



# Dual Differential Comparator – LM193

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

Rev 1.1  
21/01/18

## Description

The LM193 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:  $\pm 1.0V$  to  $\pm 18V$
- 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:

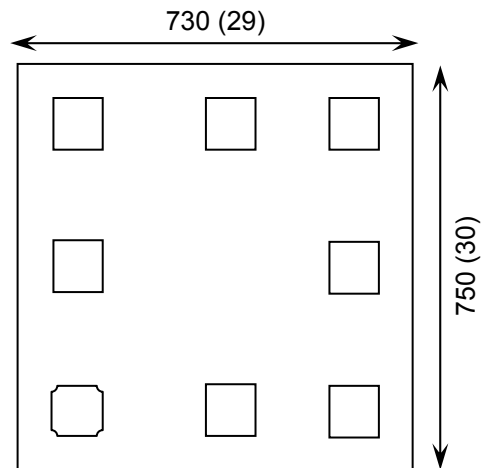
- No suffix - MIL-STD-883 /2010B Visual Inspection
- "H" - MIL-STD-883 /2010B Visual Inspection + MIL-PRF-38534 Class H LAT
- "K" - MIL-STD-883 /2010A Visual Inspection (Space) + MIL-PRF-38534 Class K LAT

LAT = Lot Acceptance Test.

For further information on LAT process flows see below.

[www.siliconsupplies.com/quality/bare-die-lot-qualification](http://www.siliconsupplies.com/quality/bare-die-lot-qualification)

## Die Dimensions in $\mu m$ (mils)



For a higher electrical grade version of this product see [LM193A](#)

## Supply Formats:

- Default – Die in Waffle Pack (400 per tray capacity)
- Sawn Wafer on Tape – On request
- Unsawn Wafer – On request
- Die Thickness  $\leftrightarrow$  350 $\mu m$ (15 Mils) – On request
- Assembled into Ceramic Package – On request

## Mechanical Specification

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

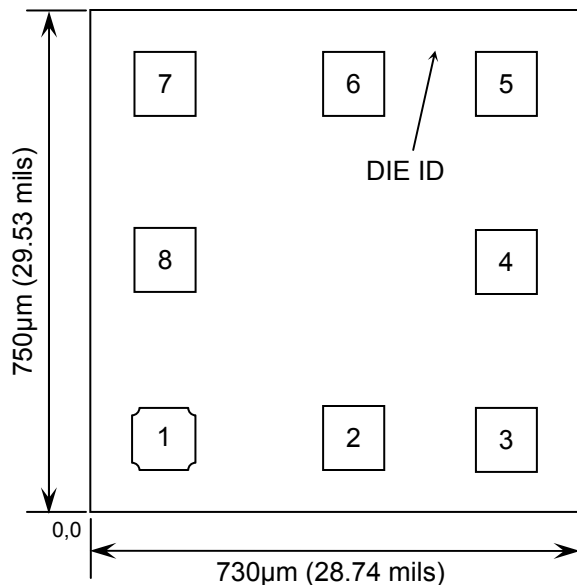




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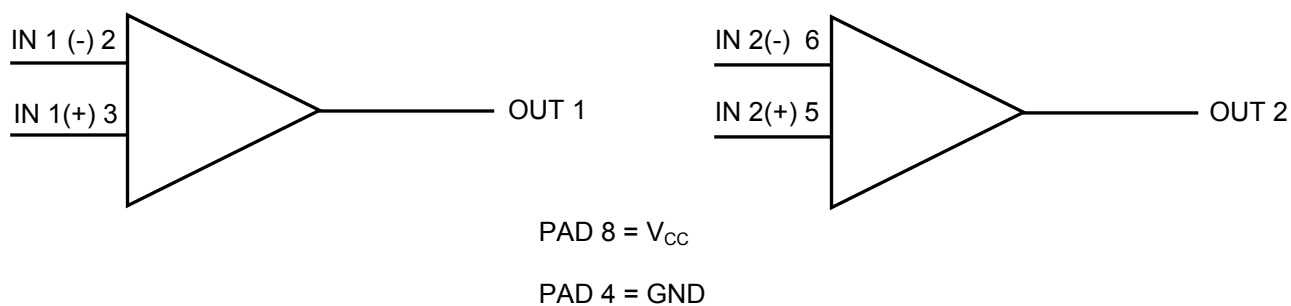
## Pad Layout and Functions



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 <sub>CC</sub>	0.065	0.330

CHIP BACK POTENTIAL IS GND OR FLOAT

## Logic Diagram





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

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) <sup>2</sup>	$I_{IN}$	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	$T_A$	-55	+125	°C

## DC Electrical Characteristics ( $T_A = -55^{\circ}C$ to $125^{\circ}C$ 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
			125°C	-	-	9	
Input Bias Current	$I_B$	$V_O = 1.4V, V_{CC} = 5-30V$ $V_{ICR} = 0V - (V_{CC} - 1.5V)$	25°C	-	25	100	nA
			125°C	-	-	300	
Input Offset Current	$I_{IO}$	$V_O = 1.4V, V_{CC} = 5-30V$ $V_{ICR} = 0V - (V_{CC} - 1.5V)$	25°C	-	±3	±25	nA
			125°C	-	-	±100	
Input Common Mode Voltage Range	$V_{ICR}$	$V_{CC} = 5-30V$	25°C	0	-	$V_{CC} - 1.5$	V
			125°C	0	-	$V_{CC} - 2.0$	
Supply Current	$I_{CC}$	$R_L = \infty, V_{CC} = 5V, T_A = 25^{\circ}C$	-	-	1	mA	
		$R_L = \infty, V_{CC} = 36V, T_A = 25^{\circ}C$	-	-	2.5		
Voltage Gain	$A_{VOL}$	$V_{CC} = 15V, R_L = 15K\Omega$ , $T_A = 25^{\circ}C, V_O = 1V$ to 11V	50	200	-	V/mV	
Large Signal Response Time	$t_1$	$V_{IN} = TTL$ Logic Swing, $V_{REF} = 1.4V, V_{CC} = 5V$ , $R_L = 5.1K\Omega, V_{RL} = 5V$ , $T_A = 25^{\circ}C$	-	300	-	ns	
Response Time	$t_2$	$V_{CC} = 5V, R_L = 5.1K\Omega$ , $V_{RL} = 5V, T_A = 25^{\circ}C$	-	1.3	-	µS	





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## DC Electrical Characteristics (T<sub>A</sub> = -55°C to 125°C unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	LIMITS			UNITS	
			MIN	TYP	MAX		
Output Sink Current	I <sub>SINK</sub>	V <sub>I(-)</sub> = 1V, V <sub>I(+)</sub> = 0V, V <sub>O</sub> ≤ 1.5V, V <sub>CC</sub> = 5V, T <sub>A</sub> = 25°C	6	16	-	mA	
Saturation Voltage	V <sub>SAT</sub>	V <sub>I(-)</sub> = 1V, V <sub>I(+)</sub> = 0V I <sub>SINK</sub> ≤ 4mA, V <sub>CC</sub> = 5V	25°C	-	250	400	mV
			125°C	-	-	700	
Output Leakage Current	I <sub>OL</sub>	V <sub>I(+)</sub> = 1V, V <sub>I(-)</sub> = 0V	V <sub>O</sub> = 5V, T <sub>A</sub> = 25°C	-	0.1	-	nA
			V <sub>O</sub> = 30V, T <sub>A</sub> = 125°C	-	-	1000	
Differential Input Voltage Range	V <sub>IDR</sub>	All V <sub>IN</sub> ≥ GND or V- Supply (if used)	-	-	V <sub>CC</sub>	V	

## Typical Applications

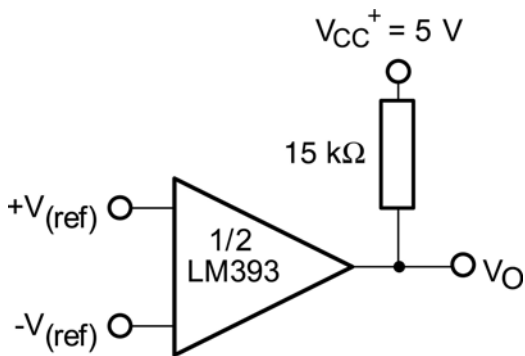


FIGURE 1. Basic Comparator

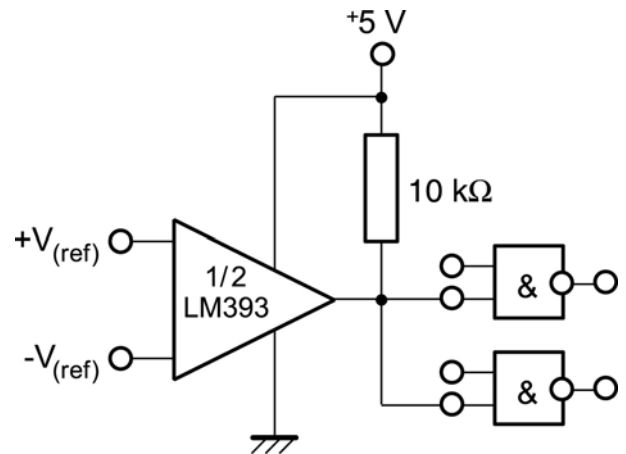


FIGURE 2. Driving TTL

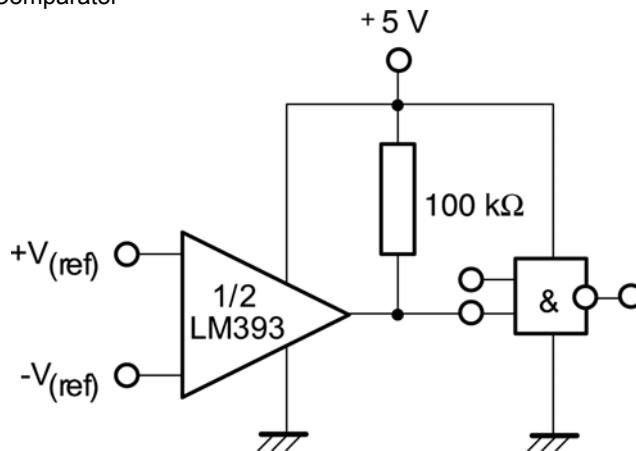


FIGURE 3. Driving CMOS





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## Typical Applications continued

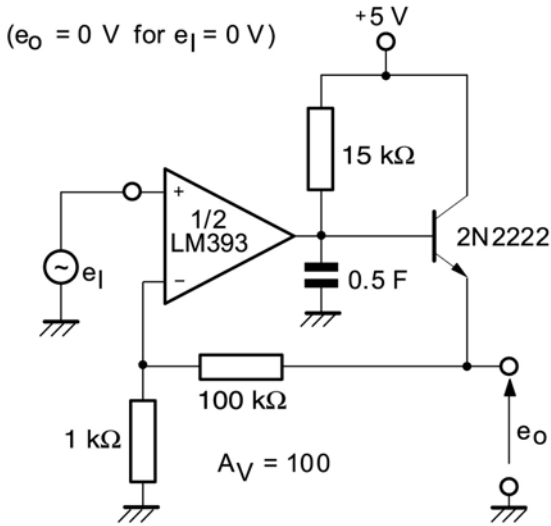


FIGURE 4. Low frequency Operational Amplifier V1

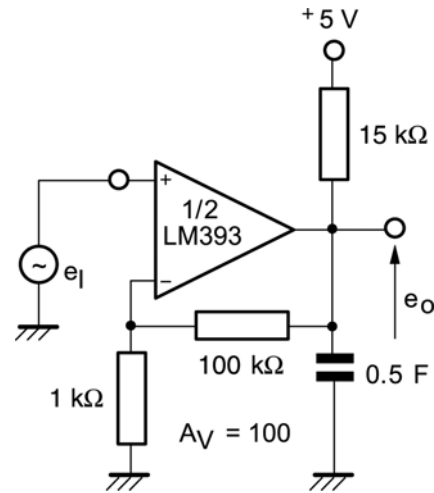


FIGURE 5. Low frequency Operational Amplifier V2

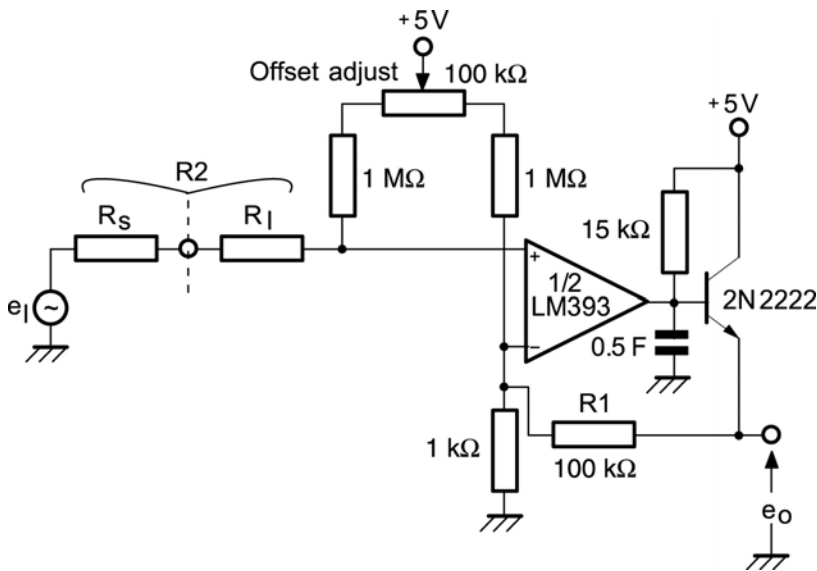


FIGURE 6. Low frequency Op-Amp with Offset adjust

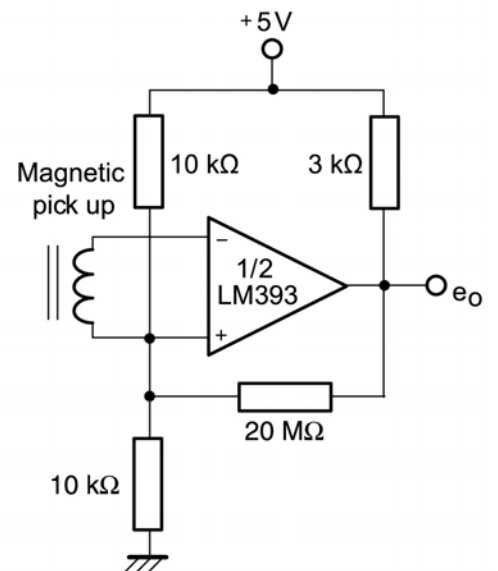


FIGURE 7. Transducer Amplifier





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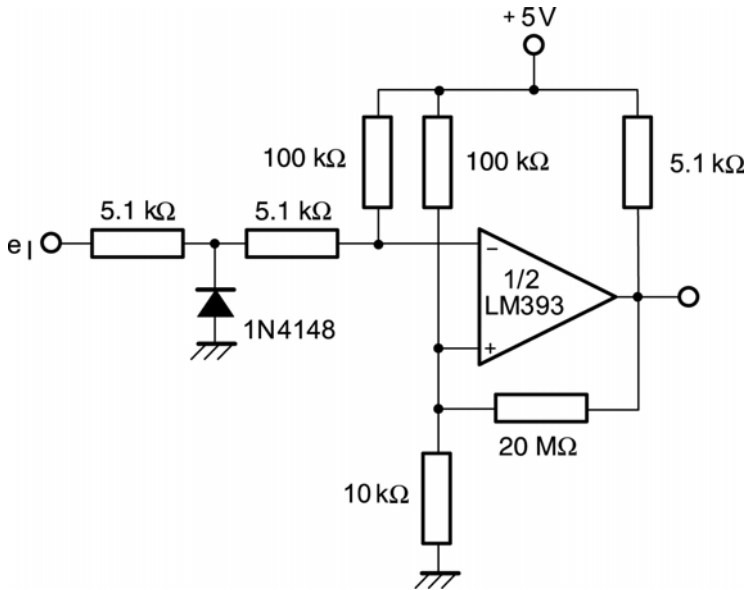


FIGURE 8. Zero crossing detector (single power supply)

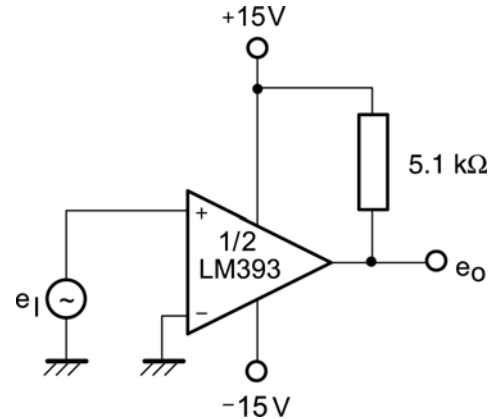


FIGURE 9. Zero crossing detector (split power supply)

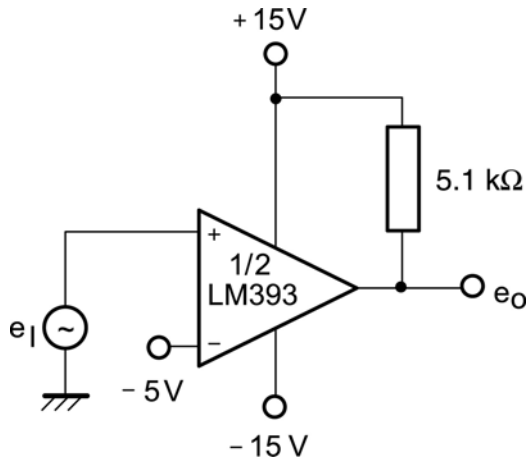


FIGURE 10. Comparator with a negative reference

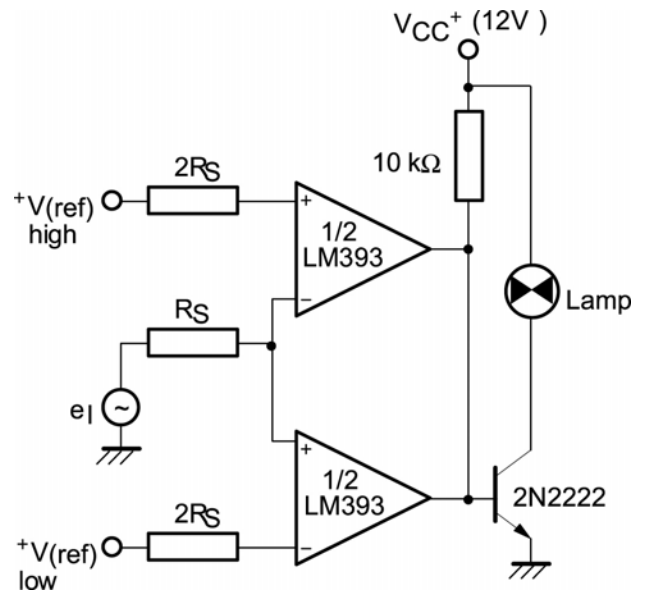


FIGURE 11. Limit Comparator





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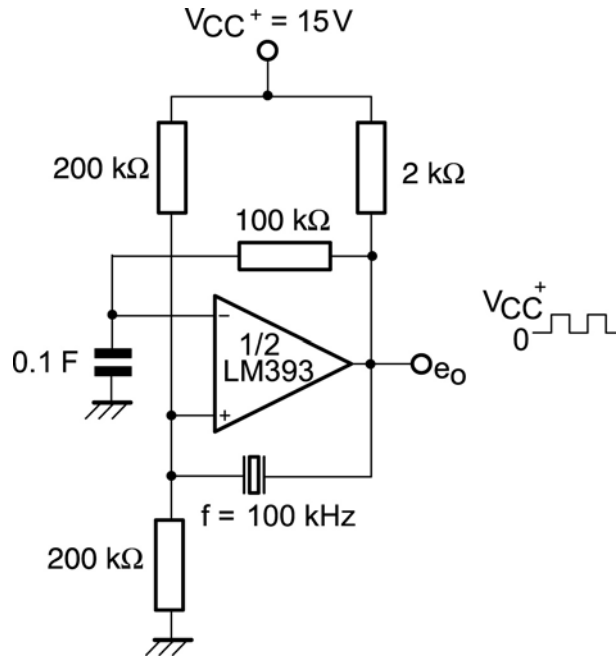


FIGURE 12. Crystal controlled Comparator

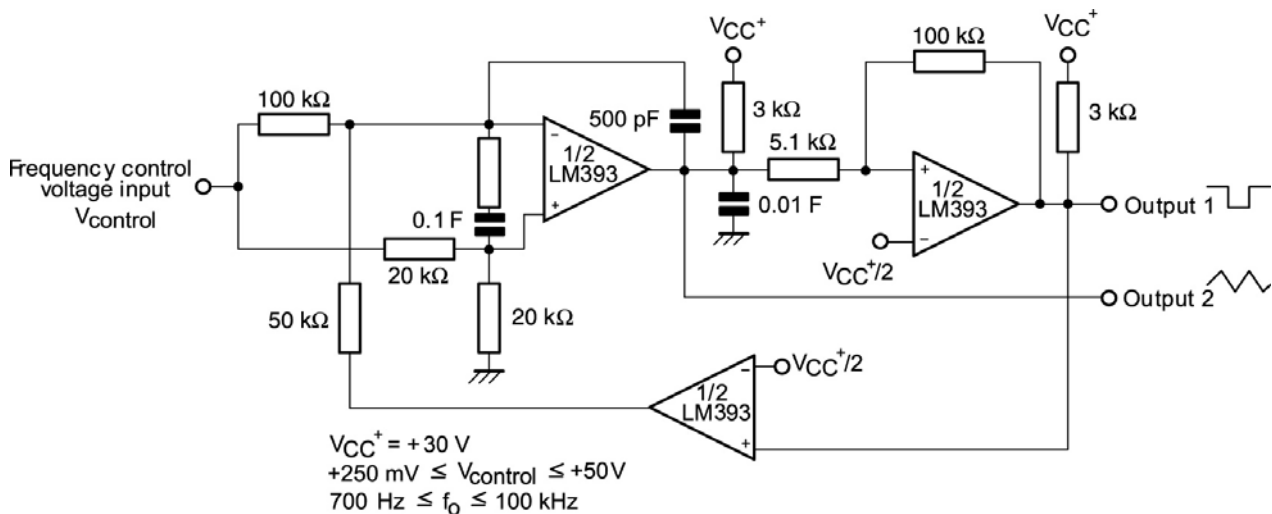


FIGURE 13. Two-decade High-Frequency VCO





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