

## 8-bit serial input and output shift register

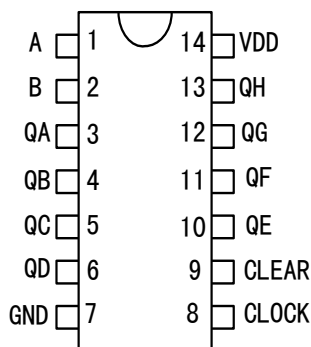
- AND-Gated (Enable/Disable) Serial Inputs
- Fully Buffered Clock and Serial Inputs
- Direct Clear
- Package Options Include Plastic Small-Outline (D) and Ceramic Flat (W) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPS

### DESCRIPTION

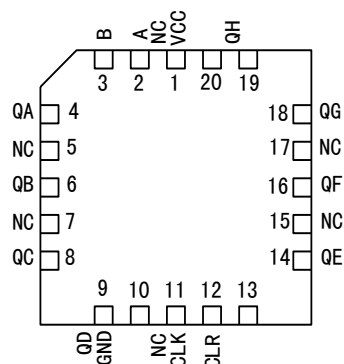
These 8-bit shift registers feature AND-gated serial inputs and an asynchronous clear (CLR) input. The gated serial (A and B) inputs permit complete control over incoming data; a low at either input inhibits entry of the new data and resets the first flip-flop to the low level at the next clock (CLK) 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 setup time requirements are met. Clocking occurs on the low-to-high-level transition of CLK.

The 54HC164 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The 74HC164 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

54HC164...J OR W PACKAGE  
74HC164...D OR N PACKAGE



54HC164...FK PACKAGE (TOP VIEW)



NC=NO internal connection

FUNCTION TABLE

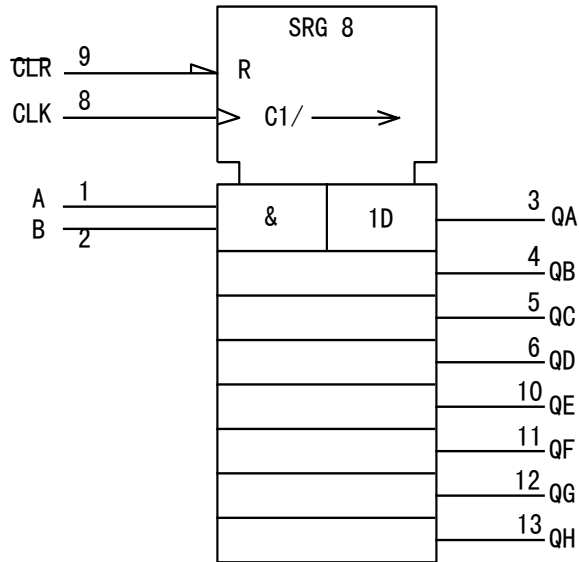
| INPUTS |     |   |   | OUTPUTS |         |     |
|--------|-----|---|---|---------|---------|-----|
| CLR    | CLK | A | B | QA      | QB...QH |     |
| L      | X   | X | X | L       | L       | L   |
| H      | L   | X | X | QA0     | QB0     | QH0 |
| H      | ↑   | H | H | H       | QAn     | QGn |
| H      | ↑   | L | X | L       | QAn     | QGn |
| H      | ↑   | X | L | L       | QAn     | QGn |

QA0, QB0, QH0=the level of QA, QB, or QH, respectively, before the indicated steady-state input conditions were established

QAn, QGn=the level of QA or QG before the most recent ↑ transition of

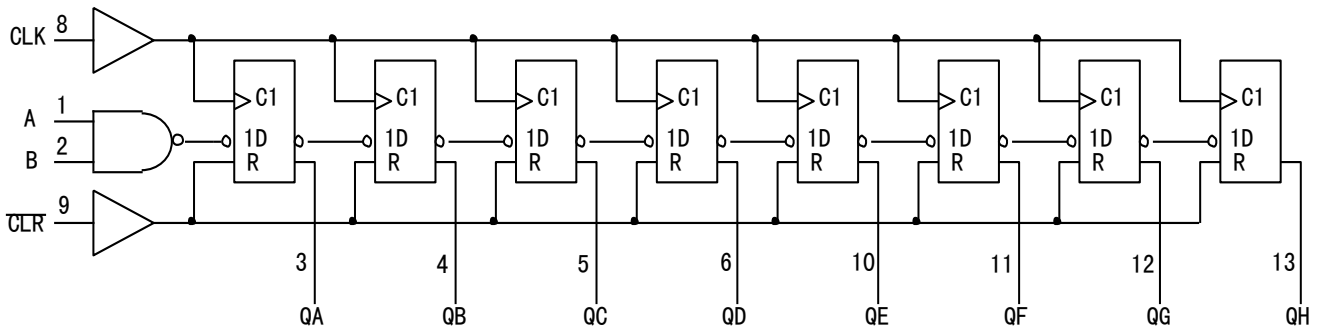
CLK: indicates a 1-bit shift

## LOGIC SYMBOL



- This symbol is in accordance with ANS/IEEE Std 91-1984 and IEC publication 617-12.
- Pin numbers shown are for the D, J, N, and W packages.

## LOGIC DIAGRAM (positive logic)



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



## RECOMMENDED OPERATING CONDITIONS

|   |                       | 54HC164 |     |                 | 74HC164 |     |                 | UNIT |
|---|-----------------------|---------|-----|-----------------|---------|-----|-----------------|------|
|   |                       | MIN     | NOM | MAX             | MIN     | NOM | MAX             |      |
| V <sub>CC</sub> Supply voltage                        |                       | 2       | 5   | 6               | 2       | 5   | 6               |      |
| V <sub>IH</sub> High-level input voltage              | V <sub>CC</sub> =2V   | 1.5     | -   | -               | 1.5     | -   | -               |      |
|   | V <sub>CC</sub> =4.5V | 3.15    | -   | -               | 3.15    | -   | -               |      |
|   | V <sub>CC</sub> =6V   | 4.2     | -   | -               | 4.2     | -   | -               |      |
| V <sub>IL</sub> Low-level input voltage               | V <sub>CC</sub> =2V   | 0       | -   | 0.5             | 0       | -   | 0.5             |      |
|   | V <sub>CC</sub> =4.5V | 0       | -   | 1.35            | 0       | -   | 1.35            |      |
|   | V <sub>CC</sub> =6V   | 0       | -   | 1.8             | 0       | -   | 1.8             |      |
| V <sub>I</sub> Input voltage                          |                       | 0       | -   | V <sub>CC</sub> |         | 0   | V <sub>CC</sub> | V    |
| V <sub>O</sub> Output voltage                         |                       | 0       | -   | V <sub>CC</sub> |         | 0   | V <sub>CC</sub> | V    |
| t <sub>IT</sub> Input transition (rise and fall) time | V <sub>CC</sub> =2V   | 0       | -   | 1000            | 0       | -   | 1000            | ns   |
|   | V <sub>CC</sub> =4.5V | 0       | -   | 500             | 0       | -   | 500             |      |
|   | V <sub>CC</sub> =6V   | 0       | -   | 400             | 0       | -   | 400             |      |
| T <sub>A</sub> Operating free-air temperature         |                       | -55     | -   | 125             | -40     | -   | 85              | °C   |

T If this device is used in the threshold region (from V<sub>IL</sub> max=0.5V to V<sub>IH</sub> min=1.5V), there is a potential to go into the wrong state from induced grounding, causing double clocking. Operating with the inputs at tt=1000ns and V<sub>CC</sub>=2V does not damage the device; however, functionally, the CLK inputs are not ensured while in the shift, count, or toggle operating modes.

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

| PARAMETER       | TEST CONDITIONS   | V <sub>CC</sub>         | T <sub>A</sub> =25°C |       |       | 54HC164 |       | 74HC164 |       | UNIT |   |
|-----------------|---|-------------------------|----------------------|-------|-------|---------|-------|---------|-------|------|---|
|                 |   |                         | MIN                  | TYP   | MAX   | MIN     | MAX   | MIN     | MAX   |      |   |
| V <sub>OH</sub> | V <sub>I</sub> =V <sub>IH</sub> or V <sub>IL</sub>      | I <sub>OH</sub> =-20uA  | 2V                   | 1.9   | 1.998 | -       | 1.9   | -       | 1.9   | -    | V |
|                 |   |                         | 4.5V                 | 4.4   | 4.499 | -       | 4.4   | -       | 4.4   | -    |   |
|                 |   | 6V                      | 5.9                  | 5.999 | -     | 5.9     | -     | 5.9     | -     |      |   |
|                 |   | I <sub>OH</sub> =-4mA   | 4.5V                 | 3.98  | 4.3   | -       | 3.7   | -       | 3.84  | -    |   |
|                 |   | I <sub>OH</sub> =-5.2mA | 6V                   | 5.48  | 5.8   | -       | 5.2   | -       | 5.34  | -    |   |
| V <sub>OL</sub> | V <sub>I</sub> =V <sub>IH</sub> or V <sub>IL</sub>      | I <sub>OL</sub> =20uA   | 2V                   | -     | 0.002 | 0.1     | -     | 0.1     | -     | 0.1  | V |
|                 |   |                         | 4.5V                 | -     | 0.001 | 0.1     | -     | 0.1     | -     | 0.1  |   |
|                 |   |                         | 6V                   | -     | 0.001 | 0.1     | -     | 0.1     | -     | 0.1  |   |
|                 |   | I <sub>OL</sub> =4mA    | 4.5V                 | -     | 0.17  | 0.26    | -     | 0.4     | -     | 0.33 |   |
|                 |   | I <sub>OL</sub> =5.2mA  | 6V                   | -     | 0.15  | 0.26    | -     | 0.4     | -     | 0.33 |   |
| I <sub>I</sub>  | V <sub>I</sub> =V <sub>CC</sub> or 0                    | 6V                      | -                    | ±0.1  | ±100  | -       | ±1000 | -       | ±1000 | nA   |   |
| I <sub>CC</sub> | V <sub>I</sub> =V <sub>CC</sub> or 0, I <sub>O</sub> =0 | 6V                      | -                    | -     | 8     | -       | 160   | -       | 80    | uA   |   |
| C <sub>I</sub>  |   | 2V to 6V                | -                    | 3     | 10    | -       | 10    | -       | 10    | pF   |   |

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

|  |                 | VCC  | T <sub>A</sub> =25°C |     | 54HC164 |     | 74HC164 |     | UNIT |
|--|-----------------|------|----------------------|-----|---------|-----|---------|-----|------|
|  |                 |      | MIN                  | MAX | MIN     | MAX | MIN     | MAX |      |
| f <sub>clock</sub> Clock frequency         |                 | 2V   | 0                    | 6   | 0       | 4.2 | 0       | 5   | MHz  |
|  |                 | 4.5V | 0                    | 31  | 0       | 21  | 0       | 25  |      |
|  |                 | 6V   | 0                    | 36  | 0       | 25  | 0       | 28  |      |
| t <sub>w</sub> Pulse duration              | CLR low         | 2V   | 100                  | -   | 150     | -   | 125     | -   | ns   |
|  |                 | 4.5V | 20                   | -   | 30      | -   | 25      | -   |      |
|  |                 | 6V   | 17                   | -   | 25      | -   | 21      | -   |      |
|  | CLK high or low | 2V   | 80                   | -   | 120     | -   | 100     | -   |      |
|  |                 | 4.5V | 16                   | -   | 24      | -   | 20      | -   |      |
|  |                 | 6V   | 14                   | -   | 20      | -   | 18      | -   |      |
| t <sub>su</sub> Setup time before CLK ↑    | Data            | 2V   | 100                  | -   | 150     | -   | 125     | -   | ns   |
|  |                 | 4.5V | 20                   | -   | 30      | -   | 25      | -   |      |
|  |                 | 6V   | 17                   | -   | 25      | -   | 21      | -   |      |
|  | CLR inactive    | 2V   | 100                  | -   | 150     | -   | 125     | -   |      |
|  |                 | 4.5V | 20                   | -   | 30      | -   | 25      | -   |      |
|  |                 | 6V   | 17                   | -   | 25      | -   | 21      | -   |      |
| t <sub>h</sub> Hold time, data after CLK ↑ |                 | 2V   | 5                    | -   | 5       | -   | 5       | -   | ns   |
|  |                 | 4.5V | 5                    | -   | 5       | -   | 5       | -   |      |
|  |                 | 6V   | 5                    | -   | 5       | -   | 5       | -   |      |

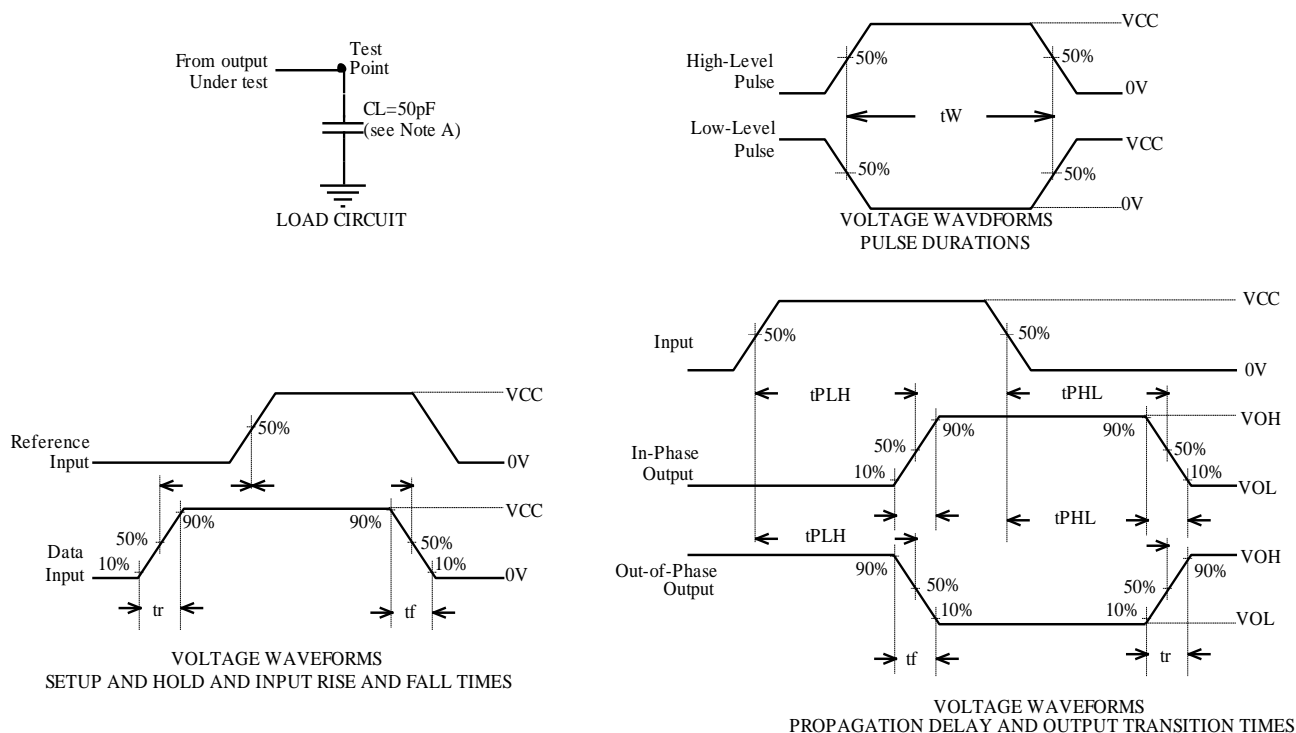
### Switching characteristics over recommended operating free-air temperature rang, C<sub>L</sub>=50pF (unless otherwise noted) (see Figure 1)

| PARAMETER        | FROM (INPUT) | TO (OUTPUT) | VCC  | T <sub>A</sub> =25°C |     |     | 54HC164 |     | 74HC164 |     | UNIT |
|------------------|--------------|-------------|------|----------------------|-----|-----|---------|-----|---------|-----|------|
|                  |              |             |      | MIN                  | TYP | MAX | MIN     | MAX | MIN     | MAX |      |
| f <sub>max</sub> |              |             | 2V   | 6                    | 10  | -   | 4.2     | -   | 5       | -   | MHz  |
|                  |              |             | 4.5V | 31                   | 54  | -   | 21      | -   | 25      | -   |      |
|                  |              |             | 6V   | 36                   | 62  | -   | 25      | -   | 28      | -   |      |
| t <sub>PHL</sub> | CLR          | Any Q       | 2V   | -                    | 140 | 205 | -       | 295 | -       | 255 | ns   |
|                  |              |             | 4.5V | -                    | 28  | 41  | -       | 59  | -       | 51  |      |
|                  |              |             | 6V   | -                    | 24  | 35  | -       | 51  | -       | 46  |      |
| t <sub>pd</sub>  | CLK          | Any Q       | 2V   | -                    | 115 | 175 | -       | 265 | -       | 220 | ns   |
|                  |              |             | 4.5V | -                    | 23  | 35  | -       | 53  | -       | 44  |      |
|                  |              |             | 6V   | -                    | 20  | 30  | -       | 45  | -       | 38  |      |
| t <sub>t</sub>   |              |             | 2V   | -                    | 38  | 75  | -       | 110 | -       | 95  | ns   |
|                  |              |             | 4.5V | -                    | 8   | 15  | -       | 22  | -       | 19  |      |
|                  |              |             | 6V   | -                    | 6   | 13  | -       | 19  | -       | 16  |      |

## Operating characteristics, $T_A=25^\circ\text{C}$

| PARAMETER                         | TEST CONDITIONS | TYP | UNIT |
|-----------------------------------|-----------------|-----|------|
| Cpd Power dissipation capacitance | No load         | 135 | pF   |

## 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:  $\text{PRR} \leq 1\text{MHz}$ ,  $Z_0 = 50\ \Omega$ ,  $t_r = 6\text{ns}$ ,  $t_f = 6\text{ns}$ .

C. For clock inputs,  $f_{\text{max}}$  is measured when the input duty cycle is 50%

D. The outputs are measured one at a time with one input transition per measurement.

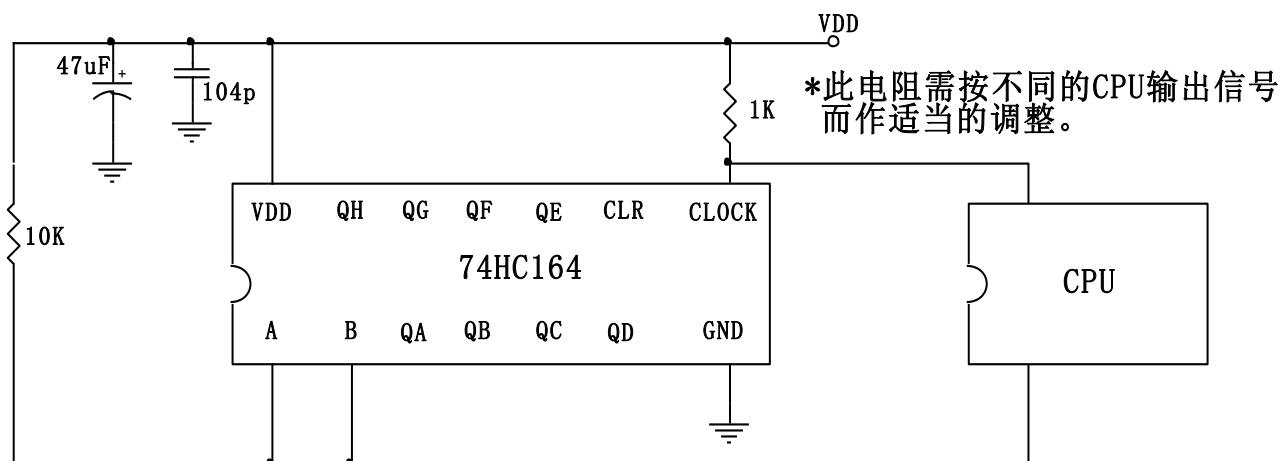
E.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

**Figure 1. Load Circuit and Voltage Waveforms**

## PAD ASSIGNMENT

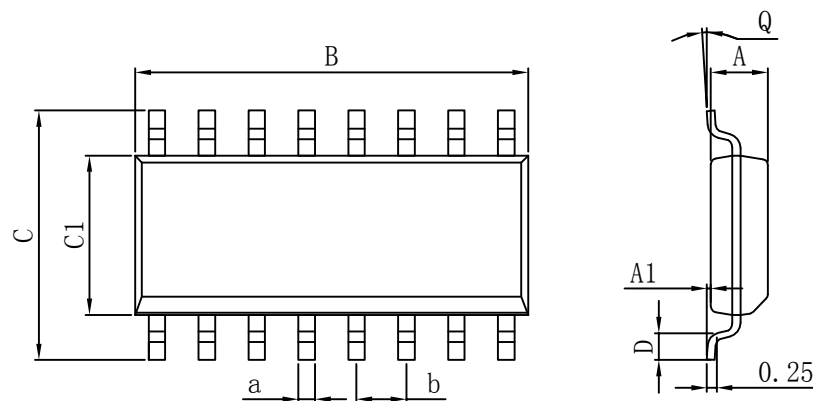
| Pad No | Pad Name | X       | Y       |
|--------|----------|---------|---------|
| 1      | A        | -242.00 | -53.50  |
| 2      | B        | -250.00 | 252.00  |
| 3      | QA       | -135.00 | -188.50 |
| 4      | QB       | 0.00    | -188.50 |
| 5      | QC       | 115.00  | -188.50 |
| 6      | QD       | 252.00  | -188.50 |
| 7      | GND      | 252.00  | -73.50  |
| 8      | CLOCK    | 241.85  | 41.50   |
| 9      | CLEAR    | 252.00  | 180.50  |
| 10     | QE       | 137.00  | 190.50  |
| 11     | QF       | 2.00    | 190.50  |
| 12     | QG       | -113.00 | 190.50  |
| 13     | QH       | -250.00 | 190.50  |
| 14     | VDD      | -250.00 | 61.50   |

附图:



## 封装外形

SOP14



| Dimensions In Millimeters |       |       |          |           |       |
|---------------------------|-------|-------|----------|-----------|-------|
| Symbol :                  | Min : | Max : | Symbol : | Min :     | Max : |
| A                         | 4.520 | 4.620 | D        | 0.400     | 0.950 |
| A1                        | 0.100 | 0.250 | Q        | 0°        | 8°    |
| B                         | 8.500 | 9.000 | a        | 0.420TYP  |       |
| C                         | 5.800 | 6.250 | b        | 1.270 TYP |       |
| C1                        | 3.800 | 4.000 |          |           |       |

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