INTERSIL

LM111, LM311
Precision Voltage Comparators

FEATURES

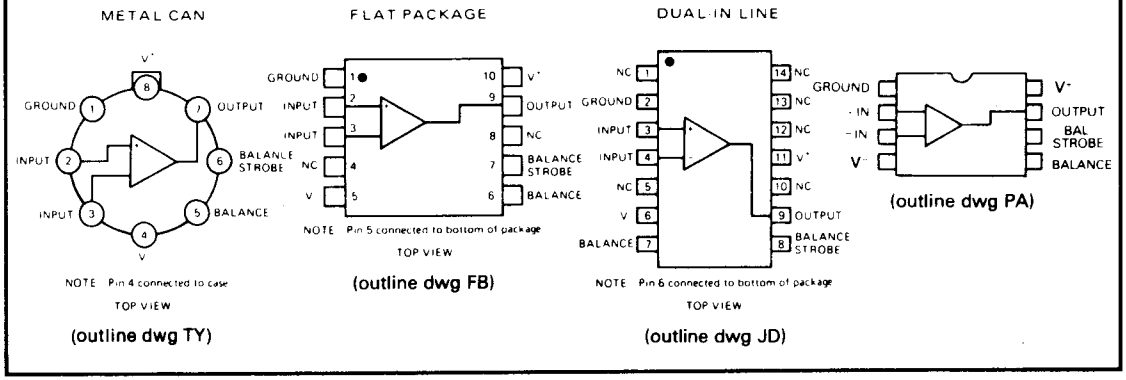
- Differential Input Voltage Range – ±30V
- Input Common Mode Voltage Range – ±14V
- Operating Power Supplies +5V to ±18V
- Input Offset Current – 20 nA max
- Input Offset Voltage – 3 mV max
- Output Flexibility – 35V; 50 mA; T^2L Compatible
- Strobed Output & Input Offset Adjustable

GENERAL DESCRIPTION

The LM111 Series comparators are designed for precision applications where the input and output characteristics of 710 and 106 high speed comparators are not adequate for low level signal detection and high level output drive capability. They are designed to operate from supplies up to ±18V and single supplies down to +5V. The output is capable of driving TTL, RTL, DTL as well as MOS and lamps or relays. Input offset voltage balancing and TTL strobe capability are provided. Outputs can be wire OR'ed.

Switching speeds to TTL logic levels are typically 250 ns.

PIN CONFIGURATIONS



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ORDERING INFORMATION

Part number	TO-99 Can	10 pin Flatpak	14 pin CER DIP	8 pin Plastic DIP	14 pin Plastic DIP	Dice
LM111	LM111H*	LM111F	LM111J*	—	LM311N-14	LM111/D
LM311	LM311H	LM311F	LM311J	LM311N	—	LM311/D

* Add /883B to order number if 883B processing is desired.

ABSOLUTE MAXIMUM RATINGS

Total Supply Voltage		36V
Output to Negative Supply Voltage	LM111,	50V
	LM311	40V
Ground to Negative Supply Voltage		30V
Differential Input Voltage		±30V
Input Voltage (Note 1)		±15V
Power Dissipation (Note 2)		500 mW
Output Short Circuit Duration		10 sec
Operating Temperature Range LM111		-55°C to +125°C
LM311		0°C to +70°C
Storage Temperature Range		-65°C to +150°C
Lead Temperature (Soldering, 10 sec)		300°C

ELECTRICAL CHARACTERISTICS (Note 3)

PARAMETER	CONDITIONS	LM111 MIN	LM111 TYP	LM111 MAX	LM311 MIN	LM311 TYP	LM311 MAX	UNITS
Input Offset Voltage (Note 4)	$T_A = 25°C$, $R_S \leq 50k$		0.7	3.0		2.0	7.5	mV
Input Offset Current (Note 4)	$T_A = 25°C$		4.0	10		6.0	50	nA
Input Bias Current	$T_A = 25°C$		60	100		100	250	nA
Voltage Gain	$T_A = 25°C$		200			200		V/mV
Response Time (Note 5)	$T_A = 25°C$		200			200		ns
Saturation Voltage	$T_A = 25°C$							
	$V_{IN} \leq -5$ mV, $I_{OUT} = 50$ mA		0.75	1.5				
	$V_{IN} < -10$ mV, $I_{OUT} = 50$ mA					0.75	1.5	V
Strobe on Current	$T_A = 25°C$		3.0			3.0		mA
Output Leakage Current	$T_A = 25°C$							
	$V_{IN} \geq 5$ mV, $V_{OUT} = 35V$		0.2	10				
	$V_{IN} \geq 10$ mV, $V_{OUT} = 35V$					0.2	50	nA
Input Offset Voltage (Note 4)	$R_S \leq 50k$			4.0			10	mV
Input Offset Current (Note 4)				20			70	nA
Input Bias Current				150			300	nA
Input Voltage Range			±14			±14		V
Saturation Voltage	$V^+ \geq 4.5V$, $V^- = 0$							
	$V_{IN} \leq -6$ mV, $I_{SINK} \leq 8$ mA		0.23	0.4				
	$V_{IN} \leq -10$ mV, $I_{SINK} \leq 8$ mA					0.23	0.4	V
Output Leakage Current (Note 6)	$V_{IN} \geq 5$ mV, $V_{OUT} = 35V$		0.1	0.5				μA
Positive Supply Current	$T_A = 25°C$		5.1	6.0		5.1	7.5	mA
Negative Supply Current	$T_A = 25°C$		4.1	5.0		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 111 is 150°C, while that of the 311 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 conductor. 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 over the operating temperature range, unless otherwise stated. The offset voltage, offset current and bias current specifications apply for any supply voltage from a single 5V supply up to ±15 supplies.

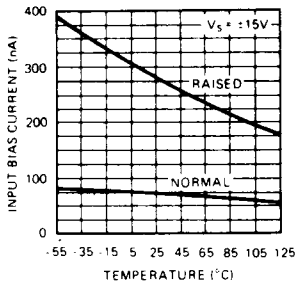
NOTE 4: The offset voltages and offset currents given are the maximum values required to drive the output within a volt of either supply with a 1 mA load. Thus, these parameters define an error band and take into account the worst case effects of voltage gain and input impedance.

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

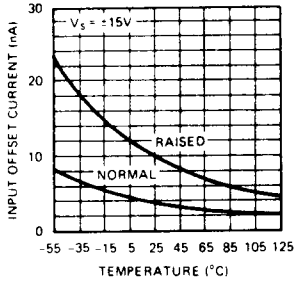
NOTE 6: This specification applies for Pin 1 = -15V, Pin 7 = +20V.

TYPICAL PERFORMANCE

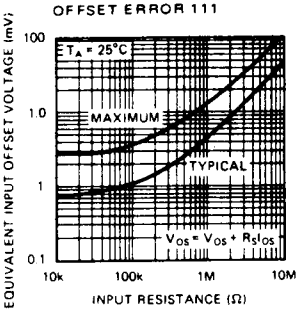
INPUT BIAS CURRENT 111



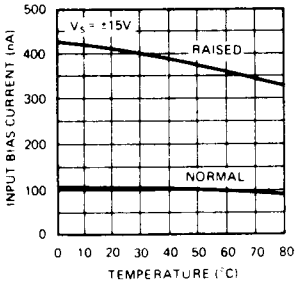
INPUT OFFSET CURRENT 111



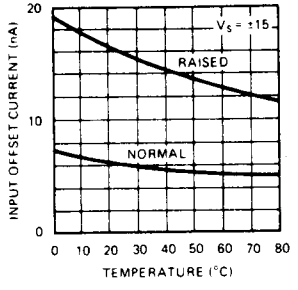
OFFSET ERROR 111



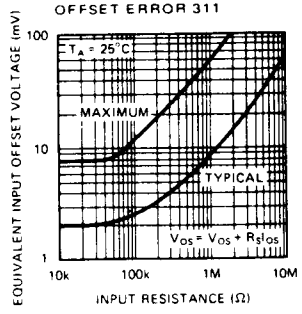
INPUT BIAS CURRENT 311



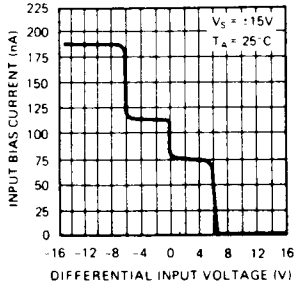
INPUT OFFSET CURRENT 311



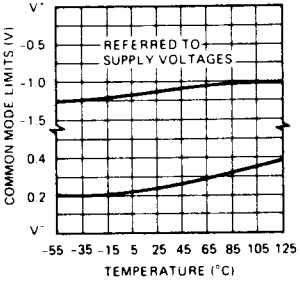
OFFSET ERROR 311



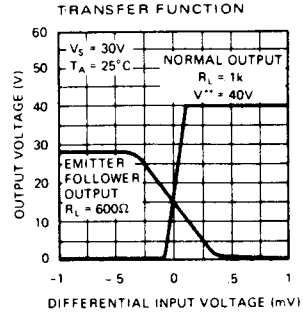
INPUT CHARACTERISTICS



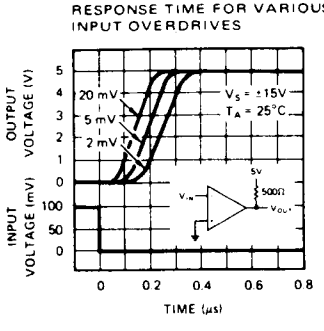
COMMON MODE LIMITS



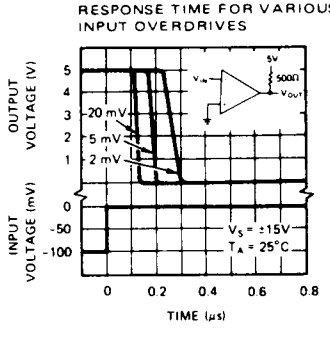
TRANSFER FUNCTION



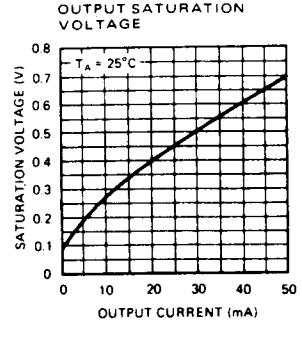
RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



OUTPUT SATURATION VOLTAGE



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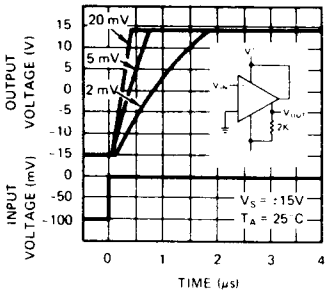
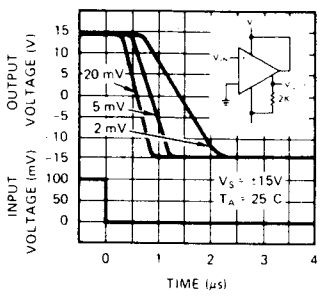
TYPICAL PERFORMANCE (Cont)

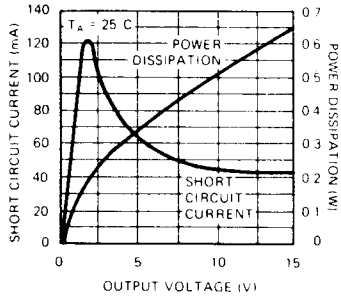
RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



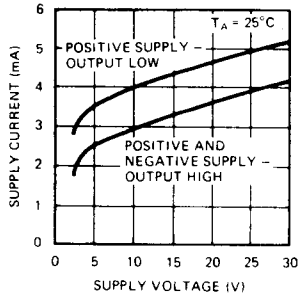
RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



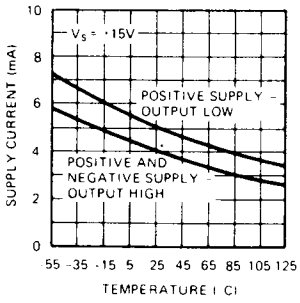
OUTPUT LIMITING CHARACTERISTICS



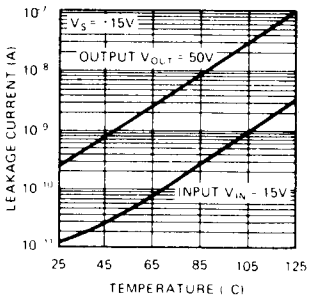
SUPPLY CURRENT



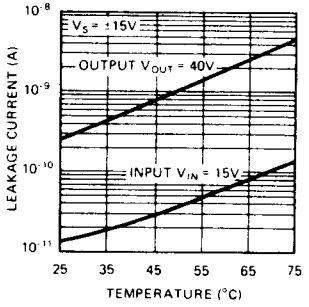
SUPPLY CURRENT



LEAKAGE CURRENTS 111/211



LEAKAGE CURRENTS 311



DEFINITION OF TERMS

INPUT OFFSET VOLTAGE: The voltage between the input terminals required to make the output voltage greater than or less than specified voltages.

INPUT OFFSET CURRENT: The difference between the two input currents for which the output will be driven higher than or lower than specified voltages.

INPUT BIAS CURRENT: The average of the two input currents.

INPUT VOLTAGE RANGE: The range of voltage on the input terminals (common mode) over which the offset specifications apply.

VOLTAGE GAIN: The ratio of the change in output voltage to the change in voltage between the input terminals producing it.

RESPONSE TIME: The interval between the application of an input step function and the time when the output crosses the logic threshold voltage. The input step drives the comparator from some initial, saturated input voltage to an input level just barely in excess of that required to bring the output from saturation to the logic threshold voltage. This excess is referred to as the voltage overdrive.

SATURATION VOLTAGE: The low output voltage level with the input drive equal to or greater than a specified value.

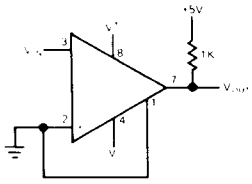
STROBE ON CURRENT: The current that must be drawn out of the strobe terminal to disable the comparator.

OUTPUT LEAKAGE CURRENT: The current into the output terminal with a specified output voltage relative to the ground pin and the input drive equal to or greater than a given value.

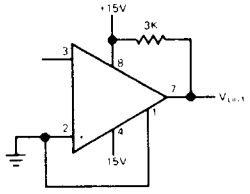
SUPPLY CURRENT: The current required from the positive or negative supply to operate the comparator with no output load. The power will vary with input voltage, but is specified as a maximum for the entire range of input voltage conditions.

TYPICAL APPLICATIONS

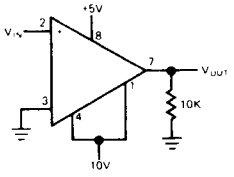
TTL COMPATIBLE OUTPUT SWING



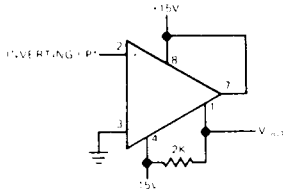
HIGH LEVEL TTL COMPATIBLE OUTPUT SWING



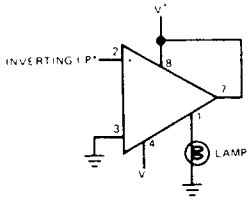
MOS LOGIC COMPATIBLE OUTPUT SWING



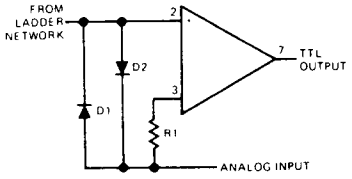
OBTAINING ±15 VOLT OUTPUT SWING



DRIVING GROUND REFERRED LOAD

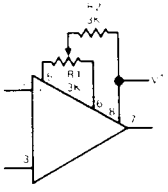


USING CLAMP DIODES TO IMPROVE RESPONSE

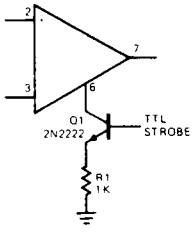


*INPUT POLARITY REVERSED WHEN USING PIN 1 AS OUTPUT

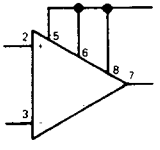
OFFSET BALANCING



STROBING



INCREASING INPUT STAGE SLEW RATE*



*INCREASES TYPICAL COMMON MODE SLEW FROM 7.0V/μs TO 18V/μs