

# 100341

## Low Power 8-Bit Shift Register

### General Description

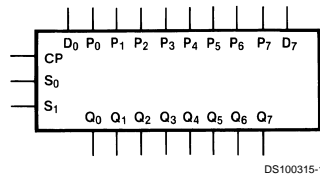
The 100341 contains eight edge-triggered, D-type flip-flops with individual inputs ( $P_n$ ) and outputs ( $Q_n$ ) for parallel operation, and with serial inputs ( $D_n$ ) and steering logic for bidirectional shifting. The flip-flops accept input data a setup time before the positive-going transition 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.

### Features

- 35% power reduction of the 100141
- 2000V ESD protection
- Pin/function compatible with 100141
- Voltage compensated operating range = -4.2V to -5.7V
- Standard Microcircuit Drawing (SMD) 5962-9459101

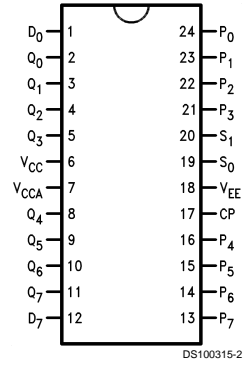
### Logic Symbol



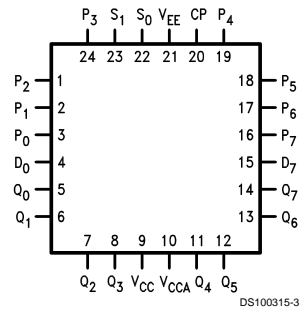
Pin Names	Description
CP	Clock Input
$S_0, S_1$	Select Inputs
$D_0, D_7$	Serial Inputs
$P_0-P_7$	Parallel Inputs
$Q_0-Q_7$	Data Outputs

## Connection Diagrams

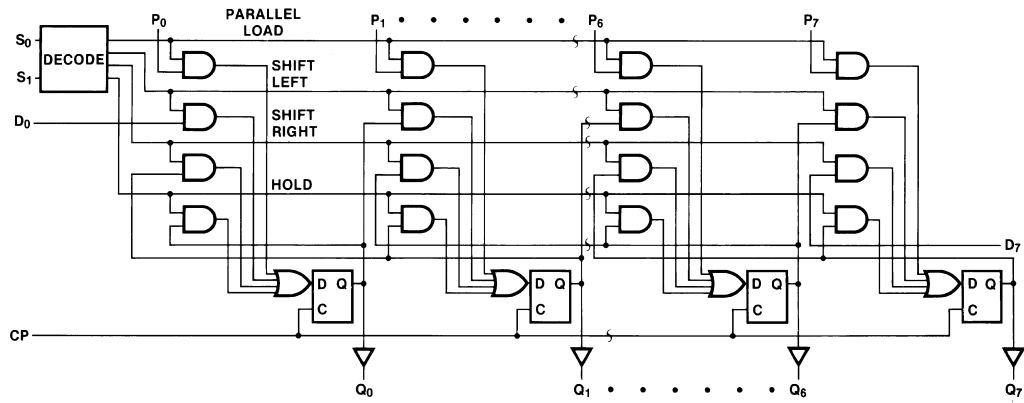
24-Pin DIP



24-Pin Quad Cerpak



## Logic Diagram



DS100315-5

## 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 (Note 1)

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

Above which the useful life may be impaired

Storage Temperature ( $T_{STG}$ )	-65°C to +150°C
Maximum Junction Temperature ( $T_J$ )	
Ceramic	+175°C
$V_{EE}$ Pin Potential to Ground Pin	-7.0V to +0.5V
Input Voltage (DC)	$V_{EE}$ to +0.5V
Output Current (DC Output HIGH)	-50 mA

ESD (Note 2)

≥2000V

## Recommended Operating Conditions

Case Temperature ( $T_C$ )	
Military	-55°C to +125°C
Supply Voltage ( $V_{EE}$ )	-5.7V to -4.2V

**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:** ESD testing conforms to MIL-STD-883, Method 3015.

## Military Version

### DC Electrical Characteristics

$V_{EE} = -4.2V$  to  $-5.7V$ ,  $V_{CC} = V_{CCA} = GND$ ,  $T_C = -55°C$  to  $+125°C$

Symbol	Parameter	Min	Max	Units	$T_C$	Conditions	Notes	
$V_{OH}$	Output HIGH Voltage	-1025	-870	mV	0°C to +125°C	$V_{IN} = V_{IH}$ (Max) or $V_{IL}$ (Min)	Loading with 50Ω to -2.0V	(Notes 3, 4, 5)
		-1085	-870	mV	-55°C			
$V_{OL}$	Output LOW Voltage	-1830	-1620	mV	0°C to +125°C			
		-1830	-1555	mV	-55°C			
$V_{OHC}$	Output HIGH Voltage	-1035		mV	0°C to +125°C	$V_{IN} = V_{IH}$ (Min) or $V_{IL}$ (Max)	Loading with 50Ω to -2.0V	(Notes 3, 4, 5)
		-1085		mV	-55°C			
$V_{OLC}$	Output LOW Voltage		-1610	mV	0°C to +125°C			
			-1555	mV	-55°C			
$V_{IH}$	Input HIGH Voltage	-1165	-870	mV	-55°C to +125°C	Guaranteed HIGH Signal for All Inputs	(Notes 3, 4, 5, 6)	
$V_{IL}$	Input LOW Current	-1830	-1475	mV	-55°C to +125°C	Guaranteed LOW Signal for All Inputs	(Notes 3, 4, 5, 6)	
$I_{IL}$	Input LOW Current	0.50		μA	-55°C to +125°C	$V_{EE} = -4.2V$ $V_{IN} = V_{IL}$ (Min)	(Notes 3, 4, 5, 6)	
$I_{IH}$	Input High Current		240	μA	0°C to +125°C	$V_{EE} = -5.7V$ $V_{IN} = V_{IH}$ (Max)	(Notes 3, 4, 5)	
			340	μA	-55°C			
$I_{EE}$	Power Supply Current	-168	-55	mA	-55°C to +125°C	Inputs Open $V_{EE} = -4.2V$ to $-4.8V$ $V_{EE} = -4.2V$ to $-5.7V$	(Notes 3, 4, 5)	
		-178	-55	mA				

**Note 3:** F100K 300 Series cold temperature testing is performed by temperature soaking (to guarantee junction temperature equals -55°C), then testing immediately without allowing for the junction temperature to stabilize due to heat dissipation after power-up. This provides "cold start" specifications which can be considered a worst case condition at cold temperatures.

**Note 4:** Screen tested 100% on each device at -55°C, +25°C and +125°C, Subgroups 1, 2, 3, 7, and 8.

**Note 5:** Sample tested (Method 5005, Table I) on each manufactured lot at -55°C, +25°C, and +125°C, Subgroups A1, 2, 3, 7, and 8.

**Note 6:** Guaranteed by applying specified input condition and testing  $V_{OH}/V_{OL}$ .

### AC Electrical Characteristics

$V_{EE} = -4.2V$  to  $-5.7V$ ,  $V_{CC} = V_{CCA} = GND$

Symbol	Parameter	$T_C = -55°C$		$T_C = +25°C$		$T_C = +125°C$		Units	Conditions	Notes
		Min	Max	Min	Max	Min	Max			
$f_{max}$	Max Clock Frequency	400		400		300		MHz	Figures 2, 3	4
$t_{PLH}$	Propagation Delay	0.50	2.50	0.50	2.30	0.50	2.80	ns	Figures 1, 3	(Notes 7, 8, 9, 11)
$t_{PHL}$	CP to Output									
$t_{TLH}$	Transition Time	0.30	1.30	0.30	1.30	0.30	1.30	ns		
$t_{THL}$	20% to 80%, 80% to 20%									

## AC Electrical Characteristics (Continued)

$V_{EE} = -4.2V$  to  $-5.7V$ ,  $V_{CC} = V_{CCA} = GND$

Symbol	Parameter	$T_C = -55^\circ C$		$T_C = +25^\circ C$		$T_C = +125^\circ C$		Units	Conditions	Notes
		Min	Max	Min	Max	Min	Max			
$t_s$	Setup Time	$D_n, P_n$	0.60	0.60	0.60	0.60	0.60	ns	Figure 4	(Note 10)
		$S_n$	1.70	1.60	2.40					
$t_h$	Hold Time	$D_n, P_n$	0.90	0.90	0.90	0.90	0.90	ns		
		$S_n$	0.50	0.50	0.50					
$t_{pw(H)}$	Pulse Width HIGH	CP	2.00	2.00	2.00	2.00	ns	Figure 3		

**Note 7:** F100K 300 Series cold temperature testing is performed by temperature soaking (to guarantee junction temperature equals  $-55^\circ C$ ), then testing immediately after power-up. This provides "cold start" specifications which can be considered a worst case condition at cold temperatures.

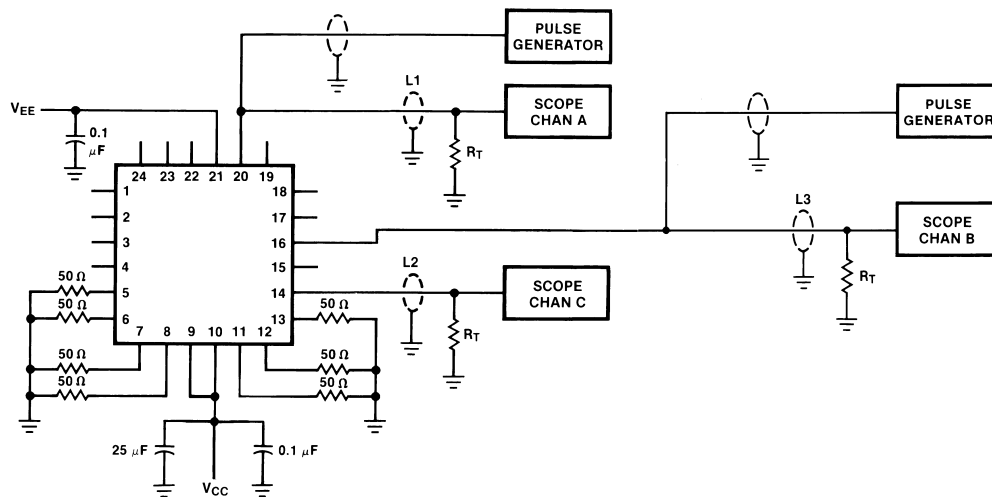
**Note 8:** Screen tested 100% on each device at  $+25^\circ C$  temperature only, Subgroup A9.

**Note 9:** Sample tested (Method 5005, Table I) on each manufactured lot at  $+25^\circ C$ , Subgroup A9, and at  $+125^\circ C$  and  $-55^\circ C$  temperatures, Subgroups A10 and A11.

**Note 10:** Not tested at  $+25^\circ C$ ,  $+125^\circ C$  and  $-55^\circ C$  temperature (design characterization data).

**Note 11:** The propagation delay specified is for the switching of a single output. Delays may vary up to 0.40 ns if multiple outputs are switching simultaneously.

## Test Circuitry



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### Notes:

$V_{CC}, V_{CCA} = +2V$ ,  $V_{EE} = -2.5V$

L1, L2 and L3 = equal length  $50\Omega$  impedance lines

$R_T = 50\Omega$  terminator internal to scope

Decoupling  $0.1\ \mu F$  from GND to  $V_{CC}$  and  $V_{EE}$

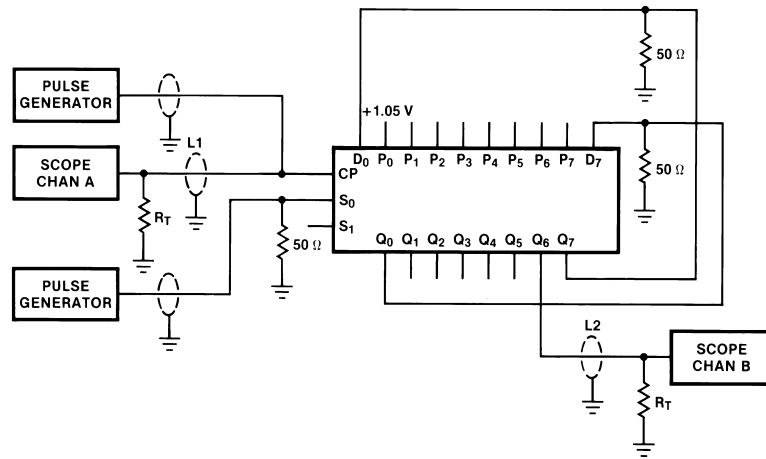
All unused outputs are loaded with  $50\Omega$  to GND

$C_L$  = Fixture and stray capacitance  $\leq 3\ pF$

Pin numbers shown are for Flatpak; for DIP see logic symbol

FIGURE 1. AC Test Circuit

**Test Circuitry** (Continued)



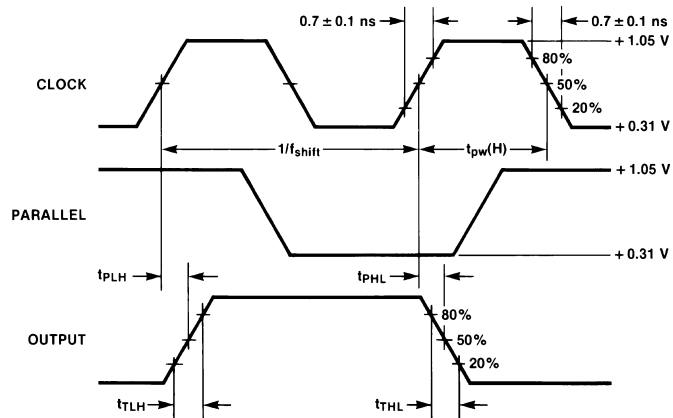
DS100315-7

**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.

**FIGURE 2. Shift Frequency Test Circuit (Shift Left)**

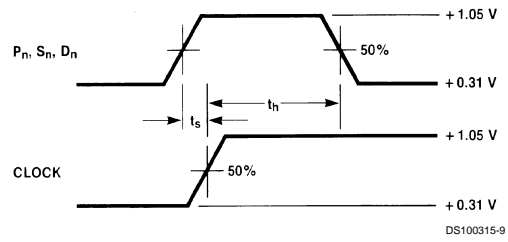
**Switching Waveforms**



DS100315-8

**FIGURE 3. Propagation Delay and Transition Times**

## Switching Waveforms (Continued)



DS100315-9

### Notes:

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

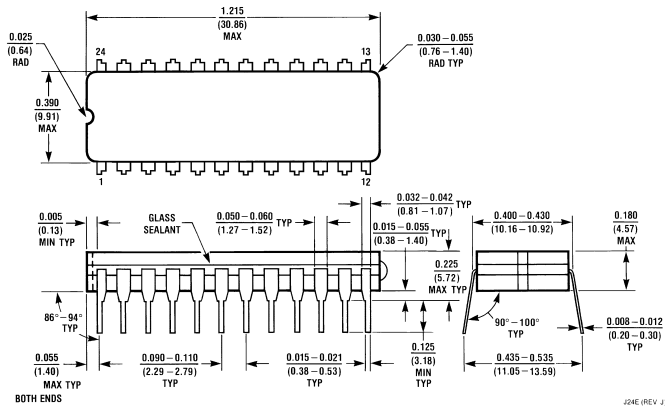
$t_h$  is the minimum time after the transition of the clock that information must remain unchanged at the data input.

**FIGURE 4. Setup and Hold Times**

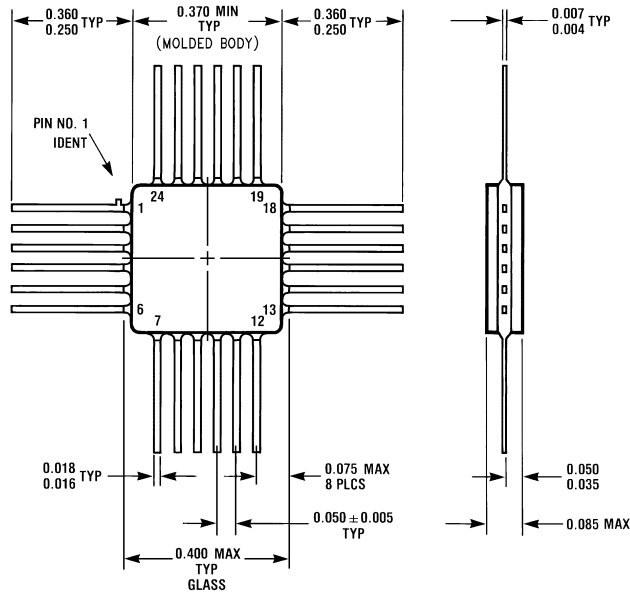




**Physical Dimensions** inches (millimeters) unless otherwise noted



**24-Lead Ceramic Dual-In-Line Package (0.400" Wide) (D)**  
NS Package Number J24E



**24-Lead Quad Cerpak (F)**  
NS Package Number W24B

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