

# DATA SHEET

**74F164**

**8-bit serial-in parallel-out shift register**

Product specification  
Supersedes data of 1995 Sep 22

2000 Dec 18

# 8-bit serial-in parallel-out shift register

# 74F164

## FEATURES

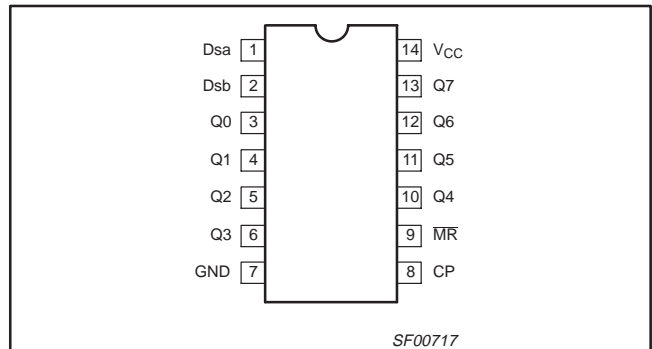
- Gated serial data inputs
- Typical shift frequency of 100MHz
- Asynchronous Master Reset
- Buffered clock and data inputs
- Fully synchronous data transfer
- Industrial temperature range available (-40 to +85 °C)

## DESCRIPTION

The 74F164 is an 8-bit edge-triggered shift register with serial data entry and an output from each of the eight stages. Data is entered through one of two inputs (Dsa, Dsb); either input can be used as an active High enable for data entry through the other input. Both inputs must be connected together or an unused input must be tied High.

Data shifts one place to the right on each Low-to-High transition of the clock (CP) input, and enters into Q0 the logical AND of the two data inputs (Dsa, Dsb) that existed one setup time before the rising edge. A Low level on the Master Reset ( $\overline{MR}$ ) input overrides all other inputs and clears the register asynchronously, forcing all outputs Low.

## PIN CONFIGURATION



| TYPE   | TYPICAL $f_{max}$ | TYPICAL SUPPLY CURRENT (TOTAL) |
|--------|-------------------|--------------------------------|
| 74F164 | 100MHz            | 33 mA                          |

## ORDERING INFORMATION

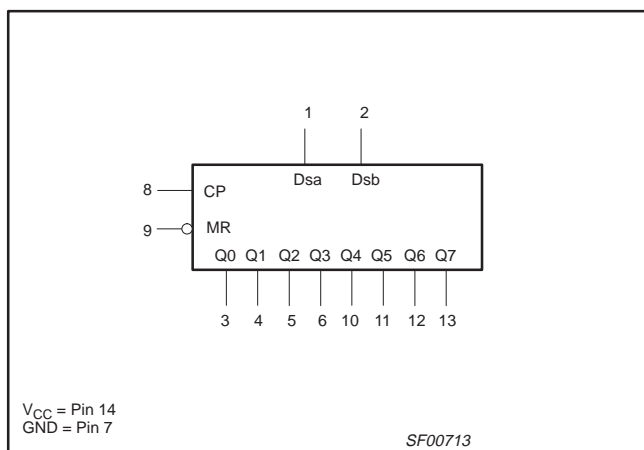
| DESCRIPTION        | ORDER CODE   |  | DRAWING NUMBER |
|--------------------|--|--|----------------|
|                    | COMMERCIAL RANGE<br>$V_{CC} = 5 V \pm 10\%$ , $T_{amb} = 0 \text{ to } +70 \text{ }^\circ\text{C}$ | INDUSTRIAL RANGE<br>$V_{CC} = 5 V \pm 10\%$ , $T_{amb} = -40 \text{ to } +85 \text{ }^\circ\text{C}$ |                |
| 14-pin plastic DIP | 74F164N  | I74F164N   | SOT27-1        |
| 14-pin plastic SO  | 74F164D  | I74F164D   | SOT108-1       |

## INPUT AND OUTPUT LOADING AND FAN OUT TABLE

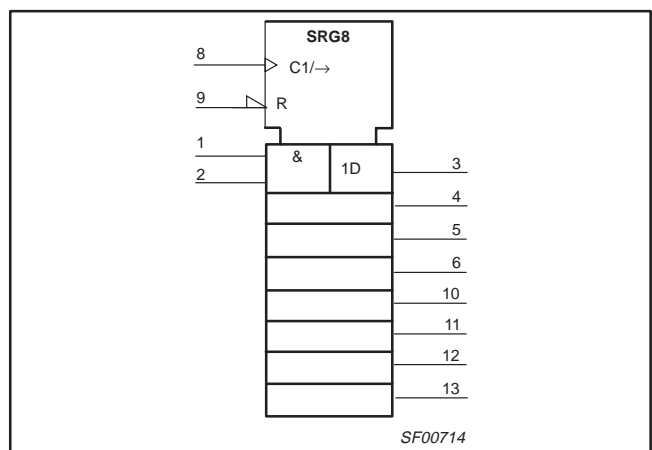
| PINS            | DESCRIPTION                            | 74F (U.L.) HIGH / LOW | LOAD VALUE HIGH / LOW     |
|-----------------|--|-----------------------|---------------------------|
| Dsa, Dsb        | Data inputs                            | 1.0 / 1.0             | 20 $\mu\text{A}$ / 0.6 mA |
| CP              | Clock pulse input (active rising edge) | 1.0 / 1.0             | 20 $\mu\text{A}$ / 0.6 mA |
| $\overline{MR}$ | Master reset input (active-Low)        | 1.0 / 1.0             | 20 $\mu\text{A}$ / 0.6 mA |
| Q0 – Q7         | Data outputs                           | 50 / 33               | 1.0 mA / 20 mA            |

One (1.0) FAST unit load is defined as: 20  $\mu\text{A}$  in the High state and 0.6 mA in the Low state.

## LOGIC SYMBOL



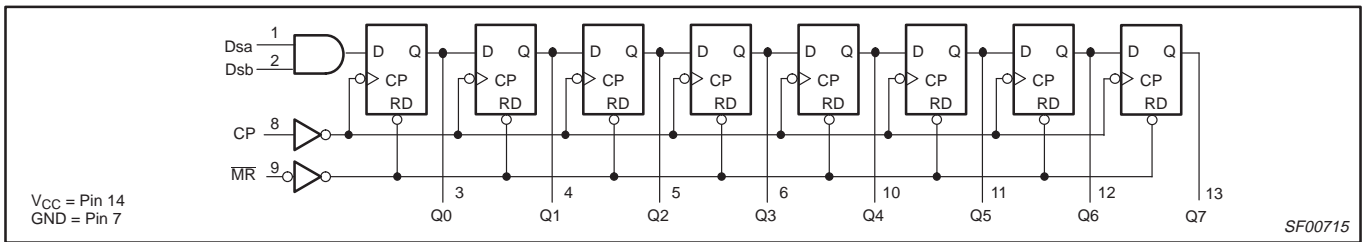
## IEC/IEEE SYMBOL



# 8-bit serial-in parallel-out shift register

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## LOGIC DIAGRAM



## FUNCTION TABLE

| INPUTS |    |     |     | OUTPUTS |    |    |    |    |    |    |    | OPERATING MODE |               |
|--------|----|-----|-----|---------|----|----|----|----|----|----|----|----------------|---------------|
| MR     | CP | Dsa | Dsb | Q0      | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 |                |               |
| L      | X  | X   | X   | L       | L  | L  | L  | L  | L  | L  | L  | L              | Reset (Clear) |
| H      | ↑  | l   | l   | L       | q0 | q1 | q2 | q3 | q4 | q5 | q6 | q6             | Shift         |
| H      | ↑  | h   | l   | L       | q0 | q1 | q2 | q3 | q4 | q5 | q6 | q6             |               |
| H      | ↑  | h   | h   | H       | q0 | q1 | q2 | q3 | q4 | q5 | q6 | q6             |               |

H = High voltage level  
 h = High voltage level one setup time prior to the Low-to-High clock transition.  
 L = Low voltage level  
 l = Low voltage level one setup time prior to the Low-to-High clock transition.  
 qn = Lower case letter indicate the state of the referenced output one setup time prior to the Low-to-High clock transition.  
 X = Don't care  
 ↑ = Low-to-High clock transition

## ABSOLUTE MAXIMUM RATINGS

(Operation beyond the limit set forth in this table may impair the useful life of the device. Unless otherwise noted these limits are over the operating free air temperature range.)

| SYMBOL           | PARAMETER                                      | RATING                  | UNIT       |
|------------------|--|-------------------------|------------|
| V <sub>CC</sub>  | Supply voltage                                 | -0.5 to +7.0            | V          |
| V <sub>IN</sub>  | Input voltage                                  | -0.5 to +7.0            | V          |
| I <sub>IN</sub>  | Input current                                  | -30 to +5               | mA         |
| V <sub>OUT</sub> | Voltage applied to output in High output state | -0.5 to V <sub>CC</sub> | V          |
| I <sub>OUT</sub> | Current applied to output in Low output state  | 40                      | mA         |
| T <sub>amb</sub> | Operating free-air temperature range           | Commercial Range        | 0 to +70   |
|                  |  | Industrial Range        | -40 to +85 |
| T <sub>stg</sub> | Storage temperature range                      | -65 to +150             | °C         |

## RECOMMENDED OPERATING CONDITIONS

| SYMBOL           | PARAMETER                            | LIMIT            |     |     | UNIT |
|------------------|--------------------------------------|------------------|-----|-----|------|
|                  |                                      | MIN              | NOM | MAX |      |
| V <sub>CC</sub>  | Supply voltage                       | 4.5              | 5.0 | 5.5 | V    |
| V <sub>IH</sub>  | High-level input voltage             | 2.0              |     |     | V    |
| V <sub>IL</sub>  | Low-level input voltage              |                  |     | 0.8 | V    |
| I <sub>Ik</sub>  | Input clamp current                  |                  |     | -18 | mA   |
| I <sub>OH</sub>  | High-level output current            |                  |     | -1  | mA   |
| I <sub>OL</sub>  | Low-level output current             |                  |     | 20  | mA   |
| T <sub>amb</sub> | Operating free-air temperature range | Commercial Range | 0   | +70 | °C   |
|                  |                                      | Industrial Range | -40 | +85 |      |

# 8-bit serial-in parallel-out shift register

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## DC ELECTRICAL CHARACTERISTICS

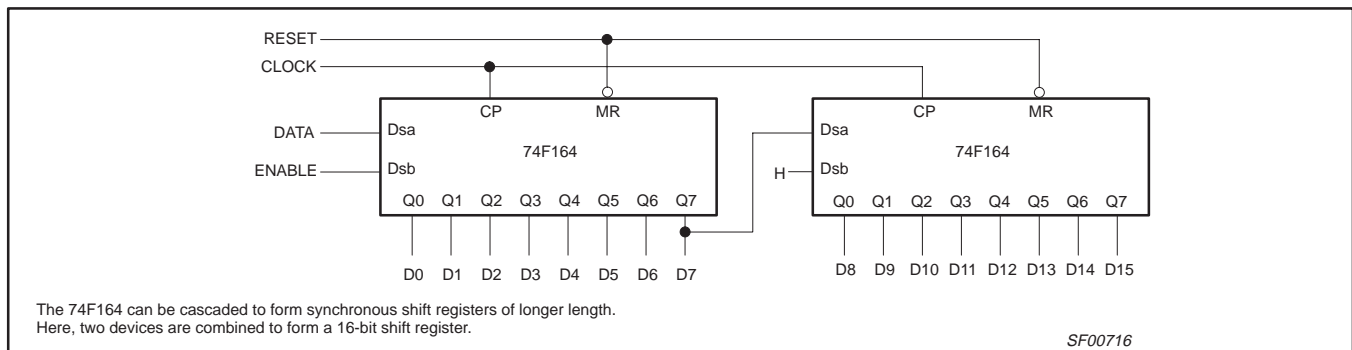
(Over recommended operating free-air temperature range unless otherwise noted.)

| SYMBOL           | PARAMETER                                 | TEST CONDITIONS <sup>1</sup>   | LIMITS              |                  |      | UNIT |   |
|------------------|---|--|---------------------|------------------|------|------|---|
|                  |   |  | MIN                 | TYP <sup>2</sup> | MAX  |      |   |
| V <sub>OH</sub>  | High-level output voltage                 | V <sub>CC</sub> = MIN, V <sub>IL</sub> = MAX, V <sub>IH</sub> = MIN, I <sub>OH</sub> = MAX | ±10%V <sub>CC</sub> | 2.5              |      | V    |   |
|                  |   |  | ±5%V <sub>CC</sub>  | 2.7              | 3.4  | V    |   |
| V <sub>OL</sub>  | Low-level output voltage                  | V <sub>CC</sub> = MIN, V <sub>IL</sub> = MAX, V <sub>IH</sub> = MIN, I <sub>OL</sub> = MAX | ±10%V <sub>CC</sub> |                  | 0.30 | 0.50 | V |
|                  |   |  | ±5%V <sub>CC</sub>  |                  | 0.30 | 0.50 | V |
| V <sub>IK</sub>  | Input clamp voltage                       | V <sub>CC</sub> = MIN, I <sub>I</sub> = I <sub>IK</sub>                                    |                     | -0.73            | -1.2 | V    |   |
| I <sub>I</sub>   | Input current at maximum input voltage    | V <sub>CC</sub> = MAX, V <sub>I</sub> = 7.0 V  |                     |                  | 100  | μA   |   |
| I <sub>IH</sub>  | High-level input current                  | V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V  |                     |                  | 20   | μA   |   |
| I <sub>ILL</sub> | Low-level input current                   | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.5 V  |                     |                  | -0.6 | mA   |   |
| I <sub>OS</sub>  | Short-circuit output current <sup>3</sup> | V <sub>CC</sub> = MAX  | -60                 |                  | -150 | mA   |   |
| I <sub>CC</sub>  | Supply current (total) <sup>4</sup>       | V <sub>CC</sub> = MAX  |                     | 33               | 55   | mA   |   |

### Notes to DC electrical characteristics

1. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
2. All typical values are at V<sub>CC</sub> = 5 V, T<sub>amb</sub> = 25 °C.
3. Not more than one output should be shorted at a time. For testing I<sub>OS</sub>, the use of high-speed test apparatus and/or sample-and-hold techniques are preferable in order to minimize internal heating and more accurately reflect operational values. Otherwise, prolonged shorting of a High output may raise the chip temperature well above normal and thereby cause invalid readings in other parameter tests. In any sequence of parameter test, I<sub>OS</sub> tests should be performed last.
4. Measure I<sub>CC</sub> with the serial inputs grounded, the clock input at 2.4 V, and a momentary ground, then applied to Master Reset, and all outputs open.

## APPLICATION



# 8-bit serial-in parallel-out shift register

74F164

## AC ELECTRICAL CHARACTERISTICS

| SYMBOL                 | PARAMETER                     | TEST CONDITION | LIMITS  |            |             |  |             |  | UNIT        |     |
|------------------------|-------------------------------|----------------|---|------------|-------------|--|-------------|--|-------------|-----|
|                        |                               |                | $T_{amb} = +25\text{ }^{\circ}\text{C}$<br>$V_{CC} = 5\text{ V}$<br>$C_L = 50\text{ pF}$<br>$R_L = 500\text{ }\Omega$ |            |             | $T_{amb} = 0\text{ to }+70\text{ }^{\circ}\text{C}$<br>$V_{CC} = +5\text{ V}\pm 10\%$<br>$C_L = 50\text{ pF}$<br>$R_L = 500\text{ }\Omega$ |             | $T_{amb} = -40\text{ to }+85\text{ }^{\circ}\text{C}$<br>$V_{CC} = +5\text{ V}\pm 10\%$<br>$C_L = 50\text{ pF}$<br>$R_L = 500\text{ }\Omega$ |             |     |
|                        |                               |                | MIN   | TYP        | MAX         | MIN  | MAX         | MIN  |             | MAX |
| $f_{max}$              | Maximum clock frequency       | Waveform 1     | 80  | 100        |             | 80   |             | 80   |             | MHz |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>CP to Qn | Waveform 1     | 3.0<br>5.0  | 5.0<br>7.0 | 8.0<br>10.0 | 2.5<br>5.0   | 9.0<br>11.0 | 2.5<br>5.0   | 9.0<br>11.0 | ns  |
| $t_{PHL}$              | Propagation delay<br>MR to Qn | Waveform 3     | 5.5   | 7.5        | 10.5        | 5.5  | 11.5        | 5.5  | 11.5        | ns  |

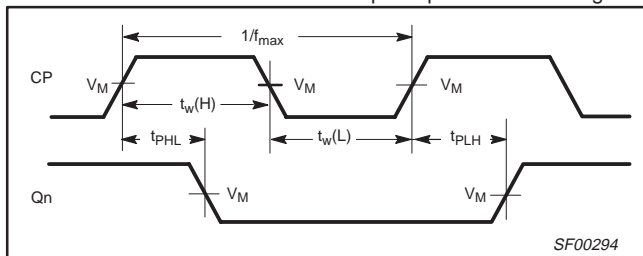
## AC SETUP REQUIREMENTS

| SYMBOL                   | PARAMETER                           | TEST CONDITION | LIMITS  |     |     |  |     |  | UNIT |     |
|--------------------------|-------------------------------------|----------------|---|-----|-----|--|-----|--|------|-----|
|                          |                                     |                | $T_{amb} = +25\text{ }^{\circ}\text{C}$<br>$V_{CC} = 5\text{ V}$<br>$C_L = 50\text{ pF}$<br>$R_L = 500\text{ }\Omega$ |     |     | $T_{amb} = 0\text{ to }+70\text{ }^{\circ}\text{C}$<br>$V_{CC} = +5\text{ V}\pm 10\%$<br>$C_L = 50\text{ pF}$<br>$R_L = 500\text{ }\Omega$ |     | $T_{amb} = -40\text{ to }+85\text{ }^{\circ}\text{C}$<br>$V_{CC} = +5\text{ V}\pm 10\%$<br>$C_L = 50\text{ pF}$<br>$R_L = 500\text{ }\Omega$ |      |     |
|                          |                                     |                | MIN   | TYP | MAX | MIN  | MAX | MIN  |      | MAX |
| $t_{s(H)}$<br>$t_{s(L)}$ | Setup time, High or Low<br>Dn to CP | Waveform 2     | 7.0<br>7.0  |     |     | 7.0<br>7.0   |     | 7.0<br>7.0   |      | ns  |
| $t_{h(H)}$<br>$t_{h(L)}$ | Hold time, High or Low<br>Dn to CP  | Waveform 2     | 1.0<br>1.0  |     |     | 2.0<br>2.0   |     | 2.0<br>2.0   |      | ns  |
| $t_{w(H)}$<br>$t_{w(L)}$ | CP Pulse width<br>High or Low       | Waveform 1     | 4.0<br>7.0  |     |     | 4.0<br>7.0   |     | 4.0<br>7.0   |      | ns  |
| $t_{w(L)}$               | MR Pulse width<br>Low               | Waveform 3     | 7.0   |     |     | 7.0  |     | 7.0  |      | ns  |
| $t_{REC}$                | Recovery time<br>MR to CP           | Waveform 3     | 7.0   |     |     | 7.0  |     | 7.0  |      | ns  |

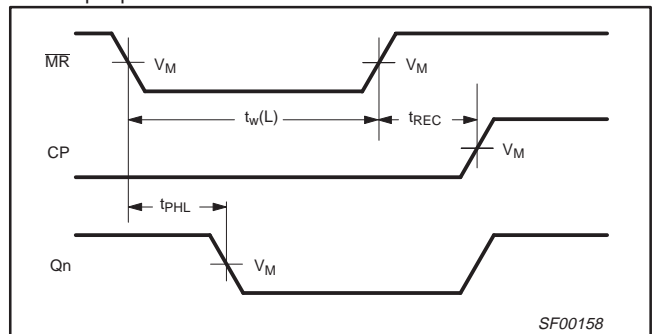
## AC WAVEFORMS

For all waveforms,  $V_M = 1.5\text{ V}$ .

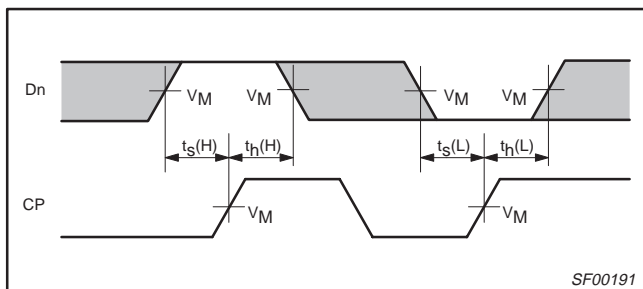
The shaded areas indicate when the input is permitted to change for predictable output performance.



Waveform 1. Propagation delay for Clock input to output, Clock Pulse width, and maximum Clock frequency



Waveform 3. Master Reset pulse width, Master Reset to output delay and Master Reset to Clock recovery time

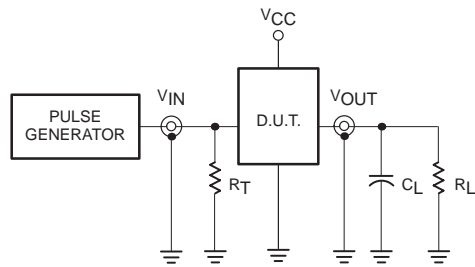


Waveform 2. Data setup and hold times

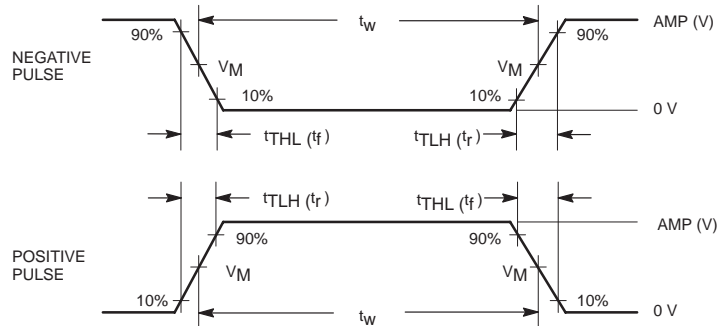
# 8-bit serial-in parallel-out shift register

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## TEST CIRCUIT AND WAVEFORMS



Test Circuit for Totem-Pole Outputs



Input Pulse Definition

**DEFINITIONS:**

- $R_L$  = Load resistor; see AC ELECTRICAL CHARACTERISTICS for value.
- $C_L$  = Load capacitance includes jig and probe capacitance; see AC ELECTRICAL CHARACTERISTICS for value.
- $R_T$  = Termination resistance should be equal to  $Z_{OUT}$  of pulse generators.

| family | INPUT PULSE REQUIREMENTS |       |           |        |           |           |
|--------|--------------------------|-------|-----------|--------|-----------|-----------|
|        | amplitude                | $V_M$ | rep. rate | $t_w$  | $t_{TLH}$ | $t_{THL}$ |
| 74F    | 3.0 V                    | 1.5 V | 1 MHz     | 500 ns | 2.5 ns    | 2.5 ns    |

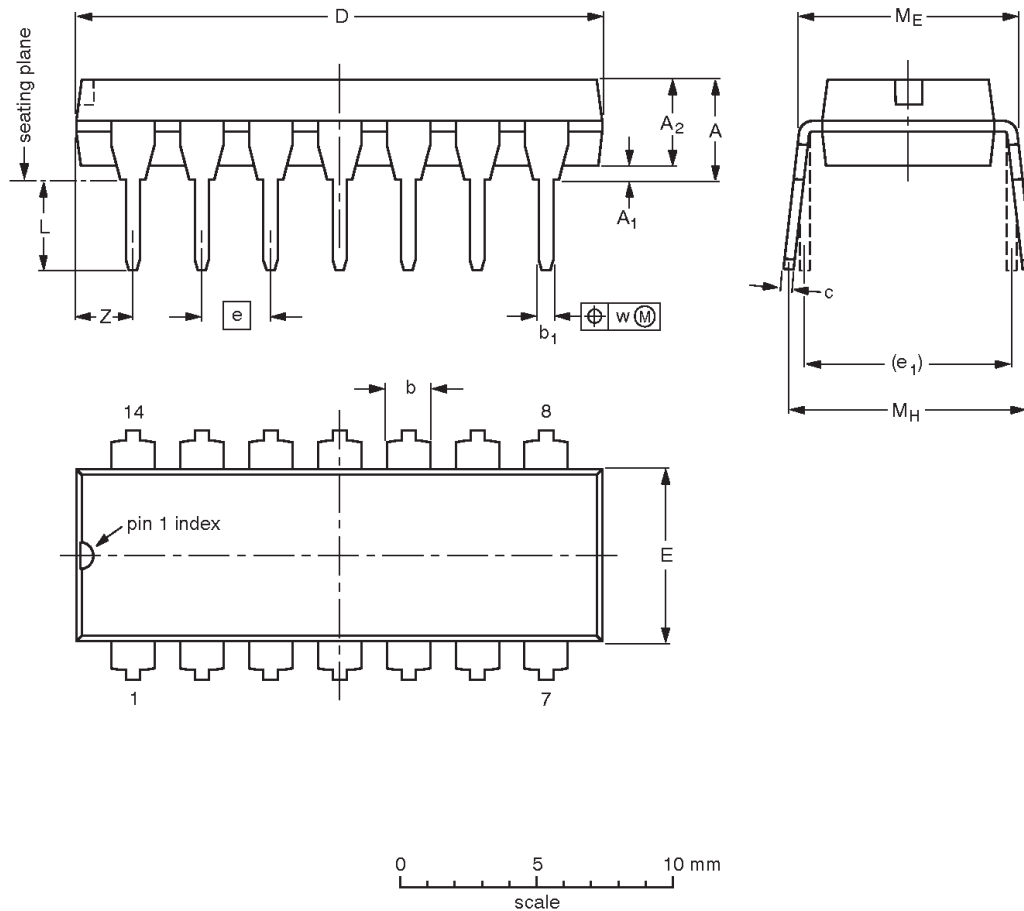
SF00006

# 8-bit serial-in parallel-out shift register

74F164

DIP14: plastic dual in-line package; 14 leads (300 mil)

SOT27-1



**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

| UNIT   | A max. | A <sub>1</sub> min. | A <sub>2</sub> max. | b              | b <sub>1</sub> | c              | D <sup>(1)</sup> | E <sup>(1)</sup> | e    | e <sub>1</sub> | L            | M <sub>E</sub> | M <sub>H</sub> | w     | Z <sup>(1)</sup> max. |
|--------|--------|---------------------|---------------------|----------------|----------------|----------------|------------------|------------------|------|----------------|--------------|----------------|----------------|-------|-----------------------|
| mm     | 4.2    | 0.51                | 3.2                 | 1.73<br>1.13   | 0.53<br>0.38   | 0.36<br>0.23   | 19.50<br>18.55   | 6.48<br>6.20     | 2.54 | 7.62           | 3.60<br>3.05 | 8.25<br>7.80   | 10.0<br>8.3    | 0.254 | 2.2                   |
| inches | 0.17   | 0.020               | 0.13                | 0.068<br>0.044 | 0.021<br>0.015 | 0.014<br>0.009 | 0.77<br>0.73     | 0.26<br>0.24     | 0.10 | 0.30           | 0.14<br>0.12 | 0.32<br>0.31   | 0.39<br>0.33   | 0.01  | 0.087                 |

**Note**

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

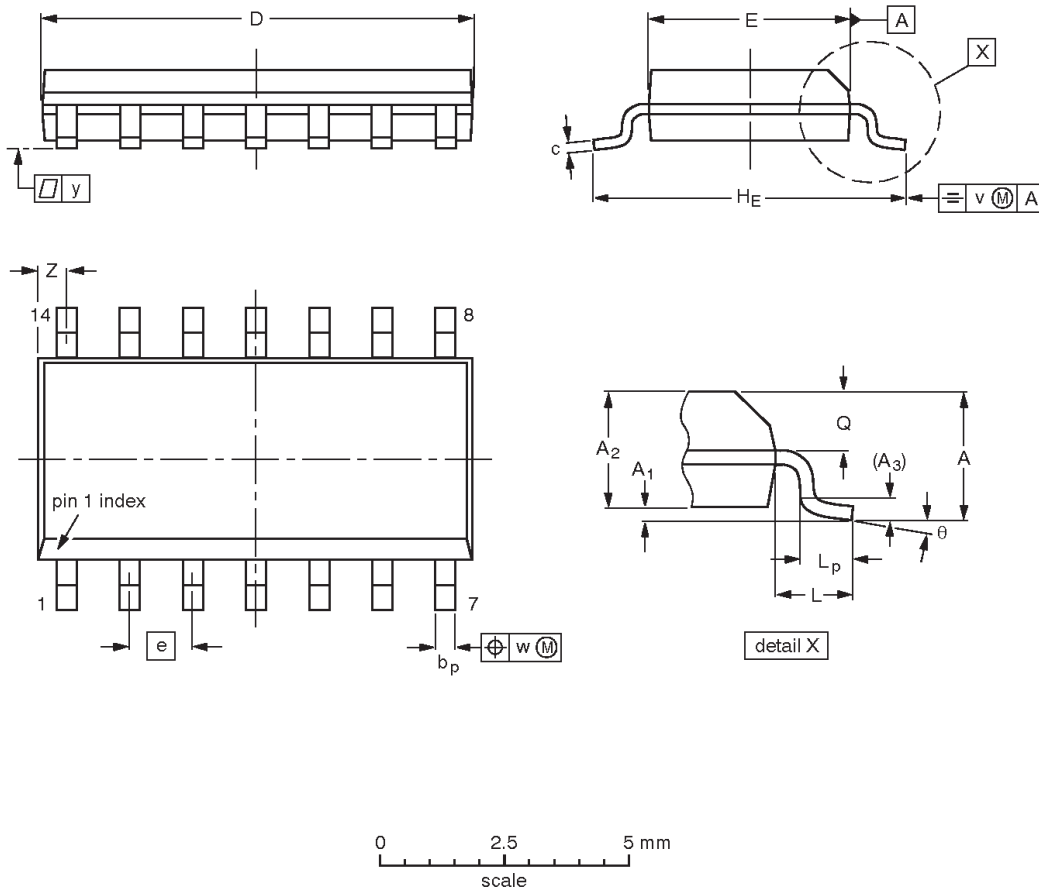
| OUTLINE VERSION | REFERENCES |        |           |  | EUROPEAN PROJECTION | ISSUE DATE           |
|-----------------|------------|--------|-----------|--|---------------------|----------------------|
|                 | IEC        | JEDEC  | EIAJ      |  |                     |                      |
| SOT27-1         | 050G04     | MO-001 | SC-501-14 |  |                     | 95-03-11<br>99-12-27 |

# 8-bit serial-in parallel-out shift register

74F164

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1



**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

| UNIT   | A max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c                | D <sup>(1)</sup> | E <sup>(1)</sup> | e     | H <sub>E</sub> | L     | L <sub>p</sub> | Q              | v    | w    | y     | Z <sup>(1)</sup> | θ        |
|--------|--------|----------------|----------------|----------------|----------------|------------------|------------------|------------------|-------|----------------|-------|----------------|----------------|------|------|-------|------------------|----------|
| mm     | 1.75   | 0.25<br>0.10   | 1.45<br>1.25   | 0.25           | 0.49<br>0.36   | 0.25<br>0.19     | 8.75<br>8.55     | 4.0<br>3.8       | 1.27  | 6.2<br>5.8     | 1.05  | 1.0<br>0.4     | 0.7<br>0.6     | 0.25 | 0.25 | 0.1   | 0.7<br>0.3       | 8°<br>0° |
| inches | 0.069  | 0.010<br>0.004 | 0.057<br>0.049 | 0.01           | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.35<br>0.34     | 0.16<br>0.15     | 0.050 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.024 | 0.01 | 0.01 | 0.004 | 0.028<br>0.012   |          |

**Note**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES |        |      |  | EUROPEAN PROJECTION | ISSUE DATE           |
|-----------------|------------|--------|------|--|---------------------|----------------------|
|                 | IEC        | JEDEC  | EIAJ |  |                     |                      |
| SOT108-1        | 076E06     | MS-012 |      |  |                     | 97-05-22<br>99-12-27 |



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8-bit serial-in parallel-out shift register

74F164

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**NOTES**

## 8-bit serial-in parallel-out shift register

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## Data sheet status

| Data sheet status         | Product status | Definition [1]   |
|---------------------------|----------------|--|
| Objective specification   | Development    | This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.  |
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[1] Please consult the most recently issued datasheet before initiating or completing a design.

## Definitions

**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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