



## F100141 8-Bit Shift Register

### General Description

The F100141 contains eight edge-triggered, D-type flip-flops with individual inputs ( $P_n$ ) and outputs ( $Q_n$ ) for parallel operation, and with serial inputs ( $D_n$ ) and steering logic for bidirectional shifting. The flip-flops accept input data a setup time before the positive-going transition of the clock pulse and their outputs respond a propagation delay after this rising clock edge.

The circuit operating mode is determined by the Select inputs  $S_0$  and  $S_1$ , which are internally decoded to select either

“parallel entry”, “hold”, “shift left” or “shift right” as described in the Truth Table. All inputs have 50 k $\Omega$  pull-down resistors.

Refer to the F100341 datasheet for:

PCC packaging

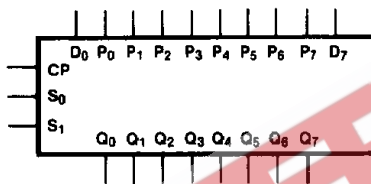
Lower power

Military versions

Extended voltage specs (–4.2V to –5.7V)

**Ordering Code:** See Section 8

### Logic Symbol

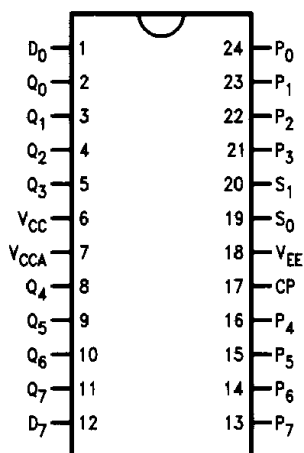


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| Pin Names  | Description     |
|------------|-----------------|
| CP         | Clock Input     |
| $S_0, S_1$ | Select Inputs   |
| $D_0, D_7$ | Serial Inputs   |
| $P_0-P_7$  | Parallel Inputs |
| $Q_0-Q_7$  | Data Outputs    |

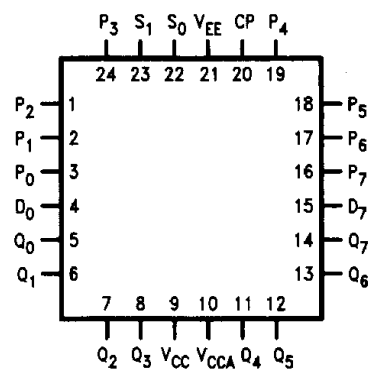
### Connection Diagrams

24-Pin DIP



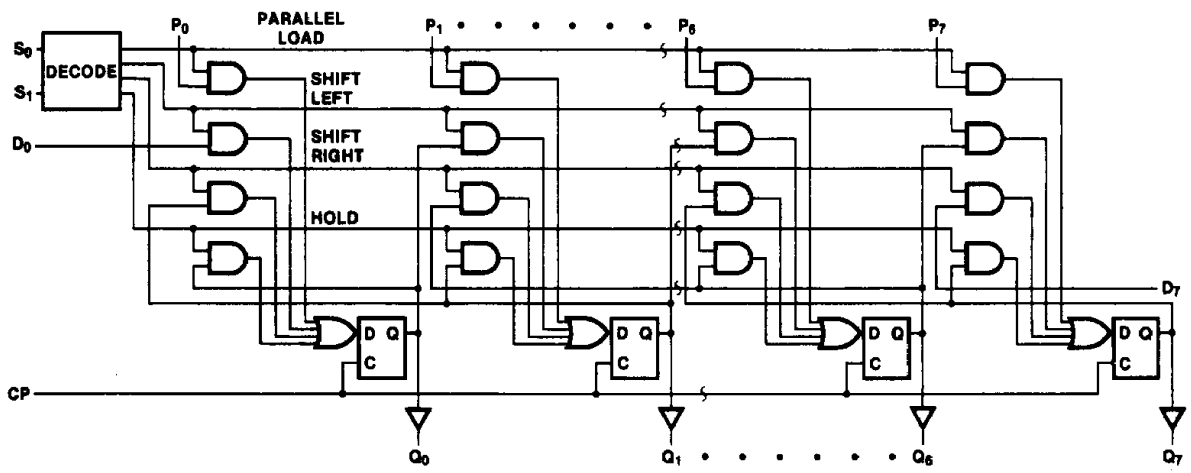
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24-Pin Quad Cerpak



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### Logic Diagram



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### Truth Table

| Function      | Inputs         |                |                |                |    | Outputs        |                |                |                |                |                |                |                |
|---------------|----------------|----------------|----------------|----------------|----|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
|               | D <sub>7</sub> | D <sub>0</sub> | S <sub>1</sub> | S <sub>0</sub> | CP | Q <sub>7</sub> | Q <sub>6</sub> | Q <sub>5</sub> | Q <sub>4</sub> | Q <sub>3</sub> | Q <sub>2</sub> | Q <sub>1</sub> | Q <sub>0</sub> |
| Load Register | X              | X              | L              | L              | ↗  | P <sub>7</sub> | P <sub>6</sub> | P <sub>5</sub> | P <sub>4</sub> | P <sub>3</sub> | P <sub>2</sub> | P <sub>1</sub> | P <sub>0</sub> |
| Shift Left    | X              | L              | L              | H              | ↗  | Q <sub>6</sub> | Q <sub>5</sub> | Q <sub>4</sub> | Q <sub>3</sub> | Q <sub>2</sub> | Q <sub>1</sub> | Q <sub>0</sub> | L              |
| Shift Left    | X              | H              | L              | H              | ↗  | Q <sub>6</sub> | Q <sub>5</sub> | Q <sub>4</sub> | Q <sub>3</sub> | Q <sub>2</sub> | Q <sub>1</sub> | Q <sub>0</sub> | H              |
| Shift Right   | L              | X              | H              | L              | ↗  | L              | Q <sub>7</sub> | Q <sub>6</sub> | Q <sub>5</sub> | Q <sub>4</sub> | Q <sub>3</sub> | Q <sub>2</sub> | Q <sub>1</sub> |
| Shift Right   | H              | X              | H              | L              | ↗  | H              | Q <sub>7</sub> | Q <sub>6</sub> | Q <sub>5</sub> | Q <sub>4</sub> | Q <sub>3</sub> | Q <sub>2</sub> | Q <sub>1</sub> |
| Hold          | X              | X              | H              | H              | X  | No Change      |                |                |                |                |                |                |                |
| Hold          | X              | X              | X              | X              | H  |                |                |                |                |                |                |                |                |
| Hold          | X              | X              | X              | X              | L  |                |                |                |                |                |                |                |                |

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Don't Care  
 ↗ = LOW-to-HIGH transition

## Absolute Maximum Ratings

Above which the useful life may be impaired. (Note 1)

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

Storage Temperature  $-65^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$   
Maximum Junction Temperature ( $T_J$ )  $+150^{\circ}\text{C}$

Case Temperature under Bias ( $T_C$ )  $0^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$   
 $V_{EE}$  Pin Potential to Ground Pin  $-7.0\text{V}$  to  $+0.5\text{V}$   
Input Voltage (DC)  $V_{EE}$  to  $+0.5\text{V}$   
Output Current (DC Output HIGH)  $-50\text{ mA}$   
Operating Range (Note 2)  $-5.7\text{V}$  to  $-4.2\text{V}$

## DC Electrical Characteristics

$V_{EE} = -4.5\text{V}$ ,  $V_{CC} = V_{CCA} = \text{GND}$ ,  $T_C = 0^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  (Note 3)

| Symbol    | Parameter           | Min     | Typ     | Max     | Units         | Conditions (Note 4)                                      |   |
|-----------|---------------------|---------|---------|---------|---------------|--|---|
| $V_{OH}$  | Output HIGH Voltage | $-1025$ | $-955$  | $-880$  | mV            | $V_{IN} = V_{IH}(\text{Max})$<br>or $V_{IL}(\text{Min})$ | Loading with $50\Omega$ to $-2.0\text{V}$ |
| $V_{OL}$  | Output LOW Voltage  | $-1810$ | $-1705$ | $-1620$ |               |  |   |
| $V_{OHC}$ | Output HIGH Voltage | $-1035$ |         |         | mV            | $V_{IN} = V_{IH}(\text{Min})$<br>or $V_{IL}(\text{Max})$ | Loading with $50\Omega$ to $-2.0\text{V}$ |
| $V_{OLC}$ | Output LOW Voltage  |         |         | $-1610$ |               |  |   |
| $V_{IH}$  | Input HIGH Voltage  | $-1165$ |         | $-880$  | mV            | Guaranteed HIGH Signal for All Inputs                    |   |
| $V_{IL}$  | Input LOW Voltage   | $-1810$ |         | $-1475$ | mV            | Guaranteed LOW Signal for All Inputs                     |   |
| $I_{IL}$  | Input LOW Current   | $0.50$  |         |         | $\mu\text{A}$ | $V_{IN} = V_{IL}(\text{Min})$                            |   |

## DC Electrical Characteristics

$V_{EE} = -4.2\text{V}$ ,  $V_{CC} = V_{CCA} = \text{GND}$ ,  $T_C = 0^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  (Note 3)

| Symbol    | Parameter           | Min     | Typ | Max     | Units         | Conditions (Note 4)                                      |   |
|-----------|---------------------|---------|-----|---------|---------------|--|---|
| $V_{OH}$  | Output HIGH Voltage | $-1020$ |     | $-870$  | mV            | $V_{IN} = V_{IH}(\text{Max})$<br>or $V_{IL}(\text{Min})$ | Loading with $50\Omega$ to $-2.0\text{V}$ |
| $V_{OL}$  | Output LOW Voltage  | $-1810$ |     | $-1605$ |               |  |   |
| $V_{OHC}$ | Output HIGH Voltage | $-1030$ |     |         | mV            | $V_{IN} = V_{IH}(\text{Min})$<br>or $V_{IL}(\text{Max})$ | Loading with $50\Omega$ to $-2.0\text{V}$ |
| $V_{OLC}$ | Output LOW Voltage  |         |     | $-1595$ |               |  |   |
| $V_{IH}$  | Input HIGH Voltage  | $-1150$ |     | $-870$  | mV            | Guaranteed HIGH Signal for All Inputs                    |   |
| $V_{IL}$  | Input LOW Voltage   | $-1810$ |     | $-1475$ | mV            | Guaranteed LOW Signal for All Inputs                     |   |
| $I_{IL}$  | Input LOW Current   | $0.50$  |     |         | $\mu\text{A}$ | $V_{IN} = V_{IL}(\text{Min})$                            |   |

## DC Electrical Characteristics

$V_{EE} = -4.8\text{V}$ ,  $V_{CC} = V_{CCA} = \text{GND}$ ,  $T_C = 0^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  (Note 3)

| Symbol    | Parameter           | Min     | Typ | Max     | Units         | Conditions (Note 4)                                      |   |
|-----------|---------------------|---------|-----|---------|---------------|--|---|
| $V_{OH}$  | Output HIGH Voltage | $-1035$ |     | $-880$  | mV            | $V_{IN} = V_{IH}(\text{Max})$<br>or $V_{IL}(\text{Min})$ | Loading with $50\Omega$ to $-2.0\text{V}$ |
| $V_{OL}$  | Output LOW Voltage  | $-1830$ |     | $-1620$ |               |  |   |
| $V_{OHC}$ | Output HIGH Voltage | $-1045$ |     |         | mV            | $V_{IN} = V_{IH}(\text{Min})$<br>or $V_{IL}(\text{Max})$ | Loading with $50\Omega$ to $-2.0\text{V}$ |
| $V_{OLC}$ | Output LOW Voltage  |         |     | $-1610$ |               |  |   |
| $V_{IH}$  | Input HIGH Voltage  | $-1165$ |     | $-880$  | mV            | Guaranteed HIGH Signal for All Inputs                    |   |
| $V_{IL}$  | Input LOW Voltage   | $-1830$ |     | $-1490$ | mV            | Guaranteed LOW Signal for All Inputs                     |   |
| $I_{IL}$  | Input LOW Current   | $0.50$  |     |         | $\mu\text{A}$ | $V_{IN} = V_{IL}(\text{Min})$                            |   |

**Note 1:** Absolute maximum ratings are those values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

**Note 2:** Parametric values specified at  $-4.2\text{V}$  to  $-4.8\text{V}$ .

**Note 3:** The specified limits represent the "worst case" value for the parameter. Since these "worst case" values normally occur at the temperature extremes, additional noise immunity and guard banding can be achieved by decreasing the allowable system operating ranges.

**Note 4:** Conditions for testing shown in the tables are chosen to guarantee operation under "worst case" conditions.

**DC Electrical Characteristics** $V_{EE} = -4.2V$  to  $-4.8V$  unless otherwise specified,  $V_{CC} = V_{CCA} = GND$ ,  $T_C = 0^\circ C$  to  $+85^\circ C$ 

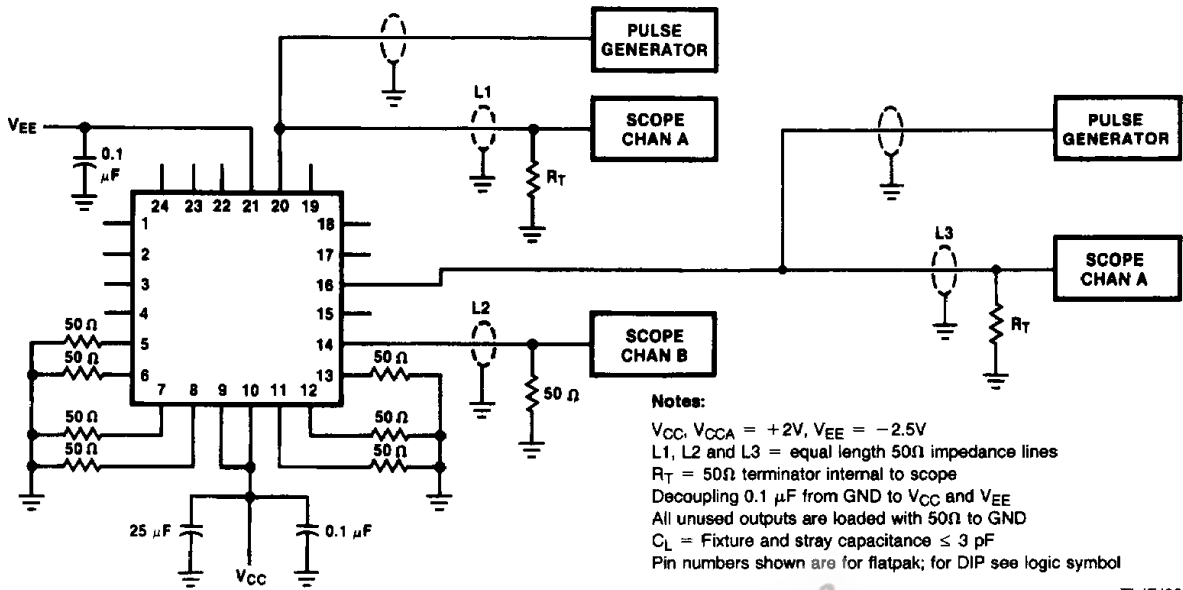
| Symbol   | Parameter                                   | Min  | Typ  | Max        | Units   | Conditions              |
|----------|---|------|------|------------|---------|-------------------------|
| $I_{IH}$ | Input HIGH Current<br>$D_n, P_n, S_n$<br>CP |      |      | 220<br>550 | $\mu A$ | $V_{IN} = V_{IH} (Max)$ |
| $I_{EE}$ | Power Supply Current                        | -238 | -170 | -119       | mA      | Inputs Open             |

**Ceramic Dual-In-Line Package AC Electrical Characteristics** $V_{EE} = -4.2V$  to  $-4.8V$ ,  $V_{CC} = V_{CCA} = GND$ 

| Symbol                 | Parameter                                 | $T_C = 0^\circ C$ |      | $T_C = +25^\circ C$ |      | $T_C = +85^\circ C$ |      | Units | Conditions      |
|------------------------|---|-------------------|------|---------------------|------|---------------------|------|-------|-----------------|
|                        |   | Min               | Max  | Min                 | Max  | Min                 | Max  |       |                 |
| $f_{shift}$            | Shift Frequency                           | 275               |      | 275                 |      | 255                 |      | MHz   | Figures 2 and 3 |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>CP to Output         | 0.90              | 2.40 | 1.10                | 2.30 | 1.10                | 2.50 | ns    | Figures 1 and 3 |
| $t_{TLH}$<br>$t_{THL}$ | Transition Time<br>20% to 80%, 80% to 20% | 0.45              | 1.50 | 0.45                | 1.40 | 0.45                | 1.50 | ns    |                 |
| $t_s$                  | Setup Time<br>$D_n, P_n$<br>$S_n$         | 0.85<br>2.20      |      | 0.85<br>2.20        |      | 0.85<br>2.20        |      | ns    | Figure 4        |
| $t_H$                  | Hold<br>$D_n, P_n$<br>$S_n$               | 0.60<br>0.10      |      | 0.60<br>0.10        |      | 0.60<br>0.10        |      | ns    |                 |
| $t_{pw(H)}$            | Pulse Width HIGH<br>CP                    | 2.00              |      | 2.00                |      | 2.00                |      | ns    | Figure 3        |

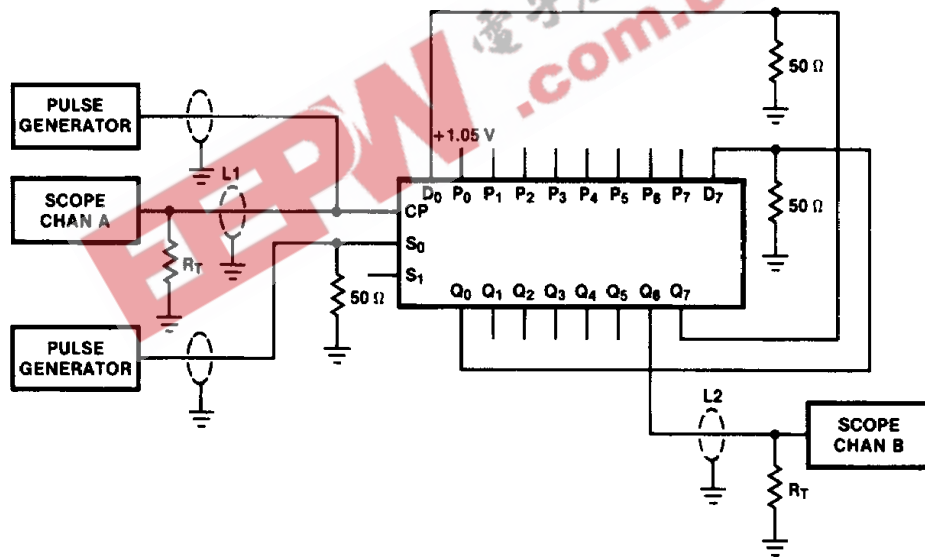
**Cerpak AC Electrical Characteristics** $V_{EE} = -4.2V$  to  $-4.8V$ ,  $V_{CC} = V_{CCA} = GND$ 

| Symbol                 | Parameter                                 | $T_C = 0^\circ C$ |      | $T_C = +25^\circ C$ |      | $T_C = +85^\circ C$ |      | Units | Conditions      |
|------------------------|---|-------------------|------|---------------------|------|---------------------|------|-------|-----------------|
|                        |   | Min               | Max  | Min                 | Max  | Min                 | Max  |       |                 |
| $f_{shift}$            | Shift Frequency                           | 300               |      | 300                 |      | 280                 |      | MHz   | Figures 2 and 3 |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>CP to Output         | 0.90              | 2.20 | 1.10                | 2.10 | 1.10                | 2.30 | ns    | Figures 1 and 3 |
| $t_{TLH}$<br>$t_{THL}$ | Transition Time<br>20% to 80%, 80% to 20% | 0.45              | 1.40 | 0.45                | 1.30 | 0.45                | 1.40 | ns    |                 |
| $t_s$                  | Setup Time<br>$D_n, P_n$<br>$S_n$         | 0.75<br>2.10      |      | 0.75<br>2.10        |      | 0.75<br>2.10        |      | ns    | Figure 4        |
| $t_H$                  | Hold<br>$D_n, P_n$<br>$S_n$               | 0.50<br>0         |      | 0.50<br>0           |      | 0.50<br>0           |      | ns    |                 |
| $t_{pw(H)}$            | Pulse Width HIGH<br>CP                    | 2.00              |      | 2.00                |      | 2.00                |      | ns    | Figure 3        |



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FIGURE 1. AC Test Circuit

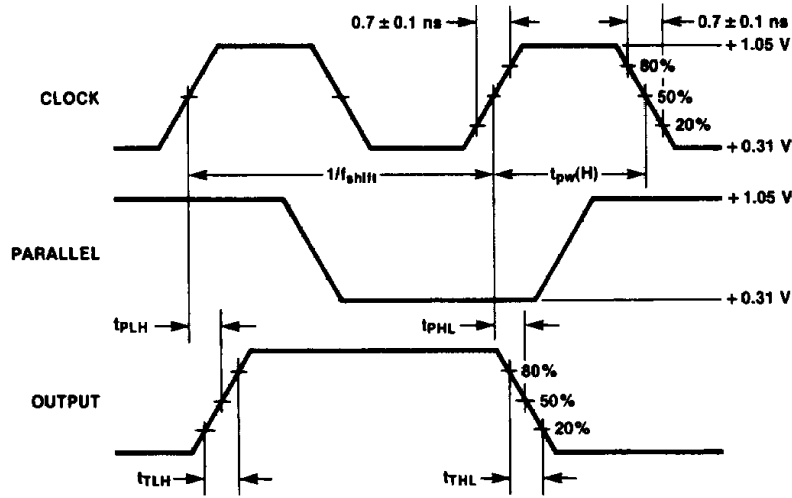


**Notes:**

For shift right mode pulse generator connected to  $S_0$  is moved to  $S_1$ .  
 Pulse generator connected to  $S_1$  has a LOW frequency 99% duty cycle, which allows occasional parallel load.  
 The feedback path from output to input should be as short as possible.

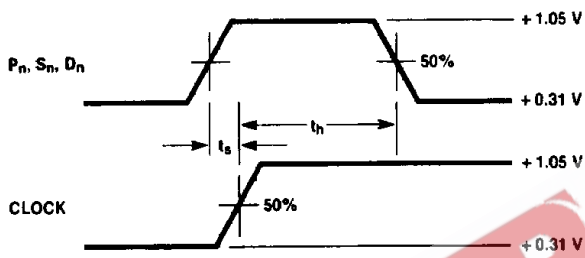
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FIGURE 2. Shift Frequency Test Circuit (Shift Left)



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FIGURE 3. Propagation Delay and Transition Times



**Note:**

$t_s$  is the minimum time before the transition of the clock that information must be present at the data input.

$t_h$  is the minimum time after the transition of the clock that information must remain unchanged at the data input.

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FIGURE 4. Setup and Hold Times