

## LOW POWER DUAL VOLTAGE COMPARATORS

- WIDE SINGLE SUPPLY VOLTAGE RANGE OR DUAL SUPPLIES +2V TO +36V OR ±1V TO ±18V
- VERY LOW SUPPLY CURRENT (0.4mA) INDEPENDENT OF SUPPLY VOLTAGE (1mW/comparator at +5V)
- LOW INPUT BIAS CURRENT: 25nA TYP
- LOW INPUT OFFSET CURRENT: ±5nA TYP
- INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GROUND
- LOW OUTPUT SATURATION VOLTAGE: 250mV TYP. ( $I_O = 4mA$ )
- DIFFERENTIAL INPUT VOLTAGE RANGE EQUAL TO THE SUPPLY VOLTAGE
- TTL, DTL, ECL, MOS, CMOS COMPATIBLE OUTPUTS

### DESCRIPTION

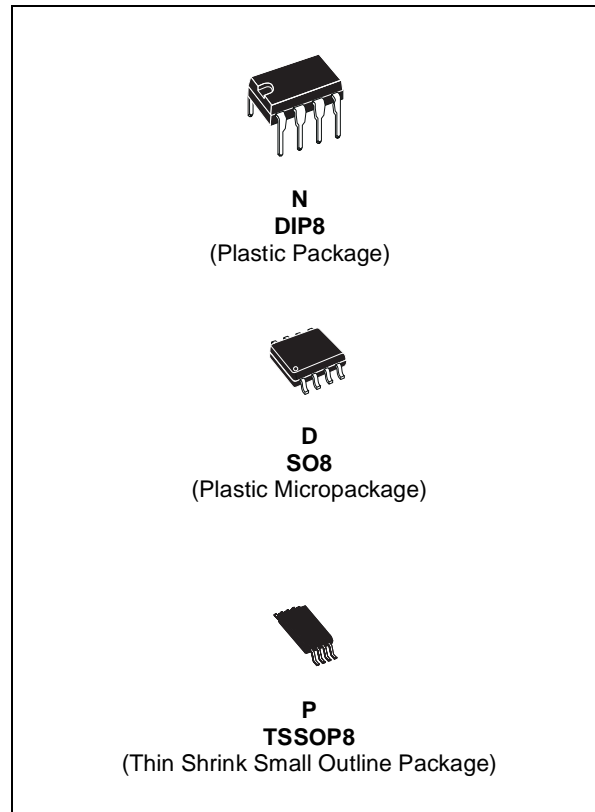
This device consists of two independent low power voltage comparators designed specifically to operate from a single supply over a wide range of voltages. Operation from split power supplies is also possible.

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.

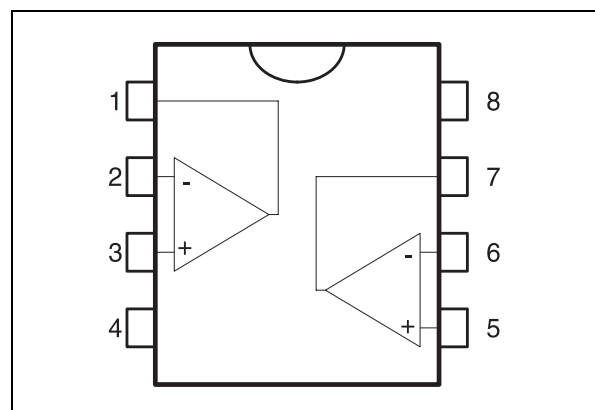
### ORDER CODE

Part Number	Temperature Range	Package		
		N	D	P
LM2903	-40°C, +125°C	•	•	•

**N** = Dual in Line Package (DIP)  
**D** = Small Outline Package (SO) - also available in Tape & Reel (DT)  
**P** = Thin Shrink Small Outline Package (TSSOP) - only available in Tape & Reel (PT)

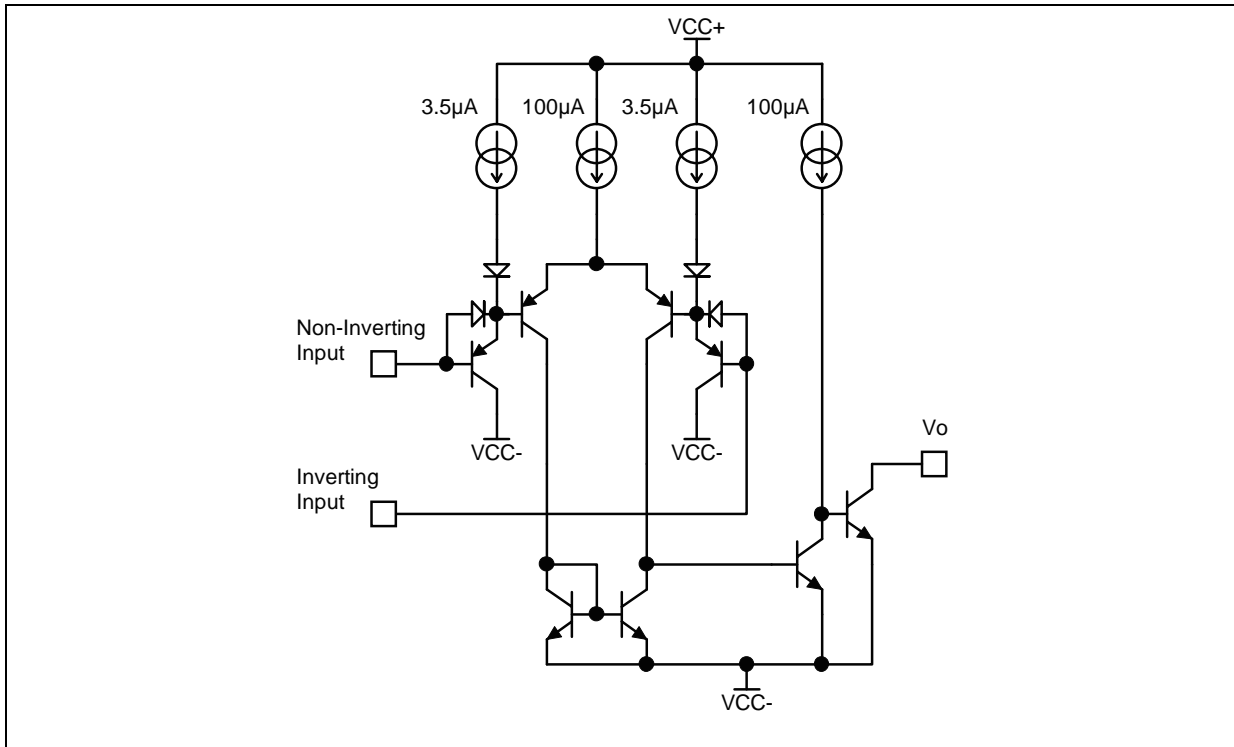


### PIN CONNECTIONS (top view)



# LM2903

## SCHEMATIC DIAGRAM (1/2 LM2903)



## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit	
$V_{CC}$	Supply Voltage	$\pm 18$ to 36	V	
$V_{ID}$	Differential Input Voltage	$\pm 36$	V	
$V_I$	Input Voltage	-0.3 to +36	V	
	Output Short-circuit to Ground <sup>1)</sup>	Infinite		
$P_d$	Power Dissipation <sup>2)</sup>	DIP8 SO8 TSSOP8	1250 710 625	mW
$T_{Junction}$	Junction Temperature	+150	°C	
$T_{stg}$	Storage Temperature Range	-65 to +150	°C	

- Short-circuit from the output to  $V_{CC}^+$  can cause excessive heating and eventual destruction. The maximum output current is approximately 20mA, independent of the magnitude of  $V_{CC}^+$ .
- $P_d$  is calculated with  $T_{amb} = +25^\circ\text{C}$ ,  $T_j = +150^\circ\text{C}$  and  $R_{thja} = 100^\circ\text{C/W}$  for DIP8 package  
 $= 175^\circ\text{C/W}$  for SO8 package  
 $= 200^\circ\text{C/W}$  for TSSOP8 package

## OPERATING CONDITIONS

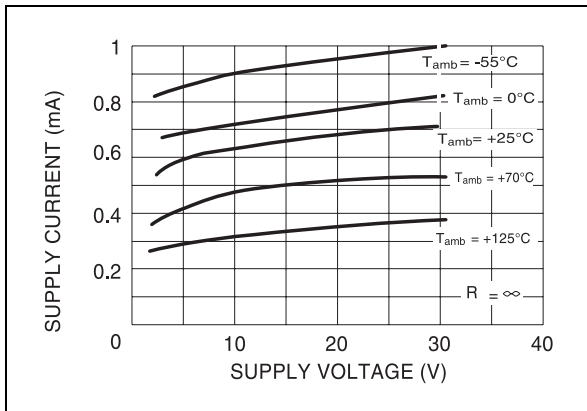
Symbol	Parameter	Value	Unit
$V_{icm}$	Common Mode Input Voltage Range	0 to $V_{CC}^+ - 1.5$	V
$T_{oper}$	Operating Free-Air Temperature range	-40 to +125	°C

**ELECTRICAL CHARACTERISTICS**
 $V_{CC}^+ = 5V$ ,  $V_{CC}^- = GND$ ,  $T_{amb} = 25^\circ C$  (unless otherwise specified)

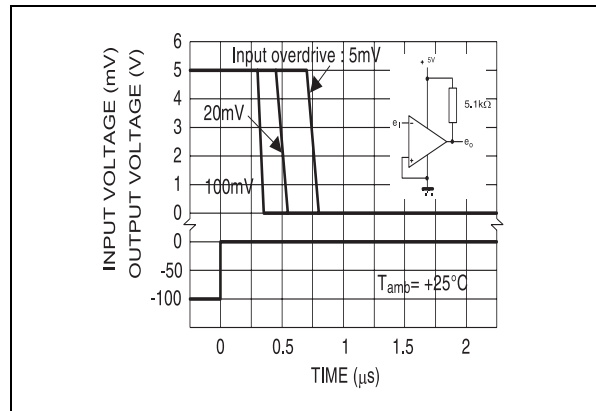
Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{IO}$	Input Offset Voltage <sup>1)</sup> $T_{amb} = +25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$ .		1	7 15	mV
$I_{IO}$	Input Offset Current $T_{amb} = +25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$ .		5	50 150	nA
$I_{IB}$	Input Bias Current <sup>2)</sup> $T_{amb} = +25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$ .		25	250 400	nA
$A_{VD}$	Large Signal Voltage Gain ( $V_{CC} = 15V, R_L = 15k\Omega, V_O = 1$ to $11V$ )	25	200		V/mV
$I_{CC}$	Supply Current (all comparators) $V_{CC} = 5V$ , no load $V_{CC} = 30V$ , no load		0.4 1	1 2.5	mA
$V_{ICM}$	Input Common Mode Voltage Range ( $V_{CC} = 30V$ ) <sup>3)</sup> $T_{amb} = +25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$ .	0 0		$V_{CC}^+ - 1.5$ $V_{CC}^+ - 2$	V
$V_{ID}$	Differential Input Voltage <sup>4)</sup>			$V_{CC}^+$	V
$V_{OL}$	Low Level Output Voltage ( $V_{id} = -1V, I_{sink} = 4mA$ ) $T_{amb} = +25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$		250	400 700	mV
$I_{OH}$	High Level Output Current ( $V_{CC} = V_O = 30V, V_{id} = 1V$ ) $T_{amb} = +25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$		0.1	1	nA $\mu A$
$I_{SINK}$	Output Sink Current ( $V_{id} = -1V, V_O = 1.5V$ )	6	16		mA
$t_{RE}$	Small Signal Response Time <sup>5)</sup> ( $R_L = 5.1k\Omega$ to $V_{CC}^+$ )		1.3		$\mu s$
$t_{REL}$	Large Signal Response Time <sup>6)</sup> TTL Input ( $V_{ref} = +1.4V, R_L = 5.1k\Omega$ to $V_{CC}^+$ ) Output Signal at 50% of final value Output Signal at 95 % of final value			500 1	ns $\mu s$

- At output switch point,  $V_O = 1.4V$ ,  $R_S = 0\Omega$  with  $V_{CC}^+$  from 5V to 30V, and over the full input common-mode range (0V to  $V_{CC}^+ - 1.5V$ ).
- The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output, so no loading charge exists on the reference of input lines
- The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is  $V_{CC}^+ - 1.5V$ , but either or both inputs can go to +30V without damage.
- Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator will provide a proper output state.  
The low input voltage state must not be less than  $-0.3V$  (or  $0.3V$  below the negative power supply, if used)
- The response time specified is for a 100mV input step with 5mV overdrive.
- Maximum values are guaranteed by design & evaluation.

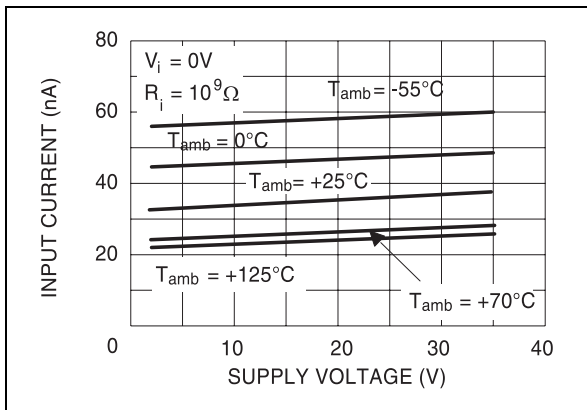
SUPPLY CURRENT versus SUPPLY VOLTAGE



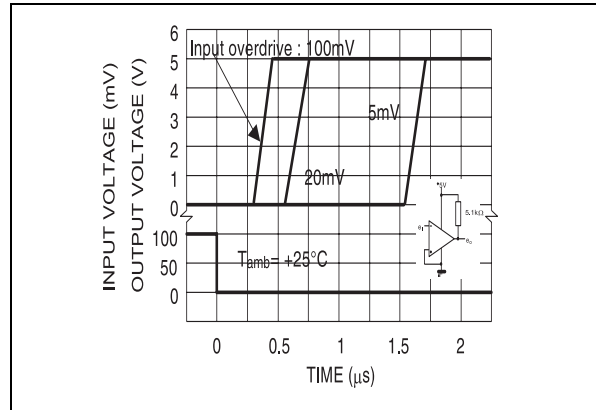
RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - NEGATIVE TRANSITION



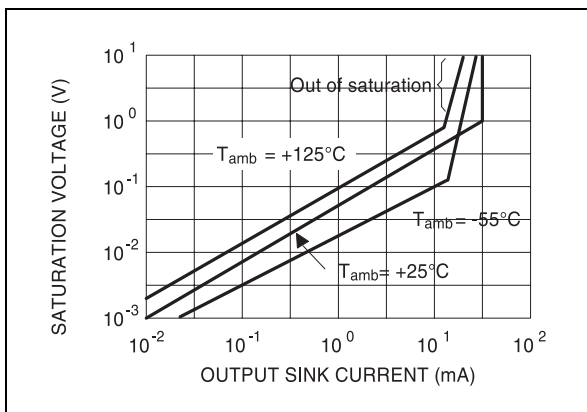
INPUT CURRENT versus SUPPLY VOLTAGE



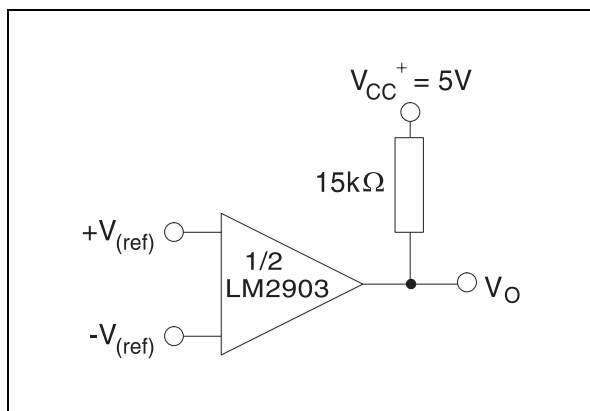
RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - POSITIVE TRANSITION



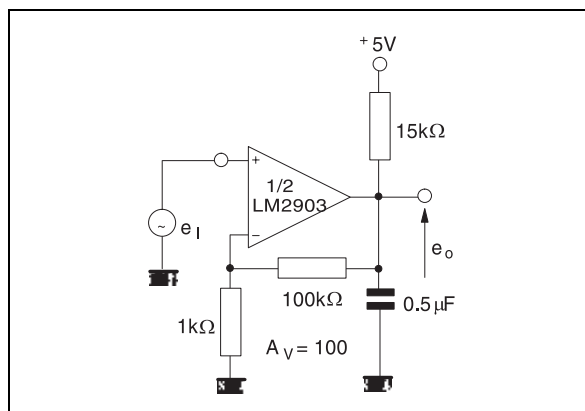
OUTPUT SATURATION VOLTAGE versus OUTPUT CURRENT



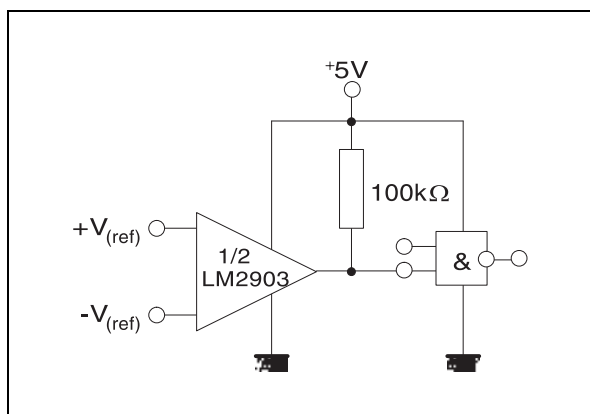
**TYPICAL APPLICATIONS**  
**BASIC COMPARATOR**



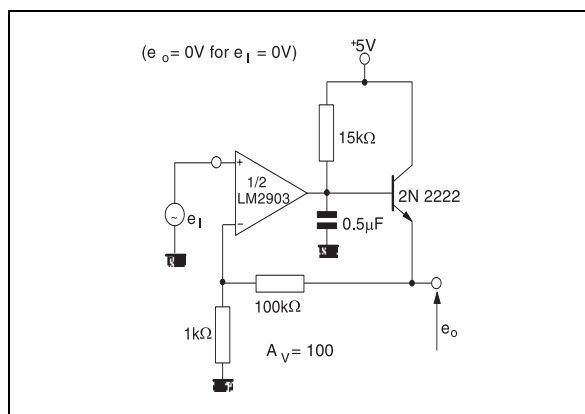
**LOW FREQUENCY OP AMP**



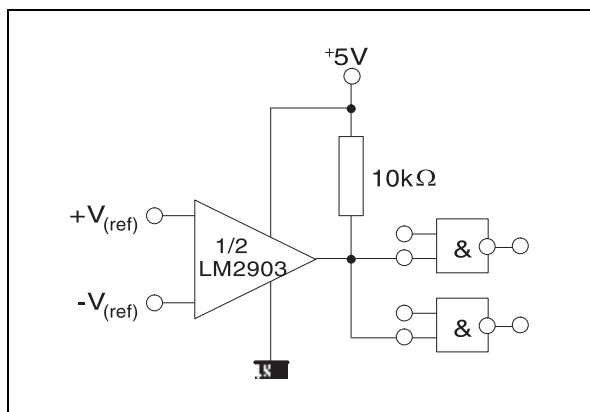
**DRIVING CMOS**



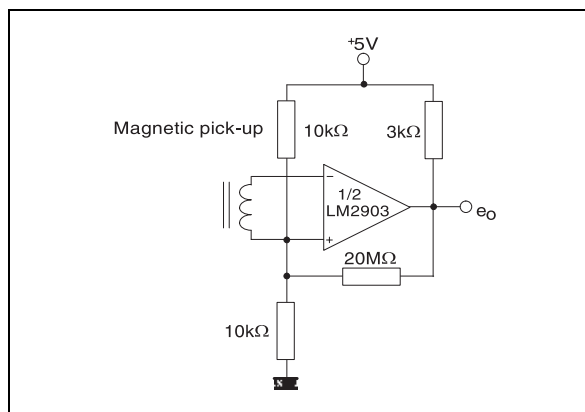
**LOW FREQUENCY OP AMP**



**DRIVING TTL**

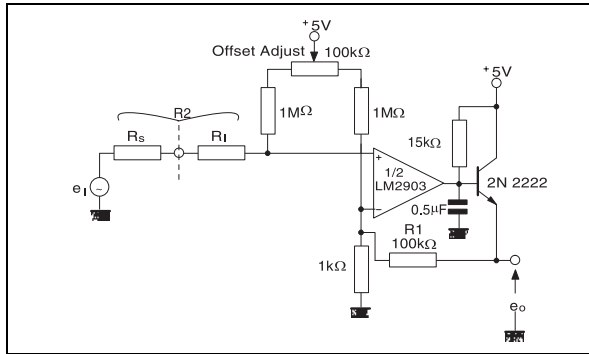


**TRANSDUCER AMPLIFIER**

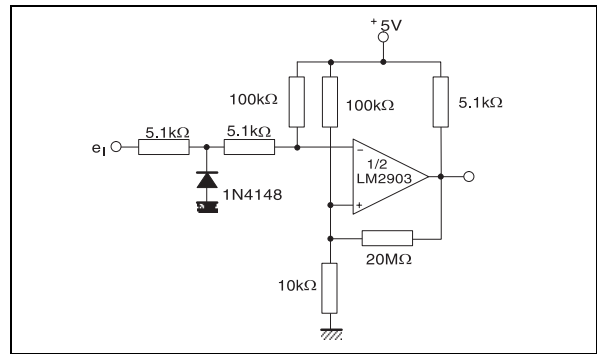


# LM2903

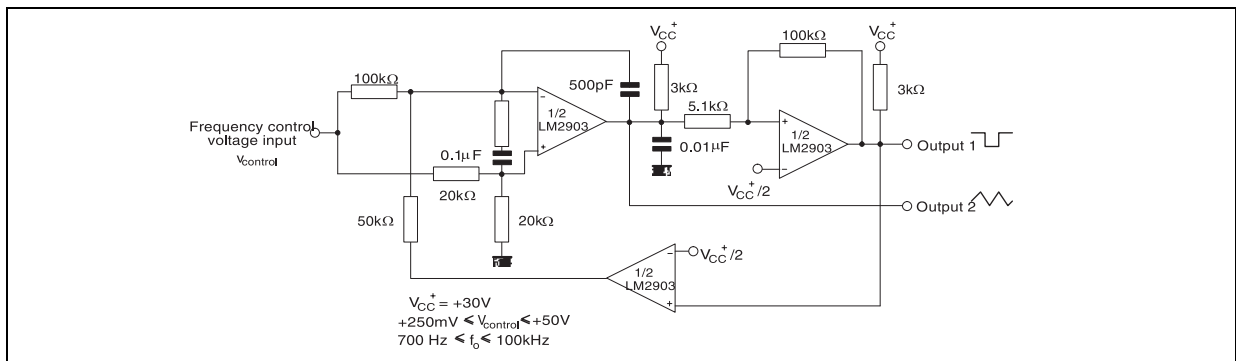
## LOW FREQUENCY OP AMP WITH OFFSET ADJUST



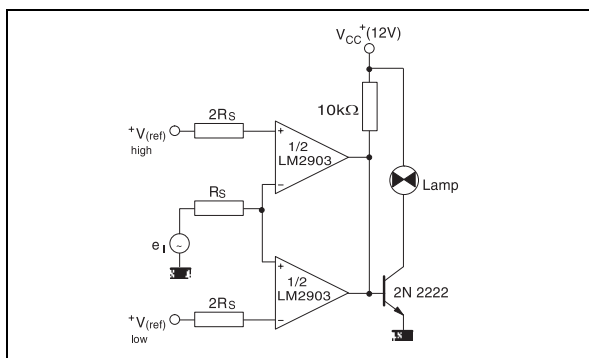
## ZERO CROSSING DETECTOR (single power supply)



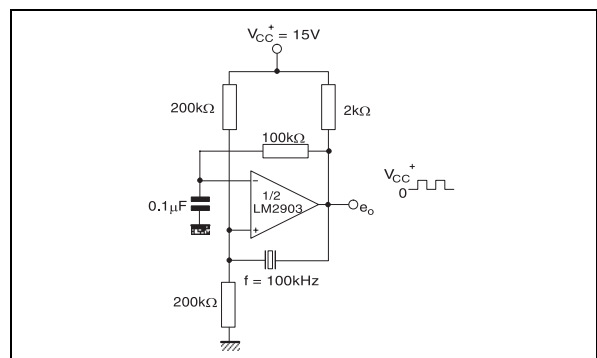
## TWO-DECADE HIGH-FREQUENCY VCO



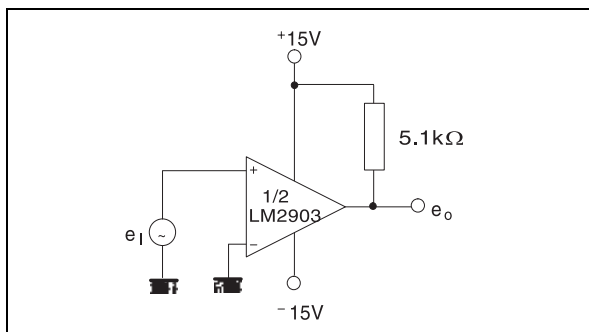
## LIMIT COMPARATOR



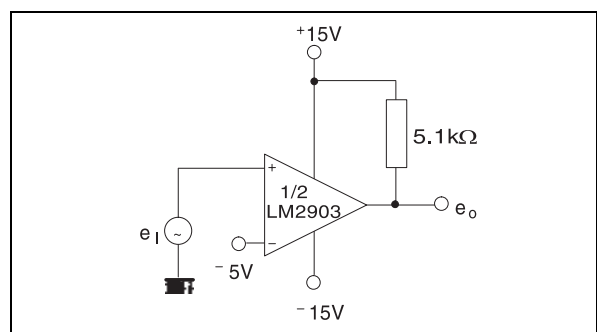
## CRYSTAL CONTROLLED OSCILLATOR



## SPLIT-SUPPLY APPLICATIONS ZERO CROSSING DETECTOR

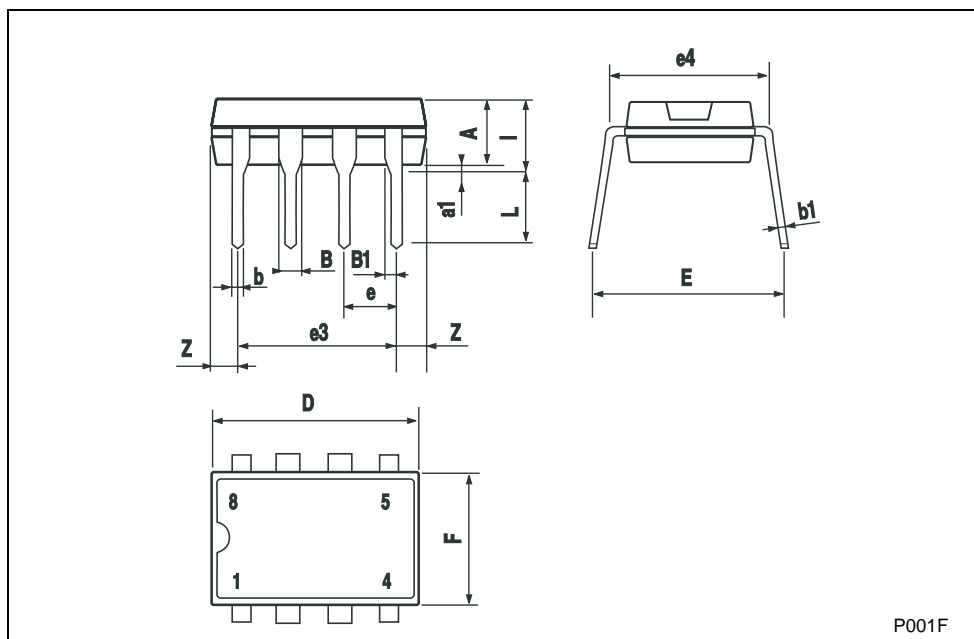


## COMPARATOR WITH A NEGATIVE REFERENCE



## PACKAGE MECHANICAL DATA

Plastic DIP-8 MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A		3.3			0.130	
a1	0.7			0.028		
B	1.39		1.65	0.055		0.065
B1	0.91		1.04	0.036		0.041
b		0.5			0.020	
b1	0.38		0.5	0.015		0.020
D			9.8			0.386
E		8.8			0.346	
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			7.1			0.280
I			4.8			0.189
L		3.3			0.130	
Z	0.44		1.6	0.017		0.063

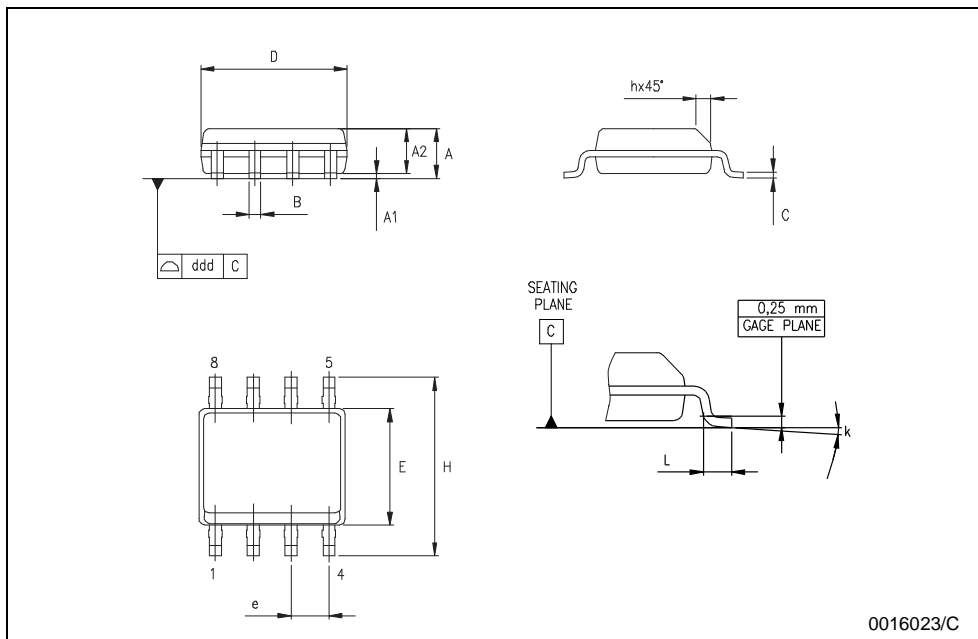


P001F

PACKAGE MECHANICAL DATA

**SO-8 MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.04		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D	4.80		5.00	0.189		0.197
E	3.80		4.00	0.150		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	8° (max.)					
ddd			0.1			0.04

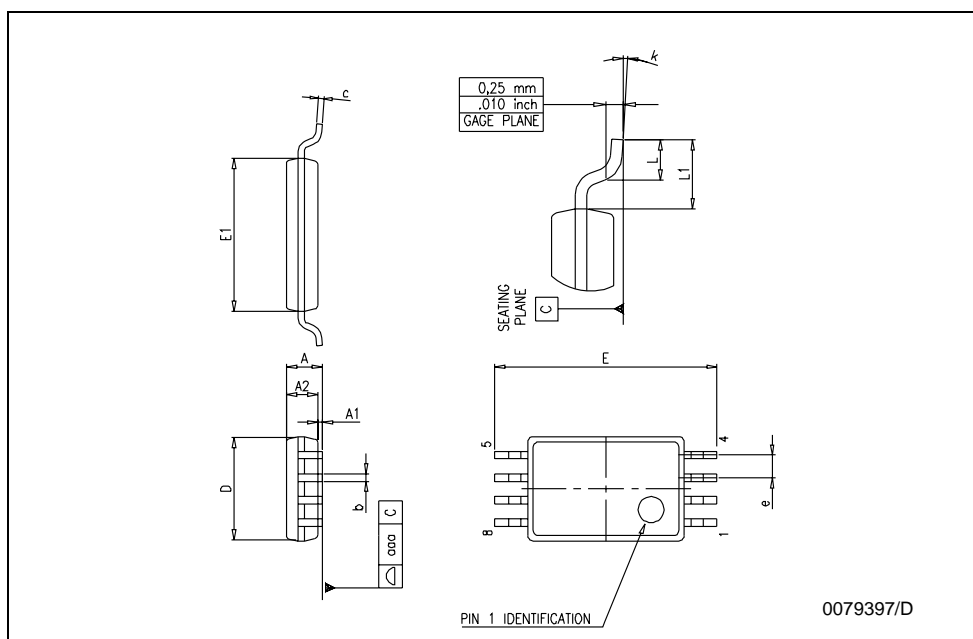


0016023/C



## PACKAGE MECHANICAL DATA

TSSOP8 MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.008
D	2.90	3.00	3.10	0.114	0.118	0.122
E	6.20	6.40	6.60	0.244	0.252	0.260
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.0256	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030
L1		1			0.039	



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