

# LM2903/LM2903I, LM393/LM393A, LM293/LM293A

## Dual Differential Comparator

### Features

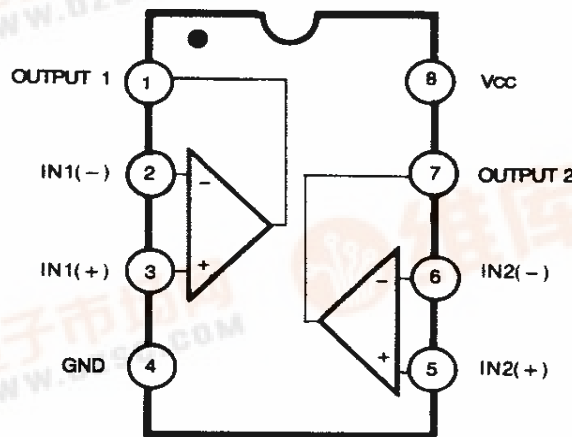
- Single Supply Operation: 2V to 36V
- Dual Supply Operation:  $\pm 1V$  to  $\pm 18V$
- Allow Comparison of Voltages Near Ground Potential
- Low Current Drain 800 $\mu A$  Typ.
- Compatible with all Forms of Logic
- Low Input Bias Current 25nA Typ.
- Low Input Offset Current  $\pm 5nA$  Typ.
- Low Offset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

### Description

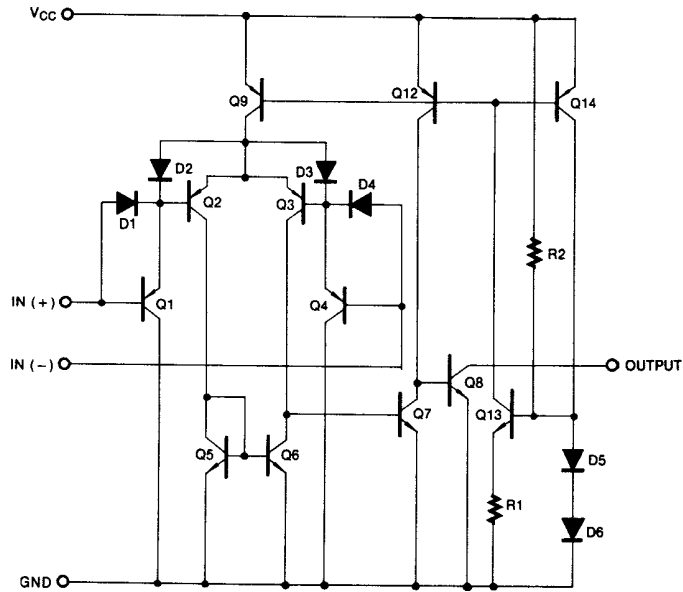
The LM2903/LM2903I, LM393/LM393A, LM293/LM293A consist of two independent voltage comparators designed to operate from a single power supply over a wide voltage range.



### Internal Block Diagram



## Schematic Diagram



## Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Power Supply Voltage	VCC	±18 or 36	V
Differential Input Voltage	V <sub>I(DIFF)</sub>	36	V
Input Voltage	V <sub>I</sub>	- 0.3 to +36	V
Output Short Circuit to GND	-	Continuous	-
Power Dissipation, T <sub>a</sub> = 25°C	P <sub>D</sub>	1040	mW
8-DIP		480	
Operating Temperature	T <sub>OPR</sub>	0 ~ +70	°C
LM393/LM393A		- 40 ~ +85	
LM2903		-40 ~ +105	
LM2903I		-25 ~ +85	
Storage Temperature	T <sub>STG</sub>	- 65 ~ +150	°C

## Thermal Data

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

## Electrical Characteristics

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

Parameter	Symbol	Conditions	LM293A/LM393A			LM293/LM393			Unit	
			Min.	Typ.	Max.	Min.	Typ.	Max.		
Input Offset Voltage	VIO	VO(P) = 1.4V, RS = 0Ω	-	±1	±2	-	±1	±5	mV	
		VCM = 0 to 1.5V   Note 1	-	-	±4.0	-	-	±9.0		
Input Offset Current	IIO		-	±5	±50	-	±5	±50	nA	
		Note 1	-	-	±150	-	-	±150		
Input Bias Current	IBIAS		-	65	250	-	65	250	nA	
		Note 1	-	-	400	-	-	400		
Input Common Mode Voltage Range	VI(R)		0	-	VCC - 1.5	0	-	VCC - 1.5	V	
		Note 1	0	-	VCC - 2	0	-	VCC - 2		
Supply Current	ICC	RL = ∞, VCC = 5V	-	0.6	1	-	0.6	1	mA	
		RL = ∞, VCC = 30V	-	0.8	2.5	-	0.8	2.5		
Voltage Gain	GV	VCC = 15V, RL ≥ 15KΩ (for large VO(P-P) swing)	50	200	-	50	200	-	V/mV	
Large Signal Response Time	TLRES	VI = TTL Logic Swing VREF = 1.4V, VRL = 5V, RL = 5.1KΩ	-	350	-	-	350	-	nS	
Response Time	TRES	VRL = 5V, RL = 5.1KΩ	-	1.4	-	-	1.4	-	μS	
Output Sink Current	ISINK	VI(-) ≥ 1V, VI(+) = 0V, VO(P) ≤ 1.5V	6	18	-	6	18	-	mA	
Output Saturation Voltage	VSAT	VI(-) ≥ 1V, VI(+) = 0V	-	160	400	-	160	400	mV	
		ISINK = 4mA   Note 1	-	-	700	-	-	700		
Output Leakage Current	IO(LKG)	VI(-) = 0V, VI(+) = 1V	VO(P) = 5V	-	0.1	-	-	0.1	-	nA
			VO(P) = 30V	-	-	1.0	-	-	1.0	μA

### NOTE 1

LM393/LM393A: 0 ≤ TA ≤ +70°C

LM2903: -40 ≤ TA ≤ +85°C

LM2903I: -40 ≤ TA ≤ +105°C

LM293/LM293A: -25 ≤ TA ≤ +85°C

**Electrical Characteristics** (Continued)

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

Parameter	Symbol	Conditions	LM2903/LM2903I			Unit
			Min.	Typ.	Max.	
Input Offset Voltage	V <sub>IO</sub>	V <sub>O(P)</sub> = 1.4V, R <sub>S</sub> = 0Ω	-	±1	±7	mV
		V <sub>CM</sub> = 0 to 1.5V	Note 1	-	±9	
Input Offset Current	I <sub>IO</sub>		-	±5	±50	nA
		Note 1	-	±50	±200	
Input Bias Current	I <sub>BIAS</sub>		-	65	250	nA
		Note 1	-	-	500	
Input Common Mode Voltage Range	V <sub>I(R)</sub>		0	-	V <sub>CC</sub> -1.5	V
		Note 1	0	-	V <sub>CC</sub> -2	
Supply Current	I <sub>CC</sub>	R <sub>L</sub> = ∞, V <sub>CC</sub> = 5V	-	0.6	1	mA
		R <sub>L</sub> = ∞, V <sub>CC</sub> = 30V	-	1	2.5	
Voltage Gain	G <sub>V</sub>	V <sub>CC</sub> = 15V, R <sub>L</sub> ≥ 15KΩ (for large V <sub>O(P-P)</sub> swing)	25	100	-	V/mV
Large Signal Response Time	T <sub>LR</sub>	V <sub>I</sub> = TTL Logic Swing V <sub>REF</sub> = 1.4V, V <sub>RL</sub> = 5V, R <sub>L</sub> = 5.1KΩ	-	350	-	nS
Response Time	T <sub>RES</sub>	V <sub>RL</sub> = 5V, R <sub>L</sub> = 5.1KΩ	-	1.5	-	μS
Output Sink Current	I <sub>SINK</sub>	V <sub>I(-)</sub> ≥ 1V, V <sub>I(+)</sub> = 0V, V <sub>O(P)</sub> ≤ 1.5V	6	16	-	mA
Output Saturation Voltage	V <sub>SAT</sub>	V <sub>I(-)</sub> ≥ 1V, V <sub>I(+)</sub> = 0V	-	160	400	mV
		I <sub>SINK</sub> = 4mA	Note 1	-	-	
Output Leakage Current	I <sub>O(LKG)</sub>	V <sub>I(-)</sub> = 0V, V <sub>O(P)</sub> = 5V	-	0.1	-	nA
		V <sub>I(+)</sub> = 1V, V <sub>O(P)</sub> = 30V	-	-	1.0	μA

**Note 1**

LM393/LM393A: 0 ≤ TA ≤ +70°C

LM2903: -40 ≤ TA ≤ +85°C

LM2903I: -40 ≤ TA ≤ +105°C

LM293/LM293A : -25 ≤ TA ≤ +85°C

## Typical Performance Characteristics

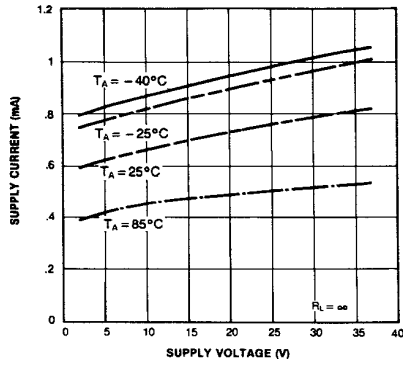


Figure 1. Supply Current vs Supply Voltage

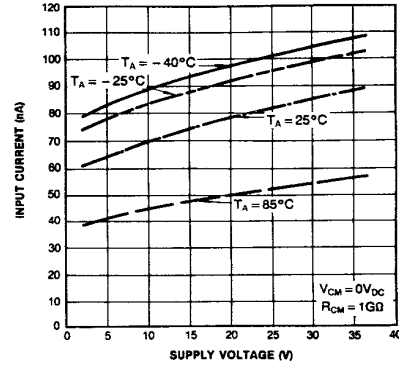


Figure 2. Input Current vs Supply Voltage

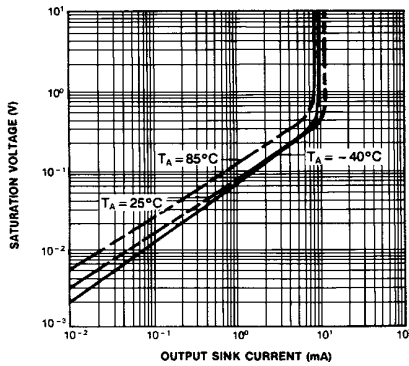


Figure 3. Output Saturation Voltage vs Sink Current

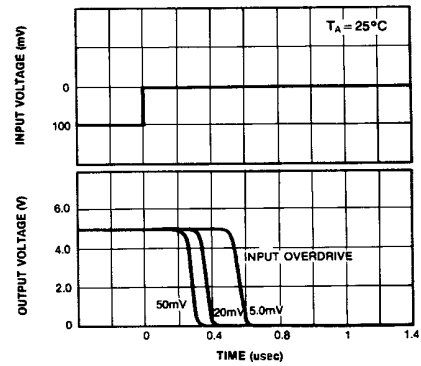


Figure 4. Response Time for Various Input Overdrive-Negative Transition

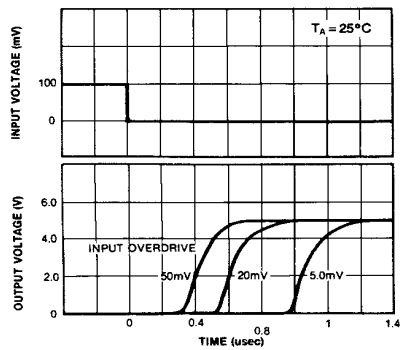


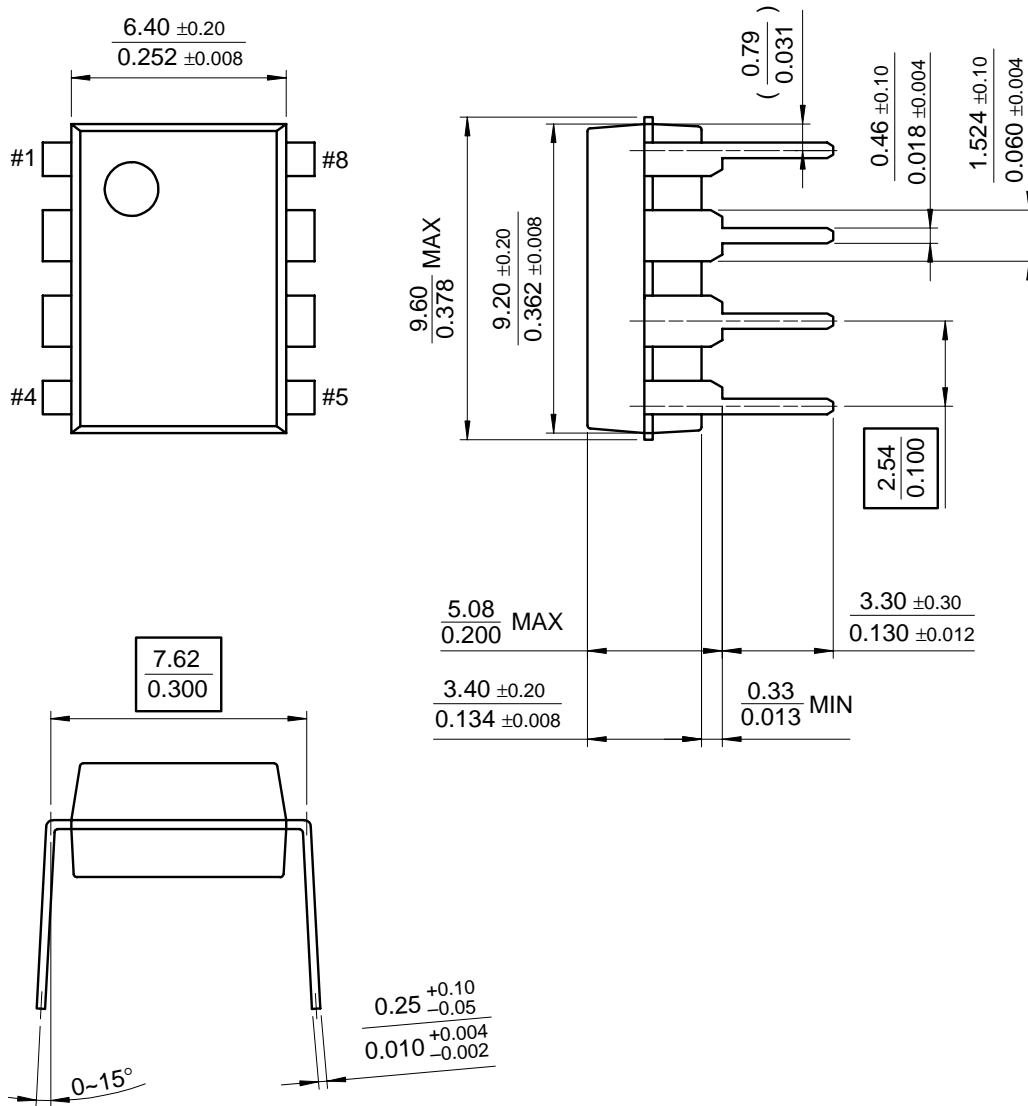
Figure 5. Response Time for Various Input Overdrive-Positive Transition

## Mechanical Dimensions

### Package

Dimensions in millimeters

### 8-DIP

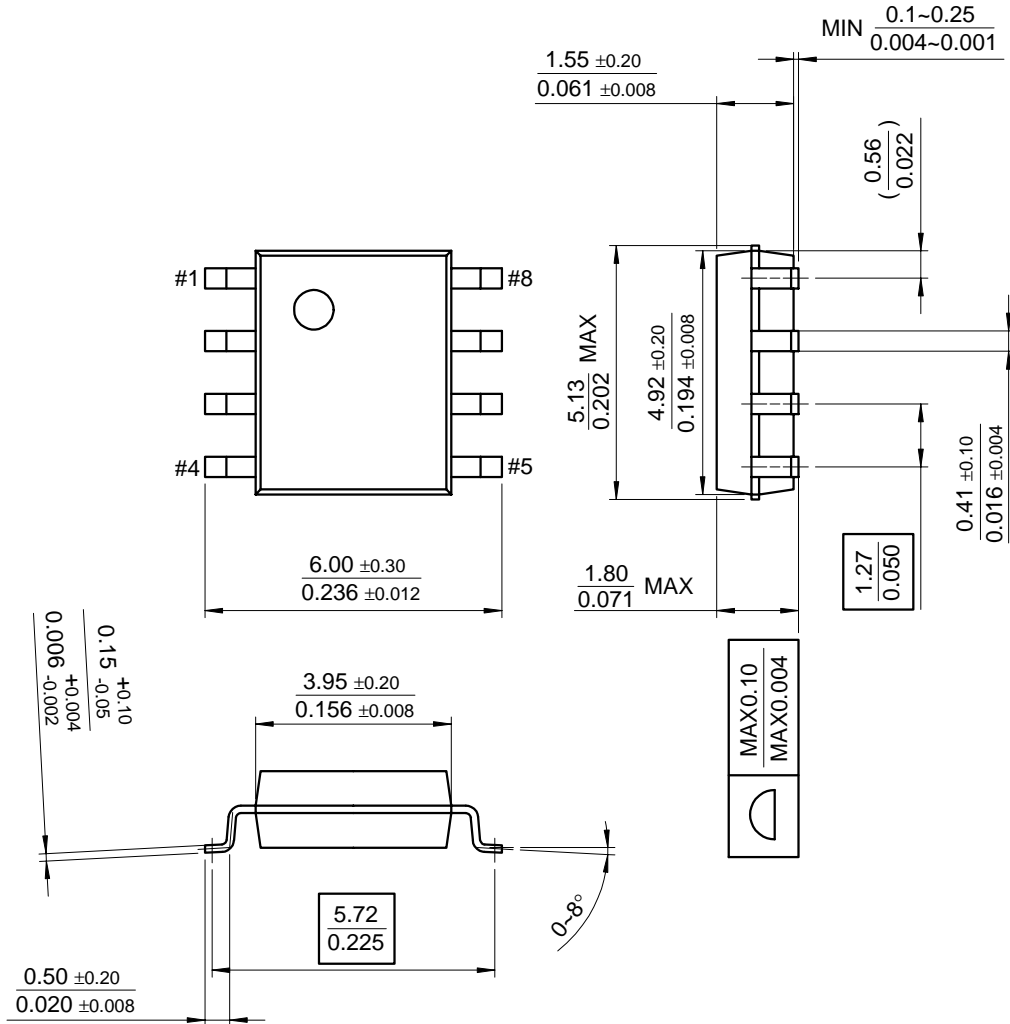


**Mechanical Dimensions** (Continued)

**Package**

Dimensions in millimeters

**8-SOP**



## Ordering Information

Product Number	Package	Operating Temperature
LM393N	8-DIP	0 ~ + 70°C
LM393AN		
LM393M	8-SOP	
LM393AM		
LM2903N	8-DIP	-40 ~ + 85°C
LM2903M	8-SOP	
LM2903IN	8-DIP	-40 ~ + 105°C
LM2903IM	8-SOP	
LM293N	8-DIP	-25 ~ + 85°C
LM293AN		
LM293M	8-SOP	
LM293AM		

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