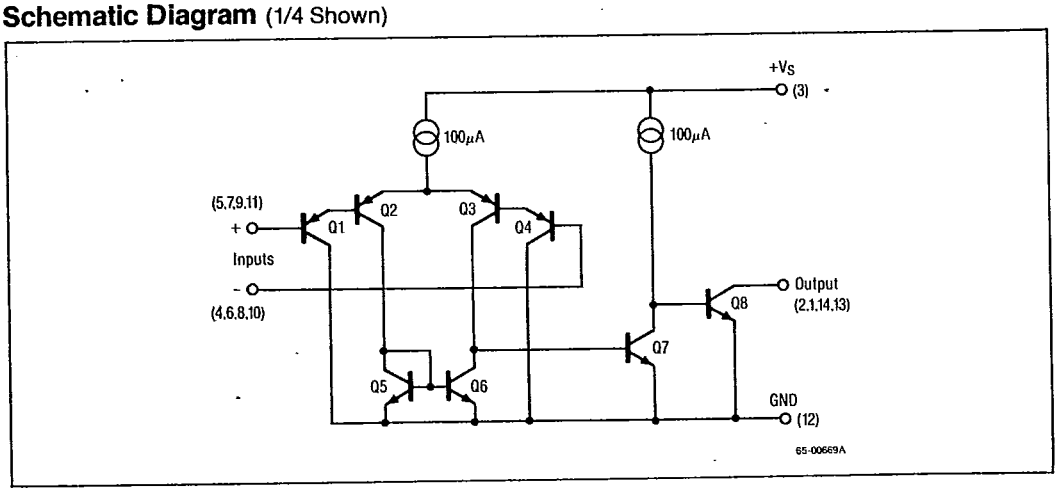
They are intended for applications not needing response time less than 1μS, but demanding excellent op amp input parameters of offset voltage, current, and bias current, to ensure accurate comparison with a reference voltage.

Mask Pattern



Die Size: 59 x 77 mils
Min. Pad Dimensions: 4 x 4 mils

Schematic Diagram (1/4 Shown)



LM139/139A, 239/239A, 339/339A, LM2901, RC3302

Single-Supply Quad Comparators

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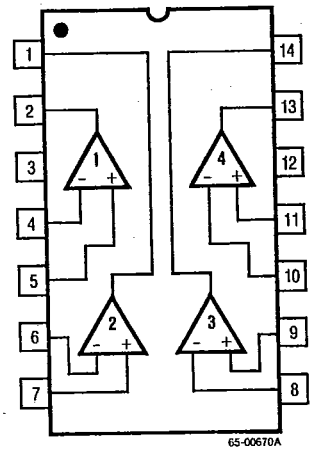
Connection Information

14-Lead
Dual In-Line Package
(Top View)



Pin	Function
1	Output 2
2	Output 1
3	$+V_S$
4	-Input 1
5	+Input 1
6	-Input 2
7	+Input 2
8	-Input 3
9	+Input 3
10	-Input 4
11	+Input 4
12	Ground
13	Output 4
14	Output 3

Thermal Characteristics

	14-Lead Micro-Pak Plastic DIP	14-Lead Plastic DIP	14-Lead Ceramic DIP
Max. Junction Temp.	125°C	125°C	175°C
Max. P_D $T_A < 50°C$	300mW	468mW	1042mW
Therm. Res. θ_{JC}	—	—	60°C/W
Therm. Res. θ_{JA}	200°C/W	160°C/W	120°C/W
For $T_A > 50°C$ Derate at	5.0mW per °C	6.25mW per °C	8.38mW per °C

Absolute Maximum Ratings

Supply Voltage, $+V_S$ ..... +36 or ±18V
RC3302 ..... +28V or ±14V
Differential Input Voltage ..... +36V
RC3302 ..... +28V
Input Voltage ..... -0.3V to +36V
RC3302 ..... -0.3V to +28V
Output Short Circuit to Ground[1] ..... Continuous
Input Current ($V_{IN} < -0.3V$)[2] 50mA
Operating Temperature Range
LM139 ..... -55°C to +125°C
LM239 ..... -25°C to +85°C
LM339 ..... 0°C to +70°C
LM2901/RC3302 ..... -40°C to +85°C
Storage Temperature Range
Standard Packages ..... -65°C to +150°C
Micro-Pak (LM only) ..... -40°C to +125°C
Lead Soldering Temperature (10 Sec)
Standard Packages ..... +300°C
Micro-Pak (LM only) ..... +260°C

Ordering Information

Part Number	Package	Operating Temperature Range
LM339J	Ceramic	0°C to +70°C
LM339M	Micro-Pak	0°C to +70°C
LM339N	Plastic	0°C to +70°C
LM339AJ	Ceramic	0°C to +70°C
LM339AM	Micro-Pak	0°C to +70°C
LM339AN	Plastic	0°C to +70°C
LM239J	Ceramic	-25°C to +85°C
LM239N	Plastic	-25°C to +85°C
LM239AJ	Ceramic	-25°C to +85°C
LM239AN	Plastic	-25°C to +85°C
LM2901N	Plastic	-40°C to +85°C
RC3302DB	Plastic	-40°C to +85°C
LM139J	Ceramic	-55°C to +125°C
LM139J/883C*	Ceramic	-55°C to +125°C
LM139AJ	Ceramic	-55°C to +125°C
LM139AJ/883C*	Ceramic	-55°C to +125°C

*MIL-STD-883, Level C Processing

Single-Supply Quad Comparators

LM139/139A, 239/239A, 339/339A, LM2901, RC3302

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Electrical Characteristics ($+V_S = +5V$[3])

Parameters	Test Conditions	LM139A			LM239A, 339A			Units
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	$T_A = +25°C$ [8]		±1.0	±2.0		±1.0	±2.0	mV
Input Bias Current	Output in Linear Range $T_A = +25°C$ [4]		25	100		25	250	nA
Input Offset Current	$T_A = +25°C$		±3.0	±25		±5.0	±50	nA
Input Voltage Range	$T_A = +25°C$ [5]	0		$+V_S$ −1.5	0		$+V_S$ −1.5	V
Supply Current	$R_L = \infty$ on all Comparators, $T_A = +25°C$		0.8	2.0		0.8	2.0	mA
Large Signal Voltage Gain	$R_L \geq 15k\Omega$, $+V_S = +15V$ (To Support Large V_O Swing), $T_A = +25°C$	50	200		50	200		V/mV
Large Signal Response Time	V_{IN} = TTL Logic Swing, $V_{REF} = 1.4V$, $V_{RL} = 5V$, $R_L = 5.1k\Omega$, $T_A = +25°C$		300			300		nS
Response Time	$V_{RL} = 5V$, $R_L = 5.1k\Omega$, $T_A = +25°C$ [6]		1.3			1.3		μS
Output Sink Current	$V_{IN-} \geq 1V$, $V_{IN+} = 0$, $V_O \leq 1.5V$, $T_A = +25°C$	6.0	16		6.0	16		mA
Saturation Voltage	$V_{IN-} \geq 1V$, $V_{IN+} = 0$, $I_{SINK} \leq 4mA$, $T_A = +25°C$		250	400		250	400	mV
Output Leakage Current	$V_{IN+} \geq 1V$, $V_{IN-} = 0$, $V_O = 5V$, $T_A = +25°C$		0.1			0.1		μA
Input Offset Voltage	Note 8			±4.0			±4.0	mV
Input Offset Current				±100			±150	nA
Input Bias Current	Output in Linear Range			300			400	nA
Input Voltage Range		0		$+V_S$ −2.0	0		$+V_S$ −2.0	V
Saturation Voltage	$V_{IN-} \geq 1V$, $V_{IN+} = 0$, $I_{SINK} \leq 4mA$			700			700	mV
Output Leakage Current	$V_{IN+} \geq 1V$, $V_{IN-} = 0$, $V_O = 30V$			1.0			1.0	μA
Differential Input Voltage	Keep all V_{IN}s ≥ 0V (or $-V_S$, if used)[7]			36			36	V

LM139/139A, 239/239A, 339/339A, LM2901, RC3302

Single-Supply Quad Comparators

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Electrical Characteristics (Continued)

Parameters	Test Conditions	LM139			LM239, 339			Units
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	T_A = +25°C [8]		±2.0	±5.0		±2.0	±5.0	mV
Input Bias Current	Output in Linear Range, T_A = +25°C [4]		25	100		25	250	nA
Input Offset Current	T_A = +25°C		±3.0	±25		±5.0	±50	nA
Input Voltage Range	T_A = +25°C [5]	0		$+V_S$ −1.5	0		$+V_S$ −1.5	V
Supply Current	R_L = ∞ on all Comparators, T_A = +25°C		0.8	2.0		0.8	2.0	mA
Large Signal Voltage Gain	$R_L \geq 15k\Omega$, $+V_S$ = 15V (To Support Large V_O Swing), T_A = +25°C		200			200		V/mV
Large Signal Response Time	V_{IN} = TTL Logic Swing, V_{REF} = +1.4V, V_{RL} = +5V, R_L = 5.1kΩ, T_A = +25°C		300			300		nS
Response Time	V_{RL} = 5V, R_L = 5.1kΩ, T_A = +25°C [6]		1.3			1.3		μS
Output Sink Current	$V_{IN-} \geq 1V$, V_{IN+} = 0, $V_O \leq 1.5V$, T_A = +25°C	6.0	16		6.0	16		mA
Output Voltage V_{OL}	$V_{IN-} \geq 1V$, V_{IN+} = 0, $I_{SINK} \leq 4mA$, T_A = +25°C		250	400		250	400	mV
Output Leakage Current	$V_{IN+} \geq 1V$, V_{IN-} = 0, V_O = +5V, T_A = +25°C		0.1			0.1		μA
Input Offset Voltage	Note 8			±9.0			±9.0	mV
Input Offset Current				±100			±150	nA
Input Bias Current	Output in Linear Range			300			400	nA
Input Voltage Range		0		$+V_S$ −2.0	0		$+V_S$ −2.0	V
Output Voltage V_{OL}	$V_{IN-} \geq 1V$, V_{IN+} = 0, $I_{SINK} \leq 4mA$			700			700	mV
Output Leakage Current	$V_{IN+} \geq 1V$, V_{IN-} = 0, V_O = 30V			1.0			1.0	μA
Differential Input Voltage	Keep all V_{IN}s ≥ 0V (or $-V_S$, if used)[7]			36			36	V

Single-Supply Quad Comparators

LM139/139A, 239/239A, 339/339A, LM2901, RC3302

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Electrical Characteristics (Continued)

Parameters	Test Conditions	LM2901			RC3302			Units
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	T_A = +25°C [8]		±2.0	±7.0		±3.0	±20	mV
Input Bias Current	Output in Linear Range, T_A = +25°C [4]		25	250		25	500	nA
Input Offset Current	T_A = +25°C		±5.0	±50		±3.0	±100	nA
Input Voltage Range	T_A = +25°C [5]	0		$+V_S$ −1.5	0		$+V_S$ −1.5	V
Supply Current	R_L = ∞ on all Comparators, T_A = +25°C		0.8	2.0		0.8	2.0	mA
	R_L = ∞, $+V_S$ = 30V, T_A = +25°C		1.0	2.5				mA
Large Signal Voltage Gain	$R_L \geq 15k\Omega$, $+V_S$ = 15V (To Support Large V_O Swing), T_A = +25°C	25	100		2.0	30		V/mV
Large Signal Response Time	V_{IN} = TTL Logic Swing, V_{REF} = +1.4V, V_{RL} = +5V, R_L = 5.1kΩ, T_A = +25°C		300			300		nS
Response Time	V_{RL} = 5V, R_L = 5.1kΩ, T_A = +25°C [6]		1.3			1.3		μS
Output Sink Current	$V_{IN-} \geq 1V$, V_{IN+} = 0, $V_O \leq 1.5V$, T_A = +25°C	6.0	16		2.0	16		mA
Output Voltage V_{OL}	$V_{IN-} \geq 1V$, V_{IN+} = 0, $I_{SINK} \leq 4mA$, T_A = +25°C			400		250	500	mV
Output Leakage Current	$V_{IN+} \geq 1V$, V_{IN-} = 0, V_O = 5V, T_A = +25°C		0.1			0.1		μA
Input Offset Voltage	Note 8		±9.0	±15			±40	mV
Input Offset Current			50	200			300	nA
Input Bias Current	Output in Linear Range		200	500			1000	nA
Input Voltage Range		0		$+V_S$ −2.0	0		$+V_S$ −2.0	V
Output Voltage V_{OL}	$V_{IN-} \geq 1V$, V_{IN+} = 0, $I_{SINK} \leq 4mA$		400	700			700	mV
Output Leakage Current	$V_{IN+} \geq 1V$, V_{IN-} = 0, V_O = 30V			1.0			1.0	μA
Differential Input Voltage	Keep all $V_{INS} \geq 0V$ (or $-V_S$, if used)[7]	0		$+V_S$			$+V_S$	V

LM139/139A, 239/239A, 339/339A, LM2901, RC3302

Single-Supply Quad Comparators

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Electrical Characteristics (Continued)

Notes:
1. Short circuits from the output to $+V_S$ can cause excessive heating and eventual destruction. The maximum output current is approximately 20mA independent of the magnitude of $+V_S$.
2. This input current will only exist when the voltage at any of the input leads is driven negative. It is due to the collector base junction of the input PNP transistors becoming forward biased and thereby acting as input diode clamps. In addition to this diode action, there is also lateral NPN parasitic transistor action on the IC chip. This transistor action can cause the output voltage of the comparators to go to the $+V_S$ voltage level (or to ground for a large overdrive) for the time duration that an input is driven negative. This is not destructive and normal output states will re-establish when the input voltage, which was negative, again returns to a value greater than -0.3V.
3. These specifications apply for $+V_S$ = 5V and $-55°C \leq T_A \leq +125°C$, unless otherwise stated. With the LM239 all temperature specifications are limited to $-25°C \leq T_A \leq +85°C$, the LM339 temperature specifications are limited to $0°C \leq T_A \leq +70°C$, and the LM2901, RC3302 temperature range is $-40°C \leq T_A \leq +85°C$.
4. The direction of the input current is out of the IC due to the PNP input state. This current is essentially constant, independent of the state of the output so no loading change exists on the reference or input lines.
5. The input common mode voltage or 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 $+V_S$ -1.5V, but either or both inputs can go to +30V without damage.
6. The response time specified is for a 100mV input step with 5mV overdrive. For larger overdrive signals 300nS can be obtained. See Typical Performance Characteristics section.
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 -0.3V (or 0.3V below the magnitude of the negative power supply, if used).
8. At output switch point, $V_O \cong 1.4V$, $R_S = 0\Omega$ with $+V_S$ from 5V; and over the full input common mode range (0V to $+V_S$ -1.5V).
9. For input signals that exceed $+V_S$, only the overdriven comparator is affected. With a 5V supply, V_{IN} should be limited to 25V max, and a limiting resistor should be used on all inputs that might exceed the positive supply.

Single-Supply Quad Comparators

LM139/139A, 239/239A, 339/339A, LM2901, RC3302

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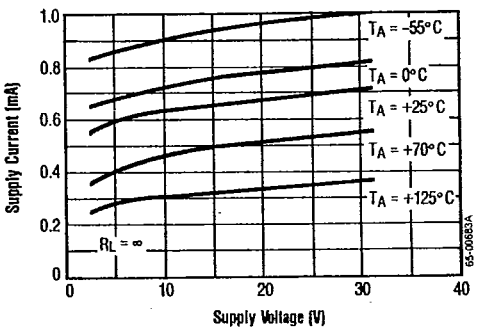
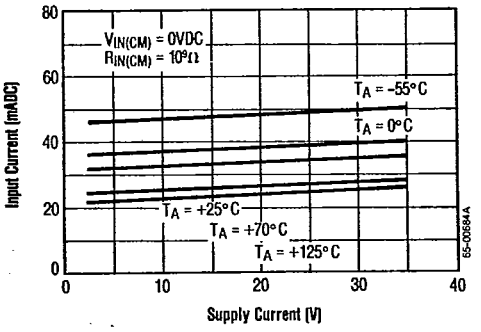
Typical Performance Characteristics LM139/139A, 239/239A, 339/339A, RC3302

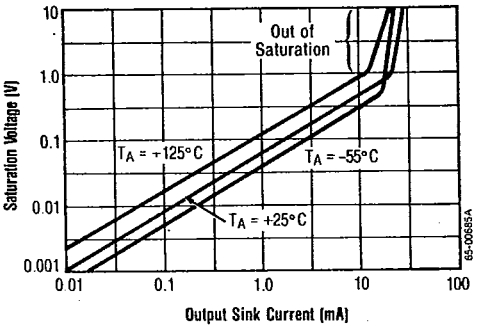
Supply Current



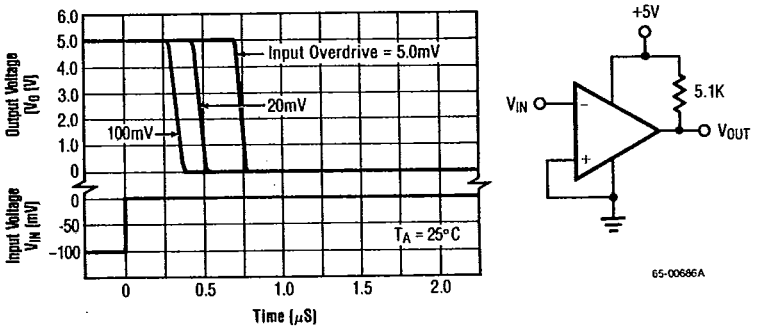
Input Current



Output Saturation Voltage



Response Time for Various Input Overdrives Negative Transition



LM139/139A, 239/239A, 339/339A, LM2901, RC3302

Single-Supply Quad Comparators

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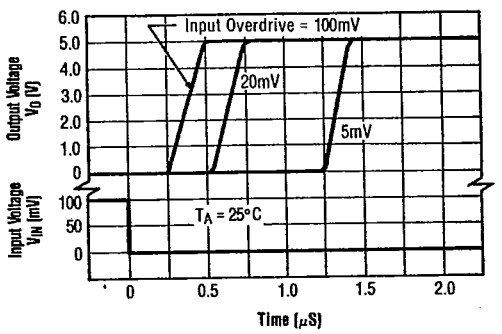
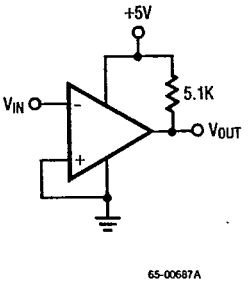
Typical Performance Characteristics (Continued) LM139/139A, 239/239A, 339/339A, RC3302

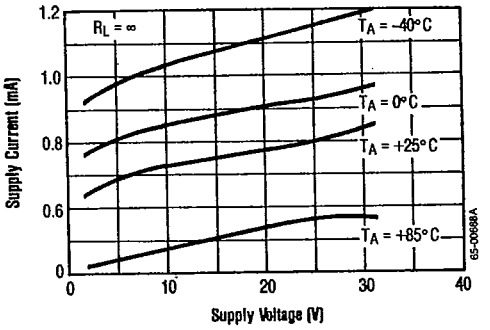
Response Time for Various Input Overdrive Positive Transition



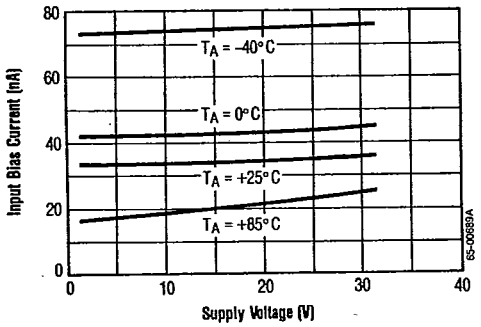


Typical Performance Characteristics LM2901

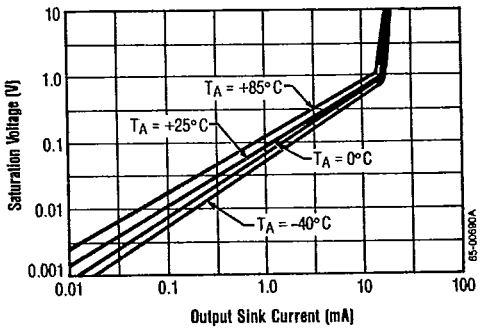
Supply Current



Input Current



Output Saturation Voltage



Single-Supply Quad Comparators

LM139/139A, 239/239A, 339/339A, LM2901, RC3302

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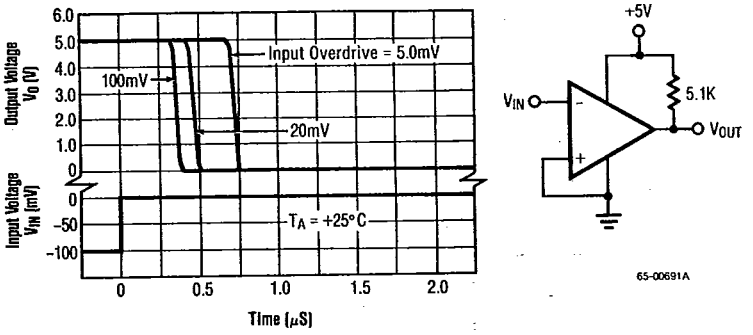
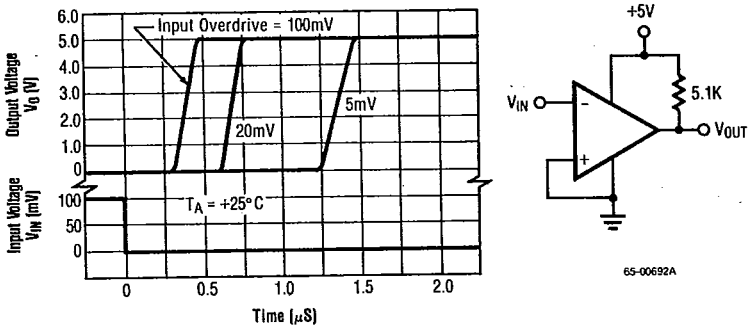
Typical Performance Characteristics (Continued) LM2901

Response Time for Various Input Overdrives Negative Transition



Response Time for Various Input Overdrives Positive Transition



LM139/139A, 239/239A, 339/339A, LM2901, RC3302

Single-Supply Quad Comparators

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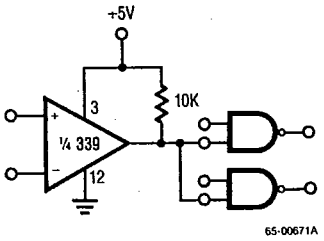
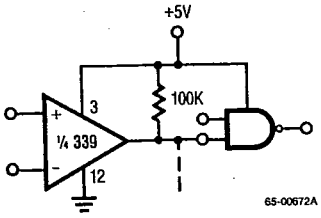
Typical Applications — Single Supply ($+V_S = +15V$)

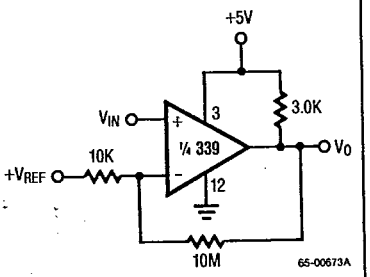
Driving TTL



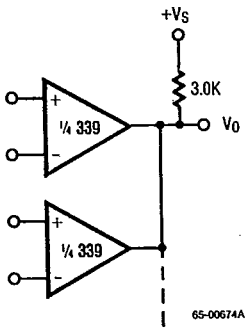
Driving CMOS



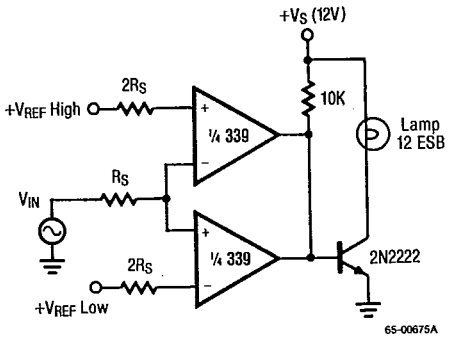
Comparator With Hysteresis



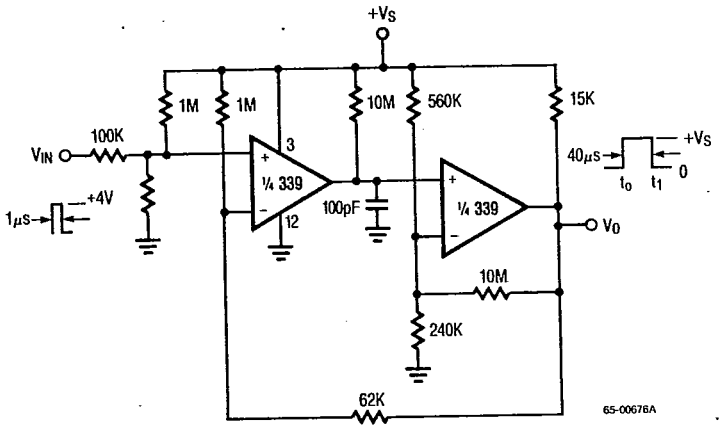
ORing the Output



Limit Comparator



One-Shot Multivibrator With Input Lock Out



Single-Supply Quad Comparators

LM139/139A, 239/239A, 339/339A, LM2901, RC3302

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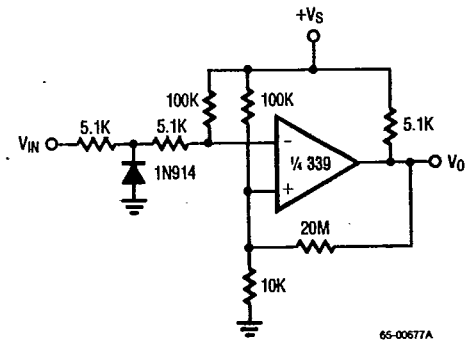
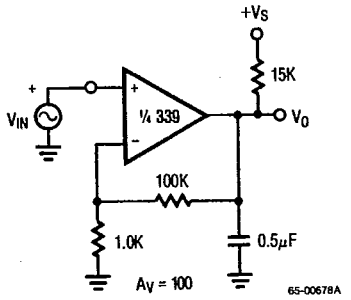
Typical Applications — Single Supply (Continued)

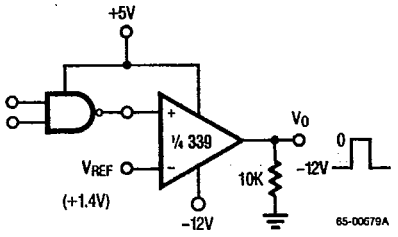
Zero Crossing Detector (Single Power Supply)



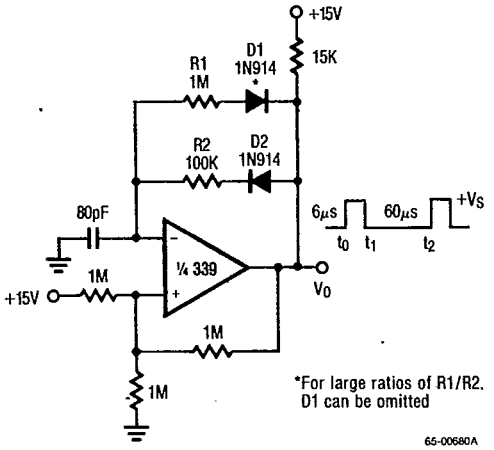
Low Frequency Op Amp



TTL to MOS Logic Converter



Pulse Generator



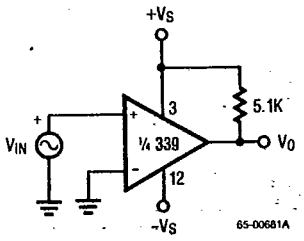
LM139/139A, 239/239A, 339/339A, LM2901, RC3302

Single-Supply Quad Comparators

T-73-53

Typical Applications — Split Supply ($+V_S$ = +15V and $-V_S$ = −15V)

Zero Crossing Detector



Comparator With a Negative Reference