LM2901

Low power quad voltage comparator

Features

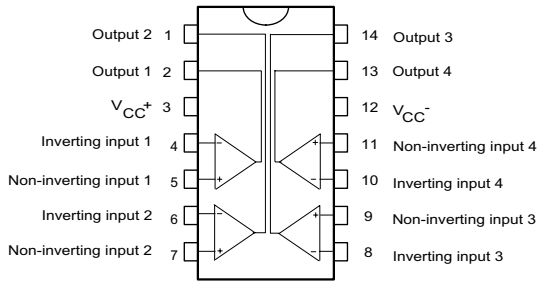
- Wide single supply voltage range or dual supplies for all devices: +2V to +36V or ±1V to ±18V
- Very low supply current (1.1mA) independent of supply voltage (1.4mW/comparator at +5V)
- Low input bias current: 25nA typ.
- Low input offset current: ±5nA typ.
- Input common-mode voltage range includes 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
DIP14
(Plastic Package)

D
SO-14
(Plastic Micropackage)

P
TSSOP14
(Thin Shrink Small Outline Package)

Pin connections (top view)



Description

This device consists of four independent precision voltage comparators. All these comparators are 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
LM2901N	-40°C, +125°C	DIP14	Tube	LM2901N
LM2901D/LM2901DT		SO-14	Tube or tape & reel	2901
LM2901PT		TSSOP14 (Thin shrink outline package)	Tape & reel	
LM2901YD/YDT		SO-14 (automotive grade level)	Tube or tape & reel	2901Y
LM2901YPT		TSSOP14 (automotive grade level)	Tape & reel	

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1 Absolute maximum ratings and operating conditions

Table 1. 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)		
P_d	Power dissipation (2) DIP14 SO-14 TSSOP14	 1500 830 710	mW
T_J	Junction temperature	+150	°C
T_{stg}	Storage temperature range	-65 to +150	°C
ESD	HBM: human body model(3)	500	V
	MM: machine model(4)	100	V
	CDM: charged device model	1500	V

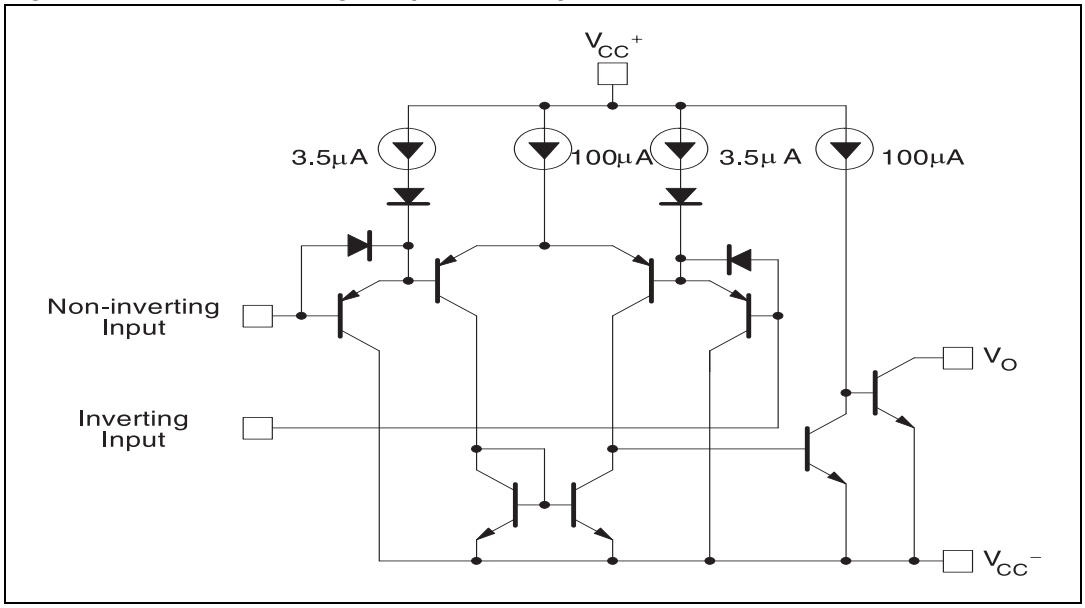
1. Short-circuit from the output to V_{CC}^+ can cause excessive heating and eventual destruction. The maximum output current is approximately 20mA, independent of the magnitude of V_{CC}^+.
2. Pd is calculated with T_{amb} = +25°C, T_j = +150°C and
   R_{thja} = 80°C/W for DIP14 package,
   R_{thja} = 150°C/W for SO-14 package,
   R_{thja} = 175°C/W for TSSOP14 package.
3. Human body model, 100pF discharged through a 1.5kΩ resistor into pin of device.
4. Machine model ESD, a 200pF cap is charged to the specified voltage, then discharged directly into the IC with no external series resistor (internal resistor < 5Ω), into pin to pin of device.

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	2 to 32 ±1 to ±16	V
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 Schematic diagram

Figure 1. Schematic diagram (1/4 LM2901)



3 Electrical characteristics

Table 3. Electrical characteristics at 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 (I_I^+ or I_I^-) (2) T_{amb} = 2.5V $T_{min} \le T_{amb} \le T_{max}$		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		1.1 1.3	2 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 connected 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 = 0 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. The response time specified is for a 100mV input step with 5mV overdrive.
5. 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).
6. Maximum values are guaranteed by design.

Figure 2. Supply current vs. supply voltage

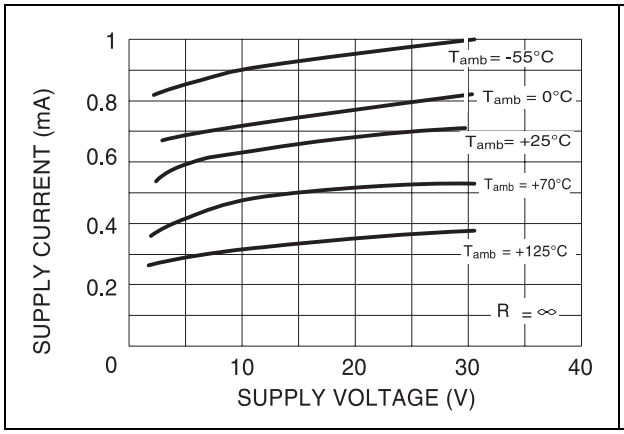


Figure 3. Input current vs. supply voltage

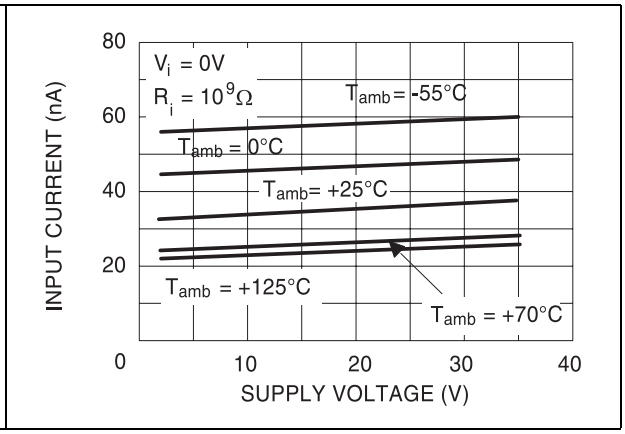


Figure 4. Output saturation voltage vs. output current

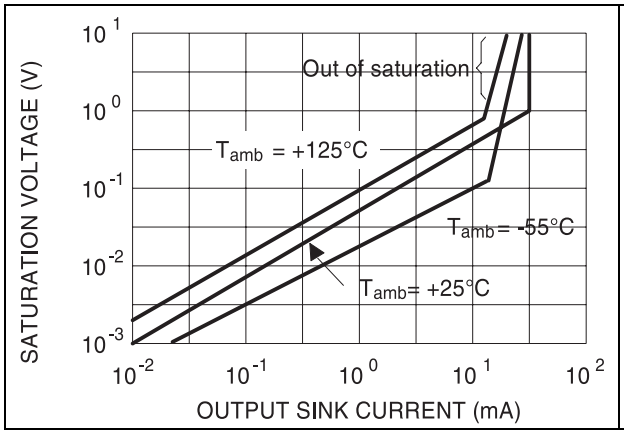


Figure 5. Response time for various input overdrives - negative transition

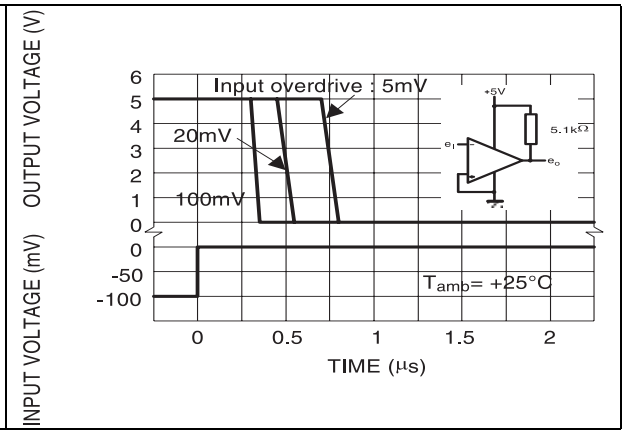
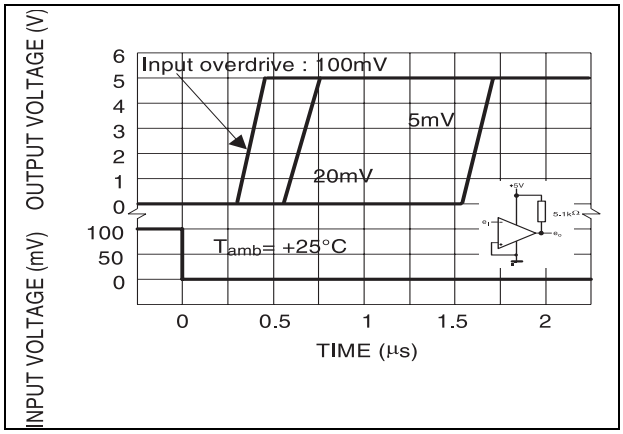


Figure 6. Response time for various input overdrives - positive transition



Typical applications schematics

Figure 7. Basic comparator

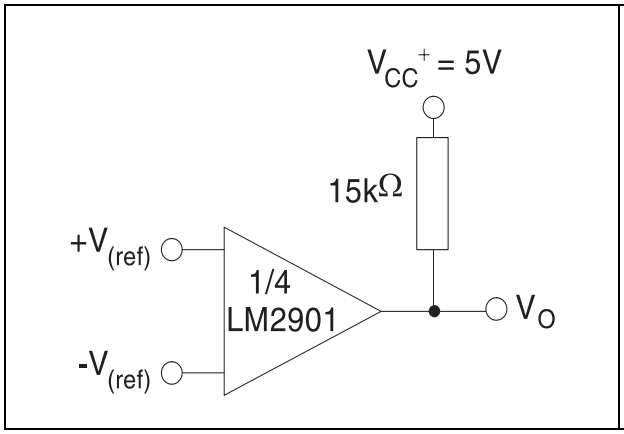


Figure 8. Driving CMOS

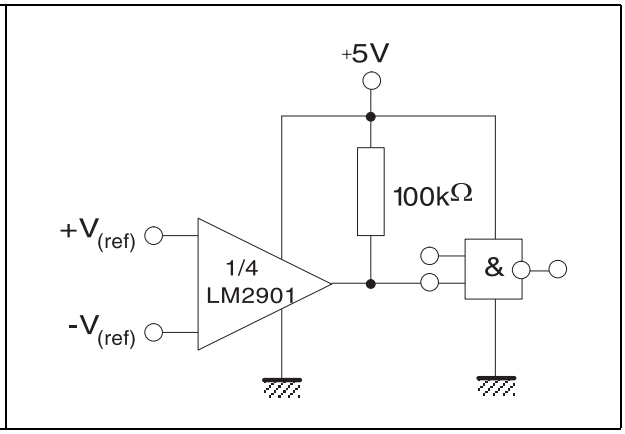


Figure 9. Driving TTL

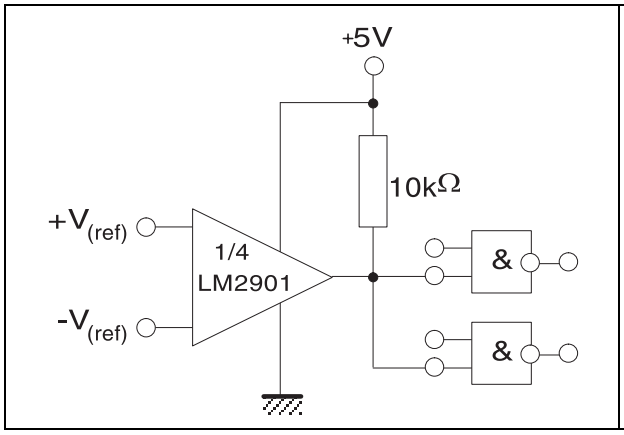


Figure 10. Low frequency op-amp

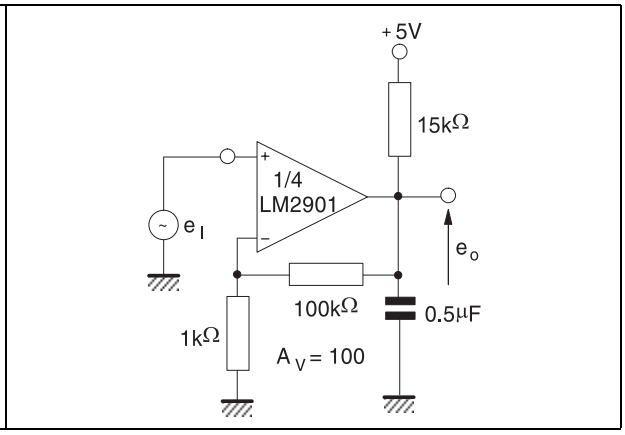


Figure 11. Low frequency op-amp

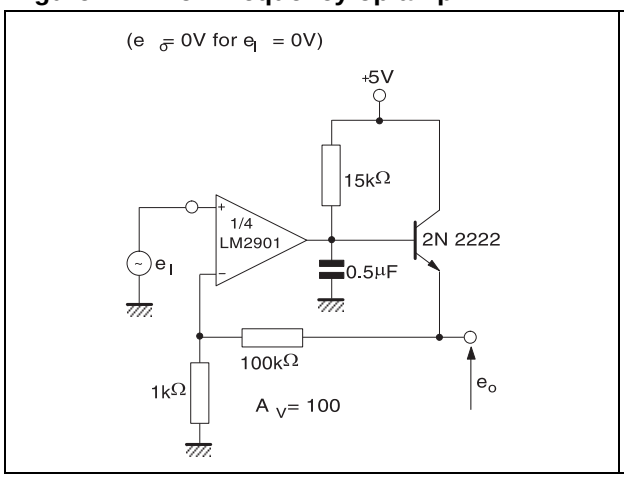


Figure 12. Transducer amplifier

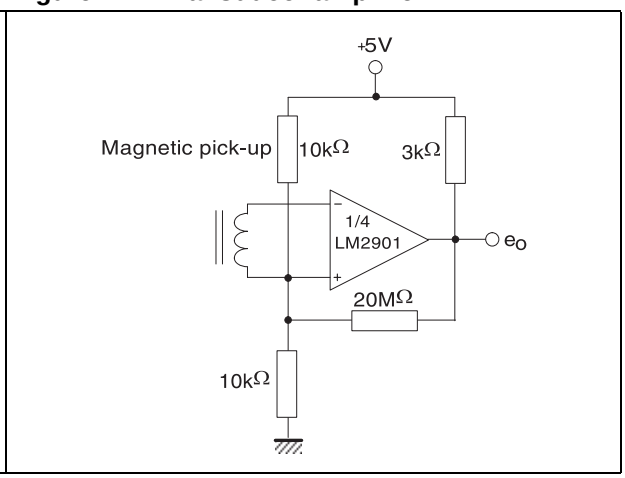


Figure 13. Low frequency op- amp with offset adjust

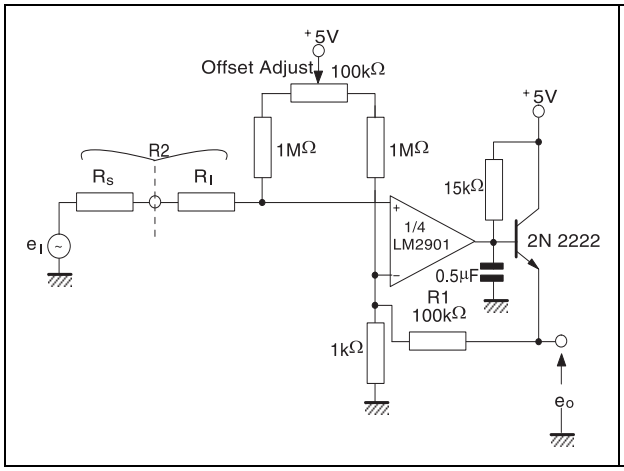


Figure 14. Zero crossing detector (single power supply)

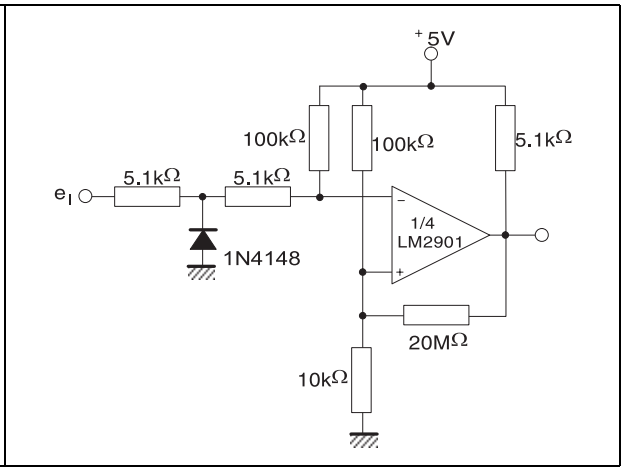


Figure 15. Limit comparator

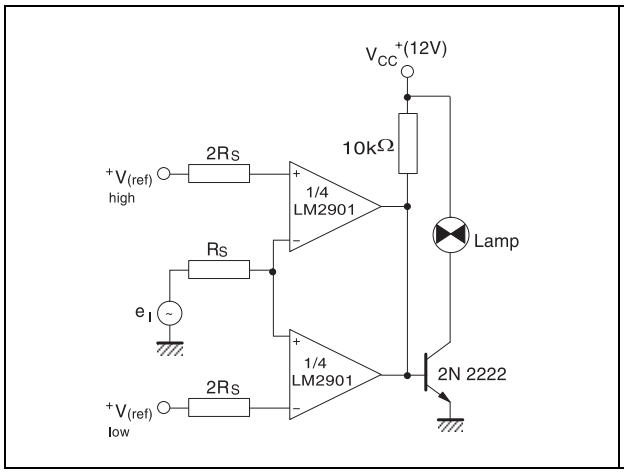


Figure 16. Split-supply applications - zero crossing detector

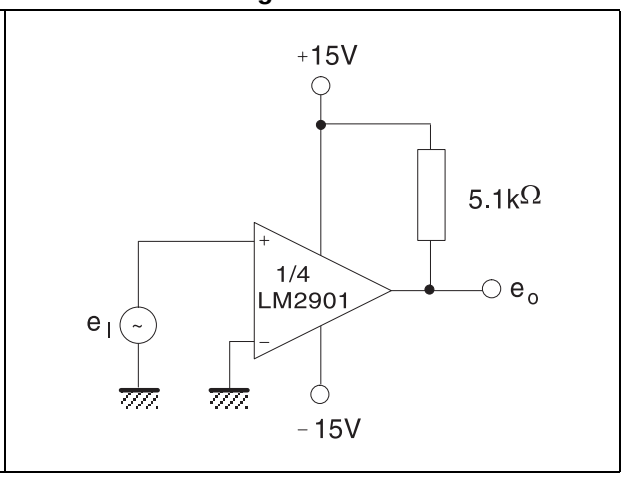


Figure 17. Crystal controlled oscillator

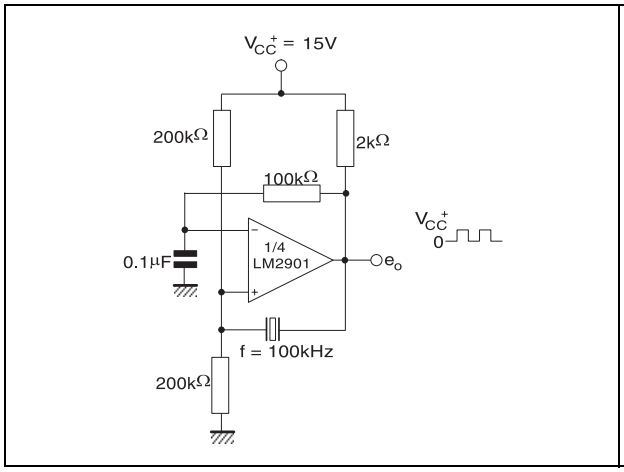


Figure 18. Comparator with a negative reference

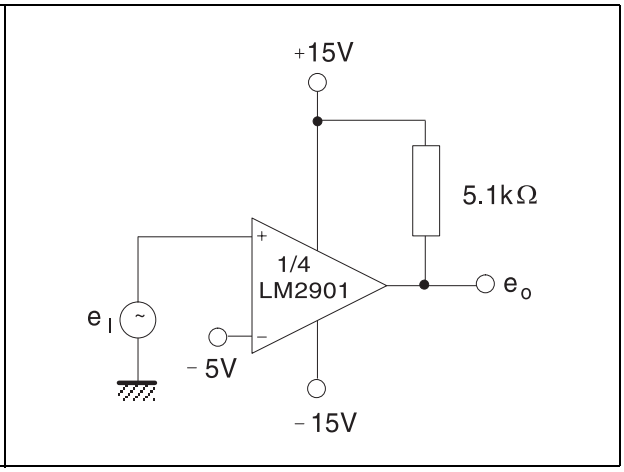


Figure 19. Time delay generator

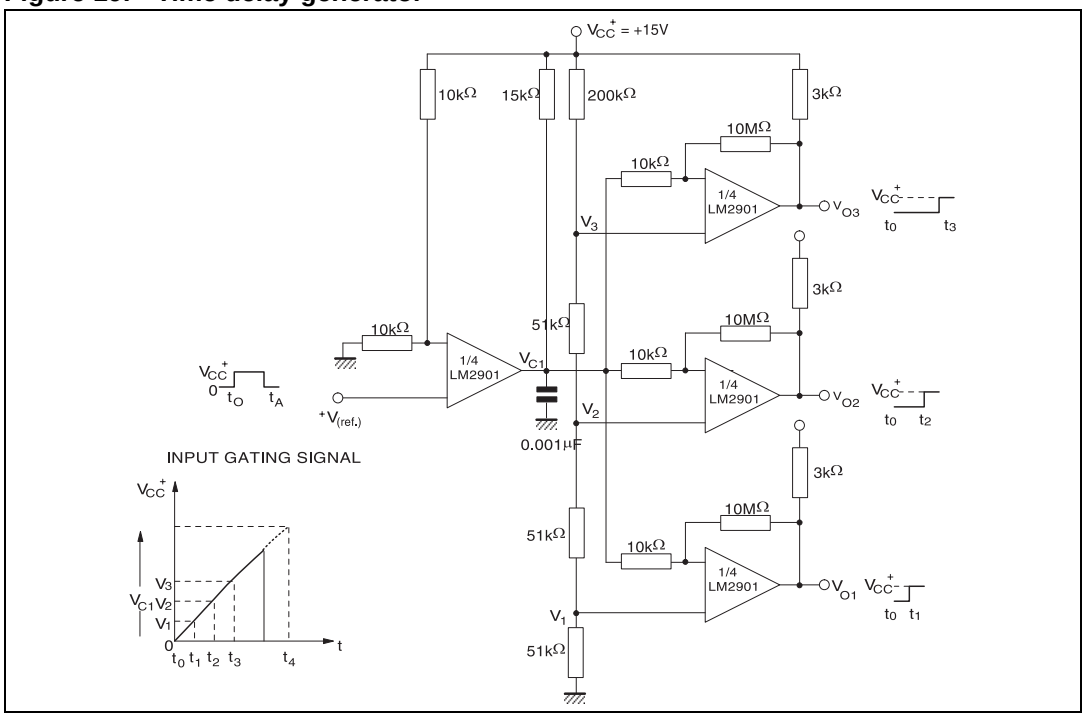
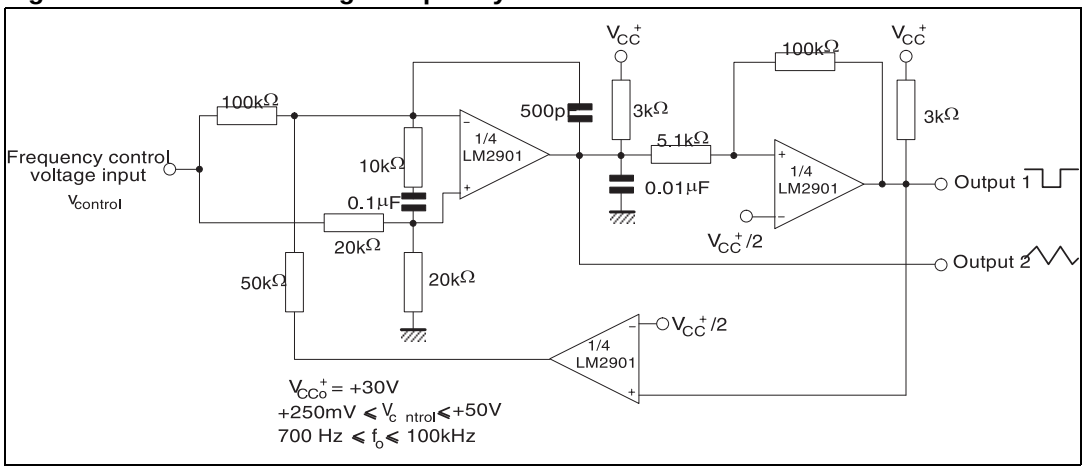


Figure 20. Two-decade high-frequency VCO



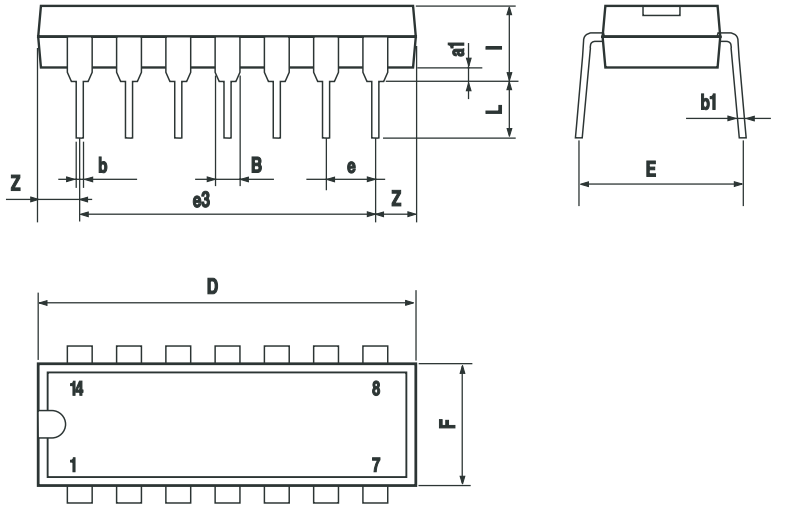
4 Package mechanical data

In order to meet environmental requirements, STMicroelectronics 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 STMicroelectronics trademark. ECOPACK specifications are available at: www.st.com.

4.1 DIP14 package

Plastic DIP-14 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100

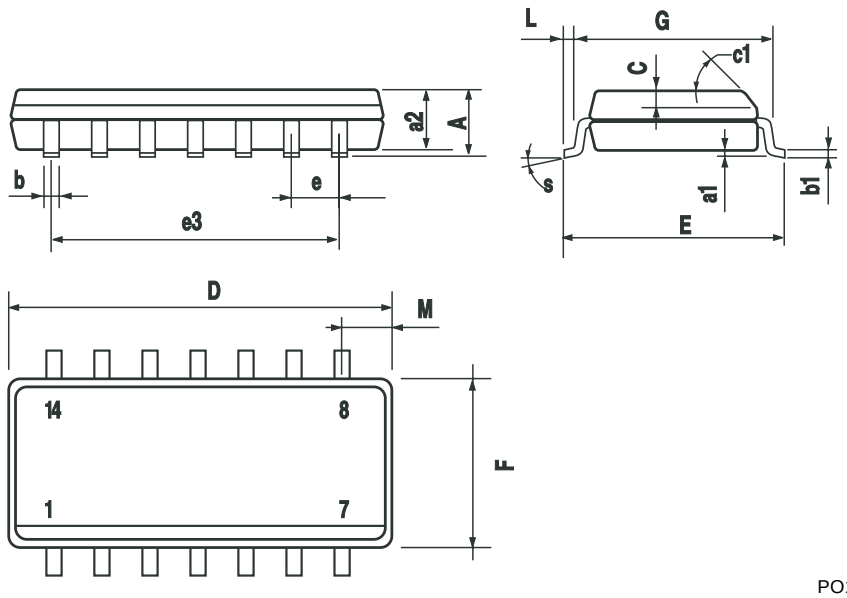


P001A

4.2 SO-14 package

SO-14 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45˚ (typ.)					
D	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.68			0.026
S	8˚ (max.)					

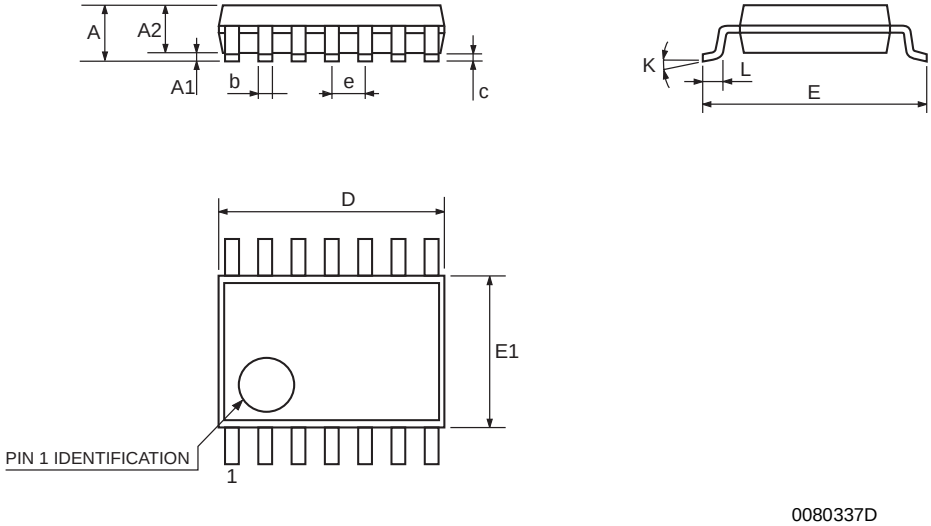


PO13G

4.3 TSSOP14 package

TSSOP14 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



5 Revision history

Table 4. Document revision history

Date	Revision	Changes
Jan-2002	1	Initial release.
Jul-2005	2	1 - PPAP references inserted in the datasheet see *Table : Order codes on page 1*. 2 - ESD protection inserted in *Table 1 on page 3*.
Oct-2005	3	The following changes were made in this revision: – PPAP part number added in table *Order codes on page 1*. – Formatting changes throughout.
18-Jul-2006	4	ESD HBM value corrected in *Table 1 on page 3*.

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