TS3704

Micropower quad CMOS voltage comparators

Features

- Push-pull CMOS output (no external pull-up resistor required)
- Extremely low supply current: 9µa typ per 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 current: 1pA typ
- Input common-mode voltage range includes GND
- High input impedance: $10^{12}\Omega$ typ
- Last response time: 2µs typ. for 5mV overdrive
- Pin-to-pin and functionally compatible with bipolar LM339

Description

The TS3704 is a micropower CMOS quad voltage comparator with extremely low consumption of 9µA typ / comparator (20 times less than bipolar LM339). The push-pull CMOS output stage allows power and space saving by eliminating the external pull-up resistor required by usual open-collector output comparators.

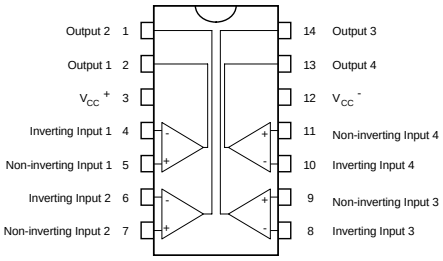
Thus response times remain similar to the LM339.

N
DIP14
(Plastic package)

D
SO14
(Plastic micropackage)

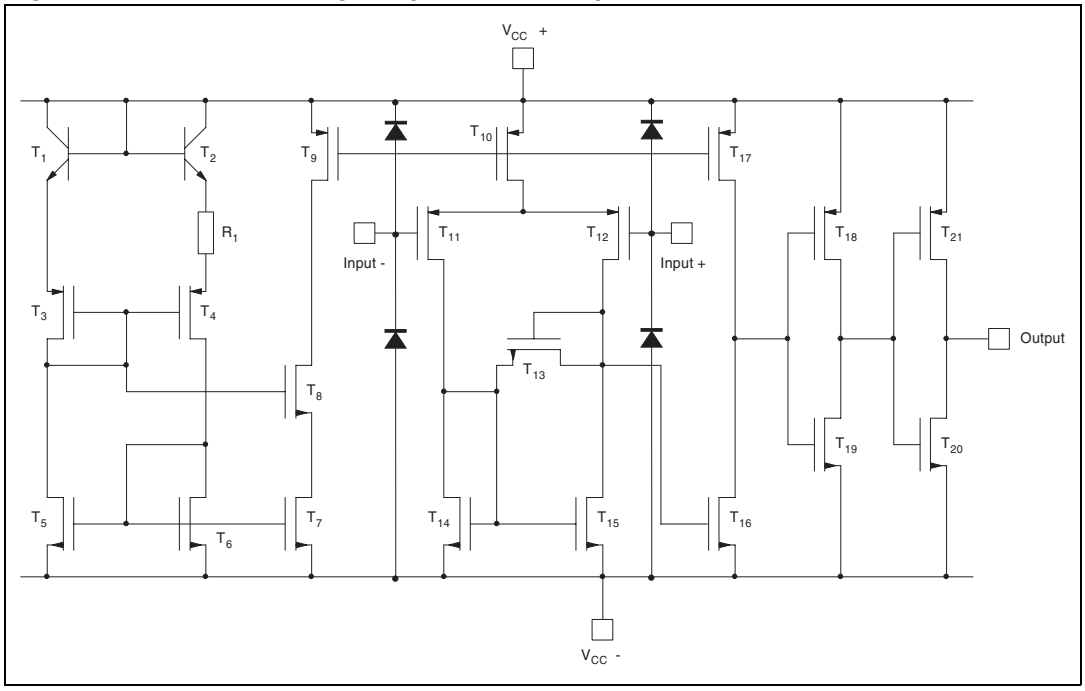
P
TSSOP14
(Thin shrink small outline package)

Pin connections
(Top view)



1 Schematic diagram

Figure 1. Schematic diagram (for 1/4 TS3704)



2 Absolute maximum ratings

Table 1. 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 input (4)	50	mA
p_d	Power dissipation (5) DIP14 SO14 TSSOP14	 1500 830 710	mW
T_{stg}	Storage temperature range	-65 to +150	°C
ESD	HBM: human body model(6)	500	V
	MM: machine model(7)	50	V
	CDM: charged device model(8)	1.5	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. The magnitude of the input and the output voltages must never exceed the magnitude of the positive and negative supply voltages.
4. Guaranteed by design.
5. Pd is calculated with T_{amb} = +25°C, T_j = +150°C and
   R_{thja} = 80°C/W for DIP14 package
   R_{thja} = 150°C/W for SO14 package
   R_{thja} = 175°C/W for TSSOP14 package
6. Human body model: A 100pF capacitor is charged to the specified voltage, then discharged through a 1.5kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are floating.
7. Machine model: A 200pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5Ω). This is done for all couples of connected pin combinations while the other pins are floating.
8. Charged device model: all pins and the package are charged together to the specified voltage and then discharged directly to the ground through only one pin. This is done for all pins.

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}^+	Supply voltage TS3704C, TS3704I TS3704M	 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 TS3704C TS3704I TS3704M	 0 to +70 -40 to +125 -55 to +125	°C

3 Electrical characteristics

Table 3. 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 $V_{ic} = V_{icm\ min}$		80		dB
SVR	Supply voltage rejection ratio V_{CC}^+ = 3V to 5V		75		dB
V_{OH}	High level output voltage V_{id} = 1V, I_{OH} = -4mA $T_{min} \le T_{amb} \le T_{max}$	2 1.8	2.4		V
V_{OL}	Low level output voltage V_{id} = -1V, I_{OL} = 4mA $T_{min} \le T_{amb} \le T_{max}$		300	400 575	mV
I_{CC}	Supply current (each comparator) No load - Outputs low $T_{min} \le T_{amb} \le T_{max}$		7	20 25	µA
t_{PLH}	Response time low to high V_{ic} = 0V, f = 10kHz, C_L = 50pF, overdrive = 5mV TTL input		1.2 0.7		µs
t_{PHL}	Response time high to low V_{ic} = 0V, f = 10kHz, C_L = 50pF, overdrive = 5mV TTL input		2 0.15		µs

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 include unavoidable inaccuracies of the industrial tests.

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage (1) V_{ic} = 2.5V, V_{cc}^+ = 5V to 10V $T_{min} \le T_{amb} \le T_{max}$		1.2	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 $V_{ic} = V_{icm\ min}$		80		dB
SVR	Supply voltage rejection ratio V_{CC}^+ = +5V to +10V		92		dB
V_{OH}	High level output voltage V_{id} = 1V, I_{OH} = -4mA $T_{min} \le T_{amb} \le T_{max}$	4.5 4.3	4.7		V
V_{OL}	Low level output voltage V_{id} = -1V, I_{OL} = 4mA $T_{min} \le T_{amb} \le T_{max}$		200	300 375	mV
I_{CC}	Supply current (each comparator) No load - Outputs low		9	20 25	µA
t_{PLH}	Response time low to high V_{ic} = 0V, f = 10kHz, C_L = 50pF, overdrive = 5mV Overdrive = 10mV Overdrive = 20mV Overdrive = 40mV TTL input		 1.2 1 0.9 0.8 0.7		µs
t_{PHL}	Response time high to low V_{ic} = 0V, f = 10kHz, C_L = 50pF, overdrive = 5mV Overdrive = 10mV Overdrive = 20mV Overdrive = 40mV TTL input		 2 1.5 0.9 0.7 0.15		µs
t_f	Fall time f = 10kHz, C_L = 50pF, overdrive 50mV		30		ns

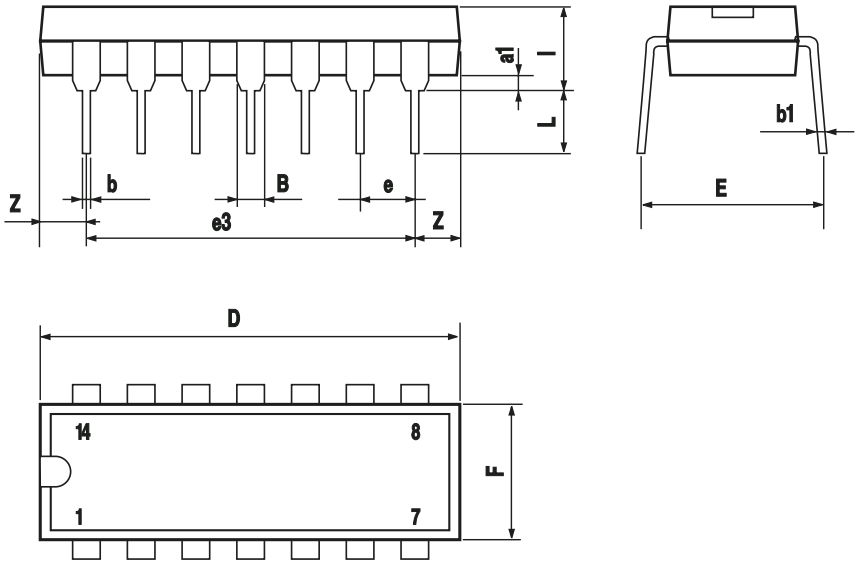
1. The specified offset voltage is the maximum value required to drive the output up to 4.5V or down to 0.3V.
2. Maximum values include unavoidable inaccuracies of the industrial tests.

4 Package information

In order to meet environmental requirements, STMicroelectronics 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 STMicroelectronics trademark. ECOPACK specifications are available at: www.st.com.

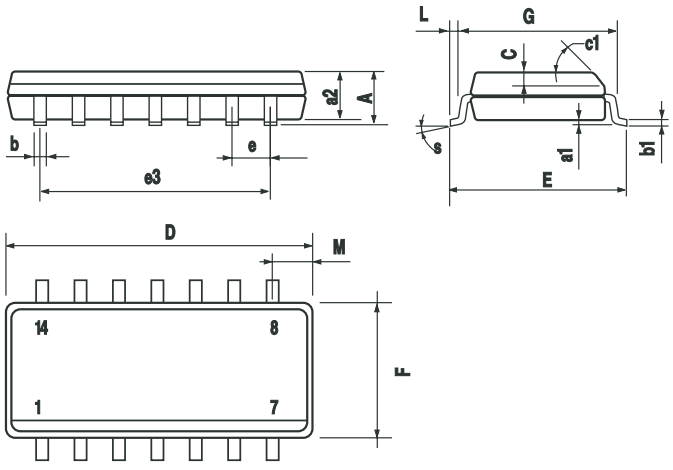
4.1 DIP14 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100



4.2 SO14 package mechanical data

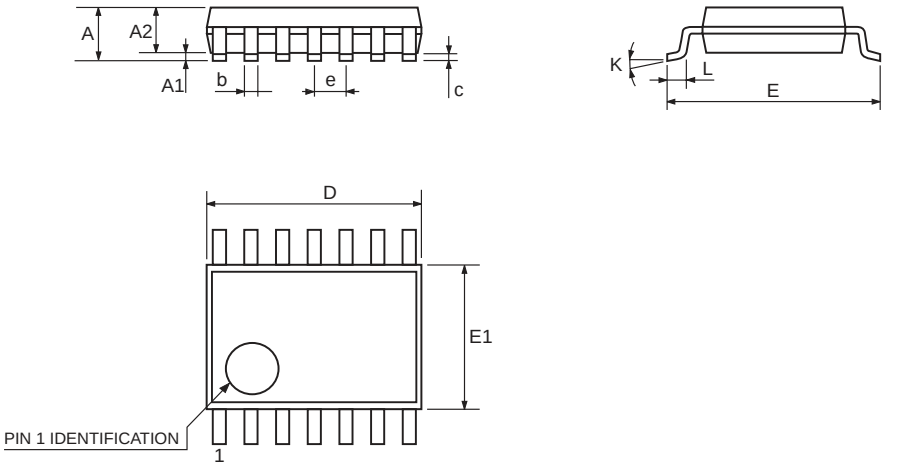
Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.68			0.026
S	8° (max.)					



4.3 TSSOP14 package mechanical data

Figure 2. TSSOP14 package

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



5 Ordering information

Table 5. Order codes

Part number	Temperature range	Package	Packaging	Marking
TS3704CN	0°C, +70°C	DIP14	Tube	TS3704CN
TS3704CD/CDT		SO14	Tube or tape & reel	3704C
TS3704IN	-40°C, +125°C	DIP14	Tube	TS3704IN
TS3704ID/IDT		SO14	Tube or tape & reel	3704I
TS3704IPT		TSSOP14	Tape & reel	3704I
TS3704MN	-55°C, +125°C	DIP14	Tube	TS3704MN
TS3704MD/MDT		SO14	Tube or tape & reel	3704M
TS3704MPT		TSSOP14	Tape & reel	3704M

6 Revision history

Date	Revision	Changes
1-Oct- 2004	1	Initial release.
1-Aug-2005	2	1 - PPAP references inserted in the datasheet. 2 - ESD protection inserted in *Table 1 on page 3*.
26-Feb-2007	3	PPAP references removed. Updated footnotes related to ESD in *Table 1 on page 3*. Added *Table 2 on page 3*. Order codes added to *Table 5 on page 10*.

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