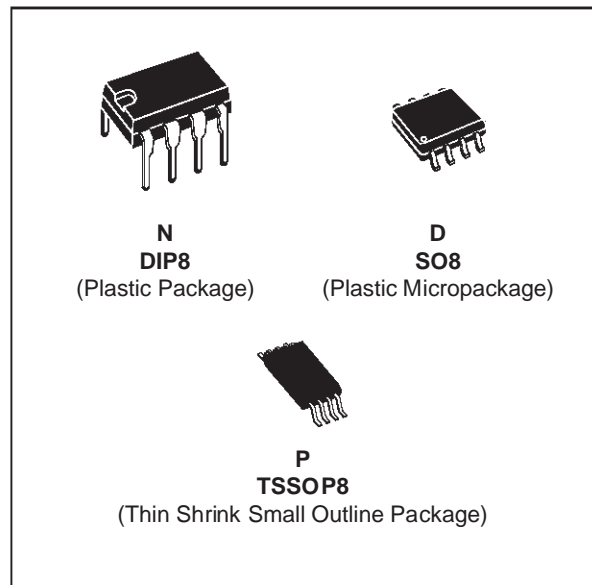




# TS393C,I,M

## MICROPOWER DUAL CMOS VOLTAGE COMPARATORS

- EXTREMELY LOW SUPPLY CURRENT :  
9 $\mu$ A TYP/COMPARATOR
- WIDE SINGLE SUPPLY RANGE (3V to 16V)  
OR DUAL SUPPLIES ( $\pm 1.5$ V to  $\pm 8$ V)
- 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<sup>12</sup> $\Omega$  TYP
- FAST RESPONSE TIME : 2.5 $\mu$ s 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 9 $\mu$ A typ / comparator (20 times less than bipolar LM393). Similar performances are offered by the dual micropower comparator TS3702 with a push-pull CMOS output.

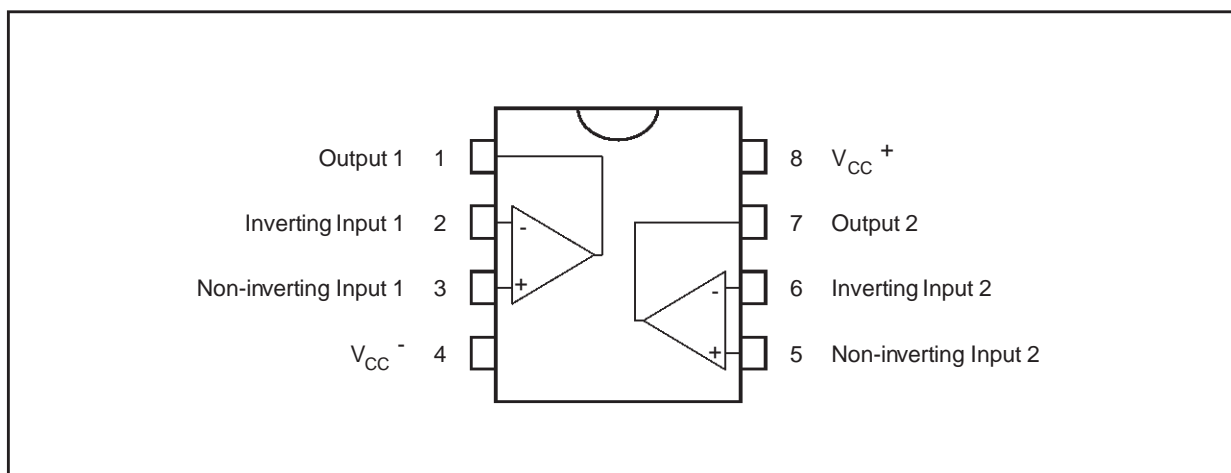
Thus response times remain similar to the LM393.

### ORDER CODES

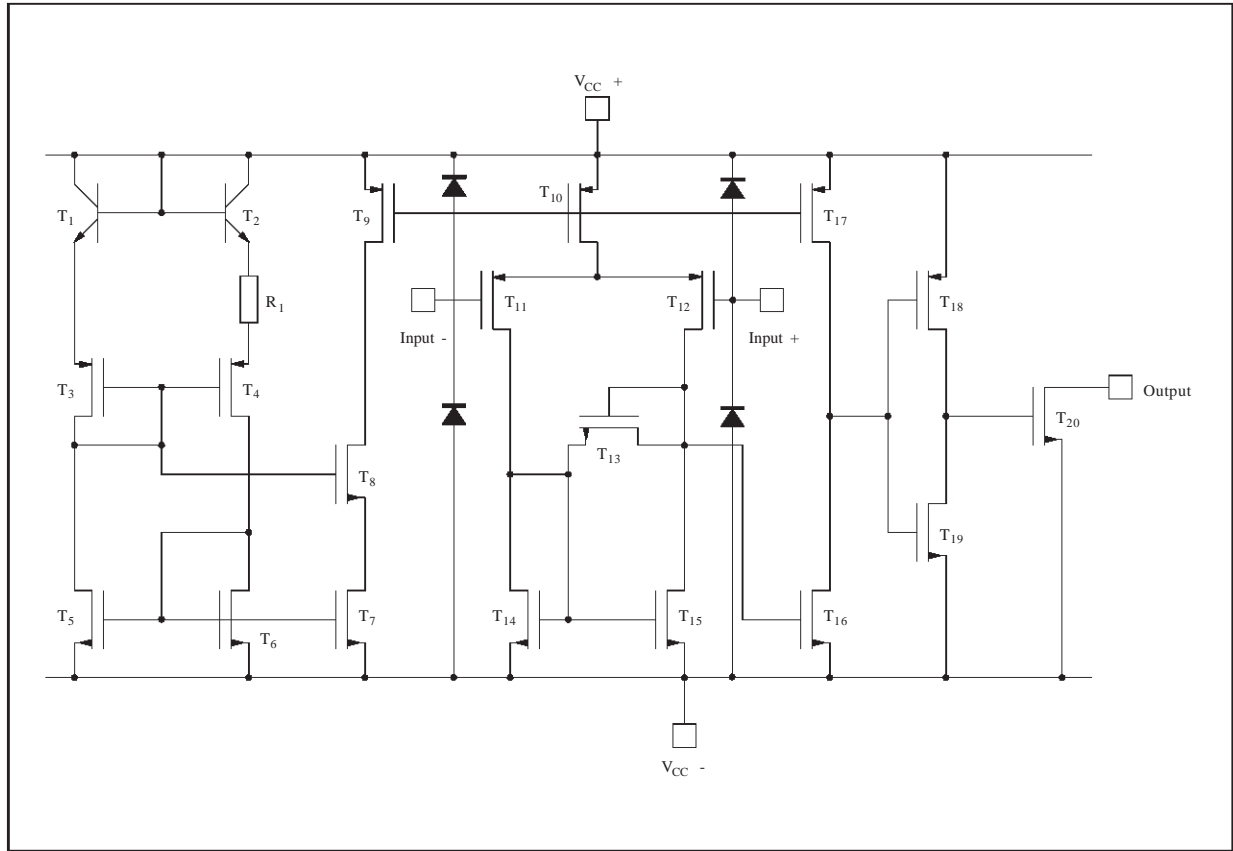
Part Number	Temperature Range	Package		
		N	N	P
TS393C	0°C, +70°C	●	●	●
TS393I	-40°C, +125°C	●	●	●
TS393M	-55°C, +125°C	●	●	●

**Example : TS393CN**

### PIN CONNECTIONS (top view)



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



**MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$V_{CC}^+$	Supply Voltage - (note 1)	18	V
$V_{id}$	Differential Input Voltage - (note 2)	$\pm 18$	V
$V_i$	Input Voltage - (note 3)	18	V
$V_O$	Output Voltage	18	V
$I_O$	Output Current	20	mA
$I_F$	Forward Current in ESD Protection Diodes on Input - (note 4)	50	mA
$T_{oper}$	Operating Free-Air Temperature Range	TS393C 0 to +70 TS393I -40 to +125 TS393M -55 to +125	$^{\circ}C$
$T_{stg}$	Storage Temperature Range	-65 to +150	$^{\circ}C$

- Notes :**
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. The output must never exceed the power supply voltage.
  4. Guaranteed by design.
  5. Short circuit from outputs to  $V_{CC}^+$  can cause excessive heating and eventual destruction.

**OPERATING CONDITIONS**

Symbol	Parameter	Value	Unit
$V_{CC}^+$	Supply Voltage	TS393C,I 3 to 16 TS393M 4 to 16	V
$V_{icm}$	Common Mode Input Voltage Range	0 to $V_{CC}^+ - 1.5$	V

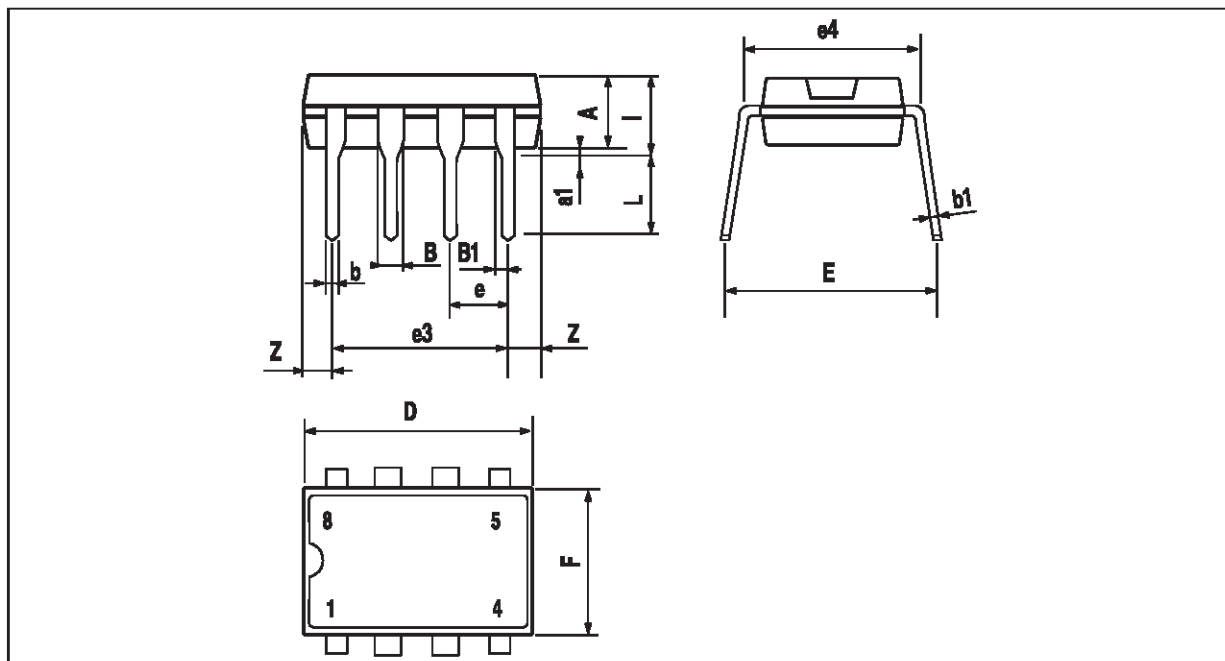
**ELECTRICAL CHARACTERISTICS**

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{io}$	Input Offset Voltage $V_{IC} = V_{IC\ min.}$ , $V_{CC}^+ = 5V$ to $10V$ - (note 1) $T_{min.} \leq T_{amb} \leq T_{max.}$		1.4	5 6.5	mV
$I_{io}$	Input Offset Current - (note 2) $V_{IC} = 2.5V$ $T_{min.} \leq T_{amb} \leq T_{max.}$		1	300	pA
$I_{ib}$	Input Bias Current - (note 2) $V_{IC} = 2.5V$ $T_{min.} \leq T_{amb} \leq T_{max.}$		1	600	pA
$V_{icm}$	Input Common Mode Voltage Range $T_{min.} \leq T_{amb} \leq T_{max.}$	0 to $V_{CC}^+ - 1.2$ 0 to $V_{CC}^+ - 1.5$			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 (2 comparators) No load - Outputs low $T_{min.} \leq T_{amb} \leq T_{max.}$		20	40 50	$\mu A$
$t_{PLH}$	Response Time Low to High $V_{ic} = 0V$ , $f = 10kHz$ , $R_L = 5.1k\Omega$ , $C_L = 15pF$ , 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 $V_{ic} = 0V$ , $f = 10kHz$ , $R_L = 5.1k\Omega$ , $C_L = 15pF$ , 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 $f = 10kHz$ , $C_L = 15pF$ , $R_L = 5.1k\Omega$ , Overdrive 50mV		25		ns

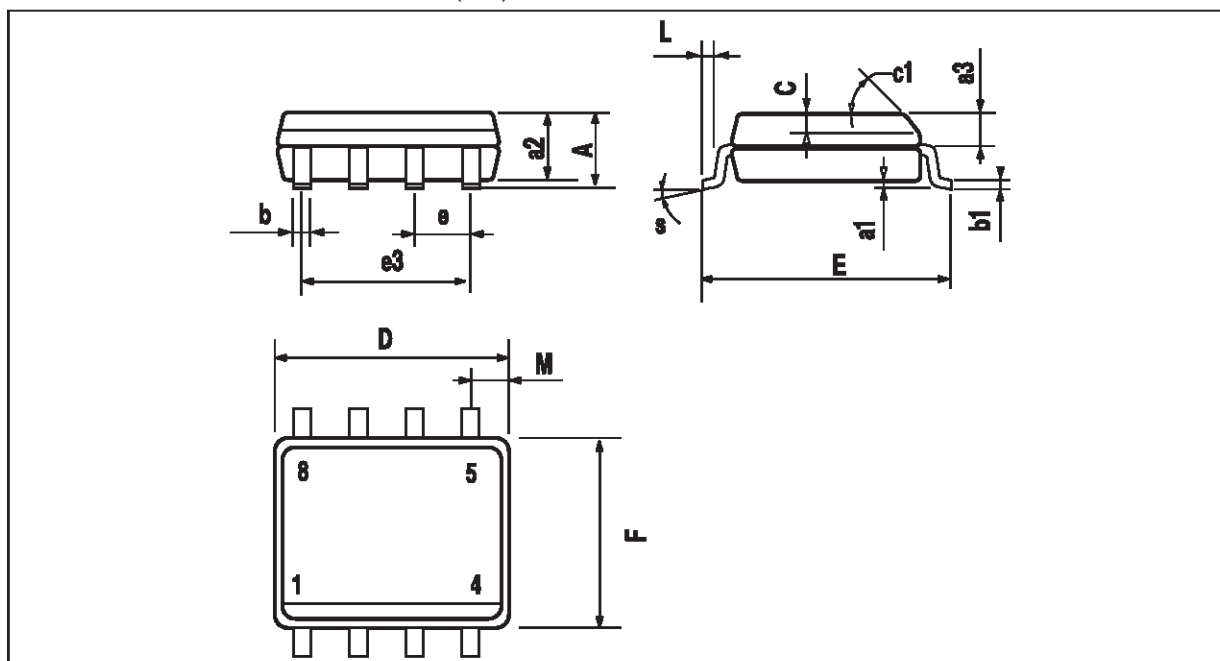
**Note :** 1. The specified offset voltage is the maximum value required to drive the output up to 4.5V or down to 0.3V.  
2. Maximum values including unavoidable inaccuracies of the industrial test.

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



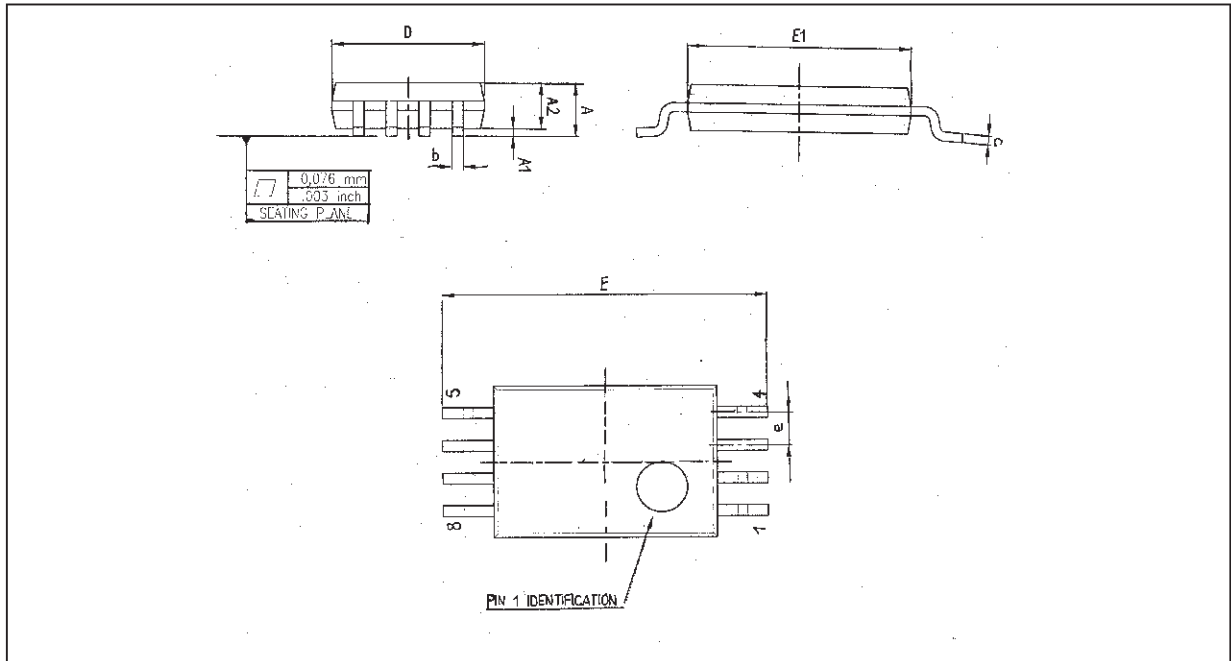
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0.260
i			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

**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**



Dim.	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

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