GENERAL PURPOSE LOW VOLTAGE COMPARATOR

Description

The LMV331/LMV393 series are low-voltage, (2.7V to 5.5V) single and dual comparators, which are designed to effectively reduce cost and space at low-voltage levels.

These devices offer specifications that meet or exceed the familiar LM331/LM393 devices operating with a lower supply voltage and consuming a far lower supply current.

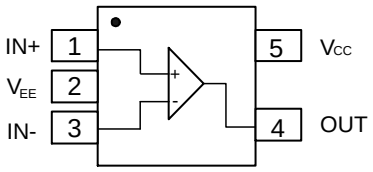
The LMV331 is available in 5-Pin SOT353/SOT25 packages that reduce space on PC boards and portable electronic devices. LMV393 is available in industry standard SOP-8 and MSOP-8 packages.

Features

- Guaranteed 2.7V and 5.5V performance
- Operating temperature range (-40°C to +125°C)
- Low supply current 40 µA/comparator Typ
- Input Common Mode Voltage Range includes ground
- Open Collector Output for Maximums Flexibility
- SOT353, SOT25, MSOP-8, SO-8: Available in “Green” Molding Compound (No Br, Sb)
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. “Green” Device (Note 3)**

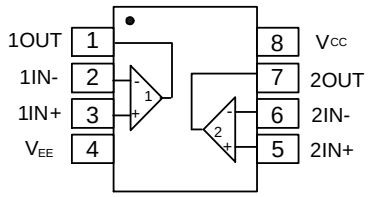
Pin Assignments

(Top View)



SOT25/SOT353

(Top View)



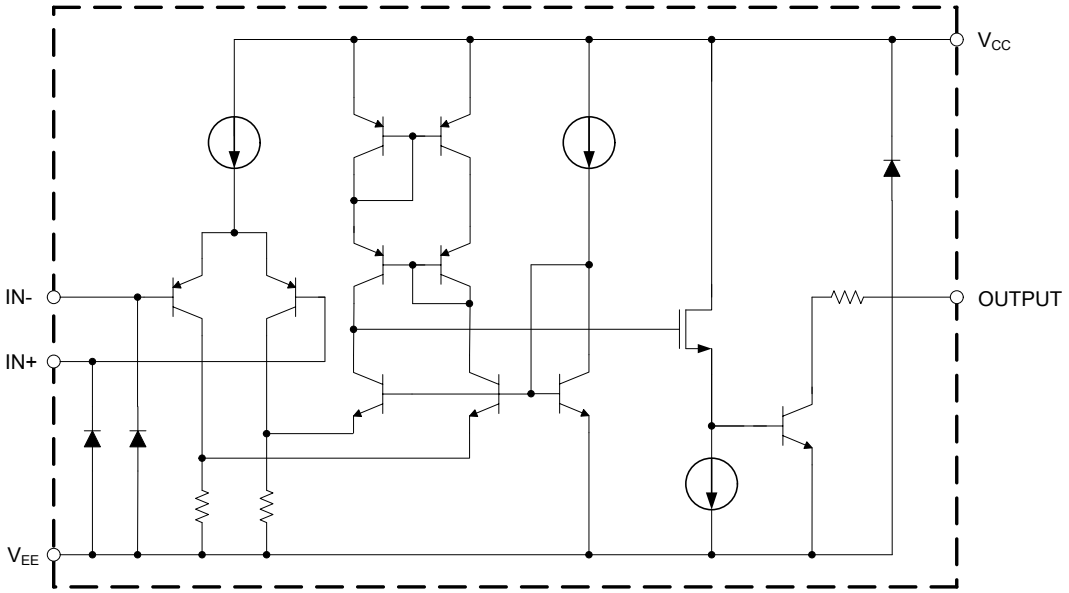
SO-8/MSOP-8

Applications

- Mobile Communications
- Battery Powered Devices
- Notebooks and PDA’s
- General Purpose Low-Voltage Applications
- General Purpose Portable Devices

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated’s definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green” products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Schematic Diagram



Each Comparator

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Pin Descriptions

LMV331		
Pin Name	**Pin #**	**Function**
IN+	1	Non-Inverting Input
V_{EE}	2	Chip Supply Voltage(Negative)/GND
IN-	3	Inverting Input
OUT	4	Output
V_{CC}	5	Chip Supply Voltage(Positive)
LMV393		
1OUT	1	Channel 1 Output
1IN-	2	Channel 1 Inverting Input
1IN+	3	Channel 1 Non-inverting Input
V_{EE}	4	Chip Supply Voltage(Negative)/GND
2IN+	5	Channel 2 Non-inverting Input
2IN-	6	Channel 2 Inverting Input
2OUT	7	Channel 2 Output
V_{CC}	8	Chip Supply Voltage(Positive)

Absolute Maximum Ratings (Note 4) (@T_A = +25°C, unless otherwise specified.)

Symbol	Description		Rating	Unit
ESD HBM	Human Body Model ESD Protection		6.0	KV
ESD MM	Machine Model ESD Protection		200	V
V_{ID}	Differential Input Voltage		±Supply Voltage	V
V_{CC} -V_{EE}	Supply Voltage		5.5	V
θ_{JA}	Thermal Resistance Junction-to-Ambient	SOT353 (Note 5)	371	°C/W
		SOT25 (Note 5)	204	
		SO-8 (Note 5)	120	
		MSOP-8 (Note 5)	180	
T_{ST}	Storage Temperature		-65 to +150	°C
T_J	Maximum Junction Temperature		+150	°C

Notes: 4. Stresses greater than the 'Absolute Maximum Ratings' specified above, may cause permanent damage to the device. These are stress ratings only; functional operation of the device at these or any other conditions exceeding those indicated in this specification is not implied. Device reliability may be effected by exposure to absolute maximum rating conditions for extended periods of time.
5. All numbers are typical, and apply for packages soldered directly onto a PC board in still air.

Recommended Operating Conditions (@T_A = +25°C, unless otherwise specified.)

Symbol	Description	Rating	Unit
V_{CC} -V_{EE}	Supply Voltage	2.7 to 5.5	V
T_A	Operating Ambient Temperature Range	-40 to +125	°C

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Electrical Characteristics (Notes 6 & 7) (@T_A = +25°C, V_{EE} = 0V, V_{CM} = 0V and R_L = 5.1KΩ, unless otherwise specified.)

Symbol	Parameter		Test Conditions	Min	Typ	Max	Unit
2.7V DC Electrical Characteristics							
V_{OS}	Input Offset Voltage		-	-	1.7	7	mV
TCV_{OS}	Input Offset Voltage Average Drift		T_A = full range	-	5	-	µV/°C
I_B	Input Bias Current		-	-	10	250	nA
			T_A = full range	-	-	400	
I_{OS}	Input Offset Current		-	-	5	50	nA
			T_A = full range	-	-	150	
V_{CM}	Common-Mode Input Voltage Range		-	-0.1	-	+2.0	V
V_{SAT}	Saturation Voltage		I_{SINK} ≤ 1mA	-	120	-	mV
I_O	Output Sink Current		V_O≤ 1.5V	5	23	-	mA
I_{OL}	Output Leakage Current		-	-	0.003	-	µA
			T_A = full range	-	-	1	
I_S	Supply Current	LMV331	-	-	40	100	µA
		LMV393 (Both Comparators)	-	-	70	150	uA
2.7V AC Electrical Characteristics							
t_{PHL}	Propagation delay high to low		Input overdrive= 10mV	-	1,000	-	ns
			Input overdrive= 100mV	-	350	-	ns
t_{PLH}	Propagation delay low to high		Input overdrive= 10mV	-	500	-	ns
			Input overdrive= 100mV	-	400	-	ns
5V DC Electrical Characteristics							
V_{OS}	Input Offset Voltage		-	-	1.7	7	mV
			T_A = full range	-	-	9	
TCV_{OS}	Input Offset Voltage Average Drift		T_A = full range	-	5	-	µV/°C
I_B	Input Bias Current		-	-	25	250	nA
			T_A = full range	-	-	400	
I_{OS}	Input Offset Current		-	-	2	50	nA
			T_A = full range	-	-	150	
V_{CM}	Common-Mode Input Voltage Range		-	-0.1	-	4.2	V
A_V	Large Signal Differential Voltage Gain		-	20	50	-	V/mV
V_{SAT}	Saturation Voltage		I_{SINK} ≤ 4mA	-	200	400	mV
			I_{SINK} ≤ 4mA, T_A = full range	-	-	700	
I_O	Output Sink Current		V_O≤ 1.5V	10	84	-	mA
I_{OL}	Output Leakage Current		-	-	0.003	-	µA
			T_A = full range	-	-	1	
I_S	Supply Current	LMV331	-	-	60	120	µA
			T_A = full range	-	-	150	
		LMV393 (Both Comparators)	-	-	100	200	uA
			T_A=full range	-	-	250	
5VAC Electrical Characteristics							
t_{PHL}	Propagation delay high to low		Input overdrive = 10mV	-	600	-	ns
			Input overdrive = 100mV	-	200	-	ns
t_{PLH}	Propagation delay low to high		Input overdrive = 10mV	-	450	-	ns
			Input overdrive = 100mV	-	300	-	ns

Notes: 6. Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration. The typical values are not tested and are not guaranteed on shipped production material.
7. All limits are guaranteed by testing or statistical analysis.

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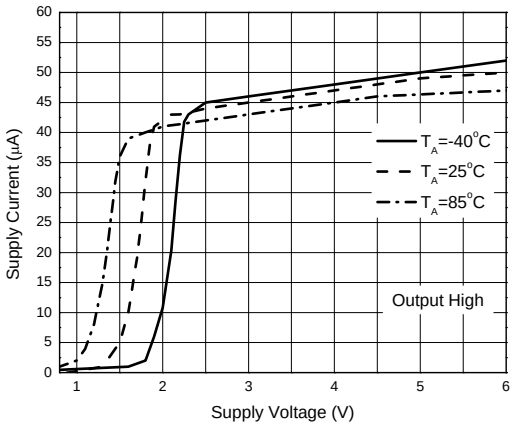
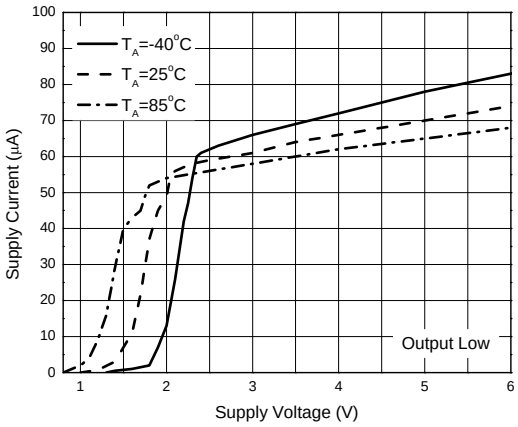
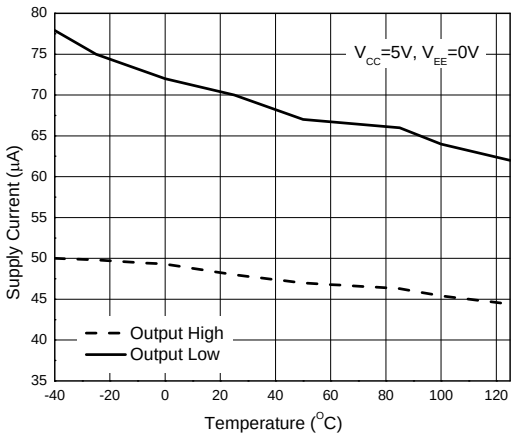
Typical Performance Characteristics (@T_A = +25°C, unless otherwise specified.)



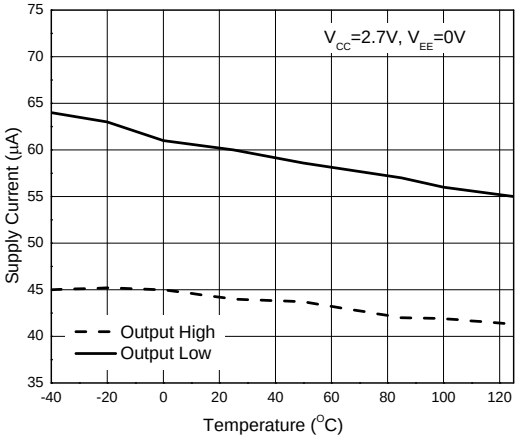
Supply Current vs. Supply Voltage (LMV331)



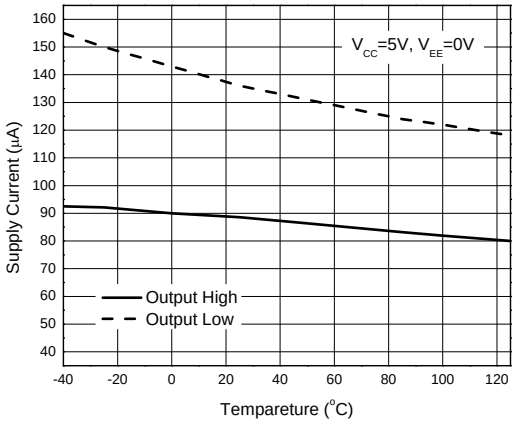
Supply Current vs. Supply Voltage (LMV331)



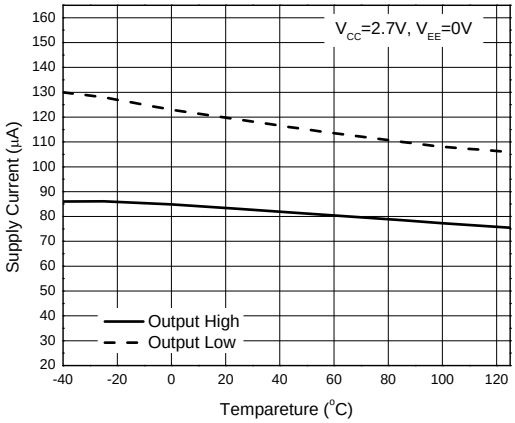
Supply Current vs. Temperature (LMV331)



Supply Current vs. Temperature (LMV331)



Supply Current vs. Temperature (LMV393)



Supply Current vs. Temperature (LMV393)

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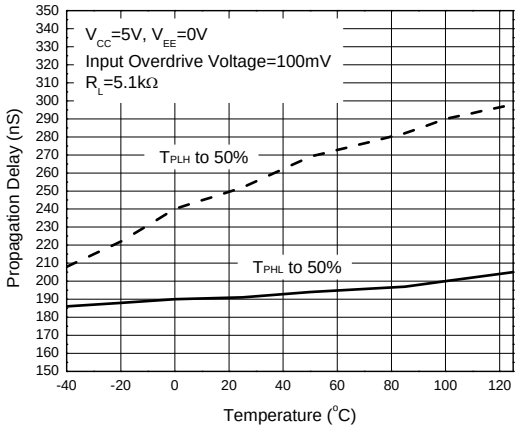
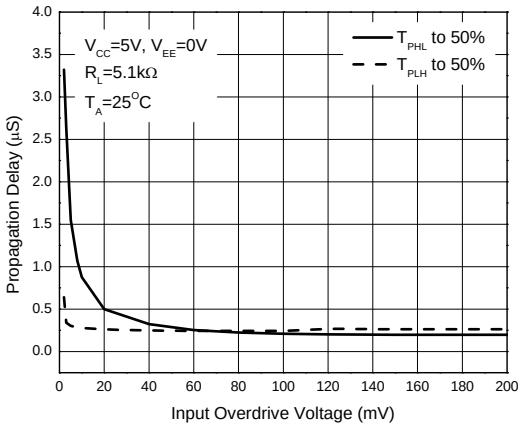
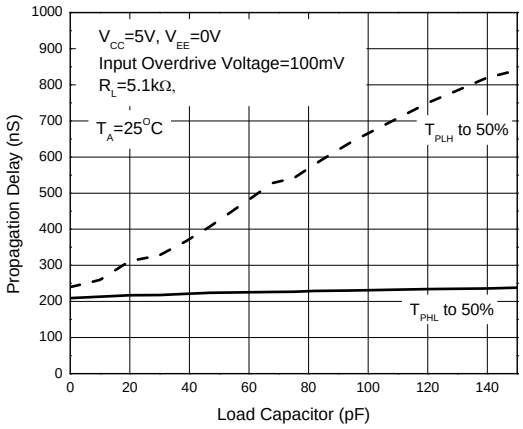
Typical Performance Characteristics (continued) (@ T_A = +25°C, unless otherwise specified.)



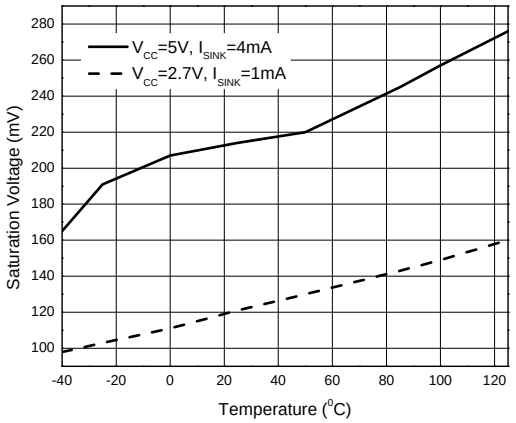
Propagation Delay vs. Temperature



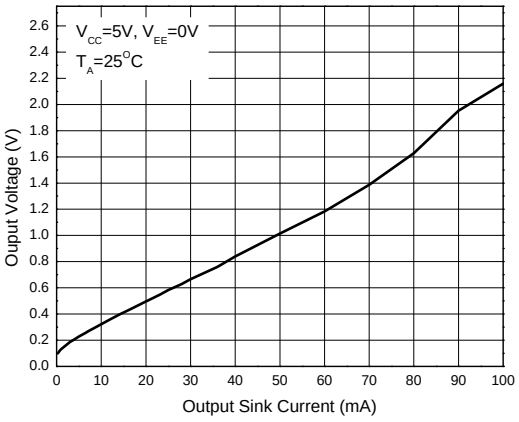
Propagation Delay vs. Input Overdrive Voltage



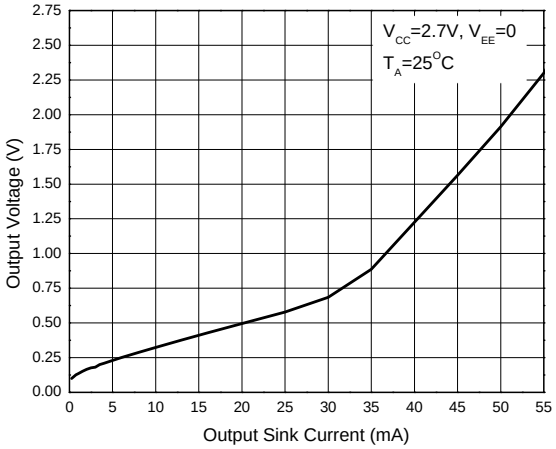
Propagation Delay vs. Load Capacitors



Saturation Voltage vs. Temperature



Output Voltage vs. Output Sink Current



Output Voltage vs. Output Sink Current

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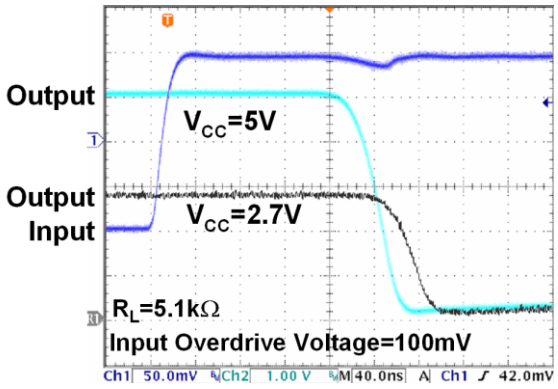
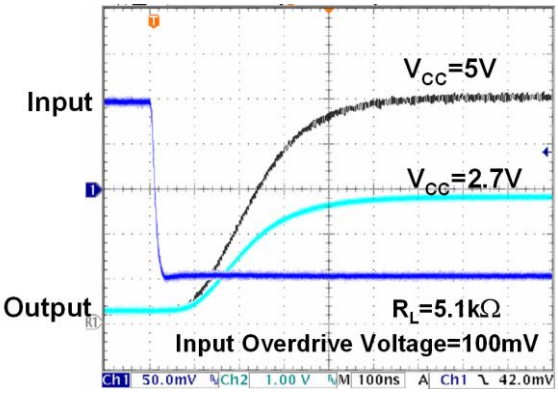
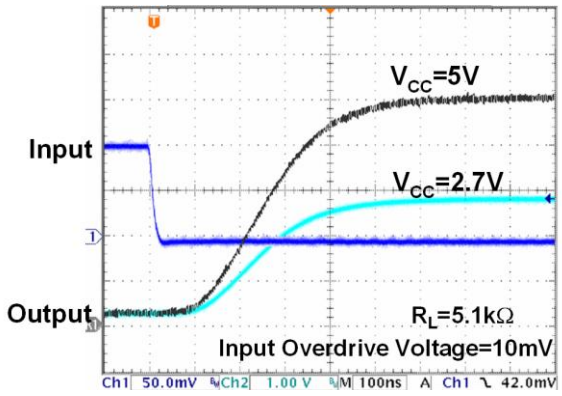
Typical Performance Characteristics (cont.) (@ T_A = +25°C, unless otherwise specified.)



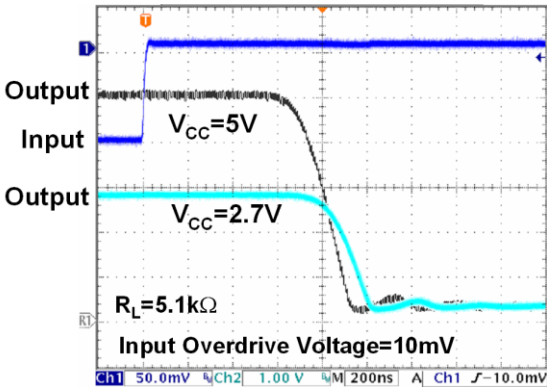
Response Time for Positive Transition



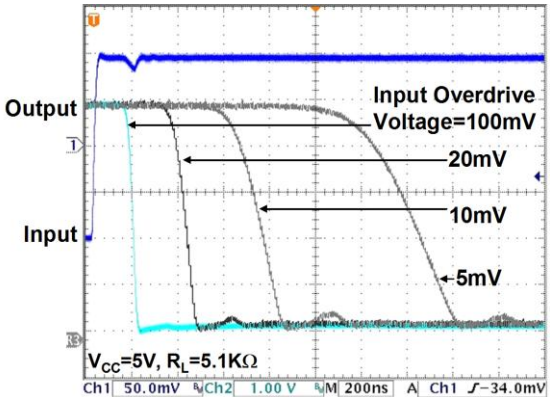
Response Time for Negative Transition



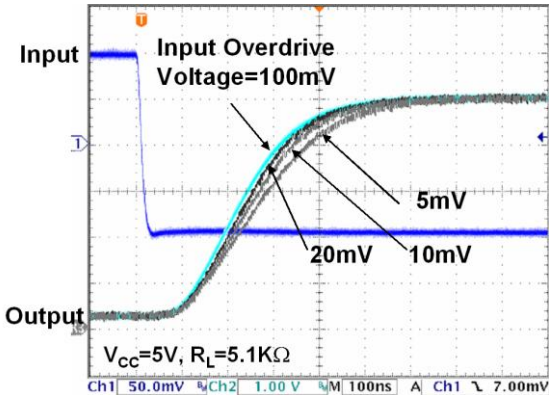
Response Time for Negative Transition



Response Time for Positive Transition



Response Time for Positive Transition



Response Time for Negative Transition

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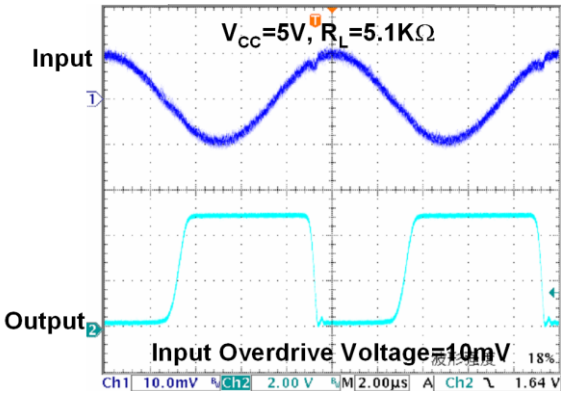
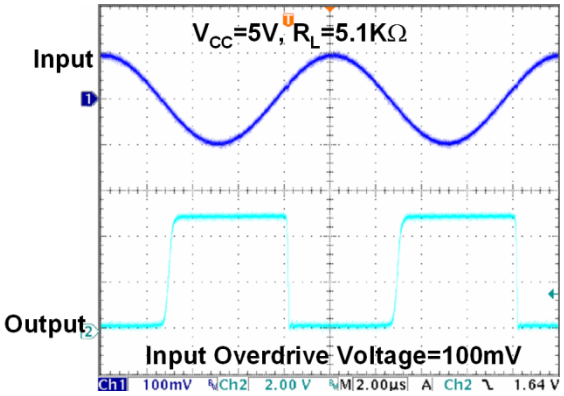
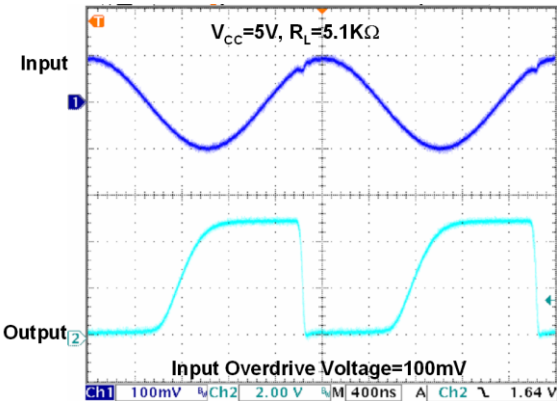
Typical Performance Characteristics (cont.) (@ T_A = +25°C, unless otherwise specified.)



100kHz Response



100kHz Response



500kHz Response

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Application Information

Detailed Description

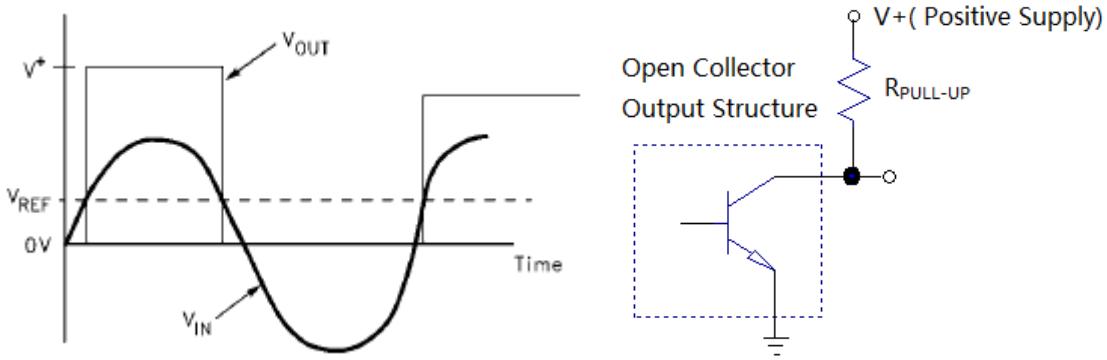
LMV331/LMV393 are low-voltage single/dual general- purpose comparators. They have a single supply operating voltage range from 2.7V to 5.5V; the common mode input voltage range extends from -0.1V below the negative supply to within 0.8V of the positive supply.

The LMV331/393 series is built using the BiCMOS process with bipolar input and output stages for improved noise performance. It is a cost-effective solution for portable consumer products where space, low voltage, low power and price are the primary specification in circuit design.

Basic Comparator

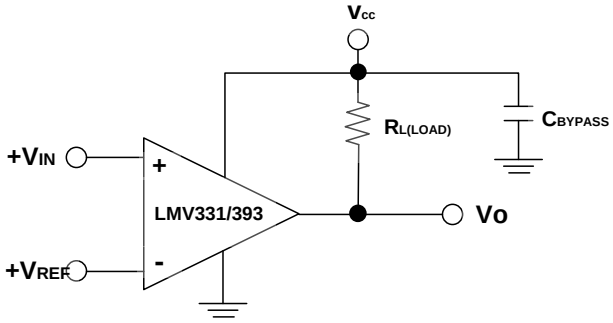
A basic comparator circuit is used for converting analog signal to digital output. The LMV331/393 has open-collector output structure, which required a pull-high resistor to positive supply voltage for the output to switch properly. When the internal output transistor is off, the output voltage will be pulled up to the external positive voltage.

The output pull- up resistor should be chosen high enough so as to avoid excessive power dissipation, yet low enough to supply enough drive to switch whatever load circuitry is used on the comparator output. On the LMV331/393 the pull-up resistor should range between 1KΩ to 10KΩ.



Power Supply Bypassing

For better performance, power supply bypass capacitor is necessary. For a single-supply operation system, a minimum of 0.1μF bypass capacitor should be recommended to place as close as possible between V_{CC} pin and GND.



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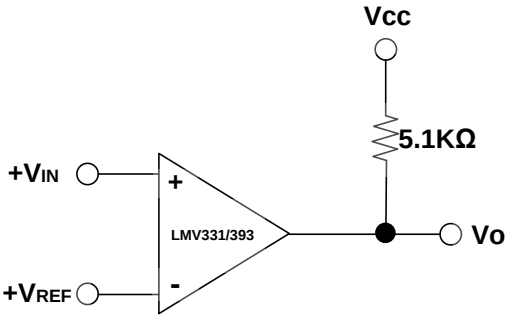
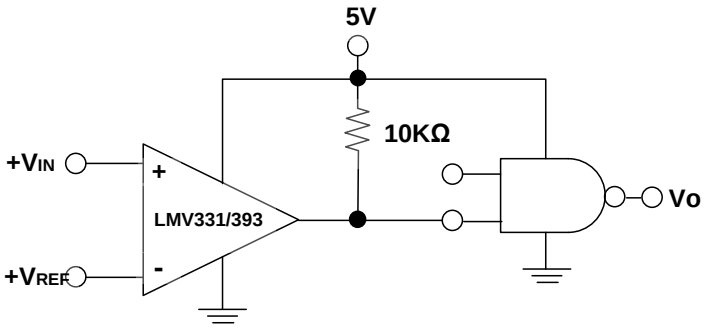
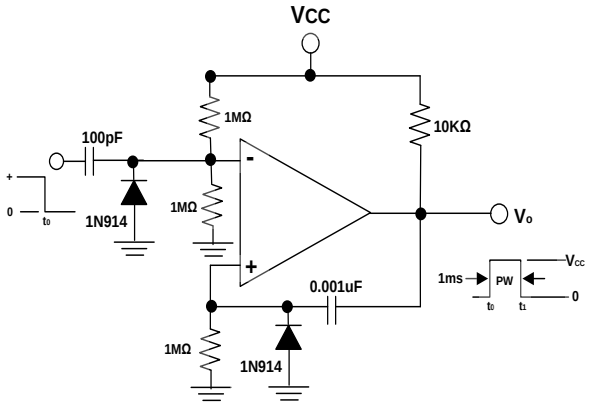
Typical Application Circuit



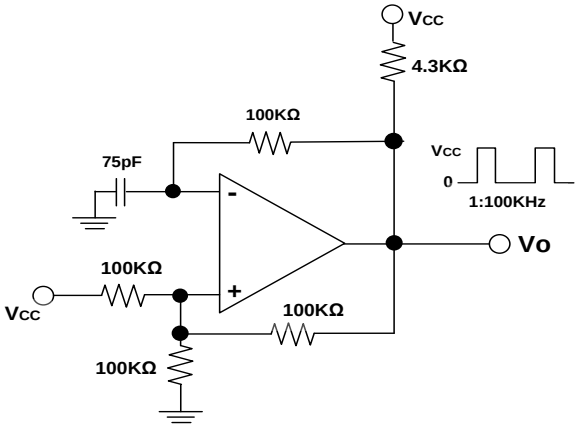
Basic Comparator



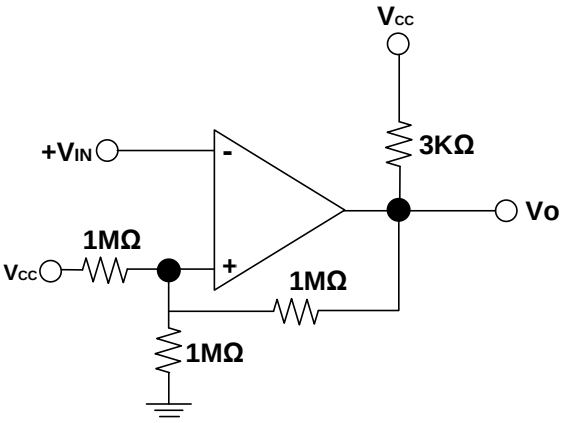
Driving CMOS/TTL



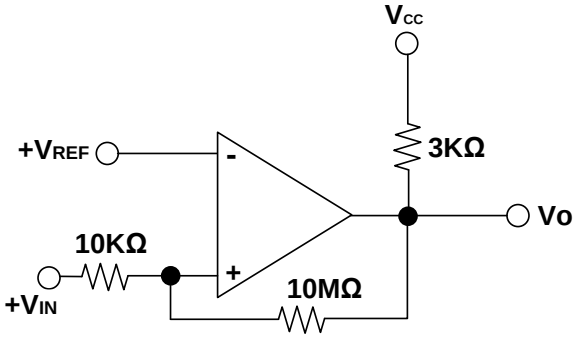
One-Shot Multivibrator



Squarewave Oscillator



Inverting Comparator with Hysteresis



Non-Inverting Comparator with Hysteresis

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Ordering Information

LMV3 XX XX - X

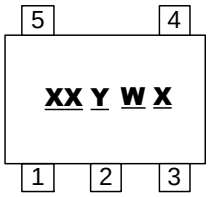
Channel	Package	Packing
Single : 31 Dual : 93	W5 : SOT25 SE : SOT353 S : SO-8 M8 : MSOP-8	7/13 : Tape & Reel

Part Number	Package Code	Packaging	7"/13" Tape and Reel	
			Quantity	Part Number Suffix
LMV331W5-7	W5	SOT25	3,000/Tape & Reel	-7
LMV331SE-7	SE	SOT353	3,000/Tape & Reel	-7
LMV393S-13	S	SO-8	2,500/Tape & Reel	-13
LMV393M8-13	M8	MSOP-8	2,500/Tape & Reel	-13

Marking Information

(1) SOT25 and SOT353

(Top View)

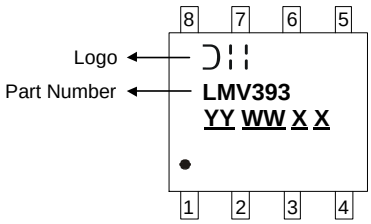


XX : Identification Code
Y : Year : 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week;
z represents 52 and 53 week
X : Internal Code

Device	Package type	Identification Code
LMV331W5	SOT25	CX
LMV331SE	SOT353	CY

(2) SO-8

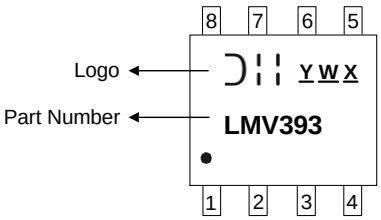
(Top View)



YY : Year : 08, 09,10~
WW : Week : 01~52; 52
represents 52 and 53 week
X X : Internal Code

(3) MSOP-8

(Top View)



Y : Year : 0~9
W : Week : A~Z :1~26 week;
a~z : 27~52 week;
z represents 52 and 53 week
X : Internal Code

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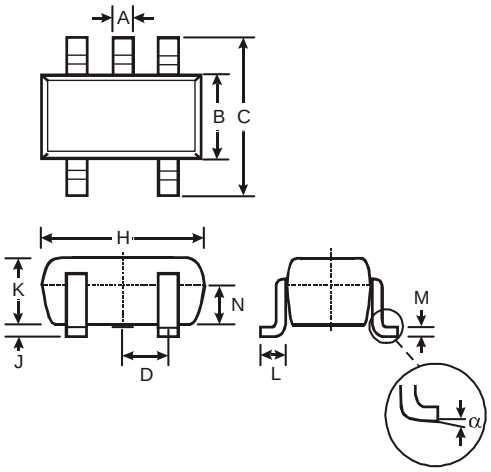
Package Outline Dimensions (All dimensions in mm.)

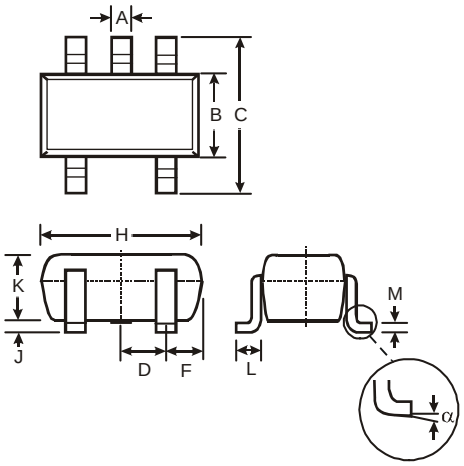
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for the latest version.

(1) Package Type: SOT25



SOT25			
Dim	**Min**	**Max**	**Typ**
A	0.35	0.50	0.38
B	1.50	1.70	1.60
C	2.70	3.00	2.80
D	—	—	0.95
H	2.90	3.10	3.00
J	0.013	0.10	0.05
K	1.00	1.30	1.10
L	0.35	0.55	0.40
M	0.10	0.20	0.15
N	0.70	0.80	0.75
α	0°	8°	—
All Dimensions in mm			

(2) Package Type: SOT353



SOT353			
Dim	**Min**	**Max**	**Typ**
A	0.10	0.30	0.25
B	1.15	1.35	1.30
C	2.00	2.20	2.10
D	0.65 Typ		
F	0.40	0.45	0.425
H	1.80	2.20	2.15
J	0	0.10	0.05
K	0.90	1.00	1.00
L	0.25	0.40	0.30
M	0.10	0.22	0.11
α	0°	8°	-
All Dimensions in mm			

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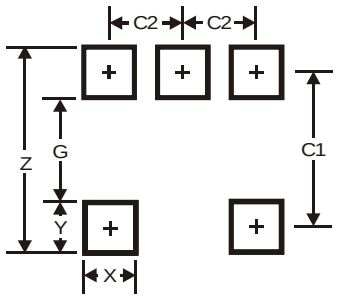
Suggested Pad Layout

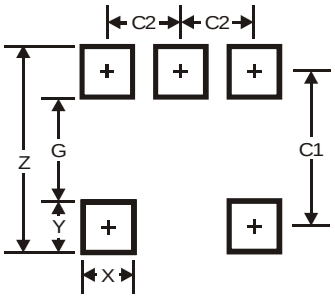
Please see AP02001 at http://www.diodes.com/datasheets/ap02001.pdf for the latest version.

(1) Package Type: SOT25



Dimensions	Value (in mm)
Z	3.20
G	1.60
X	0.55
Y	0.80
C1	2.40
C2	0.95

(2) Package Type: SOT353



Dimensions	Value (in mm)
Z	2.5
G	1.3
X	0.42
Y	0.6
C1	1.9
C2	0.65

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