LM111/211/311

Precision Voltage Comparator

Distinctive Characteristics

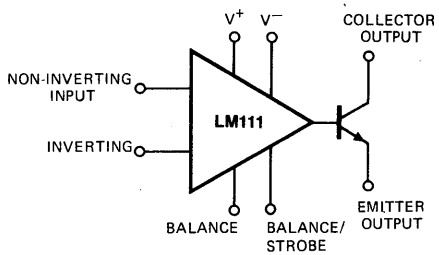
The AMD LM111/211/311 are functionally, electrically, and pin-for-pin equivalent to the National LM 111/211/311

- Output Drive – 50V and 50mA
- Input Bias Current – 150nA max.
- Input Offset Voltage – 4mV max.
- Differential Input Voltage Range – ±30V

FUNCTIONAL DESCRIPTION

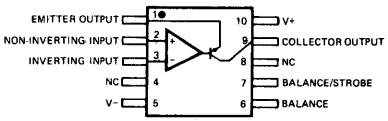
The LM111/211/311 are voltage comparators featuring low input currents, high differential and common mode voltage ranges, wide supply voltage range, and outputs compatible with all bipolar and MOS circuitry. The inputs and outputs can be isolated from system ground, and the output can drive loads refered to ground or either supply. Strobing and offset balancing are available and the outputs can be wire ORed.

FUNCTIONAL DIAGRAM



LIC-081

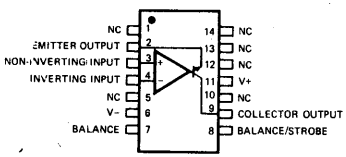
CONNECTION DIAGRAM – Top View
Ceramic Flat Package
F-10-1



Pin 5 is connected to bottom of package. LIC-083

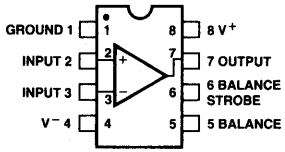
CONNECTION DIAGRAMS – Top Views

Hermetic DIP
D-14-1

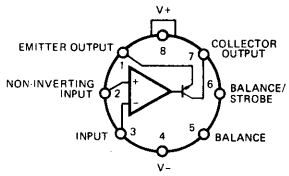


Pin 6 is connected to bottom of package.

Mini-DIP
P-8-1



Metal Can
H-8-1



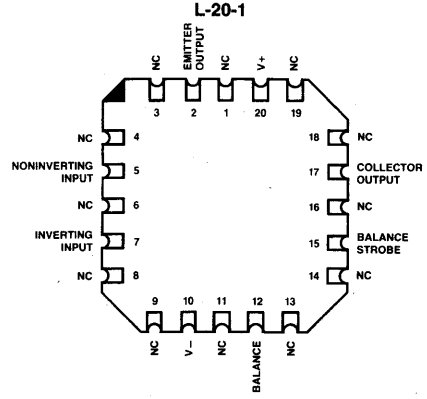
Pin 4 is connected to case. LIC-084

ORDERING INFORMATION*

Part Number	Package Type	Temperature Range	Order Number
LM311	TO-99	0 to +70°C	LM311H
	Hermetic DIP	0 to +70°C	LM311D
	Mini-DIP	0 to +70°C	LM311N
	Dice	0 to +70°C	LD311
	Leadless	0 to +70°C	LM311L
LM211	TO-99	−25 to +85°C	LM211H
	Hermetic DIP	−25 to +85°C	LM211D
	Leadless	−25 to +85°C	LM211L
	Ceramic Flat Package	−25 to +85°C	LM211F
LM111	TO-99	−55 to +125°C	LM111H
	Hermetic DIP	−55 to +125°C	LM111D
	Flat Pak	−55 to +125°C	LM111F
	Dice	−55 to +125°C	LD111
	Leadless	−55 to +125°C	LM111L
	Ceramic Flat Package	−55 to +125°C	LM111F

*Also available with burn-in processing. To order add suffix B to part number.

CONNECTION DIAGRAM – Top View
Leadless Chip-Pak
L-20-1



03934B-ANA

LM111/211/311
MAXIMUM RATINGS

Voltage from V^+ to V^-	36V
Voltage from Collector Output to V^-	
LM111/211	50V
LM311	40V
Voltage from Emitter Output to V^-	30V
Voltage between Inputs	±30V
Voltage from Inputs to V^-	+30V, −0V
Voltage from Inputs to V^+	−30V
Power Dissipation (Note 1)	500mW
Output Short Circuit Duration	10 se
Operating Temperature Range	
LM111	−55°C to +125°C
LM211	−25°C to +85°C
LM311	0°C to +70°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (soldering, 10 sec)	300°C

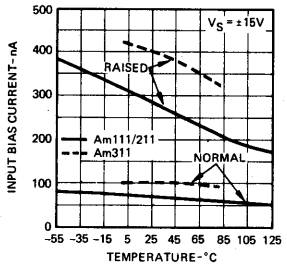
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise specified) (Note 2)

Parameters (see definitions)	Test Conditions	LM311 Min.	LM311 Typ.	LM311 Max.	LM111 LM211 Min.	LM111 LM211 Typ.	LM111 LM211 Max.	Units
Input Offset Voltage (Note 3)			2.0	7.5		0.7	3.0	mV
Input Offset Current (Note 3)			6.0	50.0		4.0	10.0	nA
Input Bias Current (Note 3)			100	250		60	100	nA
Response Time (Note 4)	R_L = 500 Ω to +5 V, V_E = 0		200			200		ns
Supply Current								
Positive			3.9	7.5		3.9	6.0	mA
Negative			2.6	5.0		2.6	5.0	mA
Voltage Gain			200			200		V/mV
Saturation Voltage	$V_{IN} \leq -5$ mV, I_C = 50 mA					0.75	1.5	Volts
	$V_{IN} \leq -10$ mV, I_C = 50 mA		0.75	1.5				Volts
Output Leakage Current	$V_{IN} \geq +5$ mV, V_C to V_E = 50 V					0.2	10.0	nA
	$V_{IN} \geq +10$ mV, V_C to V_E = 40 V		0.2	50.0				nA
The Following Specifications Apply Over The Operating Temperature Ranges								
Input Offset Voltage (Note 3)				10.0			4.0	mV
Input Offset Current (Note 3)				70.0			20.0	nA
Input Bias Current (Note 3)				300			150	nA
Saturation Voltage	$V_{IN} \leq -6$ mV, I_C = 8 mA					0.23	0.40	Volts
	$V_{IN} \leq -10$ mV, I_C = 8 mA		0.23	0.40				Volts
Output Leakage Current	$V_{IN} \geq +6$ mV, V_C to V_E = 50 V					0.1	0.5	μA
Input Voltage Range		±13	±14		±13	±14		Volts
Supply Current								
Positive (Note 5)	T_A = 125°C					5.1	6.0	mA
Negative (Note 5)						4.1	5.0	mA

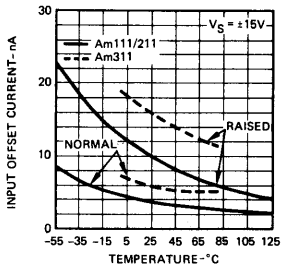
Notes:
1. For the LM111/211/311, derate Metal Can package at 6.8mW/°C for operation at ambient temperatures above 75°C, the Dual In-Line at 9mW/°C fo operation at ambient temperatures above 95°C, the Flat Packages at 5.4mW/°C for operation at ambient temperatures above 57°C, and the Mini-DIP a 6.6mW/°C above 36°.
2. Unless otherwise specified, these specifications apply for V^+ = +15V, V^- = −15V, V_E = −15V, and R_L at collector output = 7.5kΩ to +15V.
3. The offset voltage, offset current and bias current given are the maximum values required to drive the collector output to within 1V of the supplies wi a 7.5kΩ load. These parameters define an error band and take into account the worst case effects of voltage gain and input impedance.
4. The response time specified (see definitions) is for a 100mV input step with 5mV overdrive.

PERFORMANCE CURVES

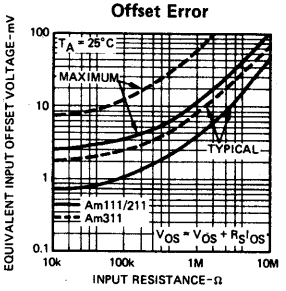
Input Bias Current



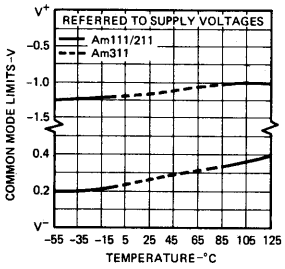
Input Offset Current



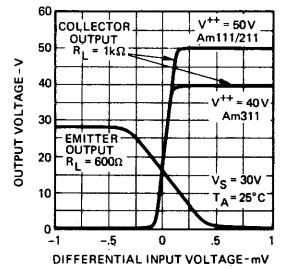
Offset Error



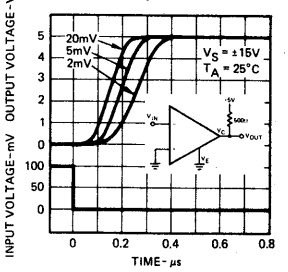
Common-Mode Limits



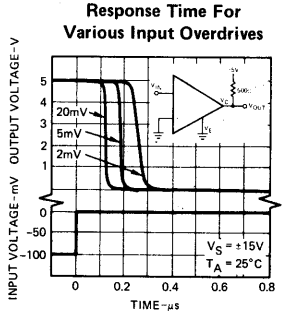
Transfer Function



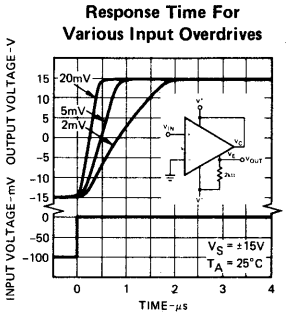
Response Time For Various Input Overdrives



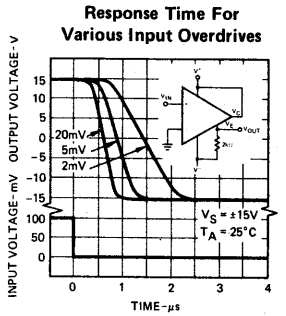
Response Time For Various Input Overdrives



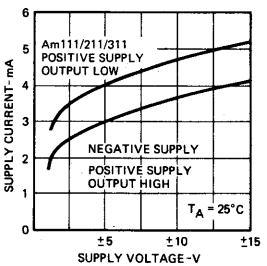
Response Time For Various Input Overdrives



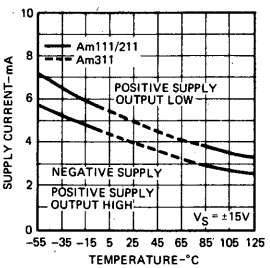
Response Time For Various Input Overdrives



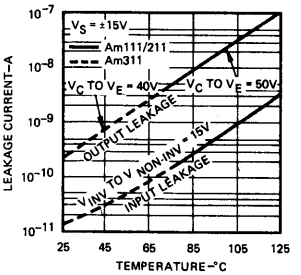
Supply Current



Supply Current



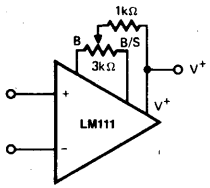
Leakage Current



LIC-085

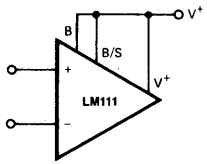
APPLICATIONS

Offset Balancing



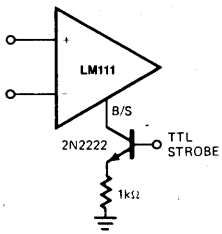
LIC-086

Increasing Input Stage Current*



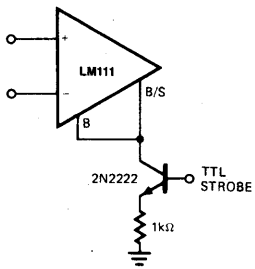
LIC-087

Strobing



LIC-088

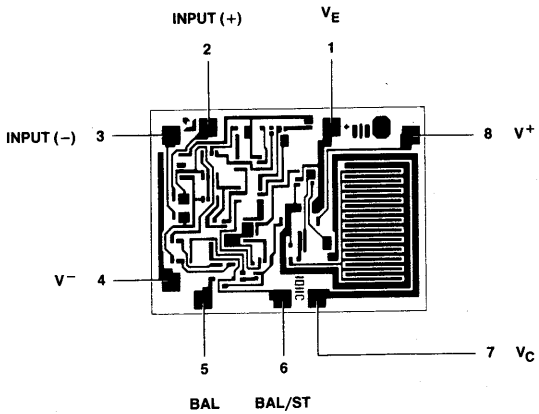
Strobing OFF both Input and Output Stages**



LIC-089

*Increases input bias current and common mode slew rate by a factor of 3.
**Typical input current = 50pA with inputs strobed OFF.

METALLIZATION AND PAD LAYOUT



DIE SIZE: 0.048" X 0.065"

LM119/219/319

Dual Comparator

Distinctive Characteristics

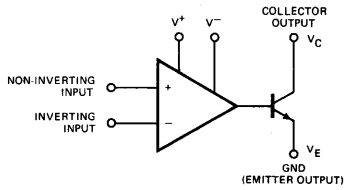
- The AMD LM119/219/319 are functionally, electrically, and pin-for-pin equivalent to the National LM119/219/319.
- Two independent comparators.
- Operates from single 5V supply.
- Output drive – 35V and 25mA.
- Input bias current – 1μA max. (1.2μA for Am319)
- Response time 80ns typical at ±15V.
- Minimum fan out of 2 each side.
- Inputs and outputs isolated from system ground.
- High common mode slew rate.

FUNCTIONAL DESCRIPTION

The LM 119/219/319 are dual high-speed voltage comparators designed to operate over a wide range of voltage supplies down to a single 5V supply and ground. They have higher gain and lower input bias currents than devices such as the μA710. The uncommitted collector of the output stage facilitates RTL, DTL and TTL interfacing, and driving lamps and relays at currents up to 25mA. The device is specified for operation from power supplies up to ±15V and features faster response than the LM111 at the expense of higher power dissipation.

The LM119 performance is specified over the temperature range −55 to 125°C, the LM219 performance is specified over the temperature range −25 to 85°C and the Am319 performance is specified over the temperature range 0 to 70°C.

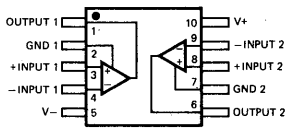
FUNCTIONAL DIAGRAM (One Comparator)



LIC-091

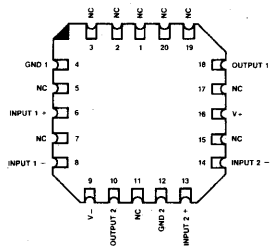
CONNECTION DIAGRAMS – Top Views

Flat Package F-10-1

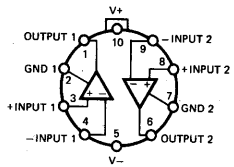


LIC-090 Pin 5 connected to bottom of package.

Leadless Chip-Pak L-20-1



Metal Can H-10-1



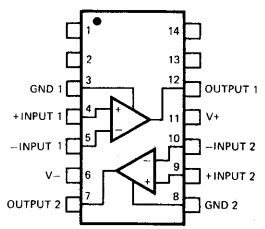
Pin 5 connected to case. LIC-092

ORDERING INFORMATION*

Part Number	Package Type	Temperature Range	Order Number
LM319	TO-99	0 to +70°C	LM319H
	Hermetic DIP	0 to +70°C	LM319D
	Molded DIP	0 to +70°C	LM319N
	Dice	0 to +70°C	LD319
	Leadless	0 to +70°C	LM319L
LM219	TO-99	−25 to +85°C	LM219H
	Hermetic DIP	−25 to +85°C	LM219D
	Flat Pak	−25 to +85°C	LM219F
	Leadless	−25 to +85°C	LM219L
LM119	TO-99	−55 to +125°C	LM119H
	Hermetic DIP	−55 to +125°C	LM119D
	Flat Pak	−55 to +125°C	LM119F
	Dice	−55 to +125°C	LD119
	Leadless	−55 to +125°C	LM119L

*Also available with burn-in processing. To order add suffix B

CONNECTION DIAGRAM Top View Hermetic and Molded Dual In-Line D-14-1, P-14-1



Pin 6 connected to bottom of package. LIC-093

LM119/219/319
MAXIMUM RATINGS (Above which the useful life may be impaired)

Voltage from V^+ to V^-	36V
Voltage from Collector Output to V^-	36V
Voltage from Ground to V^+	18V
Voltage from Ground to V^-	25V
Differential Input Voltage	±5.0V
Input Voltage (Note 1)	±15V
Power Dissipation (Note 2)	500mW
Output Short Circuit Duration	10s
Operating Temperature Range	
LM119	−55°C to +125°C
LM219	−25°C to +85°C
LM319	0°C to +70°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (soldering, 10 sec)	300°C

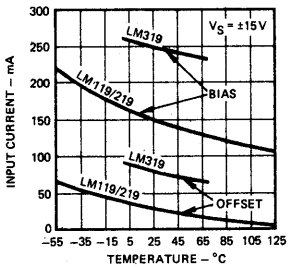
ELECTRICAL CHARACTERISTICS (T_A = 25°C, Unless Otherwise Noted) (Note 3)

Parameters (See definitions)		Conditions	LM319 Min.	LM319 Typ.	LM319 Max.	LM119/219 Min.	LM119/219 Typ.	LM119/219 Max.	Units
Input Offset Voltage (Note 4)		$R_S \leq 5k$		2.0	8.0		0.7	4.0	mV
Input Offset Current (Note 4)				80	200		30	75	nA
Input Bias Current				250	1000		150	500	nA
Response Time (Note 5)				80			80		ns
Supply Current	Positive	$V^+ = 5.0V, V^- = 0$		4.3			4.3		mA
	Positive	$V_S = \pm 15V$		8.0	12.5		8.0	11.5	mA
	Negative	$V_S = \pm 15V$		3.0	5.0		3.0	4.5	mA
Voltage Gain			8.0	40		10	40		V/mV
Saturation Voltage		$V_{in} \leq -5.0mV, I_C = 25mA$					0.75	1.5	Volts
		$V_{in} \leq -10mV, I_C = 25mA$		0.75	1.5				Volts
Output Leakage Current		$V_{in} \geq +5.0mV, V_C$ to $V_E = 35V$					0.2	2.0	μA
		$V_{in} \geq +10mV, V_C$ to $V_E = 35V$		0.2	10				μA
The Following Specifications Apply Over The Operating Temperature Ranges									
Input Offset Voltage (Note 4)		$R_S \leq 5k$			10			7.0	mV
Input Offset Current (Note 4)					300			100	nA
Input Bias Current					1200			1000	nA
Saturation Voltage		$V_{in} \leq -8.0mV, I_C = 3.2mA$, $T_A \geq 0°C$					0.23	0.4	Volts
		$V_{in} \leq -8.0mV, I_C = 3.2mA$, $T_A \leq 0°C$						0.6	Volts
		$V_{in} \leq -12mV, I_C = 3.2mA$		0.3	0.4				Volts
Output Leakage Current		$V_{in} \geq +8.0mV, V_C$ to $V_E = 35V$					1.0	10	μA
Input Voltage Range		$V_S = \pm 15V$		±13			±13		Volts
		$V^+ = 5.0V, V^- = 0$	1.0		3.0	1.0		3.0	Volts

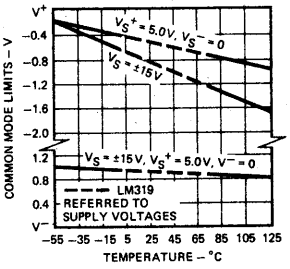
Notes:
1. For supply voltages less than ± 15V the absolute maximum rating is equal to the supply voltage.
2. Derate Metal Can package at 6.8mW/°C for operation at ambient temperatures above 75°C, the Dual-In-Line at 9mW/°C for operation at temperatures above 95°C, and the Flat Package at 5.4mW/°C for operation at temperatures above 57°C.
3. The offset voltage, offset current and bias current specifications apply for any supply voltage from a single 5V supply up to ± 15V supplies.
4. The offset voltages and offset currents given are the maximum values required to drive the output within 1 volt of either supply with a 1mA load. Thus, these parameters define an error band and take into account the worst case effects of voltage gain and input impedance.
5. The response time specified is for a 100mV input step with 5mV overdrive.

TYPICAL PERFORMANCE CURVES

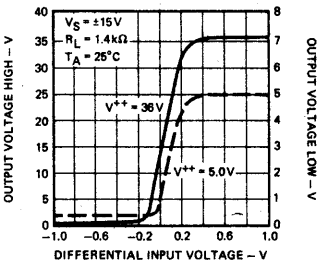
Input Currents



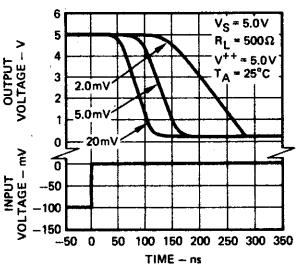
Common Mode Limits



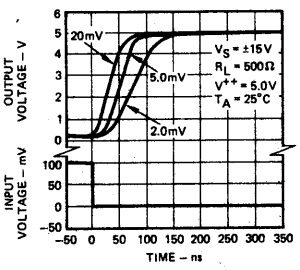
Transfer Function



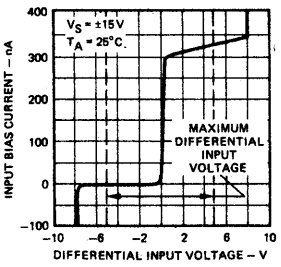
Response Time for Various Input Overdrives



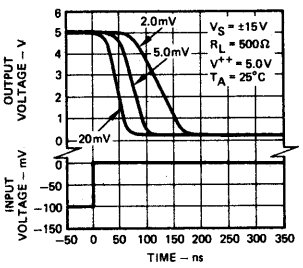
Response Time for Various Input Overdrives



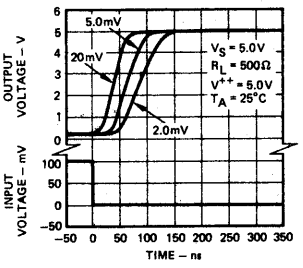
Input Characteristics



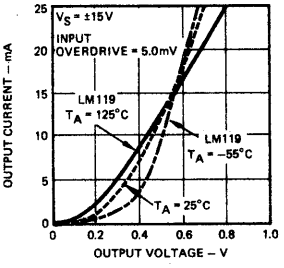
Response Time for Various Input Overdrives



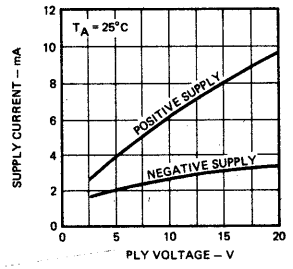
Response Time for Various Input Overdrives



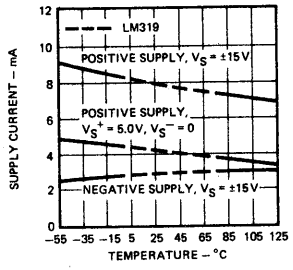
Output Saturation Voltage



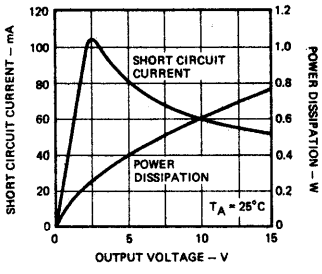
Supply Current



Supply Current



Output Limiting Characteristics

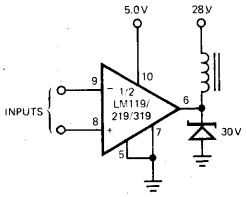


LIC-094

6

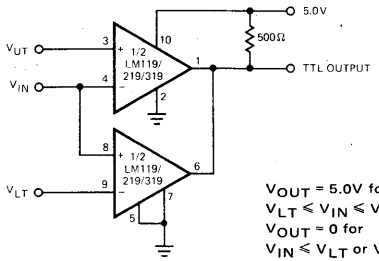
APPLICATIONS

Relay Driver



LIC-095

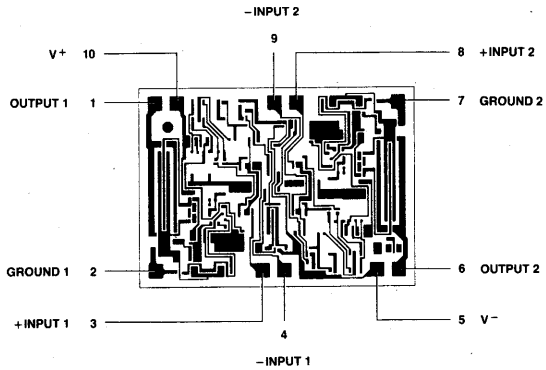
Window Detector



V_{OUT} = 5.0V for
$V_{LT} \leq V_{IN} \leq V_{UT}$
V_{OUT} = 0 for
$V_{IN} \leq V_{LT}$ or $V_{IN} \geq V_{UT}$

LIC-096

Metallization and Pad Layout



DIE SIZE: 0.078" X 0.057"