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# LM2903,LM393/LM393A,LM293A

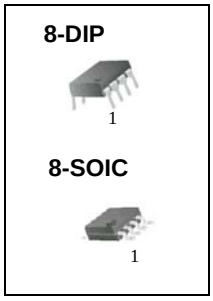
## Dual Differential Comparator

### Features

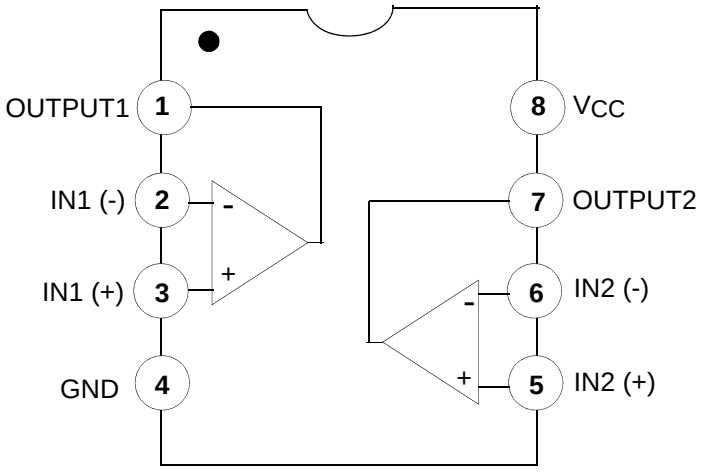
- Single Supply Operation: 2V to 36V
- Dual Supply Operation: ±1V to ±18V
- Allow Comparison of Voltages Near Ground Potential
- Low Current Drain 800μA Typ.
- Compatible with all Forms of Logic
- Low Input Bias Current 25nA Typ.
- Low Input Offset Current ±5nA Typ.
- Low Offset Voltage ±1mV Typ.

### Description

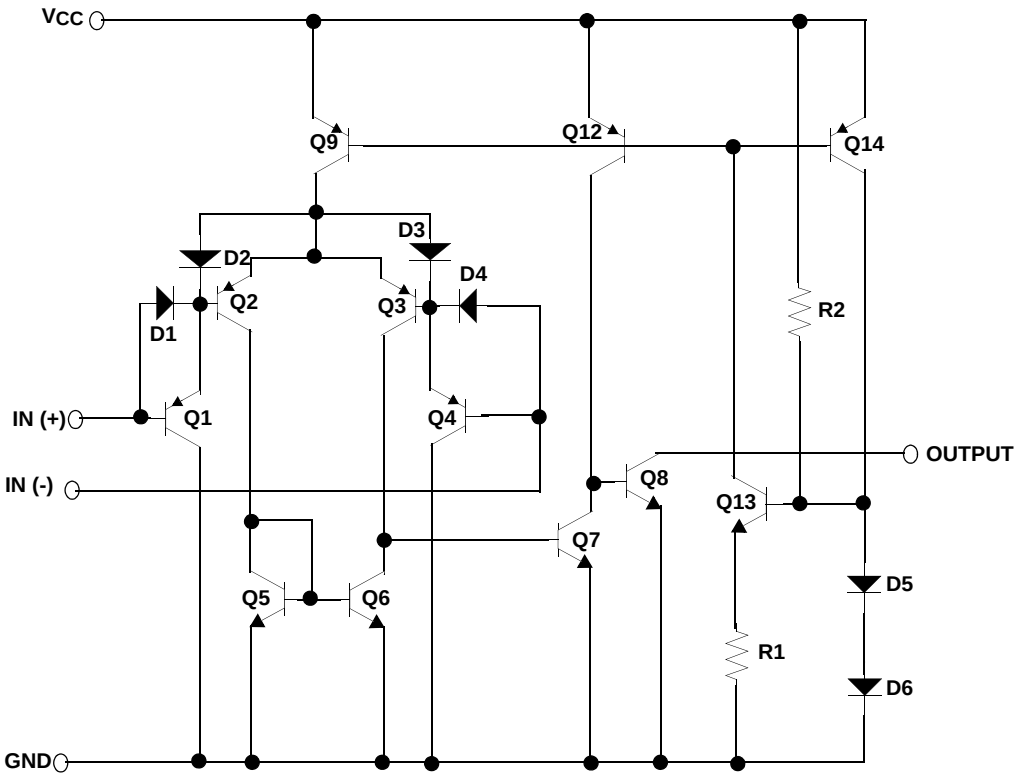
The LM2903, LM393/LM393A, LM293A consist of two independent voltage comparators designed to operate from a single power supply over a wide voltage range.




### Internal Block Diagram



## Schematic Diagram




## Absolute Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Power Supply Voltage | $V_{CC}$ | ±18 or 36 | V |
| Differential Input Voltage | $V_{I(DIFF)}$ | 36 | V |
| Input Voltage | $V_I$ | -0.3 to +36 | V |
| Output Short Circuit to GND | - | Continuous | - |
| Power Dissipation, $T_a$ = 25°C<br>8-DIP<br>8-SOIC | $P_D$ | <br>1040<br>480 | mW |
| Operating Temperature<br>LM393/LM393A<br>LM2903<br>LM293A | $T_{OPR}$ | <br>0 ~ +70<br>-40 ~ +105<br>-25 ~ +85 | °C |
| Storage Temperature | $T_{STG}$ | -65 ~ +150 | °C |

## Thermal Data

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Thermal Resistance Junction-Ambient Max.<br>8-DIP<br>8-SOIC | $R_{\theta ja}$ | <br>120<br>260 | °C/W |

## Electrical Characteristics

($V_{CC}$ = 5V, $T_A$ = 25°C, unless otherwise specified)

| Parameter | Symbol | Conditions | | LM293A/LM393A | | | LM393 | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| Input Offset Voltage | $V_{IO}$ | $V_{O(P)}$ =1.4V, $R_S$ = 0Ω | | - | ±1 | ±2 | - | ±1 | ±5 | mV |
| | | $V_{CM}$= 0 to 1.5V | Note1 | - | - | ±4.0 | - | - | ±9.0 | |
| Input Offset Current | $I_{IO}$ | | | - | ±5 | ±50 | - | ±5 | ±50 | nA |
| | | | Note1 | - | - | ±150 | - | - | ±150 | |
| Input Bias Current | $I_{BIAS}$ | | | - | 65 | 250 | - | 65 | 250 | nA |
| | | | Note1 | - | - | 400 | - | - | 400 | |
| Input Common Mode Voltage Range | $V_{I(R)}$ | | | 0 | - | $V_{CC}$ -1.5 | 0 | - | $V_{CC}$ -1.5 | V |
| | | | Note1 | 0 | - | $V_{CC}$-2 | 0 | - | $V_{CC}$-2 | |
| Supply Current | $I_{CC}$ | $R_L$ = ∞ , $V_{CC}$ = 5V | | - | 0.6 | 1 | - | 0.6 | 1 | mA |
| | | $R_L$ = ∞, $V_{CC}$ = 30V | | - | 0.8 | 2.5 | - | 0.8 | 2.5 | |
| Voltage Gain | $G_V$ | $V_{CC}$ =15V, $R_L$ ≥ 15kΩ (for large $V_{O(P-P)swing}$) | | 50 | 200 | - | 50 | 200 | - | V/mV |
| Large Signal Response Time | $T_{LRES}$ | $V_I$ =TTL Logic Swing $V_{REF}$ =1.4V, $V_{RL}$ = 5V, $R_L$ = 5.1kΩ | | - | 350 | - | - | 350 | - | nS |
| Response Time | $T_{RES}$ | $V_{RL}$ =5V, $R_L$ =5.1kΩ | | - | 1.4 | - | - | 1.4 | - | μS |
| Output Sink Current | $I_{SINK}$ | $V_{I(-)}$ ≥ 1V, $V_{I(+)}$ =0V, $V_{O(P)}$ ≤1.5V | | 6 | 18 | - | 6 | 18 | - | mA |
| Output Saturation Voltage | $V_{SAT}$ | $V_{I(-)}$ ≥ 1V, VI(+) = 0V | | - | 160 | 400 | - | 160 | 400 | mV |
| | | $I_{SINK}$ = 4mA | Note1 | - | - | 700 | - | - | 700 | |
| Output Leakage Current | $I_{O(LKG)}$ | $V_{I(-)}$ = 0V, $V_{I(+)}$ = 1V | $V_{O(P)}$ = 5V | - | 0.1 | - | - | 0.1 | - | nA |
| | | | $V_{O(P)}$ = 30V | - | - | 1.0 | - | - | 1.0 | μA |

**Note1**
LM393/LM393A: 0 ≤ $T_A$ ≤ +70°C
LM2903: -40 ≤ $T_A$ ≤ +105°C
LM293A : -25 ≤ $T_A$ ≤ +85°C

## Electrical Characteristics (Continued)

($V_{CC}$ = 5V, $T_A$ = 25°C, unless otherwise specified)

| Parameter | Symbol | Conditions | | LM2903 | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Input Offset Voltage | $V_{IO}$ | $V_{O(P)}$ =1.4V, $R_S$ = 0Ω | | - | ±1 | ±7 | mV |
| | | $V_{CM}$= 0 to 1.5V | Note1 | - | ±9 | ±15 | |
| Input Offset Current | $I_{IO}$ | | | - | ±5 | ±50 | nA |
| | | | Note1 | - | ±50 | ±200 | |
| Input Bias Current | $I_{BIAS}$ | | | - | 65 | 250 | nA |
| | | | Note1 | - | - | 500 | |
| Input Common Mode Voltage Range | $V_{I(R)}$ | | | 0 | - | $V_{CC}$ -1.5 | V |
| | | | Note1 | 0 | - | $V_{CC}$-2 | |
| Supply Current | $I_{CC}$ | $R_L$ = ∞, $V_{CC}$ = 5V | | - | 0.6 | 1 | mA |
| | | $R_L$ = ∞, $V_{CC}$ = 30V | | - | 1 | 2.5 | |
| Voltage Gain | $G_V$ | $V_{CC}$ =15V, $R_L$≥15kΩ (for large $V_{O(P-P)swing}$) | | 25 | 100 | - | V/mV |
| Large Signal Response Time | $T_{LRES}$ | $V_I$ =TTL Logic Swing $V_{REF}$ =1.4V, $V_{RL}$ = 5V, $R_L$ = 5.1kΩ | | - | 350 | - | nS |
| Response Time | $T_{RES}$ | $V_{RL}$ = 5V, $R_L$ = 5.1kΩ | | - | 1.5 | - | μS |
| Output Sink Current | $I_{SINK}$ | $V_{I(-)}$ ≥ 1V, $V_{I(+)}$ = 0V, $V_{O(P)}$ ≤ 1.5V | | 6 | 16 | - | mA |
| Output Saturation Voltage | $V_{SAT}$ | $V_{I(-)}$ ≥ 1V, VI(+) = 0V | | - | 160 | 400 | mV |
| | | $I_{SINK}$ = 4mA | Note1 | - | - | 700 | |
| Output Leakage Current | $I_{O(LKG)}$ | $V_{I(-)}$ = 0V, | $V_{O(P)}$ = 5V | - | 0.1 | - | nA |
| | | $V_{I(+)}$ = 1V | $V_{O(P)}$ = 30V | - | - | 1.0 | μA |

**Note1**
LM393/LM393A: 0 ≤ $T_A$ ≤ +70°C
LM2903: -40 ≤ $T_A$ ≤ +105°C
LM293A : -25 ≤ $T_A$ ≤ +85°C

# Typical Performance Characteristics

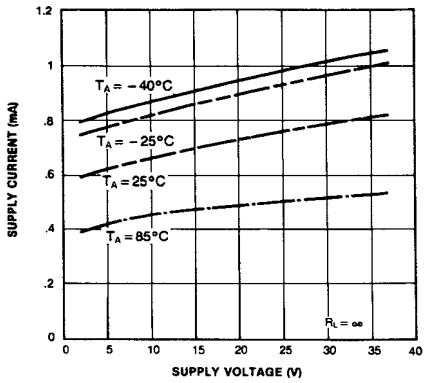



**Figure 1. Supply Current vs Supply Voltage**

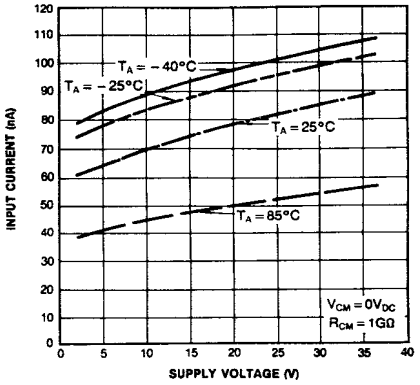



**Figure 2. Input Current vs Supply Voltage**

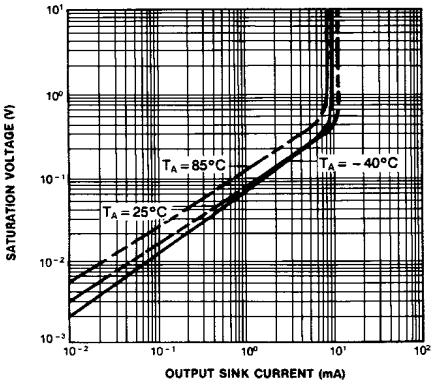



**Figure 3. Output Saturation Voltage vs Sink Current**

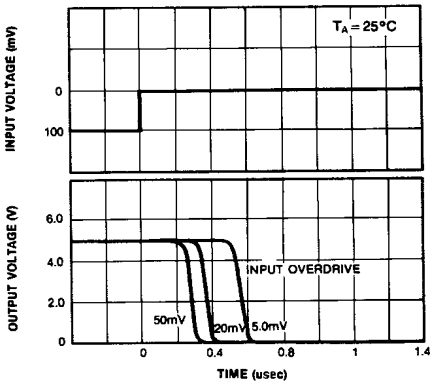



**Figure 4. Response Time for Various Input Overdrive-Negative Transition**

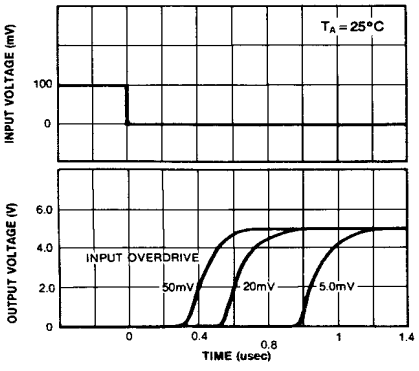


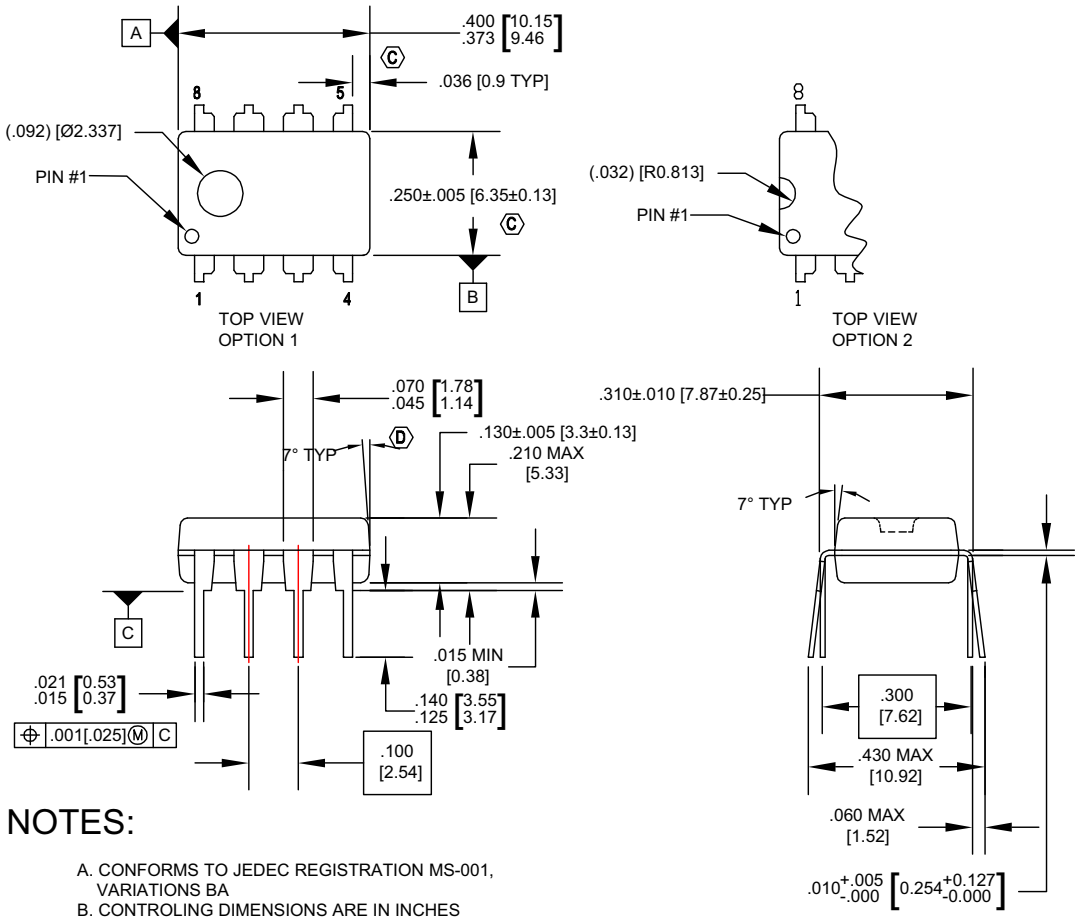

**Figure 5. Response Time for Various Input Overdrive-Positive Transition**

# Mechanical Dimensions

## Package

**Dimensions in millimeters**

# 8-DIP




NOTES:

A. CONFORMS TO JEDEC REGISTRATION MS-001, VARIATIONS BA
B. CONTROLING DIMENSIONS ARE IN INCHES
REFERENCE DIMENSIONS ARE IN MILLIMETERS
C. DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCHES OR 0.25MM.
D. DOES NOT INCLUDE DAMBAR PROTRUSIONS. DAMBAR PROTRUSIONS SHALL NOT EXCEED .010 INCHES OR 0.25MM.
E. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.

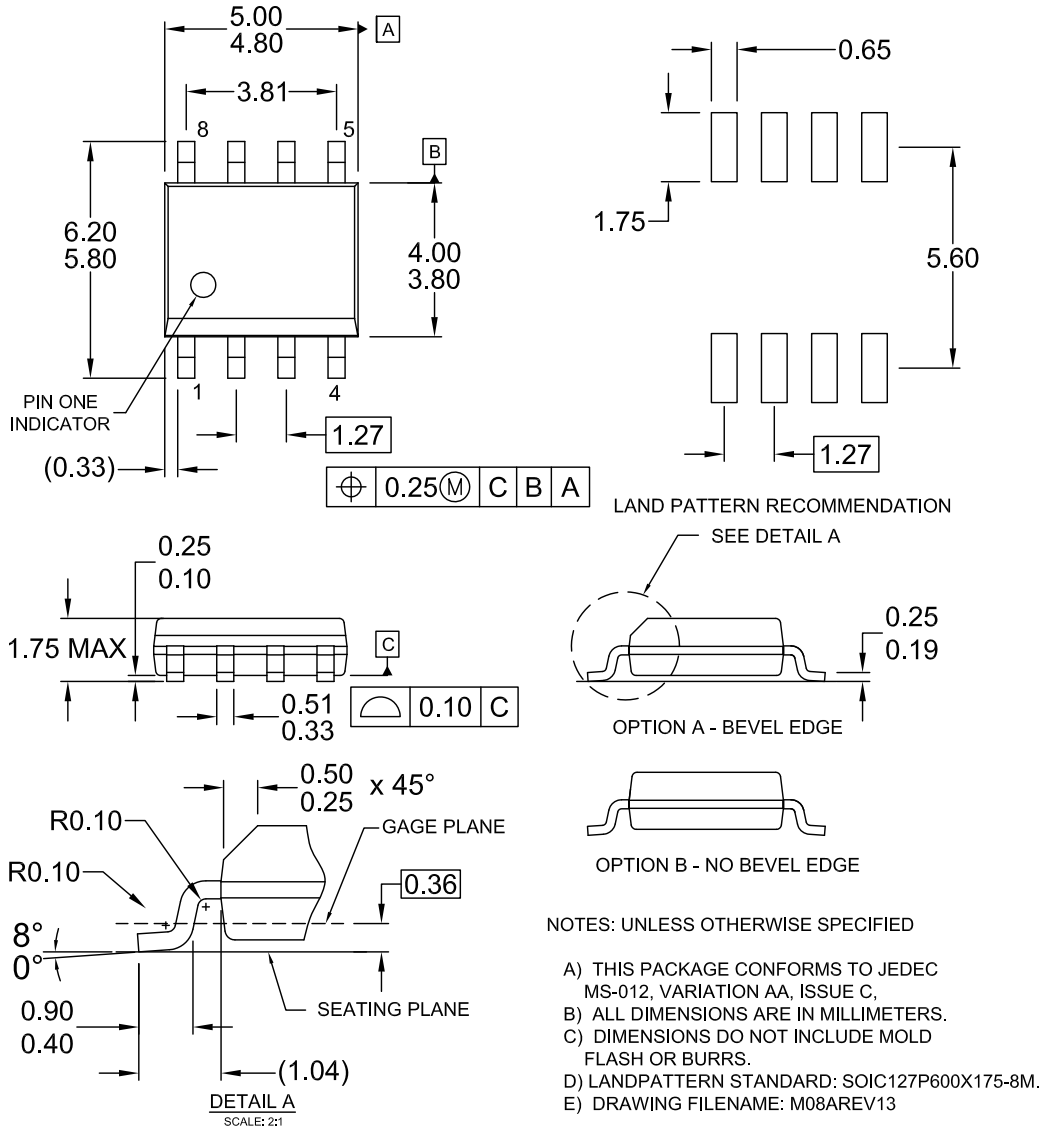
N08EREVG

## Mechanical Dimensions (Continued)

### Package

**Dimensions in millimeters**

# 8-SOIC




NOTES: UNLESS OTHERWISE SPECIFIED

A) THIS PACKAGE CONFORMS TO JEDEC MS-012, VARIATION AA, ISSUE C,
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS.
D) LANDPATTERN STANDARD: SOIC127P600X175-8M.
E) DRAWING FILENAME: M08AREV13

# Ordering Information

| Product Number | Operating Temperature | Package | Packing Method |
|---|---|---|---|
| LM393N | 0 ~ +70°C | 8-DIP | Rail |
| LM393AN | | | Rail |
| LM393M | | 8-SOIC | Rail |
| LM393MX | | | Tape & Reel |
| LM393AM | | | Rail |
| LM393AMX | | | Tape & Reel |
| LM2903N | -40 ~ +105°C | 8-DIP | Rail |
| LM2903M | | 8-SOIC | Rail |
| LM2903MX | | | Tape & Reel |
| LM293AN | -25 ~ +85°C | 8-DIP | Rail |