# DUAL VOLTAGE COMPARATOR LM393

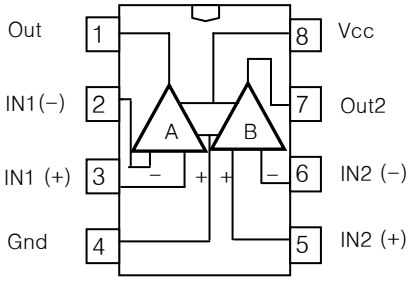
## FEATURES

- Single Supply Operation : 2V to 36V
- Dual Supply Operation : ±1V to ±18V
- Allow Comparison of Voltages Near Ground Potential
- Low Current Drain 800㎂ Typ
- Compatible with all Forms of Logic
- Low Input Bias Current 25㎁ Typ
- Low Input Offset Current ±5㎁ Typ
- Low Offset Voltage ±1㎷ Typ
- Moisture Sensitivity Level 3

SOP-8 PKG

DIP-8 PKG

SOP 8 / DIP 8 Pin Configulation



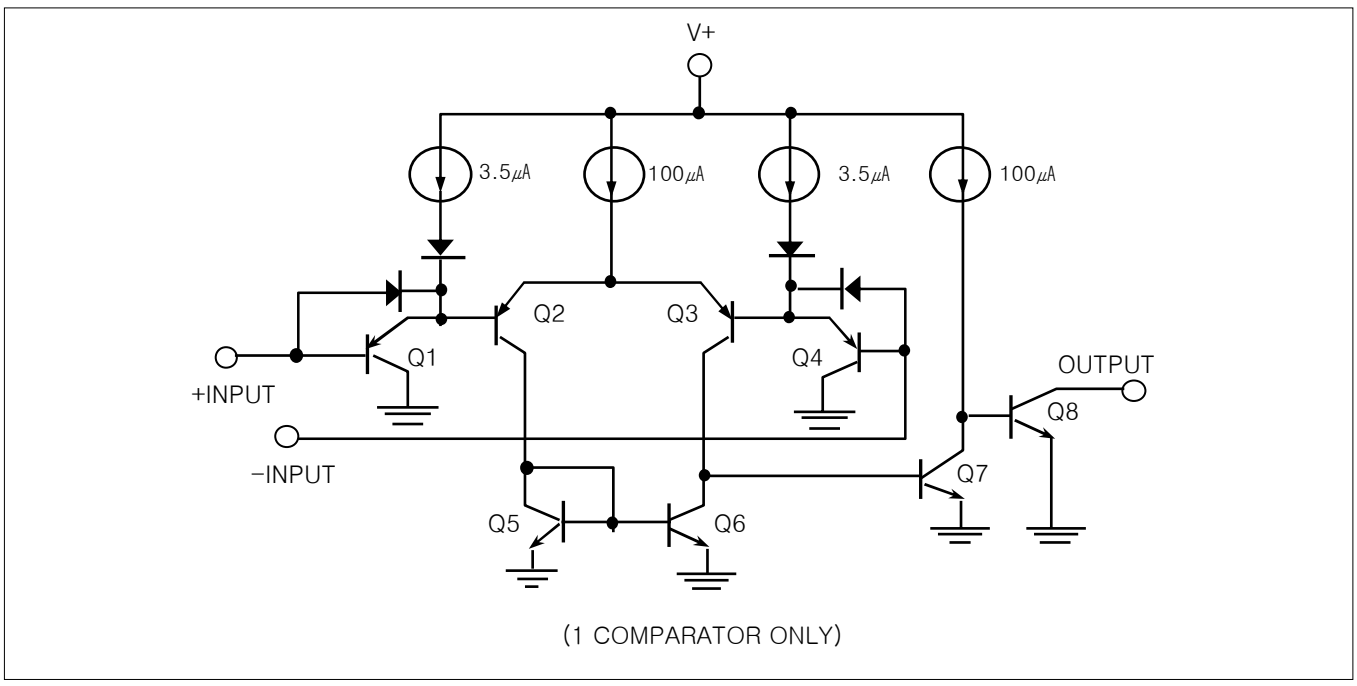

**ORDERING INFORMATION**

| Device | Package |
|---|---|
| LM393D | 8 SOP |
| LM393N | 8 DIP |

## DESCRIPTION

The LM393 series consists of two independent precision voltage comparators with an offset voltage specification as low as 2.0㎷ max. for two comparators which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.
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.
The LM393 series was designed to directly interface with TTL and CMOS. When operated from both plus and minus power supplies, the LM393 series will directly interface with MOS logic where their low power drain is a distinct advantage over standard comparators.

## EQUIVALENT CIRCUIT




(1 COMPARATOR ONLY)

## ABSOLUTE MAXIMUM RATINGS

| CHARACTERISTIC | SYMBOL | VALUE | UNIT |
|---|---|---|---|
| Power Supply Voltage | $V_{CC}$ | ±18 or 32 | V |
| Differential Input Voltage | $V_{I(DIFF)}$ | 32 | V |
| Input Voltage | $V_I$ | −0.3 to +32 | V |
| Output Short Circuit to GND | | Continuous | |
| Power Dissipation | $P_D$ | 570 | mW |
| Operating Temperature Range | $T_{OPR}$ | 0~+70 | ℃ |
| Storage Temperature Range | $T_{STG}$ | −65 to +150 | ℃ |

## Electrical characterisitics at specified free-air temperature, $V_{CC}$=5V(unless otherwise noted)

| PARAMETER | TEST CONDITIONS* | | | LM393 | | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | |
| $V_{IO}$ Input Offset Voltage | $V_{CC}$=5V to 30V, $V_{IC}$=$V_{ICR}$MIN, $V_O$=1.4V | | 25℃ | | 2 | 5 | mV |
| | | | Full Range | | | 9 | |
| $I_{IO}$ Input Offset Current | $V_O$=1.4V | | 25℃ | | 5 | 50 | nA |
| | | | Full Range | | | 150 | |
| $I_{IB}$ Input Bias Current | $V_O$=1.4V | | 25℃ | | −25 | −250 | nA |
| | | | Full Range | | | −400 | |
| $V_{ICR}$ Common-Mode Input Voltage Range** | | | 25℃ | 0to$V_{CC}$−1.5 | | | V |
| | | | Full Range | 0to$V_{CC}$−2 | | | |
| $A_{VD}$ Large-Signal Differential Voltage Amplification | $V_{CC}$=15V, $V_O$=1.4V to 11.4V, $R_L$≥15kΩ to $V_{CC}$ | | 25℃ | 50 | 200 | | V/mV |
| $I_{OH}$ High-Level Output Current | $V_{OH}$=5V, $V_{ID}$=1V | | 25℃ | | 0.1 | 50 | nA |
| | $V_{OH}$=30V, $V_{ID}$=1V | | Full Range | | | 1 | μA |
| $V_{OL}$ Low-Level Output Voltage | $I_{OL}$=4mA, $V_{ID}$=−1V | | 25℃ | | 150 | 400 | mV |
| | | | Full Range | | | 700 | |
| $I_{OL}$ Low-Level Output Current | $V_{OL}$=1.5V, $V_{ID}$=−1V | | 25℃ | 6 | | | mA |
| $I_{CC}$ Supply Current | RL=∞ | $V_{CC}$=5V | 25℃ | | 0.8 | 1 | mA |
| | | $V_{CC}$=30V | Full Range | | | 2.5 | |

* Full range (MIN to MAX), for LM393 is 0℃ to 70℃. All characteristics are measured with zero common-mode input voltage unless otherwise specified.

** The voltage at either input or common-mode should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is VCC −1.5V, but either or both inputs can go to 30V without damage.

## Switching characteristics, $V_{CC}$=5V, $T_A$=25℃

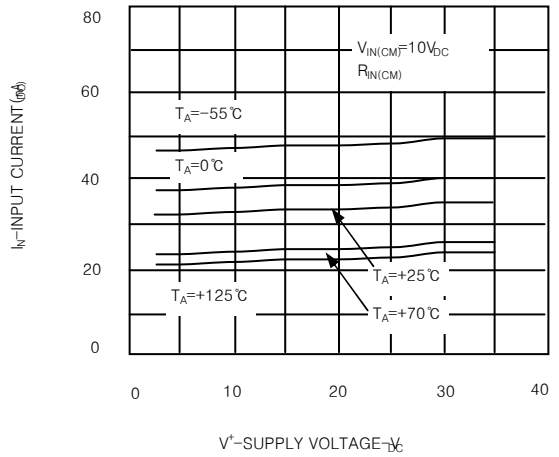
| PARAMETER | TEST CONDITION | | LM393 | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | |
| Response Time | RL Connected to 5V Through 5.1kΩ, $C_L$=15pF*(See Note 1) | 100-mV Input Step with 5-mV Overdrive | | 1.3 | | μs |
| | | TTL-Level Input Step | | 0.3 | | |

* $C_L$ includes probe and jig capacitance.

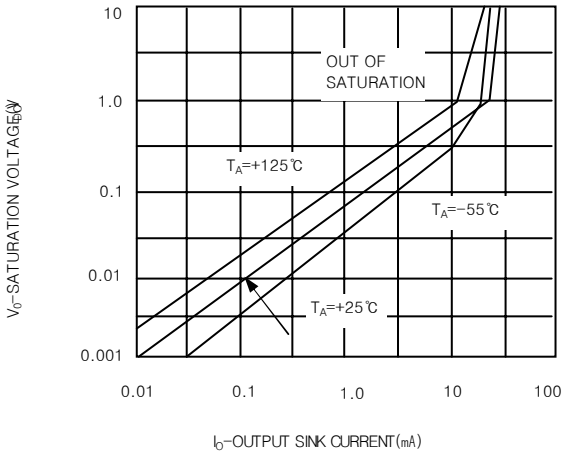
Note 1 : The response time specified is the interval between the input step function and the instant when the output crosses 1.4V.

## TYPICAL PERFORMANCE CHARACTERISTICS

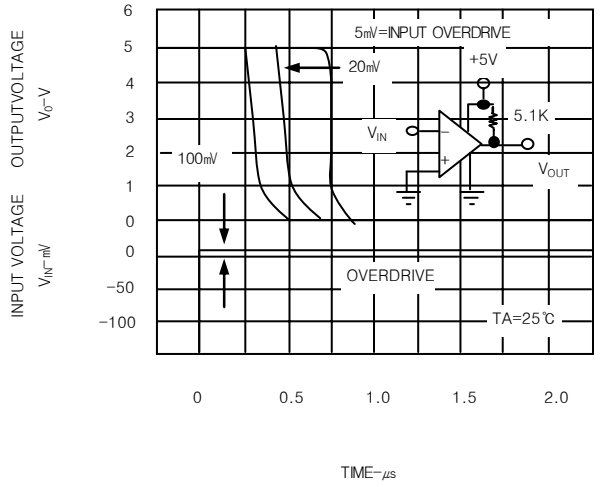
INPUT CURRENT



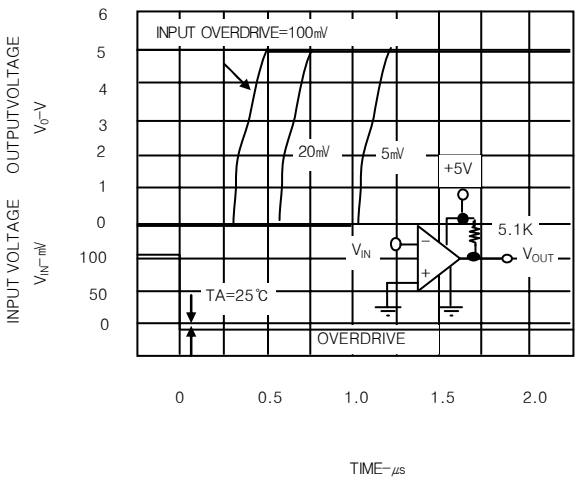

OUTPUT SATURATION VOLTAGE



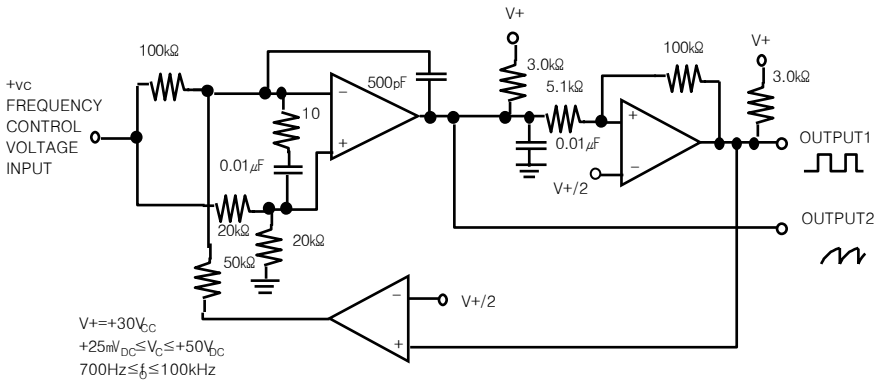

RESPONSE TIME FOR VARIOUS
INPUT OVERDRIVES–
NEGATIVE TRANSITION



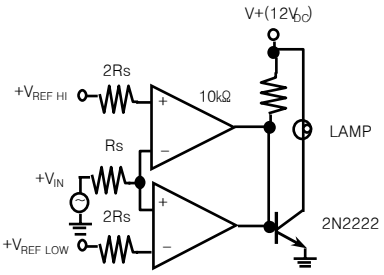

RESPONSE TIME FOR VARIOUS
INPUT OVERDRIVES–
POSITIVE TRANSITION



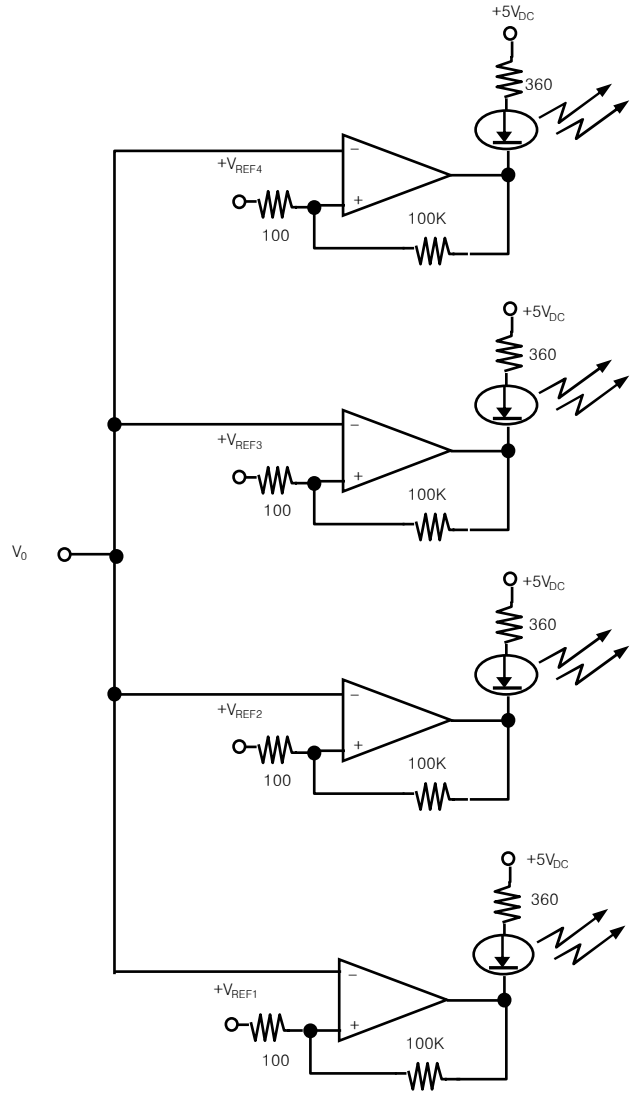
## TYPICAL APPLICATIONS



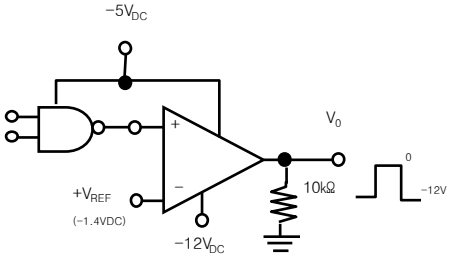

TWO-DECADE HIGH-FREQUENCY VCO



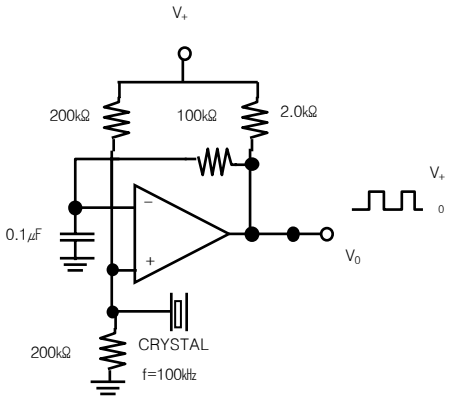

LIMIT COMPARATOR




VISIBLE VOLTAGE INDICATOR




TTL-TO-MOS LOGIC CONVERTER




CRYSTAL-CONTROLLED OSCILLATOR