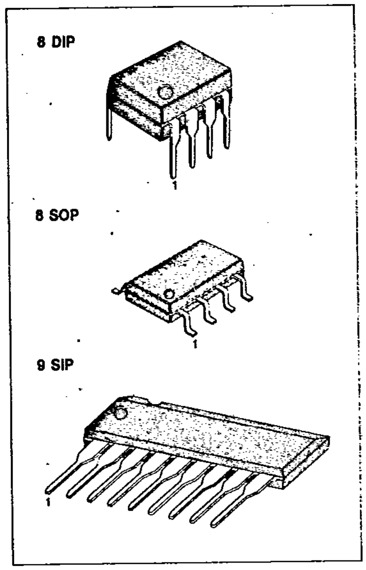
LM293/A, LM393/A, LM2903 LINEAR INTEGRATED CIRCUIT

DUAL DIFFERENTIAL COMPARATOR

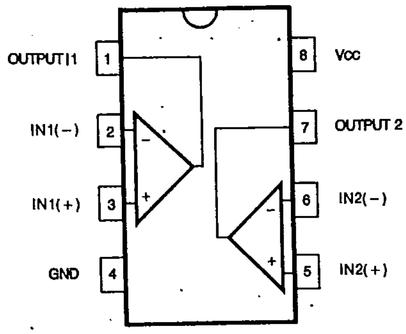
The LM293 series consists of two independent voltage comparators that one designed to operate from a single power supply over a wide range of voltage.

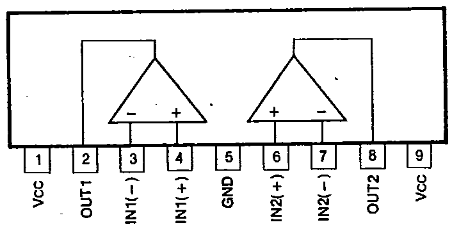


FEATURES

- 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 ±2mV Typ

BLOCK DIAGRAM





ORDERING INFORMATION

Device	Package	Operating Temperatur
LM293N LM293AN	8 DIP	−25 ~ +85°C
LM293S	9 SIP	
LM293D LM293AD	8 SOP	
LM393N LM393AN	8 DIP	0 ~ +75°C
LM393S	9 SIP	
LM393D LM393AD	8 SOP	
LM2903N	8 DIP	−40 ~ +85°C
LM2903D	8 SOP	

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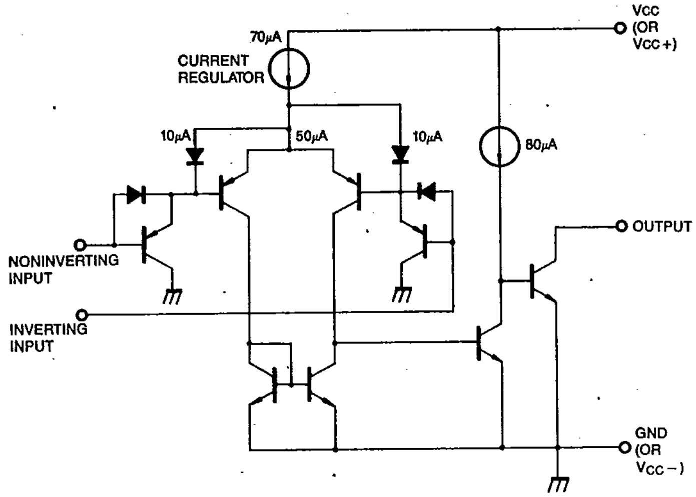
SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Characteristic	Symbol	Value	Unit
Power Supply Voltage	V_S	± 18 or 36	V
Differential Input Voltage	V_{ID}	36	V
Input Voltage	V_I	−0.3 to +36	V
Output Short Circuit to GND		Continuous	
Power Dissipation	P_D	570	mW
Operating Temperature LM293/LM293A LM393/LM393A LM2903	T_{opr}	 −25 ~ +85 0 ~ +70 −40 ~ +85	 °C °C °C
Storage Temperature	T_{stg}	−65 ~ +150	°C

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

Characteristic	Symbol	Test Conditions		LM293A/LM393A Min	LM293A/LM393A Typ	LM293A/LM393A Max	LM293/LM393 Min	LM293/LM393 Typ	LM293/LM393 Max	Unit
Input Offset Voltage	V_{IO}	$V_{CM}=0V$ to $V_{CC}-1.5V$, $V_o=1.4V$, $R_s=0$			±1	±2		±1	±5	mV
			$T_{amin} \leq T_a \leq T_{amax}$			±4.0			±9.0	
Input Offset Current	I_{IO}				±5	±50		±5	±50	nA
			$T_{amin} \leq T_a \leq T_{amax}$			±150			±150	
Input Bias Current	I_B				25	250		25	250	nA
			$T_{amin} \leq T_a \leq T_{amax}$			400			400	
Input Common Mode Voltage Range	V_{ICR}			0		V_{CC}-1.5	0		V_{CC}-1.5	V
			$T_{amin} \leq T_a \leq T_{amax}$	0		V_{CC}-2	0		V_{CC}-2	
Supply Current	I_{CC}	$R_L=\infty$			0.4	1		0.4	1	mA
		$R_L=\infty$ $V_{CC}=30V$			1	2.5		1	2.5	
Voltage Gain	A_V	$V_{CC}=15V$, $R_L \geq 15K\Omega$(for large V_o swing)		50	200		50	200		V/mV
Large Signal Response Time	t_{RES1}	V_{IN} = TTL Logic Swing, $V_{ref}=1.4V$, $V_{RL}=5V$, $R_L=5.1K\Omega$			300			300		nS
Response Time	t_{RES2}	$V_{RL}=5V$, $R_L=5.1K\Omega$			1.3			1.3		μS
Output Sink Current	I_{sink}	$V_{IN}^- \geq 1V$, $V_{IN}^+=0V$, $V_o \leq 1.5V$		6	16		6	16		mA
Output Saturation Voltage	V_{sat}	$V_{IN}^- \geq 1V$, $V_{IN}^+=0V$, $I_{sink}=4mA$			250	400		250	400	mV
			$T_{amin} \leq T_a \leq T_{amax}$			700			700	
Output Leakage Current	I_{leak}	$V_{IN}^-=0$, $V_{in}^+=1V$	$V_o=5V$		0.1			0.1		nA
			$V_o=30V$			1.0			1.0	μA

* $T_{amin} \leq T_a \leq T_{amax}$
LM293/LM293A: $T_{amin}=-25°C$, $T_{amax}=+85°C$
LM393/LM393A: $T_{amin}=0°C$, $T_{amax}=+70°C$
LM2903: $T_{amin}=-45°C$, $T_{amax}=+85°C$

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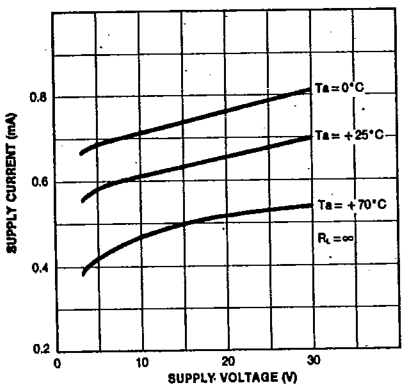
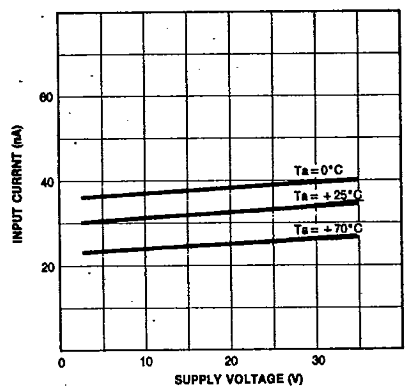
ELECTRICAL CHARACTERISTICS (V_{CC}=5V, Ta=25°C, unless otherwise specified)

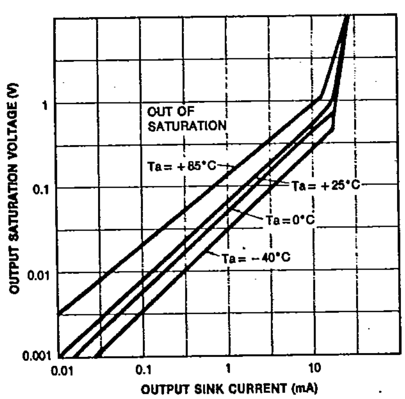
Characteristic	Symbol	Test Conditions		LM2903 Min	LM2903 Typ	LM2903 Max	Unit
Input Offset Voltage	V_{IO}	V_{CM}=0V to V_{CC}−1.5V V_o=1.4V, R_s=0			±2	±7	mV
			$T_{amin}\leq T_a\leq T_{amax}$		±9	±15	
Input Offset Current	I_{IO}				±5	±50	nA
			$T_{amin}\leq T_a\leq T_{amax}$		±50	±200	
Input Bias Current	I_B				25	250	nA
			$T_{amin}\leq T_a\leq T_{amax}$			500	
Input Common Mode Voltage Range	V_{ICR}			0		V_{CC}-1.5	V
			$T_{amin}\leq T_a\leq T_{amax}$	0		V_{CC}-2	
Supply Current	I_{CC}	$R_L=\infty$			0.4	1	mA
		$R_L=\infty$ V_{CC}=30V			1	2.5	
Voltage Gain	A_V	V_{CC}=15V, $R_L\geq$15KΩ (for large V_o swing)		25	100		V/mV
Large Signal Response Time	t_{RES1}	V_{IN}=TTL Logic Swing V_{ref}=1.4V, V_{RL}=5V, R_L=5.1KΩ			300		nS
Response Time	t_{RES2}	V_{RL}=5V, R_L=5.1KΩ			1.5		μS
Output Sink Current	I_{sink}	$V_{IN}^-\geq$1V, V_{IN}^+=0V, $V_o\leq$1.5V		6	16		mA
Output Saturation Voltage	V_{sat}	$V_{IN}^-\geq$1V, V_{IN}^+=0V I_{sink}=4mA			250	400	mV
			$T_{amin}\leq T_a\leq T_{amax}$			700	
Output Leakage Current	I_{leak}	V_{IN}^-=0, V_{in}^+=1V	V_o=5V		0.1		nA
			V_o=30V			1.0	μA

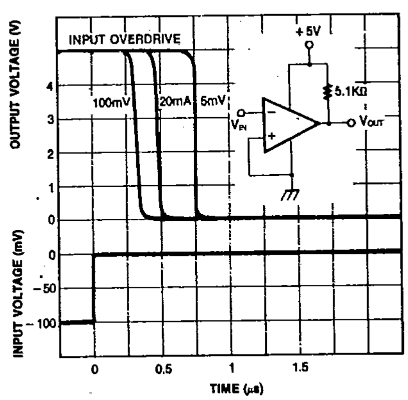
* $T_{amin}\leq T_a\leq T_{amax}$
LM293/LM293A: T_{amin}= −25°C, T_{amax}= +85°C
LM393/LM393A: T_{amin}=0°C, T_{amax}= +70°C
LM2903: T_{amin}= −45°C, T_{amax}= +85°C

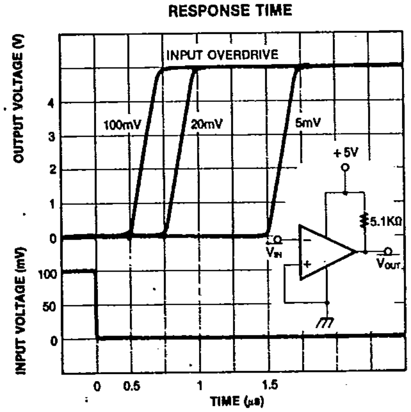
TYPICAL PERFORMANCE CHARACTERISTICS











APPLICATION INFORMATION

The LM293 series are high gain, wide bandwidth devices which, like most comparators, can easily oscillate if the output is inadvertently allowed to capacitively couple to the inputs via stray capacitance. That occurs during the output voltage transitions, when the comparator changes state.

To minimize this problem, PC board layout should be designed to reduce stray input-output coupling, reducing the input resistors to less than 10KΩ reduces the feedback signal levels and finally, adding even a small amount (1 to 10mV) of positive feedback (hysteresis) causes such a rapid transition that oscillations due to stray feedback are not possible.

If is good design practice to ground all unused pins.

The differential input voltage may be larger than positive supply without damaging the device. Note that voltages more negative than −0.3V should not used: an input clamping diode can be used as protection.

The output of the LM239 series is the uncommitted collector of a NPN transistor with grounded emitter. The allows the device to be used like any open-collector gate providing the OR-wide facility.

The output sink current capability is approximately 16mA; if this limit is exceeded, the output transistor will come out of saturation and the output voltate will rise very rapidly.
'Under this limit, the output saturation voltage is limited by the approximatively 60Ω r_{sat} of the output transistor.

TYPICAL APPLICATIONS (V_{CC} = +15V)

Basic comparator

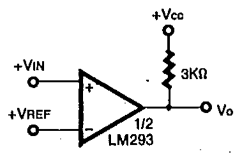


Fig. 3

Non-inverting comparator with Hysteresis

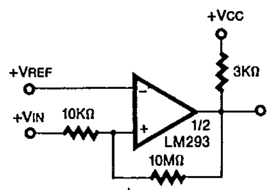


Fig. 4

Inverting comparator with Hysteresis

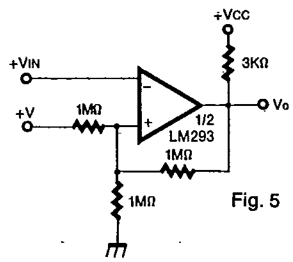


Fig. 5

Driving C-MOS

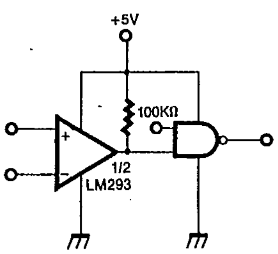


Fig. 6

Driving TTL

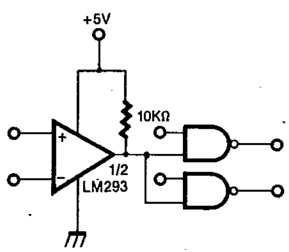


Fig. 7

APPLICATION INFORMATION (continued).

AND gate

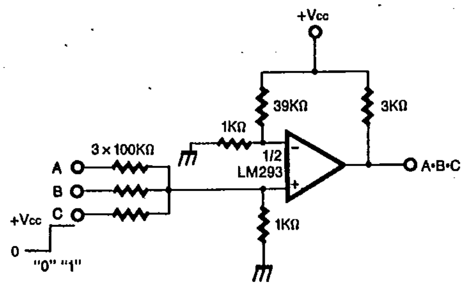


Fig. 8

OR gate

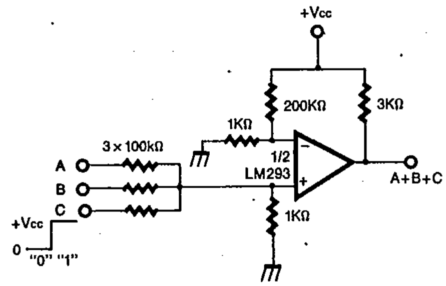


Fig. 9

Large fan-in AND gate

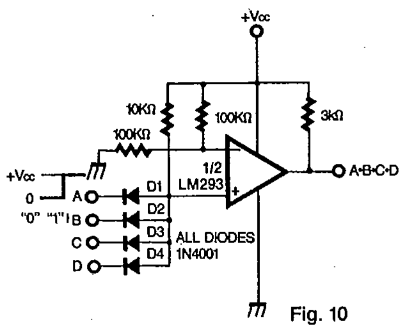


Fig. 10

Squarewave oscillator

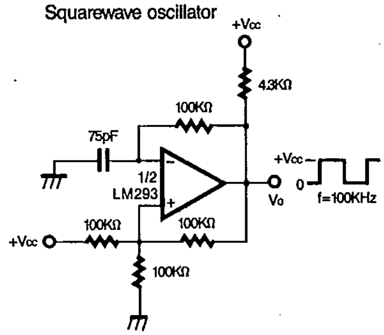


Fig. 11

Pulse generator

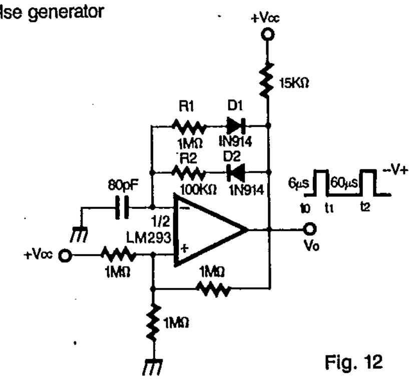


Fig. 12

One-shot multivibrator

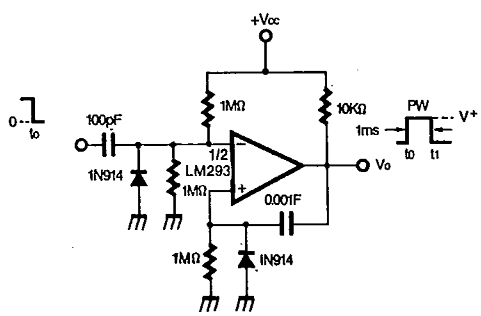


Fig. 13