



Dual Voltage Comparator

Description

The LM393 is a dual voltage comparator circuit consisting of two independent pre-voltage comparators. With an offset voltage specification as low as 3mV, it is mainly used in consumer products.

The LM393 can operate on a single power supply or dual power supplies, and its operating current is independent of the power supply voltage. It also features a unique characteristic: the input common-mode voltage range extends to ground level with a single power supply.

The LM393 is available in SOP-8 and DIP-8 package types.

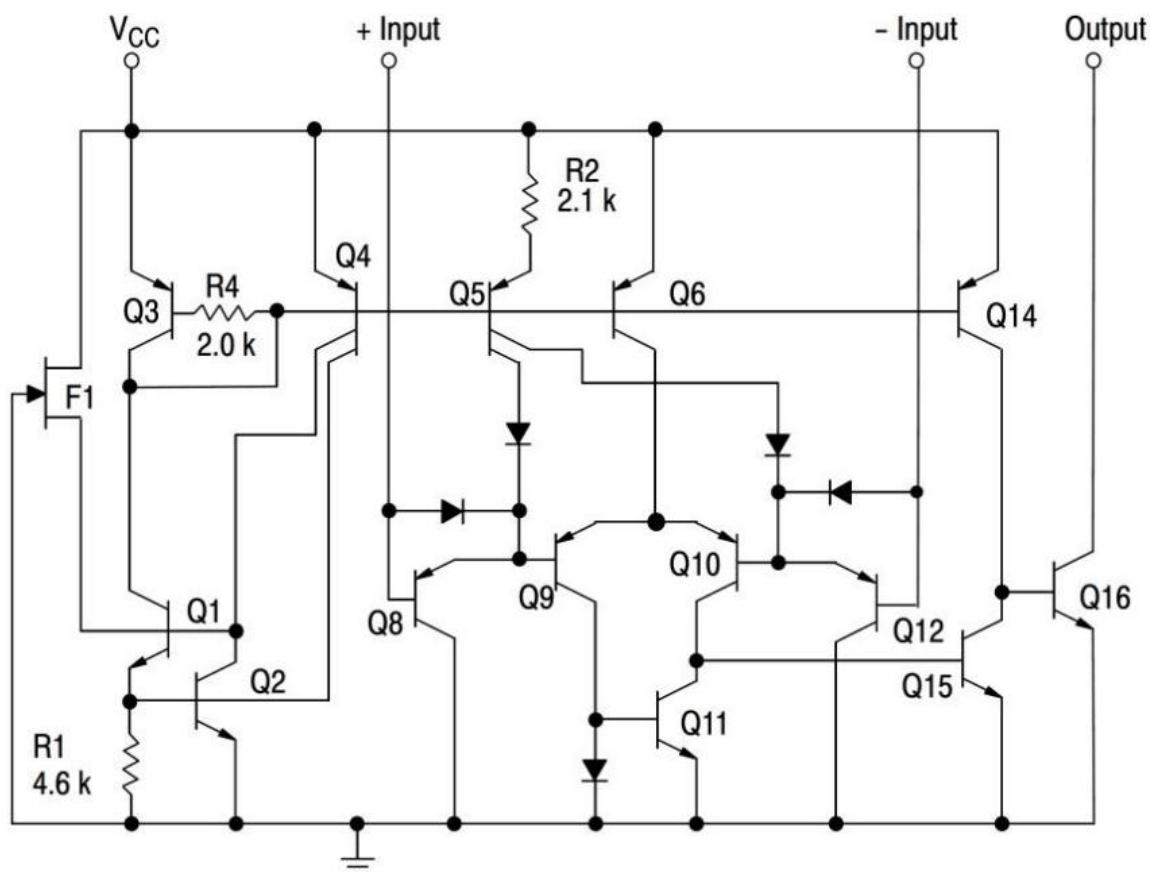
Features

- Wide Operating Power Supply Voltage Range:
Single Power Supply: 3V~36V
Dual Power Supplies: $\pm 1.5\text{V} \sim \pm 18\text{V}$
- Low Input Bias Current: 25nA(Typ.)
- Low Input Offset Current: $\pm 5\text{nA}$ (Typ.)
- Output Compatible with TTL, MOS, and CMOS

Applications

- Power Supply Monitoring
- Peak Detectors
- Logic Voltage Conversion

Function Block Diagram(One Channel Only)





LM393

Ordering Information

Type	Marking	Package
LM393-H8	LM393	DIP-8
LM393-P8	LM393	SOP-8

Pin Description

Pin Number	Pin Name	I/O	Description	Pin Configuration Diagram
1	1OUT	O	Output of the 1st comparator	
2	1IN-	I	Inverting input of the 1st comparator	
3	1IN+	I	Non-inverting input of the 1st comparator	
4	GND	P	Ground	
5	2IN+	I	Non-inverting input of the 2nd comparator	
6	2IN-	I	Inverting input of the 2nd comparator	
7	2OUT	O	Output of the 2nd comparator	
8	V _{CC}	P	Power supply	

Absolute Maximum Ratings (T_A=25°C unless otherwise noted)

Parameter	Symbol	Value	Unit
Supply Voltage	V _{CC}	36 or ± 18	V
Input Differential Voltage	V _{ID}	36	V
Input Common-Mode Voltage	V _{ICR}	-0.3~(V _{CC} -1.5)	V
Output Short-Circuit Current to Ground	I _{SC}	20	mA
Maximum Operating Junction Temperature	T _J	150	°C
Storage Temperature	T _S	-65~+150	°C
Lead Temperature(Soldering, 10s)	T _W	260	°C

Note: Exceeding these absolute maximum ratings may result in permanent damage to the device.



LM393

Recommended Operating Conditions($T_A=25^{\circ}\text{C}$ unless otherwise noted)

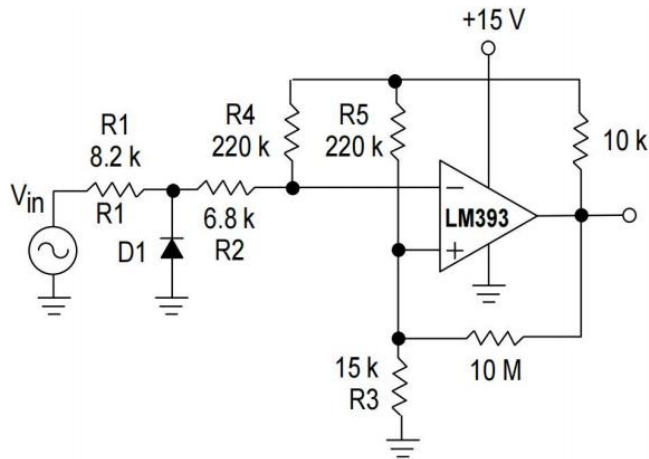
Parameter	Symbol	Min	Max	Unit
Supply Voltage	V_{CC}	3	32 or ± 16	V
Operating Temperature	T_A	-20	+85	$^{\circ}\text{C}$

Electrical Characteristics($T_A=25^{\circ}\text{C}$, $V_{CC}=5\text{V}$, unless otherwise noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Input Offset Voltage	V_{IO}	$T_A=25^{\circ}\text{C}$	-	± 1	± 5	mV
		$T_{\text{low}} \leq T_A \leq T_{\text{high}}$	-	-	± 7	
Input Offset Current	I_{IO}	$T_A=25^{\circ}\text{C}$	-	± 5	± 50	nA
		$T_{\text{low}} \leq T_A \leq T_{\text{high}}$	-	-	± 150	
Input Bias Current	I_{IB}	$T_A=25^{\circ}\text{C}$	-	25	250	nA
		$T_{\text{low}} \leq T_A \leq T_{\text{high}}$	-	-	400	
Input Common-Mode Voltage Range	V_{ICR}	$T_A=25^{\circ}\text{C}$	0	-	$V_{CC}-1.5$	V
		$T_{\text{low}} \leq T_A \leq T_{\text{high}}$	0	-	$V_{CC}-2.0$	
Power Supply Current	I_{CC}	$R_L=\infty, V_{CC}=5\text{V}$	-	0.4	1.0	mA
		$R_L=\infty, V_{CC}=30\text{V}$	-	0.45	2.5	
Voltage Gain	G_V	$R_L \geq 15\text{k}\Omega, V_{CC}=15\text{V}$	50	200	-	V/mV
Large-Signal Response Time	t_{RES}	$V_{IN}=\text{TTL Logic Swing}, V_{REF}=1.4\text{V}, V_{RL}=5\text{V}, R_L=5.1\text{k}\Omega$	-	300	-	ns
Response Time	t_{TLH}	$V_{RL}=5\text{V}, R_L=5.1\text{k}\Omega$	-	1.3	-	μs
Input Differential Voltage	V_{ID}		-0.3	-	V_{CC}	V
Output Sink Current	I_{SINK}	$I_N \geq 1.0\text{V}, I_{N+}=0\text{V}, V_O \leq 1.5\text{V}$	6	16	-	mA
Output Saturation Voltage	V_{SAT}	$I_N \geq 1.0\text{V}, I_{N+}=0\text{V}, I_{SINK} \leq 4.0\text{mA}$	-	150	400	mV
		$I_N \geq 1.0\text{V}, I_{N+}=0\text{V}, I_{SINK} \leq 4.0\text{mA}, T_{\text{low}} \leq T_A \leq T_{\text{high}}$	-	-	700	
Output Leakage Current	I_{OL}	$I_{N+} \geq 1.0\text{V}, I_N=0\text{V}, V_O=5\text{V}$	-	0.1	-	μA
		$I_{N+} \geq 1.0\text{V}, I_N=0\text{V}, V_O=30\text{V}, T_{\text{low}} \leq T_A \leq T_{\text{high}}$	-	-	1	



Typical Application

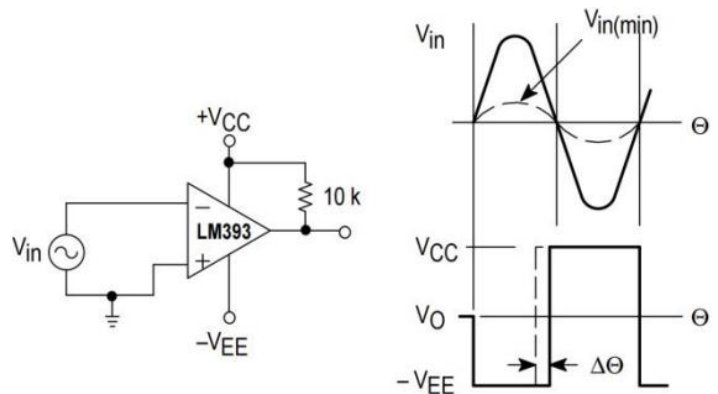


D1 prevents input from going negative by more than 0.6 V.

$$R1 + R2 = R3$$

$$R3 \leq \frac{R5}{10} \text{ for small error in zero crossing.}$$

**Figure 1. Zero-Crossing Detector
(Single Power Supply Application)**



$$V_{in(min)} \approx 0.4 \text{ V peak for } 1\% \text{ phase distortion } (\Delta\Theta).$$

**Figure 2. Zero-Crossing Detector
(Dual Power Supply Application)**

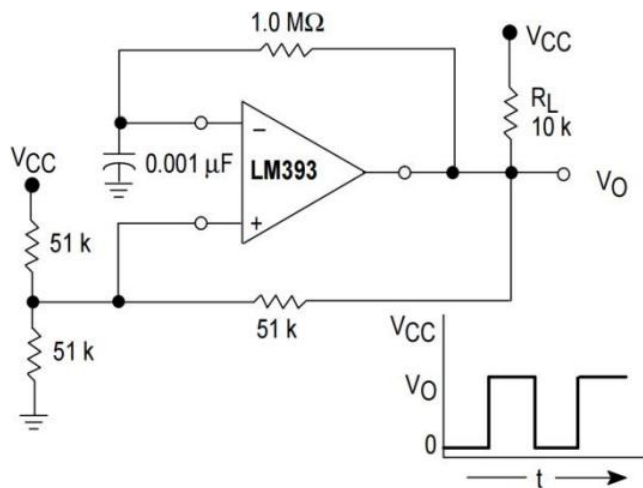
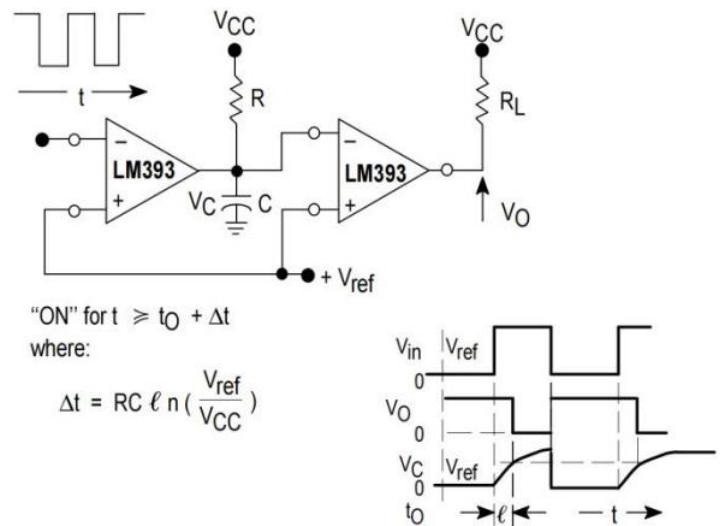


Figure 3. Square Wave Oscillator



"ON" for $t \geq t_0 + \Delta t$
where:

$$\Delta t = RC \ln \left(\frac{V_{ref}}{V_{CC}} \right)$$

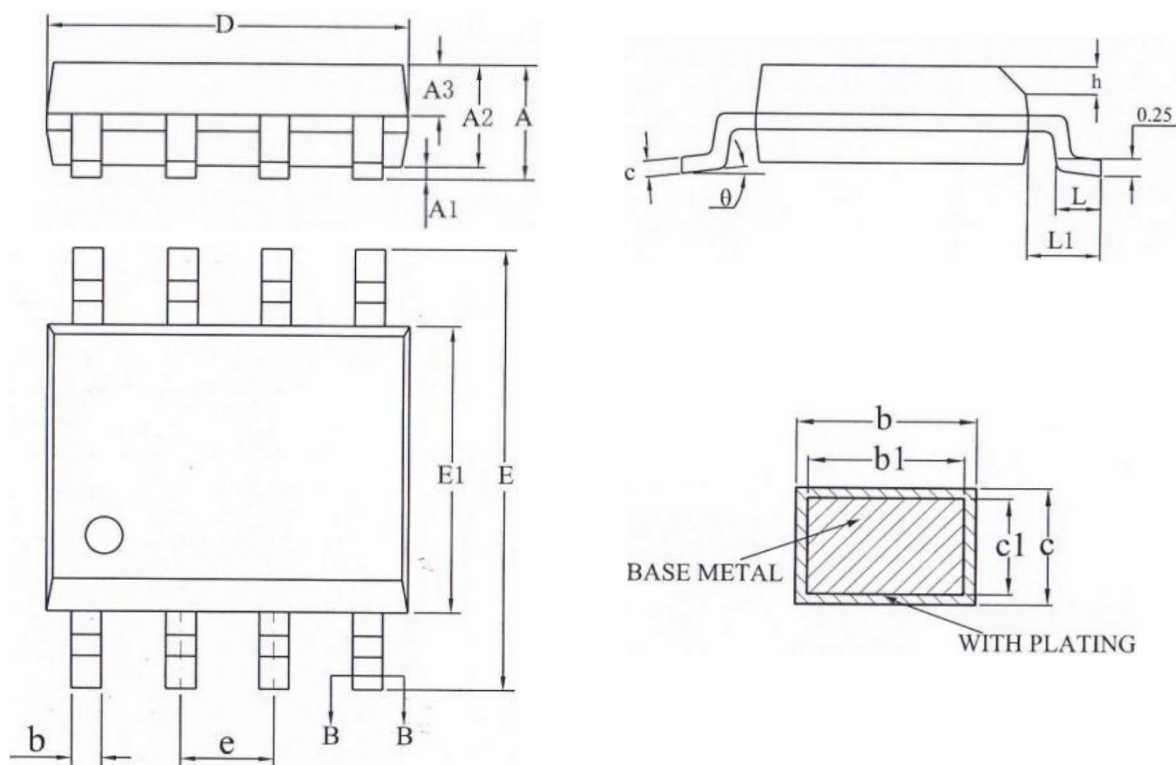
Figure 4. Delay Generator



Package Information

SOP-8

Dimensions in mm



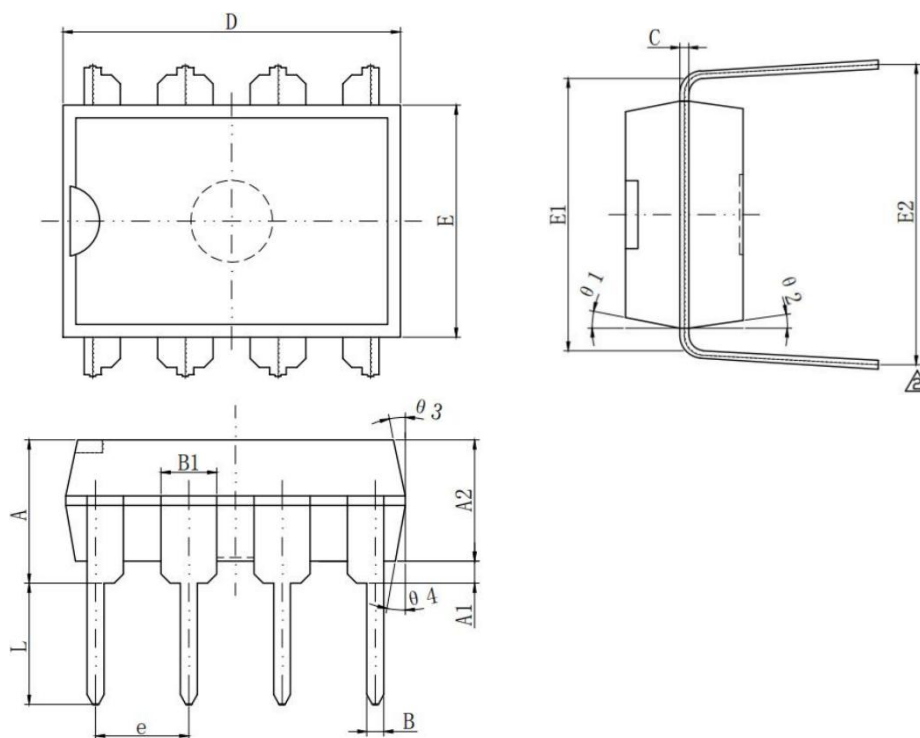
Symbol	Millimeter(mm)			Symbol	Millimeter(mm)		
	Min	Non	Max		Min	Non	Max
A	-	-	1.75	D	4.80	4.90	5.00
A1	0.10	-	0.225	E	5.80	6.00	6.20
A2	1.30	1.40	1.50	E1	3.80	3.90	4.00
A3	0.60	0.65	0.70	e	1.27 BSC		
b	0.39	-	0.47	h	0.25	-	0.50
b1	0.38	0.41	0.44	L	0.50	-	0.80
c	0.20	-	0.24	L1	1.05 REF		
c1	0.19	0.20	0.21	θ	0°	-	8°



Package Information

DIP-8

Dimensions in mm



Symbol	Millimeter(mm)			Symbol	Millimeter(mm)		
	Min	Non	Max		Min	Non	Max
A	3.75	3.90	4.15	E1	7.35	7.62	7.85
A1	0.60	-	-	E2	8.00	8.40	8.80
A2	3.15	3.30	3.40	e	2.54 BSC		
B	0.38	0.46	0.56	L	3.00	3.30	3.60
B1	1.52 BSC			θ1	10°	-	14°
C	0.20	0.25	0.34	θ2	8°	-	12°
D	9.00	9.25	9.40	θ3	10°	-	14°
E	6.20	6.35	6.50	θ	8°	-	12°



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