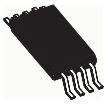
LM2903

Low Power Dual Voltage Comparator

- 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

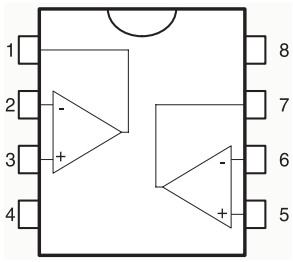
N
DIP8
(Plastic Package)

D
SO-8
(Plastic Micropackage)



P
TSSOP8
(Thin Shrink Small Outline Package)

Pin connections (top view)



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 Codes

Part Number	Temperature Range	Package	Packing	Marking
LM2903N	-40°C, +125°C	DIP8	Tube	LM2903N
LM2903D/LM2903DT		SO-8	Tube or Tape & Reel	2903
LM2903PT		TSSOP8 (Thin Shrink Outline Package)	Tape & Reel	
LM2903YD/YDT		SO-8 (automotive grade level)	Tube or Tape & Reel	2903Y
LM2903YPT		TSSOP8 (automotive grade level)	Tape & Reel	

1 Absolute Maximum Ratings

Table 1. Key parameters and their absolute maximum ratings

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

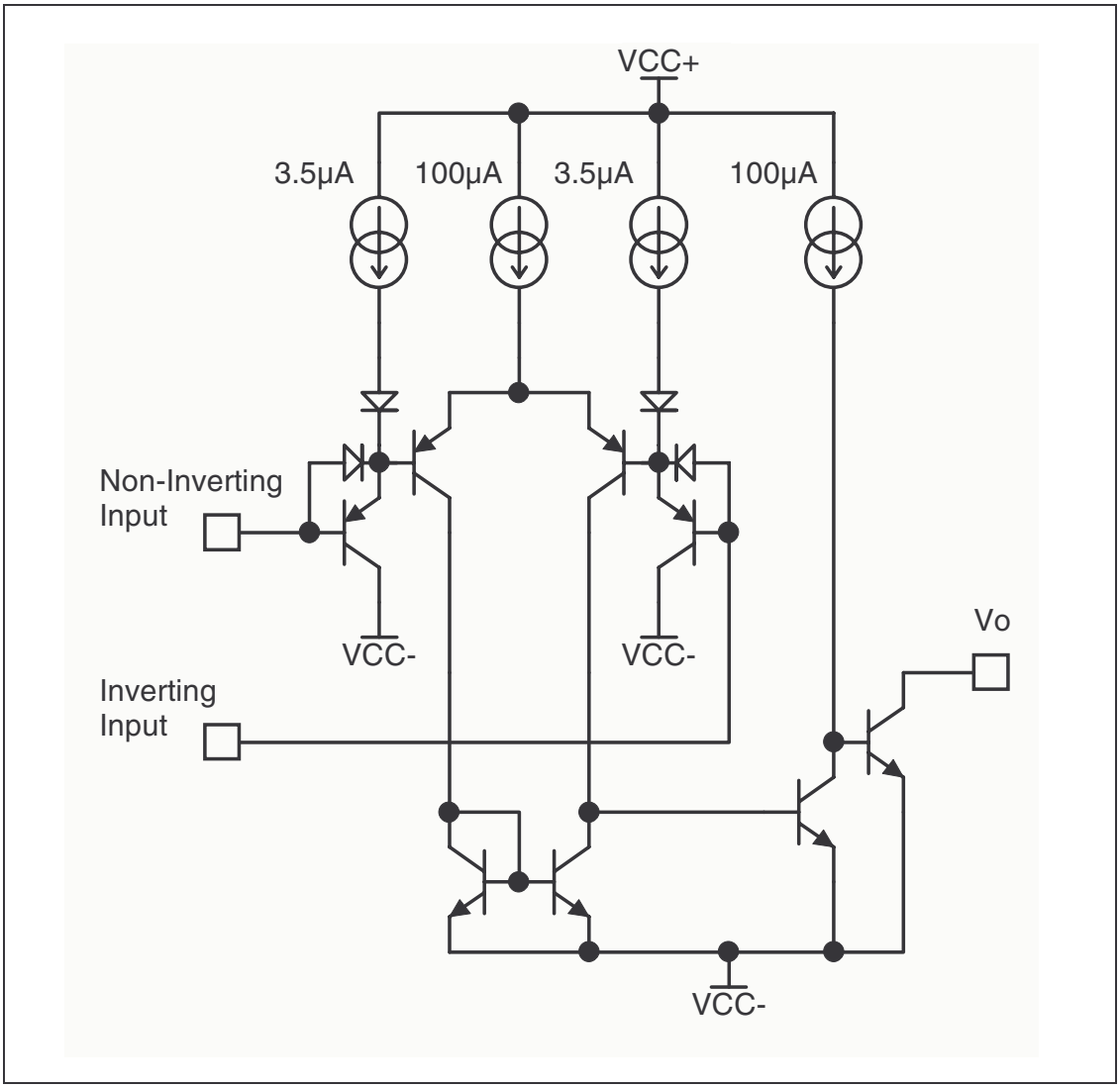
1. Short-circuit from the output to V_{cc}^+ can cause excessive heating and eventual destruction. The maximum output current is approximately 20mA, independent of the magnitude of V_{cc}^+
2. Pd is calculated with T_{amb} = +25°C, T_j = +150°C and R_{thja} = 100°C/W for DIP8 package
   = 175°C/W for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

Table 2. 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

2 Typical Application Schematic

Figure 1. Schematic diagram (1/2 LM2903)



3 Electrical Characteristics

Table 3. V_{CC}^+ = 5V, V_{cc}^- = GND, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{IO}	Input Offset Voltage (1) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.		1	7 15	mV
I_{IO}	Input Offset Current T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.		5	50 150	nA
I_{IB}	Input Bias Current (2) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.		25	250 400	nA
A_{VD}	Large Signal Voltage Gain V_{cc} = 15V,R_L=15kΩ, 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) (3) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.	0 0		V_{CC}^+-1.5 V_{CC}^+-2	V
V_{ID}	Differential Input Voltage (4)			V_{CC}^+	V
V_{OL}	Low Level Output Voltage (V_{id} = -1V, I_{sink} = 4mA) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$		250	400 700	mV
I_{OH}	High Level Output Current (V_{CC} =V_o =30V, V_{id} = 1V) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$		0.1	 1	nA µA
I_{SINK}	Output Sink Current (V_{id} = -1V,V_o = 1.5V)	6	16		mA
t_{RE}	Small Signal Response Time (5) (R_L = 5.1kΩ to V_{CC}^+)		1.3		µs
t_{REL}	Large Signal Response Time (6) TTL Input (V_{ref} = +1.4 V, R_L=5.1kΩ to V_{CC}^+) Output Signal at 50% of final value Output Signal at 95% of final value			 500 1	 ns µs

1. At output switch point, $V_O \approx$ 1.4V, R_S = 0Ω with V_{CC}^+ from 5V to 30V, and over the full input common-mode range (0V to V_{CC}^+ –1.5V).
2. 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
3. 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.
4. 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)
5. The response time specified is for a 100mV input step with 5mV overdrive.
6. Maximum values are guaranteed by design & evaluation.

Figure 2. Supply current versus supply voltage

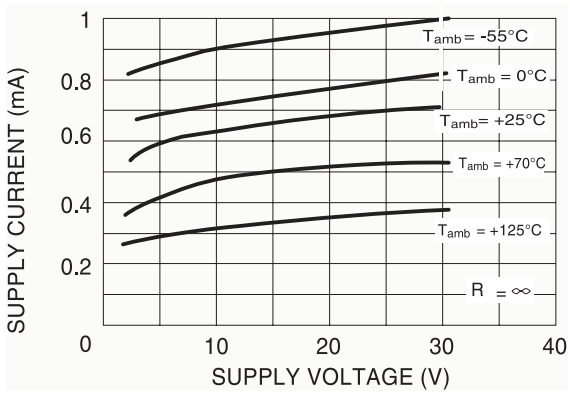


Figure 3. Input current versus supply voltage

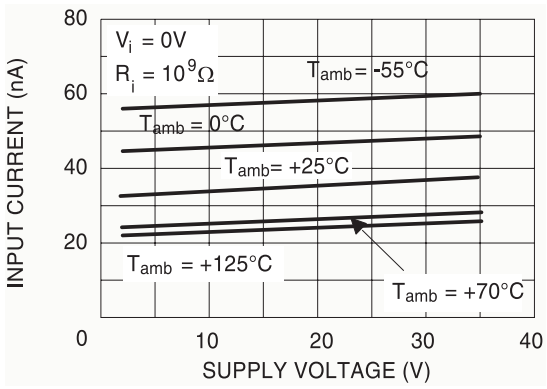


Figure 4. Output saturation voltage versus output current

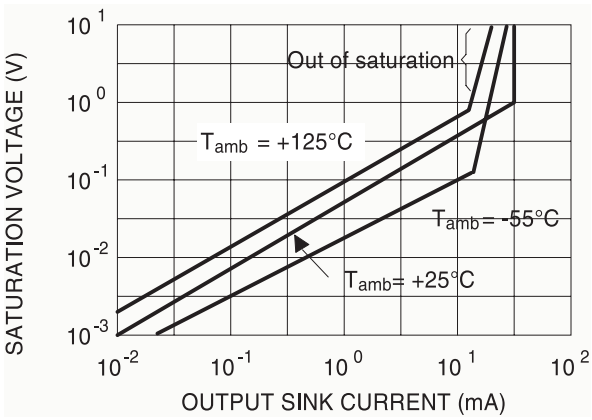


Figure 5. Response time for various input overdrives - negative transition

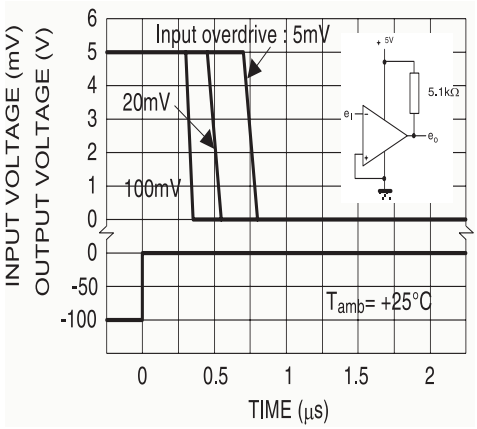
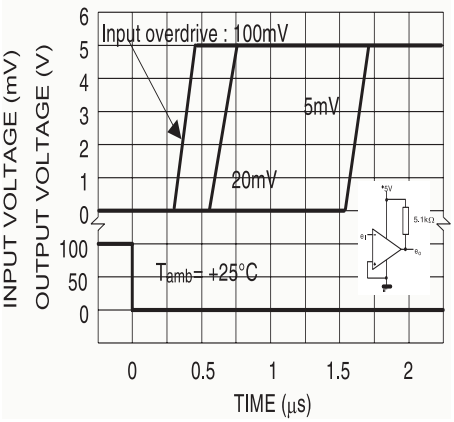


Figure 6. Response time for various input overdrives - positive transition



4 Typical Applications

Figure 7. Basic comparator

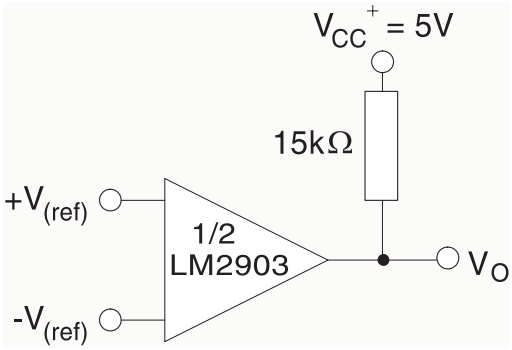


Figure 8. Driving CMOS

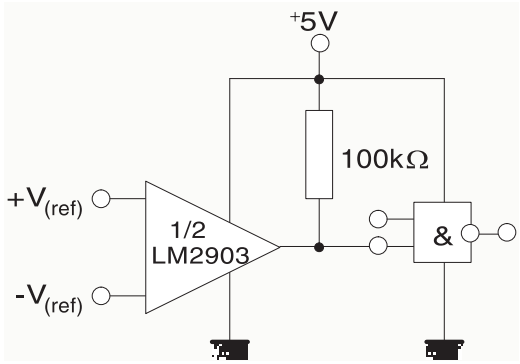


Figure 9. Driving TTL

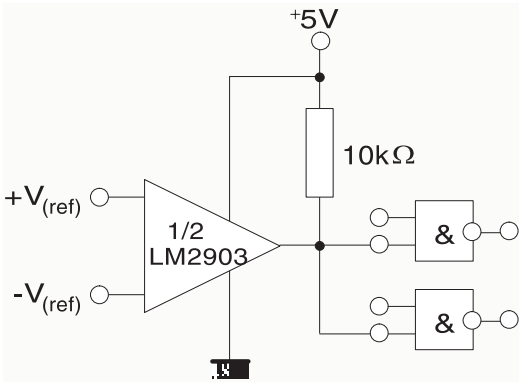


Figure 10. Low frequency op-amp

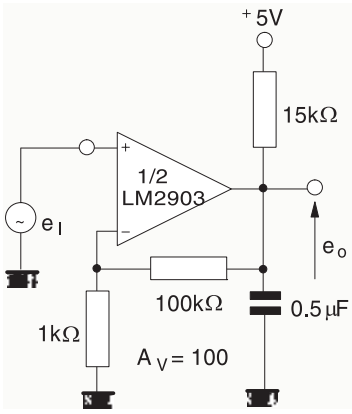


Figure 11. Low frequency op-amp

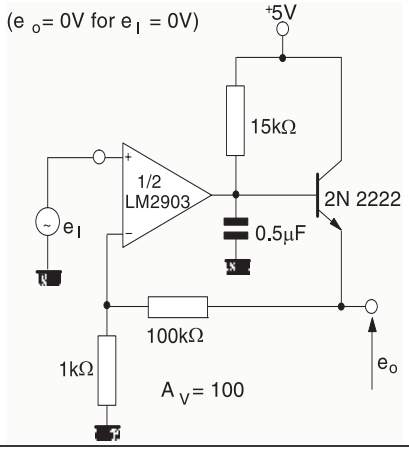


Figure 12. Transducer amplifier

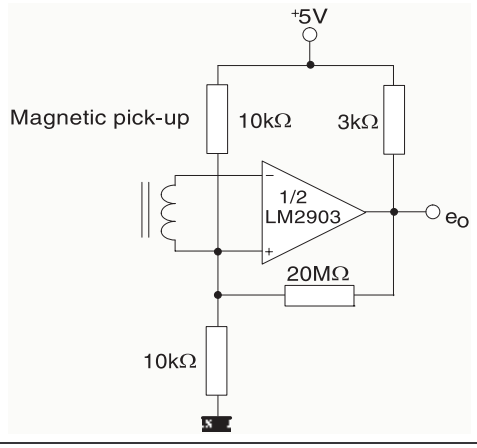


Figure 13. Low frequency op- amp with offset adjust

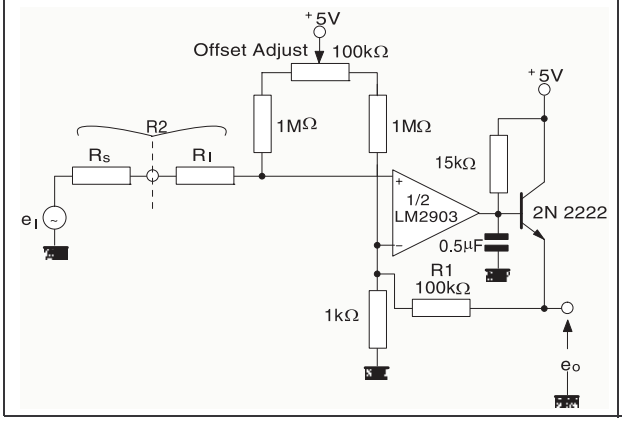


Figure 14. Zero crossing detector (single power supply)

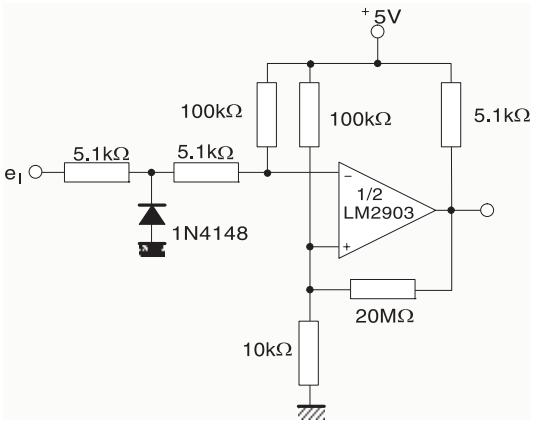


Figure 15. Limit comparator

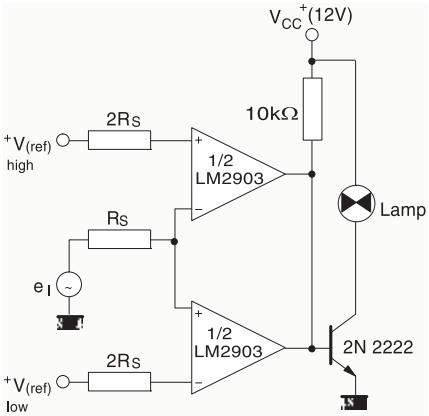


Figure 16. Split-supply applications - zero crossing detector

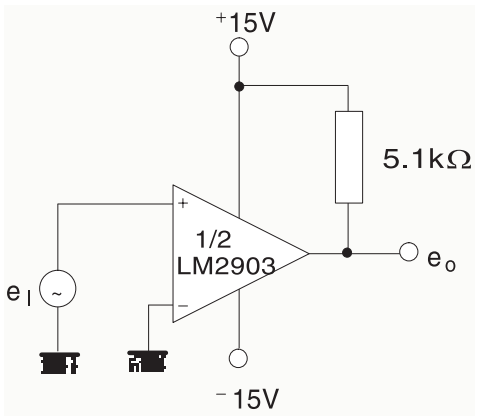


Figure 17. Split-supply applications - crystal controlled oscillator

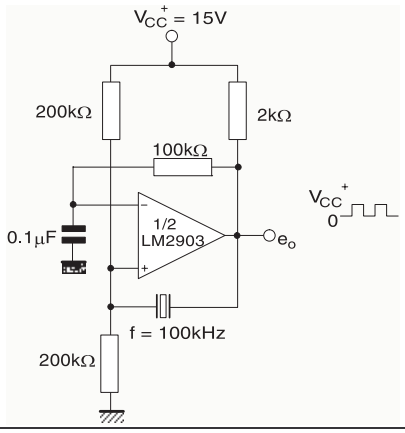


Figure 18. Comparator with a negative reference

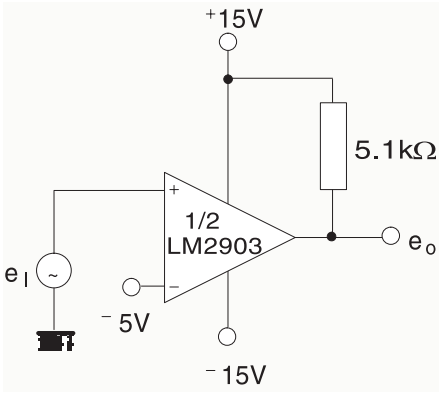
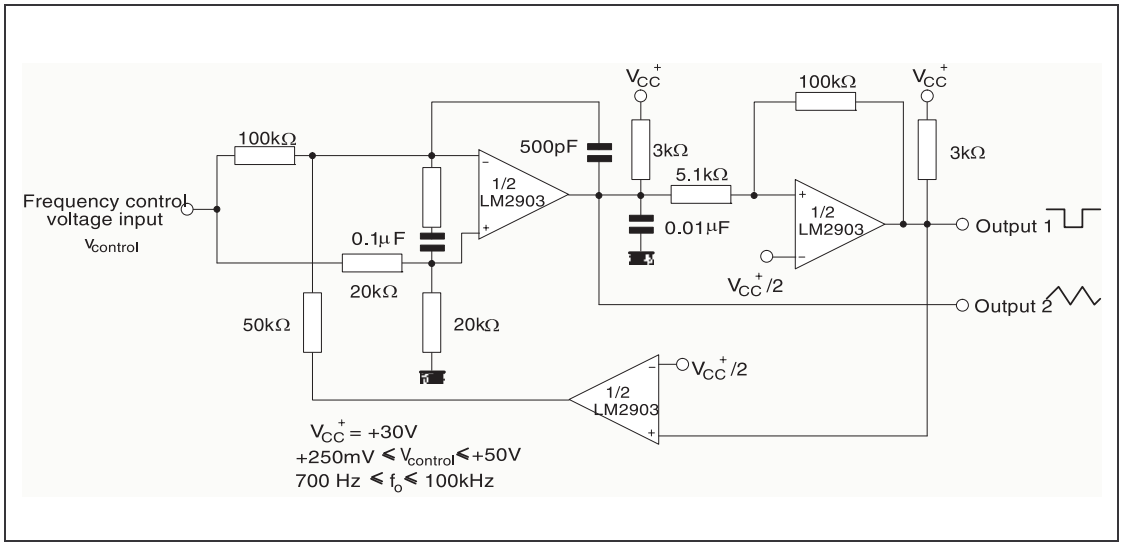


Figure 19. Two-decade high-frequency VCO



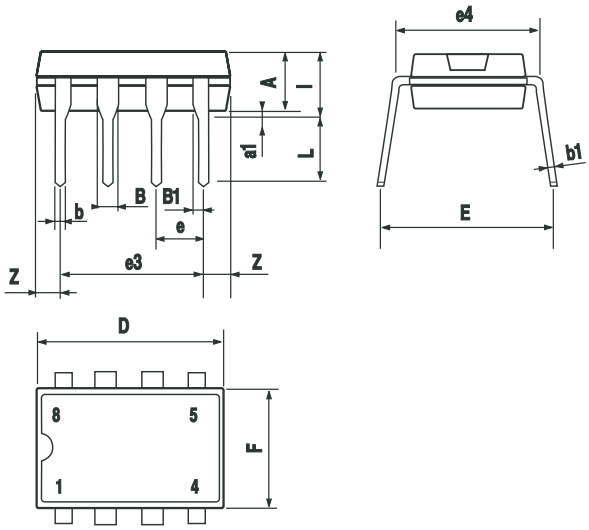
5 Package Mechanical Data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

5.1 DIP8 Package

Plastic DIP-8 MECHANICAL DATA

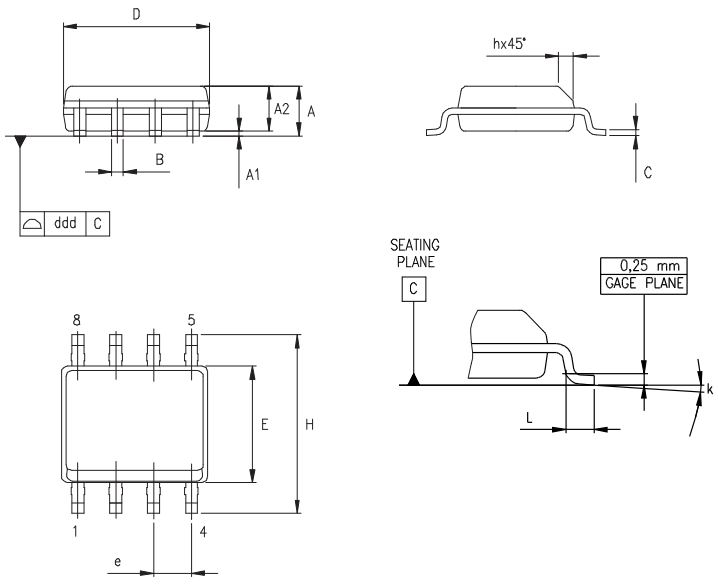
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A		3.3			0.130	
a1	0.7			0.028		
B	1.39		1.65	0.055		0.065
B1	0.91		1.04	0.036		0.041
b		0.5			0.020	
b1	0.38		0.5	0.015		0.020
D			9.8			0.386
E		8.8			0.346	
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			7.1			0.280
I			4.8			0.189
L		3.3	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



5.2 SO-8 Package

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

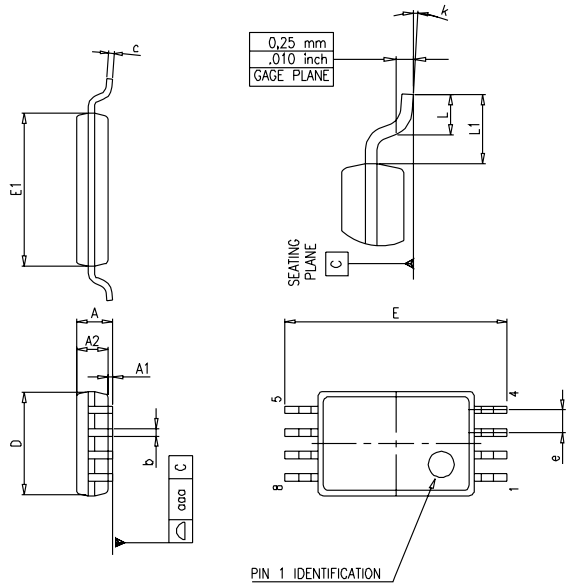


0016023/C

5.3 TSSOP8 Package

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	



5.4 Revision History

Date	Revision	Changes
June 2003	1	Initial release.
May 2005	2	PIPAP references inserted in the datasheet see table order code p1.
Aug. 2005	3	Electrical characteristics table corrected (see *Table 3 on page 4*). Table data was badly formatted. Pin connections diagram moved back to cover page. Pb-free package information added.
Oct. 2005	4	PPAP part number added in table *Order Codes on page 1*.