



# Dual Differential Comparators

## LM393

### General Description

The LM393 consists of two independent precision voltage comparators with an offset voltage specification as low as 2.0 mV max for two comparators which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. These comparators also have a unique characteristic in that the input common-mode voltage range includes ground, even though operated from a single power supply voltage.

Application areas include limit comparators, simple analog to digital converters; pulse, squarewave and time delay generators; wide range VCO; MOS clock timers; multivibrators and high voltage digital logic gates. The LM393 was designed to directly interface with TTL and CMOS. When operated from both plus and minus power supplies, the WS393MX will directly interface with MOS logic where their low power drain is a distinct advantage over standard comparators.

### Advantages

- High precision comparators

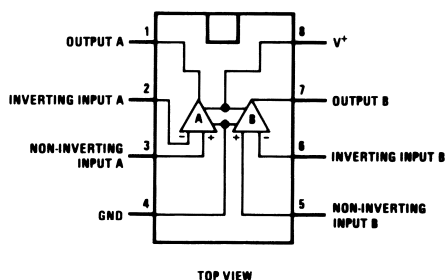
- Reduced  $V_{OS}$  drift over temperature
- Eliminates need for dual supplies
- Allows sensing near ground
- Compatible with all forms of logic
- Power drain suitable for battery operation

### Features

- Wide supply
  - Voltage range: 2.0V to 36V
  - single or dual supplies:  $\pm 1.0V$  to  $\pm 18V$
- Very low supply current drain (0.4 mA) — independent of supply voltage
- Low input biasing current: 25 nA
- Low input offset current:  $\pm 5$  nA
- Maximum offset voltage:  $\pm 9$  mV
- Input common-mode voltage range includes ground
- Differential input voltage range equal to the power supply voltage
- Low output saturation voltage, : 150 mV at 4 mA
- Output voltage compatible with TTL, DTL, ECL, MOS and CMOS logic systems

### Pin Configuration

DIP-8 LM393N  
SOP-8 LM393M



electrical characteristics at specified free-air temperature,  $V_{CC} = 4\text{ V}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
$V_{IO}$ input offset voltage	$V_{CC} = 5\text{V to } 30\text{V}$ $V_{IC} = V_{ICR} \text{ min,}$ $V_O = 1.4\text{V}$	$25^\circ\text{C}$		2	5	mV
		Full range			9	
$I_{IO}$ input offset current	$V_O = 1.4\text{V}$	$25^\circ\text{C}$		5	50	nA
		Full range			150	
$I_{IB}$ input bias current	$V_O = 1.4\text{V}$	$25^\circ\text{C}$		-25	-250	nA
		Full range			-400	
$V_{ICR}$ Common-mode input voltage range**		$25^\circ\text{C}$	0 to $V_{CC}-1.5$			V
		Full range	0 to $V_{CC}-2.0$			
$A_{VD}$ Large-signal differential voltage amplification	$V_{CC} = 15\text{V}$ $V_O = 1.4\text{V to } 11.4\text{V}$ $R_L \geq 15\text{k}\Omega \text{ to } V_{CC}$	$25^\circ\text{C}$	50	200		V/m V
$I_{OH}$ High-level output current	$V_{OH}=5\text{V}, V_{ID}=1\text{V}$	$25^\circ\text{C}$		0.1	50	nA
	$V_{OH}=30\text{V}, V_{ID}=1\text{V}$	Full range			1	$\mu\text{A}$
$V_{OL}$ Low-level output voltage	$I_{OL}=4\text{mA}, V_{ID}=1\text{V}$	$25^\circ\text{C}$		150	400	mV
		Full range			700	
$I_{OL}$ Low-level output current	$V_{OL}=1.5\text{V}, V_{ID}=1\text{V}$	$25^\circ\text{C}$	6			m A
$I_{CC}$ Supply current	$R_L = \infty$	$V_{CC}=5\text{V}$ $25^\circ\text{C}$		0.8	1	m A
		$V_{CC}=30\text{V}$ Full range			2.5	

\*Full range(MIN to MAX),for the LM393 is  $0^\circ\text{C}$  to  $70^\circ\text{C}$ .All characteristics are measured with zero common-mode input voltage unless otherwise speified.

\*\*The voltage at either input or common-mode should not be go negative by more than 0.3V.The upper end of the common-mode voltage range is  $V_{CC}+-1.5\text{V}$ ,but either or both inputs can go to 30V without damage

switching characteristics , $V_{CC}=5\text{V}, T_A=25^\circ\text{C}$

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Response time	$R_L$ connected to 5V through 5.1K $C_L=15\text{pF}$ see Note1	100mV input step with 5-m V overdrive		1.3		$\mu\text{s}$
		TTL-level input step		0.3		

\*  $C_L$  includes probe and jig capacitance

NOTE1: The response time specified is the interval between the input step function and the instant when the output crosses 1.4V.

