

#### Low power, low offset voltage dual comparator in bare die form

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#### Description

The LM293 is a dual precision voltage comparator operating with either single or split supply over a wide voltage range. In single supply operation, the device uniquely produces a common mode range-to-ground level. In split supply operation the low power supply current drain is independent of the magnitude of supply voltage and reduces power consumption versus standard comparators. The device directly interfaces TTL, CMOS and also interfaces MOS in split supply configuration. Offset voltage characteristics as low as 1mV improve efficiency and further reduce power consumption. The die size is one of the smallest in the industry.

### **Ordering Information**

The following part suffixes apply:

No suffix - MIL-STD-883 /2010B Visual Inspection

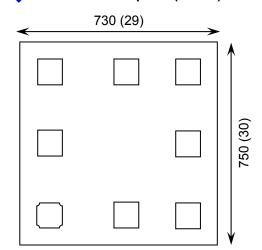
For High Reliability versions of this product rieses see

LM193 and LM193A

#### Features:

- Single-Supply range: 2-36V
- Split–Supply range: ±1.0V to \$18V
- Very low supply current independent of supply voltage (1 mW/comparator at 55V)
- Very Low Current Draw
- Very Low Input Offset Current
- Low Input Affset Wiltage
- TTL, DTL, CL, MOS, CMOS compatible outputs.

#### Die Dimensions in µm (mils)



### Supply Formats:

- Default Die in Waffle Pack (400 per tray capacity)
- Sawn Wafer on Tape On request
- Unsawn Wafer On request
- Die Thickness <> 350µm(15 Mils) On request
- Assembled into Ceramic Package On request

### **Mechanical Specification**

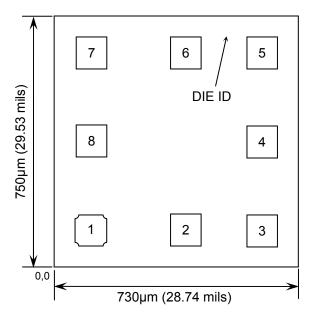
Die Size (Unsawn)	730 x 750 29 x 30	μm mils	
Minimum Bond Pad Size	90 x 90 3.54 x 3.54	μm mils	
Die Thickness	350 (±20) μ 13.78 (±0.79) m		
Top Metal Composition	Al 1%Si 1.1μm		
Back Metal Composition	N/A – Bare Si		





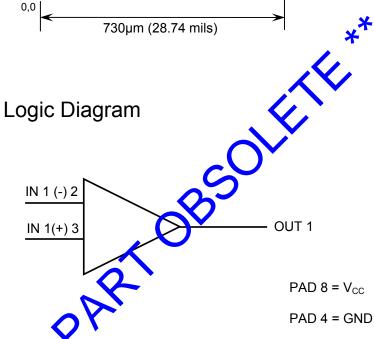
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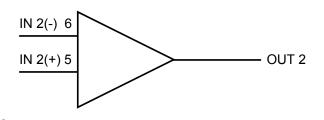
## Pad Layout and Functions



PAD	FUNCTION	COORDINATES			
		X	Y		
1	OUT 1	0.065	0.065		
2	IN 1	0.347	0.065		
3	IN 1	0.575	0.065		
4	GND	0.575	0.330		
5	IN 2 +	0.575	0.595		
C	IN 2 -	0.347	0.595		
	OUT 2	0.065	0.595		
8	V <sub>CC</sub>	0.065	0.330		
CHIP	BACK POTENTIA	L IS GND O	R FLOAT		

## Logic Diagram







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## Absolute Maximum Ratings<sup>1</sup>

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage – Single Supply	V <sub>cc</sub>	36	V
Supply Voltage – Split Supply	• 66	±18	<b>X</b>
Input Differential Voltage Range	$V_{IDR}$	36	
Input Common Mode Voltage Range	$V_{ICR}$	-0.3 to V <sub>CC</sub>	V
Output Short Circuit to Ground	-	Continuous	-
Input Current (per pin) <sup>2</sup>	I <sub>IN</sub>	50	mA
Junction Temperature	$T_J$	150	°C
Power Dissipation in Still Air	$P_D$	70	mW

<sup>1.</sup> Operation above the absolute maximum rating may cause device failure. Operation at the absolute haximum ratings, for extended periods, may reduce device reliability.

**Recommended Operating Conditions** 

PARAMETER	SYMBOL	MIN	MAX	UNITS
DC Supply Voltage	V <sub>CC</sub>	±2.5 or 5	±15 or 30	V
Operating Temperature	T <sub>A</sub>	-25	+85	°C

## DC Electrical Characteristics (T\_\_\_\_25 to 85°C unless otherwise specified)

PARAMETER	CAMBOI	MBOL CONDITIONS		LIMITS			UNITS	
PARAIVIETER	STIVIDOL			MIN	TYP	MAX	UNITS	
Input Offset Voltage	V <sub>IO</sub>	V = 1.4V, $V_0 = 5-30V;$	25°C	-	1	5	mV	
input Offset Voltage	VIO	$V_{\rm S} \le 100\Omega$ , $V_{\rm LR} = 0V - (V_{\rm CC} - 1.5V)$	85°C	-	-	9	1117	
Input Bias Current		V <sub>O</sub> =1.4V,V <sub>CC</sub> =5-30V	25°C	-	25	250	n 1	
input bias Current		$V_{ICR} = 0V - (V_{CC} - 1.5)V$	85°C	-	-	400	nA nA	
Input Offset Current	Y	V <sub>0</sub> =1.4V,V <sub>CC</sub> =5-30V		-	±5	±50	A	
input Onset Current	I <sub>IO</sub>	$V_{ICR} = 0V - (V_{CC} - 1.5V)$	85°C	-	-	±150	nA	
Input Common Mode	\/	V - 5 20V	25°C	0	-	V <sub>CC</sub> -1.5	V	
Voltage Range	V ICR	$V_{ICR}$ $V_{CC} = 5-30V$		0	-	V <sub>CC</sub> - 2.0	V	
Supply Current	ı	R <sub>L</sub> =∞,V <sub>CC</sub> =5V, T <sub>A</sub> =	25°C	-	-	1	mΛ	
Supply vullent	I <sub>cc</sub>	R <sub>L</sub> =∞,V <sub>CC</sub> =36V, T <sub>A</sub> =	: 25°C	5°C -	-	2.5	mA mA	
Woltage Gain	A <sub>VOL</sub>	$V_{CC}$ =15V, $R_L$ = 15K $\Omega$ , $T_A$ = 25°C, $V_O$ = 1V to 11V		50	200	-	V/mV	
Large Signal Response Time	t <sub>1</sub>	$V_{IN}$ =TTL Logic Swing, $V_{REF}$ =1.4V, $V_{CC}$ = 5V, $R_L$ = 5.1K $\Omega$ , $V_{RL}$ = 5V, $T_A$ = 25°C		-	300	-	ns	
Response Time	t <sub>2</sub>	$V_{CC}$ = 5V, $R_L$ = 5.1K $\Omega$ , $V_{RL}$ = 5V, $T_A$ = 25°C		-	1.3	-	μS	



<sup>2.</sup>  $V_{IN} < -0.3V$ . This input current exists when voltage is driven negative at any of the input leads



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DC Electrical Characteristics	$(T_A = -25^{\circ}C \text{ to } 85^{\circ}C \text{ unless otherwise specified})$
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PARAMETER	SYMBOL	CONDITIONS			LIMITS		WNITS	
PARAMETER	STMBOL			MIN	TYP	MAX	GNIIS	
Output Sink Current	I <sub>SINK</sub>	$V_{I}(-) = 1V, V_{I}(+) = 0V,$ $V_{O} \le 1.5V, V_{CC} = 5V,$ $T_{A} = 25^{\circ}C$			6	16		mA
Saturation Voltage	V	$V_{I}(-) = 1V, V_{I}$	(+) = 0V	25°C	-	250	100	mV
Saturation Voltage V <sub>SAT</sub>	V SAT	I <sub>SINK</sub> ≤ 4mA, V <sub>CC</sub> =5V 85°C		-		700	IIIV	
Output Leakage	1	$V_0=5V, \ V_1(+)=1V, \ T_A=25^{\circ}C$		-	0.1	-	- nA	
Current	$V_{I}(-)=0V$ $V_{O}=30V,$ $T_{A}=85^{\circ}C$		-		1000			
Differential Input Voltage Range	V <sub>IDR</sub>	All V <sub>IN</sub> ≥ GND or V- Supply (if used)			<b>)</b> -	V <sub>CC</sub>	V	

## **Typical Applications**

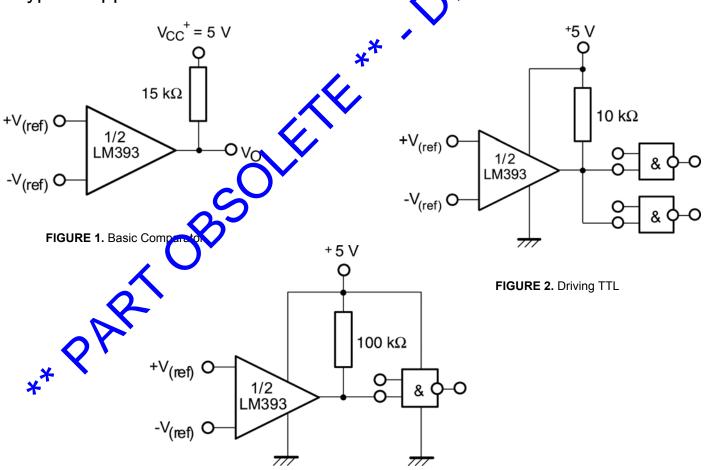


FIGURE 3. Driving CMOS





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## Typical Applications continued

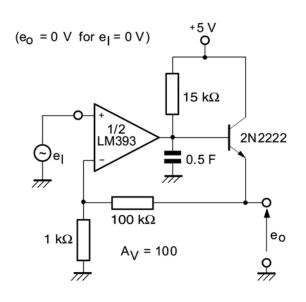


FIGURE 4. Low frequency Operational Amplifier V1

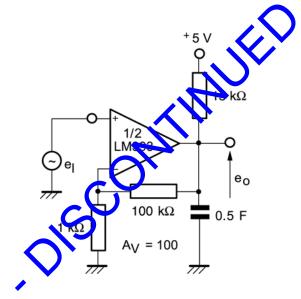


FIGURE 5. Low frequency Operational Amplifier V2

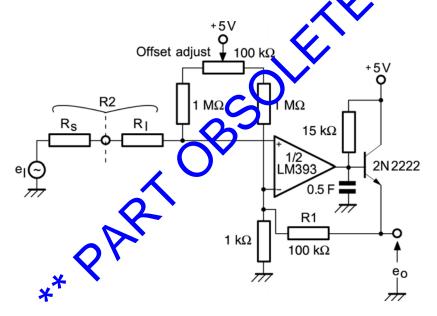


FIGURE 6. Low frequency Op-Amp with Offset adjust

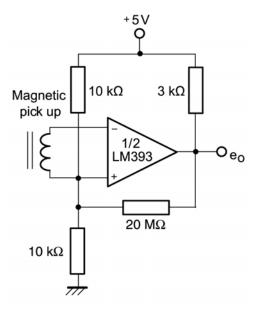


FIGURE 7. Transducer Amplifier





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## Typical Applications continued

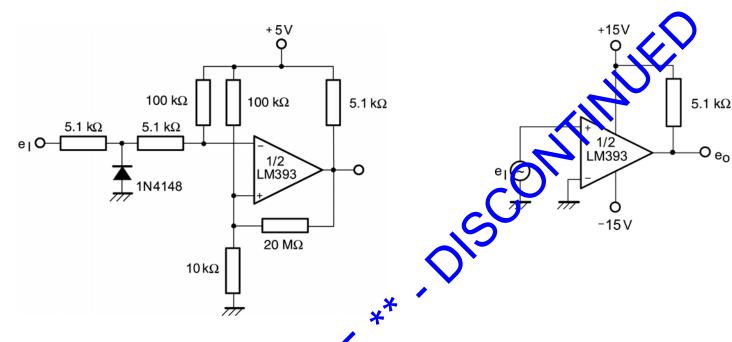


FIGURE 8. Zero crossing detector (single power supply)

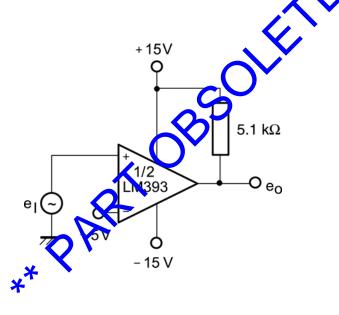


FIGURE 10. Comparator with a negative reference

**FIGURE 9.** Zero crossing detector (split power supply)

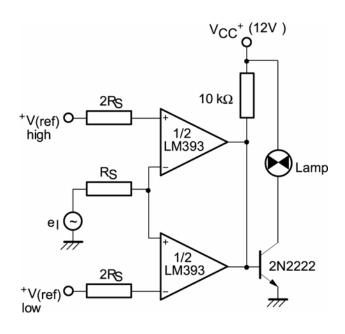


FIGURE 11. Limit Comparator





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## Typical Applications continued

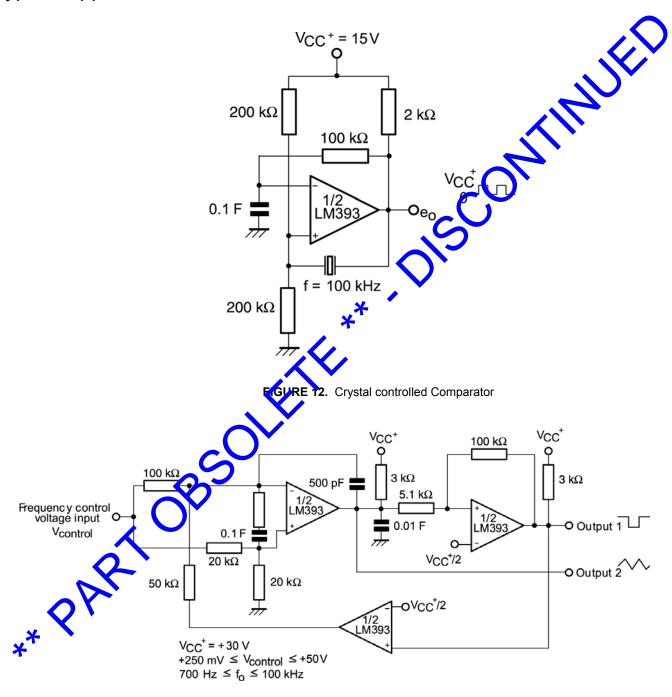


FIGURE 13. Two-decade High-Frequency VCO





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