

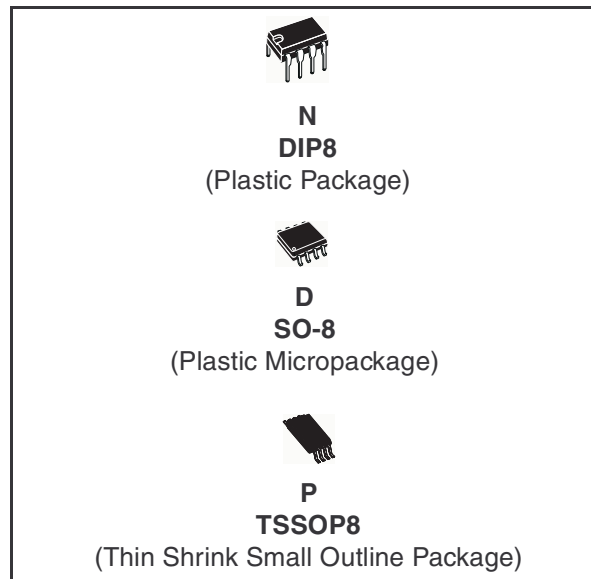
## Micropower Dual CMOS Voltage Comparators

- Extremely low supply current: **9µA typ/comp.**
- 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 current: **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

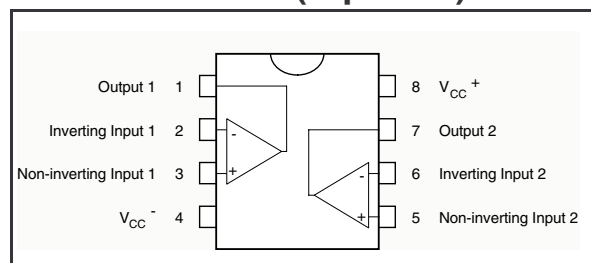
### Description

The TS393 is a micropower CMOS dual voltage comparator with extremely low consumption of 9µA typ / comparator (20 times less than bipolar LM339). Similar performances are offered by the quad micropower comparator TS3702 with a push-pull CMOS output.

Thus response times remain similar to the LM393.



### Pin Connection (top view)



### Order Codes

Part Number	Temperature Range	Package	Packaging	Marking
TS393CN	0°C, +70°C	DIP84	Tube	TS393CN
TS393CD/CDT		SO-8	Tube or Tape & Reel	S399C
TS393MD/MDT	-55°C, +125°C	SO-8	Tube or Tape & Reel	S393M
TS393IN	-40°C, +125°C	DIP8	Tube	TS393IN
TS393ID/IDT		SO-8	Tube or Tape & Reel	S393I
TS393IPT		TSSOP8 (Thin Shrink Outline Package)	Tape & Reel	S393I
TS393IYD/IYDT	-40°C, +125°C	SO-8 (automotive grade level)	Tube or Tape & Reel	S393IY

# 1 Absolute Maximum Ratings

**Table 1. Key parameters and their absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CC}^+$	Supply Voltage <sup>(1)</sup>	18	V
$V_{id}$	Differential Input Voltage <sup>(2)</sup>	±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	mW
	SO8	710	
	TSSOP8	625	
$T_{stg}$	Storage Temperature Range	-65 to +150	°C
ESD	HBM: Human Body Model <sup>(6)</sup>	50	V
	MM: Machine Model <sup>(7)</sup>	40	V
	CDM: Charged Device Model	1	kV

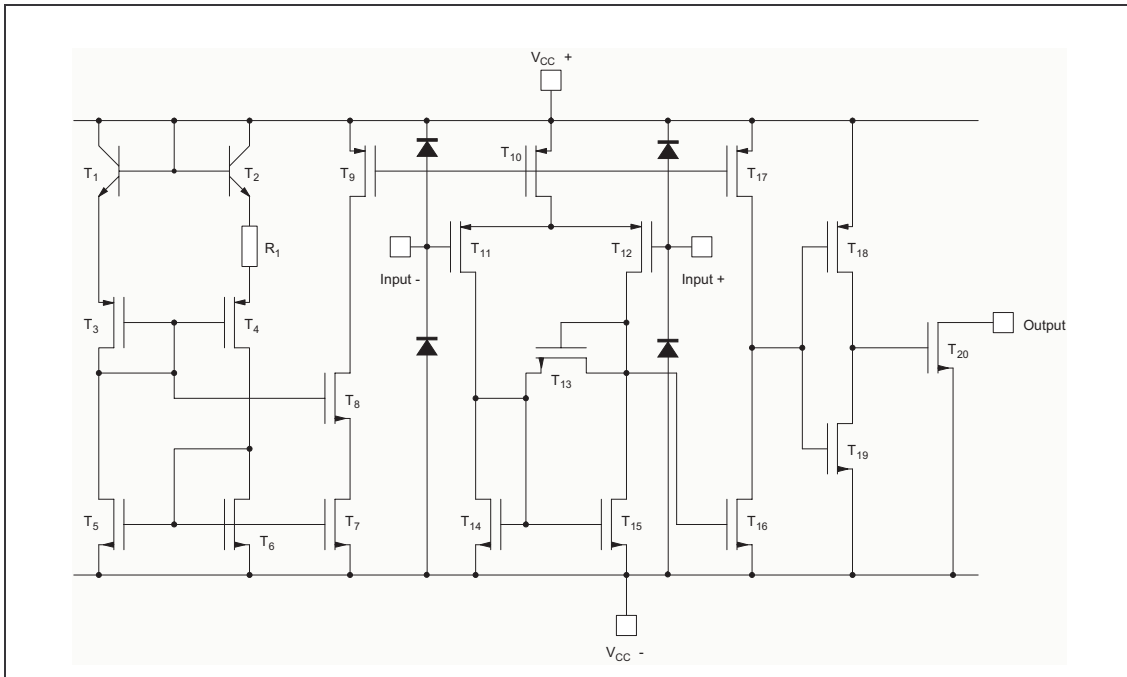
1. All voltage values, except differential voltage, are with respect to network ground terminal.
2. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
3. Excursions of input voltages may exceed the power supply level. As long as the common mode voltage  $[V_{icm}=(V_{in}^+ + V_{in}^-)/2]$  remains within the specified range, the comparator will provide a stable output state. However, the maximum current through the ESD diodes ( $I_F$ ) of the input stage must strictly be observed.
4. Guaranteed by design.
5.  $P_d$  is calculated with  $T_{amb} = +25^\circ\text{C}$ ,  $T_j = +150^\circ\text{C}$  and  $R_{thja} = 80^\circ\text{C/W}$  for DIP14 package  
 =  $150^\circ\text{C/W}$  for SO14 package  
 =  $175^\circ\text{C/W}$  for TSSOP14 package
6. Human body model, 100pF discharged through a 1.5kΩ resistor into pin of device.
7. Machine model ESD, a 200pF cap is charged to the specified voltage, then discharged directly into the IC with no external series resistor (internal resistor < 5Ω), into pin to pin of device.

**Table 2. 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

## 2 Typical Application Schematics

Figure 1. Schematic diagram (for 1/2 TS393)



### 3 Electrical Characteristics

**Table 3.**  $V_{CC}^+ = 3V$ ,  $V_{CC}^- = 0V$ ,  $T_{amb} = 25^\circ C$  (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 $V_{ic} = V_{icm \text{ min.}}$		70		dB
SVR	Supply Voltage Rejection Ratio $V_{CC}^+ = 3V \text{ to } 5V$		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.

Table 4.  $V_{CC}^+ = 5V$ ,  $V_{CC}^- = 0V$ ,  $T_{amb} = 25^\circ C$  (unless otherwise specified)

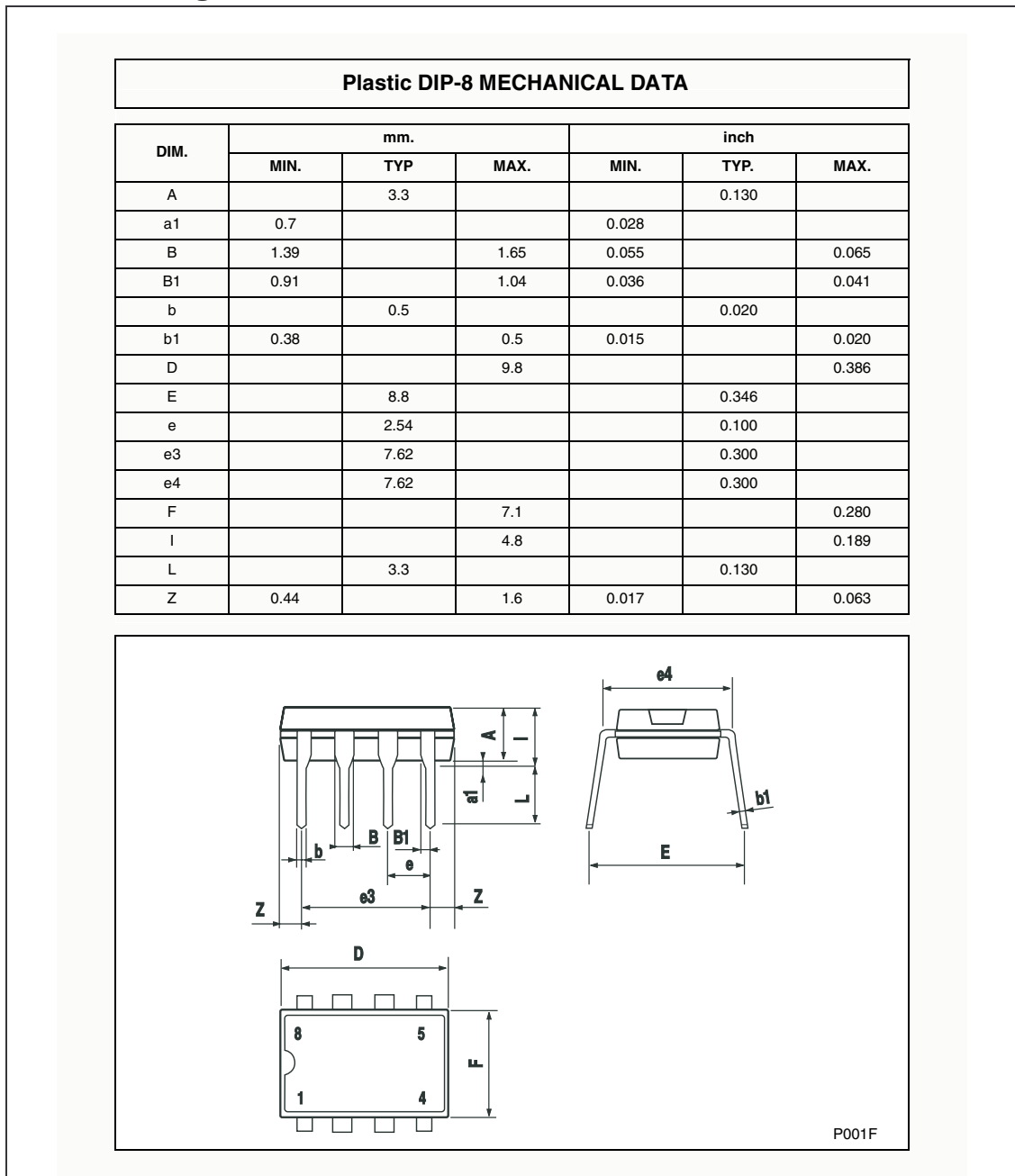
Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{io}$	Input Offset Voltage <sup>(1)</sup> $V_{ic} = 2.5V$ , $V_{CC}^+ = 5V$ to $10V$ $T_{min.} \leq T_{amb} \leq T_{max.}$		1.4	5 6.5	mV
$I_{io}$	Input Offset Current <sup>(2)</sup> $V_{ic} = 2.5V$ $T_{min.} \leq T_{amb} \leq T_{max.}$		1	300	pA
$I_{ib}$	Input 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 $V_{ic} = 0V$		71		dB
SVR	Supply Voltage Rejection Ratio $V_{CC}^+ = +5V$ to $+10V$		80		dB
$I_{OH}$	High Level Output Voltage $V_{id} = 1V$ , $V_{OH} = +5V$ $T_{min.} \leq T_{amb} \leq T_{max.}$		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		as

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.

## 4 Package Mechanical Data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com).

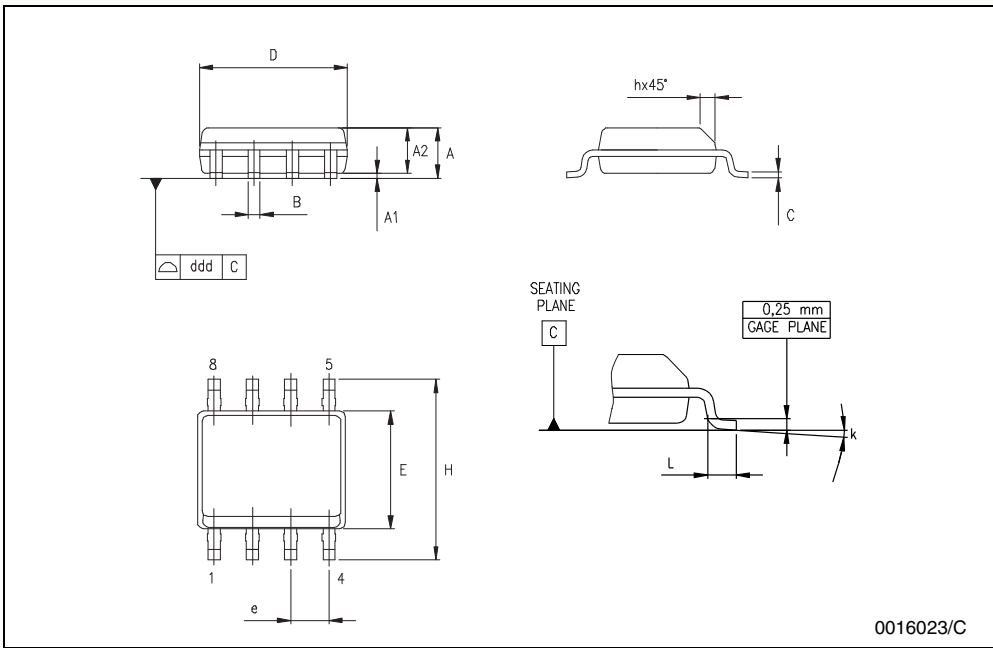
### 4.1 DIP8 Package



### 4.2 SO-8 Package

**SO-8 MECHANICAL DATA**

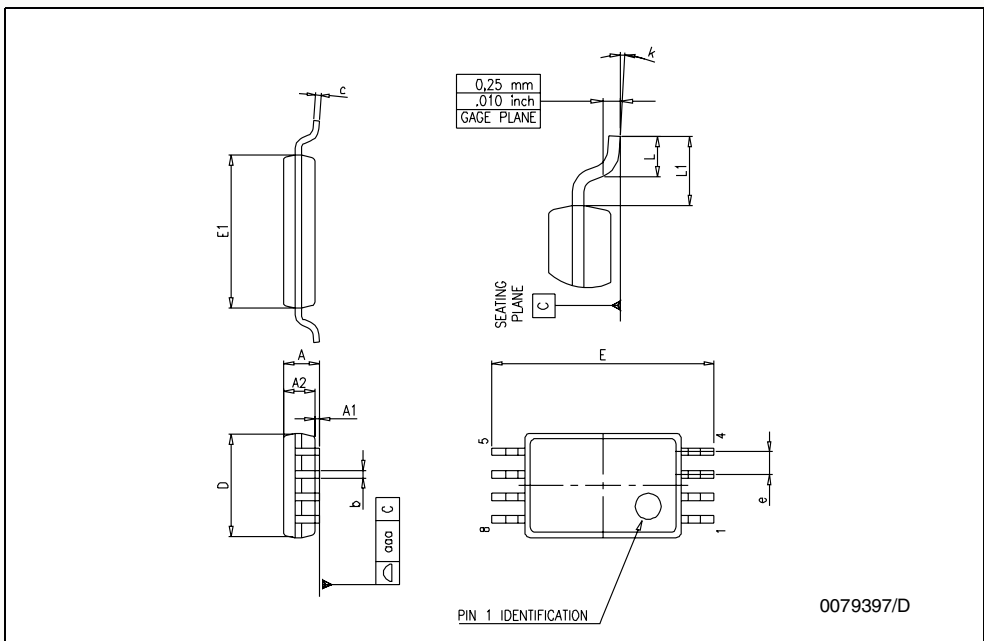
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.04		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D	4.80		5.00	0.189		0.197
E	3.80		4.00	0.150		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	8° (max.)					
ddd			0.1			0.04



### 4.3 TSSOP8 Package

**TSSOP8 MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.008
D	2.90	3.00	3.10	0.114	0.118	0.122
E	6.20	6.40	6.60	0.244	0.252	0.260
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.0256	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030
L1		1			0.039	





## 5 Revision History

Date	Revision	Changes
Jan. 2003	1	Initial release.
July 2005	2	1 - PPAP references inserted in the datasheet see <i>Table : Order Codes on page 1</i> . 2 - ESD protection inserted in <i>Table 1: Key parameters and their absolute maximum ratings on page 2</i> .

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