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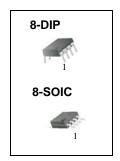
# LM2903,LM393/LM393A,LM293A Dual Differential Comparator

#### **Features**

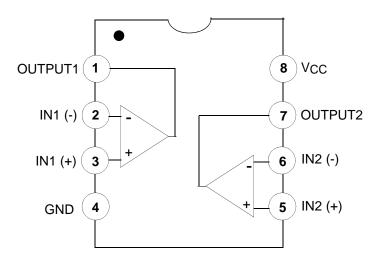
- Single Supply Operation: 2V to 36V
  Dual Supply Operation: ±1V to ±18V
- Allow Comparison of Voltages Near Ground Potential
- Low Current Drain 800µA Typ.
- Compatible with all Forms of Logic
- Low Input Bias Current 25nA Typ.
- Low Input Offset Current ±5nA Typ.
- Low Offset Voltage ±1mV Typ.

### **Description**

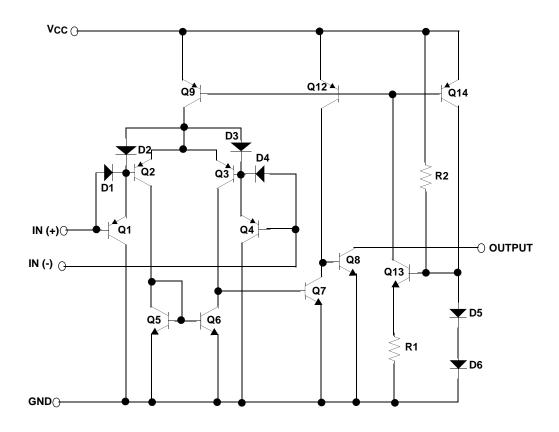
The LM2903, LM393/LM393A, LM293A consist of two independent voltage comparators designed to operate from a single power supply over a wide voltage range.



### **Internal Block Diagram**



### **Schematic Diagram**



### **Absolute Maximum Ratings**

Parameter	Symbol	Value	Unit
Power Supply Voltage	Vcc	±18 or 36	V
Differential Input Voltage	VI(DIFF)	36	V
Input Voltage	VI	-0.3 to +36	V
Output Short Circuit to GND	-	Continuous	-
Power Dissipation, T <sub>a</sub> = 25°C 8-DIP 8-SOIC	PD	1040 480	mW
Operating Temperature LM393/LM393A LM2903 LM293A	TOPR	0 ~ +70 -40 ~ +105 -25 ~ +85	°C
Storage Temperature	TSTG	-65 ~ +150	°C

### **Thermal Data**

Parameter	Symbol	Value	Unit
Thermal Resistance Junction-Ambient Max. 8-DIP 8-SOIC	R <sub>θja</sub>	120 260	°C/W

### **Electrical Characteristics**

(VCC = 5V,  $T_A = 25$ °C, unless otherwise specified)

Darameter	Cumbal	l Conditions		LM293A/LM393A			LM393			Unit	
Parameter	Symbol			Min.	Тур.	Max.	Min.	Тур.	Max.	Ullit	
Input Offset	out Offset VIO		$VO(P) = 1.4V, RS = 0\Omega$		±1	±2	-	±1	±5	mV	
Voltage	VIO	V <sub>CM</sub> = 0 to 1.5V	Note1	-	-	±4.0	-	-	±9.0	111 V	
Input Offset Current	lio			ı	±5	±50	ı	±5	±50	nA	
input Onset Current	IIO		Note1	ı	ı	±150	ı	-	±150		
Input Bias Current	IBIAS			-	65	250	-	65	250	nA	
Input bias Current	IBIAS		Note1	-	-	400	-	-	400		
Input Common Mode	VI(R)			0	-	VCC -1.5	0	-	VCC -1.5	V	
Voltage Range			Note1	0	-	VCC-2	0	-	Vcc-2		
Supply Current	ICC	$R_L = \infty$ , $V_{CC} = 5V$ - 0.6		1	-	0.6	1	mA			
Supply Current	icc	$R_L = \infty$ , $V_{CC} = 3$	80V	-	0.8	2.5	-	0.8	2.5	ША	
Voltage Gain	Gv	VCC =15V, R <sub>L</sub> ≥ 15kΩ (for large VO(P-P)swing)		50	200	-	50	200	-	V/mV	
Large Signal Response Time	T <sub>LRES</sub>	$V_I$ =TTL Logic Swing $V_{REF}$ =1.4V, $V_{RL}$ = 5V, $R_L$ = 5.1k $\Omega$		-	350	-	-	350	-	nS	
Response Time	TRES	V <sub>RL</sub> =5V, R <sub>L</sub> =5.1kΩ		-	1.4	-	-	1.4	-	μS	
Output Sink Current	ISINK	$V_{I(-)} \ge 1V, \ V_{I(+)} = 0V, \ V_{O(P)} \le 1.5V$		6	18	-	6	18	-	mA	
Output Saturation	VSAT	$V_{I(-)} \ge 1V, \ V_{I(+)}$	= 0V	-	160	400	-	160	400	mV	
Voltage		ISINK = 4mA	Note1	ı	-	700	ı	-	700	IIIV	
Output Leakage	JO(LKC)	V <sub>I</sub> (-) = 0V,	VO(P) = 5V	•	0.1	-	•	0.1	-	nA	
Current	IO(LKG)	$V_{I(+)} = 1V$ $V_{O(P)} = 3$		ı	-	1.0	ı	-	1.0	μΑ	

#### Note1

$$\begin{split} LM393/LM393A: \ 0 &\leq T_A \leq +70^{\circ}C \\ LM2903: \ -40 &\leq T_A \leq +105^{\circ}C \\ LM293A: \ -25 &\leq T_A \leq +85^{\circ}C \end{split}$$

### **Electrical Characteristics** (Continued)

(VCC = 5V,  $T_A = 25$ °C, unless otherwise specified)

Devemeter	Cumbal	Conditions			11:0:4			
Parameter	Symbol			Min.	Тур.	Max.	Unit	
Input Offset Voltage	Vio	VO(P) =1.4V, RS = 0	-	±1	±7	mV		
input Onset voltage	VIO	V <sub>CM</sub> = 0 to 1.5V	Note1	-	±9	±15	] ''''	
Input Offact Current	lio	,		-	±5	±50	A	
Input Offset Current	lio		Note1	-	±50	±200	nA	
Input Pigg Current	Inua			-	65	250	n 1	
Input Bias Current	IBIAS		Note1	-	-	500	nA	
Input Common Mode	V <sub>I</sub> (R)			0	-	VCC -1.5	V	
Voltage Range			Note1	0	-	Vcc-2		
Supply Current	Icc	R <sub>L</sub> = ∞, V <sub>C</sub> C = 5V		-	0.6	1	mΛ	
Supply Current	ICC	R <sub>L</sub> = ∞, V <sub>C</sub> C = 30V	R <sub>L</sub> = ∞, V <sub>C</sub> C = 30V		1	2.5	mA	
Voltage Gain	G∨	VCC =15V, RL≥15kΩ (for large VO(P-P)swing)		25	100	-	V/mV	
Large Signal Response Time	TLRES	$V_I$ =TTL Logic Swing $V_{REF}$ =1.4V, $V_{RL}$ = 5V, $R_L$ = 5.1kΩ		-	350	-	nS	
Response Time	TRES	$V_{RL} = 5V$ , $R_L = 5.1k\Omega$		-	1.5	-	μS	
Output Sink Current	ISINK	$VI(-) \ge 1V, \ VI(+) = 0V, \ VO(P) \le 1.5V$		6	16	-	mA	
Output Saturation Voltage	VSAT	$V_{I(-)} \ge 1V, \ V_{I(+)} = 0V$		-	160	400	mV	
Output Saturation voltage		ISINK = 4mA	Note1	-	-	700	] '''V	
Output Leakage Current	IO(LKG)	VI(-) = 0V,	VO(P) = 5V	-	0.1	-	nA	
Output Leakage Current		V <sub>I</sub> (+) = 1V V <sub>O</sub> (P) = 30V		-	-	1.0	μΑ	

#### Note1

$$\begin{split} LM393/LM393A\colon 0 &\leq T_A \leq +70^{\circ}C \\ LM2903\colon -40 &\leq T_A \leq +105^{\circ}C \\ LM293A\colon -25 &\leq T_A \leq +85^{\circ}C \end{split}$$

### **Typical Performance Characteristics**

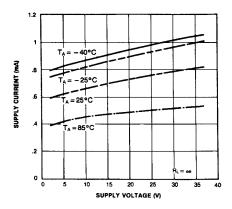


Figure 1. Supply Current vs Supply Voltage

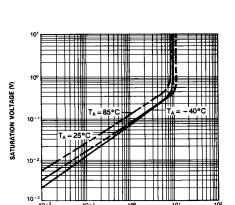


Figure 3. Output Saturation Voltage vs Sink Current

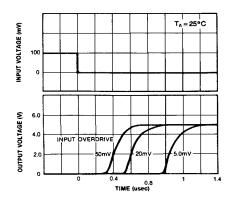


Figure 5. Response Time for Various Input Overdrive-Positive Transition

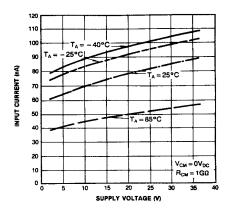


Figure 2. Input Current vs Supply Voltage

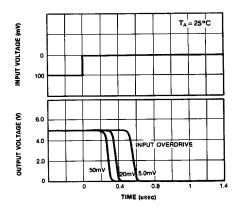


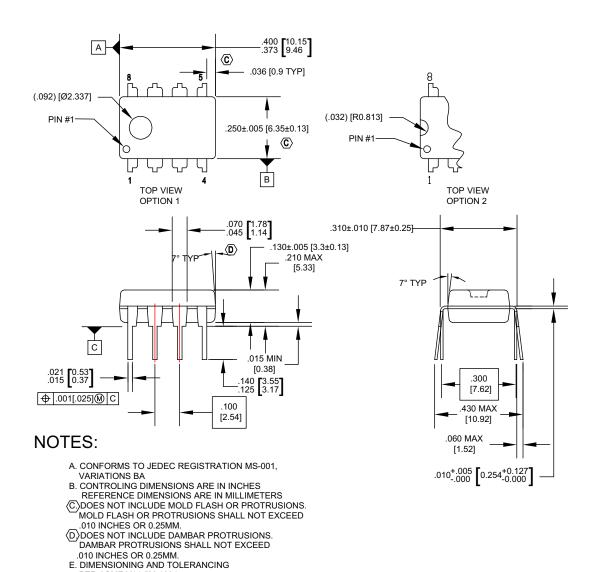
Figure 4. Response Time for Various Input Overdrive-Negative Transition

#### **Mechanical Dimensions**

#### **Package**

#### **Dimensions in millimeters**

### 8-DIP



N08EREVG

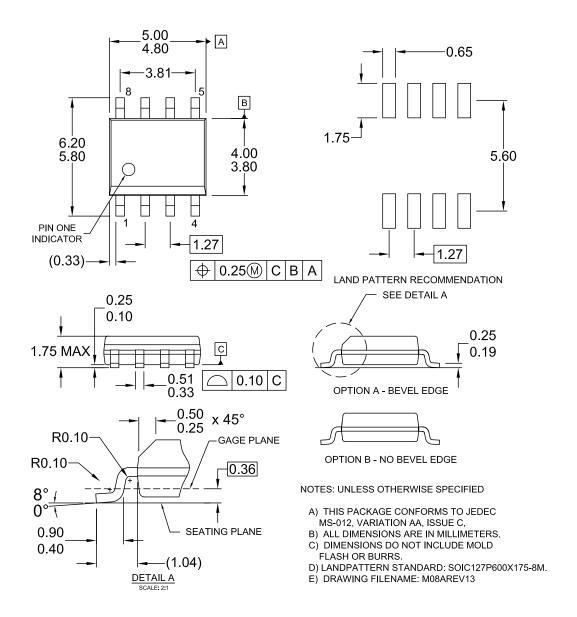
PER ASME Y14.5M-1994.

### **Mechanical Dimensions** (Continued)

#### **Package**

#### **Dimensions in millimeters**

### 8-SOIC



#### **Ordering Information**

Product Number	Operating Temperature	Package	Packing Method	
LM393N		8-DIP	Rail	
LM393AN		0-DIF	Rail	
LM393M	0 ~ +70°C		Rail	
LM393MX	0~+70°C	8-SOIC	Tape & Reel	
LM393AM		6-SOIC	Rail	
LM393AMX			Tape & Reel	
LM2903N		8-DIP	Rail	
LM2903M	-40 ~ +105°C	8-SOIC	Rail	
LM2903MX		0-30IC	Tape & Reel	
LM293AN	-25 ~ +85°C	8-DIP	Rail	

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