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# **Low Voltage Comparators**

The NCS2200 Series is an industry first sub—one volt, low power comparator family. These devices consume only 10 µA of supply current. They are guaranteed to operate at a low voltage of 0.85 V which allows them to be used in systems that require less than 1.0 V and are fully operational up to 6.0 V which makes them convenient for use in both 3.0 V and 5.0 V systems. Additional features include no output phase inversion with overdriven inputs, internal hysteresis, which allows for clean output switching, and rail—to—rail input and output performance. The NCS2200 Series is available in complementary and open drain outputs and a variety of packages. There are two industry standard pinouts for SOT–23–5 and SC70–5 packages. The NCS2200 is also available in the tiny DFN 2x2.2 package. The NCS2200A and NCS2202A are available in UDFN 1.2x1.0 package. See package option information in Table 1 on page 2 for more information.

#### **Features**

- Operating Voltage of 0.85 V to 6.0 V
- Rail-to-Rail Input/Output Performance
- Low Supply Current of 10 μA
- No Phase Inversion with Overdriven Input Signals
- Glitchless Transitioning in or out of Tri-State Mode
- Complementary or Open Drain Output Configuration
- Internal Hysteresis
- Propagation Delay of 1.0 μs for NCS2200
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant

### **Typical Applications**

- Single Cell NiCd/NiMH Battery Powered Applications
- Automotive

#### **End Products**

- Cellphones, Smart Phones
- Alarm and Security Systems
- Personal Digital Assistants



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SOT-23-5 (TSOP-5) SN SUFFIX CASE 483



DFN 2x2.2 SQL SUFFIX CASE 488



SC70-5 SQ SUFFIX CASE 419A



UDFN 1.2x1.0 MU SUFFIX CASE 517AA

#### **ORDERING INFORMATION**

See detailed ordering and shipping information in the package dimensions section on page 13 of this data sheet.

#### **DEVICE MARKING INFORMATION**

See general marking information in the device marking section on page 14 of this data sheet.

**Table 1. COMPARATOR SELECTOR GUIDE** 

| Output Type   | Device         | Package         | Pinout Style |
|---------------|----------------|-----------------|--------------|
| Complementary | NCS2200AMUT1G  | UDFN, 1.2x1.0   | N/A          |
| Complementary | NCS2200SN1T1G  | SOT-23-5        | 1            |
| Complementary | NCV2200SN1T1G* | SOT-23-5        | 1            |
| Complementary | NCS2200SN2T1G  | SOT-23-5        | 2            |
| Complementary | NCV2200SN2T1G* | SOT-23-5        | 2            |
| Complementary | NCS2200SQ2T2G  | SC70-5          | 2            |
| Complementary | NCV2200SQ2T2G* | SC70-5          | 2            |
| Complementary | NCS2200SQLT1G  | DFN, 2x2.2      | N/A          |
| Open Drain    | NCS2202SN1T1G  | SOT-23-5        | 1            |
| Open Drain    | NCS2202SN2T1G  | SOT-23-5        | 2            |
| Open Drain    | NCV2202SN2T1G* | SOT-23-5        | 2            |
| Open Drain    | NCS2202SQ1T2G  | SC70-5          | 1            |
| Open Drain    | NCS2202SQ2T2G  | SC70-5          | 2            |
| Open Drain    | NCS2202AMUTBG  | UDFN, 1.2 x 1.0 | N/A          |

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

#### **PIN CONNECTIONS**



Figure 1. SOT-23-5 (NCS2200, NCS2202), SC70-5 (NCS2200, NCS2202)



Figure 2. DFN 2x2.2 (NCS2200)

Figure 3. UDFN 1.2x1.0 (NCS2200A/NCS2202A)

#### **MAXIMUM RATINGS**

| Rating  | Symbol                       | Value  | Unit |
|---|------------------------------|--|------|
| Supply Voltage Range (V <sub>CC</sub> to V <sub>EE</sub> )  | V <sub>S</sub>               | 6.0  | V    |
| Non-inverting/Inverting Input to V <sub>EE</sub>  | V <sub>CM</sub>              | -0.2 to (V <sub>CC</sub> + 0.2)                                  | V    |
| Operating Junction Temperature  | TJ                           | 150  | °C   |
| Operating Ambient Temperature Range<br>NCS2200, NCS2202, NCS2200A, NCS2202A<br>NCV2200, NCV2202   | T <sub>A</sub>               | -40 to +105<br>-40 to +125                                       | °C   |
| Storage Temperature Range   | T <sub>stg</sub>             | -65 to +150  | °C   |
| Output Short Circuit Duration Time (Note 1)   | t <sub>S</sub>               | Indefinite   | S    |
| ESD Tolerance (Note 2) NCS2200 Human Body Model Machine Model NCS2202 Human Body Model Machine Model NCS2200A Human Body Model Machine Model NCS2202A Human Body Model – all pins except output Human Body Model – output pin Machine Model | ESD HBM MM HBM MM HBM HBM MM | 2000<br>200<br>2000<br>2000<br>1900<br>200<br>1500<br>500<br>150 | V    |
| Thermal Resistance, Junction-to-Ambient TSOP-5 DFN (Note 3) SC70-5 UDFN   | $R_{	hetaJA}$                | 238<br>215<br>283<br>350   | °C/W |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. The maximum package power dissipation limit must not be exceeded.  $P_D = \frac{T_J(max) - T_A}{R_{\theta J}A}$ 2. ESD data available upon request.
3. For more information, refer to application note, AND8080/D.

$$P_D = \frac{T_{J(max)} - T_{A}}{R_{\theta JA}}$$

NCS2200 ELECTRICAL CHARACTERISTICS (For all values  $V_{CC} = 0.85 \text{ V}$  to 6.0 V,  $V_{EE} = 0 \text{ V}$ ,  $T_A = 25^{\circ}C$ , unless otherwise noted.) (Note 4)

| Symbol            | Parameter                                | Conditions  | Min  | Тур                                | Max  | Unit |
|-------------------|--|---|--|------------------------------------|--|------|
| $V_{HYS}$         | Input Hysteresis                         | T <sub>A</sub> = 25°C   | 2.0  | 8.0                                | 20   | mV   |
| V <sub>IO</sub>   | Input Offset Voltage                     | $V_{CC} = 0.85 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = T_{Low} \text{ to } T_{High} \text{ (Note 5)}$  | -10<br>-12                                       | 0.5                                | +10<br>+12                                       | mV   |
|                   |  | $V_{CC} = 3.0 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = T_{Low} \text{ to } T_{High}$  | -6.0<br>-8.0                                     | 0.5<br>-                           | +6.0<br>+8.0                                     |      |
|                   |  | $V_{CC} = 6.0 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = T_{Low} \text{ to } T_{High}$  | -5.0<br>-7.0                                     | 0.5<br>-                           | +5.0<br>+7.0                                     |      |
| $V_{CM}$          | Common Mode Voltage Range                |   | -  | V <sub>EE</sub> to V <sub>CC</sub> | -  | V    |
| I <sub>LEAK</sub> | Output Leakage Current                   | V <sub>CC</sub> = 6.0 V   | -  | 3.3                                | -  | nA   |
| I <sub>SC</sub>   | Output Short–Circuit Sourcing or Sinking | V <sub>out</sub> = GND  | -  | 70                                 | _  | mA   |
| CMRR              | Common Mode Rejection Ratio              | $V_{CM} = V_{CC}$   | 53   | 65                                 | -  | dB   |
| $I_{IB}$          | Input Bias Current                       |   | -  | 1.0                                | -  | рА   |
| PSRR              | Power Supply Rejection Ratio             | $\Delta V_{S} = 2.575 \text{ V}$  | 45   | 55                                 | -  | dB   |
| I <sub>CC</sub>   | Supply Current                           | $V_{CC} = 0.85 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = T_{Low} \text{ to } T_{High} \text{ (Note 5)}$  | -  | 10<br>-                            | 15<br>17   | μА   |
|                   |  | $V_{CC} = 3.0 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = T_{Low} \text{ to } T_{High}$  | -  | 10<br>-                            | 15<br>17   |      |
|                   |  | $V_{CC} = 6.0 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = T_{Low} \text{ to } T_{High}$  | -  | 10<br>-                            | 15<br>17   |      |
| V <sub>OH</sub>   | Output Voltage High                      | $V_{CC} = 0.85 \text{ V, } I_{source} = 0.5 \text{ mA}$ $T_A = 25^{\circ}\text{C}$ $T_A = T_{Low} \text{ to } T_{High} \text{ (Note 5)}$  | V <sub>CC</sub> - 0.2<br>V <sub>CC</sub> - 0.225 | V <sub>CC</sub> - 0.10             | -  | V    |
|                   |  | $\begin{aligned} V_{CC} &= 3.0 \text{ V, I}_{source} = 3.0 \text{ mA} \\ T_{A} &= 25^{\circ}\text{C} \\ T_{A} &= T_{Low} \text{ to } T_{High} \end{aligned}$                          | V <sub>CC</sub> - 0.2<br>V <sub>CC</sub> - 0.25  | V <sub>CC</sub> - 0.12             | -  |      |
|                   |  | $V_{CC}$ = 6.0 V, $I_{source}$ = 5.0 mA<br>$T_A$ = 25°C<br>$T_A$ = $T_{Low}$ to $T_{High}$  | V <sub>CC</sub> - 0.2<br>V <sub>CC</sub> - 0.25  | V <sub>CC</sub> - 0.12             | _  |      |
| V <sub>OL</sub>   | Output Voltage Low                       | $\begin{aligned} V_{CC} &= 0.85 \text{ V, } I_{sink} = 0.5 \text{ mA} \\ T_{A} &= 25^{\circ}\text{C} \\ T_{A} &= T_{Low} \text{ to } T_{High} \text{ (Note 5)} \end{aligned}$         | -  | V <sub>EE</sub> + 0.10             | V <sub>EE</sub> + 0.2<br>V <sub>EE</sub> + 0.225 | V    |
|                   |  | $\begin{aligned} \text{V}_{CC} &= 3.0 \text{ V, I}_{Sink} = 3.0 \text{ mA} \\ \text{T}_{A} &= 25^{\circ}\text{C} \\ \text{T}_{A} &= \text{T}_{Low} \text{ to T}_{High} \end{aligned}$ | -  | V <sub>EE</sub> + 0.12<br>-        | V <sub>EE</sub> + 0.2<br>V <sub>EE</sub> + 0.25  |      |
|                   |  | $\begin{aligned} V_{CC} &= 6.0 \text{ V, } I_{sink} = 5.0 \text{ mA} \\ T_{A} &= 25^{\circ}\text{C} \\ T_{A} &= T_{Low} \text{ to } T_{High} \end{aligned}$                           | _  | V <sub>EE</sub> + 0.12<br>–        | V <sub>EE</sub> + 0.2<br>V <sub>EE</sub> + 0.25  |      |
| t <sub>PHL</sub>  | Propagation Delay, High-to-Low           | 20 mV Overdrive, C <sub>L</sub> = 15 pF   | -  | 1080                               | -  | ns   |
| t <sub>PLH</sub>  | Propagation Delay, Low-to-High           | 20 mV Overdrive, C <sub>L</sub> = 15 pF   | -  | 900                                | -  | ns   |
| t <sub>FALL</sub> | Output Fall Time                         | $V_{CC} = 6.0 \text{ V}, C_L = 50 \text{ pF}$   | -  | 13                                 | -  | ns   |
| t <sub>RISE</sub> | Output Rise Time                         | $V_{CC} = 6.0 \text{ V}, C_L = 50 \text{ pF}$   | -  | 8.0                                | -  | ns   |
| $t_{PU}$          | Powerup Time                             |   | -  | 35                                 | -  | μS   |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. The limits over the extended temperature range are guaranteed by design only.

5. NCS2200: T<sub>Low</sub> = -40°C, T<sub>High</sub> = +105°C; NCV2200: T<sub>Low</sub> = -40°C, T<sub>High</sub> = +125°C

NCS2202 ELECTRICAL CHARACTERISTICS (For all values  $V_{CC}$  = 0.85 V to 6.0 V,  $V_{EE}$  = 0 V,  $T_A$  = 25°C,  $R_{pullup}$  = 10 k $\Omega$ , unless otherwise noted.) (Note 6)

| Symbol            | Parameter                                | Conditions  | Min          | Тур                                | Max  | Unit |
|-------------------|--|---|--------------|------------------------------------|--|------|
| V <sub>HYS</sub>  | Input Hysteresis                         | T <sub>A</sub> = 25°C   | 2.0          | 8.0                                | 20   | mV   |
| V <sub>IO</sub>   | Input Offset Voltage                     | $V_{CC} = 0.85 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = T_{Low} \text{ to } T_{High} \text{ (Note 7)}$  | -10<br>-12   | 0.5<br>-                           | +10<br>+12                                       | mV   |
|                   |  | $V_{CC} = 3.0 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = T_{Low} \text{ to } T_{High}$  | -6.0<br>-8.0 | 0.5<br>-                           | +6.0<br>+8.0                                     |      |
|                   |  | $V_{CC} = 6.0 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = T_{Low} \text{ to } T_{High}$  | -5.0<br>-7.0 | 0.5<br>-                           | +5.0<br>+7.0                                     |      |
| $V_{CM}$          | Common Mode Voltage Range                |   | _            | V <sub>EE</sub> to V <sub>CC</sub> | -  | V    |
| I <sub>LEAK</sub> | Output Leakage Current                   | $V_{CC} = 6.0 \text{ V}$  | -            | 3.3                                | -  | nA   |
| I <sub>SC</sub>   | Output Short–Circuit Sourcing or Sinking | V <sub>out</sub> = GND  | _            | 70                                 | _  | mA   |
| CMRR              | Common Mode Rejection Ratio              | V <sub>CM</sub> = V <sub>CC</sub>   | 53           | 65                                 | -  | dB   |
| I <sub>IB</sub>   | Input Bias Current                       |   | -            | 1.0                                | -  | рА   |
| PSRR              | Power Supply Rejection Ratio             | $\Delta V_{S} = 2.575 \text{ V}$  | 45           | 55                                 | -  | dB   |
| lcc               | Supply Current                           | $V_{CC} = 0.85 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = T_{Low} \text{ to } T_{High} \text{ (Note 7)}$  | -            | 10<br>-                            | 15<br>17   | μΑ   |
|                   |  | $V_{CC} = 3.0 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = T_{Low} \text{ to } T_{High}$  | -            | 10<br>-                            | 15<br>17   |      |
|                   |  | $V_{CC} = 6.0 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = T_{Low} \text{ to } T_{High}$  | -            | 10<br>-                            | 15<br>17   |      |
| V <sub>OL</sub>   | Output Voltage Low                       | $V_{CC} = 0.85 \text{ V}, I_{Sink} = 0.5 \text{ mA}$ $T_A = 25^{\circ}\text{C}$ $T_A = T_{Low} \text{ to } T_{High} \text{ (Note 7)}$                       | -            | V <sub>EE</sub> + 0.10             | V <sub>EE</sub> + 0.2<br>V <sub>EE</sub> + 0.225 | V    |
|                   |  | $V_{CC}$ = 3.0 V, $I_{Sink}$ = 3.0 mA<br>$T_A$ = 25°C<br>$T_A$ = $T_{Low}$ to $T_{High}$  | -            | V <sub>EE</sub> + 0.12             | V <sub>EE</sub> + 0.2<br>V <sub>EE</sub> + 0.25  |      |
|                   |  | $\begin{aligned} V_{CC} &= 6.0 \text{ V, } I_{Sink} = 5.0 \text{ mA} \\ T_{A} &= 25^{\circ}\text{C} \\ T_{A} &= T_{Low} \text{ to } T_{High} \end{aligned}$ | -            | V <sub>EE</sub> + 0.12             | V <sub>EE</sub> + 0.2<br>V <sub>EE</sub> + 0.25  |      |
| t <sub>PHL</sub>  | Propagation Delay, High-to-Low           | 20 mV Overdrive, C <sub>L</sub> = 15 pF   | -            | 1000                               | -  | ns   |
| t <sub>PLH</sub>  | Propagation Delay, Low-to-High           | 20 mV Overdrive, C <sub>L</sub> = 15 pF   | -            | 800                                | -  | ns   |
| t <sub>FALL</sub> | Output Fall Time                         | $V_{CC} = 6.0 \text{ V}, C_L = 50 \text{ pF}$   | -            | 6.0                                | -  | ns   |
| t <sub>RISE</sub> | Output Rise Time                         | $V_{CC} = 6.0 \text{ V}, C_L = 50 \text{ pF}$   | -            | 260                                | -  | ns   |
| t <sub>PU</sub>   | Powerup Time                             |   | -            | 35                                 | -  | μS   |
|                   |  |   |              |                                    |  |      |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance is indicated by the Electrical Characteristics if operated under different conditions.

6. The limits over the extended temperature range are guaranteed by design only.

7. NCS2202: T<sub>Low</sub> = -40°C, T<sub>High</sub> = +105°C; NCV2202: T<sub>Low</sub> = -40°C, T<sub>High</sub> = +125°C

 $\textbf{NCS2200A ELECTRICAL CHARACTERISTICS} \ (\text{For all values V}_{CC} = 0.85 \ \text{V to } 6.0 \ \text{V}, \ V_{EE} = 0 \ \text{V}, \ T_{A} = 25^{\circ}\text{C}, \ unless otherwise}$ noted.) (Note 8)

| Symbol            | Parameter                                   | Conditions  | Min   | Тур                                | Max   | Unit |
|-------------------|---|---|---|------------------------------------|---|------|
| V <sub>HYS</sub>  | Input Hysteresis                            | T <sub>A</sub> = 25°C   | 2.0   | 4.5                                | 20  | mV   |
| V <sub>IO</sub>   | Input Offset Voltage                        | $V_{CC} = 0.85 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = -40^{\circ}\text{C} \text{ to } 105^{\circ}\text{C}$                              | -10<br>-12  | 0.5<br>-                           | +10<br>+12  | mV   |
|                   |   | $V_{CC} = 3.0 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = -40^{\circ}\text{C}$ to 105°C  | -6.0<br>-8.0                                      | 0.5<br>-                           | +6.0<br>+8.0                                      |      |
|                   |   | $V_{CC} = 6.0 \text{ V}$ $T_{A} = 25^{\circ}\text{C}$ $T_{A} = -40^{\circ}\text{C} \text{ to } 105^{\circ}\text{C}$                           | -5.0<br>-7.0                                      | 0.5<br>-                           | +5.0<br>+7.0                                      |      |
| $V_{CM}$          | Common Mode Voltage Range                   |   | _   | V <sub>EE</sub> to V <sub>CC</sub> | _   | V    |
| I <sub>SC</sub>   | Output Short–Circuit Sourcing or<br>Sinking | V <sub>out</sub> = GND  | -   | 60                                 | -   | mA   |
| CMRR              | Common Mode Rejection Ratio                 | $V_{CM} = V_{CC}$   | 53  | 70                                 | -   | dB   |
| I <sub>IB</sub>   | Input Bias Current                          |   | -   | 1.0                                | -   | рA   |
| PSRR              | Power Supply Rejection Ratio                | $\Delta V_{S} = 2.575 \text{ V}$  | 45  | 80                                 | -   | dB   |
| Icc               | Supply Current                              | $V_{CC} = 0.85 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = -40^{\circ}\text{C} \text{ to } 105^{\circ}\text{C}$                              | -   | 7.5<br>-                           | 15<br>17  | μΑ   |
|                   |   | $V_{CC} = 3.0 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = -40^{\circ}\text{C} \text{ to } 105^{\circ}\text{C}$                               | -   | 8.0<br>-                           | 15<br>17  |      |
|                   |   | $V_{CC} = 6.0 \text{ V}$ $T_A = 25^{\circ}\text{C}$ $T_A = -40^{\circ}\text{C} \text{ to } 105^{\circ}\text{C}$                               | -   | 9.0<br>-                           | 15<br>17  |      |
| V <sub>OH</sub>   | Output Voltage High                         | $V_{CC} = 0.85 \text{ V}, I_{source} = 0.5 \text{ mA}$ $T_A = 25^{\circ}\text{C}$ $T_A = -40^{\circ}\text{C} \text{ to } 105^{\circ}\text{C}$ | V <sub>CC</sub> - 0.25<br>V <sub>CC</sub> - 0.275 | V <sub>CC</sub> - 0.10             | -   | V    |
|                   |   | $V_{CC} = 3.0 \text{ V}, I_{source} = 3.0 \text{ mA}$ $T_A = 25^{\circ}\text{C}$ $T_A = -40^{\circ}\text{C} \text{ to } 105^{\circ}\text{C}$  | V <sub>CC</sub> - 0.3<br>V <sub>CC</sub> - 0.35   | V <sub>CC</sub> - 0.12             | -   |      |
|                   |   | $V_{CC} = 6.0 \text{ V}, I_{source} = 5.0 \text{ mA}$ $T_A = 25^{\circ}\text{C}$ $T_A = -40^{\circ}\text{C} \text{ to } 105^{\circ}\text{C}$  | V <sub>CC</sub> - 0.3<br>V <sub>CC</sub> - 0.35   | V <sub>CC</sub> - 0.12             | -   |      |
| V <sub>OL</sub>   | Output Voltage Low                          | $V_{CC} = 0.85 \text{ V, } I_{sink} = 0.5 \text{ mA}$ $T_A = 25^{\circ}\text{C}$ $T_A = -40^{\circ}\text{C to } 105^{\circ}\text{C}$          | -   | V <sub>EE</sub> + 0.10             | V <sub>EE</sub> + 0.25<br>V <sub>EE</sub> + 0.275 | V    |
|                   |   | $V_{CC} = 3.0 \text{ V}, I_{sink} = 3.0 \text{ mA}$ $T_A = 25^{\circ}\text{C}$ $T_A = -40^{\circ}\text{C} \text{ to } 105^{\circ}\text{C}$    | -   | V <sub>EE</sub> + 0.12             | V <sub>EE</sub> + 0.3<br>V <sub>EE</sub> + 0.35   |      |
|                   |   | $V_{CC} = 6.0 \text{ V}, I_{sink} = 5.0 \text{ mA}$ $T_A = 25^{\circ}\text{C}$ $T_A = -40^{\circ}\text{C} \text{ to } 105^{\circ}\text{C}$    | -   | V <sub>EE</sub> + 0.12             | V <sub>EE</sub> + 0.3<br>V <sub>EE</sub> + 0.35   |      |
| t <sub>PHL</sub>  | Propagation Delay, High-to-Low              | 20 mV Overdrive, C <sub>L</sub> = 15 pF,  | -   | 625                                | -   | ns   |
| t <sub>PLH</sub>  | Propagation Delay, Low-to-High              | V <sub>CC</sub> = 2.85 V  | _   | 750                                | -   | ns   |
| t <sub>FALL</sub> | Output Fall Time                            | $V_{CC} = 6.0 \text{ V}, C_L = 50 \text{ pF (Note 9)}$  | _   | 22                                 | -   | ns   |
| t <sub>RISE</sub> | Output Rise Time                            | $V_{CC} = 6.0 \text{ V}, C_L = 50 \text{ pF (Note 9)}$  | _   | 20                                 | -   | ns   |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

8. The limits over the extended temperature range are guaranteed by design only.

<sup>9.</sup> Input signal: 1 kHz, squarewave signal with 10 ns edge rate.

 $\textbf{NCS2202A ELECTRICAL CHARACTERISTICS} \ (\text{For all values V}_{CC} = 0.85 \ \text{V to } 6.0 \ \text{V}, \ V_{EE} = 0 \ \text{V}, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 25 ^{\circ}\text{C}, \ R_{pullup} = 10 \ \text{k}\Omega, \ T_{A} = 10$ unless otherwise noted.) (Note 10)

| Symbol            | Parameter                                   | Conditions  | Min        | Тур                                | Max                    | Unit |
|-------------------|---|---|------------|------------------------------------|------------------------|------|
| $V_{HYS}$         | Input Hysteresis                            | T <sub>A</sub> = 25°C   | 2.0        | 4.5                                | 20                     | mV   |
| V <sub>IO</sub>   | Input Offset Voltage                        | V <sub>CC</sub> = 0.85 V<br>T <sub>A</sub> = 25°C                                   | -10        | 0.3                                | +10                    | mV   |
|                   |   | $T_A = 23 \text{ C}$<br>$T_A = -40^{\circ}\text{C} \text{ to } 105^{\circ}\text{C}$ | -10<br>-12 | 0.5                                | +10                    |      |
|                   |   | V <sub>CC</sub> = 3.0 V   |            |                                    |                        | 1    |
|                   |   | T <sub>A</sub> = 25°C   | -6.0       | 0.4                                | +6.0                   |      |
|                   |   | $T_A = -40$ °C to $105$ °C  | -8.0       | -                                  | +8.0                   |      |
|                   |   | V <sub>CC</sub> = 6.0 V   |            |                                    |                        |      |
|                   |   | $T_A = 25^{\circ}C$   | -5.0       | 0.4                                | +5.0                   |      |
|                   |   | $T_A = -40^{\circ}C \text{ to } 105^{\circ}C$                                       | -7.0       | _                                  | +7.0                   |      |
| V <sub>CM</sub>   | Common Mode Voltage Range                   |   | -          | V <sub>EE</sub> to V <sub>CC</sub> | -                      | V    |
| I <sub>SC</sub>   | Output Short–Circuit Sourcing or<br>Sinking | V <sub>out</sub> = GND  | _          | 60                                 | -                      | mA   |
| CMRR              | Common Mode Rejection Ratio                 | $V_{CM} = V_{CC}$   | 53         | 80                                 | -                      | dB   |
| I <sub>IB</sub>   | Input Bias Current                          |   | -          | 1.0                                | -                      | pА   |
| PSRR              | Power Supply Rejection Ratio                | $\Delta V_{S} = 2.575 \text{ V}$  | 45         | 80                                 | -                      | dB   |
| Icc               | Supply Current                              | V <sub>CC</sub> = 0.85 V  |            |                                    |                        | μΑ   |
|                   |   | T <sub>A</sub> = 25°C   | _          | 7.5                                | 15                     |      |
|                   |   | $T_A = -40^{\circ}\text{C} \text{ to } 105^{\circ}\text{C}$                         |            | _                                  | 17                     | _    |
|                   |   | V <sub>CC</sub> = 3.0 V   |            | 0.0                                | 4.5                    |      |
|                   |   | $T_A = 25^{\circ}C$<br>$T_A = -40^{\circ}C$ to 105°C                                | _          | 8.0                                | 15<br>17               |      |
|                   |   | V <sub>CC</sub> = 6.0 V   |            | _                                  | 17                     | 4    |
|                   |   | $V_{CC} = 6.0 \text{ V}$ $T_{A} = 25^{\circ}\text{C}$                               | _          | 9.0                                | 15                     |      |
|                   |   | $T_A = -40^{\circ}\text{C} \text{ to } 105^{\circ}\text{C}$                         |            | -                                  | 17                     |      |
| V <sub>OL</sub>   | Output Voltage Low                          | V <sub>CC</sub> = 0.85 V, I <sub>sink</sub> = 0.5 mA                                |            |                                    |                        | V    |
| 02                |   | $T_A = 25^{\circ}C$   | -          | $V_{EE} + 0.14$                    | $V_{EE} + 0.25$        |      |
|                   |   | $T_A = -40^{\circ}C$ to $105^{\circ}C$  |            | -                                  | $V_{EE} + 0.275$       |      |
|                   |   | $V_{CC} = 3.0 \text{ V}, I_{sink} = 3.0 \text{ mA}$                                 |            |                                    |                        |      |
|                   |   | $T_A = 25^{\circ}C$   | _          | V <sub>EE</sub> + 0.18             | V <sub>EE</sub> + 0.3  |      |
|                   |   | $T_A = -40^{\circ}\text{C to } 105^{\circ}\text{C}$                                 |            |                                    | V <sub>EE</sub> + 0.35 | _    |
|                   |   | $V_{CC} = 6.0 \text{ V}, I_{sink} = 5.0 \text{ mA}$<br>$T_{A} = 25^{\circ}\text{C}$ | _          | V <sub>EE</sub> + 0.20             | V <sub>EE</sub> + 0.3  |      |
|                   |   | $T_A = -40^{\circ}\text{C} \text{ to } 105^{\circ}\text{C}$                         |            | -                                  | V <sub>EE</sub> + 0.35 |      |
| t <sub>PHL</sub>  | Propagation Delay - High to Low             | 20 mV Overdrive, C <sub>L</sub> = 15 pF,  | _          | 580                                | _                      | ns   |
|                   | , ,   | V <sub>CC</sub> = 2.85 V  |            |                                    |                        |      |
|                   |   | 50 mV Overdrive, C <sub>L</sub> = 15 pF,  | _          | 350                                | -                      |      |
|                   |   | V <sub>CC</sub> = 2.85 V  |            |                                    |                        |      |
|                   |   | 100 mV Overdrive, C <sub>L</sub> = 15 pF,   | -          | 220                                | -                      |      |
|                   |   | V <sub>CC</sub> = 2.85 V  |            |                                    |                        |      |
| t <sub>PLH</sub>  | Propagation Delay – Low to High             | 20 mV Overdrive, $C_L = 15 pF$ , $V_{CC} = 2.85 V$                                  | _          | 550                                | -                      | ns   |
|                   |   | 50 mV Overdrive, C <sub>L</sub> = 15 pF,  | -          | 400                                | -                      | 1    |
|                   |   | V <sub>CC</sub> = 2.85 V  |            | 1                                  |                        |      |
|                   |   | 100 mV Overdrive, C <sub>L</sub> = 15 pF,<br>V <sub>CC</sub> = 2.85 V               | -          | 340                                | -                      | 1    |
| t <sub>FALL</sub> | Output Fall Time                            | $V_{CC} = 6.0 \text{ V}, C_L = 50 \text{ pF (Note)}$                                | _          | 5.0                                | _                      | ns   |
| TALL              |   | 11)   |            | ]                                  |                        |      |
| t <sub>RISE</sub> | Output Rise Time                            | V <sub>CC</sub> = 6.0 V, C <sub>L</sub> = 50 pF (Note                               | _          | 235                                | _                      | ns   |
| 5_                | •   | 11)   |            |                                    | l                      |      |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

10. The limits over the extended temperature range are guaranteed by design only.

<sup>11.</sup> Input signal: 1 kHz, squarewave signal with 10 ns edge rate.

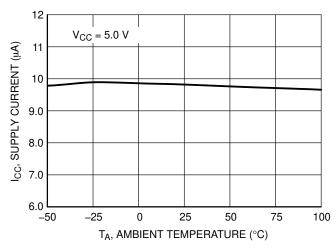


Figure 1. NCS2200 Series Supply Current versus Temperature

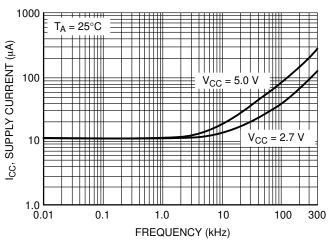


Figure 2. NCS2200 Series Supply Current versus Output Transition Frequency

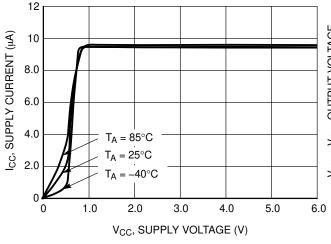


Figure 3. NCS2200 Series Supply Current versus Supply Voltage

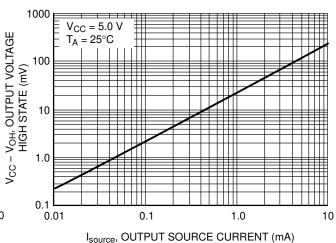


Figure 4. NCS2200 Output Voltage High State versus Output Source Current

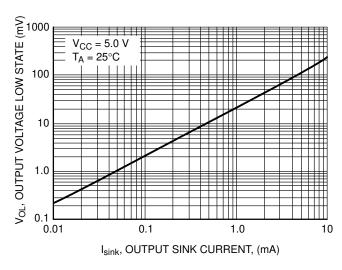


Figure 5. NCS2200 Series Output Voltage Low State versus Output Sink Current

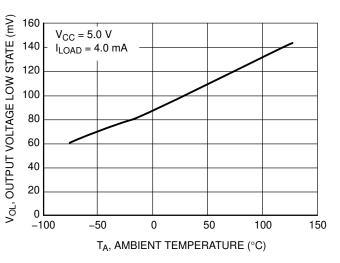


Figure 6. NCS2200 Series Output Voltage Low State versus Temperature

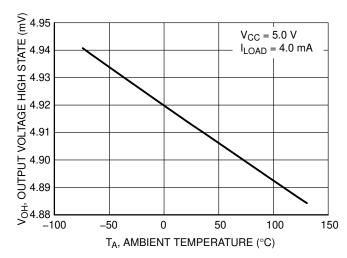


Figure 7. NCS2200 Series Output Voltage High State versus Temperature

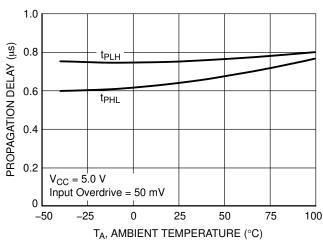


Figure 8. NCS2200 Series Propagation Delay versus Temperature

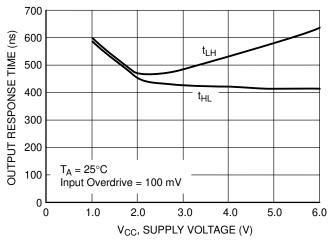


Figure 9. NCS2200 Series Output Response Time versus Supply Voltage

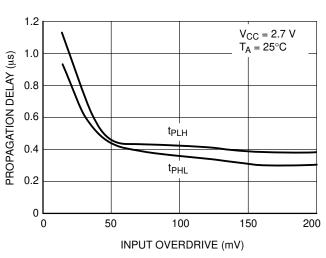


Figure 10. NCS2200 Series Propagation Delay versus Input Overdrive

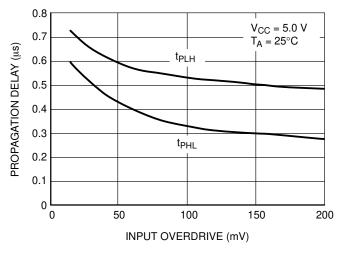


Figure 11. NCS2200 Series Propagation Delay versus Input Overdrive

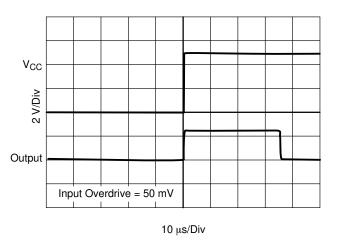
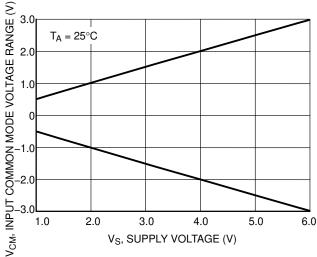


Figure 12. NCS2200 Series Powerup Delay

180

160



I<sub>LEAK</sub>, OUTPUT LEAKAGE CURRENT (nA) 140 120 100  $T_A = 85^{\circ}C$ 80 60 40  $T_A = 25^{\circ}C$ 20  $T_A = -40^{\circ}C$ 0 0 1.0 3.0 4.0 5.0 7.0 8.0 2.0 6.0 V<sub>OUT</sub>, OUTPUT VOLTAGE (V)

Figure 13. NCS2200 Series Input Common Mode Voltage Range versus Supply Voltage

Figure 14. NCS2202 Output Leakage Current versus Output Voltage

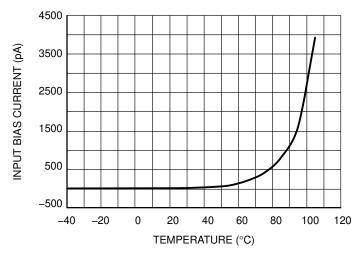


Figure 15. Input Bias Current versus **Temperature** 

### **OPERATING DESCRIPTION**

The NCS2200 Series is an industry first sub—one volt, low power comparator family. This series is designed for rail—to—rail input and output performance. These devices consume only 10 μA of supply current while achieving a typical propagation delay of 1.1 μs at a 20 mV input overdrive. Figures 10 and 11 show propagation delay with various input overdrives. This comparator family is guaranteed to operate at a low voltage of 0.85 V up to 6.0 V. This is accomplished by the use of a modified analog CMOS process that implements depletion MOSFET devices. The common—mode input voltage range extends 0.1 V beyond the upper and lower rail without phase inversion or other adverse effects. This series is available in the SOT–23–5

package. Additionally, the NCS2200 device is available in the tiny DFN 2x2.2 package and the SC70–5 package. NCS2200A is available in UDFN package.

#### **Output Stage**

The NCS2200 has a complementary P and N Channel output stage that has capability of driving a rail-to-rail output swing with a load ranging up to 5.0 mA. It is designed such that shoot-through current is minimized while switching. This feature eliminates the need for bypass capacitors under most circumstances.

The NCS2202 has an open drain N-channel output stage that can be pulled up to 6.0 V (max) with an external resistor. This facilitates mixed voltage system applications.

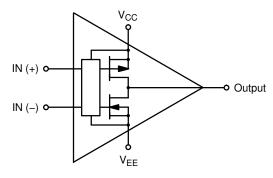


Figure 16. NCS2200/NCS2200A Complementary Output Configuration

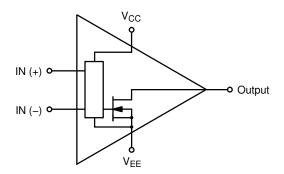
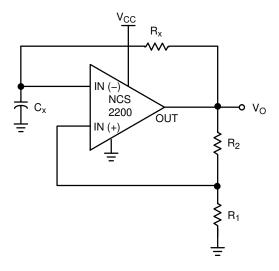


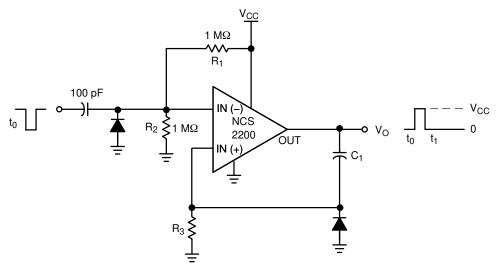
Figure 17. NCS2202/NCS2202A Open Drain Output Configuration



The oscillation frequency can be programmed as follows:

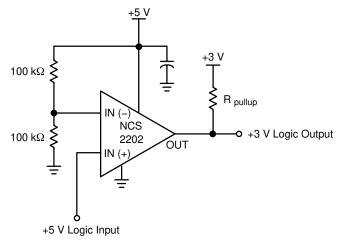
$$f = \frac{1}{T} = \frac{1}{2.2 \; R_X C_X}$$

Figure 18. Schmitt Trigger Oscillator



The resistor divider  $R_1$  and  $R_2$  can be used to set the magnitude of the input pulse. The pulse width is set by adjusting  $C_1$  and  $R_3$ .

Figure 19. One-Shot Multivibrator



This circuit converts 5 V logic to 3 V logic. Using the NCS2202/A allows for full 5 V logic swing without creating overvoltage on the 3 V logic input.

Figure 20. Logic Level Translator

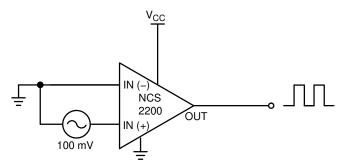


Figure 21. Zero-Crossing Detector

#### **ORDERING INFORMATION**

| Device         | Pinout Style | Output Type   | Package                        | Shipping <sup>†</sup> |
|----------------|--------------|---------------|--------------------------------|-----------------------|
| NCS2200AMUT1G  | N/A          | Complementary | UDFN<br>(Pb-Free)              | 3000 / Tape & Reel    |
| NCS2200SN1T1G  | 1            | Complementary | SOT-23-5 (TSOP-5)<br>(Pb-Free) | 3000 / Tape & Reel    |
| NCV2200SN1T1G* | 1            | Complementary | SOT-23-5 (TSOP-5)<br>(Pb-Free) | 3000 / Tape & Reel    |
| NCS2200SN2T1G  | 2            | Complementary | SOT-23-5 (TSOP-5)<br>(Pb-Free) | 3000 / Tape & Reel    |
| NCV2200SN2T1G* | 2            | Complementary | SOT-23-5 (TSOP-5)<br>(Pb-Free) | 3000 / Tape & Reel    |
| NCS2200SQ2T2G  | 2            | Complementary | SC70-5<br>(Pb-Free)            | 3000 / Tape & Reel    |
| NCV2200SQ2T2G* | 2            | Complementary | SC70-5<br>(Pb-Free)            | 3000 / Tape & Reel    |
| NCS2200SQLT1G  | N/A          | Complementary | DFN, 2x2.2<br>(Pb-Free)        | 3000 / Tape & Reel    |
| NCS2202SN1T1G  | 1            | Open Drain    | SOT-23-5 (TSOP-5)<br>(Pb-Free) | 3000 / Tape & Reel    |
| NCS2202SN2T1G  | 2            | Open Drain    | SOT-23-5 (TSOP-5)<br>(Pb-Free) | 3000 / Tape & Reel    |
| NCV2202SN2T1G* | 2            | Open Drain    | SOT-23-5 (TSOP-5)<br>(Pb-Free) | 3000 / Tape & Reel    |
| NCS2202SQ1T2G  | 1            | Open Drain    | SC70-5<br>(Pb-Free)            | 3000 / Tape & Reel    |
| NCS2202SQ2T2G  | 2            | Open Drain    | SC70-5<br>(Pb-Free)            | 3000 / Tape & Reel    |
| NCS2202AMUTBG  | N/A          | Open Drain    | UDFN<br>(Pb-Free)              | 3000 / Tape & Reel    |

This device contains 93 active transistors.

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

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

#### **MARKING DIAGRAMS**

SOT-23-5 (TSOP-5) SN SUFFIX CASE 483



x = I for NCS2200SN1T1 J for NCS2200SN2T1 M for NCS2202SN1T1 N for NCS2202SN2T1

A = Assembly Location

Y = Year W = Work Week ■ = Pb-Free Package

- -- --- ---

(Note: Microdot may be in either location)

DFN6 2x2.2 SQL SUFFIX CASE 488



CB = Specific Device Code

M = Date Code\*

= Pb–Free Package

(Note: Microdot may be in either location)

\*Date Code overbar and underbar may vary depending upon manufacturing location.

SC70-5 SQ SUFFIX CASE 419A



CBx = Specific Device Code x = A for NCS2200SQ2T2 D for NCS2202SQ1T2G E for NCS2202SQ2T2G

M = Date Code\* ■ Pb-Free Package

(Note: Microdot may be in either location)
\*Date Code orientation, position, and underbar
may vary depending upon manufacturing location.

UDFN6 1.2x1.0 MU SUFFIX CASE 517AA



(Top View)

x S for Specific Device Code

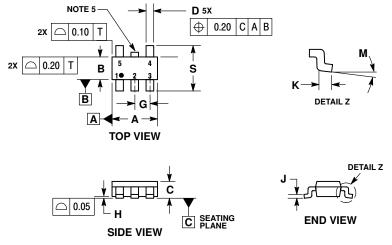
V for NCS2202A (V with 180° Rotation)

M = Date Code

■ = Pb–Free Package

#### **PACKAGE DIMENSIONS**

SOT-23-5 / TSOP-5 / SC59-5 **SN SUFFIX** CASE 483-02 ISSUE K

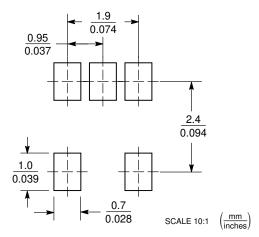


- NOTES:
  1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.

- CONTROLLING DIMENSION: MILLIMETERS.
  MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS, MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
  DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS, MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE. DIMENSION A.
  OPTIONAL CONSTRUCTION: AN ADDITIONAL TRIMMED LEAD IS ALLOWED IN THIS LOCATION. TRIMMED LEAD NOT TO EXTEND MORE THAN 0.2 FROM BODY.

|     | MILLIMETERS |      |  |  |
|-----|-------------|------|--|--|
| DIM | MIN         | MAX  |  |  |
| Α   | 3.00        | BSC  |  |  |
| В   | 1.50        | BSC  |  |  |
| C   | 0.90        | 1.10 |  |  |
| D   | 0.25 0.50   |      |  |  |
| G   | 0.95        | BSC  |  |  |
| Н   | 0.01        | 0.10 |  |  |
| J   | 0.10        | 0.26 |  |  |
| K   | 0.20        | 0.60 |  |  |
| М   | 0° 10°      |      |  |  |
| S   | 2.50        | 3.00 |  |  |

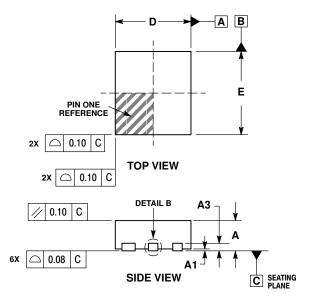
#### **SOLDERING FOOTPRINT\***

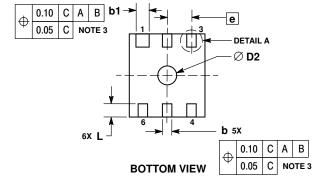


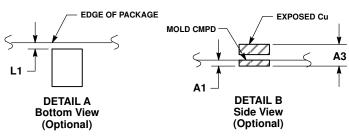
<sup>\*</sup>For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

#### **PACKAGE DIMENSIONS**

DFN6, 2x2.2 **SQL SUFFIX** CASE 488-03 ISSUE G



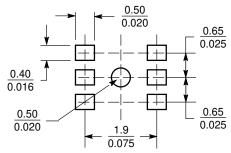




- NOTES:
  1. DIMENSIONING AND TOLERANCING PER
- ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
- DIMENSION & APPLIES TO PLATED
  TERMINAL AND IS MEASURED BETWEEN
- 1EHMINAL AND IS MEASURED BE I WEEN
  0.25 AND 0.30mm FROM TERMINAL
  COPLANARITY APPLIES TO THE EXPOSED
  PAD AS WELL AS THE TERMINALS.
  TERMINAL b MAY HAVE MOLD COMPOUND
  MATERIAL ALONG SIDE EDGE.
- DETAILS A AND B SHOW OPTIONAL VIEWS FOR END OF TERMINAL LEAD AT EDGE OF PACKAGE AND SIDE EDGE OF PACKAGE.

|     | MILLIMETERS |             |      |  |  |  |  |
|-----|-------------|-------------|------|--|--|--|--|
| DIM | MIN         | MIN NOM MAX |      |  |  |  |  |
| Α   | 0.80        | 0.90        | 1.00 |  |  |  |  |
| A1  | 0.00        | 0.03        | 0.05 |  |  |  |  |
| A3  |             | 0.20 REF    |      |  |  |  |  |
| b   | 0.20        | 0.30        |      |  |  |  |  |
| b1  | 0.30        | 0.35        | 0.40 |  |  |  |  |
| D   |             | 2.00 BSC    |      |  |  |  |  |
| D2  | 0.40        | 0.50        | 0.60 |  |  |  |  |
| E   | 2.20 BSC    |             |      |  |  |  |  |
| е   | 0.65 BSC    |             |      |  |  |  |  |
| L   | 0.30        | 0.35        | 0.40 |  |  |  |  |
| L1  | 0.00        | 0.05        | 0.10 |  |  |  |  |

#### **SOLDERING FOOTPRINT\***

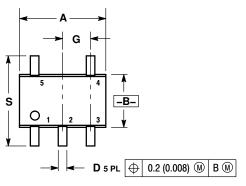


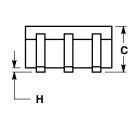
SCALE 10:1

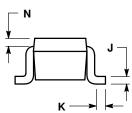
\*For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# **PACKAGE DIMENSIONS**

#### SC-88A (SC-70-5/SOT-353) SQ SUFFIX CASE 419A-02 **ISSUE L**



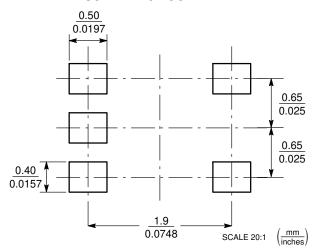




- NOTES:
  1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. 419A-01 OBSOLETE. NEW STANDARD 419A-02.
- DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE

|     | INCHES    |       | MILLIN   | IETERS |
|-----|-----------|-------|----------|--------|
| DIM | MIN       | MAX   | MIN      | MAX    |
| Α   | 0.071     | 0.087 | 1.80     | 2.20   |
| В   | 0.045     | 0.053 | 1.15     | 1.35   |
| С   | 0.031     | 0.043 | 0.80     | 1.10   |
| D   | 0.004     | 0.012 | 0.10     | 0.30   |
| G   | 0.026 BSC |       | 0.65     | BSC    |
| Н   |           | 0.004 |          | 0.10   |
| J   | 0.004     | 0.010 | 0.10     | 0.25   |
| K   | 0.004     | 0.012 | 0.10     | 0.30   |
| N   | 0.008     | REF   | 0.20 REF |        |
| S   | 0.079     | 0.087 | 2.00     | 2.20   |

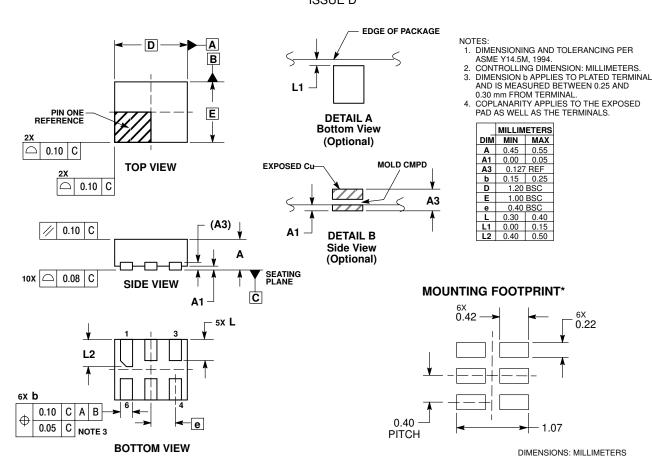
#### **SOLDERING FOOTPRINT\***



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

#### PACKAGE DIMENSIONS

#### UDFN6, 1.2x1.0, 0.4P CASE 517AA ISSUE D



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