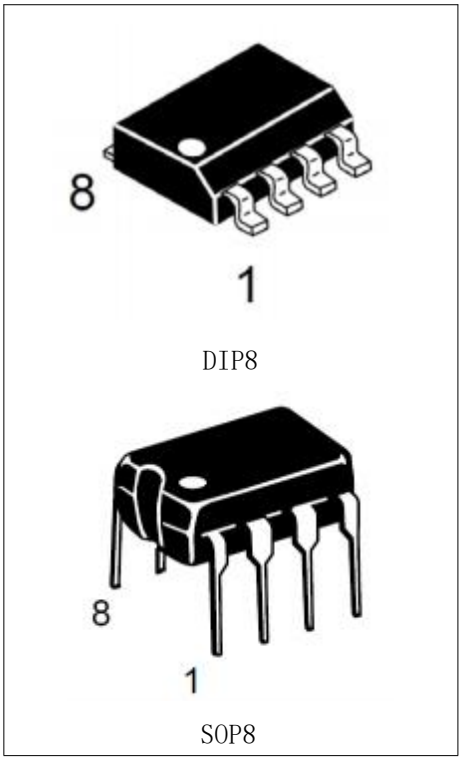
Double comparator

Overview

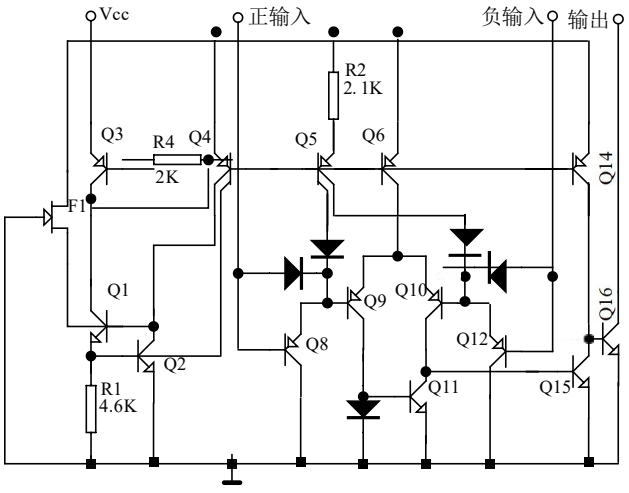
The LM393 consists of two independent, precise voltage comparators with offset voltages of up to 2.0mV. Can work on single or dual power supply. And its current is not affected by the voltage amplitude of the power supply. A unique feature of these comparators is that the input common-mode voltage range can reach zero even when operating on a single power supply. It is mainly used in consumer and industrial electronic products.



Main feature

- Wide voltage range of working power supply:
  Single power supply：2.0V~36V
  Dual power supply：±1.0V~±18V
- Small power supply current: 0.8mA has nothing to do with the power supply voltage
- Low input bias current: 25nA
- Low input offset current: 5.0nA
- Input offset low voltage: 5.0mV
- The range of the input differential voltage is consistent with that of the supply voltage.
- Compatible with TTL, DTL, ECL, MOS and CMOS.

Internal circuit diagram



Pin end function symbol

Outlet serial number	Function	Symbol	Outlet serial number	Function	Symbol
1	Comparator 1 output	OUT1	5	Comparator 2 positive phase input	IN2+
2	Comparator 1 inverting input	IN1-	6	Comparator 2 inverting input	IN2-
3	Comparator 1 positive phase input	IN1+	7	Comparator 2 output	OUT2
4	Load	GND	8	Power	Vcc

Limit parameter (absolute maximum rating, Tamb=25℃ if no other provisions are made)

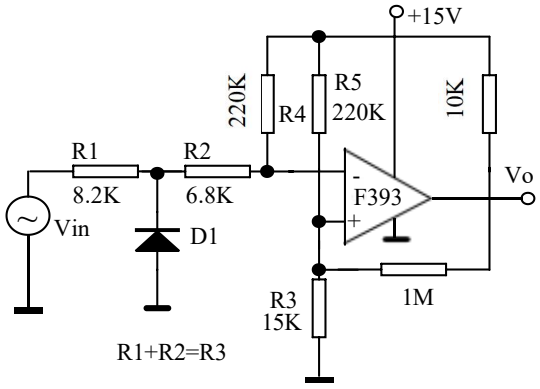
Parameter name		Symbol	Value		Unit
			Min	Max	
Supply voltage	Dual supply voltage	Vcc		±18	V
	Single supply voltage			36	
Input differential voltage		VIDR		36	V
Input common-mode voltage		VICR	-0.3	36	V
Output short-circuit current to ground		IOG		20	m A
Maximum working junction temperature		TJ(MAX)		125	℃
Power consumption (*)		PD		570	m W
Operating ambient temperature		Tamb	0	70	℃
Storage temperature		Tstg	-65	150	℃

Electrical characteristics(if not otherwise specified, Vcc=5V, Tamb=25℃)

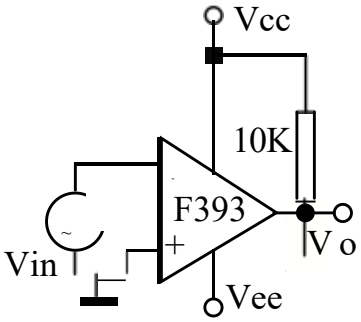
Specificity	Test conditions	Symbol	Canonical value			
			Min	Typical	Max	
Input offset voltage	Ta=25℃	V_{IO}		±1.0	±5.0	m V
	0℃≤Ta≤70℃				±9.0	
Input offset current	Ta=25℃	I_{IO}		±5.0	±50	nA
	0℃≤Ta≤70℃				±150	
Input bias current	Ta=25℃	I_{IB}		25	250	nA
	0℃≤Ta≤70℃				400	
Input common-mode voltage range	Ta=25℃	V_{ICR}	0		Vcc-1.5	V
	0℃≤Ta≤70℃		0		Vcc-2.0	
Supply current	R_L=∞ Double comparator	Icc		0.4	1.0	m A
	R_L=∞ Double comparator，Vcc=30V				2.5	
Voltage gain	R_L > 15KΩ，Vcc=15V	Gv	50	200		V/ mV
Large signal response time	V_{IN}=TTL Logic pendulum，V_{REF}=1.4V，V_{RL}=5.0V，R_L=5.1KΩ	t_{RES}		300		ns
Response time	V_{RL}=5.0V，R_L=5.1KΩ	t_{RES}		1.3		ns

Specificity	Test conditions	Symbol	Canonical value			Unit
			Min	Typical	Max	
Input differential voltage		V_{ID}			Vcc	V
Output dip current	$V_{IN(-)}$ > 1.0V， $V_{IN(+)}$=0V， Vo ≤ 1.5V	I_{SINK}	6.0	16		m A
Output saturation voltage	$V_{IN(-)}$ > 1.0V， $V_{IN(+)}$=0V， I_{SINK} ≤4.0mA	V_{SAT}		150	400	m V
	$V_{IN(-)}$ > 1.0V，$V_{IN(+)}$=0V，I_{SINK}≤4.0mA 0℃≤Ta≤70℃				700	
Output leakage current	$V_{IN(+)}$ > 1.0V，$V_{IN(-)}$=0V，Vo=5.0V	I_{OL}		0.1		nA
	$V_{IN(+)}$ > 1.0V，$V_{IN(-)}$=0V， Vo=30V 0℃≤Ta≤70℃				1000	

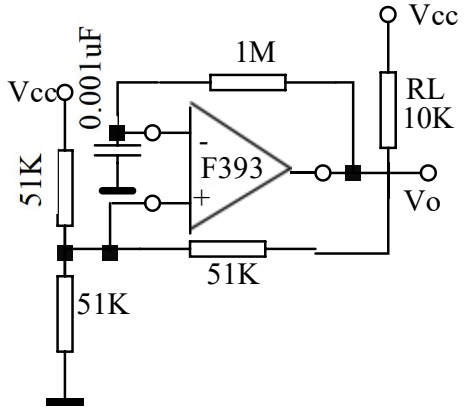
Application drawing



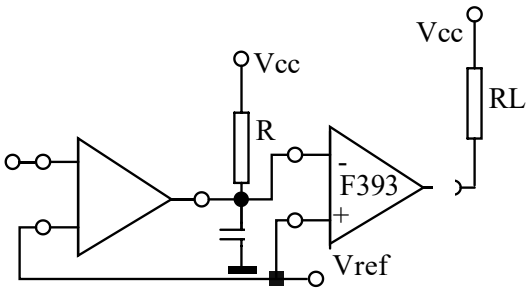
Zero-crossing detector (single-supply application)



Zero-crossing detector (dual power supply application)



Square wave oscillator



Delay generator

Instructions for use

The LM393 is a high-gain, wide-band device that, like most comparators, is prone to oscillations if there is a parasitic capacitance coupling between the output and input. This phenomenon only occurs when the comparator changes state, the output voltage transition gap. The power supply plus bypass filter does not solve this problem, and the design of the standard PC board is helpful to reduce the input-output parasitic capacitive coupling. Reducing the input resistance to less than 10K will reduce the feedback signal, and increasing even a small amount of positive feedback (hysteresis 1.0 to 10mV) can result in a rapid conversion, making it impossible to generate oscillations due to parasitic capacitance. Unless hysteresis is used, inserting the IC directly and adding a resistor to the pin will cause the input-output to oscillate in a very short conversion period, and hysteresis will not be needed if the input signal is a pulse waveform and the rise and fall times are fairly fast.All unused pins of the comparator must be grounded.

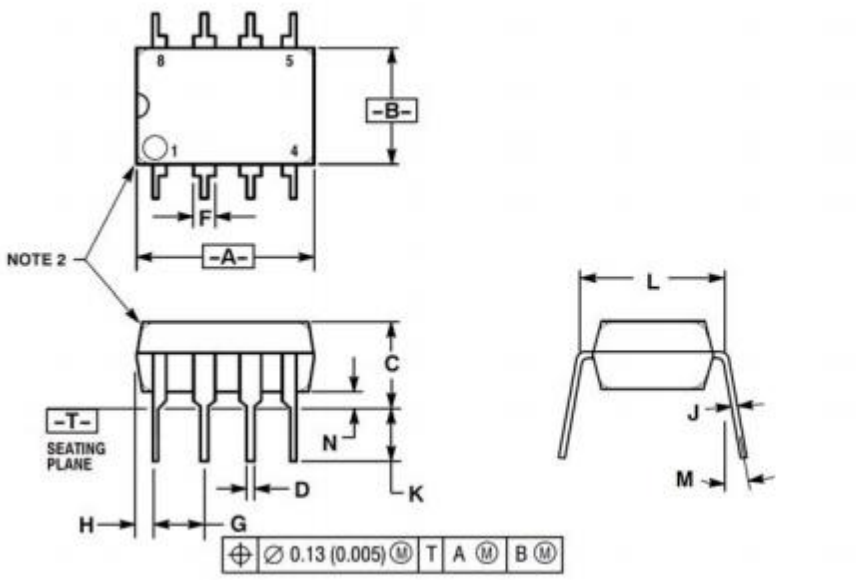
The LM393 bias network establishes that its static current is independent of the supply voltage range of 2.0~30V.

Normally, bypass capacitors are not required for power supplies.

Differential input voltages can be greater than Vcc without damaging the device. The protection part must be able to prevent the input voltage to the negative side from exceeding -0.3V.

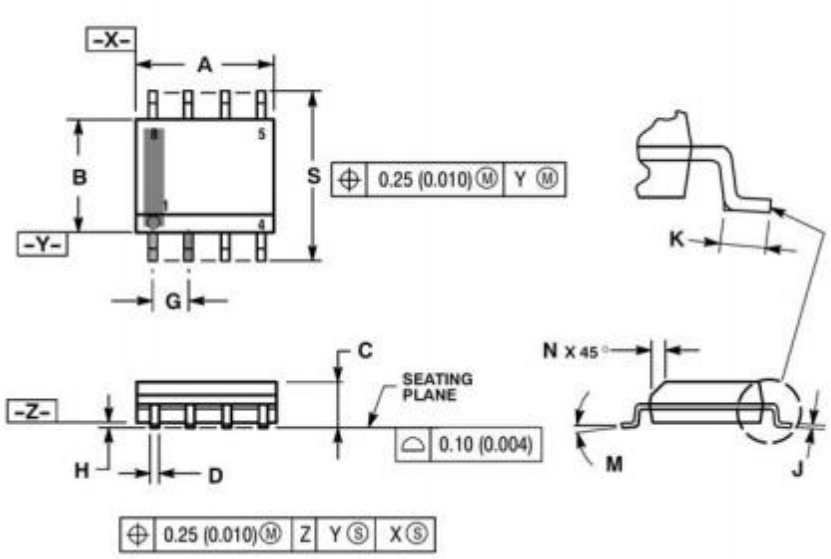
The output portion of the LM393 is an open-collector, ground-emitter NPN output transistor that can be supplied or functioned with a multi-collector output. The output load resistor can be attached to any supply voltage within the allowable supply voltage range, regardless of the Vcc terminal voltage value. This output can be used as a simple open circuit to ground SPS (when no load resistance is used), and the pit current of the output portion is limited by the possible drive and device values. When the limit current (16mA) is reached, the output transistor will retreat and the output voltage will quickly rise. The output saturation voltage is limited by YSAT of about 60 of the output transistor. When the load current is very small, the output transistor low offset current.The voltage (about 1.0mV) allows the output to be clamped at zero level.

Package information



NOTES:
1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	---	10°	---	10°
N	0.76	1.01	0.030	0.040



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0°	8°	0°	8°
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244