LM393

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.

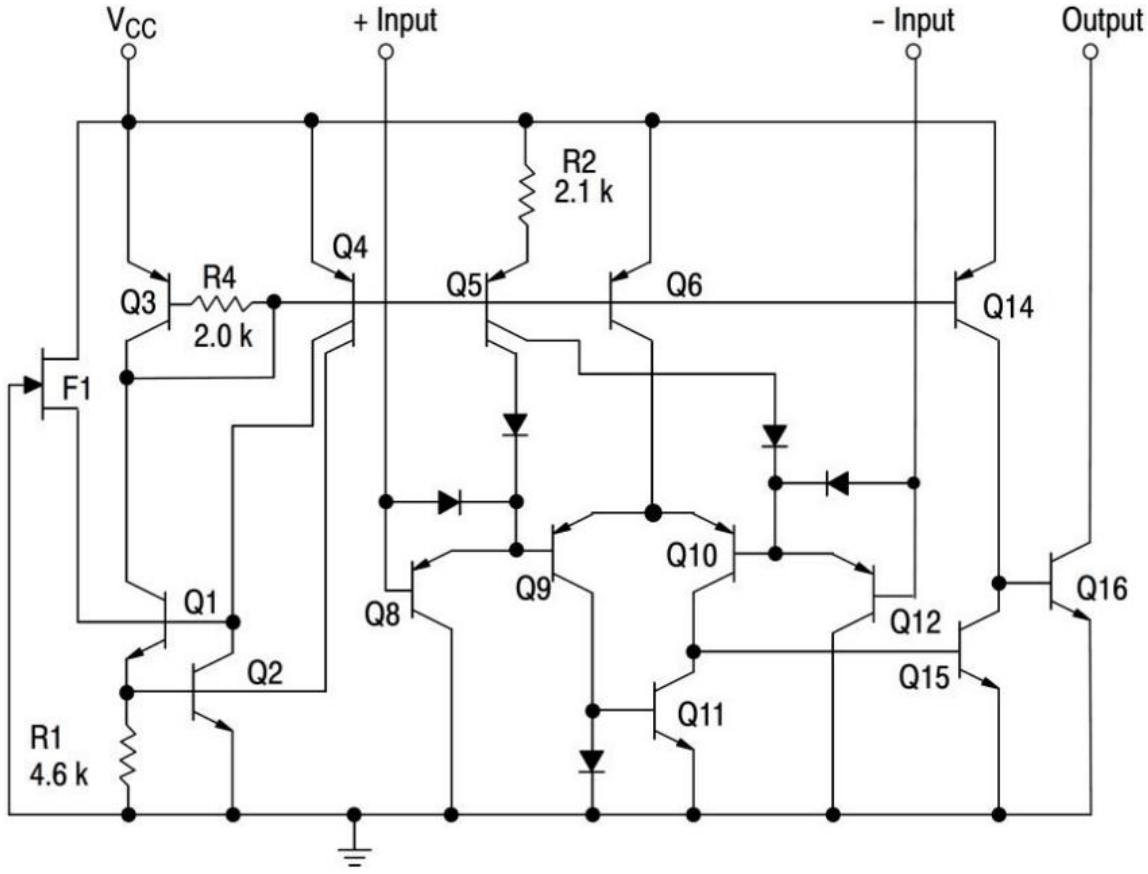
Features

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

Applications

- Power Supply Monitoring
- Peak Detectors
- Logic Voltage Conversion

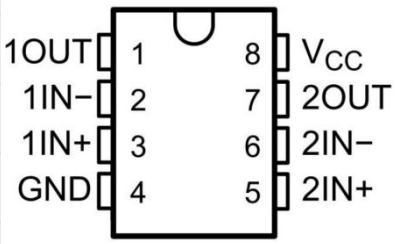
Function Block Diagram(One Channel Only)



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℃ 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	℃
Storage Temperature	T_S	-65~+150	℃
Lead Temperature(Soldering, 10s)	T_W	260	℃

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

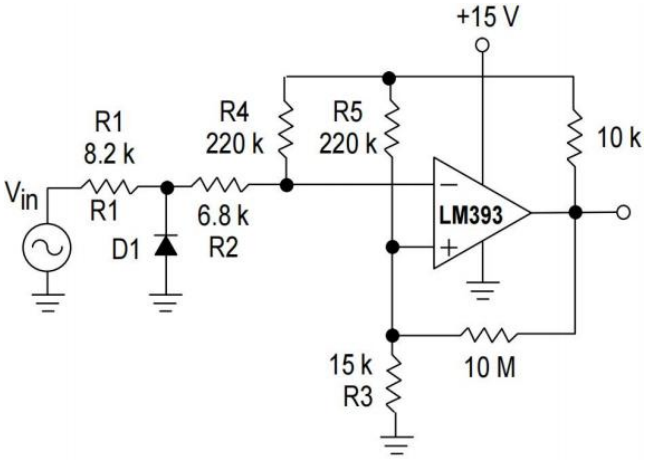
Recommended Operating Conditions(T_A=25℃ unless otherwise noted)

Parameter	Symbol	Min	Max	Unit
Supply Voltage	V_{CC}	3	32 or ±16	V
Operating Temperature	T_A	-20	+85	℃

Electrical Characteristics(T_A=25℃, V_{CC}=5V, unless otherwise noted)

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

Typical Application

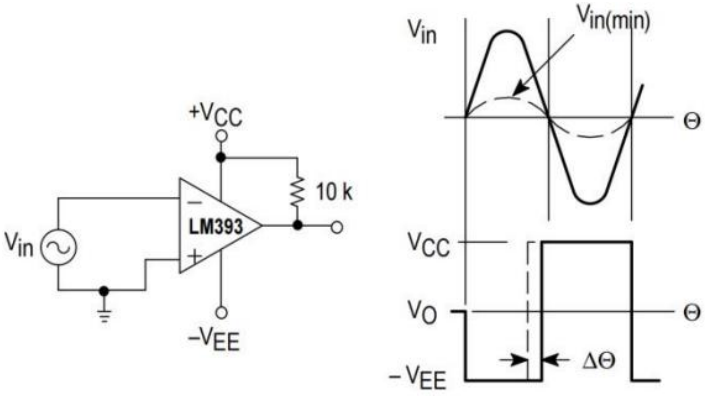


D1 prevents input from going negative by more than 0.6 V.

$$R1 + R2 = R3$$

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

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



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

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

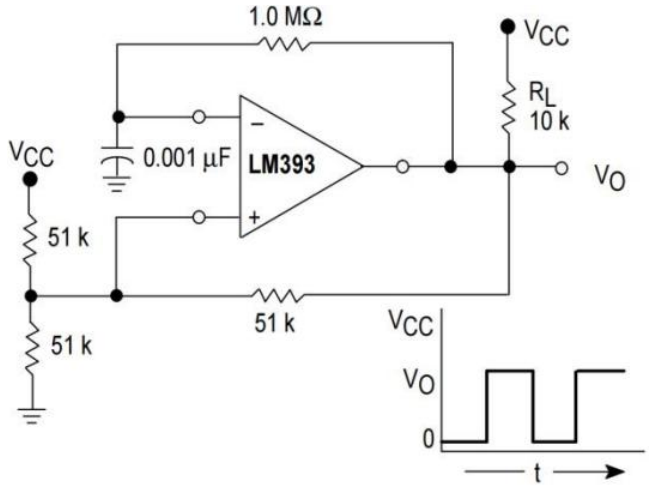


Figure 3. Square Wave Oscillator

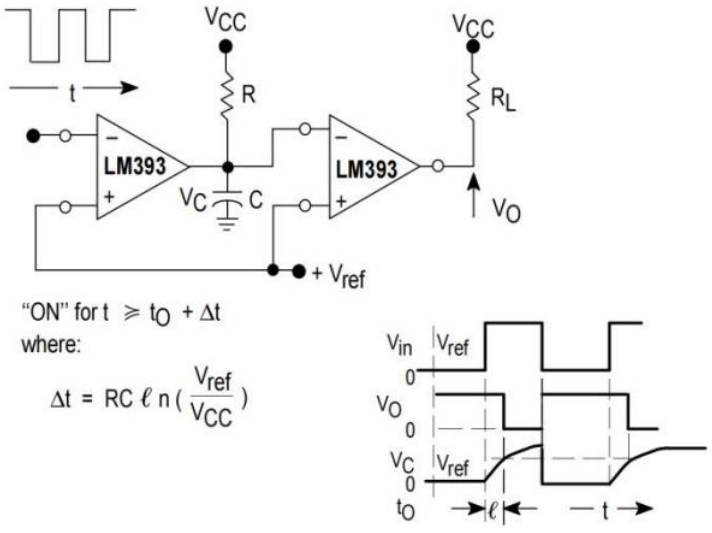
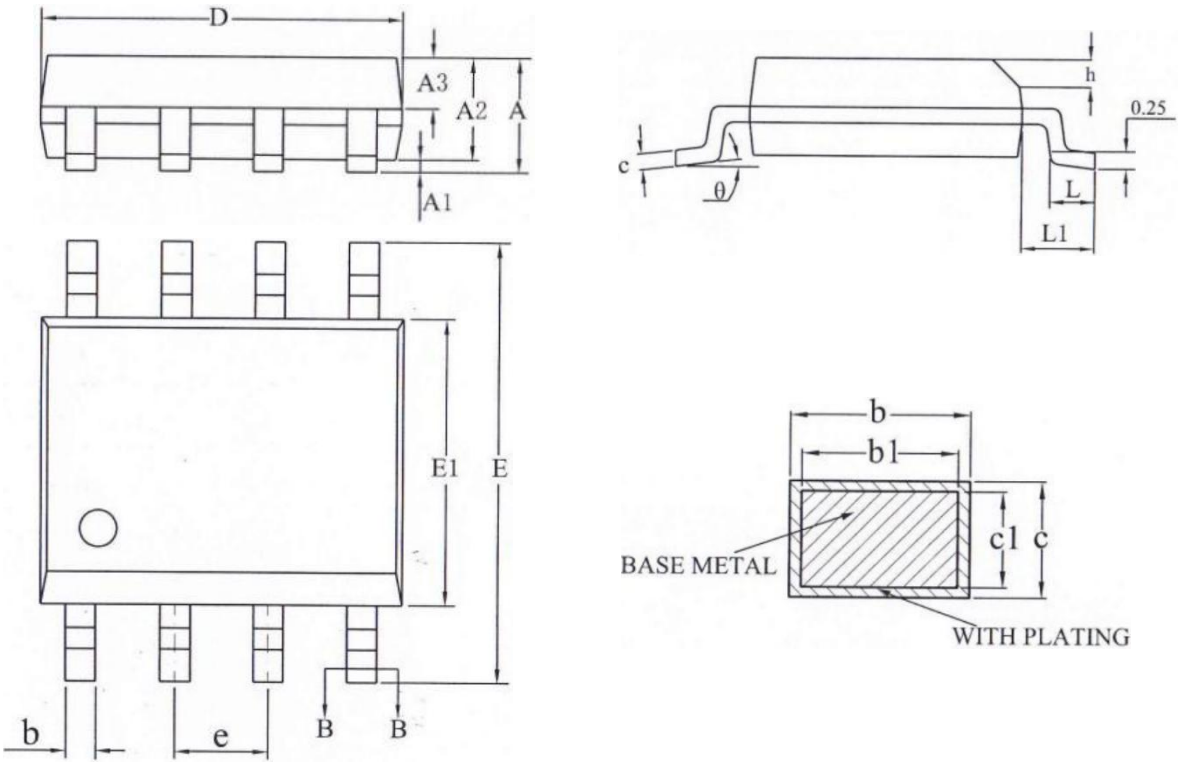


Figure 4. Delay Generator

Package Information

SOP-8

Dimensions in mm

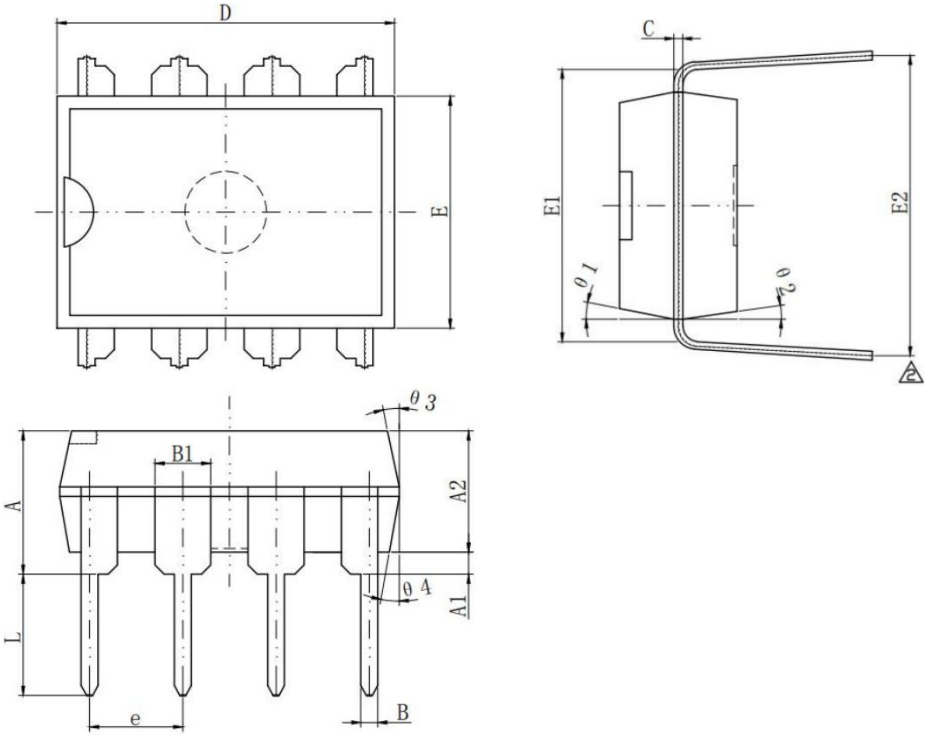


Symbol	Millimeter(mm)			Symbol	Millimeter(mm)		
	Min	Non	Max		Min	Non	Max
A	-	-	1.75	D	4.80	4.90	5.00
A1	0.10	-	0.225	E	5.80	6.00	6.20
A2	1.30	1.40	1.50	E1	3.80	3.90	4.00
A3	0.60	0.65	0.70	e	1.27 BSC		
b	0.39	-	0.47	h	0.25	-	0.50
b1	0.38	0.41	0.44	L	0.50	-	0.80
c	0.20	-	0.24	L1	1.05 REF		
c1	0.19	0.20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