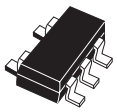
TS391

Low power single voltage comparator

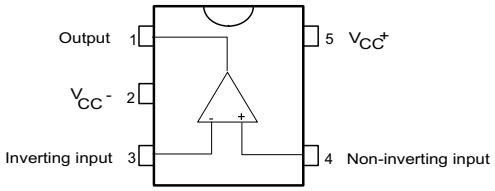
Features

- Wide single supply voltage range or dual supplies +2 V to +34 V or ±1 V to ±17 V
- Very low supply current (0.2mA) independent of supply voltage (1mW/comparator at +5 V)
- Low input bias current: 25 nA typ.
- Low input offset current: ±5 nA typ.
- Low input offset voltage: ±1 mV typ.
- Input common-mode voltage range includes ground
- Low output saturation voltage: 250 mV typ. (I_o= 4 mA)
- Differential input voltage range equal to the supply voltage
- TTL, DTL, ECL, CMOS compatible outputs



L
SOT23-5
(Plastic package)

Pin connections (top view)



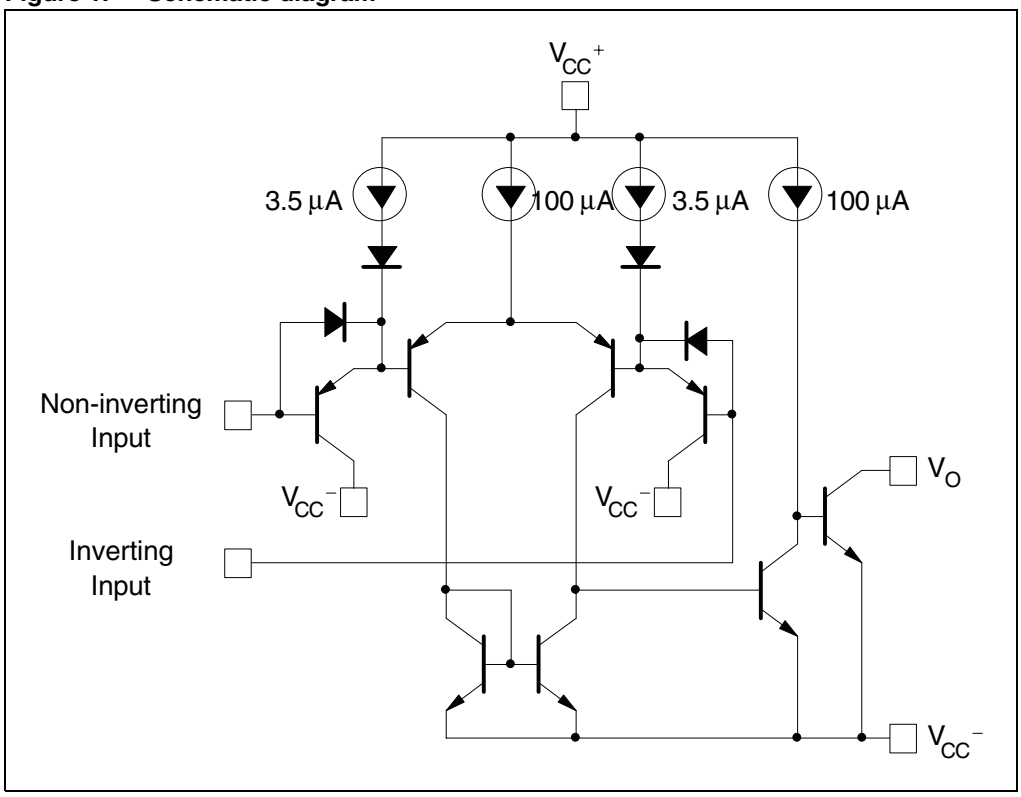
Description

This device consists of a low power voltage comparator designed specifically to operate from a single supply over a wide range of voltages. Operation from split power supplies is also possible.

This comparator also has a unique characteristic in that the input common-mode voltage range includes ground even though operated from a single power supply voltage.

1 Schematic diagram

Figure 1. Schematic diagram



2 Absolute maximum ratings and operating conditions

Table 1. Absolute maximum ratings (AMR)

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	±18 or 34	V
V_{id}	Differential input voltage	-±34	V
V_i	Input voltage	-0.3 to +34	V
	Output short-circuit to ground(1)	Infinite	
T_j	Maximum junction temperature	150	°C
R_{thja}	Thermal resistance junction to ambient(2)	250	°C/W
R_{thjc}	Thermal resistance junction to case (2)	81	°C/W
T_{stg}	Storage temperature range	-65 to +150	°C
ESD	Human body model (HBM)(3)	1500	V
	Machine model (MM)(4)	100	
	Charged device model (CDM)(5)	1000	

1. Short-circuits from the output to V_{CC}^+ can cause excessive heating and potential destruction. The maximum output current is approximately 20 mA independent of the magnitude of V_{CC}^+.
2. Short-circuits can cause excessive heating. These values are typical.
3. Human body model: a 100 pF capacitor is charged to the specified voltage, then discharged through a 1.5 kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are floating.
4. Machine model: a 200 pF 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.
5. Charged device model: all pins and package are charged together to the specified voltage and then discharged directly to ground through only one pin. This is done for all pins.

Table 2. Operation conditions

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	2 to 34 ±1 to ±17	V
V_{icm}	Input common mode voltage range (1) T_{amb} = 25°C $T_{min} \le T_{amb} \le T_{max}$	 0 to V_{CC}^+ -1.5 0 to V_{CC}^+ -2	V
T_{oper}	Operating free air temperature range	-40 to +125	°C

1. The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is V_{CC}^+ –1.5 V, but either or both inputs can go to +30 V without damage.

3 Electrical characteristics

Table 3. V_{CC}^+ = +5 V, V_{CC}^- = 0 V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage (1)	$T_{min} \le T_{amb} \le T_{max}$		1	5 9	mV
I_{io}	Input offset current	$T_{min} \le T_{amb} \le T_{max}$		5	50 150	nA
I_{ib}	Input bias current (2)	$T_{min} \le T_{amb} \le T_{max}$		25	250 400	nA
A_{vd}	Large signal voltage gain	V_{CC}^+ = 15V, R_L = 15kΩ, V_o = 1 to 11V	50	200		V/mV
I_{CC}	Supply current	V_{CC}^+ = 5V, no load V_{CC}^+ = 30V, no load		0.2 0.5	0.5 1.25	mA
V_{id}	Differential input voltage (3)				V_{CC}^+	V
I_{sink}	Output sink current	V_{id} = -1V, V_O = 1.5V	6	16		mA
V_{OL}	Low level output voltage	V_{id} = 1V, $V_{CC}^+ = V_O$ = 30V $T_{min} \le T_{amb} \le T_{max}$		250	400 700	mV
I_{OH}	High level output current	V_{id} = 1V, $V_{CC}^+ = V_O$ = 30V $T_{min} \le T_{amb} \le T_{max}$		0.1	 1	nA µA
tre	Small signal response time	R_L = 5.1kΩ to V_{CC}^+ (4)		1.3		µs
t_{rel}	Large signal response time	V_i = TTL, V_{ref} = +1.4V, R_L = 5.1kΩ to V_{CC}^+		300		ns

1. At output switch point, $V_O \approx$ 1.4V, R_S = 0Ω with V_{CC}^+ from 5V to 30V and over the full input common-mode range (0V to V_{CC}^+ -1.5V).
2. The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output, so there is no loading charge on the reference or input lines.
3. Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator will provide a proper output state. The low input voltage state must not be less than –0.3V (or 0.3V below the negative power supply, if used).
4. The response time specified is for a 100mV input step with 5mV overdrive. For larger overdrive signals, 300ns can be obtained.

Figure 2. Supply current vs. supply voltage

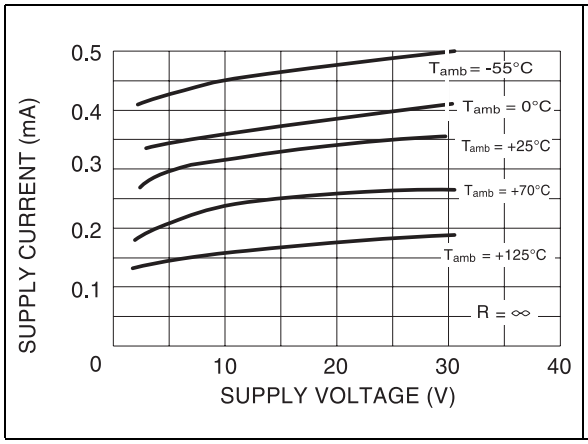


Figure 3. Response time for various input overdrives - negative transition

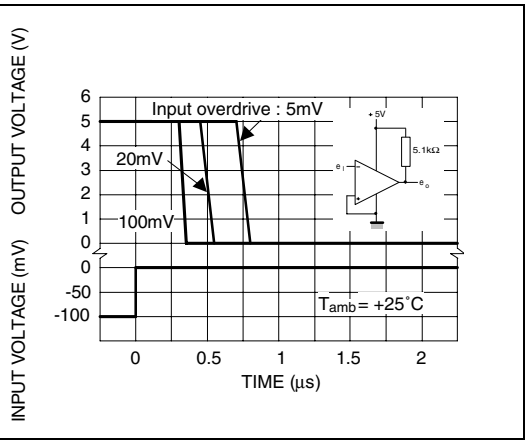


Figure 4. Input current vs. supply voltage

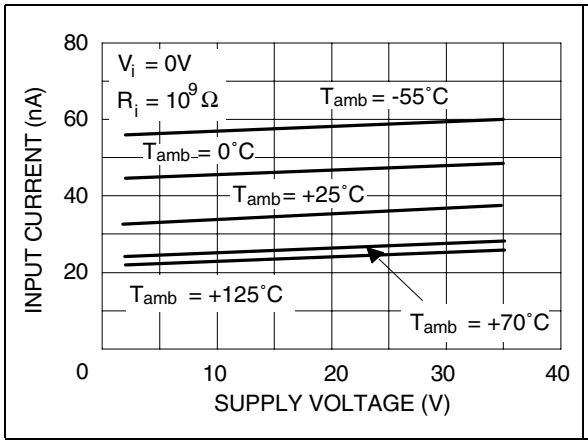


Figure 5. Response time for various input overdrives - positive transition

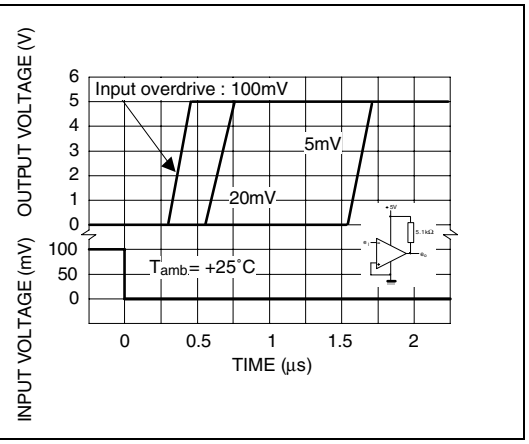
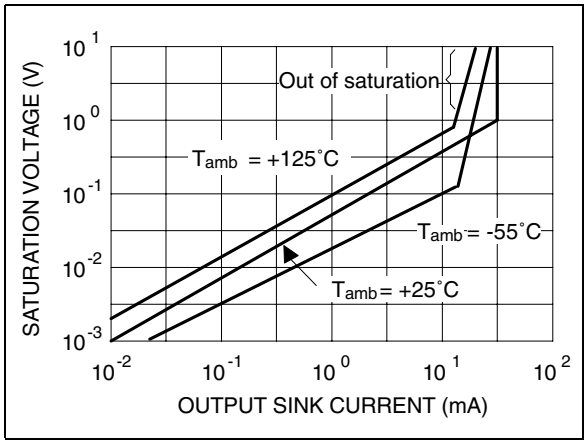


Figure 6. Output saturation voltage vs. output current



4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*. ECOPACK® is an ST trademark.

Figure 7. SOT23-5L package mechanical drawing

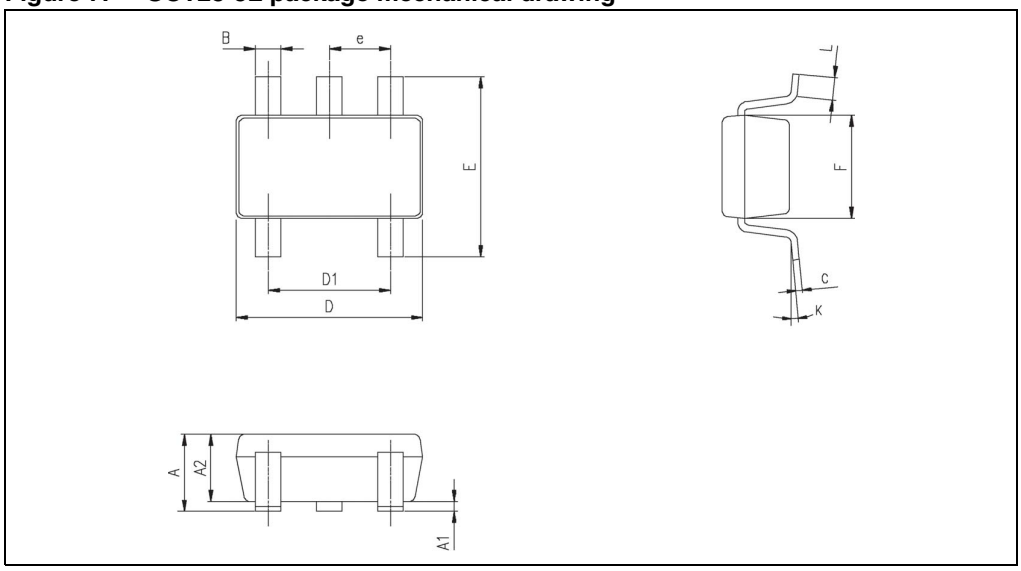


Table 4. SOT23-5L package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.90	1.20	1.45	0.035	0.047	0.057
A1			0.15			0.006
A2	0.90	1.05	1.30	0.035	0.041	0.051
B	0.35	0.40	0.50	0.013	0.015	0.019
C	0.09	0.15	0.20	0.003	0.006	0.008
D	2.80	2.90	3.00	0.110	0.114	0.118
D1		1.90			0.075	
e		0.95			0.037	
E	2.60	2.80	3.00	0.102	0.110	0.118
F	1.50	1.60	1.75	0.059	0.063	0.069
L	0.10	0.35	0.60	0.004	0.013	0.023
K	0 degrees		10 degrees			

5 Ordering information

Table 5. Order codes

Part number	Temperature range	Package	Packaging	Marking
TS391ILT	-40°C, +125°C	SOT23-5L	Tape & reel	K511
TS391IYLT(1)		SOT23-5L (Automotive grade)		K510

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q 002 or equivalent.

6 Revision history

Table 6. Document revision history

Date	Revision	Changes
22-Sep-2004	1	Initial release.
6-Jan-2006	2	PPAP reference inserted in the document.
21-Nov-2007	3	Added values for R_{thja}, R_{thjc} and ESD in *Table 1: Absolute maximum ratings (AMR)*. Added footnote for automotive grade order code in order codes table. Updated format.
21-Jan-2010	4	Corrected ESD tolerance values for human body model and machine model in *Table 1: Absolute maximum ratings (AMR)* and added ESD tolerance value for charged device model. Updated note 1 in *Table 5: Order codes*.

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