

# TS391, NCV391

## Low Power Single Voltage Comparator

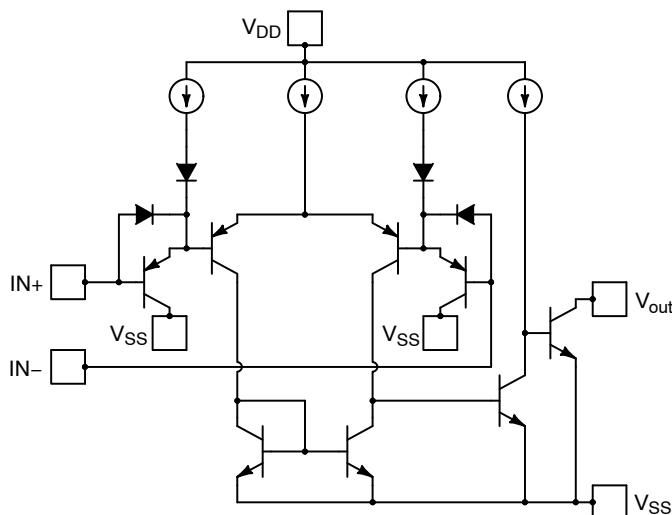
### Description

The TS391 is an open collector, 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.

### Features

- Wide Single Supply Voltage Range or Dual Supplies
- Low Supply Current (0.5 mA) Independent of Supply Voltage (1 mW/Comparator at +5 V)
- Low Input Bias Current: 25 nA TYP
- Low Input Offset Current:  $\pm 5$  nA TYP
- Low Input Offset Voltage:  $\pm 1$  mV TYP
- Input Common Mode Voltage Range includes Ground
- Low Output Saturation Voltage: 250 mV TYP at  $I_O = 4$  mA
- Differential Input Voltage Range Equal to the Supply Voltage
- TTL, DTL, ECL, CMOS Compatible Devices
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable



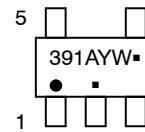
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**TSOP-5  
SN SUFFIX  
CASE 483**

### MARKING DIAGRAM

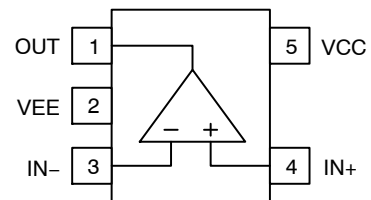


**Analog**

391 = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### PIN CONNECTIONS



### ORDERING INFORMATION

Device	Package	Shipping†
TS391SN2T1G	TSOP-5 (Pb-Free)	3000 / Tape & Reel
NCV391SN2T1G*	TSOP-5 (Pb-Free)	3000 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

\* NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable

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**Table 1. ABSOLUTE MAXIMUM RATINGS** (Over operating free-air temperature, unless otherwise stated)

Parameter	Symbol	Limit	Unit
Supply Voltage ( $V_{CC} - V_{EE}$ )	$V_S$	36	V

**INPUT AND OUTPUT PINS**

Input Voltage	$V_{IN}$	$\pm 36$	V
Differential Input Voltage	$V_{ID}$	-0.3 to 36	V
Output Short Circuit Current (Note 1)	$I_{SC}$	20	mA

**TEMPERATURE**

Storage Temperature	$T_{STG}$	-65 to +150	$^{\circ}C$
Junction Temperature	$T_J$	+150	$^{\circ}C$

**ESD RATINGS**

Human Body Model	HBM	1500	V
Charged Device Model	CDM	2000	V
Machine Model	MM	200	V

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

- Short circuits from the output to  $V_{CC}$  can cause excessive heating and potential destruction. The maximum short circuit current is independent of the magnitude of  $V_{CC}$ .

**Table 2. THERMAL INFORMATION** (Note 2)

Thermal Metric	Symbol	Limit	Unit
Junction to Ambient – SOIC8	$\theta_{JA}$	238	$^{\circ}C/W$

- Short-circuits can cause excessive heating and destructive dissipation. These values are typical.

**Table 3. OPERATING CONDITIONS**

Parameter	Symbol	Limit	Unit
Operating Supply Voltage	$V_S$	2 to 36	V
Specified Operating Range	$T_A$	-40 to +125	$^{\circ}C$

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**Table 4. ELECTRICAL CHARACTERISTICS** ( $V_S = +5.0$  V, At  $T_A = +25^\circ\text{C}$ )  
**Boldface** limits apply over the specified temperature range,  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ .

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	$V_{OS}$	$V_O = 1.4$ V, $R_S = 0$ $\Omega$ , $V_S = 5$ V to 30 V, $V_{CM} = 0$ to $V_{CC} - 1.5$ V		1	5	mV
					<b>9</b>	<b>mV</b>
Input Bias Current	$I_{IB}$			25	250	nA
					<b>400</b>	<b>nA</b>
Input Offset Current	$I_{OS}$			5	50	nA
					<b>150</b>	<b>nA</b>
Input Common Mode Range (Note 3)	$V_{ICR}$		0		$V_{CC} - 1.5$	V
			<b>0</b>		<b><math>V_{CC} - 2</math></b>	<b>V</b>
Differential Input Voltage (Note 4)	$V_{ID}$				$V_{CC}$	V
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage Low	$V_{OL}$	$V_{ID} = 1$ V, $I_O = 4$ mA		250	400	mV
					<b>700</b>	<b>mV</b>
Output Sink Current	$I_O$	$V_{ID} = -1$ , $V_O = 1.5$ V	6	16		mA
Output Leakage Current	$I_{OH}$	$V_{ID} = 1$ V, $V_{CC} = V_O = 5$ V		0.1		nA
		$V_{ID} = 1$ V, $V_{CC} = V_O = 30$ V			<b>1</b>	<b><math>\mu\text{A}</math></b>
<b>DYNAMIC PERFORMANCE</b>						
Open Loop Voltage Gain	$A_{VOL}$	$V_{CC} = 15$ V, $R_{PU} = 15$ k $\Omega$	94	106		dB
Propagation Delay L-H	$t_{PLH}$	5 mV overdrive, $R_{PU} = 5.1$ k $\Omega$		850		ns
		20 mV overdrive, $R_{PU} = 5.1$ k $\Omega$		490		ns
		100 mV overdrive, $R_{PU} = 5.1$ k $\Omega$		300		ns
		TTL Input, $V_{ref} = +1.4$ V, $R_{PU} = 5.1$ k $\Omega$		220		ns
Propagation Delay H-L	$t_{PHL}$	5 mV overdrive, $R_{PU} = 5.1$ k $\Omega$		620		ns
		20 mV overdrive, $R_{PU} = 5.1$ k $\Omega$		400		ns
		100 mV overdrive, $R_{PU} = 5.1$ k $\Omega$		250		ns
		TTL Input, $V_{ref} = +1.4$ V, $R_{PU} = 5.1$ k $\Omega$		350		ns
<b>POWER SUPPLY</b>						
Quiescent Current	$I_{CC}$	$V_{CC} = 5$ V		0.5	-	mA
		$V_{CC} = 30$ V		0.5	1.25	mA

- The input common mode voltage of either input signal 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.
- Positive excursions of the 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 stage. The low input voltage state must not be less than 0.3 V below the negative supply rail.

TYPICAL CHARACTERISTICS

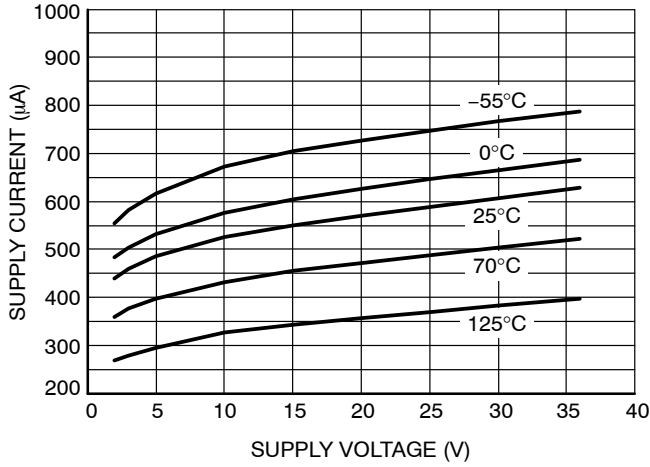


Figure 1. Supply Current vs. Supply Voltage

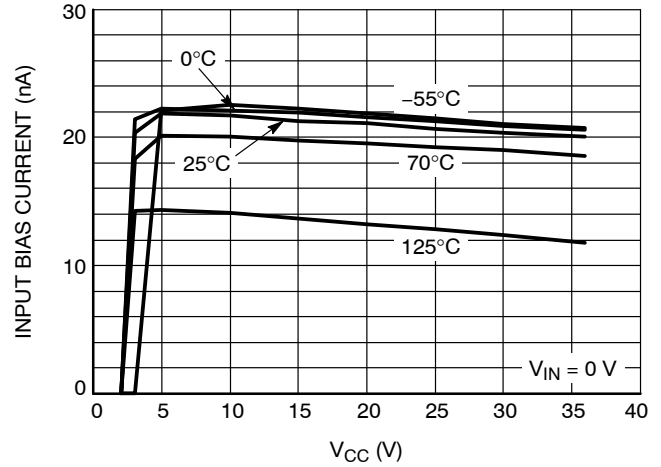


Figure 2. Input Bias Current vs.  $V_{CC}$

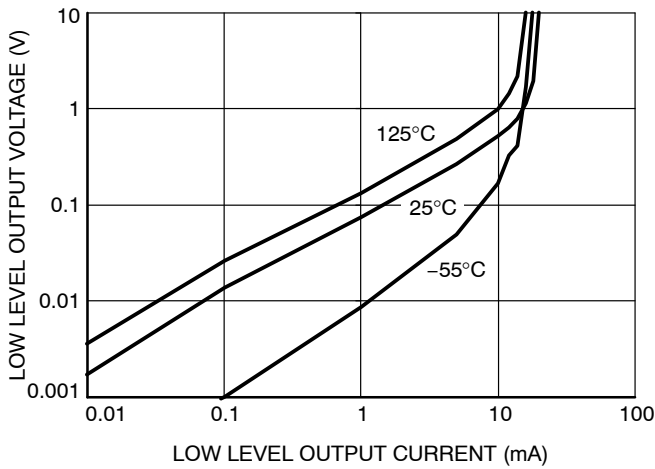


Figure 3. Low Level Output Voltage vs. Output Current

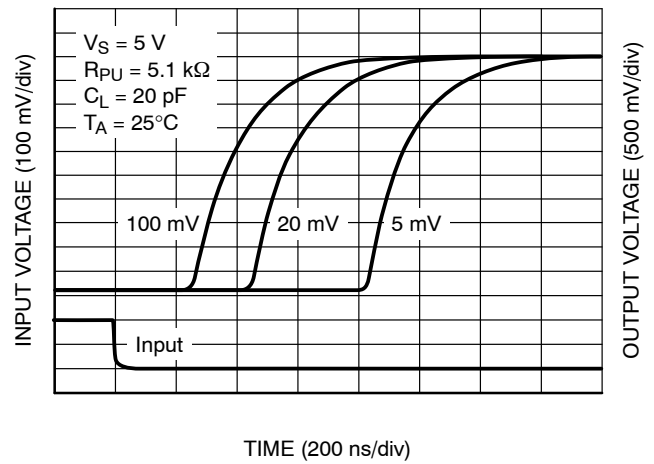


Figure 4. Propagation Delay L-H vs. Overdrive

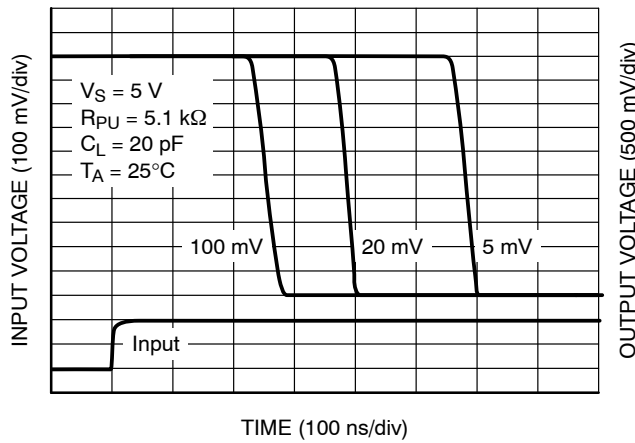
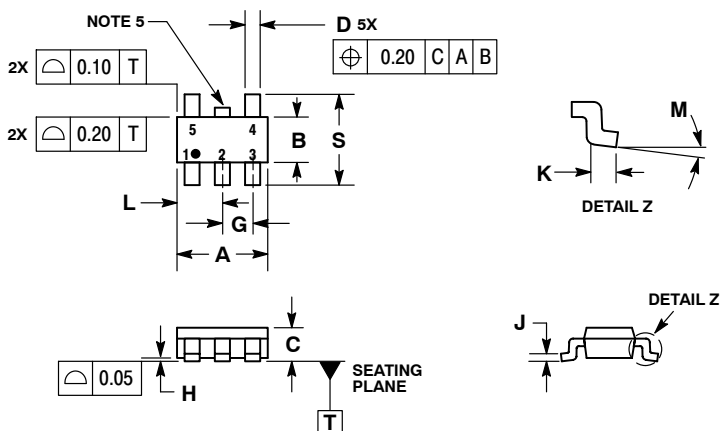


Figure 5. Propagation Delay H-L vs. Overdrive

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## PACKAGE DIMENSIONS

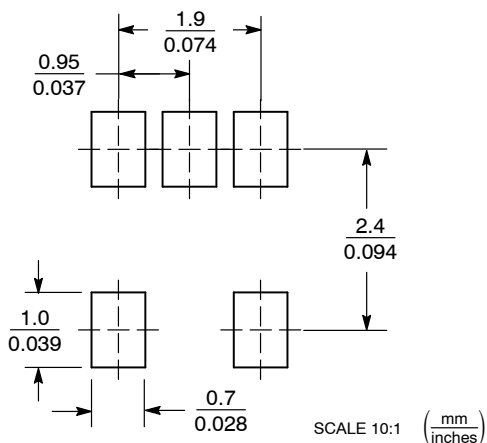
### TSOP-5 CASE 483-02 ISSUE H



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
  4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.
  5. OPTIONAL CONSTRUCTION: AN ADDITIONAL TRIMMED LEAD IS ALLOWED IN THIS LOCATION. TRIMMED LEAD NOT TO EXTEND MORE THAN 0.2 FROM BODY.

DIM	MILLIMETERS	
	MIN	MAX
A	3.00 BSC	
B	1.50 BSC	
C	0.90	1.10
D	0.25	0.50
G	0.95 BSC	
H	0.01	0.10
J	0.10	0.26
K	0.20	0.60
L	1.25	1.55
M	0° 10°	
S	2.50	3.00

### SOLDERING FOOTPRINT\*



\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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