

Micropower dual CMOS voltage comparators

Features

- Push-pull CMOS output (no external pull-up resistor required)
- 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: 2µs typ for 5mV overdrive
- Pin-to-pin and functionally compatible with bipolar LM393

Description

The TS3702 is a micropower CMOS dual voltage comparator with extremely low consumption of 9µA typ / comparator (20 times less than bipolar LM393). 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 LM393.



**N
DIP8**
(Plastic package)

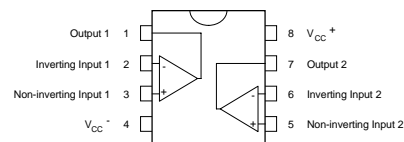


**D
SO8**
(Plastic micropackage)



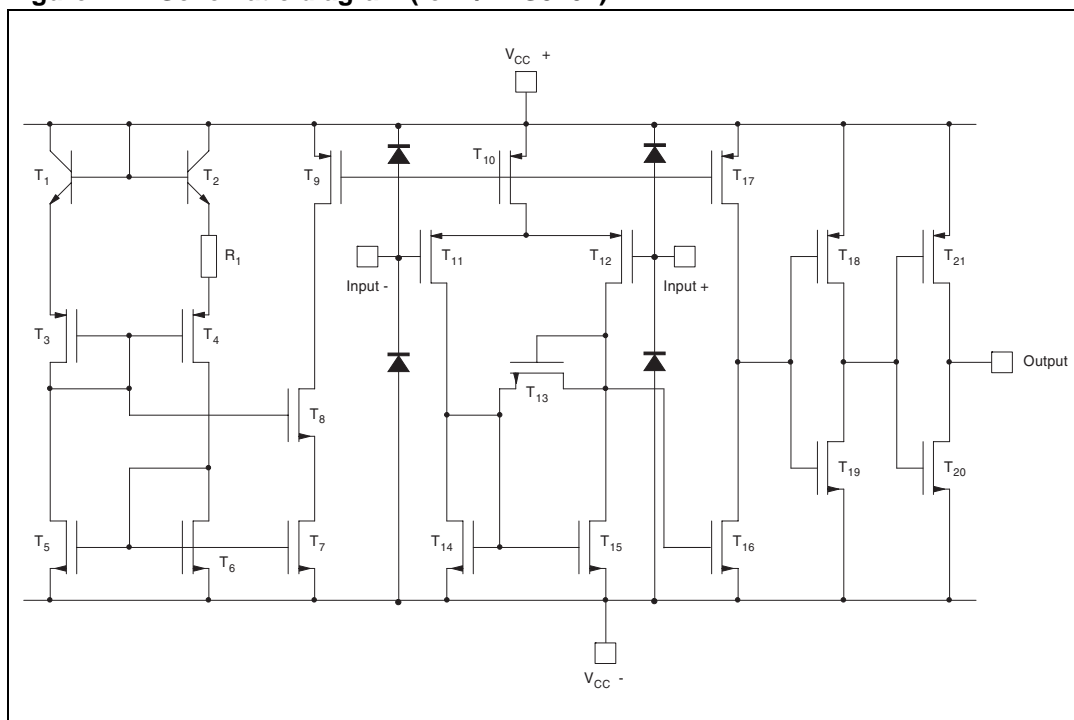
**P
TSSOP8**
(Thin shrink small outline package)

Pin connections (Top view)



1 Schematic diagram

Figure 1. Schematic diagram (for 1/2 TS3702)



2 Absolute maximum ratings and operating conditions

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⁾ DIP8 SO8 TSSOP8	1250 710 625	mW
T_{stg}	Storage temperature range	-65 to +150	°C
ESD	HBM: human body model ⁽⁶⁾	400	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. 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
 $R_{thja} = 175^\circ\text{C/W}$ for SO8 package
 $R_{thja} = 200^\circ\text{C/W}$ for TSSOP8 package
6. Human body model: A 100pF capacitor is charged to the specified voltage, then discharged through a 1.5k Ω 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 < 5 Ω). 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 TS3702C, TS3702I TS3702M	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 TS3702C TS3702I TS3702M	0 to +70 -40 to +125 -55 to +125	°C

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 ⁽¹⁾ $V_{ic} = 1.5V$ $T_{min} \leq T_{amb} \leq T_{max}$			5 6.5	mV
I_{io}	Input offset current ⁽²⁾ $V_{ic} = 1.5V$ $T_{min} \leq T_{amb} \leq T_{max}$		1	300	pA
I_{ib}	Input bias current ⁽²⁾ $V_{ic} = 1.5V$ $T_{min} \leq T_{amb} \leq T_{max}$		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 $V_{ic} = V_{icm\ min}$		80		dB
SVR	Supply voltage rejection ratio $V_{CC}^+ = 3V$ to $5V$		75		dB
V_{OH}	High level output voltage $V_{id} = 1V$, $I_{OH} = -4mA$ $T_{min} \leq T_{amb} \leq T_{max}$	2 1.8	2.4		V
V_{OL}	Low level output voltage $V_{id} = -1V$, $I_{OL} = 4mA$ $T_{min} \leq T_{amb} \leq T_{max}$		300	400 575	mV
I_{CC}	Supply current (each comparator) No load - Outputs low $T_{min} \leq T_{amb} \leq T_{max}$		7	20 25	μA
t_{PLH}	Response time low to high $V_{ic} = 0V$, $f = 10kHz$, $C_L = 50pF$, overdrive = $5mV$ TTL input		1.5 0.7		μs
t_{PHL}	Response time high to low $V_{ic} = 0V$, $f = 10kHz$, $C_L = 50pF$, overdrive = $5mV$ TTL input		2.2 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. $V_{CC}^+ = 5V$, $V_{CC}^- = 0V$, $T_{amb} = 25^\circ C$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage $V_{ic} = V_{icm\ min}$, $V_{CC}^+ = 5V$ to $10V$ ⁽¹⁾ $T_{min} \leq T_{amb} \leq T_{max}$		1.2	5 6.5	mV
I_{io}	Input offset current ⁽²⁾ $V_{ic} = 2.5V$ $T_{min} \leq T_{amb} \leq T_{max}$		1	300	pA
I_{ib}	Input bias current ⁽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 0		$V_{CC}^+ - 1.2$ $V_{CC}^+ - 1.5$	V
CMR	Common-mode rejection ratio $V_{ic} = V_{icm\ min}$		82		dB
SVR	Supply voltage rejection ratio $V_{CC}^+ = +5V$ to $+10V$		90		dB
V_{OH}	High level output voltage $V_{id} = 1V$, $I_{OH} = -4mA$ $T_{min} \leq T_{amb} \leq T_{max}$	4.5 4.3	4.7		V
V_{OL}	Low level output voltage $V_{id} = -1V$, $I_{OL} = 4mA$ $T_{min} \leq T_{amb} \leq T_{max}$		200	300 375	mV
I_{CC}	Supply current (each comparator) No load - Outputs low $T_{min} \leq T_{amb} \leq T_{max}$		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		1.5 1.1 0.9 0.7 0.6		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		2.2 1.6 1.1 0.75 0.17		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 DIP8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.3			0.130	
a1	0.7			0.028		
B	1.39		1.65	0.055		0.065
B1	0.91		1.04	0.036		0.041
b		0.5			0.020	
b1	0.38		0.5	0.015		0.020
D			9.8			0.386
E		8.8			0.346	
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			7.1			0.280
I			4.8			0.189
L		3.3			0.130	
Z	0.44		1.6	0.017		0.063

The mechanical drawings illustrate the physical characteristics of the DIP8 package. The side view (top left) shows the package height (A), lead height (a1), body width (B), lead width (B1), body thickness (b), lead thickness (b1), body length (e), lead length (e3), total length (e4), total width (E), and standoff height (Z). The perspective view (top right) shows the lead length (e4), lead thickness (b1), and total width (E). The top view (bottom) shows the package width (D), body length (L), and the pin numbering (1, 4, 5, 8).

4.2 SO8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	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 mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	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	

The mechanical drawings illustrate the TSSOP8 package geometry. The side view shows dimensions A, A1, A2, b, c, D, and E. The top view shows dimensions E, E1, and e. A detail view of the lead shows dimensions L and L1. A gage plane is indicated for the lead thickness. The package is shown with pin 1 identification.

5 Ordering information

Table 5. Order codes

Part number	Temperature range	Package	Packaging	Marking
TS3702CN	0°C, +70°C	DIP8	Tube	TS3702CN
TS3702CD/CDT		SO8	Tube or tape & reel	3702C
TS3702IN	-40°C, +125°C	DIP8	Tube	TS3702IN
TS3702ID/IDT		SO8	Tube or tape & reel	3702I
TS3702IPT		TSSOP8	Tape & reel	3702I
TS3702MN	-55°C, +125°C	DIP8	Tube	TS3702MN
TS3702MD/MDT		SO8	Tube or tape & reel	3702M
TS3702MPT		TSSOP8	Tape & reel	3702M

6 Revision history

Date	Revision	Changes
2-Jan-2003	1	First release.
2-May-2005	2	PPAP references inserted in the datasheet, see Section 5: Ordering information on page 10 .
26-Feb-2007	3	PPAP references removed. ESD data added to Table 1 on page 3 . Order codes added to Table 5 on page 10 .

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2007 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com

