Dual Differential Comparator – LM393

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

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Description

The LM393 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.

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 +5V)
- Very Low Current Drain
- Very Low Input Offset Current
- Low Input Offset Voltage
- TTL, DTL, ECL, MOS, CMOS compatible outputs

Ordering Information

The following part suffixes apply:

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

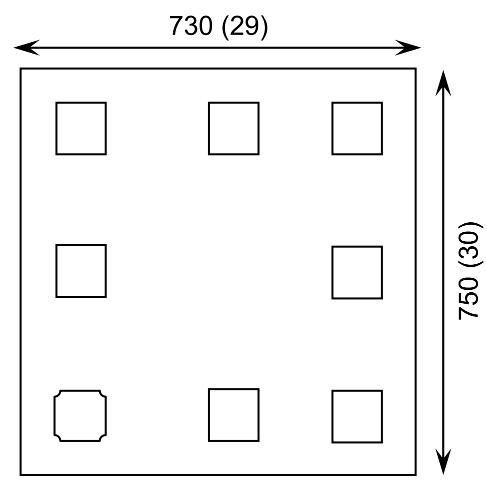
For a higher electrical grade version of this product please see

LM393A

For High Reliability versions of this product please see

LM193 and LM193A

Die Dimensions in µm (mils)



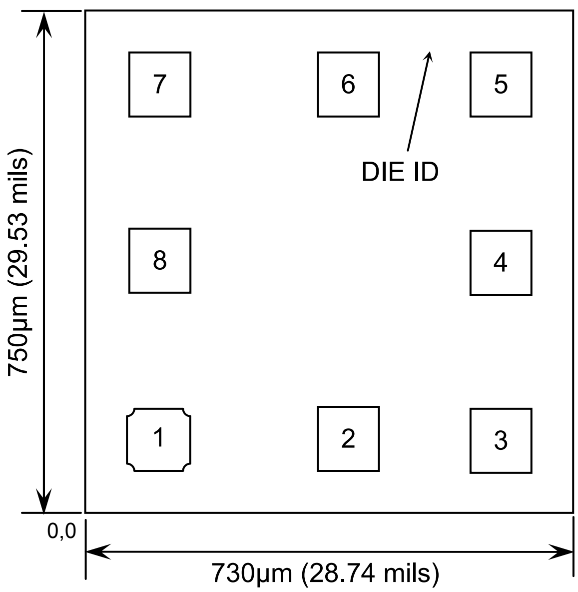
Supply Formats:

- 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

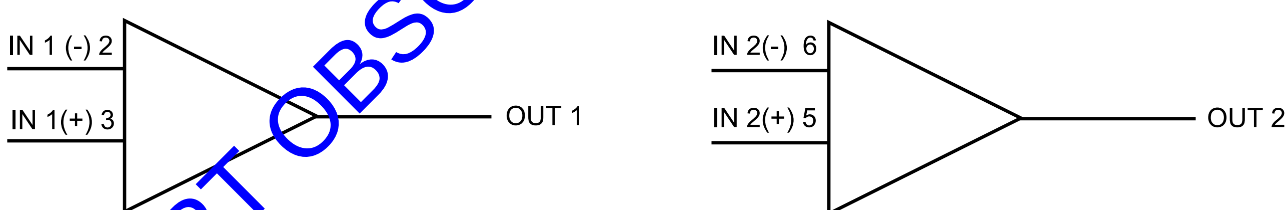
Die Size (Unsawn)	730 x 750 29 x 30	µm mils
Minimum Bond Pad Size	90 x 90 3.54 x 3.54	µm mils
Die Thickness	350 (±20) 13.78 (±0.79)	µm mils
Top Metal Composition	Al 1%Si 1.1µm	
Back Metal Composition	N/A – Bare Si	

Pad Layout and Functions



PAD	FUNCTION	COORDINATES (mm)	
		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
6	IN 2 -	0.347	0.595
7	OUT 2	0.065	0.595
8	V_{CC}	0.065	0.330
CHIP BACK POTENTIAL IS GND OR FLOAT			

Logic Diagram



PAD 8 = V_{CC}

PAD 4 = GND

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Absolute Maximum Ratings[1]

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage – Single Supply	V_{CC}	36	V
Supply Voltage – Split Supply		±18	V
Input Differential Voltage Range	V_{IDR}	36	V
Input Common Mode Voltage Range	V_{ICR}	-0.3 to V_{CC}	V
Output Short Circuit to Ground	-	Continuous	-
Input Current (per pin)[2]	I_{IN}	50	mA
Junction Temperature	T_J	150	°C
Power Dissipation in Still Air	P_D	570	mW

1. Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability.
2. V_{IN} < -0.3V. This input current exists when voltage is driven negative at any of the input leads

Recommended Operating Conditions

PARAMETER	SYMBOL	MIN	MAX	UNITS
DC Supply Voltage	V_{CC}	±2.5 or 5	±15 or 30	V
Operating Temperature	T_A	0	+70	°C

DC Electrical Characteristics (T_A = 0°C to 70°C unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS		LIMITS			UNITS
				MIN	TYP	MAX	
Input Offset Voltage	V_{IO}	V_O = 1.4V, V_{CC} = 5-30V; $R_S \leq 100\Omega$, V_{ICR} =0V-(V_{CC}-1.5V)	25°C	-	1	5	mV
			70°C	-	-	9	
Input Bias Current	I_B	V_O=1.4V,V_{CC}=5-30V V_{ICR} =0V-(V_{CC}-1.5)V	25°C	-	25	250	nA
			70°C	-	-	400	
Input Offset Current	I_{IO}	V_O=1.4V,V_{CC}=5-30V V_{ICR} =0V-(V_{CC}-1.5V)	25°C	-	±5	±50	nA
			70°C	-	-	±150	
Input Common Mode Voltage Range	V_{ICR}	V_{CC} = 5-30V	25°C	0	-	V_{CC} -1.5	V
			70°C	0	-	V_{CC} - 2.0	
Supply Current	I_{CC}	$R_L=\infty$,V_{CC}=5V, T_A = 25°C		-	-	1	mA
		$R_L=\infty$,V_{CC}=36V, T_A = 25°C		-	-	2.5	
Voltage Gain	A_{VOL}	V_{CC} =15V, R_L = 15KΩ, T_A = 25°C, V_O = 1V to 11V		50	200	-	V/mV
Large Signal Response Time	t_1	V_{IN} =TTL Logic Swing, V_{REF} =1.4V, V_{CC}= 5V, R_L = 5.1KΩ, V_{RL} = 5V, T_A = 25°C		-	300	-	ns
Response Time	t_2	V_{CC}= 5V, R_L= 5.1KΩ, V_{RL}= 5V, T_A = 25°C		-	1.3	-	µS

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DC Electrical Characteristics (T_A = 0°C to 70°C unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS		LIMITS			UNITS
				MIN	TYP	MAX	
Output Sink Current	I_{SINK}	$V_I(-)$ =1V, $V_I(+)$ = 0V, V_O ≤1.5V, V_{CC} =5V, T_A = 25°C		6	16	-	mA
Saturation Voltage	V_{SAT}	$V_I(-)$ =1V, $V_I(+)$ = 0V I_{SINK} ≤ 4mA, V_{CC}=5V	25°C	-	250	400	mV
			70°C	-	-	700	
Output Leakage Current	I_{OL}	$V_I(+)$=1V, $V_I(-)$=0V	V_O=5V, T_A = 25°C	-	0.1	-	nA
			V_O=30V, T_A = 70°C	-	-	1000	
Differential Input Voltage Range	V_{IDR}	All V_{IN} ≥ GND or V- Supply (if used)		-	-	V_{CC}	V

Typical Applications

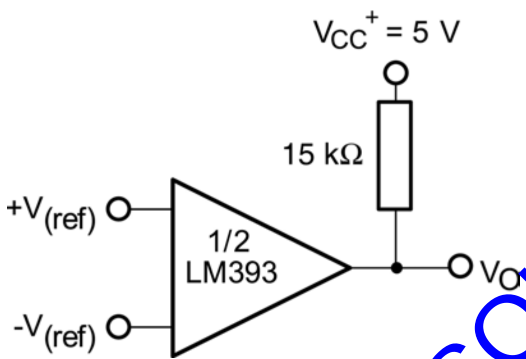

FIGURE 1. Basic Comparator

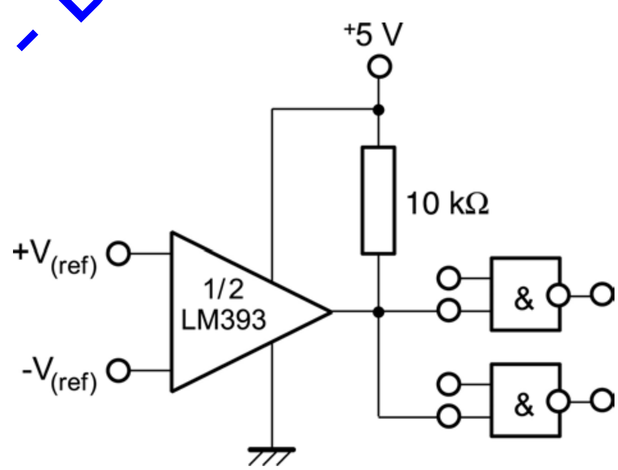

FIGURE 2. Driving TTL

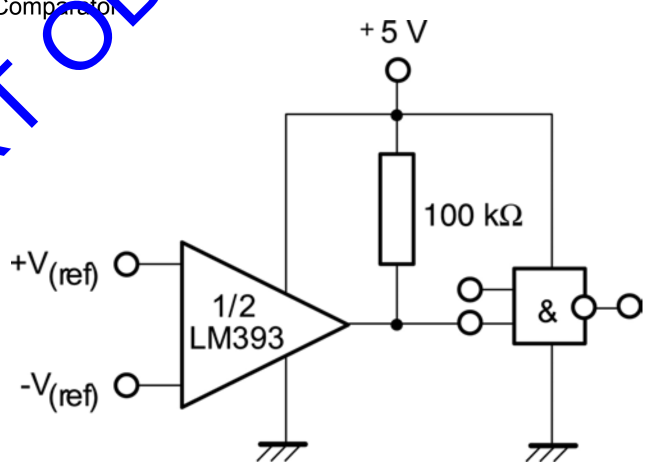

FIGURE 3. Driving CMOS

Typical Applications continued

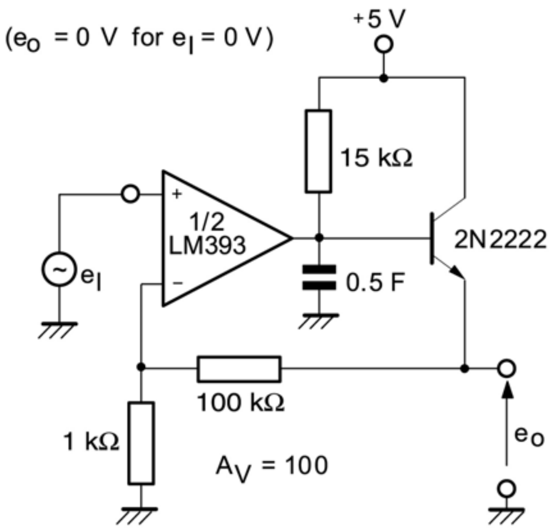

FIGURE 4. Low frequency Operational Amplifier V1

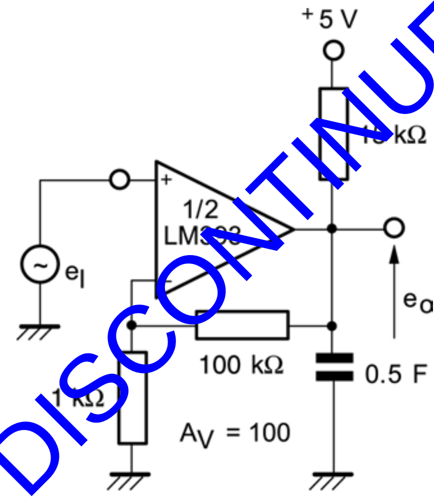

FIGURE 5. Low frequency Operational Amplifier V2

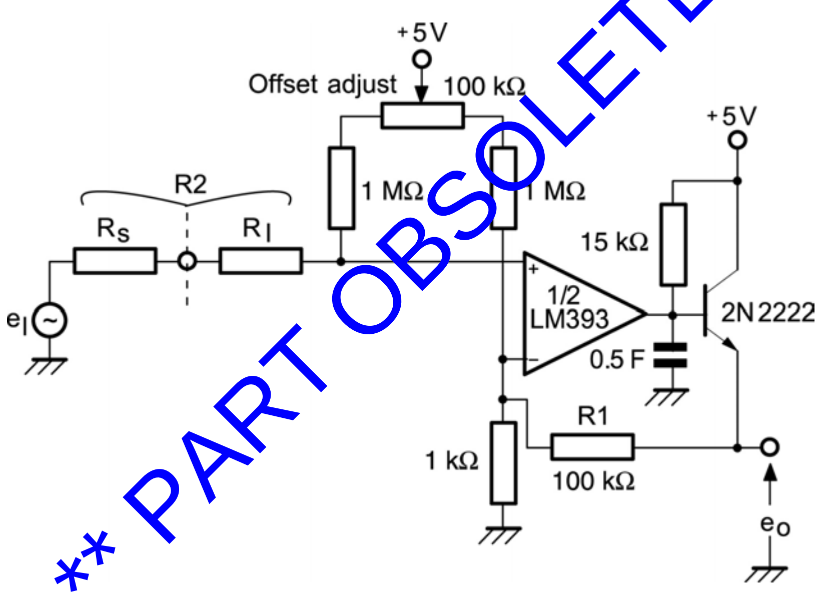

FIGURE 6. Low frequency Op-Amp with Offset adjust

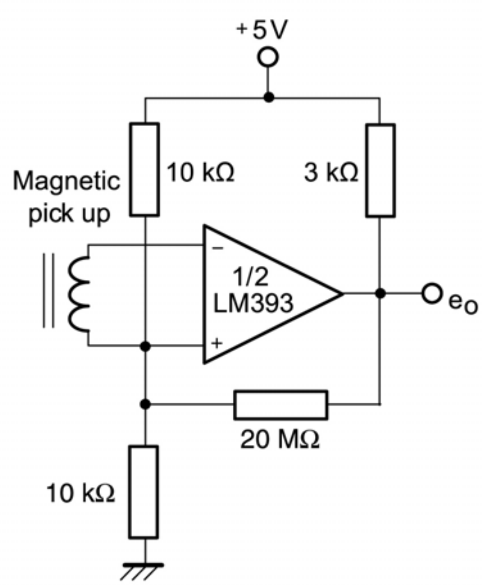

FIGURE 7. Transducer Amplifier

Typical Applications continued

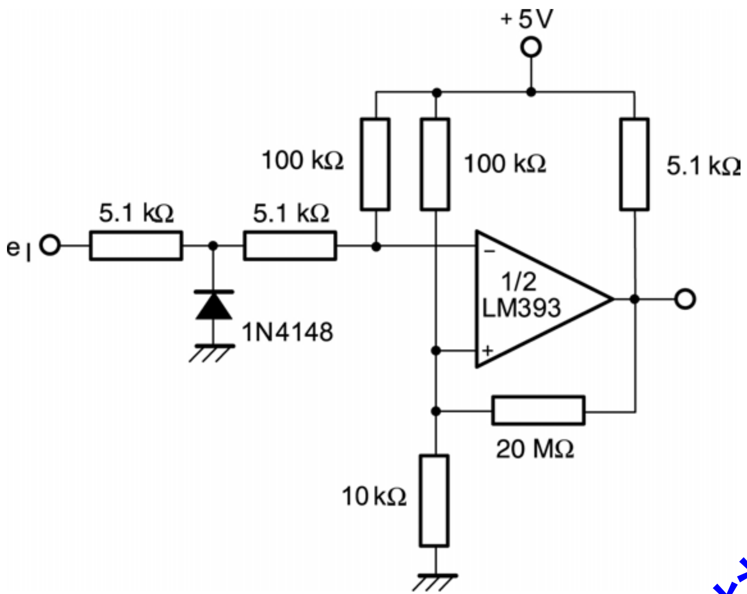

FIGURE 8. Zero crossing detector (single power supply)

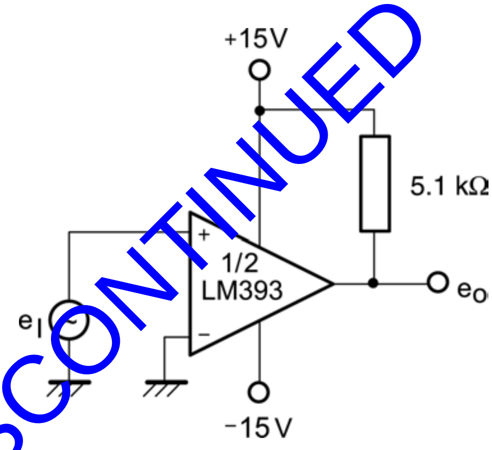

FIGURE 9. Zero crossing detector (split power supply)

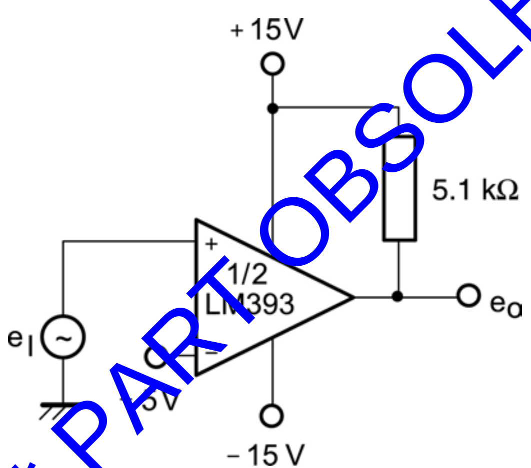

FIGURE 10. Comparator with a negative reference

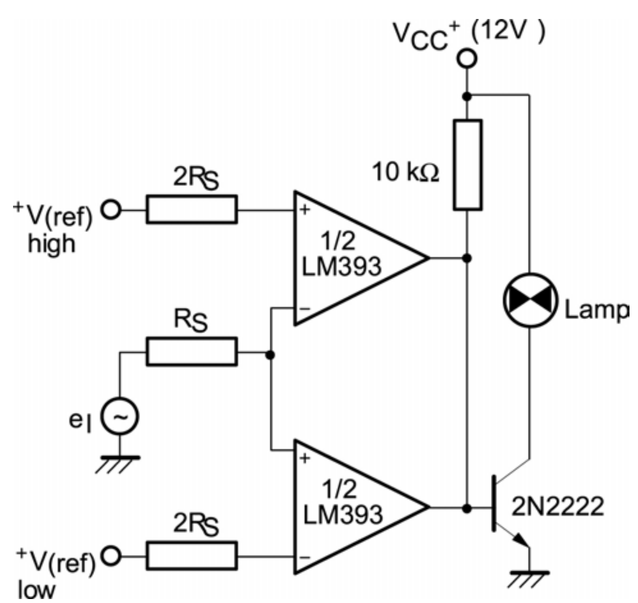

FIGURE 11. Limit Comparator

Typical Applications continued

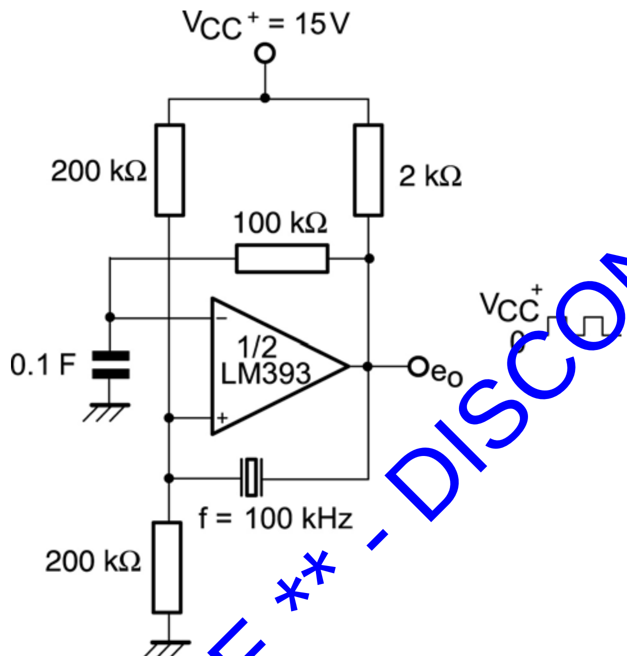

FIGURE 12. Crystal controlled Comparator

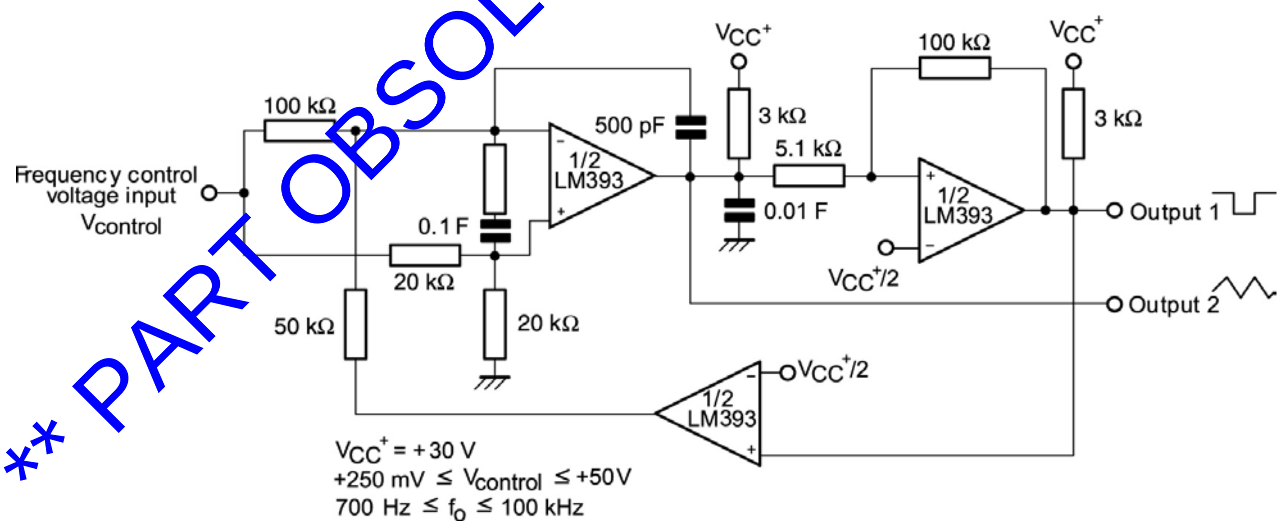

FIGURE 13. Two-decade High-Frequency VCO

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