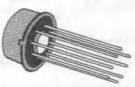
SGS-THOMSON MICROELECTRONICS

LM193,A-LM293,A LM393,A-LM2903

LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS

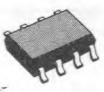
- WIDE SINGLE SUPPLY VOLTAGE RANGE OR DUAL SUPPLIES + 2 V TO + 36 V OR ± 1 V TO ± 18 V
- VERY LOW SUPPLY CURRENT DRAIN (0.4 mA) INDEPENDENT OF SUPPLY VOLTAGE (1 mW/comparator at + 5 V)
- LOW INPUT BIAS CURRENT : 25 nA TYP
- LOW INPUT OFFSET CURRENT : ± 5 nA TYP
- LOW INPUT OFFSET VOLTAGE : ± 1 mV TYP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



H
TO99
(Metal Can)

N
DIP8
(Plastic Package)

J
CERDIP8
(Cerdip Package)



D
SO8
(Plastic Micropackage)

GC
LCC20
Tricecop (LCC)

DESCRIPTION

These devices consist of two independent precision voltage comparators with an offset voltage specifications as low as 2 mV max for LM393A, LM293A and LM193A.

All these comparators were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible.

These comparators also have a unique characteristics in that the input common-mode voltage range includes ground even through operated from a single power supply voltage.

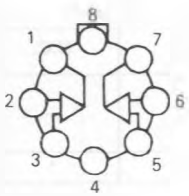
ORDER CODES

Part Number	Temperature Range	Package				
		H	N	D	GC	J
LM193,A	– 55 to + 125 °C	•	•	•	•	•
LM293,A	– 40 to + 105 °C	•	•	•		•
LM393,A	0 to + 70 °C	•	•	•		•
LM2903	– 40 to + 105 °C		•	•		•

Note : Hi-Rel Versions Available
Examples : LM193H, LM393D

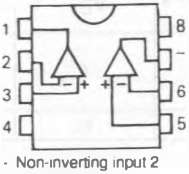
PIN CONNECTIONS (top views)

TO99



1 - Output 1
2 - Inverting input 1
3 - Non-inverting input 1
4 - V_{CC}

DIP8
CERDIP8
SO8



5 - Non-inverting input 2
6 - Inverting input 2
7 - Output 2
8 - V_{CC}

1 - NC
2 - Output 1
3 - NC
4 - NC
5 - Inverting input 1
6 - NC
7 - Non-inverting input 1
8 - NC
9 - NC
10 - V_{CC}

LCC20

11 - NC
12 - Non inverting input 2
13 - NC
14 - NC
15 - Inverting input 2
16 - NC
17 - Output 2
18 - NC
19 - NC
20 - V_{CC}

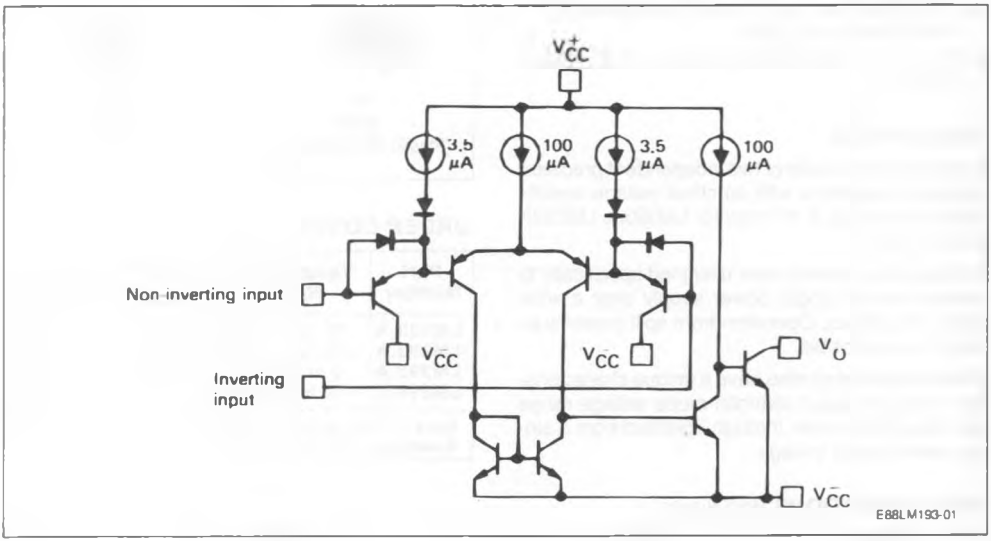
ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	LM193, A	LM293, A	LM393, A LM2903	Unit
V_{CC}	Supply Voltage	± 18 to 36	± 18 to 36	± 18 to 36	V
V_{ID}	Differential Input Voltage	36	36	36	V
V_I	Input Voltage	– 0.3 to + 36	– 0.3 to + 36	– 0.3 to + 36	V
	Output Short-circuit to Ground – (note 2)	Continuous	Continuous	Continuous	
P_{tot}	Power Dissipation – (note 1) LM393AH	830	830	570 830	mW
T_{oper}	Operating Free-air Temperature Range LM2903	– 55 to + 125	– 25 to + 85	0 to + 70 – 40 to + 105	°C
T_{stg}	Storage Temperature Range	– 65 to + 150	– 65 to + 150	– 65 to + 150	°C

Notes : 1. For operating at high temperatures the LM393, LM393A, LM2903 must be derated based on a + 125 °C max junction temperature and a thermal resistance of 175 °C/W which applies for the devices soldered on a printed circuit board, operating in a still air ambient. The LM393, LM393A, LM293 and LM293A must be derated based on a + 150 °C max junction temperature.

2. Short-circuit from the output to V_{CC} can cause excessive heating and eventual destruction. The maximum output current is approximately 20 mA, independent of the magnitude of V_{CC}.

SCHEMATIC DIAGRAM (1/2 LM193)



CASE	Outputs	Inverting Inputs	Non-inverting Inputs	V_{CC}^-	V_{CC}^+	N.C.
TO99 SO8 DIP8	1, 7	3, 5	2, 6	4	8	–
LCC20	2, 17	7, 12	5, 15	10	20	*

* LCC20 : Other pins are not connected.

ELECTRICAL CHARACTERISTICS

LM393A / LM393 : $0\,°C \le T_{amb} \le +70\,°C$
LM293A / LM293 / LM2903 : $-40\,°C \le T_{amb} \le +105\,°C$
LM193A / LM193 : $-55\,°C \le T_{amb} \le +125\,°C$
* = $\ge V_{CC} = +5$ V, $V_{CC}^- = GND$
(unless otherwise specified)

Symbol	Parameter	LM193A - LM293A LM393A			LM193 - LM293 LM393 - LM2903			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{IO}	Input Offset Voltage – (note 3) $T_{amb} = +25\,°C$ $T_{min} \le T_{amb} \le T_{max}$		1	2 4		1	5 9	mV
I_{IB}	Input Bias Current – (note 4) $T_{amb} = +25\,°C$ $T_{min} \le T_{amb} \le T_{max}$		25	100 300		25	250 400	nA
I_{IO}	Input Offset Current $T_{amb} = +25\,°C$ $T_{min} \le T_{amb} \le T_{max}$		3	25 100		5	50 150	nA
A_{VD}	Large Signal Voltage Gain ($V_{CC} = +15$ V, $V_a = +10$ V, $R_L \ge 15\,k\Omega$) $T_{amb} = +25\,°C$	50	200		25	200		V/mV
I_{CC}	Supply Current, no Load (all comparators) $T_{amb} = 25\,°C$ $V_{CC} = 30$ V		0.4 1	1 2.5		0.4 1	1 2.5	mA
V_I	Input Voltage Range – (note 5) $T_{amb} = +25\,°C$ $T_{min} \le T_{amb} \le T_{max}$	0 0		$V_{CC} - 1.5$ $V_{CC} - 2$	0 0		$V_{CC} - 1.5$ $V_{CC} - 2$	V
V_{ID}	Differential Input Voltage ($V_I^+ = 0$ V or if used $V_I^- = 0$ V) – (note 7)			V_{CC}			V_{CC}	V
I_{OS}	Output Sink Current $V_I^+ = 0$ V, $V_I^- \ge 1$ V, $V_O \le +1.5$ V $T_{amb} = 25\,°C$	6	16		6	16		mA
V_{OL}	Low Level Output Voltage $V_I^- \ge = 1$ V, $V_I^+ = 0$ V, $I_{OS} \le = 4$ mA $T_{amb} = 25\,°C$ $T_{min} \le T_{amb} \le T_{max}$		250	400 700		250	400 700	mV
I_{OH}	High Level Output Current $V_I^+ \ge 1$ V, $V_I^- = 0$ V $T_{amb} = 25\,°C$, $V_O = +5$ V $T_{min} \le T_{amb} \le T_{max}$, $V_O = +30$ V		0.1	 1000		0.1	 1000	nA

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	LM193A - LM293A LM393A			LM193 - LM293 LM393 - LM2903			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
t_{re}	Response Time V_L = + 5 V, R_L = 5.1 kΩ – (note 6) T_{amb} = 25 °C		1.3			1.3		µs
t_{rel}	Large Signal Response Time e_i = TTL, V_{re} = + 1.4 V, V_L = + 5 V T_{amb} = 25 °C		300			300		ns

Notes : 3. At output switch point, V_O = 1.4 V, R_S = 0 with V_{CC} from 5 V to 30 V the full input common-mode range (0 V to V_{CC} - 1.5 V).

4. 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 or input lines.

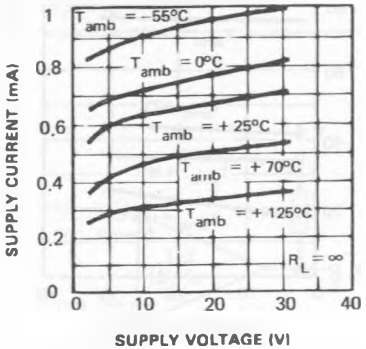
5. The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3 V.
The upper end of the common-mode voltage range is V_{CC} – 1.5 V, but either or both inputs can go to + 30 V without damage.

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

7. 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 – 0.3 V (or 0.3 V below the negative power supply, if used).

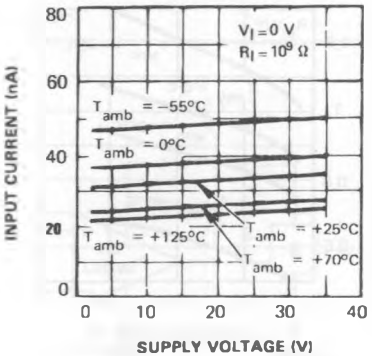
LM193,A - LM393,A

SUPPLY CURRENT



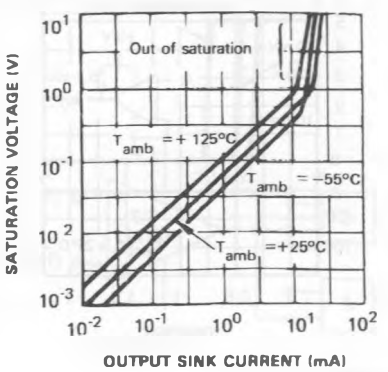
E88LM193-02

INPUT CURRENT



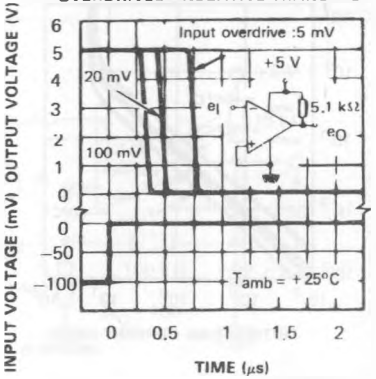
E88LM193-03

OUTPUT SATURATION VOLTAGE



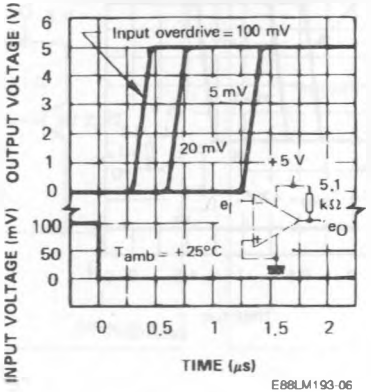
E88LM193-04

RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - NEGATIVE TRANSITION



E88LM193-05

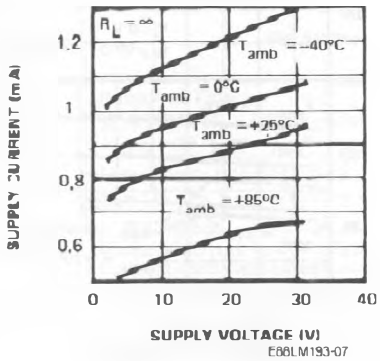
RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - POSITIVE TRANSITION



E88LM193-06

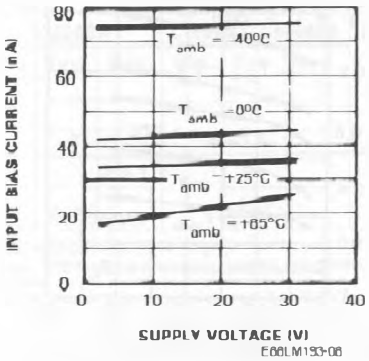
LM293,A - LM2903

SUPPLY CURRENT



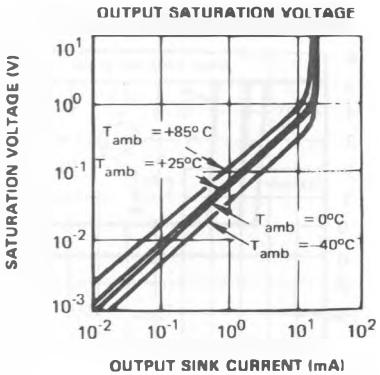
E88LM193-07

INPUT CURRENT



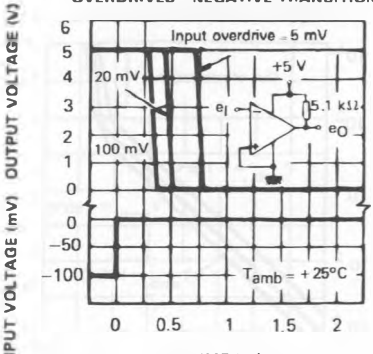
E88LM193-08

OUTPUT SATURATION VOLTAGE



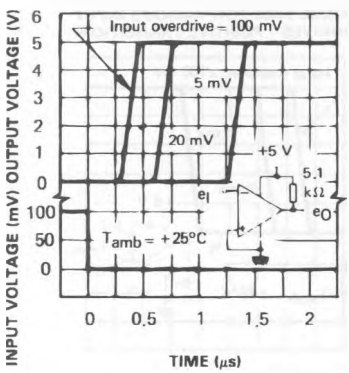
E88LM193-09

RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - NEGATIVE TRANSITION



E88LM193-10

RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - POSITIVE TRANSITION



E88LM193-11