

SNx4HC164 8-Bit Parallel-Out Serial Shift Registers

1 Features

- Wide Operating Voltage Range of 2 V to 6 V
- Outputs Can Drive Up to 10 LSTTL Loads
- Low Power Consumption, 80- μ A Maximum I_{CC}
- Typical $t_{pd} = 20$ ns
- ± 4 -mA Output Drive at 5 V
- Low Input Current of 1- μ A Maximum
- AND-Gated (Enable/Disable) Serial Inputs
- Fully Buffered Clock and Serial Inputs
- Direct Clear
- On Products Compliant to MIL-PRF-38535, All Parameters Are Tested Unless Otherwise Noted. On All Other Products, Production Processing Does Not Necessarily Include Testing of All Parameters.

2 Applications

- Programmable Logic Controllers
- Appliances
- Video Display Systems
- Output Expander

3 Description

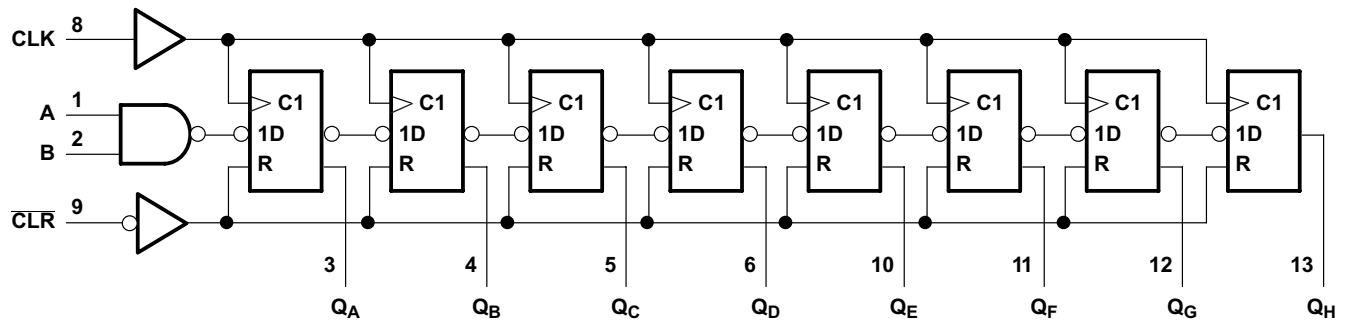
These 8-bit shift registers feature AND-gated serial inputs and an asynchronous clear (CLR) input. The gated serial (A and B) inputs permit complete control over incoming data; a low at either input inhibits entry of the new data and resets the first flip-flop to the low level at the next clock (CLK) pulse. A high-level input enables the other input, which then determines the state of the first flip-flop. Data at the serial inputs can be changed while CLK is high or low, provided the minimum set-up time requirements are met. Clocking occurs on the low-to-high-level transition of CLK.

Device Information⁽¹⁾

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|-------------|------------|---------------------------|
| SN74HC164 | SOIC (14) | 8.65 mm \times 3.91 mm |
| | PDIP (14) | 19.30 mm \times 6.35 mm |
| | SO (14) | 10.30 mm \times 5.30 mm |
| | TSSOP (14) | 5.00 mm \times 4.40 mm |
| SN54HC164 | CDIP (14) | 19.94 mm \times 6.92 mm |
| | CFP (14) | 9.21 mm \times 6.29 mm |
| | LCCC (14) | 9.39 mm \times 9.39 mm |

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Logic Diagram (Positive Logic)



Pin numbers shown are for the D, J, N, NS, PW, and W packages.



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4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from Revision F (October 2013) to Revision G | Page |
|---|-------------|
| • Added <i>Applications</i> section, <i>Device Information</i> table, <i>Pin Configuration and Functions</i> section, <i>ESD Ratings</i> table, <i>Thermal Information</i> table, <i>Typical Characteristics</i> section, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section..... | 1 |
| • Added Military Disclaimer to <i>Features</i> list | 1 |
| • Added Handling Ratings table..... | 6 |

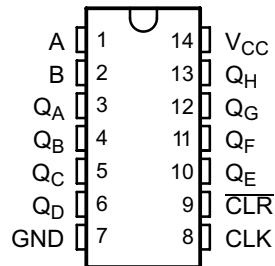
| Changes from Revision E (November 2010) to Revision F | Page |
|--|-------------|
| • Updated document to new TI data sheet format | 1 |
| • Removed Ordering Information table. | 1 |
| • Updated operating temperature range. | 6 |

5 Device Comparison Table

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|-------------|------------|--------------------|
| SN74HC164D | SOIC (14) | 8.65 mm × 3.91 mm |
| SN74HC164N | PDIP (14) | 19.30 mm × 6.35 mm |
| SN74HC164NS | SO (14) | 10.30 mm × 5.30 mm |
| SN74HC164PW | TSSOP (14) | 5.00 mm × 4.40 mm |
| SN54HC164J | CDIP (14) | 19.94 mm × 6.92 mm |
| SN54HC164W | CFP (14) | 9.21 mm × 6.29 mm |
| SN54HC164FK | LCCC (14) | 9.39 mm × 9.39 mm |

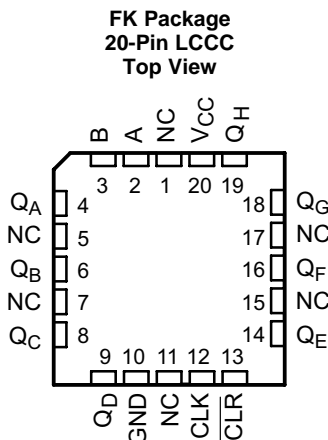
6 Pin Configuration and Functions

D, N, NS, J, W, or PW Package
 14-Pin SOIC, PDIP, SO, CDIP, CFP, or TSSOP
 Top View



Pin Functions

| PIN | | I/O | DESCRIPTION |
|---|-------------------------|-----|----------------------|
| SOIC, PDIP, SO, CDIP, CFP, or TSSOP NO. | NAME | | |
| 1 | A | I | Gated Serial Input 1 |
| 2 | B | I | Gated Serial Input 2 |
| 3 | Q _A | O | Parallel Output |
| 4 | Q _B | O | Parallel Output |
| 5 | Q _C | O | Parallel Output |
| 6 | Q _D | O | Parallel Output |
| 7 | GND | - | Ground |
| 8 | CLK | I | Clock |
| 9 | $\overline{\text{CLR}}$ | I | Clear 1 Active-Low |
| 10 | Q _E | O | Parallel Output |
| 11 | Q _F | O | Parallel Output |
| 12 | Q _G | O | Parallel Output |
| 13 | Q _H | O | Parallel Output |
| 14 | V _{CC} | — | Power |



NC – No internal connection

Pin Functions

| PIN | | I/O | DESCRIPTION |
|----------|-------------------------|-----|----------------------|
| LCCC NO. | NAME | | |
| 1 | NC | — | No Connect |
| 2 | A | I | Gated Serial Input 1 |
| 3 | B | I | Gated Serial Input 2 |
| 4 | Q _A | O | Parallel Output |
| 5 | NC | — | No Connect |
| 6 | Q _B | O | Parallel Output |
| 7 | NC | — | No Connect |
| 8 | Q _C | O | Parallel Output |
| 9 | Q _D | O | Parallel Output |
| 10 | GND | — | Ground |
| 11 | NC | — | No Connect |
| 12 | CLK | I | Clock |
| 13 | $\overline{\text{CLR}}$ | I | Clear 1 Active-Low |
| 14 | Q _E | O | Parallel Output |
| 15 | NC | — | No Connect |
| 16 | Q _F | O | Parallel Output |
| 17 | NC | — | No Connect |
| 18 | Q _G | O | Parallel Output |
| 19 | Q _H | O | Parallel Output |
| 20 | VCC | — | Power |

7 Specifications

7.1 Absolute Maximum Ratings

 over operating free-air temperature range (unless otherwise noted)⁽¹⁾

| | | MIN | MAX | UNITS |
|-----------|--|-----------------------------|-----|--------|
| V_{CC} | Supply voltage | -0.5 | 7 | V |
| I_{IK} | Input clamp current ⁽²⁾ | $V_I < 0$ or $V_I > V_{CC}$ | | ±20 mA |
| I_{OK} | Output clamp current ⁽²⁾ | $V_O < 0$ or $V_O > V_{CC}$ | | ±20 mA |
| I_O | Continuous output current | $V_O = 0$ to V_{CC} | | ±25 mA |
| | Continuous current through V_{CC} or GND | | | ±50 mA |
| T_{stg} | Storage temperature | -65 | 150 | °C |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

7.2 ESD Ratings

| | | VALUE | UNIT |
|-------------|-------------------------|--|-------|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ | ±2000 |
| | | Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾ | ±1000 |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

7.3 Recommended Operating Conditions

 over operating free-air temperature range (unless otherwise noted)⁽¹⁾

| | | SN54HC164 | | | SN74HC164 | | | UNIT |
|------------------------------------|-------------------------------------|------------------|----------|-----|-----------|----------|------|------|
| | | MIN | NOM | MAX | MIN | NOM | MAX | |
| V_{CC} | Supply voltage | 2 | 5 | 6 | 2 | 5 | 6 | V |
| V_{IH} | High-level input voltage | $V_{CC} = 2$ V | 1.5 | | 1.5 | | | V |
| | | $V_{CC} = 4.5$ V | 3.15 | | 3.15 | | | |
| | | $V_{CC} = 6$ V | 4.2 | | 4.2 | | | |
| V_{IL} | Low-level input voltage | $V_{CC} = 2$ V | | | 0.5 | | 0.5 | V |
| | | $V_{CC} = 4.5$ V | | | 1.35 | | 1.35 | |
| | | $V_{CC} = 6$ V | | | 1.8 | | 1.8 | |
| V_I | Input voltage | 0 | V_{CC} | | 0 | V_{CC} | | V |
| V_O | Output voltage | 0 | V_{CC} | | 0 | V_{CC} | | V |
| $\Delta t/\Delta V$ ⁽²⁾ | Input transition rise and fall time | $V_{CC} = 2$ V | | | 1000 | | 1000 | ns |
| | | $V_{CC} = 4.5$ V | | | 500 | | 500 | |
| | | $V_{CC} = 6$ V | | | 400 | | 400 | |
| T_A | Operating free-air temperature | -55 | 125 | | -40 | 125 | | °C |

- (1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, [SCBA004](#).
- (2) If this device is used in the threshold region (from V_{IL} max = 0.5 V to V_{IH} min = 1.5 V), there is a potential to go into the wrong state from induced grounding, causing double clocking. Operating with the inputs at $t_f = 1000$ ns and $V_{CC} = 2$ V does not damage the device; however, functionally, the CLK inputs are not ensured while in the shift, count, or toggle operating modes.

7.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | SN54HC164 | | | SN74HC164 | | | | UNIT |
|---|-------------|------------|--------------|-------------|-------------|------------|---------------|------|
| | J (CDIP) | W (CFP) | FK (LCCC) | D (SOIC) | N (PDIP) | NS (SO) | PW (TSSOP) | |
| | 14 PINS | 14 PINS | 20 PINS | 14 PINS | 14 PINS | 14 PINS | 14 PINS | |
| R _{θJA} Junction-to-ambient thermal resistance | — | — | — | 86 | 80 | 76 | 113 | °C/W |

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, [SPRA953](#).

7.5 Electrical Characteristics, T_A = 25°C

over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | | V _{CC} | MIN | TYP | MAX | UNIT |
|-----------------|---|---------------------------|-----------------|------|-------|------|------|
| V _{OH} | V _I = V _{IH} or V _{IL} | I _{OH} = -20 μA | 2 V | 1.9 | 1.998 | | V |
| | | | 4.5 V | 4.4 | 4.499 | | |
| | | | 6 V | 5.9 | 5.999 | | |
| | | I _{OH} = -4 mA | 4.5 V | 3.98 | 4.3 | | |
| | | I _{OH} = -5.2 mA | 6 V | 5.48 | 5.8 | | |
| V _{OL} | V _I = V _{IH} or V _{IL} | I _{OL} = 20 μA | 2 V | | 0.002 | 0.1 | V |
| | | | 4.5 V | | 0.001 | 0.1 | |
| | | | 6 V | | 0.001 | 0.1 | |
| | | I _{OL} = 4 mA | 4.5 V | | 0.17 | 0.26 | |
| | | I _{OL} = 5.2 mA | 6 V | | 0.15 | 0.26 | |
| I _I | V _I = V _{CC} or 0 | | 6 V | | ±0.1 | ±100 | nA |
| I _{CC} | V _I = V _{CC} or 0 | I _O = 0 | 6 V | | | 8 | μA |
| C _i | | | 2 V to 6 V | | 3 | 10 | pF |

7.6 Electrical Characteristics, T_A = -55°C to 125°C

over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | | V _{CC} | SN54HC164 | | | Recommended SN74HC164 | | | UNIT |
|-----------------|---|---------------------------|-----------------|-----------|-----|-------|-----------------------|-----|-------|------|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| V _{OH} | V _I = V _{IH} or V _{IL} | I _{OH} = -20 μA | 2 V | 1.9 | | | 1.9 | | | V |
| | | | 4.5 V | 4.4 | | | 4.4 | | | |
| | | | 6 V | 5.9 | | | 5.9 | | | |
| | | I _{OH} = -4 mA | 4.5 V | 3.7 | | | 3.7 | | | |
| | | I _{OH} = -5.2 mA | 6 V | 5.2 | | | 5.2 | | | |
| V _{OL} | V _I = V _{IH} or V _{IL} | I _{OL} = 20 μA | 2 V | | | | | | 0.1 | V |
| | | | 4.5 V | | | | | | 0.1 | |
| | | | 6 V | | | | | | 0.1 | |
| | | I _{OL} = 4 mA | 4.5 V | | | | | 0.4 | 0.4 | |
| | | I _{OL} = 5.2 mA | 6 V | | | | | 0.4 | 0.4 | |
| I _I | V _I = V _{CC} or 0 | | 6 V | | | ±1000 | | | ±1000 | nA |
| I _{CC} | V _I = V _{CC} or 0 | I _O = 0 | 6 V | | | 160 | | | 160 | μA |
| C _i | | | 2 V to 6 V | | | 10 | | | 10 | pF |

7.7 Electrical Characteristics, $T_A = -55^\circ\text{C}$ to 85°C

over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | | V_{CC} | SN74HC164 | | | UNIT |
|-----------|----------------------------|-----------------------------|------------|-----------|------------|---------------|------|
| | | | | MIN | TYP | MAX | |
| V_{OH} | $V_I = V_{IH}$ or V_{IL} | $I_{OH} = -20\ \mu\text{A}$ | 2 V | 1.9 | | V | |
| | | | 4.5 V | 4.4 | | | |
| | | | 6 V | 5.9 | | | |
| | | $I_{OH} = -4\ \text{mA}$ | 4.5 V | 3.84 | | | |
| | | | 6 V | 5.34 | | | |
| V_{OL} | $V_I = V_{IH}$ or V_{IL} | $I_{OL} = 20\ \mu\text{A}$ | 2 V | | 0.1 | V | |
| | | | 4.5 V | | 0.1 | | |
| | | | 6 V | | 0.1 | | |
| | | $I_{OL} = 4\ \text{mA}$ | 4.5 V | | 0.33 | | |
| | | | 6 V | | 0.33 | | |
| I_I | $V_I = V_{CC}$ or 0 | | 6 V | | ± 1000 | nA | |
| I_{CC} | $V_I = V_{CC}$ or 0 | $I_O = 0$ | 6 V | | 80 | μA | |
| C_i | | | 2 V to 6 V | | 10 | pF | |

7.8 Timing Requirements, $T_A = 25^\circ\text{C}$

over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | | V_{CC} | MIN | NOM | MAX | UNIT |
|--------------------|--------------------------------------|----------|-----|-----|-----|------|
| f_{clock} | Clock frequency | 2 V | | | 6 | MHz |
| | | 4.5 V | | | 31 | |
| | | 6 V | | | 36 | |
| t_w | $\overline{\text{CLR}}$ low | 2 V | 100 | | | ns |
| | | 4.5 V | 20 | | | |
| | | 6 V | 17 | | | |
| | CLK high or low | 2 V | 80 | | | |
| | | 4.5 V | 16 | | | |
| | | 6 V | 14 | | | |
| t_{su} | Data | 2 V | 100 | | | ns |
| | | 4.5 V | 20 | | | |
| | | 6 V | 17 | | | |
| | $\overline{\text{CLR}}$ inactive | 2 V | 100 | | | |
| | | 4.5 V | 20 | | | |
| | | 6 V | 17 | | | |
| t_h | Hold time, data after CLK \uparrow | 2 V | 5 | | | ns |
| | | 4.5 V | 5 | | | |
| | | 6 V | 5 | | | |

7.9 Timing Requirements, $T_A = -55^\circ\text{C}$ to 125°C

over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | | V_{CC} | SN54HC164 | | | RECOMMENDED SN74HC164 | | | UNIT |
|--------------------|--------------------------------------|----------|-----------|-----|-----|--------------------------|-----|-----|------|
| | | | MIN | NOM | MAX | MIN | NOM | MAX | |
| f_{clock} | Clock frequency | 2 V | | | 4.2 | | | 4.2 | MHz |
| | | 4.5 V | | | 21 | | | 21 | |
| | | 6 V | | | 25 | | | 25 | |
| t_w | $\overline{\text{CLR}}$ low | 2 V | 150 | | | 125 | | | ns |
| | | 4.5 V | 30 | | | 25 | | | |
| | | 6 V | 25 | | | 21 | | | |
| | CLK high or low | 2 V | 120 | | | 120 | | | |
| | | 4.5 V | 24 | | | 24 | | | |
| | | 6 V | 20 | | | 20 | | | |
| t_{su} | Data | 2 V | 150 | | | 125 | | | ns |
| | | 4.5 V | 30 | | | 25 | | | |
| | | 6 V | 25 | | | 25 | | | |
| | $\overline{\text{CLR}}$ inactive | 2 V | 150 | | | 125 | | | |
| | | 4.5 V | 30 | | | 25 | | | |
| | | 6 V | 25 | | | 25 | | | |
| t_h | Hold time, data after CLK \uparrow | 2 V | 5 | | | 5 | | | ns |
| | | 4.5 V | 5 | | | 5 | | | |
| | | 6 V | 5 | | | 5 | | | |

7.10 Timing Requirements, $T_A = -55^\circ\text{C}$ to 85°C

over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | | V_{CC} | SN74HC164 | | | UNIT |
|--------------------|--------------------------------------|----------|-----------|-----|-----|------|
| | | | MIN | NOM | MAX | |
| f_{clock} | Clock frequency | 2 V | | | 5 | MHz |
| | | 4.5 V | | | 25 | |
| | | 6 V | | | 28 | |
| t_w | $\overline{\text{CLR}}$ low | 2 V | 125 | | | ns |
| | | 4.5 V | 25 | | | |
| | | 6 V | 21 | | | |
| | CLK high or low | 2 V | 100 | | | |
| | | 4.5 V | 20 | | | |
| | | 6 V | 18 | | | |
| t_{su} | Data | 2 V | 125 | | | ns |
| | | 4.5 V | 25 | | | |
| | | 6 V | 21 | | | |
| | $\overline{\text{CLR}}$ inactive | 2 V | 125 | | | |
| | | 4.5 V | 25 | | | |
| | | 6 V | 21 | | | |
| t_h | Hold time, data after CLK \uparrow | 2 V | 5 | | | ns |
| | | 4.5 V | 5 | | | |
| | | 6 V | 5 | | | |

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7.11 Switching Characteristics, $T_A = 25^\circ\text{C}$

 over recommended operating free-air temperature range, $C_L = 50\text{ pF}$ (unless otherwise noted) (see [Figure 3](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V_{CC} | MIN | TYP | MAX | UNIT |
|-----------|------------------|-------------|-----------|-----|-----|-----|------|
| | | | f_{max} | | | 2 V | |
| | | | 4.5 V | 31 | 54 | | |
| | | | 6 V | 36 | 62 | | |
| t_{PHL} | \overline{CLR} | Any Q | 2 V | | 140 | 205 | ns |
| | | | 4.5 V | | 28 | 41 | |
| | | | 6 V | | 24 | 35 | |
| t_{pd} | CLK | Any Q | 2 V | | 115 | 175 | |
| | | | 4.5 V | | 23 | 35 | |
| | | | 6 V | | 20 | 30 | |
| t_t | | | 2 V | | 38 | 75 | ns |
| | | | 4.5 V | | 8 | 15 | |
| | | | 6 V | | 6 | 13 | |

7.12 Switching Characteristics, $T_A = -55^\circ\text{C}$ to 125°C

 over recommended operating free-air temperature range, $C_L = 50\text{ pF}$ (unless otherwise noted) (see [Figure 3](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V_{CC} | SN54HC164 | | | RECOMMENDED SN74HC164 | | | UNIT |
|-----------|------------------|-------------|----------|-----------|-----|-----|-----------------------|-----|-----|------|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| f_{max} | | | 2 V | 4.2 | | | 4.2 | | | MHz |
| | | | 4.5 V | 21 | | | 21 | | | |
| | | | 6 V | 25 | | | 25 | | | |
| t_{PHL} | \overline{CLR} | Any Q | 2 V | | | 295 | | | 255 | ns |
| | | | 4.5 V | | | 59 | | | 51 | |
| | | | 6 V | | | 51 | | | 46 | |
| t_{pd} | CLK | Any Q | 2 V | | | 265 | | | 220 | |
| | | | 4.5 V | | | 53 | | | 44 | |
| | | | 6 V | | | 45 | | | 38 | |
| t_t | | | 2 V | | | 110 | | | 110 | ns |
| | | | 4.5 V | | | 22 | | | 22 | |
| | | | 6 V | | | 19 | | | 19 | |

7.13 Switching Characteristics, $T_A = -55^\circ\text{C}$ to 85°C

over recommended operating free-air temperature range, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 3)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V_{CC} | SN74HC164 | | | UNIT |
|-----------|------------------|-------------|----------|-----------|-----|-----|------|
| | | | | MIN | TYP | MAX | |
| f_{max} | | | 2 V | 5 | | | MHz |
| | | | 4.5 V | 25 | | | |
| | | | 6 V | 28 | | | |
| t_{PHL} | \overline{CLR} | Any Q | 2 V | 255 | | | ns |
| | | | 4.5 V | 51 | | | |
| | | | 6 V | 46 | | | |
| t_{pd} | CLK | Any Q | 2 V | 220 | | | |
| | | | 4.5 V | 44 | | | |
| | | | 6 V | 38 | | | |
| t_t | | | 2 V | 95 | | | ns |
| | | | 4.5 V | 19 | | | |
| | | | 6 V | 16 | | | |

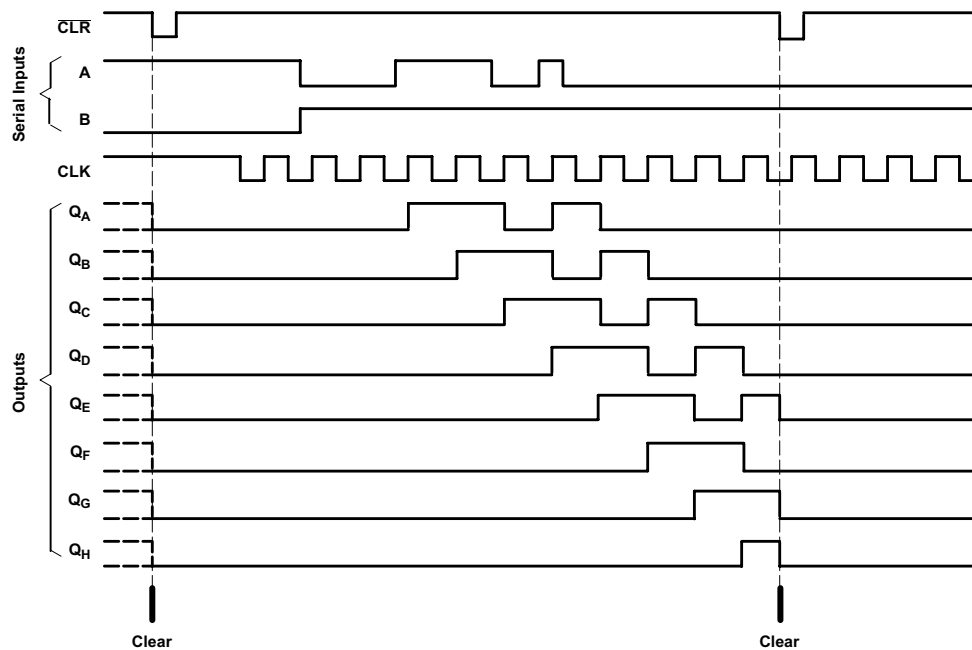
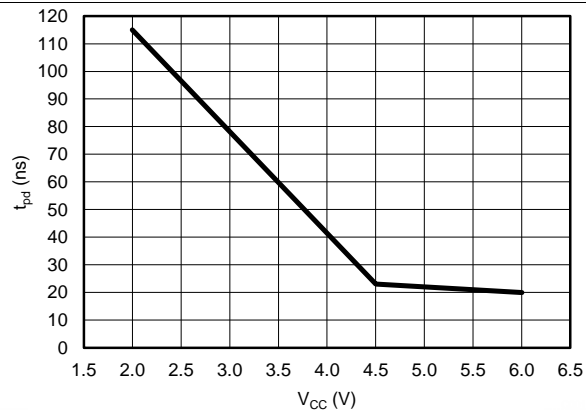


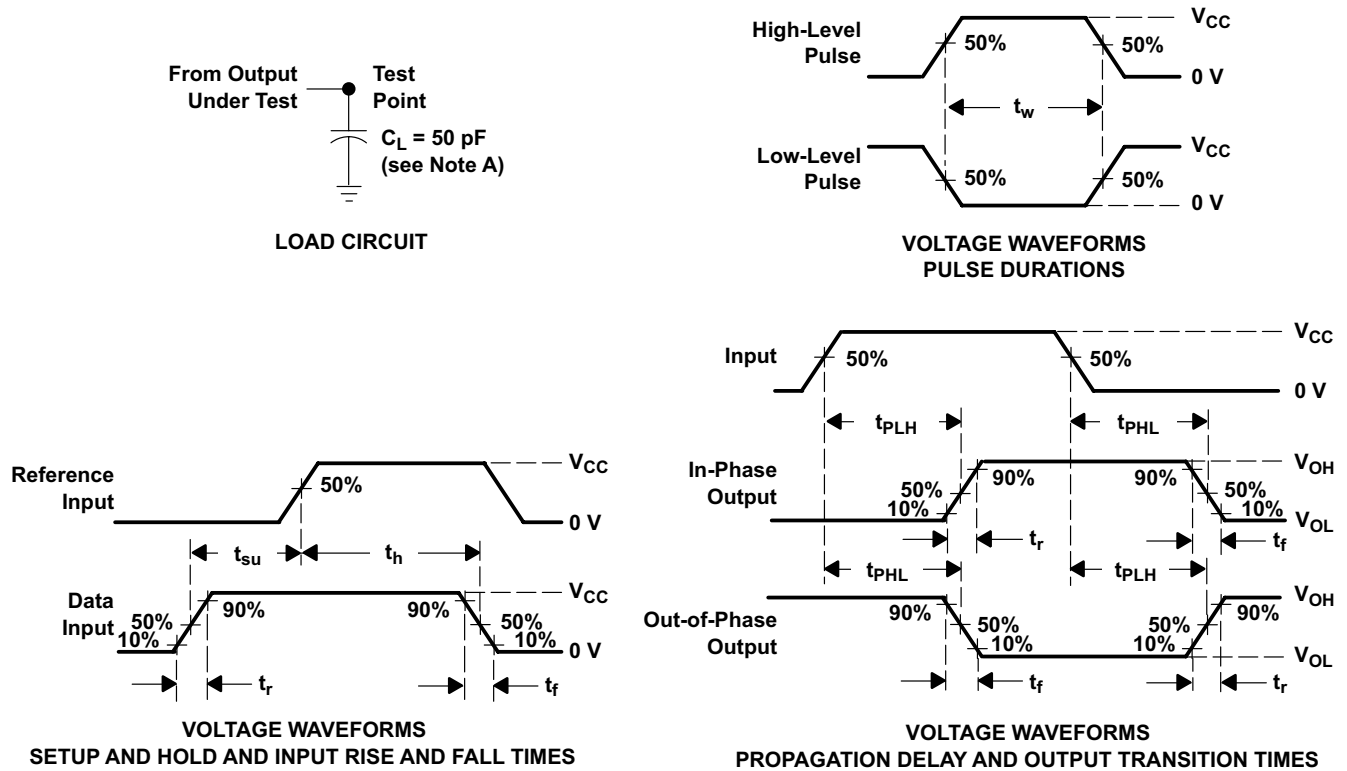
Figure 1. SN74HC164 Example Timing Diagram

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7.14 Typical Characteristics
 $T_A = 25^\circ\text{C}$

Figure 2. Propagation Delay vs Supply Voltage at $T_A = 25^\circ\text{C}$

8 Parameter Measurement Information



- NOTES:
- A. C_L includes probe and test-fixture capacitance.
 - B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r = 6 \text{ ns}$, $t_f = 6 \text{ ns}$.
 - C. For clock inputs, f_{max} is measured when the input duty cycle is 50%.
 - D. The outputs are measured one at a time with one input transition per measurement.
 - E. t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 3. Load Circuit and Voltage Waveforms

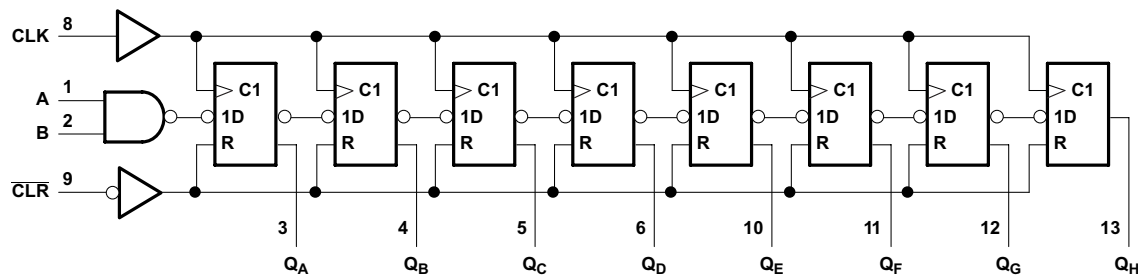
9 Detailed Description

9.1 Overview

The SN74HC164 is an 8-bit shift register with 2 serial inputs (A and B) connected through an AND gate, as well as an asynchronous clear (CLR). The device requires a high signal on both A and B in order to set the input data line high; a low signal on either input will set the input data line low. Data at A and B can be changed while CLK is high or low, provided that the minimum set-up time requirements are met.

The CLK pin of the SN74HC164 is triggered on a positive or rising-edge signal, from LOW to HIGH. Upon a positive-edge trigger, the device will store the result of the (A • B) input data line in the first register and propagate each register's data to the next register. The data of the last register, Q_H, will be discarded at each clock trigger. If a low signal is applied to the CLR pin of the SN74HC164, the device will set all registers to a value of 0 immediately.

9.2 Functional Block Diagram



Pin numbers shown are for the D, J, N, NS, PW, and W packages.

9.3 Feature Description

The HC164 has a wide operating voltage range of 2 V to 6 V, outputs that can drive up to 10 LSTTL loads and Low Power Consumption, 80- μ A maximum I. It is typically $t_{pd} = 20$ ns and has ± 4 -mA output drive at 5 V with low input current of 1- μ A maximum. It also has AND-gated (enable/disable) serial inputs a fully buffered clock and serial inputs as well as a direct clear.

9.4 Device Functional Modes

Table 1 lists the functional modes of the SNx4HC164.

Table 1. Function Table⁽¹⁾⁽²⁾

| INPUTS | | | | OUTPUTS | | | |
|-------------------------|------------|---|---|-----------------|-----------------|-----|-----------------|
| $\overline{\text{CLR}}$ | CLK | A | B | Q _A | Q _B | ... | Q _H |
| L | X | X | X | L | L | | L |
| H | L | X | X | Q _{A0} | Q _{B0} | | Q _{H0} |
| H | \uparrow | H | H | H | Q _{An} | | Q _{Gn} |
| H | \uparrow | L | X | L | Q _{An} | | Q _{Gn} |
| H | \uparrow | X | L | L | Q _{An} | | Q _{Gn} |

- (1) Q_{A0}, Q_{B0}, Q_{H0} = the level of Q_A, Q_B, or Q_H, respectively, before the indicated steady-state input conditions were established.
- (2) Q_{An}, Q_{Gn} = the level of Q_A or Q_G before the most recent \uparrow transition of CLK: indicates a 1-bit shift.

10 Application and Implementation

10.1 Application Information

The SNx4HC164 is an 8-bit shift register that can be used as a deserializer in order to reduce the number of GPIO's needed when driving multiple LED's. In order to correctly display the proper output in the LED's a sink MOSFET was added to prevent the LED's from lighting up until the correct data or the proper clock signal has been achieved.

10.2 Typical Application

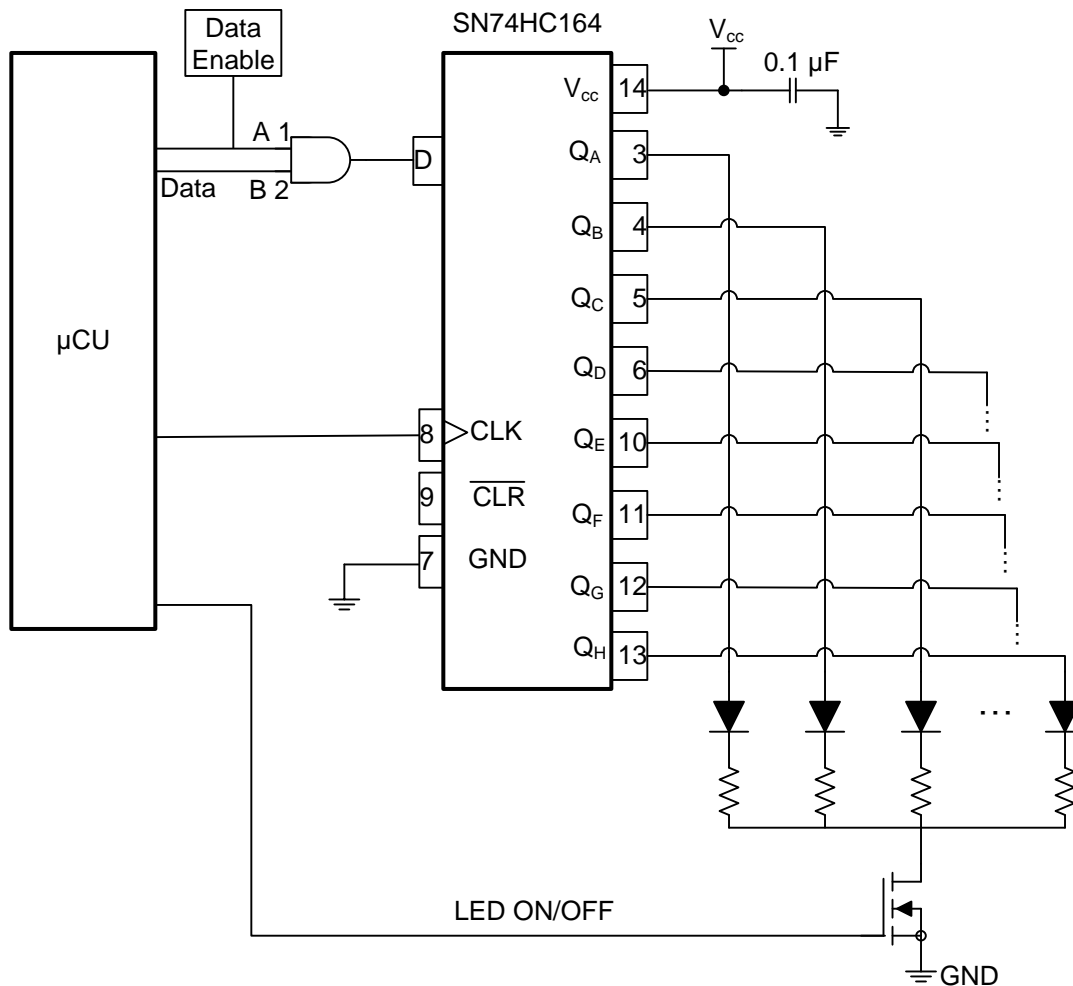


Figure 4. Typical Application Diagram

10.2.1 Design Requirements

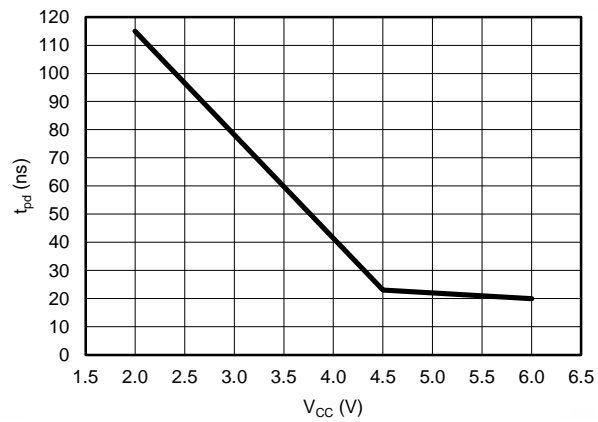
Ensure that the incoming clock rising edge meets the criteria in [Recommended Operating Conditions](#).

10.2.2 Detailed Design Procedure

Ensure that input and output voltages do not exceed ratings in [Absolute Maximum Ratings](#).

Input voltage threshold information can be found in [Recommended Operating Conditions](#).

Detailed timing requirements can be found in [Timing Requirements](#), $T_A = 25^\circ\text{C}$.

Typical Application (continued)
10.2.3 Application Curve

Figure 5. Propagation Delay vs Supply Voltage at T_A = 25°C

11 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the [Recommended Operating Conditions](#) table.

Each V_{CC} pin must have a good bypass capacitor in order to prevent power disturbance. For devices with a single supply, a 0.1- μF capacitor is recommended and if there are multiple V_{CC} pins then a 0.01- μF or 0.022- μF capacitor is recommended for each power pin. It is ok to parallel multiple bypass caps to reject different frequencies of noise. 0.1- μF and 1- μF capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power pin as possible for best results.

12 Layout

12.1 Layout Guidelines

Reflections and matching are closely related to loop antenna theory, but different enough to warrant their own discussion. When a PCB trace turns a corner at a 90° angle, a reflection can occur. This is primarily due to the change of width of the trace. At the apex of the turn, the trace width is increased to 1.414 times its width. This upsets the transmission line characteristics, especially the distributed capacitance and self-inductance of the trace — resulting in the reflection. It is a given that not all PCB traces can be straight, and so they will have to turn corners. [Figure 6](#) shows progressively better techniques of rounding corners. Only the last example maintains constant trace width and minimizes reflections.

12.2 Layout Example

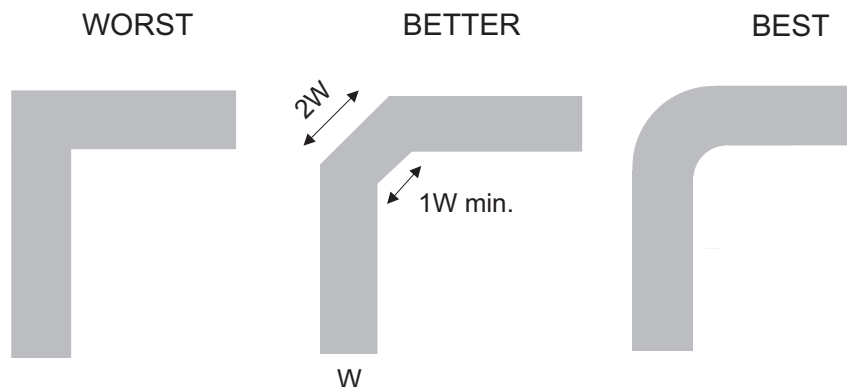


Figure 6. Trace Example

13 Device and Documentation Support

13.1 Documentation Support

13.1.1 Related Documentation

For related documentation, see the following:

Implications of Slow or Floating CMOS Inputs, [SCBA004](#)

13.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 2. Related Links

| PARTS | PRODUCT FOLDER | SAMPLE & BUY | TECHNICAL DOCUMENTS | TOOLS & SOFTWARE | SUPPORT & COMMUNITY |
|-----------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| SN54HC164 | Click here | Click here | Click here | Click here | Click here |
| SN74HC164 | Click here | Click here | Click here | Click here | Click here |

13.3 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

TI E2E™ Online Community *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

13.4 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

13.5 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

13.6 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

14 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|---------------------|--------------------------------------|----------------------|--------------|------------------------------------|-------------------------|
| 5962-8416201VCA | ACTIVE | CDIP | J | 14 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 5962-8416201VC A SNV54HC164J | Samples |
| 5962-8416201VDA | ACTIVE | CFP | W | 14 | 25 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 5962-8416201VD A SNV54HC164W | Samples |
| 84162012A | ACTIVE | LCCC | FK | 20 | 1 | Non-RoHS & Green | POST-PLATE | N / A for Pkg Type | -55 to 125 | 84162012A SNJ54HC 164FK | Samples |
| 8416201CA | ACTIVE | CDIP | J | 14 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 8416201CA SNJ54HC164J | Samples |
| SN54HC164J | ACTIVE | CDIP | J | 14 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | SN54HC164J | Samples |
| SN74HC164D | ACTIVE | SOIC | D | 14 | 50 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HC164 | Samples |
| SN74HC164DR | ACTIVE | SOIC | D | 14 | 2500 | RoHS & Green | NIPDAU SN | Level-1-260C-UNLIM | -40 to 125 | HC164 | Samples |
| SN74HC164DRG3 | ACTIVE | SOIC | D | 14 | 2500 | RoHS & Green | SN | Level-1-260C-UNLIM | -40 to 125 | HC164 | Samples |
| SN74HC164DRG4 | ACTIVE | SOIC | D | 14 | 2500 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HC164 | Samples |
| SN74HC164DT | ACTIVE | SOIC | D | 14 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HC164 | Samples |
| SN74HC164N | ACTIVE | PDIP | N | 14 | 25 | RoHS & Green | NIPDAU SN | N / A for Pkg Type | -40 to 125 | SN74HC164N | Samples |
| SN74HC164NE4 | ACTIVE | PDIP | N | 14 | 25 | RoHS & Green | NIPDAU | N / A for Pkg Type | -40 to 125 | SN74HC164N | Samples |
| SN74HC164NSR | ACTIVE | SO | NS | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HC164 | Samples |
| SN74HC164PW | ACTIVE | TSSOP | PW | 14 | 90 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HC164 | Samples |
| SN74HC164PWR | ACTIVE | TSSOP | PW | 14 | 2000 | RoHS & Green | NIPDAU SN | Level-1-260C-UNLIM | -40 to 125 | HC164 | Samples |
| SN74HC164PWRE4 | ACTIVE | TSSOP | PW | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HC164 | Samples |
| SN74HC164PWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HC164 | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|------------------|--------------------------------------|----------------------|--------------|-------------------------------|-------------------------|
| SN74HC164PWT | ACTIVE | TSSOP | PW | 14 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HC164 | Samples |
| SNJ54HC164FK | ACTIVE | LCCC | FK | 20 | 1 | Non-RoHS & Green | POST-PLATE | N / A for Pkg Type | -55 to 125 | 84162012A SNJ54HC 164FK | Samples |
| SNJ54HC164J | ACTIVE | CDIP | J | 14 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 8416201CA SNJ54HC164J | Samples |
| SNJ54HC164W | ACTIVE | CFP | W | 14 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 8416201DA SNJ54HC164W | Samples |

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSELETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) **MSL, Peak Temp.** - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) **Lead finish/Ball material** - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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OTHER QUALIFIED VERSIONS OF SN54HC164, SN54HC164-SP, SN74HC164 :

- Catalog: [SN74HC164](#), [SN54HC164](#)
- Military: [SN54HC164](#)
- Space: [SN54HC164-SP](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74HC164DR | SOIC | D | 14 | 2500 | 330.0 | 16.8 | 6.5 | 9.5 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC164DR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC164DRG3 | SOIC | D | 14 | 2500 | 330.0 | 16.8 | 6.5 | 9.5 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC164DRG4 | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC164DRG4 | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC164DT | SOIC | D | 14 | 250 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC164NSR | SO | NS | 14 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |
| SN74HC164PWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74HC164PWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74HC164PWRG4 | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74HC164PWT | TSSOP | PW | 14 | 250 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74HC164DR | SOIC | D | 14 | 2500 | 364.0 | 364.0 | 27.0 |
| SN74HC164DR | SOIC | D | 14 | 2500 | 853.0 | 449.0 | 35.0 |
| SN74HC164DRG3 | SOIC | D | 14 | 2500 | 364.0 | 364.0 | 27.0 |
| SN74HC164DRG4 | SOIC | D | 14 | 2500 | 333.2 | 345.9 | 28.6 |
| SN74HC164DRG4 | SOIC | D | 14 | 2500 | 853.0 | 449.0 | 35.0 |
| SN74HC164DT | SOIC | D | 14 | 250 | 210.0 | 185.0 | 35.0 |
| SN74HC164NSR | SO | NS | 14 | 2000 | 853.0 | 449.0 | 35.0 |
| SN74HC164PWR | TSSOP | PW | 14 | 2000 | 364.0 | 364.0 | 27.0 |
| SN74HC164PWR | TSSOP | PW | 14 | 2000 | 853.0 | 449.0 | 35.0 |
| SN74HC164PWRG4 | TSSOP | PW | 14 | 2000 | 853.0 | 449.0 | 35.0 |
| SN74HC164PWT | TSSOP | PW | 14 | 250 | 853.0 | 449.0 | 35.0 |

W (R-GDFP-F14)

CERAMIC DUAL FLATPACK



4040180-2/F 04/14

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only.
 - E. Falls within MIL STD 1835 GDFP1-F14

J 14

GENERIC PACKAGE VIEW
CDIP - 5.08 mm max height
CERAMIC DUAL IN LINE PACKAGE



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4040083-5/G

J0014A



PACKAGE OUTLINE

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



4214771/A 05/2017

NOTES:

1. All controlling linear dimensions are in inches. Dimensions in brackets are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package is hermetically sealed with a ceramic lid using glass frit.
4. Index point is provided on cap for terminal identification only and on press ceramic glass frit seal only.
5. Falls within MIL-STD-1835 and GDIP1-T14.

EXAMPLE BOARD LAYOUT

J0014A

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



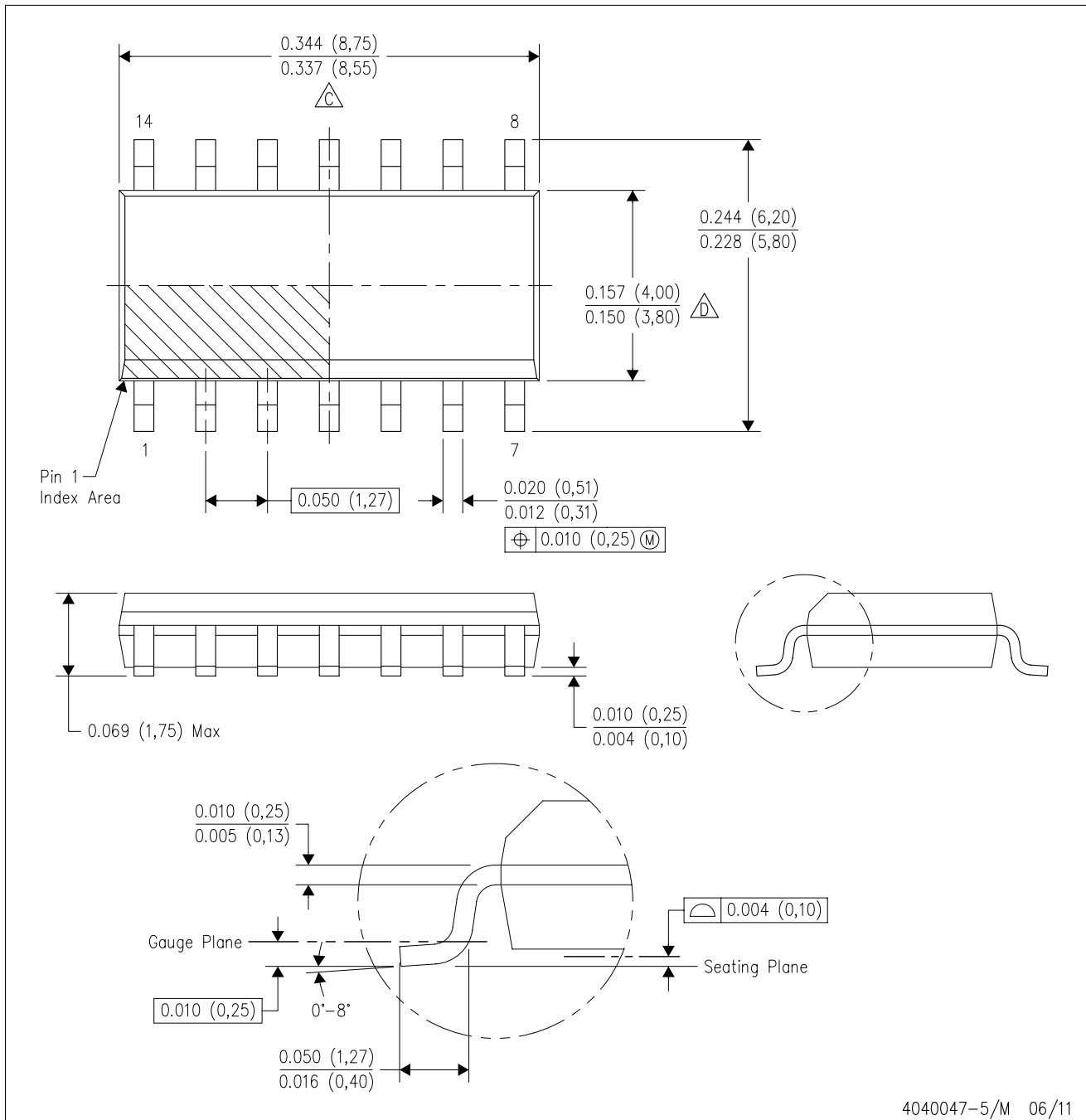
LAND PATTERN EXAMPLE
NON-SOLDER MASK DEFINED
SCALE: 5X



4214771/A 05/2017

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - $\triangle D$ Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4040064-3/G 02/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
 - E. Falls within JEDEC MO-153

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4211284-2/G 08/15

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - $\triangle D$ The 20 pin end lead shoulder width is a vendor option, either half or full width.

4040049/E 12/2002

FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



| NO. OF TERMINALS ** | A | | B | |
|---------------------|------------------|------------------|------------------|------------------|
| | MIN | MAX | MIN | MAX |
| 20 | 0.342 (8,69) | 0.358 (9,09) | 0.307 (7,80) | 0.358 (9,09) |
| 28 | 0.442 (11,23) | 0.458 (11,63) | 0.406 (10,31) | 0.458 (11,63) |
| 44 | 0.640 (16,26) | 0.660 (16,76) | 0.495 (12,58) | 0.560 (14,22) |
| 52 | 0.740 (18,78) | 0.761 (19,32) | 0.495 (12,58) | 0.560 (14,22) |
| 68 | 0.938 (23,83) | 0.962 (24,43) | 0.850 (21,6) | 0.858 (21,8) |
| 84 | 1.141 (28,99) | 1.165 (29,59) | 1.047 (26,6) | 1.063 (27,0) |



4040140/D 01/11

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package can be hermetically sealed with a metal lid.
 - Falls within JEDEC MS-004

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

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