Voltage Comparators

LF111/LF211/LF311 voltage comparators

general description

The LF111, LF211 and LF311 are FET input voltage comparators that virtually eliminate input current errors. Designed to operate over a 5.0V to ±15V range the LF111 can be used in the most critical applications.

The extremely low input currents of the LF111 allows the use of a simple comparator in applications usually requiring input current buffering. Leakage testing, long time delay circuits, charge measurements, and high source impedance voltage comparisons are easily done.

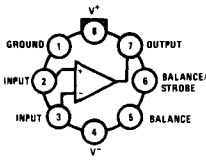
Further, the LF111 can be used in place of the LM111 eliminating errors due to input currents.

advantages

- Eliminates input current errors
- Interchangeable with LM111
- No need for input current buffering

connection diagrams*

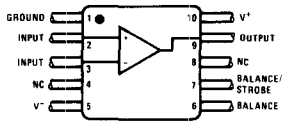
Metal Can Package



NOTE: Pin 4 connected to case.
TOP VIEW

Order Number LF111H, LF211H or LF311H
See Package 11

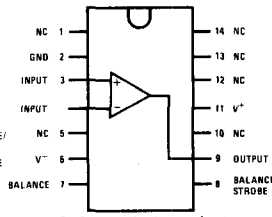
Flat Package



NOTE: Pin 5 connected to bottom of package.
TOP VIEW

Order Number LF111F
See Package 3

Dual-In-Line Package

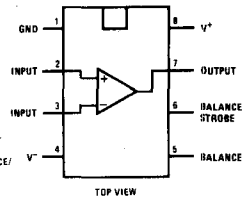


Note: Pin 6 connected to bottom of package.
TOP VIEW

Order Number LF111D, LF211D or LF311D
See Package 1

Order Number LF311N-14
See Package 22

Dual-In-Line Package

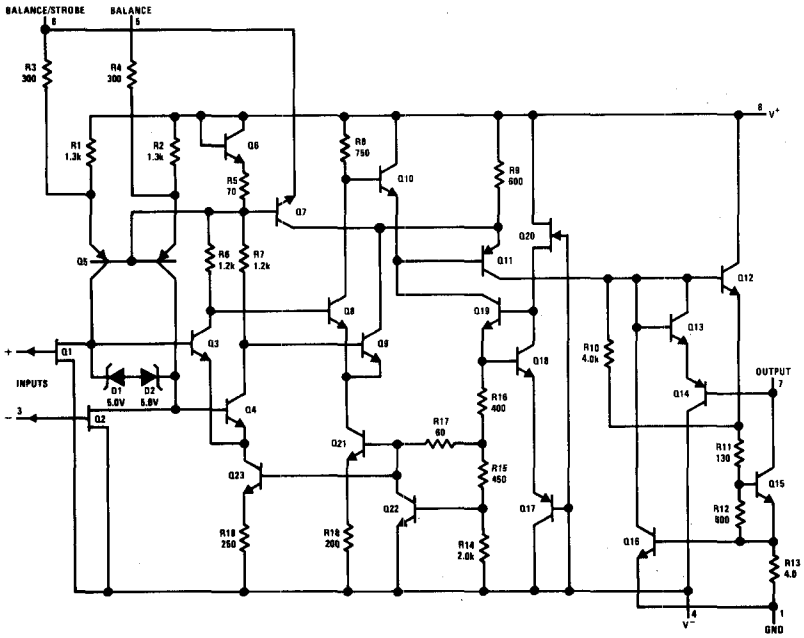


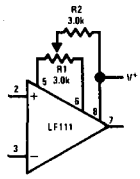
TOP VIEW

Order Number LF311N
See Package 20

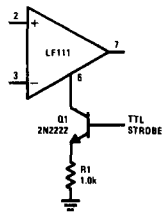
*Pin connections shown on schematic diagram and typical applications are for TO-5 package.

schematic diagram and auxiliary circuits

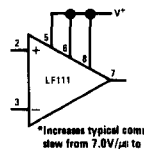




Offset Balancing



Strobing



*Increases typical common mode slew from 7.0V/μs to 18V/μs.

Increasing Input Stage Current*

absolute maximum ratings

	LF111/LF211	LF311
Total Supply Voltage (V_{84})	36V	36V
Output to Negative Supply Voltage (V_{74})	50V	40V
Ground to Negative Supply Voltage (V_{14})	30V	30V
Differential Input Voltage	±30V	±30V
Input Voltage (Note 1)	±15V	±15V
Power Dissipation (Note 2)	500 mW	500 mW
Output Short Circuit Duration	10 seconds	10 seconds
Operating Temperature Range		
LF111	−55°C to +125°C	
LF211	−25°C to +85°C	
LF311		0°C to +70°C
Storage Temperature Range	−65°C to +150°C	−65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C	300°C

electrical characteristics (LF111/LF211) (Note 3)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage (Note 4)	$T_A = 25°C$, R_S		0.7	4.0	mV
Input Offset Current (Note 4)	$T_A = 25°C$, $V_{CM} = 0$ (Note 6)		5.0	25	pA
Input Bias Current	$T_A = 25°C$, $V_{CM} = 0$ (Note 6)		20	50	pA
Voltage Gain	$T_A = 25°C$		200		V/mV
Response Time (Note 5)	$T_A = 25°C$		200		ns
Saturation Voltage	$V_{IN} \leq -5.0$ mV, $I_{OUT} = 50$ mA, $T_A = 25°C$		0.75	1.5	V
Strobe On Current	$T_A = 25°C$		3.0		mA
Output Leakage Current	$V_{IN} \geq 5.0$ mV, $V_{OUT} = 35V$, $T_A = 25°C$		0.2	10	nA
Input Offset Voltage (Note 4)				6.0	mV
Input Offset Current (Note 4)	$V_S = ±15V$, $V_{CM} = 0$ (Note 6)		2.0	3.0	nA
Input Bias Current	$V_S = ±15V$, $V_{CM} = 0$ (Note 6)		5.0	7.0	nA
Input Voltage Range			+14 −13.5		V V
Saturation Voltage	$V^+ \geq 4.5V$, $V^- = 0$ $V_{IN} \leq -6.0$ mV, $I_{SINK} \leq 8.0$ mA		0.23	0.4	V
Output Leakage Current	$V_{IN} \geq 5.0$ mV, $V_{OUT} = 35V$		0.1	0.5	μA
Positive Supply Current	$T_A = 25°C$		5.1	6.0	mA
Negative Supply Current	$T_A = 25°C$		4.1	5.0	mA

Note 1: This rating applies for ±15V supplies. The positive input voltage limit is 30V above the negative supply. The negative input voltage limit is equal to the negative supply voltage or 30V below the positive supply, whichever is less.

Note 2: The maximum junction temperature of the LF111 is +150°C, the LF211 is +110°C and the LF311 is +85°C. For operating at elevated temperatures, devices in the TO-5 package must be derated based on a thermal resistance of +150°C/W, junction to ambient, or +45°C/W, junction to case. For the flat package, the derating is based on a thermal resistance of +185°C/W when mounted on a 1/16-inch-thick epoxy glass board with ten, 0.03-inch-wide, 2-ounce copper conductors. The thermal resistance of the dual-in-line package is +100°C/W, junction to ambient.

Note 3: These specifications apply for $V_S = ±15V$ and $-55°C \leq T_A \leq +125°C$ for the LF111, unless otherwise stated. With the LF211, however, all temperature specifications are limited to $-25°C \leq T_A \leq +85°C$ and for the LF311 $0°C \leq T_A \leq +70°C$. The offset voltage, offset current and bias current specifications apply for any supply voltage from a single 5.0 mV supply up to ±15V supplies.

Note 4: The offset voltages and offset currents given are the maximum values required to drive the output within a volt of either supply with a 1.0 mA load. Thus, these parameters define an error band and take into account the worst case effects of voltage gain and input impedance.

Note 5: The response time specified (see definitions) is for a 100 mV input step with 5.0 mV overdrive.

Note 6: For input voltages greater than 15V above the negative supply the bias and offset currents will increase—see typical performance curves.

electrical characteristics (LF311) (Note 3)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage (Note 4)	$T_A = 25°C$, $R_S \leq 50k$		2.0	10	mV
Input Offset Current (Note 4)	$T_A = 25°C$, $V_{CM} = 0$ (Note 6)		5.0	75	pA
Input Bias Current	$T_A = 25°C$, $V_{CM} = 0$ (Note 6)		25	150	pA
Voltage Gain	$T_A = 25°C$		200		V/mV
Response Time (Note 5)	$T_A = 25°C$		200		ns
Saturation Voltage	$V_{IN} \leq -10$ mV, $I_{OUT} = 50$ mA, $T_A = 25°C$		0.75	1.5	V
Strobe On Current	$T_A = 25°C$		3.0		mA
Output Leakage Current	$V_{IN} \geq 10$ mV, $V_{OUT} = 35V$, $T_A = 25°C$		0.2	10	nA
Input Offset Voltage (Note 4)	$R_S \leq 50k$			15	mV
Input Offset Current (Note 4)	$V_S = \pm 15V$, $V_{CM} = 0$ (Note 6)		1.0		nA
Input Bias Current	$V_S = \pm 15V$, $V_{CM} = 0$ (Note 6)		3.0		nA
Input Voltage Range			+14 −13.5		V V
Saturation Voltage	$V^+ \geq 4.5V$, $V^- = 0$ $V_{IN} \leq -10$ mV, $I_{SINK} \leq 8.0$ mA		0.23	0.4	V
Positive Supply Current	$T_A = 25°C$		5.1	7.5	mA
Negative Supply Current	$T_A = 25°C$		4.1	5.0	mA

Note 1: This rating applies for ±15V supplies. The positive input voltage limit is 30V above the negative supply. The negative input voltage limit is equal to the negative supply voltage or 30V below the positive supply, whichever is less.

Note 2: The maximum junction temperature of the LF111 is +150°C, the LF211 is +110°C and the LF311 is +85°C. For operating at elevated temperatures, devices in the TO-5 package must be derated based on a thermal resistance of +150°C/W, junction to ambient, or +45°C/W, junction to case. For the flat package, the derating is based on a thermal resistance of +185°C/W when mounted on a 1/16-inch-thick epoxy glass board with ten, 0.03-inch-wide, 2-ounce copper conductors. The thermal resistance of the dual-in-line package is +100°C/W, junction to ambient.

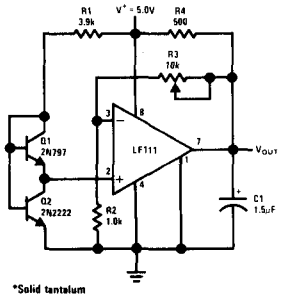
Note 3: *These specifications apply for* $V_S = \pm 15V$ *and* $-55°C \leq T_A \leq +125°C$ *for the LF111, unless otherwise stated. With the LF211, however,* all temperature specifications are limited to $-25°C \leq T_A \leq +85°C$ and for the LF311 $0°C \leq T_A \leq +70°C$. The offset voltage, offset current and bias current specifications apply for any supply voltage from a single 5.0 mV supply up to ±15V supplies.

Note 4: The offset voltages and offset currents given are the maximum values required to drive the output within a volt of either supply with a 1.0 mA load. Thus, these parameters define an error band and take into account the worst case effects of voltage gain and input impedance.

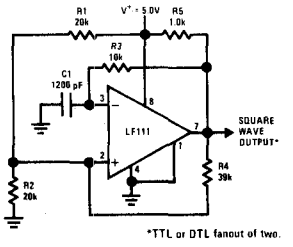
Note 5: *The response time specified (see definitions) is for a 100 mV input step with 5.0 mV overdrive.*

Note 6: For input voltages greater than 15V above the negative supply the bias and offset currents will increase—see typical performance curves.

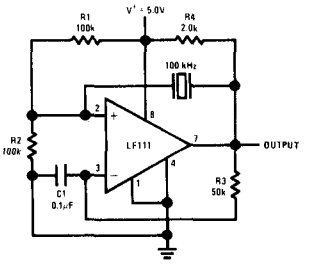
typical applications



Low Voltage Adjustable Reference Supply



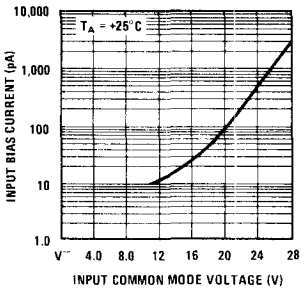
100 kHz Free Running Multivibrator



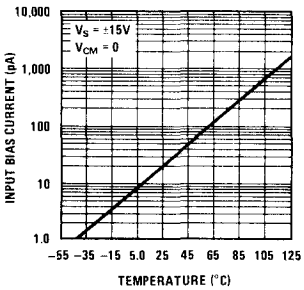
Crystal Oscillator

typical performance

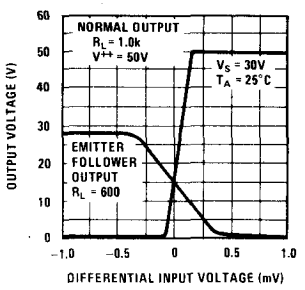
Input Bias Current vs Common Mode



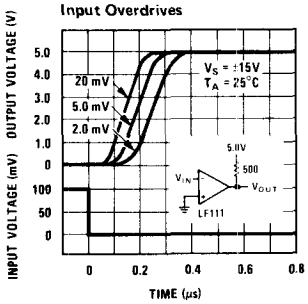
Input Bias Current vs Temperature



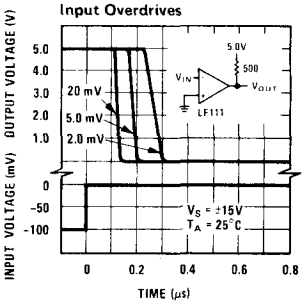
Transfer Function



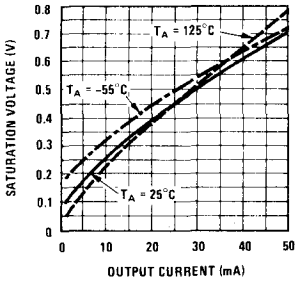
Response Time for Various Input Overdrives



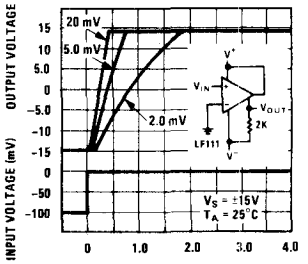
Response Time for Various Input Overdrives



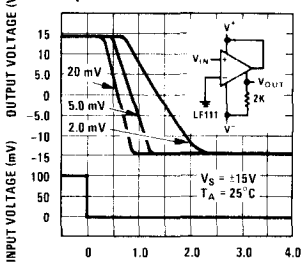
Output Saturation Voltage



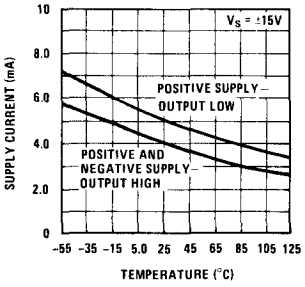
Response Time for Various Input Overdrives



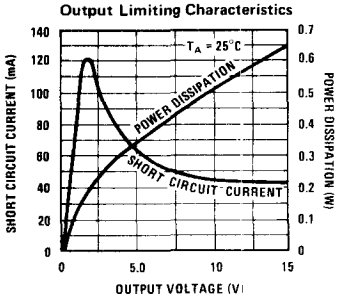
Response Time for Various Input Overdirves



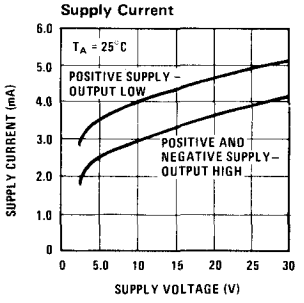
Supply Current



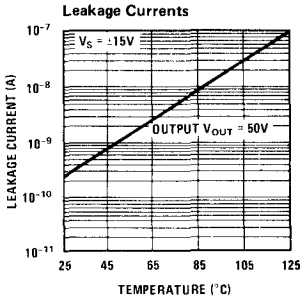
Output Limiting Characteristics



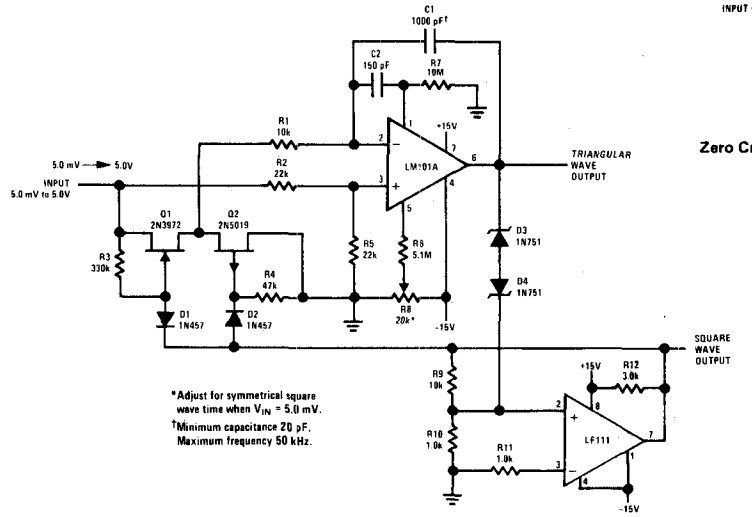
Supply Current



Leakage Currents

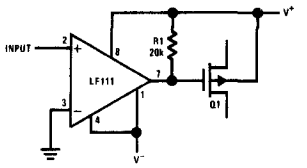


typical applications (con't)

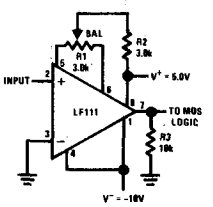


*Adjust for symmetrical square wave time when V_{IN} = 5.0 mV.
†Minimum capacitance 20 pF. Maximum frequency 50 kHz.

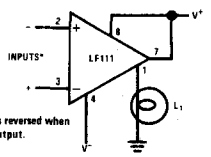
10 Hz to 10 kHz Voltage Controlled Oscillator



Zero Crossing Detector Driving MOS Switch

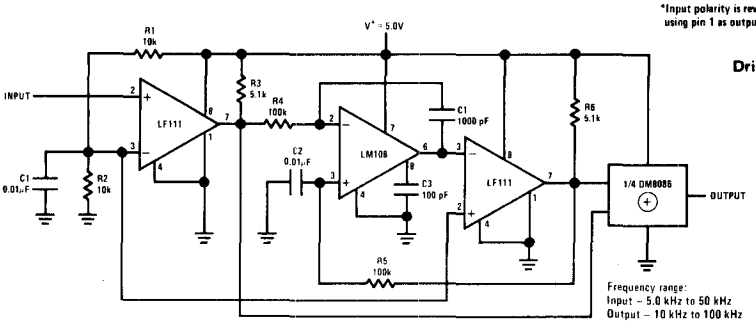


Zero Crossing Detector Driving MOS Logic

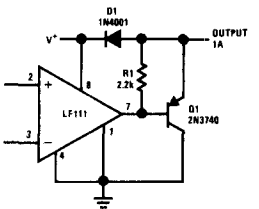


*Input polarity is reversed when using pin 1 as output.

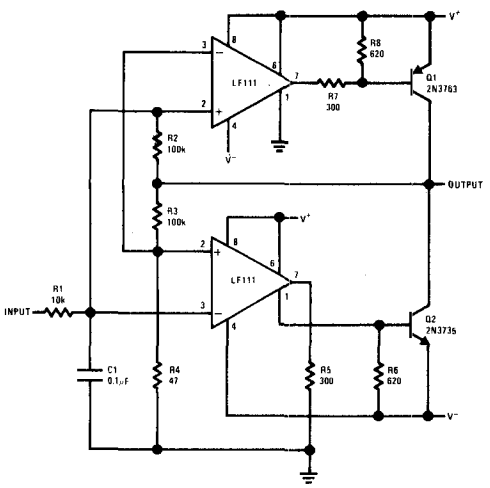
Driving Ground-Referred Load



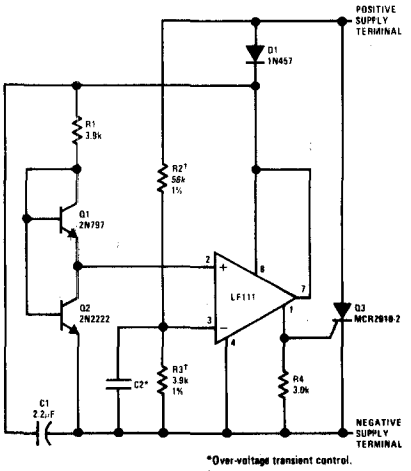
Frequency Doubler



Comparator and Solenoid Driver



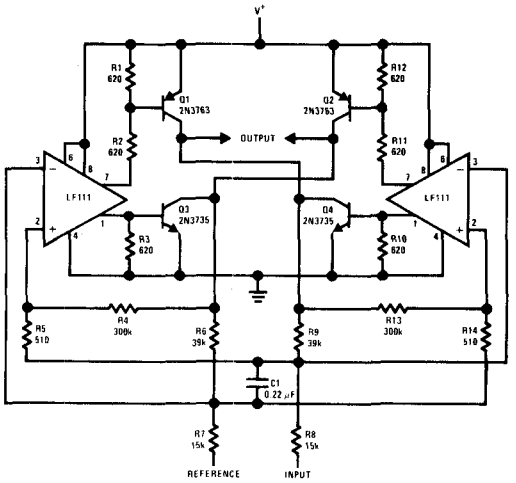
Switching Power Amplifier



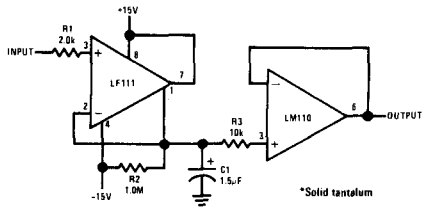
*Over-voltage transient control.
†Determines firing voltage, 5.0V as shown.

Crowbar Over-Voltage Protector

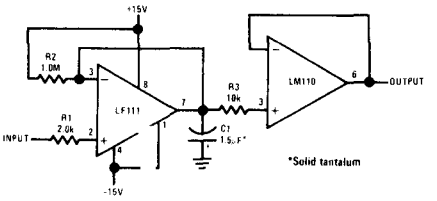
typical applications (con't)



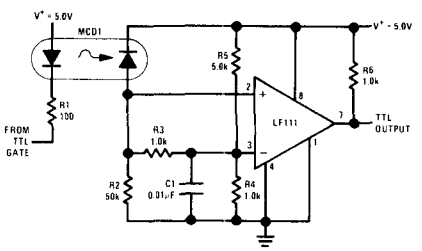
Switching Power Amplifier



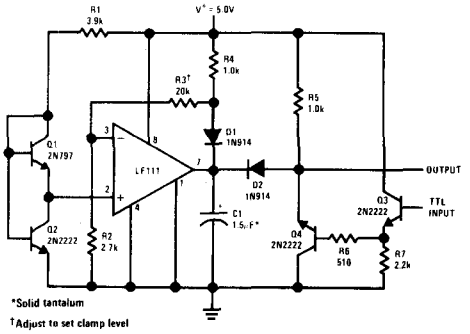
Positive Peak Detector



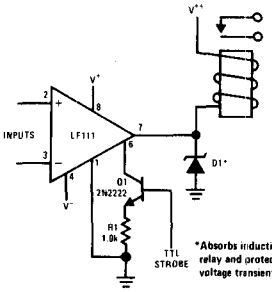
Negative Peak Detector



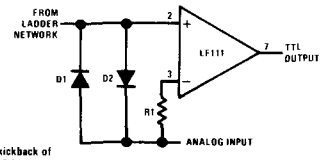
Digital Transmission Isolator



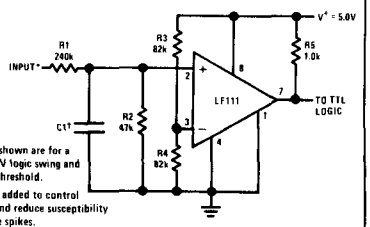
Precision Squarer



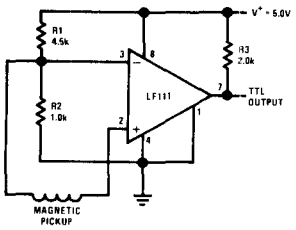
Relay Driver with Strobe



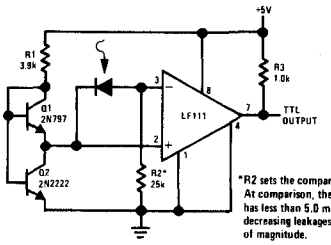
Using Clamp Diodes to Improve Response



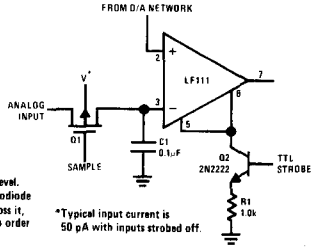
TTL Interface with High Level Logic



Detector for Magnetic Transducer



Precision Photodiode Comaprator



Strobing Off Both Input* and Output Stages