TS393C,I,M

MICROPOWER DUAL CMOS VOLTAGE COMPARATORS

- EXTREMELY LOW SUPPLY CURRENT : **9µA typ / comparator**
- WIDE SINGLE SUPPLY RANGE **2.7V TO 16V** OR DUAL SUPPLIES (±1.35V TO ±8V)
- EXTREMELY LOW INPUT BIAS CURRENT : **1pA typ**
- EXTREMELY LOW INPUT OFFSET CURRENTS : **1pA typ**
- INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GND
- HIGH INPUT IMPEDANCE : $10^{12}\Omega$ typ
- FAST RESPONSE TIME : 2.5µs typ for 5mV overdrive
- PIN-TO-PIN AND FUNCTIONALLY COMPATIBLE WITH BIPOLAR LM393



N
DIP8
(Plastic Package)



D
SO8
(Plastic Micropackage)



P
TSSOP8
(Thin Shrink Small Outline Package)

DESCRIPTION

The TS393 is a micropower CMOS dual voltage comparator with extremely low consumption of 9µA typ / comparator (20 times less than bipolar LM393). Similar performances are offered by the dual micropower comparator TS3702 with a push-pull CMOS output.

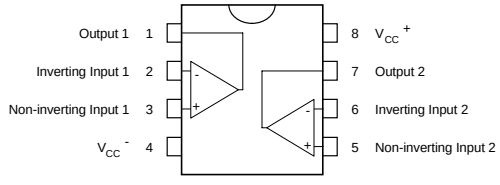
Thus response times remain similar to the LM393.

ORDER CODE

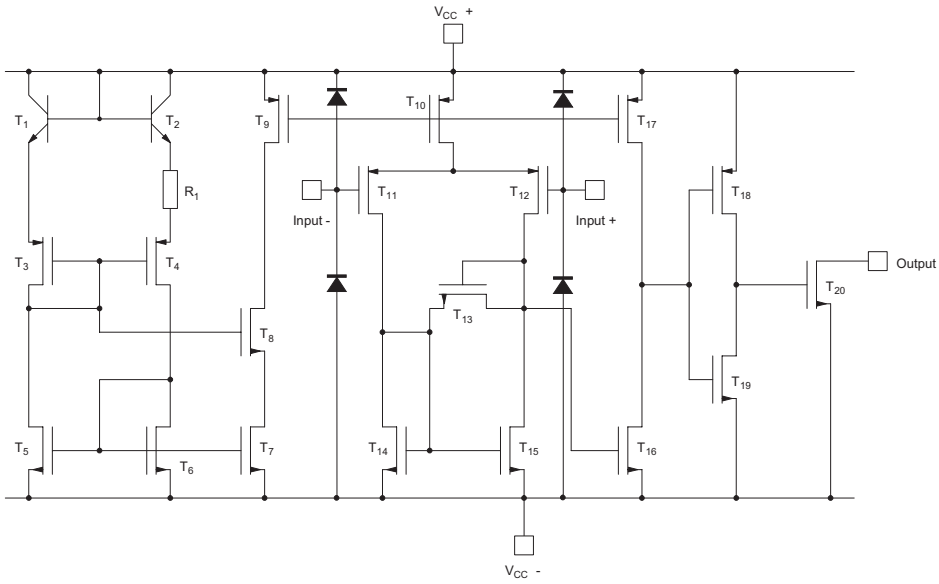
Part Number	Temperature Range	Package		
		N	D	P
TS393C	0°C, +70°C	•	•	•
TS393I	-40°C, +125°C	•	•	•
TS393M	-55°C, +125°C	•	•	•

N = Dual in Line Package (DIP)
D = Small Outline Package (SO) - also available in Tape & Reel (DT)
P = Thin Shrink Small Outline Package (TSSOP) - only available in Tape & Reel (PT)

PIN CONNECTIONS (top view)



SCHEMATIC DIAGRAM (for 1/2 TS393)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V_{CC}^+	Supply Voltage [1]		18	V
V_{id}	Differential Input Voltage [2]		±18	V
V_i	Input Voltage [3]		18	V
V_o	Output Voltage		18	V
I_o	Output Current		20	mA
I_F	Forward Current in ESD Protection Diodes on Inputs [4]		50	mA
p_d	Power Dissipation [5]	DIP8 SO8 TSSOP8	1250 710 625	mW
T_{stg}	Storage Temperature Range		-65 to +150	°C

1. All voltage values, except differential voltage, are with respect to network ground terminal.
2. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
3. Excursions of input voltages may exceed the power supply level. As long as the common mode voltage [$V_{icm}=(V_{in}^+ + V_{in}^-)/2$] remains within the specified range, the comparator will provide a stable output state. However, the maximum current through the ESD diodes (if) of the input stage must strictly be observed. The output must never exceed the power supply voltage.
4. Guaranteed by design.
5. Pd is calculated with T_{amb} = +25°C, T_j = +150°C and R_{thja} = 100°C/W for DIP8 package
= 175°C/W for SO8 package
= 200°C/W for TSSOP8 package

OPERATING CONDITIONS

Symbol	Parameter		Value	Unit
V_{CC}^+	Supply Voltage	TS393C,I TS393M	2.7 to 16 4 to 16	V
V_{icm}	Common Mode Input Voltage Range		0 to V_{CC}^+ -1.5	V
T_{oper}	Operating Free-Air Temperature range	TS393C TS393I TS393M	0 to +70 -40 to +125 -55 to +125	°C

ELECTRICAL CHARACTERISTICS

V_{CC}^+ = 3V, V_{cc}^- = 0V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage 1) V_{ic} = 1.5V $T_{min.} \le T_{amb} \le T_{max.}$			5 6.5	mV
I_{io}	Input Offset Current 2) V_{ic} = 1.5V $T_{min.} \le T_{amb} \le T_{max.}$		1	 300	pA
I_{ib}	Input Bias Current 2) V_{ic} = 1.5V $T_{min.} \le T_{amb} \le T_{max.}$		1	 600	pA
V_{icm}	Input Common Mode Voltage Range $T_{min.} \le T_{amb} \le T_{max}$	0 0		V_{CC}^+-1.2 V_{CC}^+ -1.5	V
CMR	Common-mode Rejection Ratio $V_{ic} = V_{icm\ min.}$		70		dB
SVR	Supply Voltage Rejection Ratio V_{CC}^+ = 3V to 5V		70		dB
I_{OH}	High Level Output Current V_{id} = +1V, V_{OH} = 3V $T_{min.} \le T_{amb} \le T_{max.}$		2	40 1000	nA
V_{OL}	Low Level Output Voltage V_{id} = -1V, I_{OL} = +6mA $T_{min.} \le T_{amb} \le T_{max.}$		400	550 800	mV
I_{CC}	Supply Current (each comparator) No load - Outputs low $T_{min.} \le T_{amb} \le T_{max.}$		9	20 25	µA
t_{PLH}	Response Time Low to High V_{ic} = 0V, f = 10kHz, R_L = 5.1kΩ, C_L = 50pF, Overdrive = 5mV TTL Input		1.5 0.7		µs
t_{PHL}	Response Time High to Low V_{ic} = 0V, f = 10kHz, R_L = 5.1kΩ, C_L = 50pF, Overdrive = 5mV TTL Input		2.5 0.08		µs

1. The specified offset voltage is the maximun value required to drive the output up to 2.5V or down to 0.3V.
2. Maximum values including unavoidable inaccuracies of the industrial test.

ELECTRICAL CHARACTERISTICS

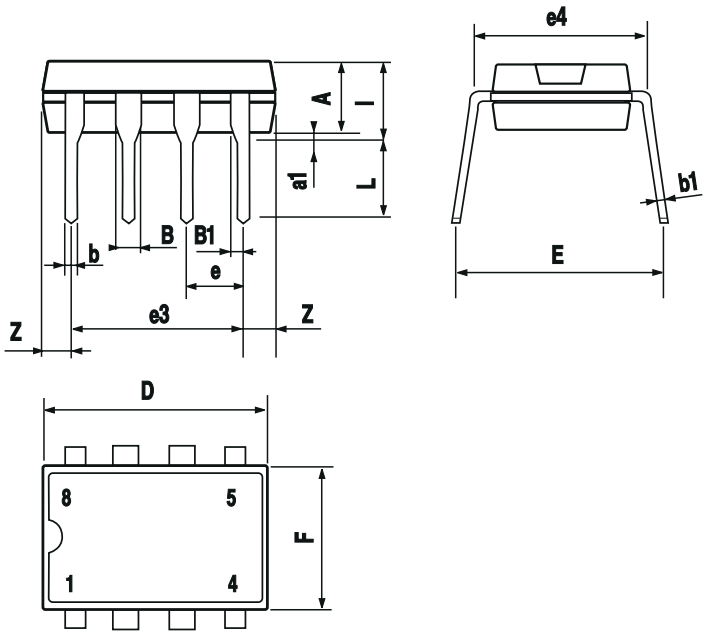
V_{CC}^+ = 5V, V_{cc}^- = 0V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage V_{ic} = 2.5V, V_{cc}^+ = 5V to 10V 1) $T_{min.} \le T_{amb} \le T_{max.}$		1.4	5 6.5	mV
I_{io}	Input Offset Current 2) V_{ic} = 2.5V $T_{min.} \le T_{amb} \le T_{max.}$		1	 300	pA
I_{ib}	Input Bias Current 2) V_{ic} = 2.5V $T_{min.} \le T_{amb} \le T_{max.}$		1	 600	pA
V_{icm}	Input Common Mode Voltage Range $T_{min.} \le T_{amb} \le T_{max}$	0 0		V_{CC}^+-1.2 V_{CC}^+ -1.5	V
CMR	Common-mode Rejection Ratio $V_{ic} = V_{icm\ min.}$		71		dB
SVR	Supply Voltage Rejection Ratio V_{CC}^+ = +5V to +10V		80		dB
I_{OH}	High Level Output Current V_{id} = 1V, V_{OH} = +5V $T_{min.} \le T_{amb} \le T_{max.}$		2	40 1000	nA
V_{OL}	Low Level Output Voltage V_{id} = -1V, I_{OL} = 6mA $T_{min.} \le T_{amb} \le T_{max.}$		260	400 650	mV
I_{CC}	Supply Current (each comparator) No load - Outputs low $T_{min.} \le T_{amb} \le T_{max.}$		10	20 25	µA
t_{PLH}	Response Time Low to High V_{ic} = 0V, f = 10kHz, R_L = 5.1kΩ, C_L = 50pF, Overdrive = 5mV Overdrive = 10mV Overdrive = 20mV Overdrive = 40mV TTL Input		 1.5 1.2 1.0 0.8 0.7		µs
t_{PHL}	Response Time High to Low V_{ic} = 0V, f = 10kHz, R_L = 5.1kΩ, C_L = 50pF, Overdrive = 5mV Overdrive = 10mV Overdrive = 20mV Overdrive = 40mV TTL Input		 2.5 1.9 1.2 0.8 0.08		µs
t_f	Fall time f = 10kHz, C_L = 50pF, R_L = 5.1kΩ, Overdrive 50mV		25		ns

1. The specified offset voltage is the maximun value required to drive the output up to 4.5V or down to 0.3V.
2. Maximum values including unavoidable inaccuracies of the industrial test.

PACKAGE MECHANICAL DATA

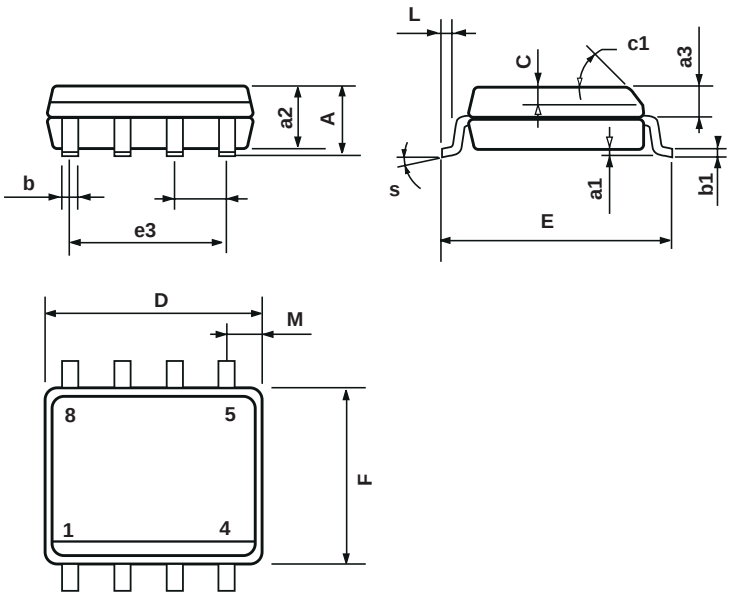
8 PINS - PLASTIC DIP



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0260
i			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

PACKAGE MECHANICAL DATA

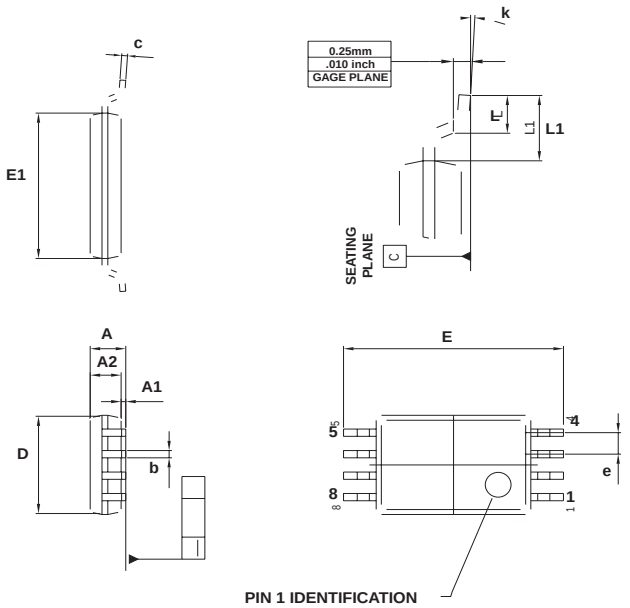
8 PINS - PLASTIC MICROPACKAGE (SO)



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.25	0.004		0.010
a2			1.65			0.065
a3	0.65		0.85	0.026		0.033
b	0.35		0.48	0.014		0.019
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.020
c1	45° (typ.)					
D	4.8		5.0	0.189		0.197
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		3.81			0.150	
F	3.8		4.0	0.150		0.157
L	0.4		1.27	0.016		0.050
M			0.6			0.024
S	8° (max.)					

PACKAGE MECHANICAL DATA

8 PINS - THIN SHRINK SMALL OUTLINE PACKAGE (TSSOP)



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	2.90	3.00	3.10	0.114	0.118	0.122
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k	0°		8°	0°		8°
l	0.50	0.60	0.75	0.09	0.0236	0.030
L	0.45	0.600	0.75	0.018	0.024	0.030
L1		1.000			0.039	

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