



# 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 ( $\pm 1.35V$  TO  $\pm 8V$ )
- 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

### DESCRIPTION

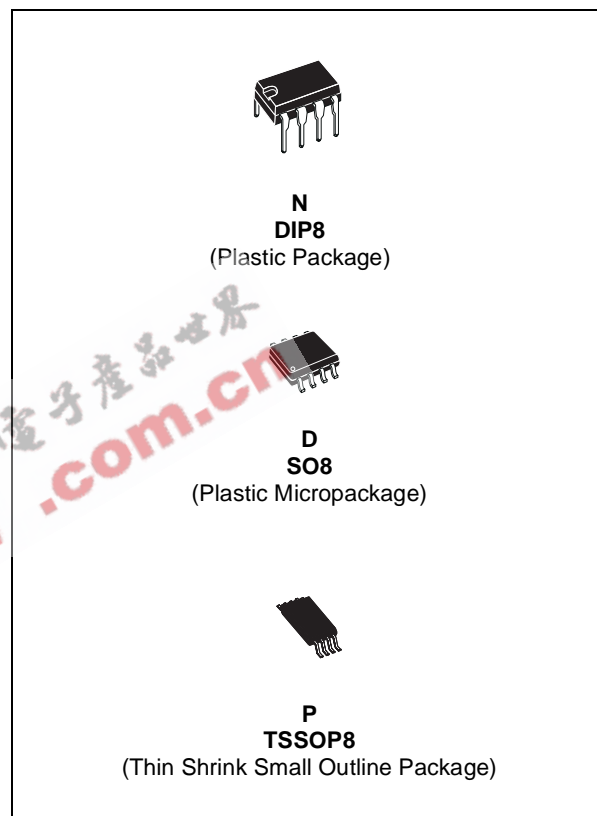
The TS393 is a micropower CMOS dual voltage comparator with extremely low consumption of 9µA typ / comparator (20 times less than bipolar LM393). Similar performances are offered by the dual micropower comparator TS3702 with a push-pull CMOS output.

Thus response times remain similar to the LM393.

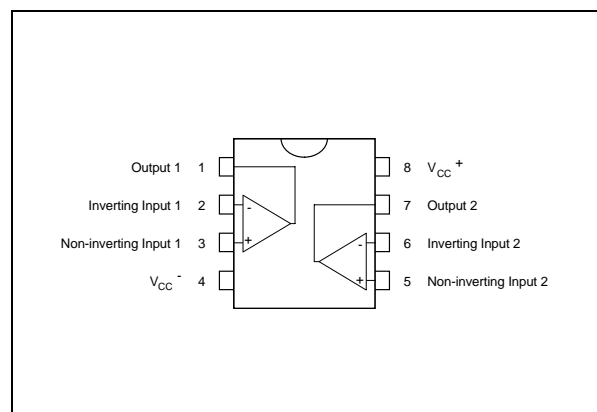
### ORDER CODE

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)

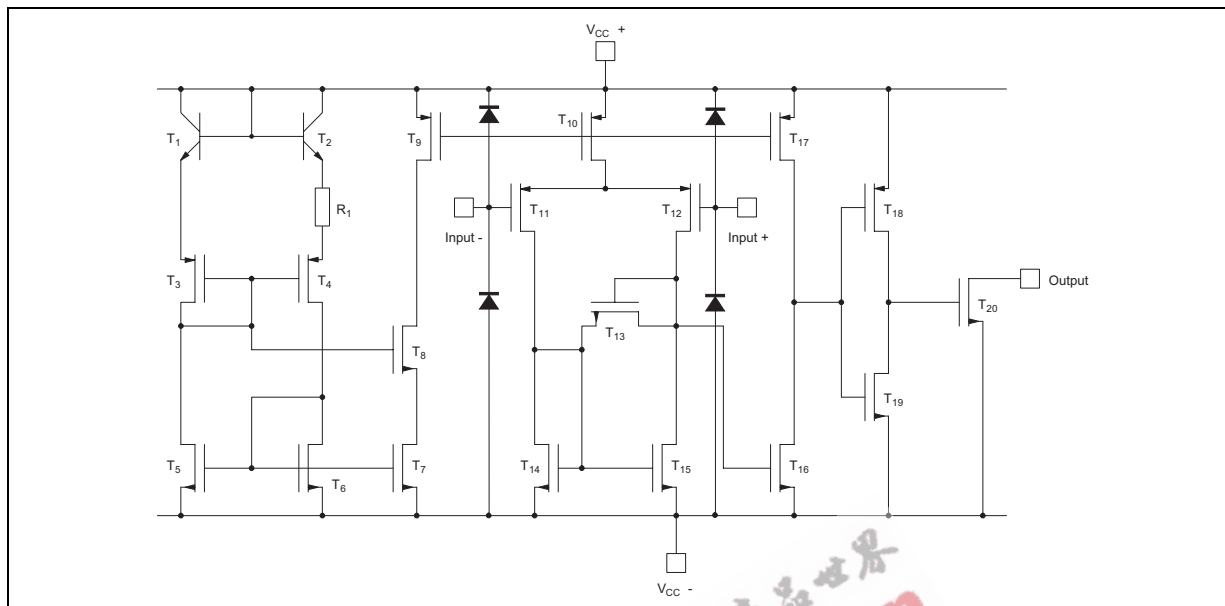


### PIN CONNECTIONS (top view)



## TS393C,I,M

### SCHEMATIC DIAGRAM (for 1/2 TS393)



### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{CC}^+$	Supply Voltage <sup>1)</sup>	18	V
$V_{id}$	Differential Input Voltage <sup>2)</sup>	$\pm 18$	V
$V_i$	Input Voltage <sup>3)</sup>	18	V
$V_o$	Output Voltage	18	V
$I_o$	Output Current	20	mA
$I_F$	Forward Current in ESD Protection Diodes on Inputs <sup>4)</sup>	50	mA
$P_d$	Power Dissipation <sup>5)</sup>	DIP8	1250
		SO8	710
		TSSOP8	625
$T_{stg}$	Storage Temperature Range	-65 to +150	$^{\circ}\text{C}$

- All voltage values, except differential voltage, are with respect to network ground terminal.
- Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
- 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.
- Guaranteed by design.
- $P_d$  is calculated with  $T_{amb} = +25^{\circ}\text{C}$ ,  $T_j = +150^{\circ}\text{C}$  and  $R_{thja} = 100^{\circ}\text{C/W}$  for DIP8 package  
 $= 175^{\circ}\text{C/W}$  for SO8 package  
 $= 200^{\circ}\text{C/W}$  for TSSOP8 package

### OPERATING CONDITIONS

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

**ELECTRICAL CHARACTERISTICS**
 $V_{CC}^+ = 3V$ ,  $V_{CC}^- = 0V$ ,  $T_{amb} = 25^\circ C$  (unless otherwise specified)

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

1. The specified offset voltage is the maximum 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.

## TS393C,I,M

### ELECTRICAL CHARACTERISTICS

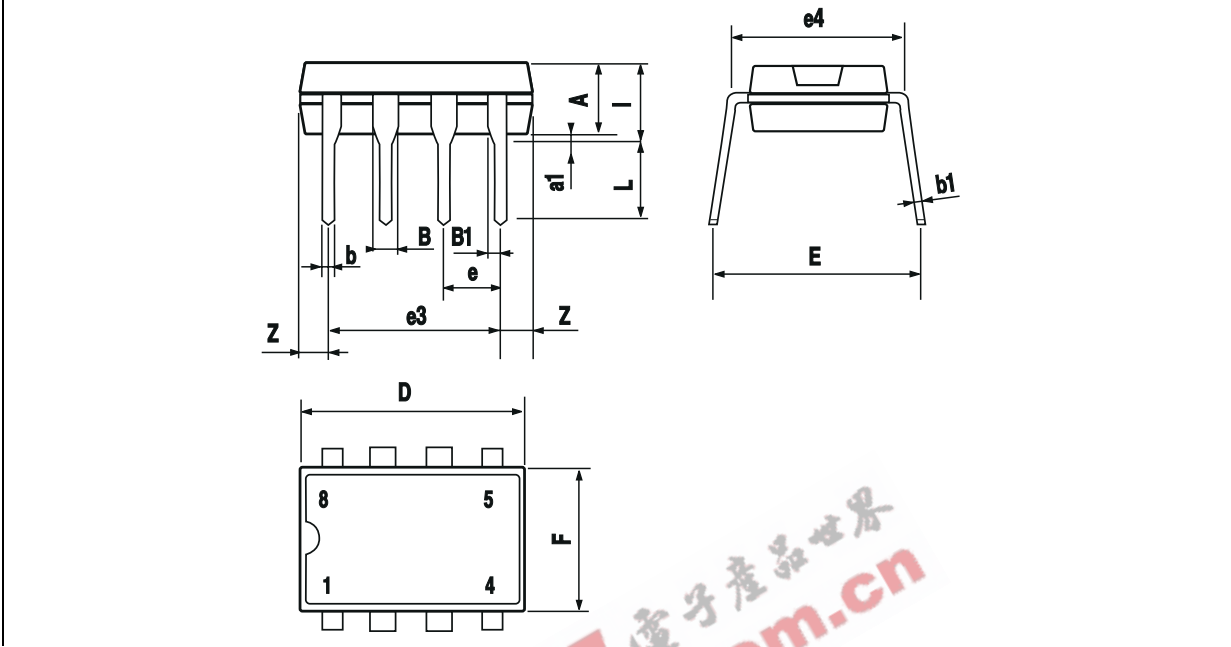
$V_{CC}^+ = 5V$ ,  $V_{CC}^- = 0V$ ,  $T_{amb} = 25^\circ C$  (unless otherwise specified)

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

1. The specified offset voltage is the maximum 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.

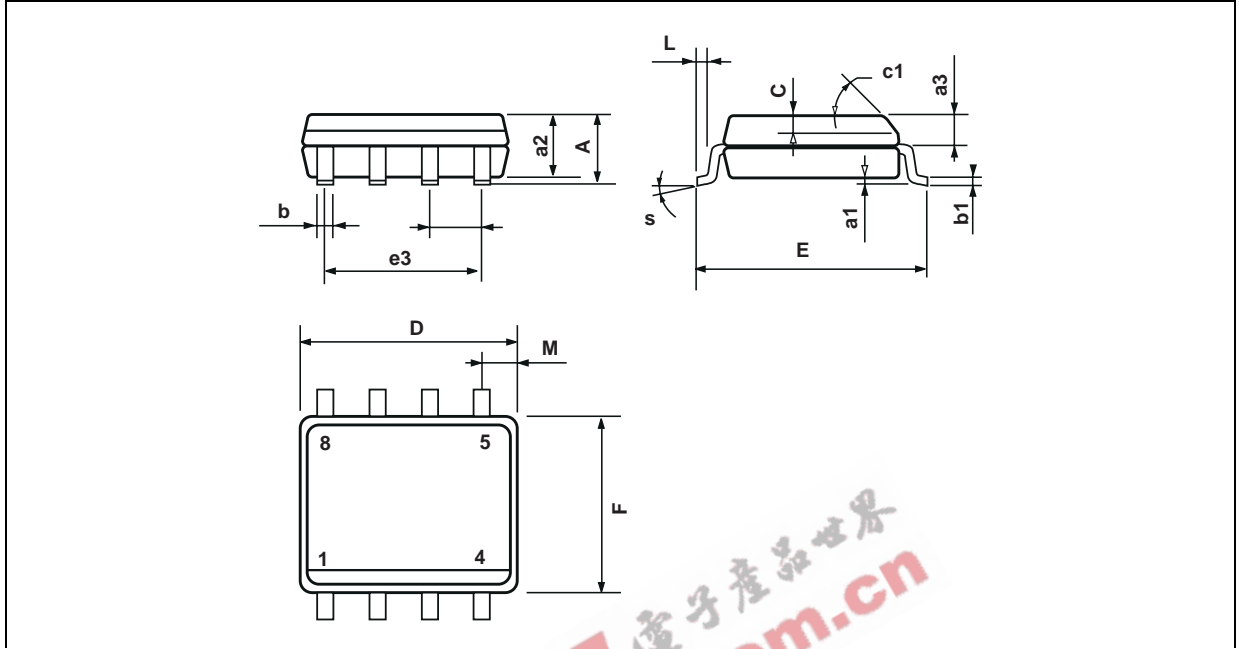
**PACKAGE MECHANICAL DATA**  
 8 PINS - PLASTIC DIP



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			0.260
i			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

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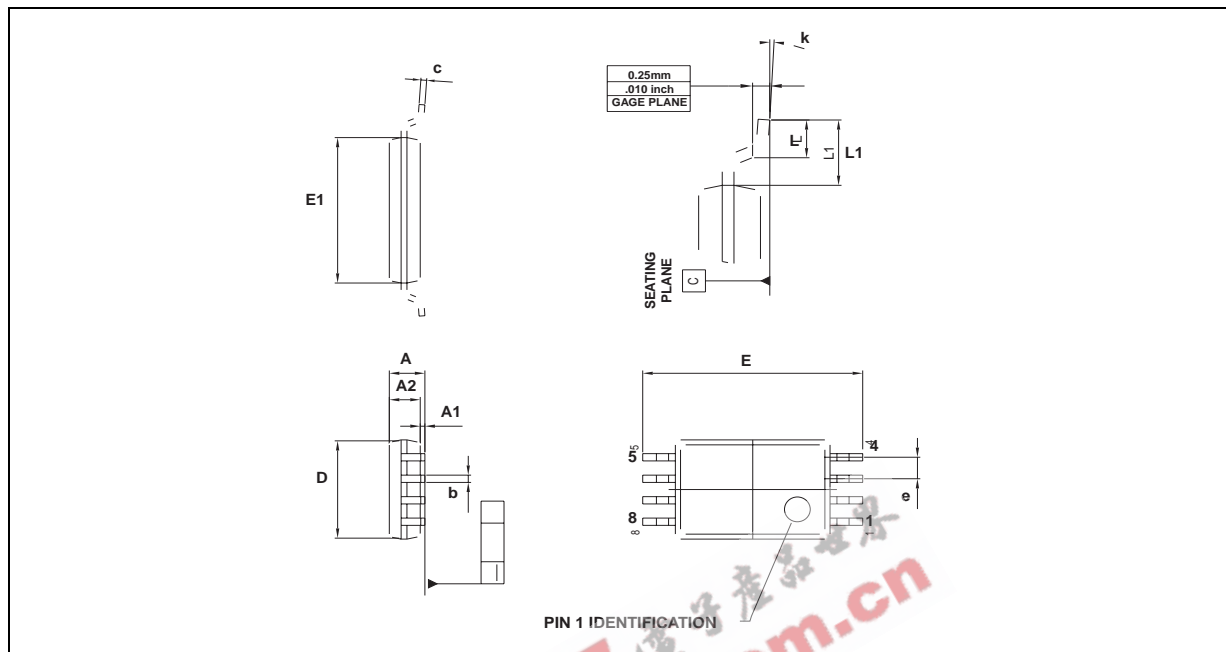
## PACKAGE MECHANICAL DATA 8 PINS - PLASTIC MICROPACKAGE (SO)



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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