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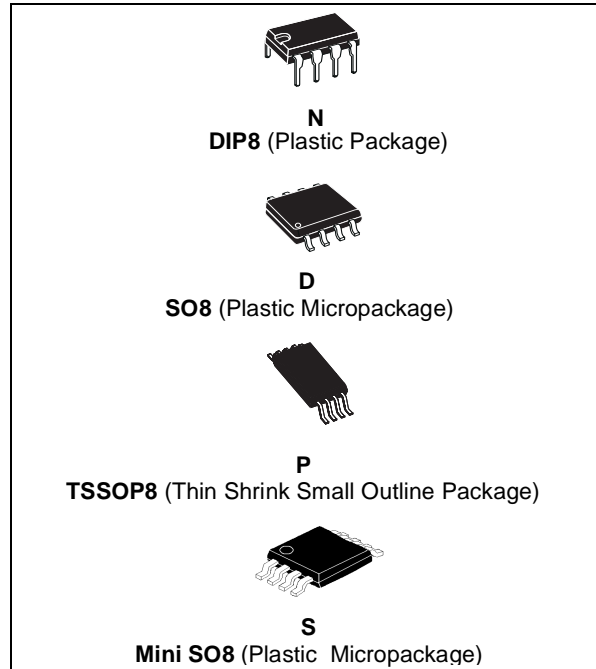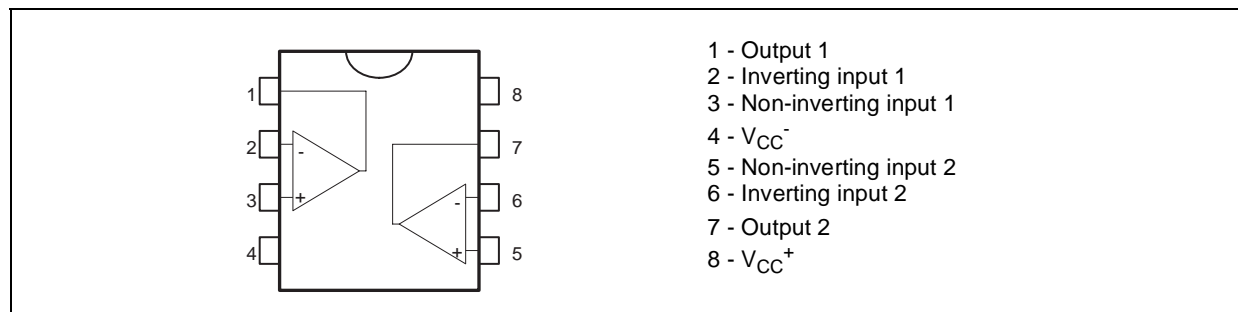
- ■ WIDE SINGLE SUPPLY VOLTAGE RANGE OR DUAL SUPPLIES : +2V TO +36V OR ±1V TO ±18V
- ■ VERY LOW SUPPLY CURRENT (0.4mA) INDEPENDENT OF SUPPLY VOLTAGE (1mW/comparator at +5V)
- ■ LOW INPUT BIAS CURRENT : 25nA TYP
- ■ LOW INPUT OFFSET CURRENT : ±5nA TYP
- ■ LOW INPUT OFFSET VOLTAGE : ±1mV TYP
- ■ INPUT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

DESCRIPTION

These devices consist of two independent low 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.
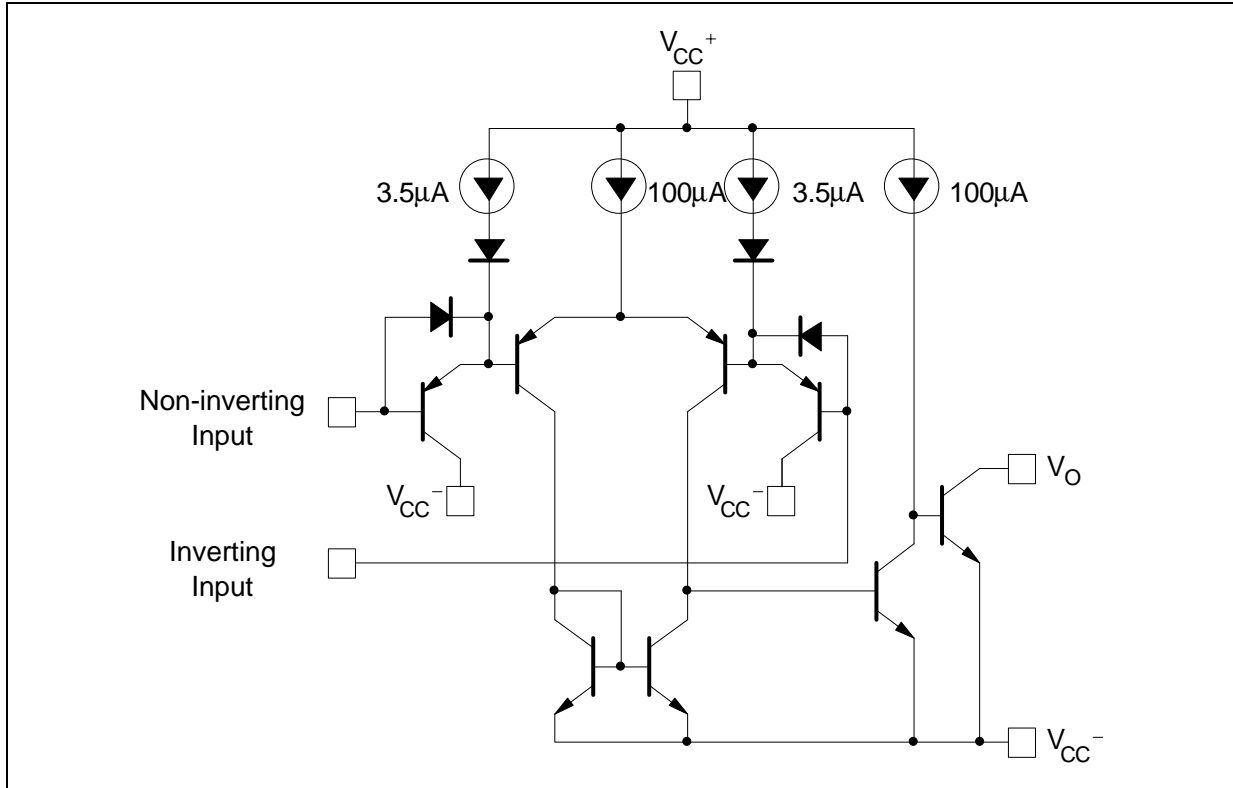
N
DIP8 (Plastic Package)

D
SO8 (Plastic Micropackage)

P
TSSOP8 (Thin Shrink Small Outline Package)

S
Mini SO8 (Plastic Micropackage)

ORDER CODE

Part Number	Temperature Range	Package			
		N	D	P	S
LM193	-55°C, +125°C	•	•	•	•
LM293	-40°C, +105°C	•	•	•	•
LM393	0°C, +70°C	•	•	•	•
Example : LM393D					

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)
S = MiniSO Package (MiniSO) only available in Tape & Reel (ST)

PIN CONNECTIONS (top view)

1 - Output 1
2 - Inverting input 1
3 - Non-inverting input 1
4 - V_{CC}^-
5 - Non-inverting input 2
6 - Inverting input 2
7 - Output 2
8 - V_{CC}^+

SCHEMATIC DIAGRAM (1/2 LM193)

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	±18 or 36	V
V_{id}	Differential Input Voltage	±36	V
V_i	Input Voltage	-0.3 to +36	V
	Output Short-circuit to Ground - note [1]	Infinite	
P_d	Power Dissipation [2] DIP8 SO8 TSSOP8 Mini SO8	1250 710 625 580	mW
T_{stg}	Storage Temperature Range	-65 to +150	°C

1. Short-circuits 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
   = 215°C/W for Mini SO8 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 LM193 LM293 LM393	-55 to +125 -40 to +125 0 to +70	°C

ELECTRICAL CHARACTERISTICS

$V_{CC}^+ = +5V$, $V_{CC}^- = 0V$, $T_{amb} = +25°C$ (unless otherwise specified)
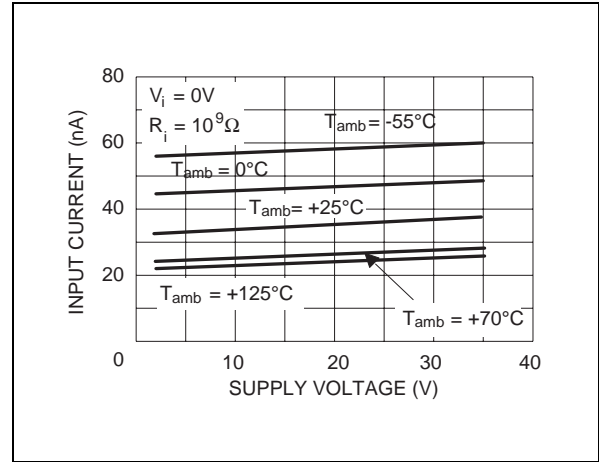
Symbol	Parameter	Min	Typ.	Max.	Unit
V_{io}	Input Offset Voltage - note [1] $T_{amb} = +25°C$ $T_{min} \leq T_{amb} \leq T_{max}$		1	5 9	mV
I_{ib}	Input Bias Current - note [2] $T_{amb} = +25°C$ $T_{min} \leq T_{amb} \leq T_{max}$		25	250 400	nA
I_{io}	Input Offset Current $T_{amb} = +25°C$ $T_{min} \leq T_{amb} \leq T_{max}$		5	50 150	nA
A_{vd}	Large Signal Voltage Gain $V_{CC} = 15V$, $R_L = 15k\Omega$, $V_o = 1V$ to $11V$	50	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 - note [3] $T_{amb} = +25°C$ $T_{min} \leq T_{amb} \leq T_{max}$	0 0		V_{CC}^+ -1.5 V_{CC}^+ -2	V
V_{id}	Differential Input Voltage -note [4]			V_{CC}^+	V
Isink	Output Sink Currrent $V_{id} = 1V$, $V_o = 1.5V$	6	16		mA
V_{OL}	Low Level Output Voltage $V_{id} = -1V$, $I_{sink} = 4mA$ $T_{amb} = +25°C$ $T_{min} \leq T_{amb} \leq T_{max}$		250	400 700	mV
I_{OH}	High Level Output Current ($V_{id} = 1V$) $V_{id} = 1V$, $V_{CC} = V_o = 30V$ $T_{amb} = +25°C$ $T_{min} \leq T_{amb} \leq T_{max}$		0.1	 1	nA µA
t_{re}	Response Time - note [5] $R_L = 5.1k\Omega$ to V_{CC}^+		1.3		µs
t_{rel}	Large Signal Response Time $V_i = TTL$, $V_{(ref)} = +1.4V$, $R_L = 5.1k\Omega$ to V_{CC}^+		300		ns

1. At output switch point, $V_o \approx 1.4V$, $R_s = 0$ with V_{CC}^+ from 5V to 30V, and over the full 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 bellow the negative power supply, if used).

5. The response time specified is for a 100mV input step with 5mV overdrive. For larger overdrive signals 300ns can be obtained
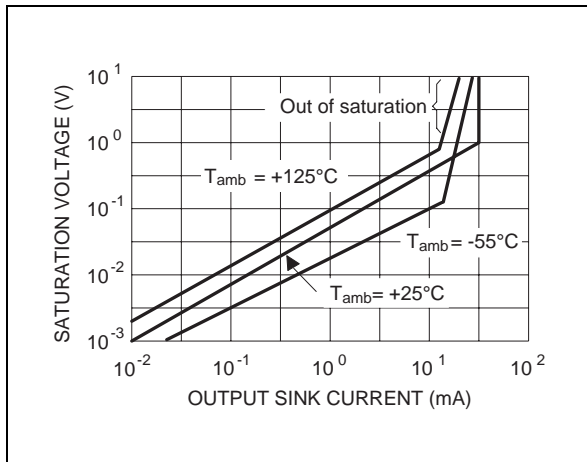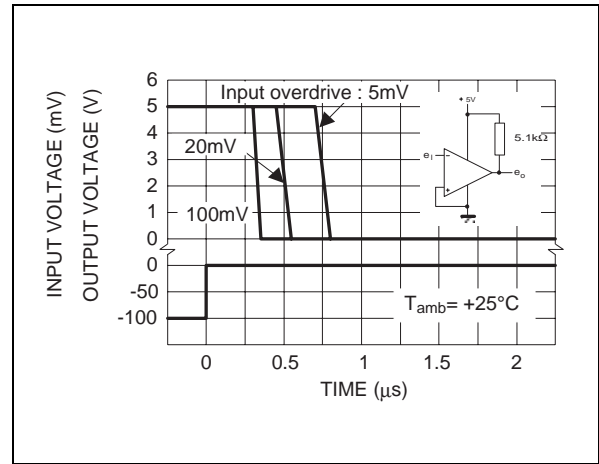
SUPPLY CURRENT versus SUPPLY VOLTAGE
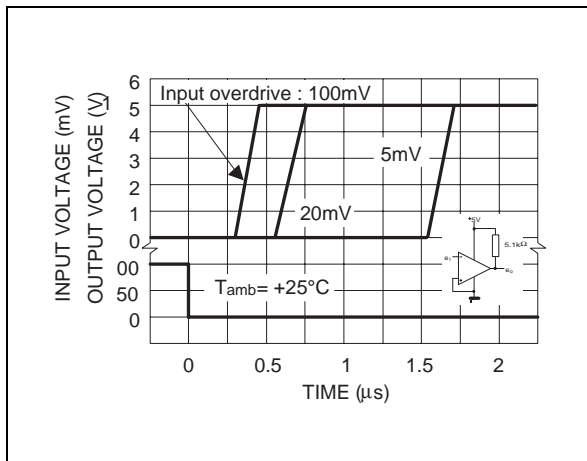

INPUT CURRENT versus SUPPLY VOLTAGE

OUTPUT SATURATION VOLTAGE versus OUTPUT CURRENT

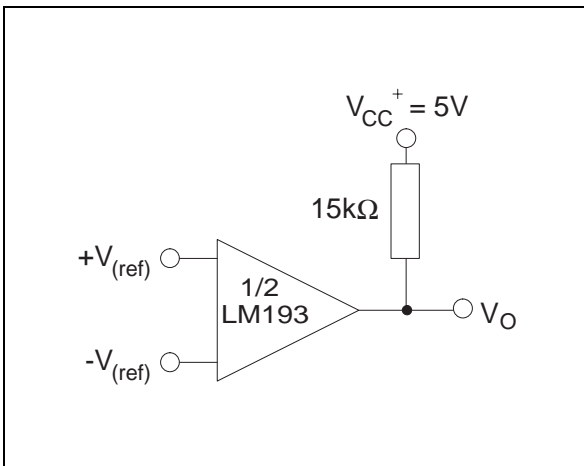**RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - NEGATIVE TRANSITION**

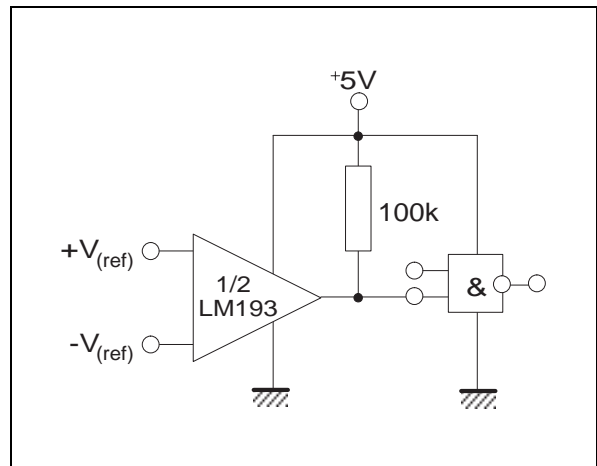**RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - POSITIVE TRANSITION**
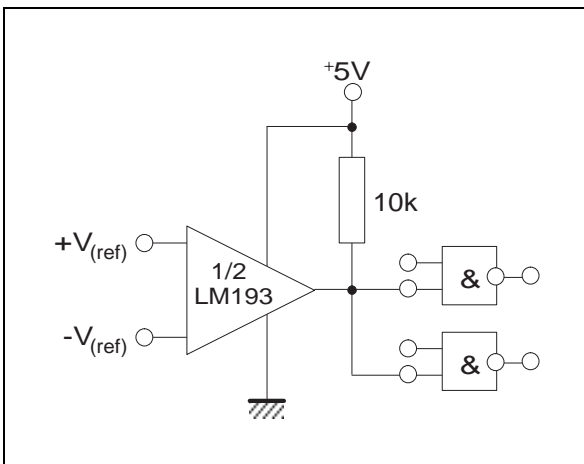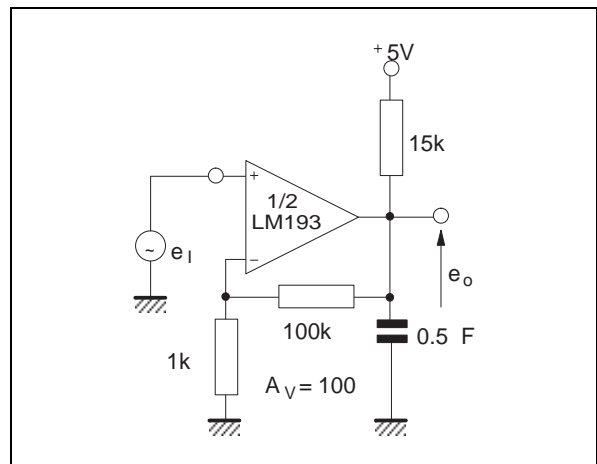
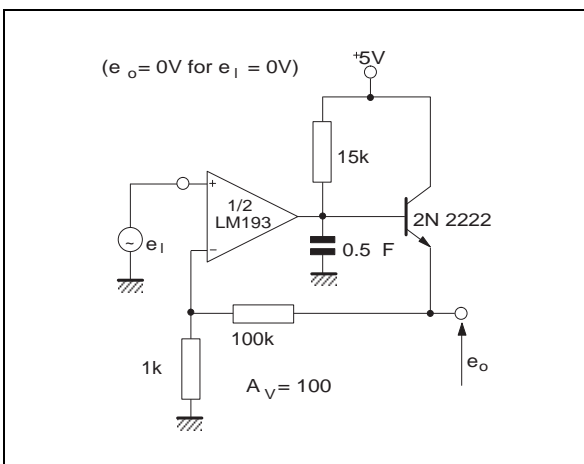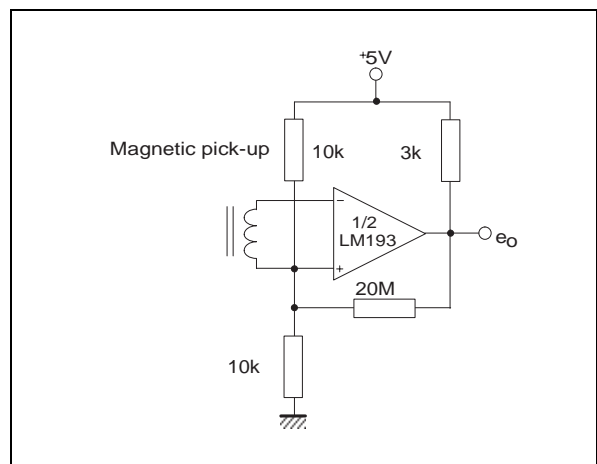**TYPICAL APPICATIONS**

BASIC COMPARATOR
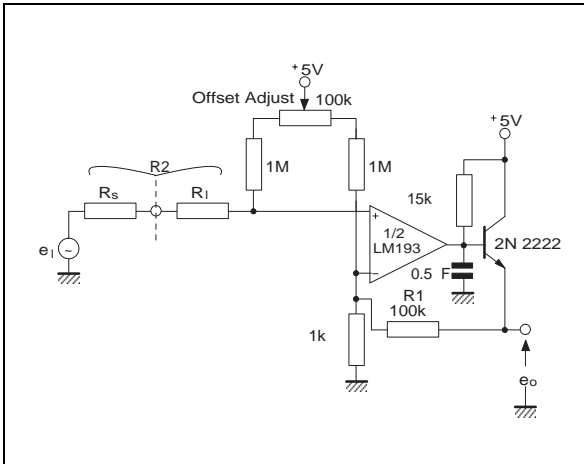

DRIVING CMOS

DRIVING TTL
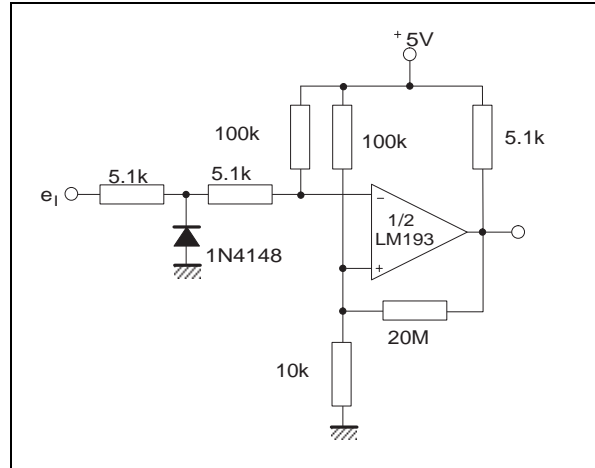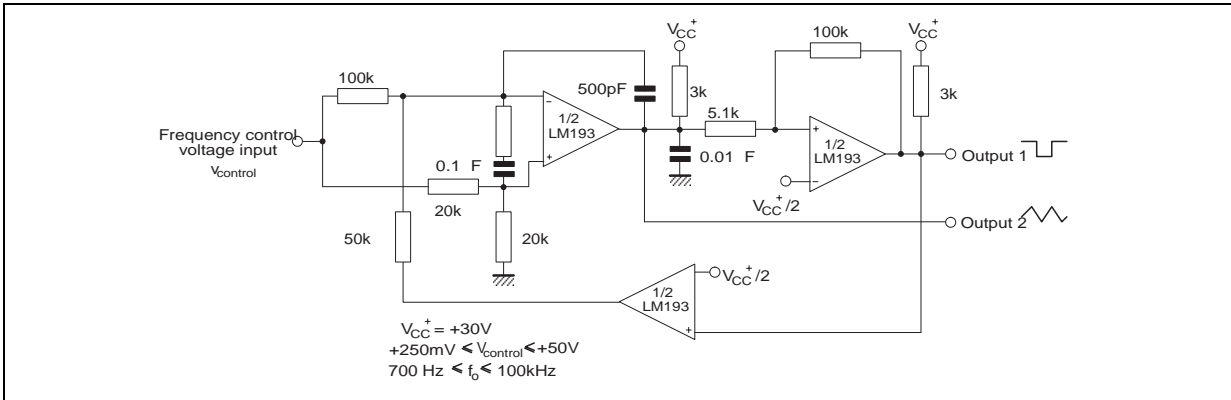

LOW FREQUENCY OP AMP

LOW FREQUENCY OP AMP

TRANSDUCER AMPLIFIER

LOW FREQUENCY OP AMP WITH OFFSET ADJUST

ZERO CROSSING DETECTOR (single power supply)

TWO-DECADE HIGH-FREQUENCY VCO

$V_{CC}^+ = +30V$
$+250mV \leqslant V_{control} \leqslant +50V$
$700\ Hz \leqslant f_o \leqslant 100kHz$

LIMIT COMPARATOR

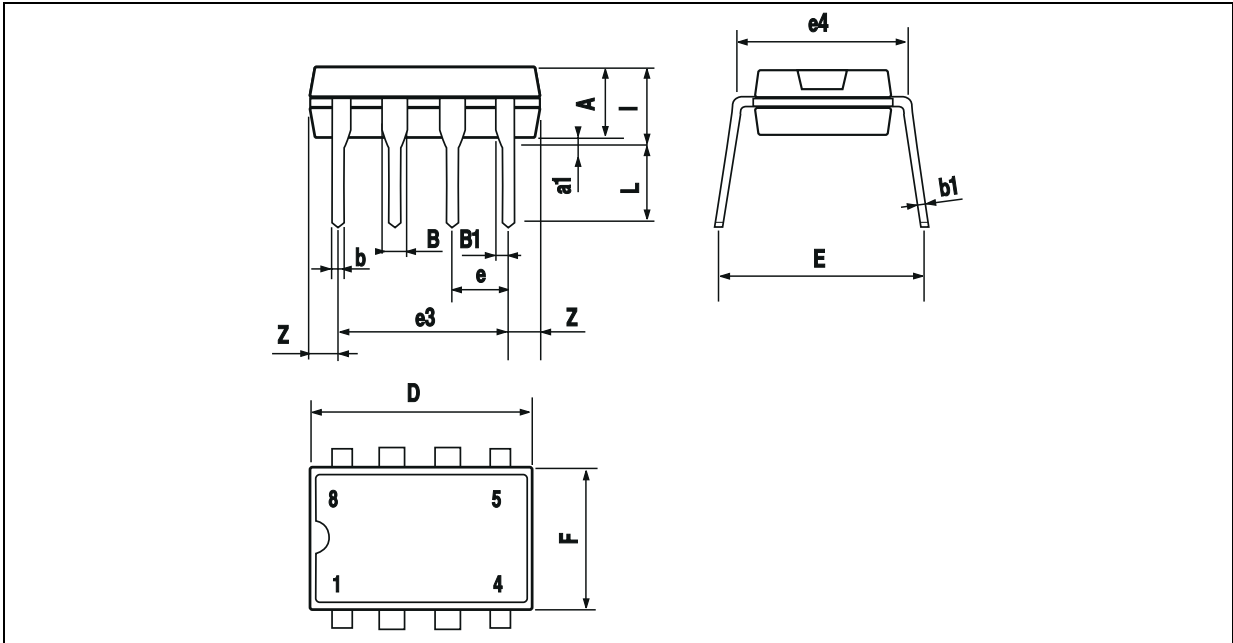## CRYSTAL CONTROLLED OSCILLATOR

SPLIT-SUPPLY APPLICATIONS

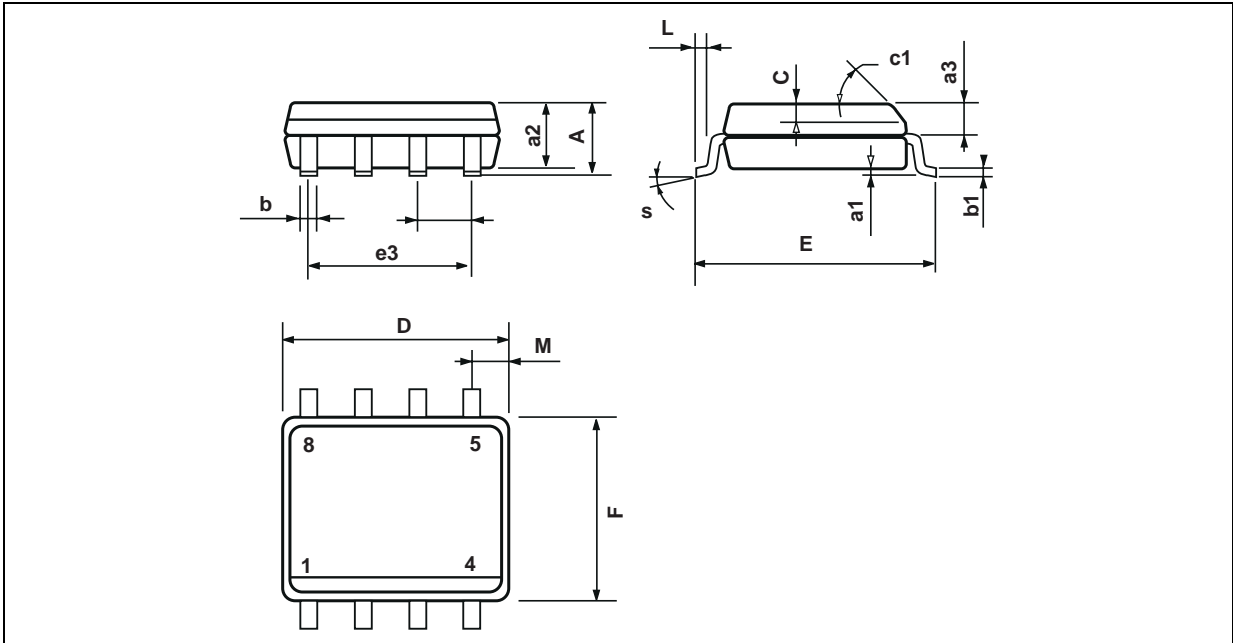ZERO CROSSING DETECTOR

COMPARATOR WITH A NEGATIVE REFERENCE
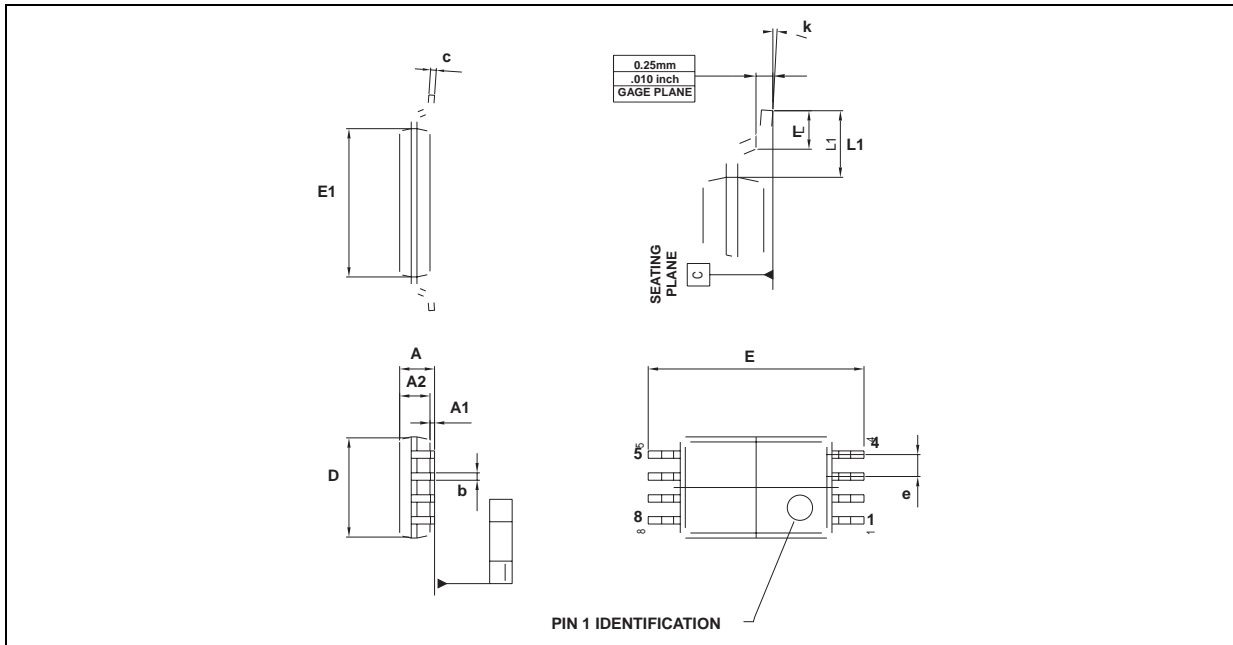
PACKAGE MECHANICAL DATA
8 PINS - PLASTIC DIP

Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0260
i			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

PACKAGE MECHANICAL DATA
8 PINS - PLASTIC MICROPACKAGE (SO)

Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.25	0.004		0.010
a2			1.65			0.065
a3	0.65		0.85	0.026		0.033
b	0.35		0.48	0.014		0.019
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.020
c1	45° (typ.)					
D	4.8		5.0	0.189		0.197
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		3.81			0.150	
F	3.8		4.0	0.150		0.157
L	0.4		1.27	0.016		0.050
M			0.6			0.024
S	8° (max.)					

PACKAGE MECHANICAL DATA
8 PINS - PLASTIC MICROPACKAGE (miniSO)

Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.100			0.043
A1	0.050	0.100	0.150	0.002	0.004	0.006
A2	0.780	0.860	0.940	0.031	0.034	0.037
b	0.250	0.330	0.400	0.010	0.013	0.016
c	0.130	0.180	0.230	0.005	0.007	0.009
D	2.900	3.000	3.100	0.114	0.118	0.122
E	4.750	4.900	5.050	0.187	0.193	0.199
E1	2.900	3.000	3.100	0.114	0.118	0.122
e		0.650			0.026	
L	0.400	0.550	0.700	0.016	0.022	0.028
L1		0.950			0.037	
k	0d	3d	6d	0d	3d	6d
aaa			0.100			0.004