Voltage Comparator

FEATURES

- *Guaranteed* Max Input Offset Voltage 1.0mV
- *Guaranteed* Max Input Offset Current 5nA
- *Guaranteed* Max Response Time 250nS
- *Guaranteed* Min. Voltage Gain 200,000
- ±30V Differential Input Voltage
- Drives 50mA Loads At Up To 50V.
- ½ The Power Dissipation For LT111A/LT311A

APPLICATIONS

- General Purpose Comparator
- Zero Crossing Detector
- Voltage To Frequency Converter

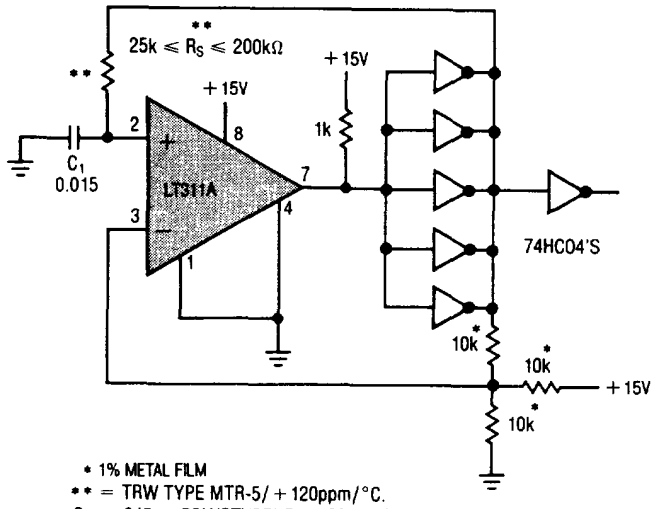
DESCRIPTION

The LT111A is an improved version of the LM111 general purpose comparator. These new devices offer maximum input offset voltage of 1.0mV and input offset current of 5.0nA with a maximum response time of 250ns. The LT111A operates from a single 5V supply to ±15V supplies and can drive up to 50mA loads referred to ground or either supply. A separate output ground pin allows output signals to be isolated from analog ground.

The versatility of the LT111A is enhanced by an input stage design which allows differential input signals of up to ±30V. Offset balancing, strobe capability and the ability to "OR" the output is also included. These features plus Linear Technology Corporation's advanced processing and reliability enhancements make the LT111A an ideal choice for most comparator applications. For higher performance requirements, see the LT1011. For operation up to 200°C, see LT111X data sheet.

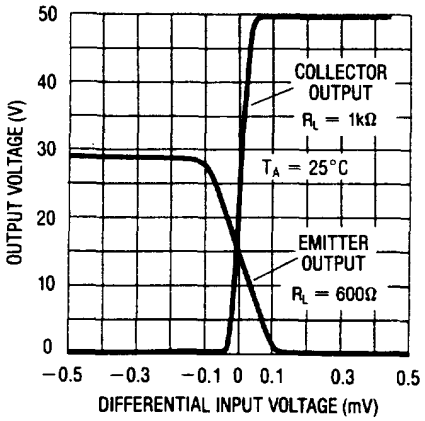
6

Low Drift R/C Oscillator



* 1% METAL FILM
** = TRW TYPE MTR-5/ + 120ppm/°C.
C_1 = .015 = POLYSTYRENE − 120ppm/°C ± 30ppm WESCO TYPE 32-P
NOTE: COMPARATOR CONTRIBUTES ≤ 10ppm/°C DRIFT FOR FREQUENCIES BELOW 10kHz.

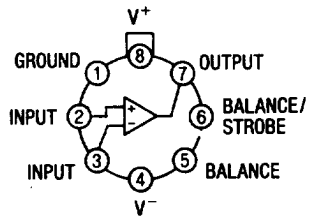
Transfer Function



ABSOLUTE MAXIMUM RATINGS

Supply Voltage
(pin 8 to pin 4) 36V
Output to Negative Supply
(pin 7 to pin 4)
LT111A/LM111 ..... 50V
LT311A/LM311 ..... 40V
Ground to Negative Supply
(pin 1 to pin 4) 30V
Differential Input Voltage ..... ±30V
Voltage at Strobe Pin (pin 6 to pin 8) 5V
Input Voltage (Note 1) ..... ±15V
Output Short Circuit Duration ..... 10 sec.
Operating Temperature Range (Note 2)
LT111A/LM111 ..... −55°C to 125°C
LT311A/LM311 ..... 0°C to 70°C
Storage Temperature Range ..... −65°C to 150°C
Lead Temperature (Soldering, 10 sec.) ..... 300°C

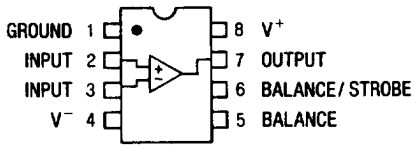
PACKAGE/ORDER INFORMATION



H PACKAGE
TO-5 METAL CAN

ORDER PART NUMBER
LT111AH
LM111H
LT311AH
LM311H

TOP VIEW



NOTE: PIN 4 CONNECTED TO CASE.
J8 PACKAGE 8 PIN CERDIP
N8 PACKAGE 8 PIN PLASTIC

LT111AJ8
LM111J8
LT311AJ8
LM311J8
LT311AN8
LM311N8

ELECTRICAL CHARACTERISTICS $V_S = \pm 15V$, $T_A = 25°C$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT111A MIN	LT111A TYP	LT111A MAX	LM111 MIN	LM111 TYP	LM111 MAX	UNITS
V_{OS}	Input Offset Voltage	$R_S \leq 50k$ (Note 3, 4)			0.5	1.0		0.7	3.0	mV
			●			2.0			4.0	
I_{OS}	Input Offset Current				2.0	5.0		4.0	10.0	nA
		(Note 3,4)	●			10.0			20.0	
I_B	Input Bias Current				60	100		60	100	nA
		Note 3	●			150			150	
A_{VOL}	Large Signal Voltage Gain	Note 7		200	500		40	200		V/mV
	Response Time	Note 5			200	250		200		nS
	Saturation Voltage	$V_{IN} \leq -5mV$, $I_{OUT} = 50mA$ $V+ \geq 4.5V$, $V- = 0$			0.75	1.5		0.75	1.5	V
		$V_{IN} \leq -6mV$, $I_{SINK} \leq 8mA$	●		0.23	0.4		0.23	0.4	V
	Strobe ON Current	Note 6			3.0	4.0		3.0		mA
	Output Leakage Current	$V_{IN} \geq 5mV$, $V_{OUT} = 35V$			0.2	10.0		0.2	10.0	nA
		$I_{STROBE} = 3mA$	●		0.1	0.5		0.1	0.5	μA
	Input Voltage Range	$V+ = 15V$, $V- = 15V$ Pin 7 Pull up may go to 5V	●	−14.5	13.8 / −14.7	13.0	−14.5	13.8 / −14.7	13.0	V
	Positive Supply Current				3.0	4.0		5.1	6.0	mA
	Negative Supply Current				1.5	2.5		4.1	5.0	mA

Shading of a specification highlights those items which offer key improvements in parametric performance or guaranteed test limits provided for the first time.

ELECTRICAL CHARACTERISTICS $V_S = \pm 15V$, $T_A = 25°C$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT311A MIN	LT311A TYP	LT311A MAX	LM311 MIN	LM311 TYP	LM311 MAX	UNITS
V_{OS}	Input Offset Voltage	$R_S \leq 50k$ (Note 3, 4)	 ●		0.5 	1.0 2.0		2.0 	7.5 10	mV
I_{OS}	Input Offset Current	 (Note 3,4)	 ●		2.0 	10 20		6.0 	50 70	nA
I_B	Input Bias Current	 Note 3			60 	100 150		100 	250 300	nA
A_{VOL}	Large Signal Voltage Gain			200	500		40	200		V/mV
	Response Time	Note 5			200	250		200		nS
	Saturation Voltage	$V_{IN} \leq -10mV$, $I_{OUT} = 50mA$ $V+ \geq 4.5V$, $V- = 0$ $V_{IN} \leq -10mV$, $I_{SINK} \leq 8mA$	 ●		0.75 0.23	1.5 0.4		0.75 0.23	1.5 0.4	V V
	Strobe ON Current	Note 6			3.0	4.0		3.0		mA
	Output Leakage Current	$V_{IN} \geq 10mV$, $V_{OUT} = 35V$ $I_{STROBE} = 3mA$	 ●		0.2 0.1	50 0.5		0.2 	50 	nA μA
	Input Voltage Range		●	−14.5	{13.8 −14.7}	13.0	−14.5	{13.8 −14.7}	13.0	V
	Positive Supply Current				3.0	4.0		5.1	7.5	mA
	Negative Supply Current				1.5	2.5		4.1	5.0	mA

The ● denotes the specifications which apply over the full operating temperature range.

Note 1: Applicable for ± 15V supplies. The positive input voltage limit is 30V above the negative supply. The negative input voltage limit is the negative supply.

Note 2: T_j max. = 150°C for the LT111A and 95°C for the LT311A.

Note 3: Offset voltage, offset current and bias current specifications apply for any supply voltage from a single 5V up to ± 15V supplies.

Note 4: Offset voltages and offset currents shown are the maximum values required to drive the output within a volt of either supply with a 1mA load. These parameters define an error band and take into account the worst case effects of voltage gain and input impedance.

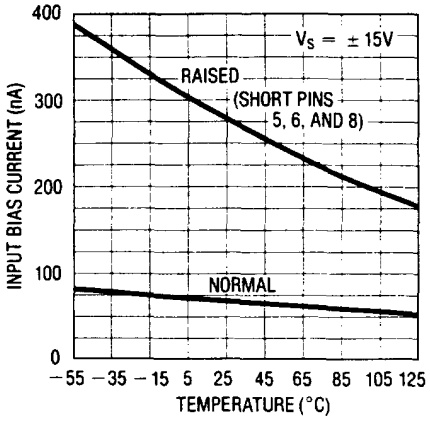
Note 5: Response time is specified for a 100mV input step with 5mV overdrive with the collector output terminated with a 500Ω pullup resistor tied to 5V.

Note 6: Do not short the strobe pin to ground. It should be current driven at 3 to 5mA for the shortest strobe time. Currents as low as 500μA will strobe the LT111A if speed is not important. External leakage on the strobe pin in excess of 0.2μA when the strobe is "off" can cause offset voltage shifts.

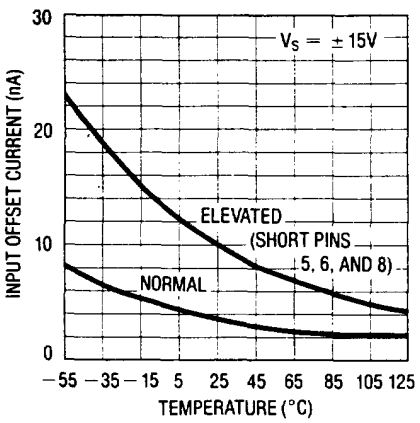
Note 7: $R_L = 1k\Omega$, $-10V \leq V_{OUT} \leq 14.5V$

TYPICAL PERFORMANCE CHARACTERISTICS

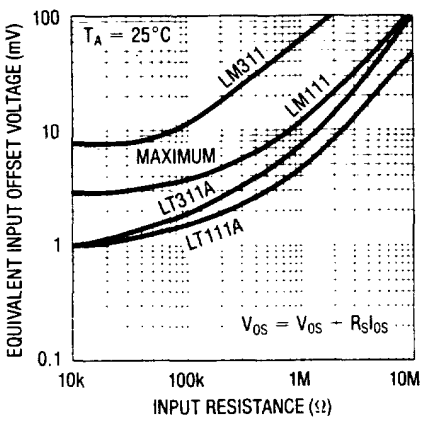
Input Bias Current



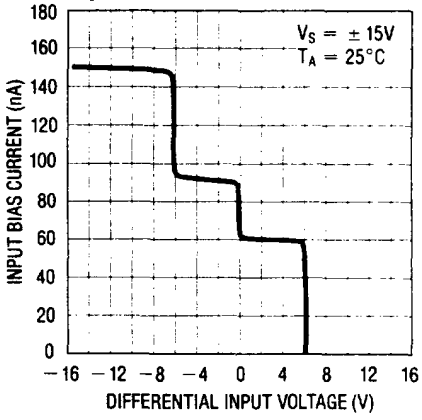
Input Offset Current



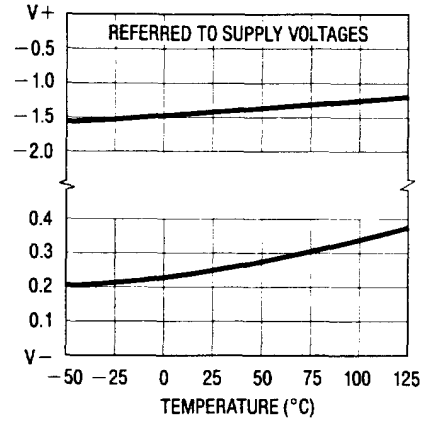
Offset Error



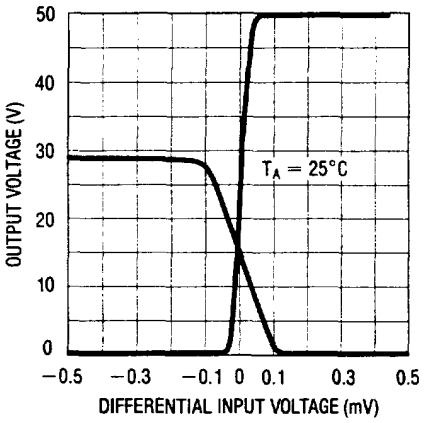
Input Characteristics



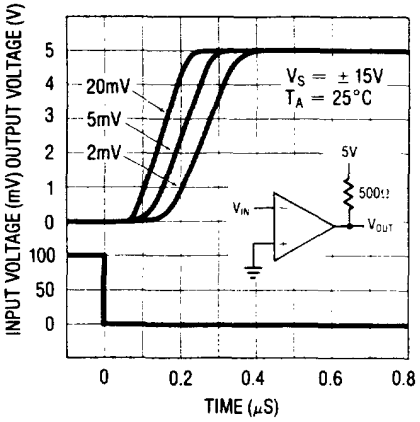
Common Mode Limits



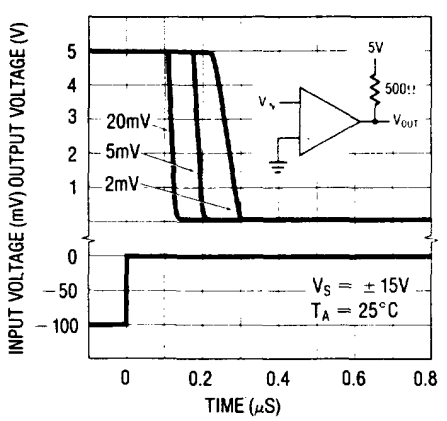
Transfer Function



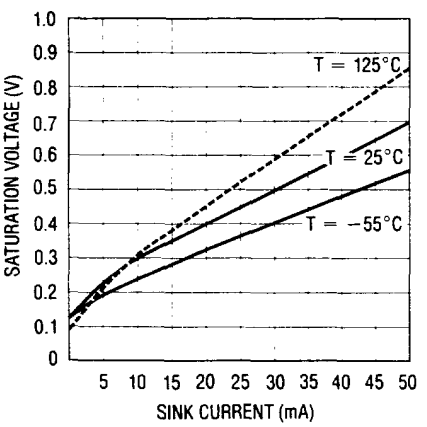
Response Time for Various Input Overdrives



Response Time for Various Input Overdrives

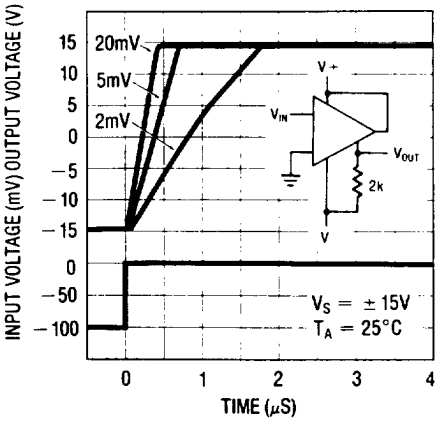


Collector Output Saturation Voltage

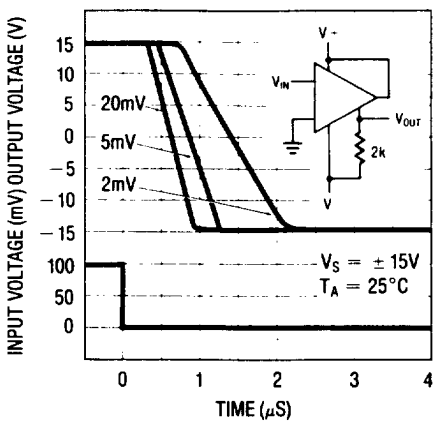


TYPICAL PERFORMANCE CHARACTERISTICS

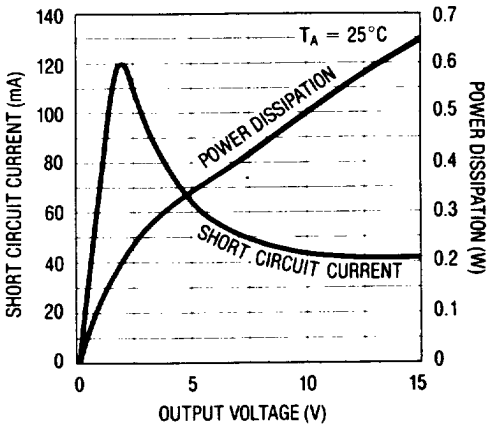
Response Time Using GND Pin as Output



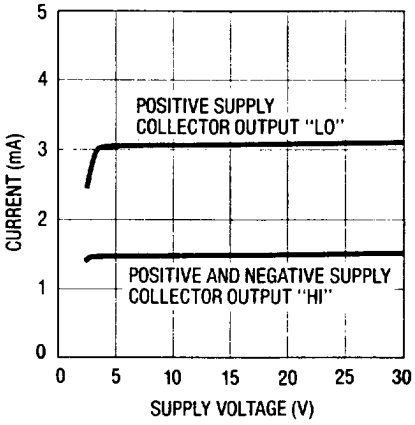
Response Time Using GND Pin as Output



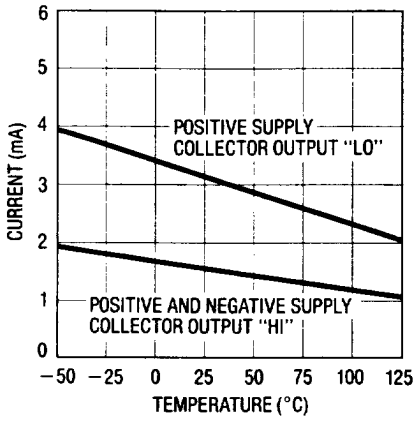
Output Limiting Characteristics



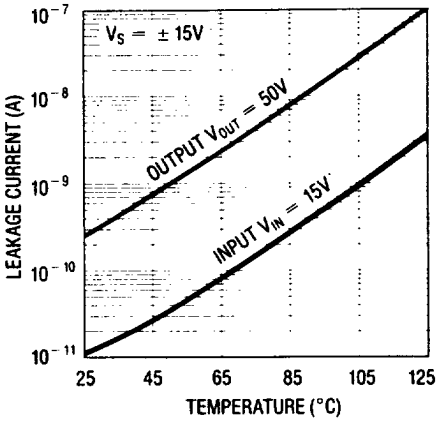
Supply Current vs Supply Voltage



Supply Current vs Temperature

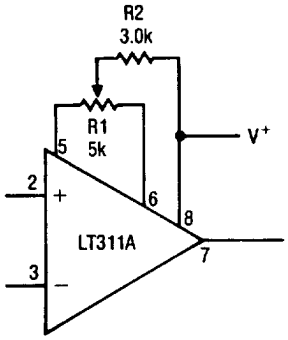


Leakage Current vs Temperature



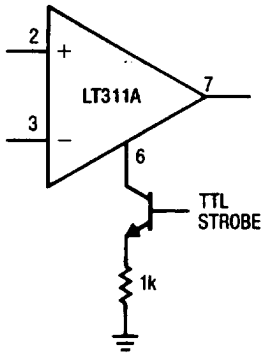
TYPICAL APPLICATIONS

Offset Balancing



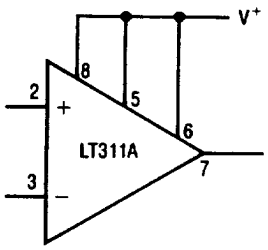
Note: Pin Connections Shown are for TO-5 package

Strobing



Note: Do Not Ground Strobe Pin.

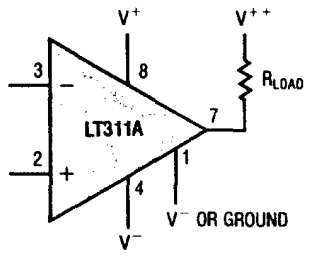
Increasing Input Stage Current



Increases typical common mode slew rate from 7.0 V/μS to 18V/μS.

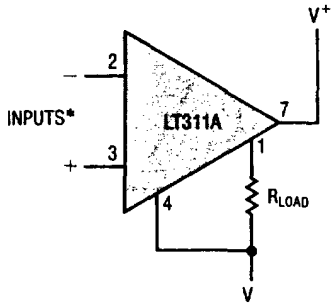
TYPICAL APPLICATIONS

Driving Load Referenced To Positive Supply



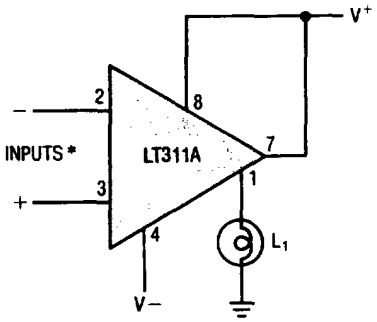
V++ CAN BE GREATER OR LESS THAN V+

Driving Load Referenced To Negative Supply



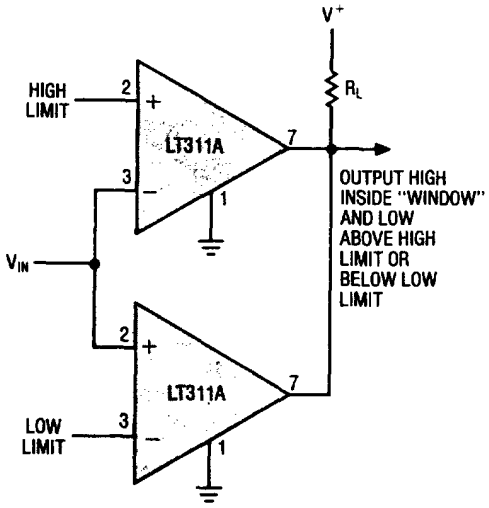
* NOTE THAT INPUT POLARITY IS REVERSED WHEN USING PIN 1 AS OUTPUT

Driving Ground Referred Load

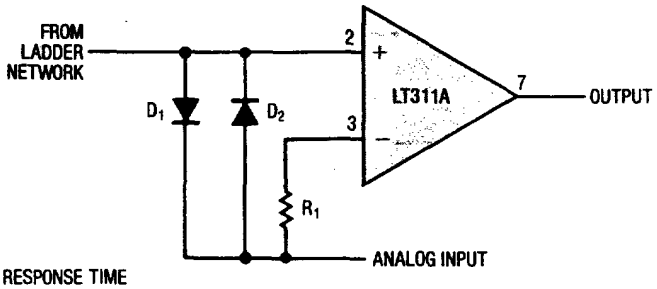


* NOTE THAT INPUT POLARITY IS REVERSED WHEN USING PIN 1 AS OUTPUT

Window Detector

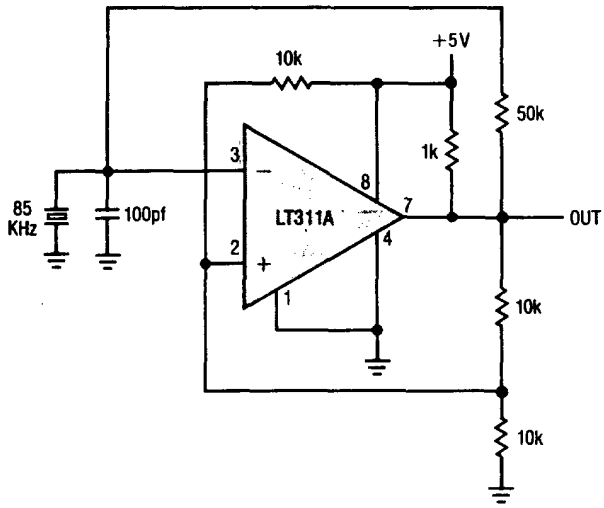


Using Clamp Diodes To Improve Frequency Response*

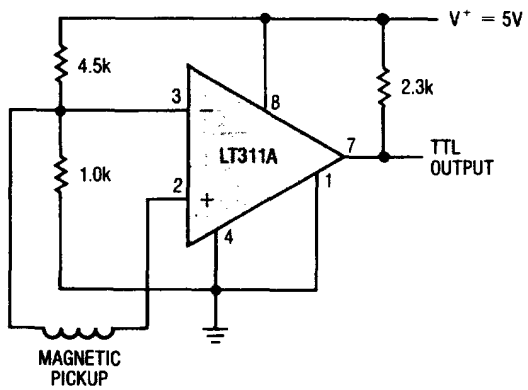


* RESPONSE TIME INCREASES TO ≈500nS IF INPUT MUST SLEW 5V TO REACH THRESHOLD.

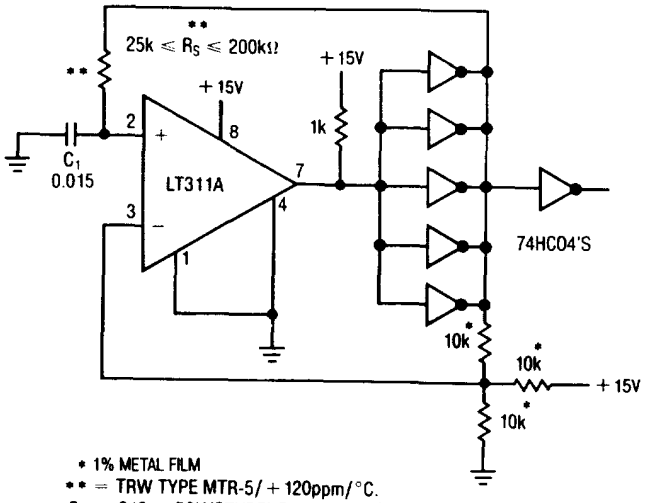
Crystal Oscillator



Detector For Magnetic Transducer

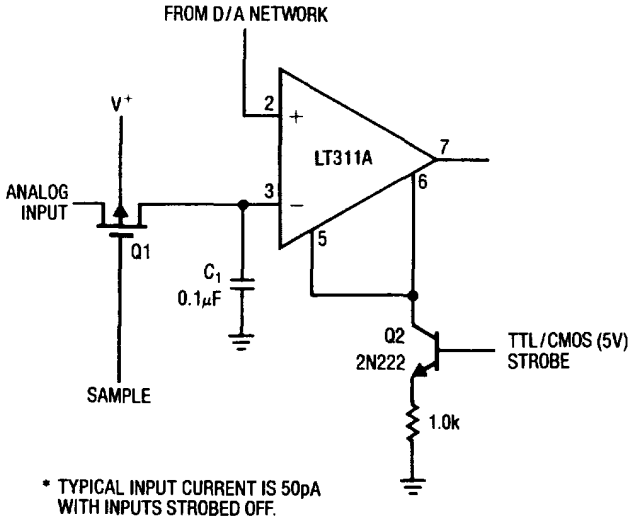


Low Drift R/C Oscillator



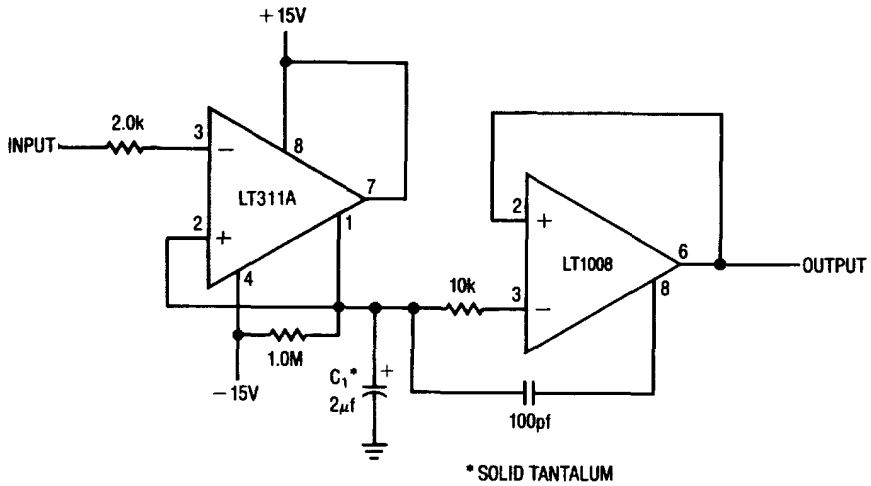
* 1% METAL FILM
** = TRW TYPE MTR-5/ + 120ppm/°C.
C_1 = .015 = POLYSTYRENE − 120ppm/°C ± 30ppm WESCO TYPE 32-P
NOTE: COMPARATOR CONTRIBUTES ≤ 10ppm/°C DRIFT FOR FREQUENCIES BELOW 10kHz.

Strobing Off Both Input* And Output Stages



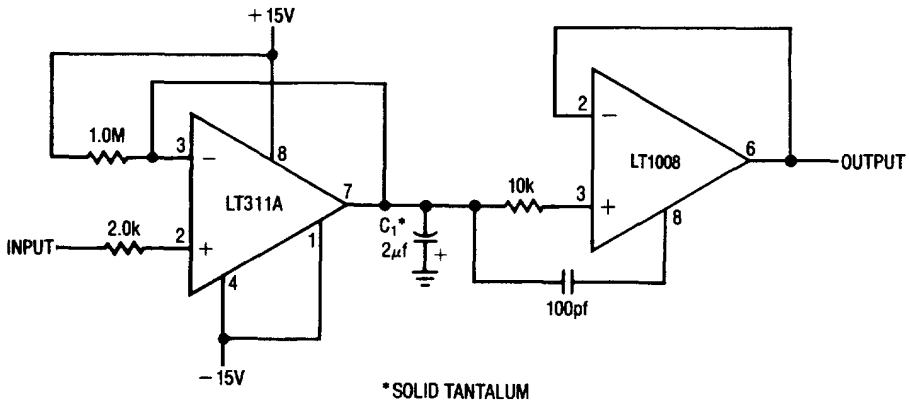
* TYPICAL INPUT CURRENT IS 50pA WITH INPUTS STROBED OFF. DO NOT GROUND STROBE PIN

Positive Peak Detector



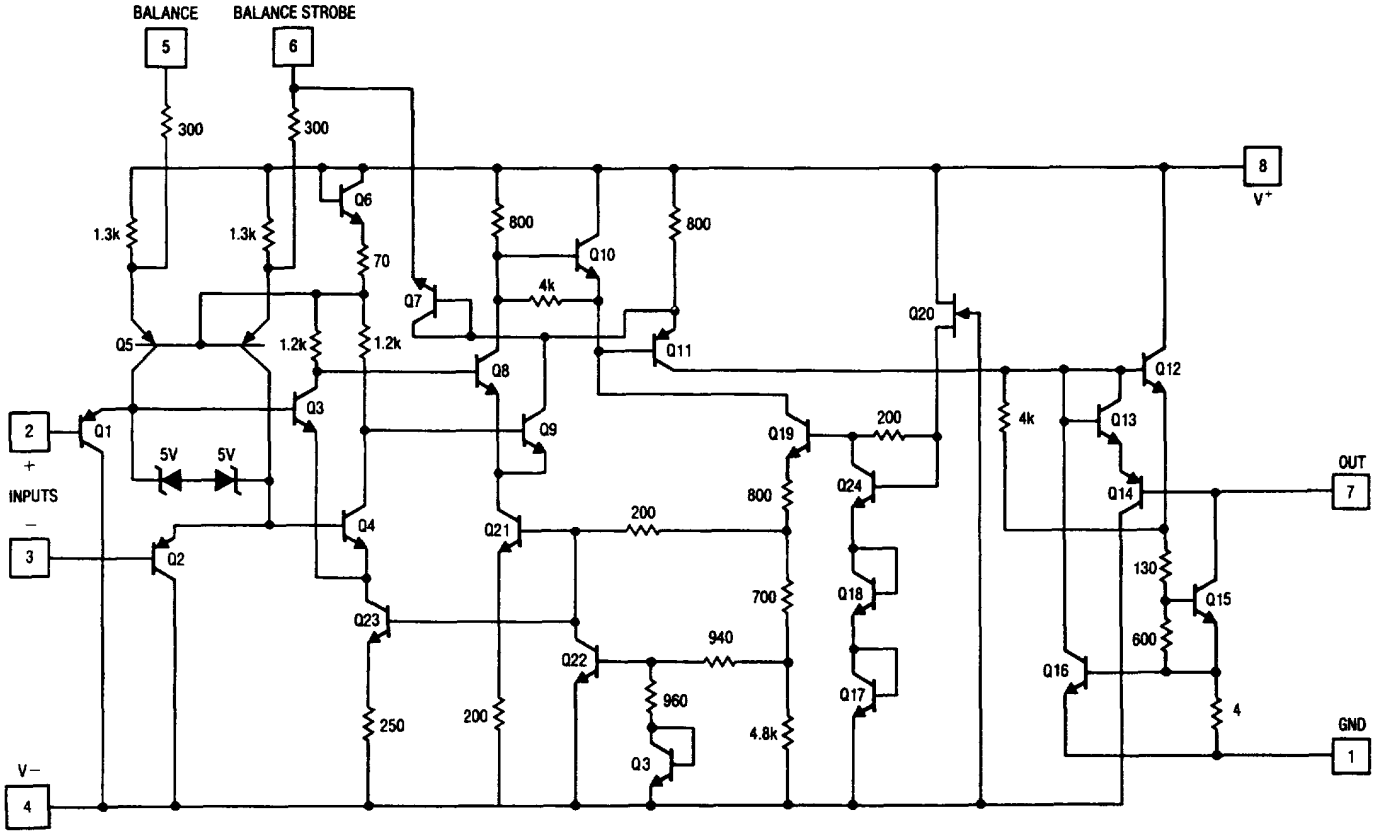
* SOLID TANTALUM

Negative Peak Detector



* SOLID TANTALUM

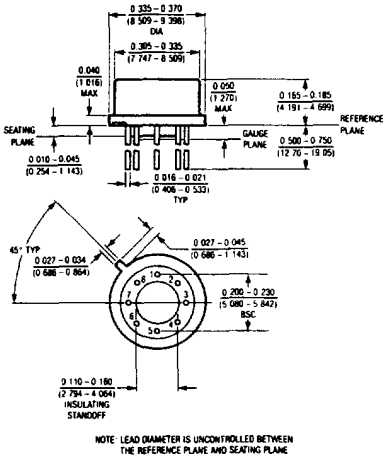
SCHEMATIC DIAGRAM



PACKAGE DESCRIPTION

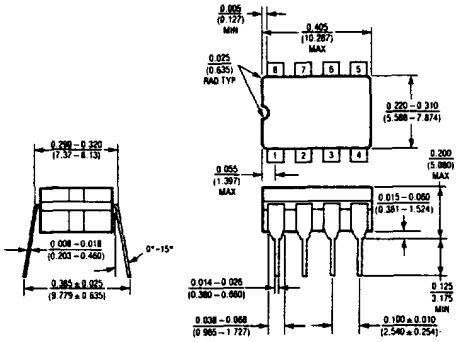
Dimensions in inches (millimeters) unless otherwise noted.

H Package
Metal Can



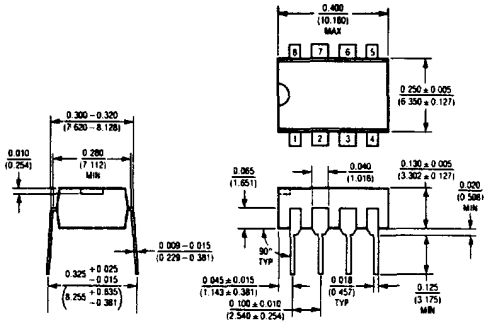
$T_j$max	Θ_{ja}	Θ_{jc}
150°C	150°C/W	45°C/W

J8 Package
8 Lead Hermetic Dip



$T_j$max	Θ_{ja}
150°C	100°C/W

N8 Package
8 Lead Plastic



$T_j$max	Θ_{ja}
100°C	130°C/W