

## *Tiny CMOS Comparator with Rail-to-Rail Input and Push-Pull Output*

The HT7211 is a micropower CMOS comparator available in the space saving SOT23-5 package. This makes the comparator ideal for space and weight critical designs. The HT7211 is supplied in two offset voltage grades, 5 mV and 15 mV. The main benefits of the Tiny package are most apparent in small portable electronic devices, such as mobile phones, pagers, notebook computers, personal digital assistants, and PCMCIA cards. The rail-to-rail input voltage makes the HT7211 a good choice for sensor interfacing, such as light detector circuits, optical and magnetic sensors, and alarm and status circuits.

### Features

- n Tiny SOT 23-5 package saves space
- n Package is less than 1.43 mm thick
- n Guaranteed specs at 2.7V, 5V, 15V supplies
- n Typical supply current 7  $\mu$ A at 5V
- n Responsetime of 4  $\mu$ s at 5V
- n HT7211 — push-pull output
- n Input common-mode range beyond  $V^-$  and  $V^+$

n Low input current

### Applications

- n Battery Powered Products
- n Notebooks and PDAs
- n PCMCIA cards
- n Mobile Communications
- n Alarm and Security circuits
- n Direct Sensor Interface
- n Replaces amplifiers used as comparators with better performance and lower current

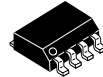
### ORDERING INFORMATION



SOT23-5 T SUFFIX  
HT7211ARTZ



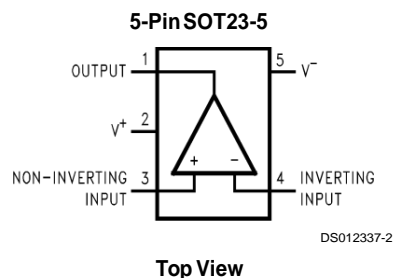
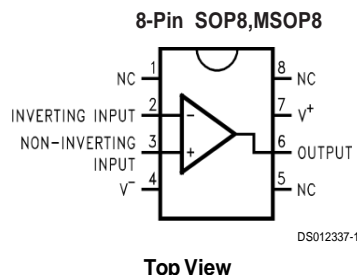
MSOP8 M SUFFIX  
HT7211ARMZ



SOP-8 R SUFFIX  
HT7211ARZ

$T_A = -40^\circ$  to  $85^\circ\text{C}$  for all packages.

### Connection Diagrams



**Absolute Maximum Ratings** (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

ESD Tolerance (Note 2)	2 kV
Differential Input Voltage	(V <sub>CC</sub> ) +0.3V to (-V <sub>CC</sub> )-0.3V
Voltage at Input/Output Pin (V <sub>CC</sub> ) + 0.3V to (-V <sub>CC</sub> )-0.3V	
Supply Voltage (V <sup>+</sup> -V <sup>-</sup> )	16V
Current at Input Pin (Note 7)	±5 mA
Current at Output Pin (Notes 3, 8)	±30 mA
Current at Power Supply Pin	40 mA
Lead Temperature (soldering, 10 sec)	260°C

Storage Temperature Range	-65°C to +150°C
Junction Temperature (Note 4)	150°C

**Operating Ratings** (Note 1)

Supply Voltage	2.7 ≤
HT7211	-40°C ≤ T <sub>J</sub> ≤ +85°C
Thermal Resistance (θ <sub>JA</sub> )	
SO-8 Package,	
8-Pin Surface Mount	180°C/W
M05A Package,	
5-Pin Surface Mount	325°C/W

**2.7V Electrical Characteristics**

Unless otherwise specified, all limits guaranteed for T<sub>J</sub> = 25°C, V<sup>+</sup> = 2.7V, V<sup>-</sup> = 0V, V<sub>CM</sub> = V<sub>O</sub> = V<sup>+</sup>/2. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Typ (Note 5)	HT7211A Limit (Note 6)	HT7211B Limit (Note 6)	Units
V <sub>OS</sub>	Input Offset Voltage		3	5 <b>8</b>	15 <b>18</b>	mV max
TCV <sub>OS</sub>	Input Offset Voltage Temperature Drift		1.0			μV/°C
	Input Offset Voltage Average Drift	(Note 10)	3.3			μV/Month
I <sub>B</sub>	Input Current		0.04			pA
I <sub>OS</sub>	Input Offset Current		0.02			pA
CMRR	Common Mode Rejection Ratio	0V ≤	75			dB
PSRR	Power Supply Rejection Ratio	2.7V ≤ V <sup>+</sup> ≤ 15V	80			dB
A <sub>V</sub>	Voltage Gain		100			dB
CMVR	Input Common-Mode Voltage Range	CMRR > 55 dB	3.0	2.9 <b>2.7</b>	2.9 <b>2.7</b>	V min
		CMRR > 55 dB	-0.3	-0.2 <b>0.0</b>	-0.2 <b>0.0</b>	V max
V <sub>OH</sub>	Output Voltage High	I <sub>load</sub> = 2.5 mA	2.5	2.4 <b>2.3</b>	2.4 <b>2.3</b>	V min
V <sub>OL</sub>	Output Voltage Low	I <sub>load</sub> = 2.5 mA	0.2	0.3 <b>0.4</b>	0.3 <b>0.4</b>	V max
I <sub>S</sub>	Supply Current	V <sub>OUT</sub> = Low	7	12	12	μA max
				<b>14</b>	<b>14</b>	

**5.0V and 15.0V Electrical Characteristics**

Unless otherwise specified, all limits guaranteed for T<sub>J</sub> = 25°C, V<sup>+</sup> = 5.0V and 15V, V<sup>-</sup> = 0V, V<sub>CM</sub> = V<sub>O</sub> = V<sup>+</sup>/2. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Typ (Note 5)	HT7211A Limit (Note 6)	HT7211B Limit (Note 6)	Units
V <sub>OS</sub>	Input Offset Voltage		3	5 <b>8</b>	15 <b>18</b>	mV max

**5.0V and 15.0V Electrical Characteristics** (Continued)

Unless otherwise specified, all limits guaranteed for  $T_J = 25^\circ\text{C}$ ,  $V^+ = 5.0\text{V}$  and  $15\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{\text{CM}} = V_O = V^+/2$ . **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Typ (Note 5)	HT7211A Limit (Note 6)	HT7211B Limit (Note 6)	Units
TCV <sub>OS</sub>	Input Offset Voltage Temperature Drift	V <sup>+</sup> = 5V	1.0			μV/°C
		V <sup>+</sup> = 15V	4.0			
	Input Offset Voltage Average Drift	V <sup>+</sup> = 5V	3.3			μV/Month
		V <sup>+</sup> = 15V	4.0			
I <sub>B</sub>	Input Current		0.04			pA
I <sub>OS</sub>	Input Offset Current		0.02			pA
CMRR	Common Mode Rejection Ration	V <sup>+</sup> = 5.0V	75			dB
		V <sup>+</sup> = 15.0V	82			dB
PSRR	Power Supply Rejection Ratio	5V ≤ V <sup>+</sup> ≤ 10V	80			dB
A <sub>V</sub>	Voltage Gain		100			dB
CMVR	Input Common-Mode Voltage Range	V <sup>+</sup> = 5.0V CMRR > 55 dB	5.3	5.2 <b>5.0</b>	5.2 <b>5.0</b>	V min
		V <sup>+</sup> = 5.0V CMRR > 55 dB	-0.3	-0.2 <b>0.0</b>	-0.2 <b>0.0</b>	V max
		V <sup>+</sup> = 15.0V CMRR > 55 dB	15.3	15.2 <b>15.0</b>	15.2 <b>15.0</b>	V min
		V <sup>+</sup> = 15.0V CMRR > 55 dB	-0.3	-0.2 <b>0.0</b>	-0.2 <b>0.0</b>	V max
V <sub>OH</sub>	Output Voltage High	V <sup>+</sup> = 5V I <sub>load</sub> = 5 mA	4.8	4.6 <b>4.45</b>	4.6 <b>4.45</b>	mV min
		V <sup>+</sup> = 15V I <sub>load</sub> = 5 mA	14.8	14.6 <b>14.45</b>	14.6 <b>14.45</b>	mV min
V <sub>OL</sub>	Output Voltage Low	V <sup>+</sup> = 5V I <sub>load</sub> = 5 mA	0.2	0.40 <b>0.55</b>	0.40 <b>0.55</b>	mV max
		V <sup>+</sup> = 15V I <sub>load</sub> = 5 mA	0.2	0.40 <b>0.55</b>	0.40 <b>0.55</b>	mV max
I <sub>S</sub>	Supply Current	V <sub>OUT</sub> = Low	7	14 <b>18</b>	14 <b>18</b>	μA max
I <sub>SC</sub>	Short Circuit Current	Sourcing	30			mA
		Sinking (Note 8)	45			mA

**AC Electrical Characteristics**

Unless otherwise specified, all limits guaranteed for  $T_J = 25^\circ\text{C}$ ,  $V^+ = 5\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{\text{CM}} = V_O = V^+/2$ . **Boldface** limits apply at the temperature extreme.

Symbol	Parameter	Conditions	Typ (Note 5)	HT7211A Limit (Note 6)	HT7211B Limit (Note 6)	Units
t <sub>rise</sub>	Rise Time	f = 10 kHz, C <sub>I</sub> = 50 pF, Overdrive = 10 mV (Note 9)	0.3			μs
t <sub>fall</sub>	Fall Time	f = 10 kHz, C <sub>I</sub> = 50 pF, Overdrive = 10 mV (Note 9)	0.3			μs

**AC Electrical Characteristics** (Continued)

Unless otherwise specified, all limits guaranteed for  $T_J = 25^\circ\text{C}$ ,  $V^+ = 5\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{\text{CM}} = V_O = V^+/2$ . **Boldface** limits apply at the temperature extreme.

Symbol	Parameter	Conditions	Typ (Note 5)	HT7211A Limit (Note 6)	HT7211B Limit (Note 6)	Units
$t_{\text{PHL}}$	Propagation Delay (High to Low) (Note 11)	$f = 10\text{ kHz}$ , $C_L = 50\text{ pF}$ (Note 9)	10 mV	10		$\mu\text{s}$
			100 mV	4		
		$V^+ = 2.7\text{V}$ , $f = 10\text{ kHz}$ , $C_L = 50\text{ pF}$ (Note 9)	10 mV	10		$\mu\text{s}$
			100 mV	4		
$t_{\text{PLH}}$	Propagation Delay (Low to High) (Note 11)	$f = 10\text{ kHz}$ , $C_L = 50\text{p}$ (Note 9)	10 mV	6		$\mu\text{s}$
			100 mV	4		
		$V^+ = 2.7\text{V}$ , $f = 10\text{ kHz}$ , $C_L = 50\text{ pF}$ (Note 9)	10 mV	7		$\mu\text{s}$
			100 mV	4		

**Note 1:** Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.

**Note 2:** Human body model, 1.5 k $\Omega$  in series with 100 pF.

**Note 3:** Applies to both single-supply and split-supply operation. Continuous short circuit operation at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150°C. Output currents in excess of  $\pm 30\text{ mA}$  over long term may adversely affect reliability.

**Note 4:** The maximum power dissipation is a function of  $T_{\text{J(max)}}$ ,  $\theta_{\text{JA}}$ , and  $T_{\text{A}}$ . The maximum allowable power dissipation at any ambient temperature is  $P_{\text{D}} = (T_{\text{J(max)}} - T_{\text{A}})/\theta_{\text{JA}}$ . All numbers apply for packages soldered directly into a PC board.

**Note 5:** Typical values represent the most likely parametric norm.

**Note 6:** All limits are guaranteed by testing or statistical analysis.

**Note 7:** Limiting input pin current is only necessary for input voltages that exceed absolute maximum input voltage rating.

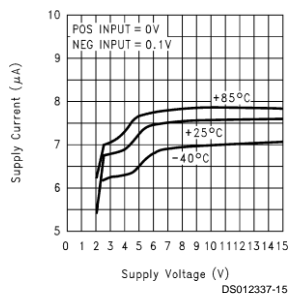
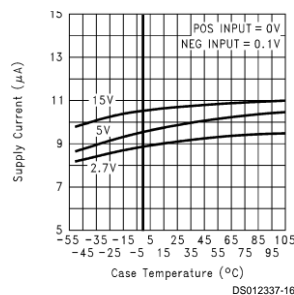
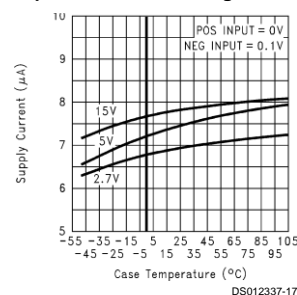
**Note 8:** Do not short circuit output to  $V^+$ , when  $V^+$  is greater than 12V or reliability will be adversely affected.

**Note 9:**  $C_L$  includes the probe and jig capacitance.

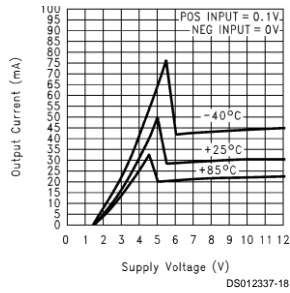
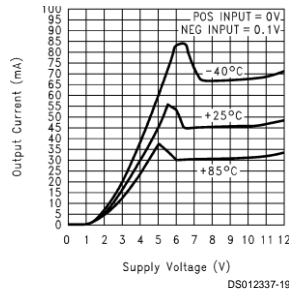
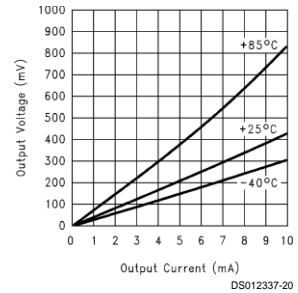
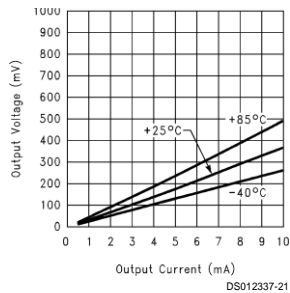
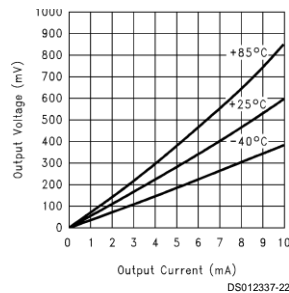
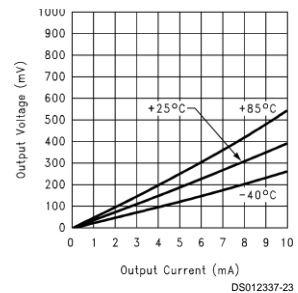
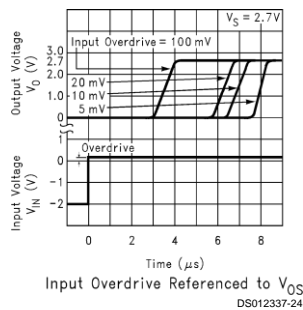
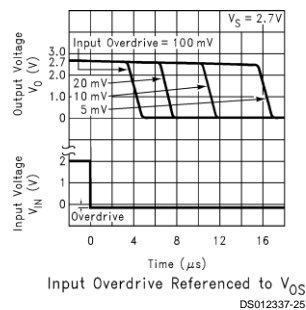
**Note 10:** Input offset voltage average drift is calculated by dividing the accelerated operating life  $V_{\text{OS}}$  drift by the equivalent operational time. This represents worst case input conditions and includes the first 30 days of drift.

**Note 11:** Input step voltage for propagation delay measurement is 2V.

**Typical Performance Characteristics** Single Supply  $T_{\text{A}} = 25^\circ\text{C}$  unless specified

**Supply Current vs Supply Voltage**

**Supply Current vs Temperature while Sourcing**

**Supply Current vs Temperature while Sinking**


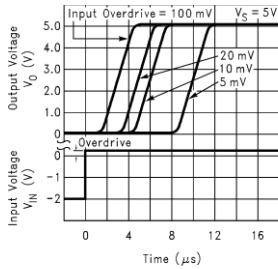
**Typical Performance Characteristics** Single Supply  $T_A = 25^\circ\text{C}$  unless specified (Continued)

**Output Sourcing Current vs Supply Voltage**

**Output Sinking Current vs Supply Voltage**

**Output Sourcing Current vs Output Voltage @ 5V**

**Output Sinking Current vs Output Voltage @ 5V**

**Output Sourcing Current vs Output Voltage @ 15V**

**Output Sinking Current vs Output Voltage @ 15V**

**Response Time for Various Input Overdrives -  $t_{PLH}$** 

**Response Time for Various Input Overdrives -  $t_{PHL}$** 




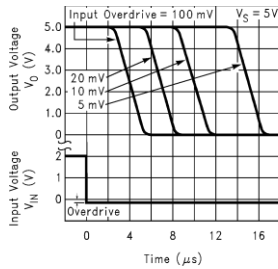
Typical Performance Characteristics Single Supply  $T_A = 25^\circ\text{C}$  unless specified (Continued)

Response Time for Various Input Overdrives  $-t_{PLH}$



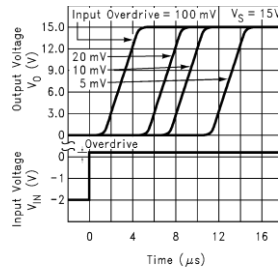
Input Overdrive Referenced to  $V_{OS}$   
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Response Time for Various Input Overdrives  $-t_{PHL}$



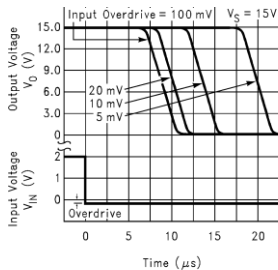
Input Overdrive Referenced to  $V_{OS}$   
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Response Time for Various Input Overdrives  $-t_{PLH}$



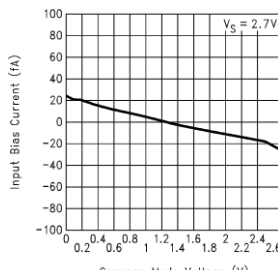
Input Overdrive Referenced to  $V_{OS}$   
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Response Time for Various Input Overdrives  $-t_{PHL}$



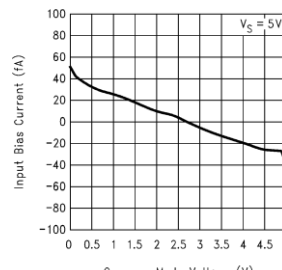
Input Overdrive Referenced to  $V_{OS}$   
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Input Bias Current vs Common Mode Voltage



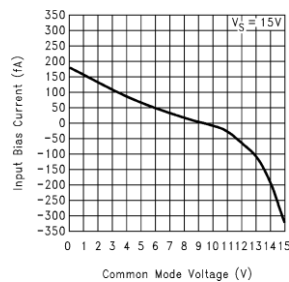
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Input Bias Current vs Common Mode Voltage



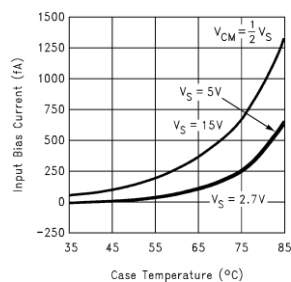
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Input Bias Current vs Common Mode Voltage



DS012337-32

Input Bias Current vs Temperature



DS012337-33

## Application Information

### 1.0 Benefits of the HT7211 Tiny Comparator

**Size.** The small footprint of the SOT 23-5 packaged Tiny Comparator, (0.120 x 0.118 inches, 3.05 x 3.00 mm) saves space on printed circuit boards, and enable the design of smaller electronic products. Because they are easier to carry, many customers prefer smaller and lighter products.

**Height.** The height of the HT7211B (0.056 inches, 1.43 mm) of the Tiny Comparator makes it possible to use it in PCMCIA type III cards.

**Simplified Board Layout.** The Tiny Comparator can simplify board layout in several ways. First, by placing a comparator where comparators are needed, instead of routing signals to a dual or quad device, long pc traces may be avoided.

By using multiple Tiny Comparators instead of duals or quads, complex signal routing and possibly crosstalk can be reduced.

**Low Supply Current.** The typical 7  $\mu$ A supply current of the HT7211 extends battery life in portable applications, and may allow the reduction of the size of batteries in some applications.

**Wide Voltage Range.** The HT7211 is characterized at 15V, 5V and 2.7V. Performance data is provided at these popular voltages. This wide voltage range makes the HT7211 a good choice for devices where the voltage may vary over the life of the batteries.

**Digital Outputs Representing Signal Level.** Comparators provide a high or low digital output depending on the voltage levels of the (+) and (-) inputs. This makes comparators useful for interfacing analog signals to microprocessors and other digital circuits. The HT7211 can be used as a one-bit a/d converter.

**Push-Pull Output.** The push-pull output of the HT7211 is capable of both sourcing and sinking milliamp level currents even at a 2.7 volt supply. This can allow the HT7211 to drive multiple logic gates.

**Driving LEDs (Light Emitting Diodes).** With a 5 volt power supply, the HT7211B output sinking current can drive small, high efficiency LEDs for indicator and test point circuits. The small size of the Tiny package makes it easy to find space to add this feature to even compact designs.

**Input range to Beyond Rail to Rail.** The input common mode range of the HT7211 is slightly larger than the actual power supply range. This wide input range means that the comparator can be used to sense signals close to the power supply rails. This wide input range can make design easier by eliminating voltage dividers, amplifiers, and other front end circuits previously used to match signals to the limited input range of earlier comparators. This is useful to power supply monitoring circuits which need to sense their own power supply, and compare it to a reference voltage which is close to the power supply voltage. The wide input range can also be useful for sensing the voltage drop across a current sense resistor for battery chargers.

**Zero Crossing Detector.** Since the HT7211's common mode input range extends below ground even when powered by a single positive supply, it can be used with large input resistors as a zero crossing detector.

**Low Input Currents and High Input Impedance.** These characteristics allow the HT7211 to be used to sense high impedance signals from sensors. They also make it possible to use the HT7211 in timing circuits built with large value resistors. This can reduce the power dissipation of timing circuits.

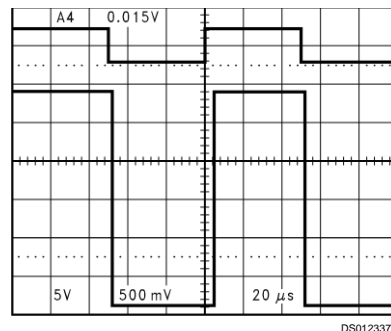
For very long timing circuits, using high value resistors can reduce the size and cost of large value capacitors for the same R-C time constant.

**Direct Sensor Interfacing.** The wide input voltage range and high impedance of the HT7211 may make it possible to directly interface to a sensor without the use of amplifiers or bias circuits. In circuits with sensors which can produce outputs in the tens to hundreds of millivolts, the HT7211 can compare the sensor signal with an appropriately small reference voltage. This may be done close to ground or the positive supply rail. Direct sensor interfacing may eliminate the need for an amplifier for the sensor signal. Eliminating the amplifier can save cost, space, and design time.

### 2.0 Low Voltage Operation

Comparators are the common devices by which analog signals interface with digital circuits. The HT7211 has been designed to operate at supply voltages of 2.7V without sacrificing performance to meet the demands of 3V digital systems.

At supply voltages of 2.7V, the common-mode voltage range extends 200 mV (guaranteed) below the negative supply. This feature, in addition to the comparator being able to sense signals near the positive rail, is extremely useful in low voltage applications.



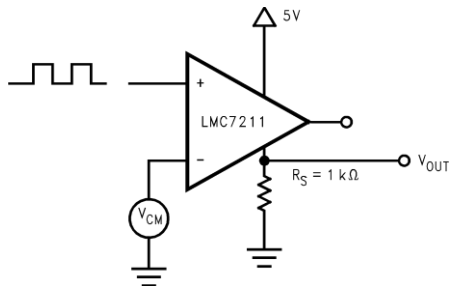
**FIGURE 1. Even at Low-Supply Voltage of 2.7V, an Input Signal which Exceeds the Supply Voltages Produces No Phase Inversion at the Output**

At  $V^+ = 2.7V$  propagation delays are  $t_{PLH} = 4 \mu s$  and  $t_{PHL} = 4 \mu s$  with overdrives of 100 mV.

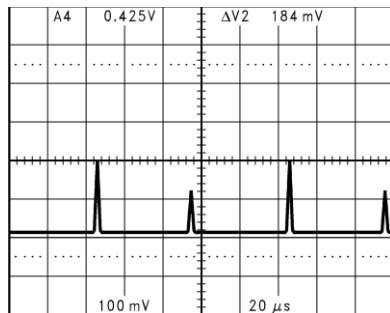
Please refer to the performance curves for more extensive characterization.

### 3.0 Shoot-Through Current

The shoot-through current is defined as the current surge, above the quiescent supply current, between the positive and negative supplies of a device. The current surge occurs when the output of the device switches states. The shoot-through current results in glitches in the supply voltages. Usually, glitches in the supply lines are prevented by bypass capacitors. When the glitches are minimal, the value of the bypass capacitors can be reduced.

**Application Information** (Continued)


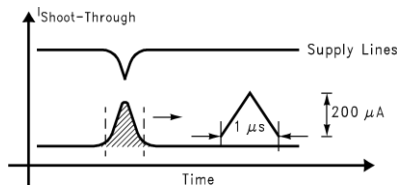
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**FIGURE 2. Circuit for Measurement of the Shoot-Through Current**


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**FIGURE 3. Measurement of the Shoot-Through Current**

From *Figure 3*, the shoot-through current for the HT7211 can be calculated to be 0.2 mA (typical), and the duration is 1 μs. The values needed for the bypass capacitors can be calculated as follows:



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$$\text{Area of } \Delta \\ = 100 \text{ pC}$$

The capacitor needs to supply 100 picocoulomb. To avoid large shifts in the comparator threshold due to changes in the voltage level, the voltage drop at the bypass capacitor should be limited to 100 mV or less.

The charge needed (100 picocoulomb) and the allowable voltage drop (100 mV) will give us the minimum capacitor value required.

$$\Delta Q = C (\Delta V)$$

$$C = \Delta Q / \Delta V = 100 \text{ picocoulomb} / 100 \text{ mV}$$

$$C = 10^{-10} / 10^{-1} = 10^{-9} = 1 \text{ nF} = 0.001 \text{ } \mu\text{F}$$

$$10^{-9} = 1 \text{ nF} = 0.001 \text{ } \mu\text{F}$$

The voltage drop of ~100 mV will cause a threshold shift in the comparator. This threshold shift will be reduced by the power supply rejection ratio, (PSRR). The PSRR which is applicable here is not the DC value of PSRR (~80 dB), but a transient PSRR which will be usually about 20 dB–40 dB, depending on the circuit and the speed of the transient. This will result in an effective threshold shift of about 1 mV to 10 mV.

For precision and level sensing circuits, it is generally a good goal to reduce the voltage delta on the power supply to a value equal to or less than the hysteresis of the comparator circuit. If the above circuit was to be used with 50 mV of hysteresis, it would be reasonable to increase the bypass capacitor to 0.01 μF to reduce the voltage delta to 10 mV. Larger values may be useful for obtaining more accurate and consistent switching.

Note that the switching current of the comparator can spread to other parts of the board as noise. The bypass capacitor reduces this noise. For low noise systems this may be reason to make the capacitor larger.

For non-precision circuits, such as using a comparator to determine if a push-button switch is on or off, it is often cheaper and easier to use a larger value of hysteresis and a small value or bypass capacitance. The low shoot-through current of the HT7211 can allow the use of smaller and less expensive bypass capacitors in non-critical circuits.

**4.0 Output Short Circuit Current**

The HT7211 has short circuit protection of 40 mA. However, it is not designed to withstand continuous short circuits, transient voltage or current spikes, or shorts to any voltage beyond the supplies. A resistor in series with the output should reduce the effect of shorts. For outputs which send signals off PC boards additional protection devices, such as diodes to the supply rails, and varistors may be used.

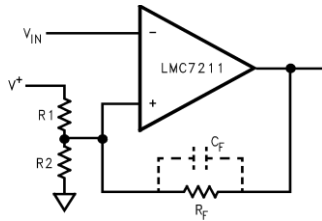
**5.0 Hysteresis**

If the input signal is very slow or very noisy, the comparator output might trip several times as the input signal passes through the threshold. Using positive feedback to add hysteresis to the switching can reduce or eliminate this problem. The positive feedback can be added by a high value resistor ( $R_F$ ). This will result in two switching thresholds, one for increasing signals and one for decreasing signals. A capacitor can be added across  $R_F$  to increase the switching speed and provide more short term hysteresis. This can result in greater noise immunity for the circuit.

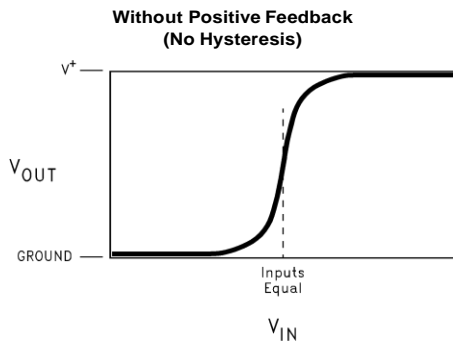
See *Figure 4*, *Figure 5* and *Figure 6*.

Note that very heavy loading of the comparator output, such as LED drive or bipolar logic gates, will change the output voltage and shift the voltage thresholds.

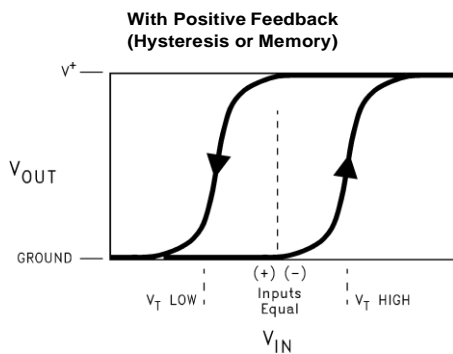


**Application Information** (Continued)


DS012337-9

 $R_F @ R_1$  and  
 $R_F @ R_2$ 
**FIGURE 4. Positive Feedback for Hysteresis**


DS012337-10

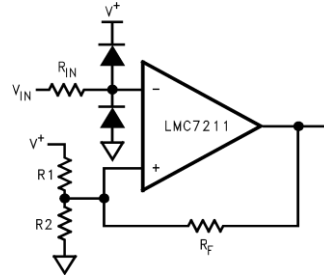
**FIGURE 5.**


DS012337-11

**FIGURE 6.**
**6.0 Input Protection**

If input signals are like to exceed the common mode range of the HT7211, or it is likely that signals may be present when power is off, damage to the HT7211 may occur. Large value (100 k $\Omega$  to M $\Omega$ ) input resistors may reduce the likelihood of damage by limiting the input currents. Since the HT7211 has very low input leakage currents, the effect on accuracy will be small. Additional protection may require the use of diodes, as shown in Figure 7. Note that diode leakage

current may affect accuracy during normal operation. The R-C time constant of  $R_{IN}$  and the diode capacitance may also slow response time.



DS012337-12

**FIGURE 7.**
**7.0 Layout Considerations**

The HT7211 is not an especially fast comparator, so high speed design practices are not required. The HT7211 is capable of operating with very high impedance inputs, so precautions should be taken to reduce noise pickup with high impedance (~ 100 k $\Omega$  and greater) designs and in electrically noisy environments.

Keeping high value resistors close to the HT7211 and minimizing the size of the input nodes is a good practice. With multilayer designs, try to avoid long loops which could act as inductors (coils). Sensors which are not close to the comparator may need twisted pair or shielded connections to reduce noise.

**8.0 Open Drain Output, Dual Versions**

The HT7211 is a comparator similar to the HT7211, but with an open drain output which allows the output voltage to be different (higher or lower) than the supply voltage. The open drain output is like the open collector output of a logic gate. This makes the HT7211 very useful for mixed voltage systems. Many systems will have different voltages for the analog and microprocessor sections. Please see the HT7211 datasheet for details.

The performance of the HT7211 is available in dual devices. Please see the HT7211 datasheet for details on a dual push-pull output device. For a dual device with open drain outputs, please see the HT7211 datasheet.

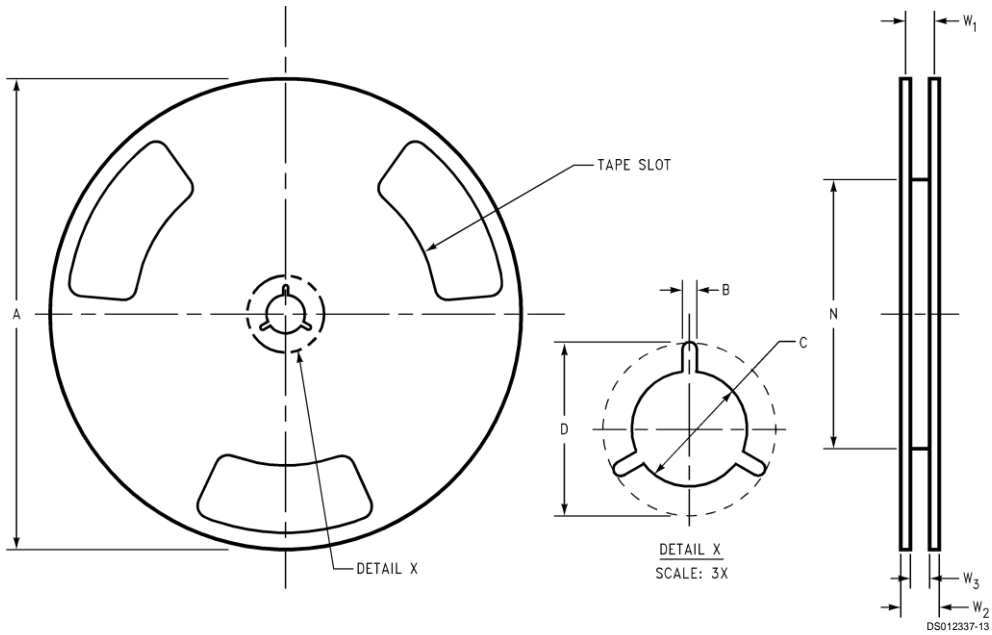
**Rail-to-Rail Input Low Power Comparators—**
**Push-Pull Output**

HT7211	SOT23-5, SO-8	Single
HT6762	SO-8, DIP	Dual

**Open Drain Output**

HT7211	SOT23-5, SO-8	Single
HT7211	SO-8, DIP	Dual

**REEL DIMENSIONS**



8 mm	7.00	0.059	0.512	0.795	2.165	0.331 + 0.059/-0.000	0.567	W1 + 0.078/-0.039
	330.00	1.50	13.00	20.20	55.00	8.40 + 1.50/-0.00	14.40	W1 + 2.00/-1.00
Tape Size	A	B	C	D	N	W1	W2	W3

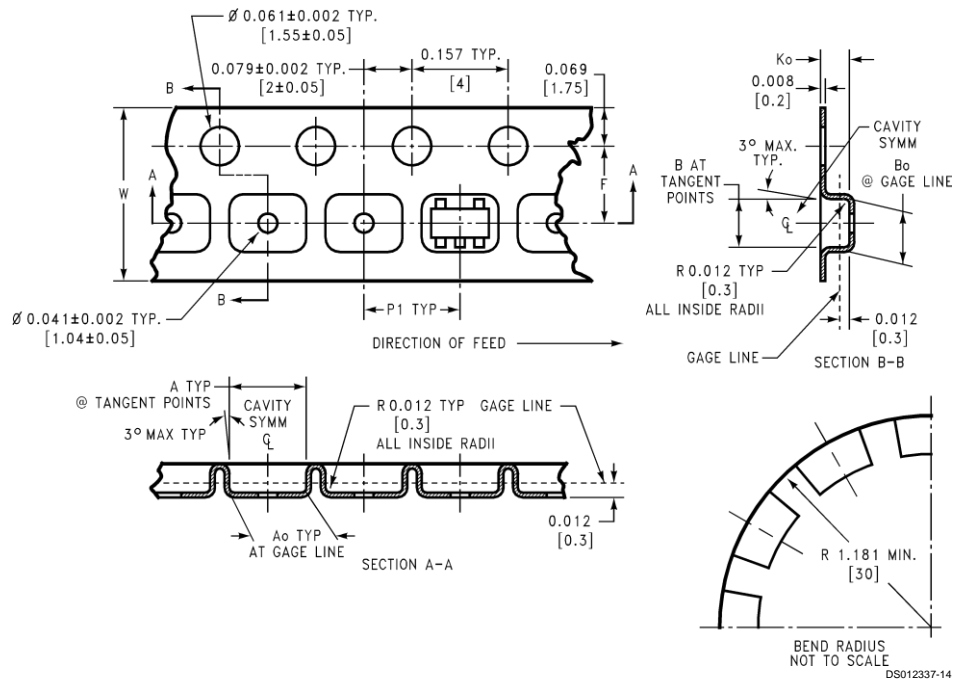
**SOT-23-5 Tape and Reel Specification**

**TAPE FORMAT**

Tape Section	# Cavities	Cavity Status	Cover Tape Status
Leader (Start End)	0 (min)	Empty	Sealed
	75 (min)	Empty	Sealed

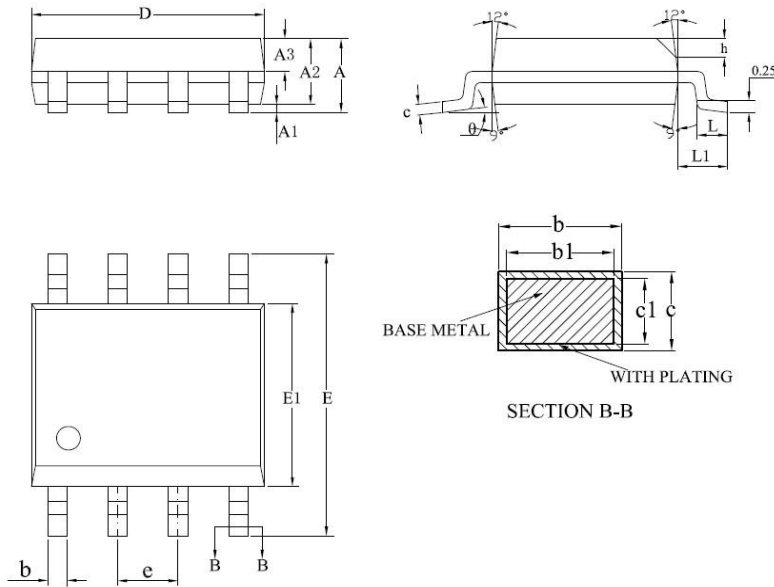
**SOT-23-5 Tape and Reel Specification (Continued)**
**TAPE FORMAT (Continued)**

Tape Section	# Cavities	Cavity Status	Cover Tape Status
Carrier	3000	Filled	Sealed
	1000	Filled	Sealed
Trailer (Hub End)	125 (min)	Empty	Sealed
	0 (min)	Empty	Sealed

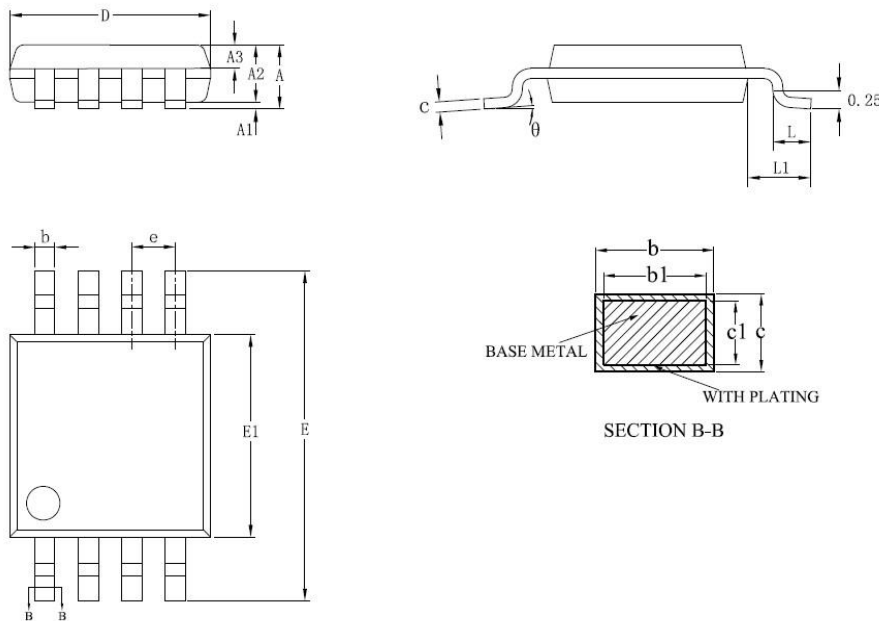
**TAPE DIMENSIONS**


<b>8 mm</b>	<b>0.130</b>	<b>0.124</b>	<b>0.130</b>	<b>0.126</b>	<b>0.138 ± 0.002</b>	<b>0.055 ± 0.004</b>	<b>0.157</b>	<b>0.315 ± 0.012</b>
	<b>(3.3)</b>	<b>(3.15)</b>	<b>(3.3)</b>	<b>(3.2)</b>	<b>(3.5 ± 0.05)</b>	<b>(1.4 ± 0.11)</b>	<b>(4)</b>	<b>(8 ± 0.3)</b>
Tape Size	DIM A	DIM A0	DIM B	DIM B0	DIM F	DIM Ko	DIM P1	DIM W



**SOIC-8**


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.75
A1	0.10	—	0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	—	0.47
b1	0.38	0.41	0.44
c	0.20	—	0.24
c1	0.19	0.20	0.21
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
h	0.25	—	0.50
L	0.50	—	0.80
L1	1.05REF		
$\theta$	0	—	8°

**MSOP-8**


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.10
A1	0.05	—	0.15
A2	0.75	0.85	0.95
A3	0.30	0.35	0.40
b	0.28	—	0.36
b1	0.27	0.30	0.33
c	0.15	—	0.19
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
e	0.65BSC		
L	0.40	—	0.70
L1	0.95REF		
$\theta$	0	—	8°