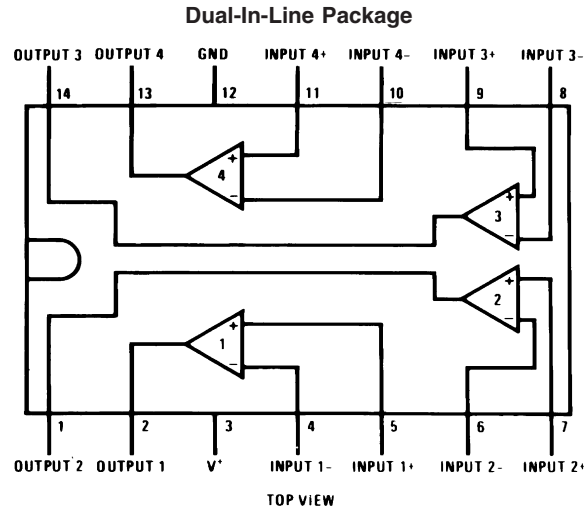
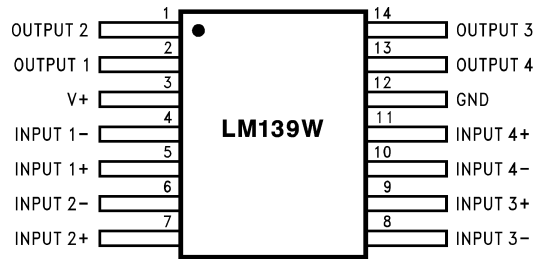


Connection Diagrams



20129502

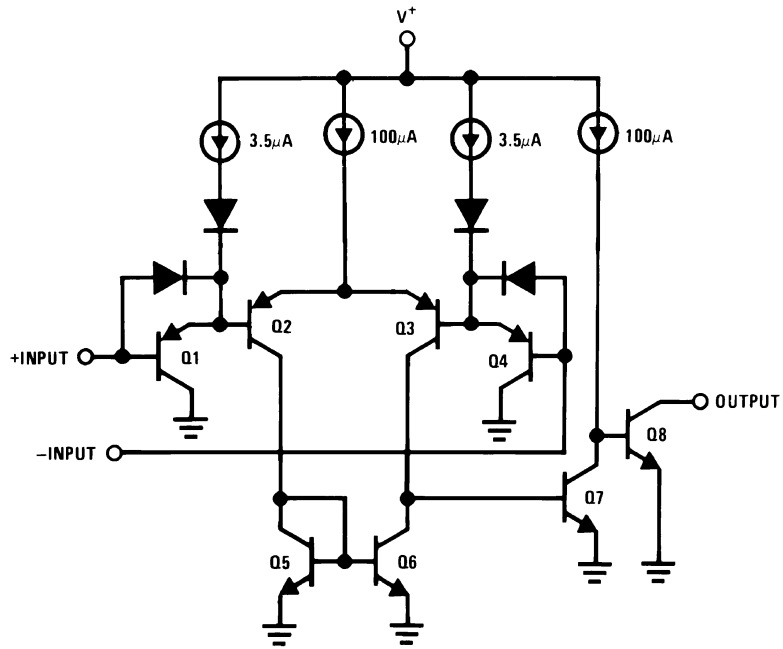
See NS Package Number J14A



20129527

See NS Package Number W14B, WG14A

Schematic Diagram



20129501

Absolute Maximum Ratings (Note 1)

Supply Voltage, V ⁺	36 V _{DC} or ±18 V _{DC}
Differential Input Voltage (Note 7)	36 V _{DC}
Output Voltage	36 V _{DC}
Input Voltage	-0.3 V _{DC} to +36 V _{DC}
Input Current (V _{IN} < -0.3 V _{DC}) (Note 3)	50 mA
Power Dissipation (Notes 4, 12)	
CERDIP	400 mW @ T _A = 125°C
CERPACK	350 mW @ T _A = 125°C
SOIC	350 mW @ T _A = 125°C
Output Short-Circuit to GND, (Note 2)	Continuous
Storage Temperature Range	-65°C ≤ T _A ≤ +150°C
Maximum Junction Temperature (T _J)	+175°C
Lead Temperature (Soldering, 10 seconds)	260°C
Operating Temperature Range	-55°C ≤ T _A ≤ +125°C
Thermal Resistance	
θ _{JA}	
CERDIP (Still Air)	103°C/W
CERDIP (500LF / Min Air flow)	65°C/W
CERPACK (Still Air)	183°C/W
CERPACK (500LF / Min Air flow)	120°C/W
SOIC (Still Air)	183°C/W
SOIC (500LF / Min Air flow)	120°C/W
θ _{JC}	
CERDIP	23°C/W
CERPACK	23°C/W
SOIC	23°C/W
Package Weight (typical)	
CERDIP	2,190mg
CERPACK	460mg
SOIC	410mg
ESD rating (Note 11)	600V

Quality Conformance Inspection

Mil-Std-883, Method 5005 — Group A

Subgroup	Description	Temp (°C)
1	Static tests at	25
2	Static tests at	125
3	Static tests at	-55
4	Dynamic tests at	25
5	Dynamic tests at	125
6	Dynamic tests at	-55
7	Functional tests at	25
8A	Functional tests at	125
8B	Functional tests at	-55
9	Switching tests at	25
10	Switching tests at	125
11	Switching tests at	-55

LM139 JAN Electrical Characteristics

DC Parameters

The following conditions apply, unless otherwise specified. $-V_{CC} = 0V$

Symbol	Parameters	Conditions	Notes	Min	Max	Unit	Sub-groups
V_{IO}	Input Offset Voltage	$+V_{CC} = 30V, V_O = 15V$		-5.0	5.0	mV	1
				-7.0	7.0	mV	2, 3
		$+V_{CC} = 2V, -V_{CC} = -28V, V_O = -13V$		-5.0	5.0	mV	1
				-7.0	7.0	mV	2, 3
		$+V_{CC} = 5V, V_O = 1.4V$		-5.0	5.0	mV	1
				-7.0	7.0	mV	2, 3
		$+V_{CC} = 2V, -V_{CC} = -3V, V_O = -1.6V$		-5.0	5.0	mV	1
				-7.0	7.0	mV	2, 3
I_{IO}	Input Offset Current	$+V_{CC} = 30V, R_S = 20K\Omega, V_O = 15V$	(Note 8)	-25	25	nA	1, 2
			(Note 8)	-75	75	nA	3
		$+V_{CC} = 2V, -V_{CC} = -28V, R_S = 20K\Omega, V_O = -13V$	(Note 8)	-25	25	nA	1, 2
			(Note 8)	-75	75	nA	3
		$+V_{CC} = 5V, R_S = 20K\Omega, V_O = 1.4V$	(Note 8)	-25	25	nA	1, 2
			(Note 8)	-75	75	nA	3
		$+V_{CC} = 2V, -V_{CC} = -3V, R_S = 20K\Omega, V_O = -1.6V$	(Note 8)	-25	25	nA	1, 2
			(Note 8)	-75	75	nA	3
$+/-I_{IB}$	Input Bias Current	$+V_{CC} = 30V, R_S = 20K\Omega, V_O = 15V$	(Note 8)	-100	+0.1	nA	1, 2
			(Note 8)	-200	+0.1	nA	3
		$+V_{CC} = 2V, -V_{CC} = -28V, R_S = 20K\Omega, V_O = -13V$	(Note 8)	-100	+0.1	nA	1, 2
			(Note 8)	-200	+0.1	nA	3
		$+V_{CC} = 5V, R_S = 20K\Omega, V_O = 1.4V$	(Note 8)	-100	+0.1	nA	1, 2
			(Note 8)	-200	+0.1	nA	3
		$+V_{CC} = 2V, -V_{CC} = -3V, R_S = 20K\Omega, V_O = -1.6V$	(Note 8)	-100	+0.1	nA	1, 2
			(Note 8)	-200	+0.1	nA	3
CMRR	Input Voltage Common Mode Rejection	$+V_{CC} = 30V$		76		dB	1, 2, 3
		$+V_{CC} = 5V$		70		dB	1, 2, 3
I_{CEX}	Output Leakage	$+V_{CC} = 30V, V_O = +30V$			1.0	μA	1, 2, 3
$+I_{IL}$	Input Leakage Current	$+V_{CC} = 36V, V + i = 34V, V - i = 0V$		-500	500	nA	1, 2, 3
$-I_{IL}$	Input Leakage Current	$+V_{CC} = 36V, V + i = 0V, V - i = 34V$		-500	500	nA	1, 2, 3
V_{OL}	Logical "0" Output Voltage	$+V_{CC} = 4.5V, I_O = 4mA$			0.4	V	1
					0.7	V	2, 3
		$+V_{CC} = 4.5V, I_O = 8mA$			1.5	V	1
					2.0	V	2, 3
I_{CC}	Power Supply Current	$+V_{CC} = 5V, V_{ID} = 15mV$			2.0	mA	1, 2
					3.0	mA	3
		$+V_{CC} = 30V, V_{ID} = 15mV$			3.0	mA	1, 2
					4.0	mA	3
Delta V_{IO} / Delta T	Temperature Coefficient of Input Offset Voltage	$25^\circ C \leq T_A \leq 125^\circ C$	(Note 9)	-25	25	$\mu V/^\circ C$	2
		$-55^\circ C \leq T_A \leq 25^\circ C$	(Note 9)	-25	25	$\mu V/^\circ C$	3
Delta I_{IO} / Delta T	Temperature Coefficient of Input Offset Current	$25^\circ C \leq T_A \leq 125^\circ C$	(Note 9)	-300	300	$pA/^\circ C$	2
		$-55^\circ C \leq T_A \leq 25^\circ C$	(Note 9)	-400	400	$pA/^\circ C$	3
A_{VS}	Open Loop Voltage Gain	$+V_{CC}=15V, R_L=15K\Omega, 1V \leq V_O \leq 11V$	(Note 10)	50		V/mV	4
			(Note 10)	25		V/mV	5, 6
V_{IO}	Tempco Screen				4.0	mV	

LM139 JAN Electrical Characteristics (Continued)**DC Parameters** (Continued)The following conditions apply, unless otherwise specified. $-V_{CC} = 0V$

Symbol	Parameters	Conditions	Notes	Min	Max	Unit	Sub-groups
CMRR	Tempco Screen				70	dB	
I_{IO}	Tempco Screen				13	nA	
I_{IB}	Tempco Screen				12	nA	

AC Parameters

Symbol	Parameters	Conditions	Notes	Min	Max	Unit	Sub-groups
t_{RLH}	Response Time: Low-to-High	$+V_{CC} = 5V, V_I = 100mV,$ $R_L = 5.1K\Omega, V_{OD} = 5mV$			5.0	μS	7, 8B
					7.0	μS	8A
		$+V_{CC} = 5V, V_I = 100mV,$ $R_L = 5.1K\Omega, V_{OD} = 50mV$			0.8	μS	7, 8B
t_{RHL}	Response Time: High-to-Low	$+V_{CC} = 5V, V_I = 100mV,$ $R_L = 5.1K\Omega, V_{OD} = 5mV$			2.5	μS	7, 8B
					3.0	μS	8A
		$+V_{CC} = 5V, V_I = 100mV,$ $R_L = 5.1K\Omega, V_{OD} = 50mV$			0.8	μS	7, 8B
C_S	Channel Separation	$+V_{CC} = 20V, -V_{CC} = -10V,$ A to B		80		dB	7
		$+V_{CC} = 20V, -V_{CC} = -10V,$ A to C		80		dB	7
		$+V_{CC} = 20V, -V_{CC} = -10V,$ A to D		80		dB	7
		$+V_{CC} = 20V, -V_{CC} = -10V,$ B to A		80		dB	7
		$+V_{CC} = 20V, -V_{CC} = -10V,$ B to C		80		dB	7
		$+V_{CC} = 20V, -V_{CC} = -10V,$ B to D		80		dB	7
		$+V_{CC} = 20V, -V_{CC} = -10V,$ C to A		80		dB	7
		$+V_{CC} = 20V, -V_{CC} = -10V,$ C to B		80		dB	7
		$+V_{CC} = 20V, -V_{CC} = -10V,$ C to D		80		dB	7
		$+V_{CC} = 20V, -V_{CC} = -10V,$ D to A		80		dB	7
		$+V_{CC} = 20V, -V_{CC} = -10V,$ D to B		80		dB	7
		$+V_{CC} = 20V, -V_{CC} = -10V,$ D to C		80		dB	7
V_{LAT}	Voltage Latch (Logical "1" Input)	$+V_{CC} = 5V, V_I = 10V,$ $I_O = 4mA$			0.4	V	9

LM139 JAN Electrical Characteristics (Continued)

DC Parameters Drift Values

The following conditions apply, unless otherwise specified. $-V_{CC} = 0V$

Delta calculations performed on JAN S product at Group B, Subgroup 5.

Symbol	Parameters	Conditions	Notes	Min	Max	Unit	Sub-groups
V_{IO}	Input Offset Voltage	$V_{CC} = 30V, V_O = 15V$		-1.0	1.0	mV	1
$\pm I_{Bias}$	Input Bias Current	$V_{CC} = 30V, R_S = 20K\Omega,$ $V_O = 15V$		-15	15	nA	1

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see, the Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

Note 2: Short circuits from the output to V^+ can cause excessive heating and eventual destruction. When considering short circuits to ground, the maximum output current is approximately 20 mA independent of the magnitude of V^+ .

Note 3: 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 voltages of the comparators to go to the V^+ 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 $-0.3 V_{DC}$ (at 25°C).

Note 4: The low bias dissipation and the ON-OFF characteristics of the outputs keeps the chip dissipation very small ($P_D \leq 100mW$), provided the output transistors are allowed to saturate.

Note 5: 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 change exists on the reference or input lines.

Note 6: Short circuits from the output to V^+ can cause excessive heating and eventual destruction. When considering short circuits to ground, the maximum output current is approximately 20mA independent of the magnitude of V^+

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 $-0.3 V_{DC}$ (or $0.3 V_{DC}$ below the magnitude of the negative power supply, if used) (at 25°C).

Note 8: S/S $R_S = 20K\Omega$, tested at $R_S = 10K\Omega$ as equivalent test.

Note 9: Calculated parameter; for Delta V_{IO} / Delta T use V_{IO} test at $+V_{CC} = 30V, -V_{CC} = 0V, V_O = 15V$; and for Delta I_{IO} / Delta T use I_{IB} test at $+V_{CC} = 30V, -V_{CC} = 0V, V_O = 15V$

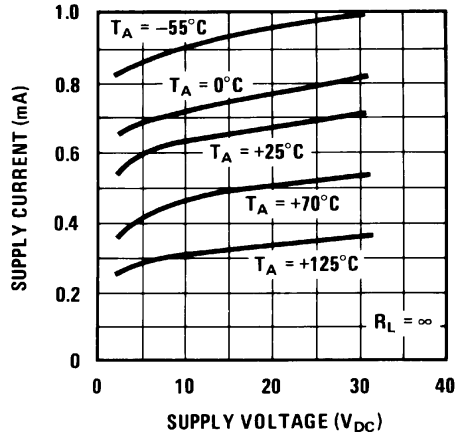
Note 10: Datalog of $K = V/mV$.

Note 11: Human Body model, 1.5 K Ω in series with 100 pF

Note 12: The maximum power dissipation must be derated at elevated temperatures and is dictated by T_{Jmax} (maximum junction temperature), θ_{JA} (Package junction to ambient thermal resistance), and T_A (ambient temperature). The maximum allowable power dissipation at any temperature is $P_{Dmax} = (T_{Jmax} - T_A) / \theta_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower.

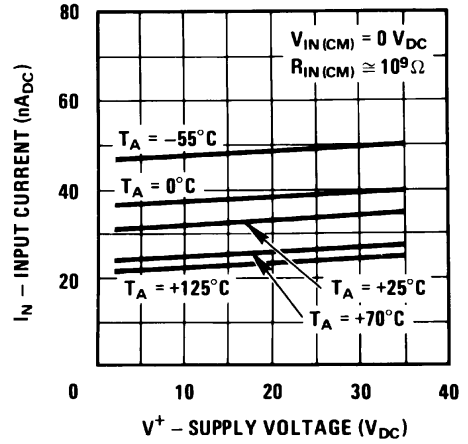
Typical Performance Characteristics

Supply Current



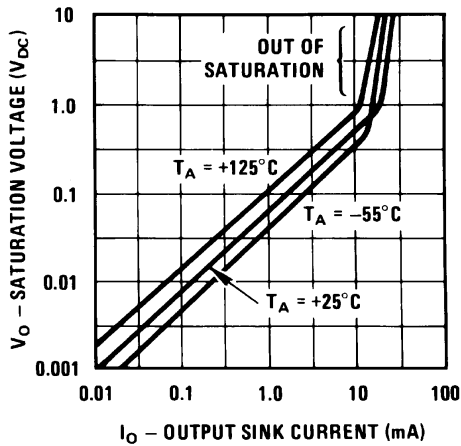
20129534

Input Current



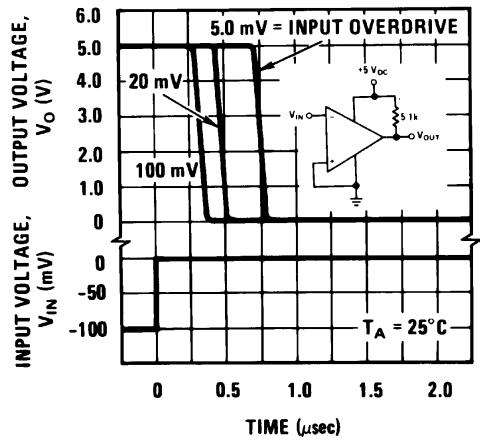
20129535

Output Saturation Voltage



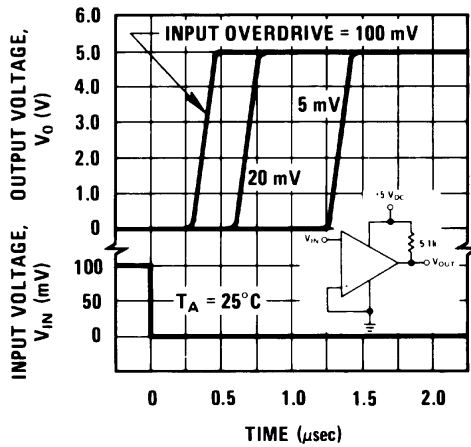
20129536

Response Time for Various Input Overdrives — Negative Transition



20129537

Response Time for Various Input Overdrives — Positive Transition



20129538

Application Hints

The LM139 is a high gain, wide bandwidth device which, like most comparators, can easily oscillate if the output lead is inadvertently allowed to capacitively couple to the inputs via stray capacitance. This shows up only during the output voltage transition intervals as the comparator changes states. Power supply bypassing is not required to solve this problem. Standard PC board layout is helpful as it reduces stray input-output coupling. Reducing the input resistors to $< 10\text{ k}\Omega$ reduces the feedback signal levels and finally, adding even a small amount (1 to 10 mV) of positive feedback (hysteresis) causes such a rapid transition that oscillations due to stray feedback are not possible. Simply socketing the IC and attaching resistors to the pins will cause input-output oscillations during the small transition intervals unless hysteresis is used. If the input signal is a pulse waveform, with relatively fast rise and fall times, hysteresis is not required.

All pins of any unused comparators should be tied to the negative supply.

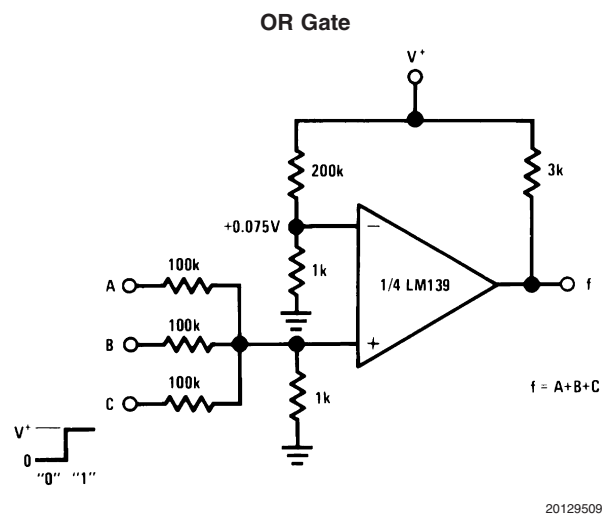
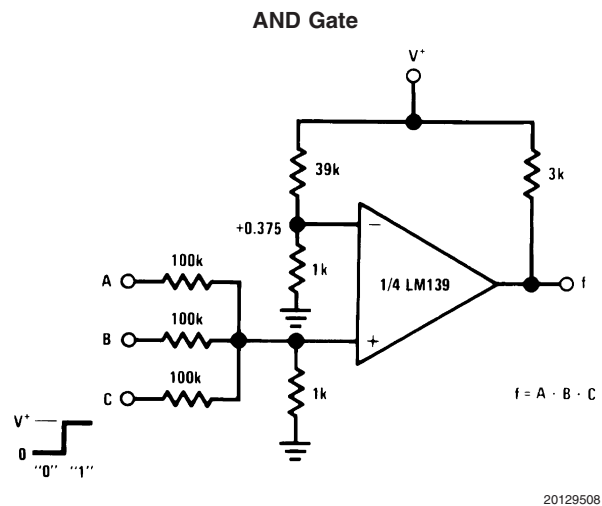
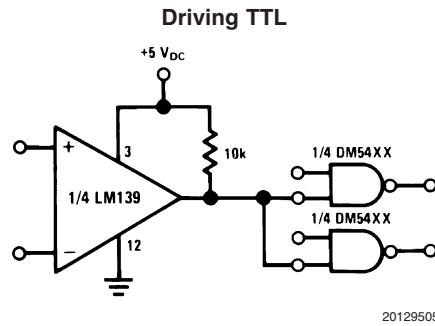
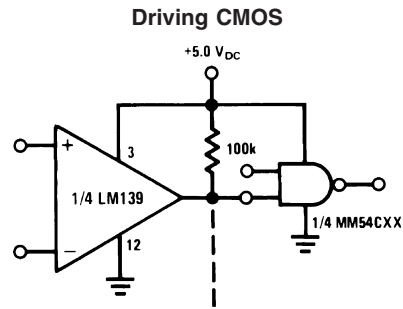
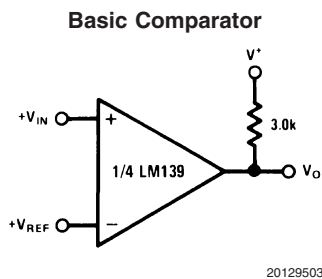
The bias network of the LM139 establishes a drain current which is independent of the magnitude of the power supply voltage over the range of from 5 V_{DC} to 30 V_{DC} .

It is usually unnecessary to use a bypass capacitor across the power supply line.

The differential input voltage may be larger than V^+ without damaging the device. Protection should be provided to prevent the input voltages from going negative more than $-0.3\text{ V}_{\text{DC}}$ (at 25°C). An input clamp diode can be used as shown in the applications section.

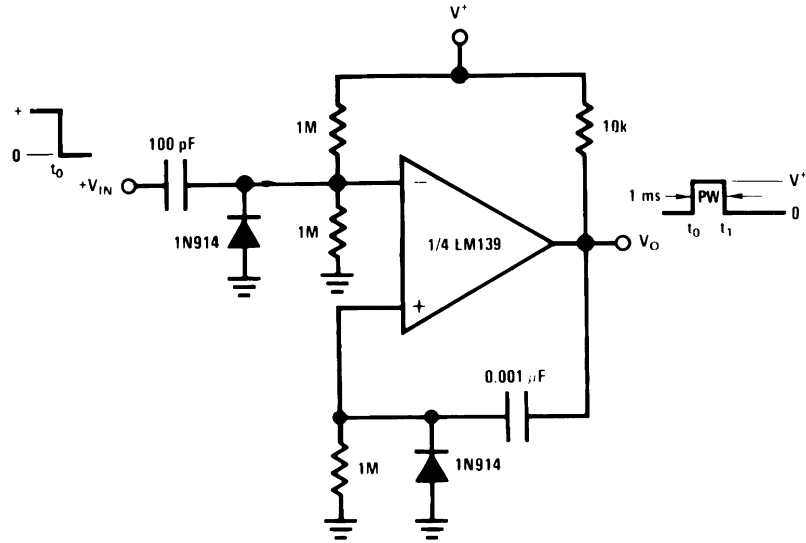
The output of the LM139 is the uncommitted collector of a grounded-emitter NPN output transistor. Many collectors can be tied together to provide an output OR'ing function. An output pull-up resistor can be connected to any available power supply voltage within the permitted supply voltage range and there is no restriction on this voltage due to the magnitude of the voltage which is applied to the V^+ terminal of the LM139 package. The output can also be used as a simple SPST switch to ground (when a pull-up resistor is not used). The amount of current which the output device can sink is limited by the drive available (which is independent of V^+) and the β of this device. When the maximum current limit is reached (approximately 16 mA), the output transistor will come out of saturation and the output voltage will rise very rapidly. The output saturation voltage is limited by the approximately $60\Omega R_{\text{SAT}}$ of the output transistor. The low offset voltage of the output transistor (1 mV) allows the output to clamp essentially to ground level for small load currents.

Typical Applications $(V^+ = 5.0\text{ V}_{\text{DC}})$



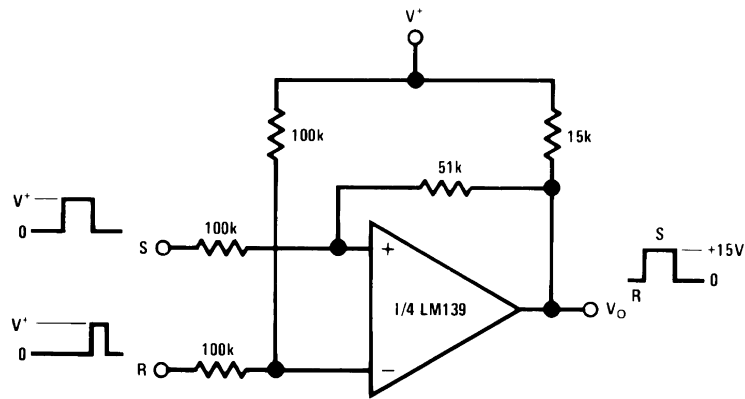
Typical Applications $(V^+ = 15\text{ V}_{\text{DC}})$

One-Shot Multivibrator



20129510

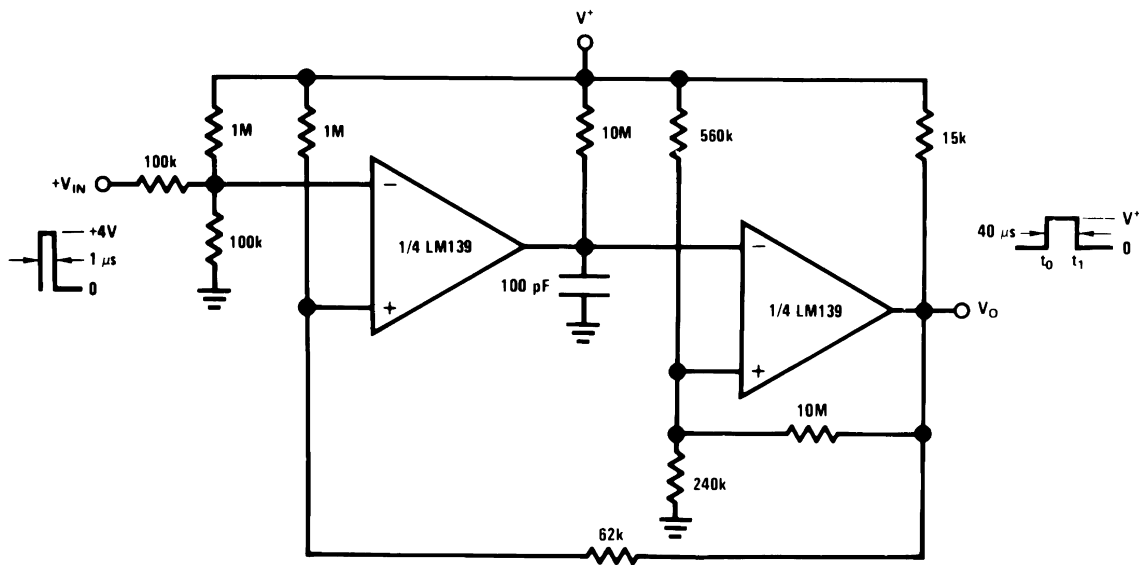
Bi-Stable Multivibrator



20129511

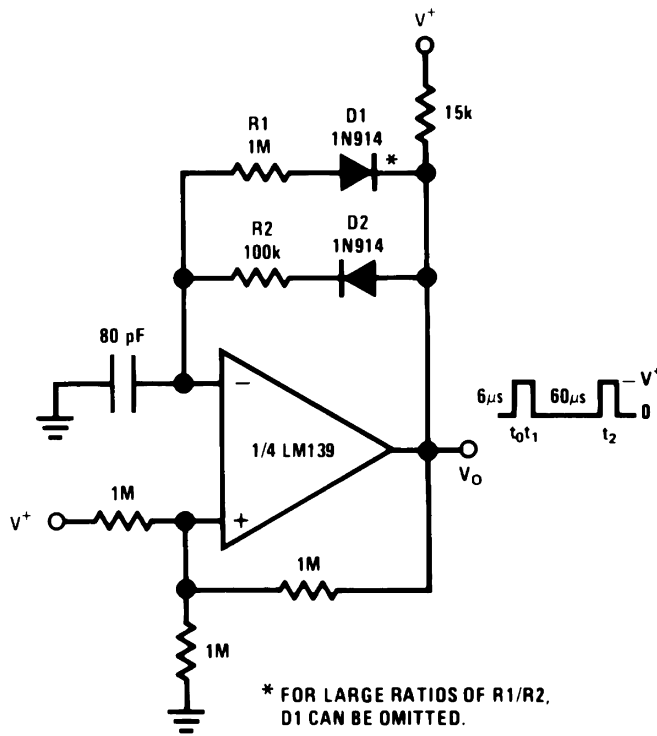
Typical Applications ($V^+ = 15\text{ V}_{DC}$) (Continued)

One-Shot Multivibrator with Input Lock Out



20129512

Pulse Generator

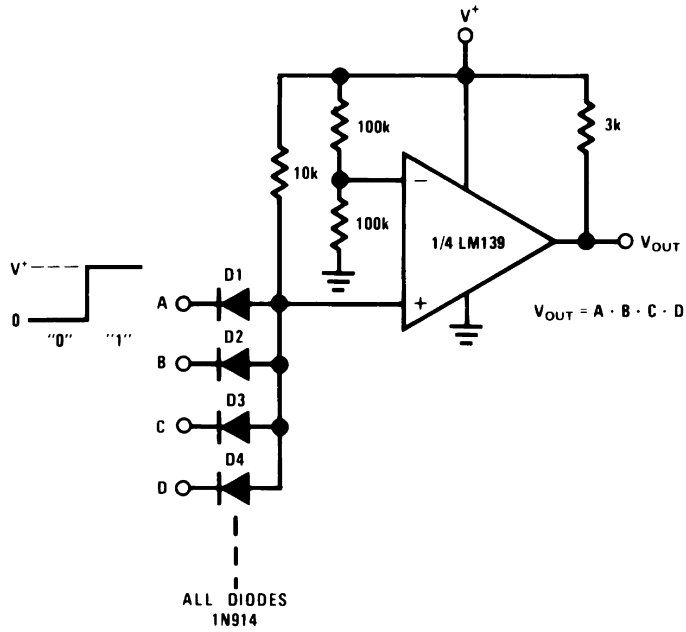


* FOR LARGE RATIOS OF $R1/R2$,
D1 CAN BE OMITTED.

20129517

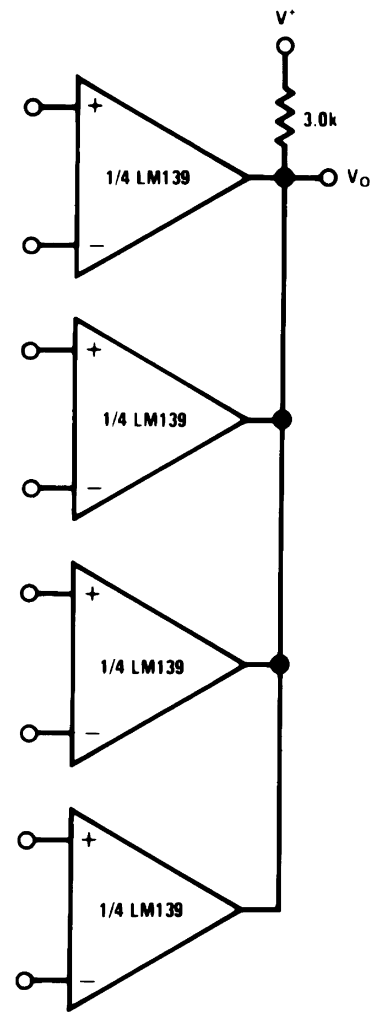
Typical Applications ($V^+ = 15 V_{DC}$) (Continued)

Large Fan-In AND Gate



20129513

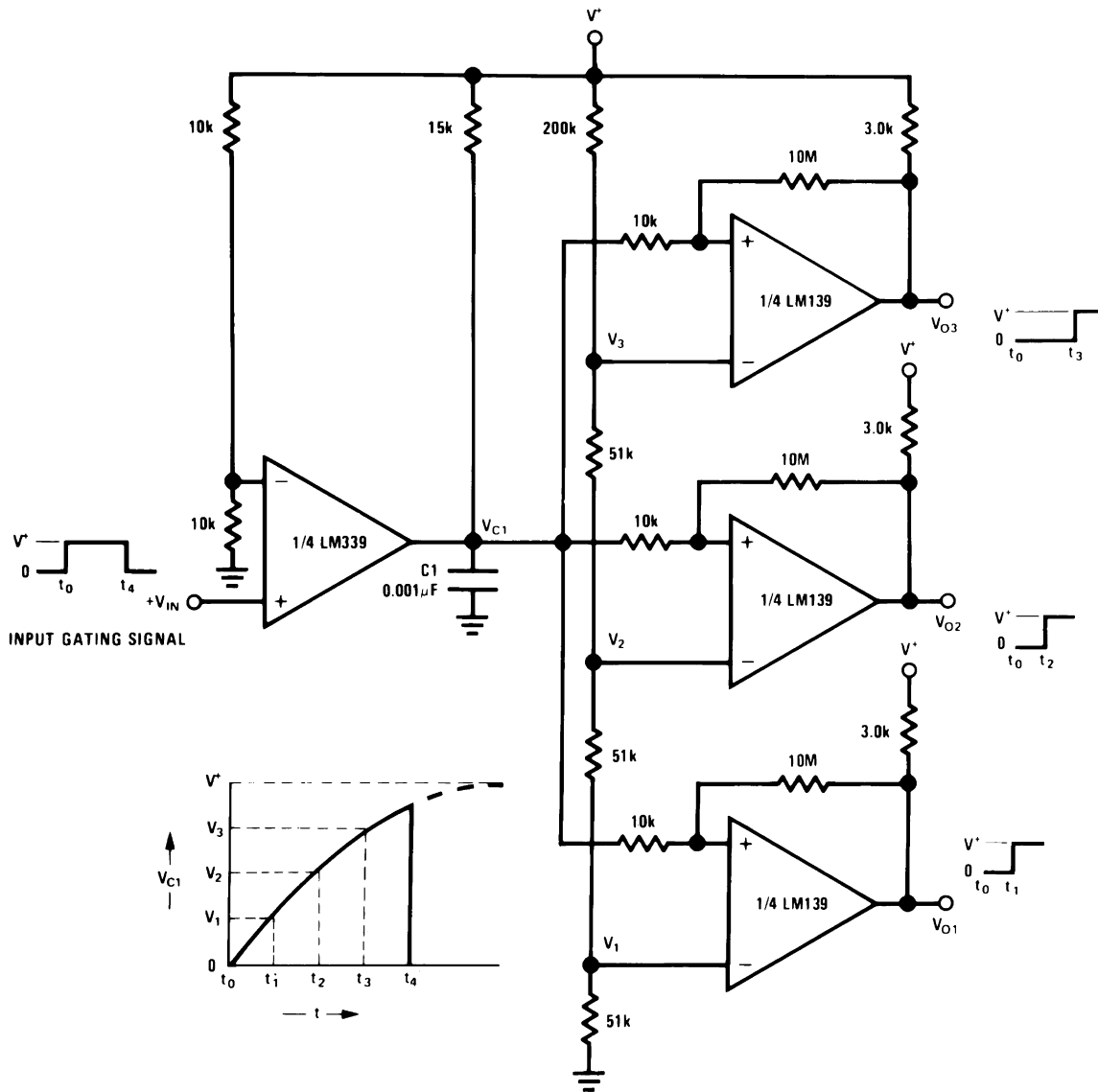
ORing the Outputs



20129515

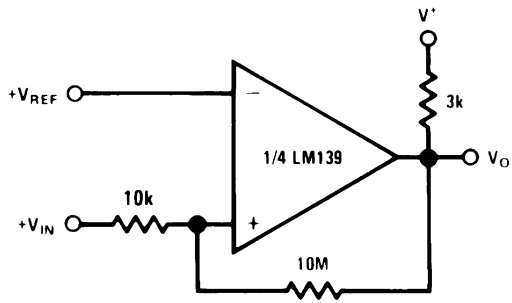
Typical Applications ($V^+ = 15\text{ V}_{DC}$) (Continued)

Time Delay Generator



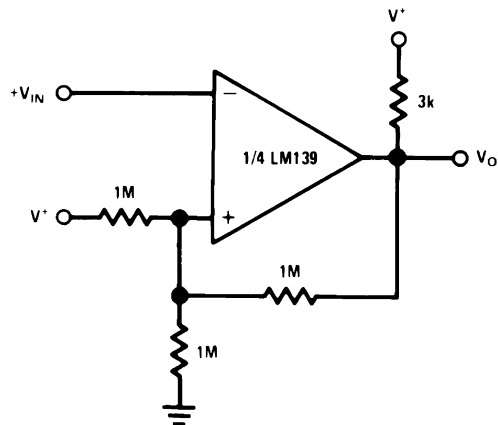
20129514

Non-Inverting Comparator with Hysteresis



20129518

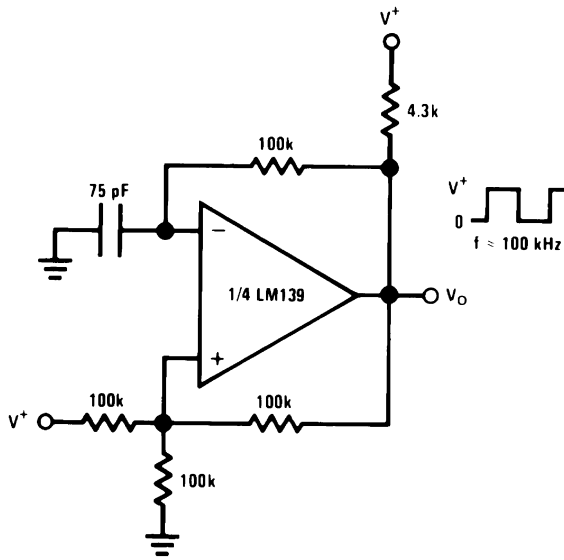
Inverting Comparator with Hysteresis



20129519

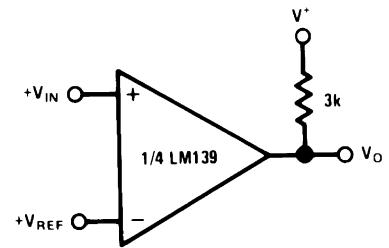
Typical Applications ($V^+ = 15 V_{DC}$) (Continued)

Squarewave Oscillator



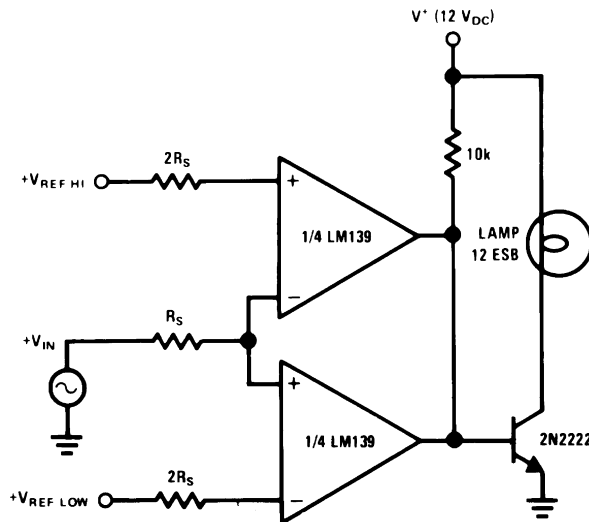
20129516

Basic Comparator



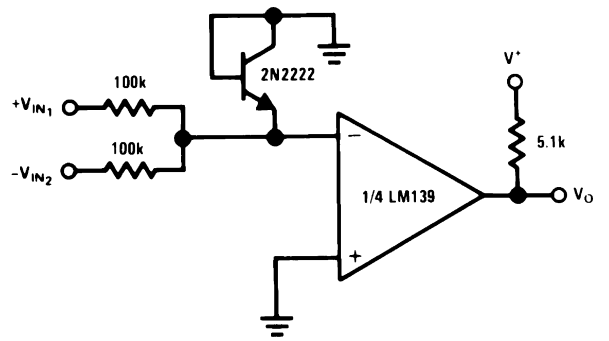
20129521

Limit Comparator



20129524

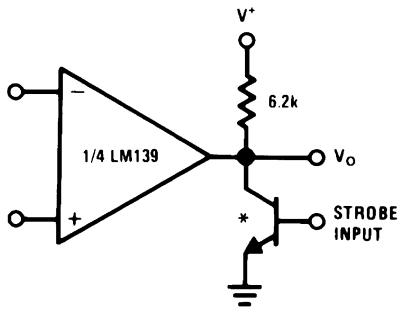
Comparing Input Voltages of Opposite Polarity



20129520

Typical Applications ($V^+ = 15\text{ V}_{DC}$) (Continued)

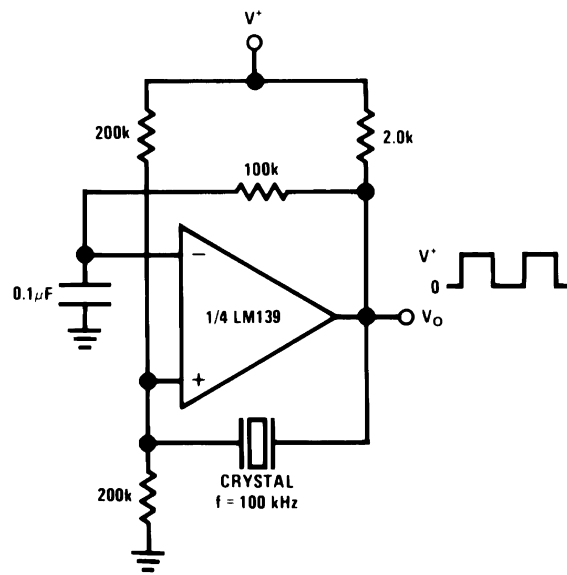
Output Strobing



20129522

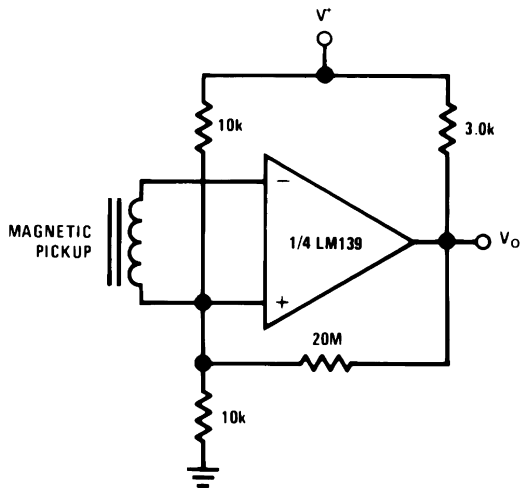
* Or open-collector logic gate without pull-up resistor

Crystal Controlled Oscillator



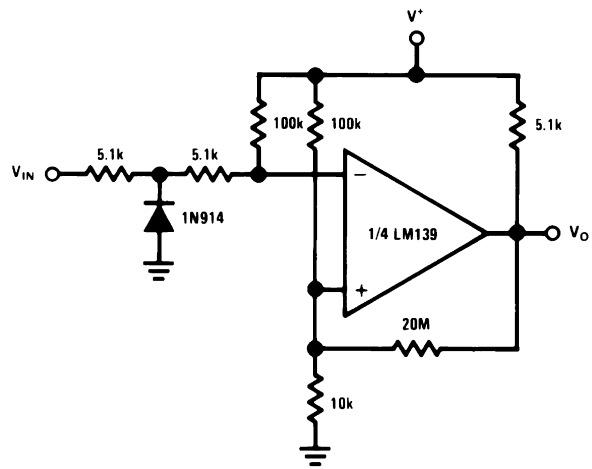
20129525

Transducer Amplifier



20129528

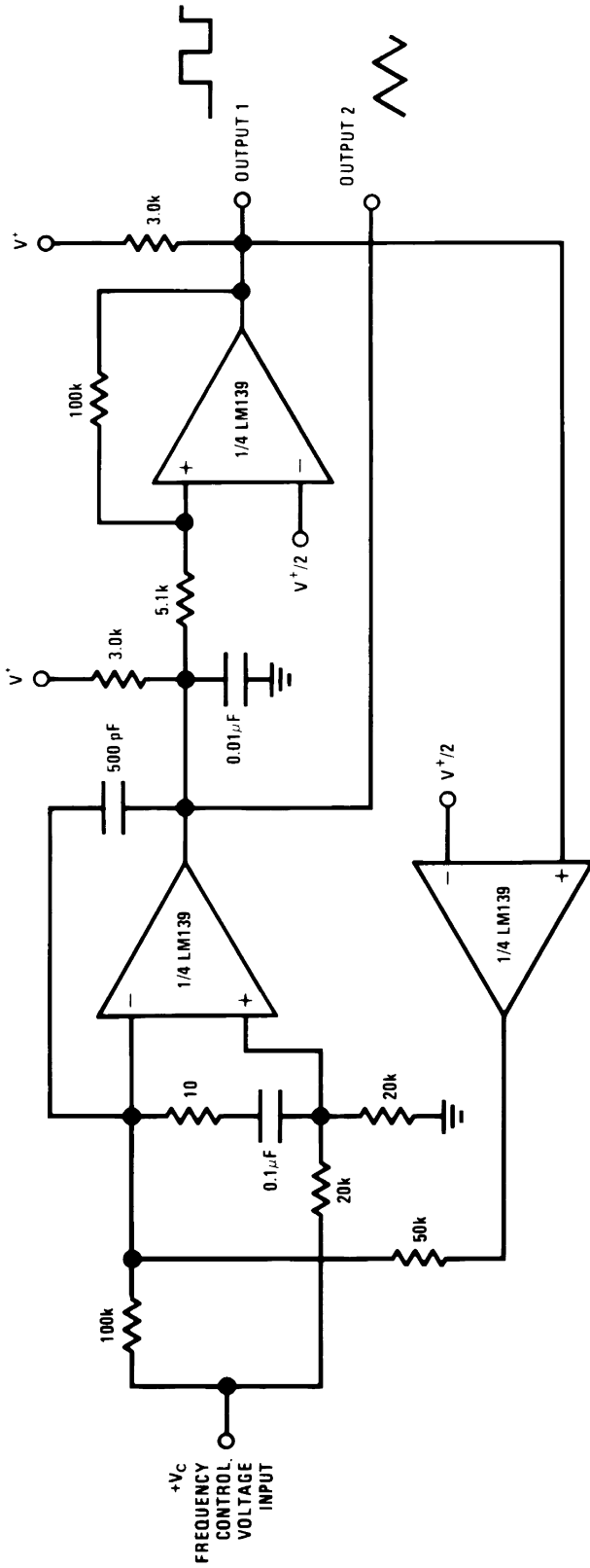
Zero Crossing Detector (Single Power Supply)



20129530

Typical Applications ($V^+ = 15 V_{DC}$) (Continued)

Two-Decade High-Frequency VCO

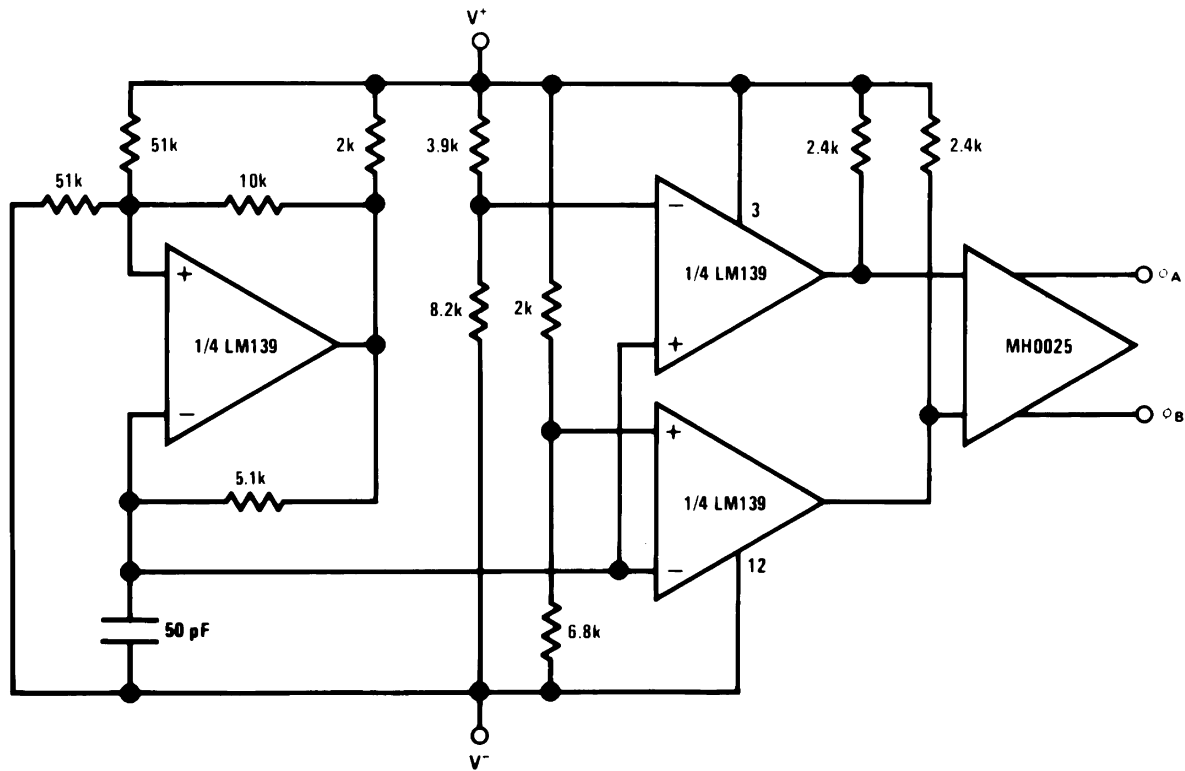


$V^+ = +30 V_{DC}$
 $250 mV_{DC} \leq V_C \leq +50 V_{DC}$
 $700 Hz \leq f_o \leq 100 kHz$

20129523

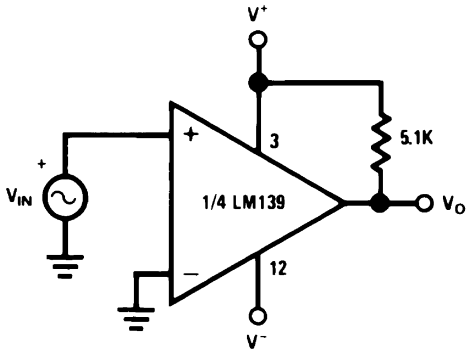
Split-Supply Applications ($V^+ = +15 V_{DC}$ and $V^- = -15 V_{DC}$)

MOS Clock Driver



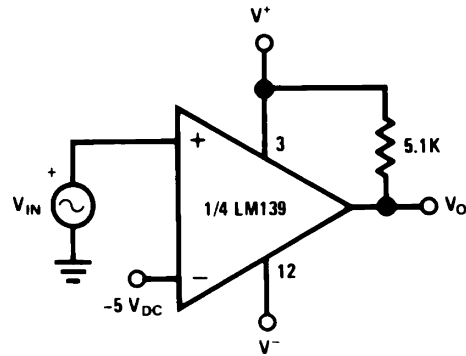
20129531

Zero Crossing Detector



20129532

Comparator With a Negative Reference



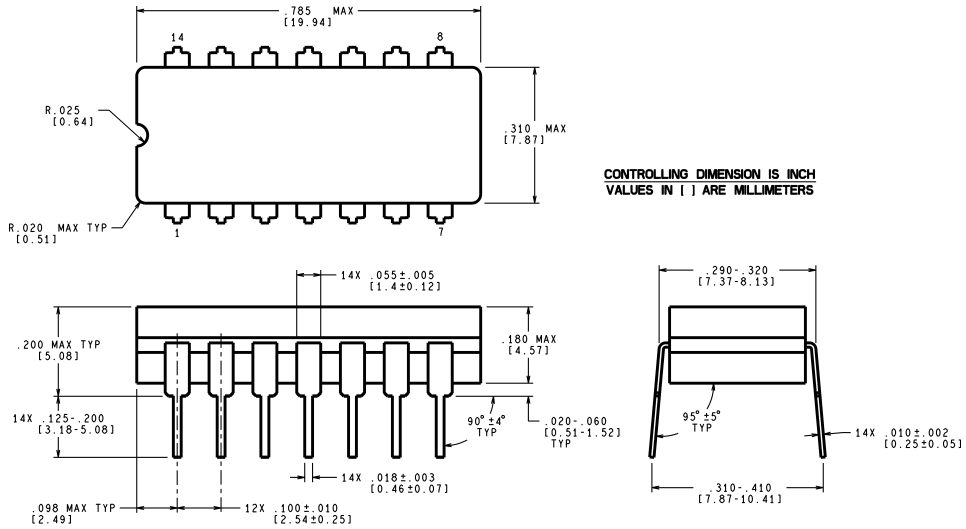
20129533

Revision History Section

Date Released	Revision	Section	Originator	Changes
02/15/05	A	New Release to corporate format	L. Lytle	1 MDS datasheet converted into Corp. datasheet format. MJLM139-X rev 0D0. MDS datasheet will be archived.

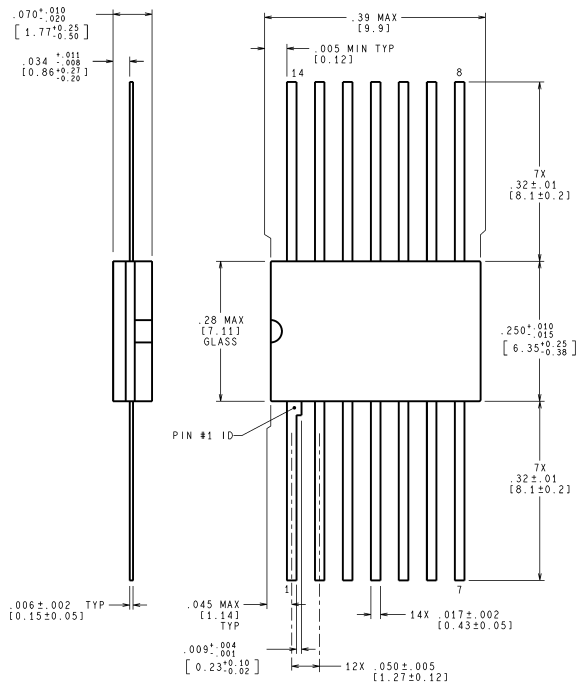
Physical Dimensions inches (millimeters)

unless otherwise noted



J14A (Rev J)

**Ceramic Dual-In-Line Package (J)
NS Package Number J14A**



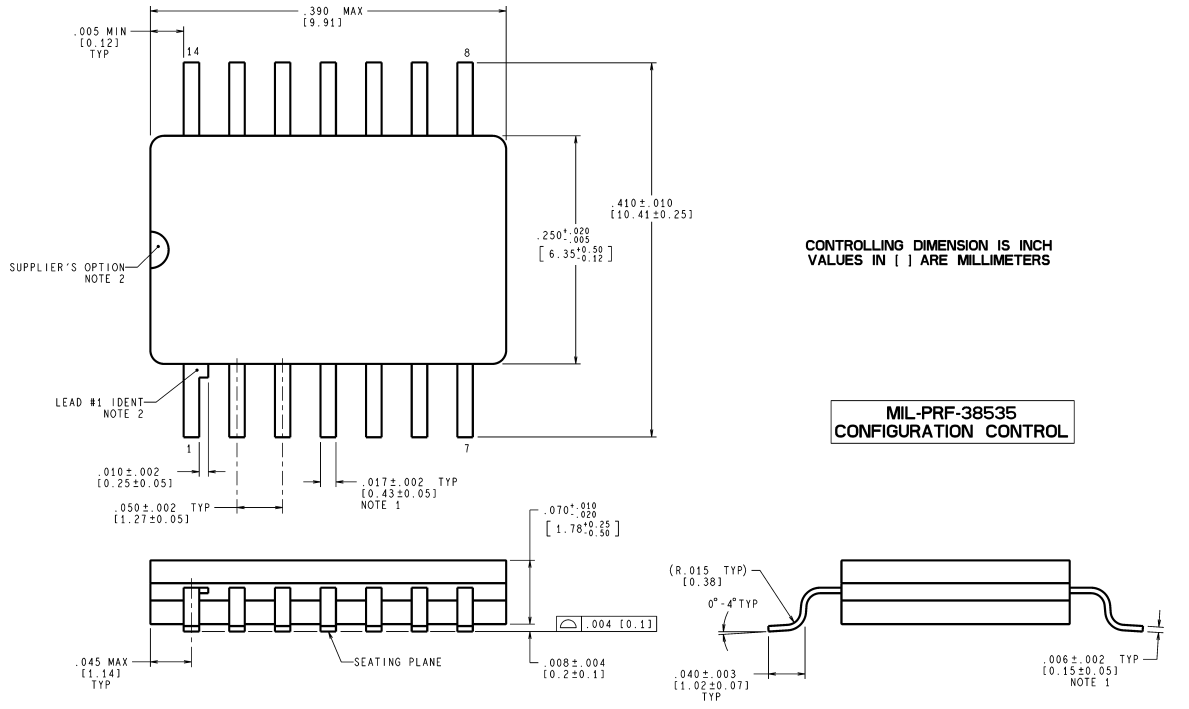
MIL-PRF-38535
CONFIGURATION CONTROL

MIL-STD-18358
CONFIGURATION CONTROL

W14B (Rev P)

**Ceramic Flat Package (W)
NS Package Number W14B**

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



**Ceramic SOIC (WG)
NS Package Number WG14A**

WG14A (Rev C)

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