2.5V 20-Bit Flip-Flop with 3-State Outputs

Product Features

- PI74AVC+16721 is designed for low voltage operation, V_{CC} = 1.65V to 3.6V
- True ±24mA Balanced Drive @ 3.3V
- I_{OFF} supports partial power-down operation
- 3.6V I/O Tolerant inputs and outputs
- All outputs contain a patented DDC (Dynamic DriveControl) circuit that reduces noise without degrading propagation delay.
- Industrial operation at –40°C to +85°C
- Available Packages:
  – 56-pin 240 mil wide plastic TSSOP (A)
  – 56-pin 173 mil wide plastic TVSOP (TSSOP) (K)

Product Description

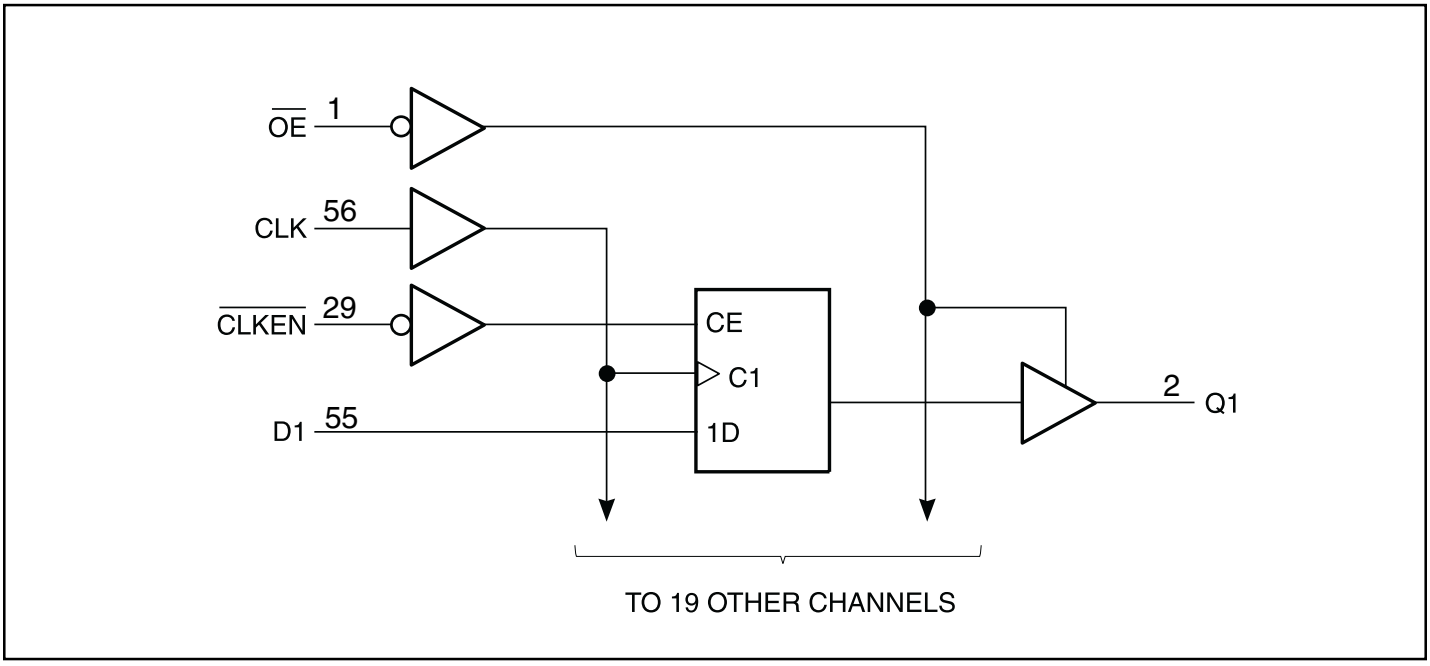
Pericom Semiconductor's PI74AVC+ series of logic circuits are produced using the Company's advanced submicron CMOS technology, achieving industry leading speed.

The PI74AVC+16721 is a 20-bit flip-flop with 3-state outputs designed specifically for 1.65V to 3.6V V_{CC} operation. The device is designed with edge-triggered D-type flip-flops with qualified clock storage. On the positive transition of clock (CLK) input, the device provides true data at the Q outputs, provided that the clock-enable ($\overline{CLKEN}$) input is LOW. If $\overline{CLKEN}$ is HIGH, no data is stored.

A buffered output-enable ($\overline{OE}$) input can be used to place the 20 outputs in either a normal logic state (HIGH or LOW level) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased drive provide the capacity to drive bus lines without the need for interface or pullup components. $\overline{OE}$ does not affect the internal operation of the flip-flops. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

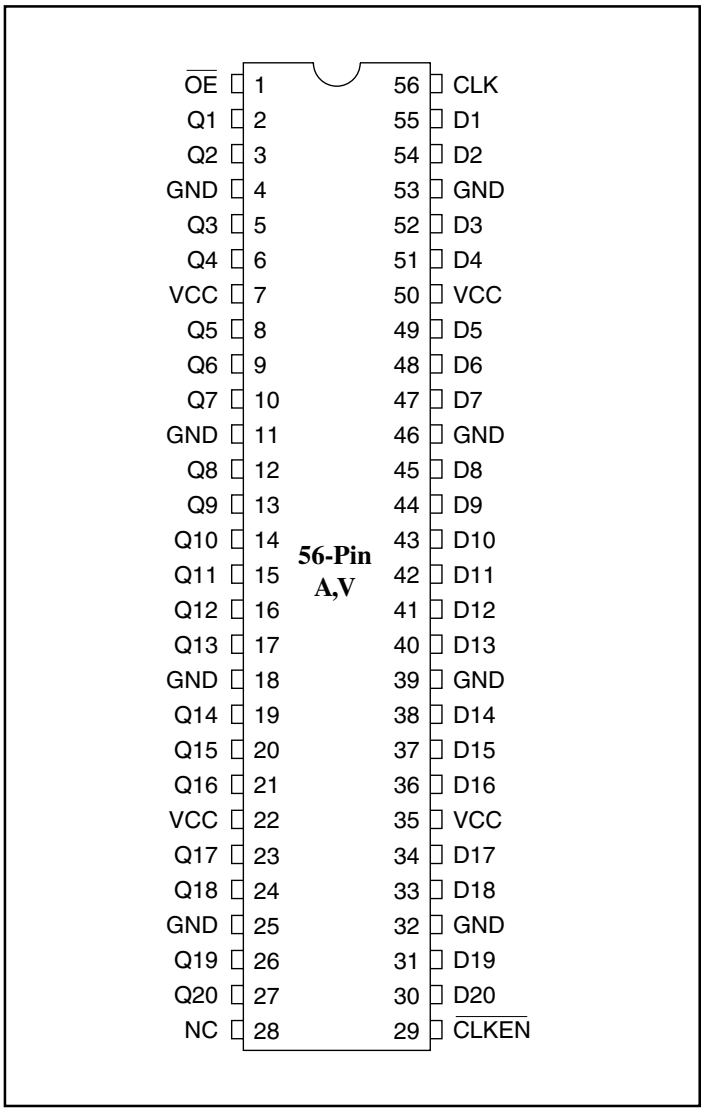
Logic Block Diagram



Product Pin Description

Pin Name	Description
$\overline{\text{OE}}$	Output Enable Input (Active LOW)
$\overline{\text{CLKEN}}$	Clock Enable Input (Active LOW)
CLK	Clock Input (Active HIGH)
Dx	Data Inputs
Qx	3-State Outputs
GND	Ground
VCC	Power

Product Pin Configuration



Truth Table[1]

Inputs				Outputs
$\overline{\text{OE}}$	$\overline{\text{CLKEN}}$	CLK	Dx	Qx
L	H	X	X	Q_0
L	L	–	H	H
L	L	–	L	L
L	L	L or H	X	Q_0
H	X	X	X	Z

Notes:

1. H = High Signal Level
   L = Low Signal Level
   X = Don't Care or Irrelevant
   Z = High Impedance
   ↑ = LOW-to-HIGH Transition

Maximum Ratings above which the useful life may be impaired. (For user guidelines, not tested.)

Supply voltage range, V_{CC}	–0.5V to +4.6V
Input voltage range, V_I	–0.5V to +4.6V
Voltage range applied to any output in the high-impedance or power-off state, V_O(1)	–0.5V to +4.6V
Voltage range applied to any output in the high or low state, V_O(1,2)	–0.5V to V_{CC}+0.5V
Input clamp current, I_{IK} (V_I<0)	–50mA
Output clamp current, I_{OK} (V_O<0)	–50mA
Continuous output current, I_O	±50mA
Continuous current through each V_{CC} or GND	±100mA
Package thermal impedance, θ_{JA}(3): package A	64°C/W
package K	48°C/W
Storage Temperature range, T_{stg}	–65°C to 150°C

Note:
Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Notes:
1. Input & output negative-voltage ratings may be exceeded if the input and output curent rating are observed.
2. Output positive-voltage rating may be exceeded up to 4.6V maximum if theoutput current rating is observed.
3. The package thermal impedance is calculated in accordance with JESD 51.

Recommended Operating Conditions(1)

		Min.	Max.	Units
V_{CC} Supply Voltage	Operating	1.65	3.6	V
	Data retention only	1.2		
V_{IH} High-level Input Voltage	V_{CC} = 1.2V	V_{CC}		
	V_{CC} = 1.65V to 1.95V	0.65 x V_{CC}		
	V_{CC} = 2.3V to 2.7V	1.7		
	V_{CC} = 3V to 3.6V	2		
V_{IL} Low-level Input Voltage	V_{CC} = 1.2V		Gnd	
	V_{CC} = 1.65V to 1.95V		0.35 x V_{CC}	
	V_{CC} = 2.3V to 2.7V		0.7	
	V_{CC} = 3V to 3.6V		0.8	
V_I Input Voltage		0	3.6	
V_O Output Voltage	Active State	0	V_{CC}	
	3-State	0	3.6	
I_{OH} High-level output current	V_{CC} = 1.65V to 1.95V		– 6	mA
	V_{CC} = 2.3V to 2.7V		– 12	
	V_{CC} = 3V to 3.6V		– 24	
I_{OL} Low-level output current	V_{CC} = 1.65V to 1.95V		6	
	V_{CC} = 2.3V to 2.7V		12	
	V_{CC} = 3V to 3.6V		24	
$\Delta t/\Delta v$ Input transition rise or fall rate	V_{CC} = 1.65V to 3.6V		5	ns/V
T_A Operating free-air temperature		–40	85	°C

Notes:
1. All unused inputs must be held at V_{CC} or GND to ensure proper device operation.

DC Electrical Characteristics over the Operating Range ($T_A = –40°C$ +85°C)

Parameters		Test Conditions[1]	V_{CC}	Min.	Typ.	Max.	Units
V_{OH}		I_{OH} = –100µA	1.65V to 3.6V	V_{CC} –0.2V			V
		I_{OH} = –6mA V_{IH} = 1.07V	1.65V	1.2			
		I_{OH} = –12mA V_{IH} = 1.7V	2.3V	1.75			
		I_{OH} = –24mA V_{IH} = 2V	3V	2.0			
V_{OL}		I_{OL} = 100µA	1.65V to 3.6V			0.2	
		I_{OL} = 6mA V_{IH} = 0.57V	1.65V			0.45	
		I_{OL} = 12mA V_{IH} = 0.7V	2.3V			0.55	
		I_{OL} = 24mA V_{IH} = 0.8V	3V			0.8	
I_I	Control Inputs	$V_I = V_{CC}$ or GND	3.6V			±2.5	µA
I_{OFF}		V_I or V_O = 3.6V	0			±10	
I_{OZ}		$V_I = V_{CC}$ or GND	3.6V			±10	
I_{CC}		$V_O = V_{CC}$ or GND I_O = 0	3.6V			40	
C_I	Control Inputs	$V_I = V_{CC}$ or GND	2.5V		4		pF
			3.3V		4		
	Data Inputs		2.5V		6		
			3.3V		6		
C_O	Outputs	$V_O = V_{CC}$ or GND	2.5V		8		
			3.3V		8		

Note: Typical values are measured at $T_A = 25°C$.

Timing Requirements over recommended operating free-air temperature range

(unless otherwise noted, see Figures 1 thru 4)

		V_{CC} = 1.2 V		V_{CC} = 1.5V ±0.1V		V_{CC} = 1.8V ±0.15V		V_{CC} = 2.5V ±0.2V		V_{CC} = 3.3V ±0.3V		Units
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
f_{clock} Clock Frequency							150		180		180	MHz
t_w Pulse duration, CLK high or low						6.0		3.0		3.0		ns
t_{su} Setup time	Data before CLK↑					5.7		3.5		2.4		ns
	$\overline{CLKEN}$ before CLK↑					2.2		2.0		1.6		ns
t_h Hold time	Data after CLK↑					0		0		0		ns
	$\overline{CLKEN}$ after CLK↑					1.2		1.0		1.0		ns

Switching Characteristics over recommended operating free-air temperature range

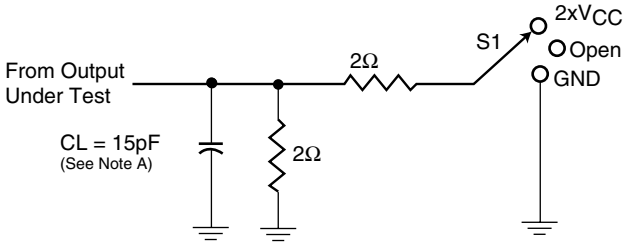
(unless otherwise noted, see Figures 1 thru 4)

Parameters	From (Input)	To (Output)	V_{CC} = 1.2V		V_{CC} = 1.5V ±0.1V		V_{CC} = 1.8V ±0.15V		V_{CC} = 2.5V ±0.2V		V_{CC} = 3.3V ±0.3V		Units
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
f_{max}							150		180		180		MHz
t_{pd}	CLK	Q						4.3		3.0		2.6	ns
t_{en}	$\overline{OE}$	Q						5.8		4.8		4.0	ns
t_{dis}	$\overline{OE}$	Q						4.8		3.6		3.4	ns

Operating Characteristics, T_A= 25°C

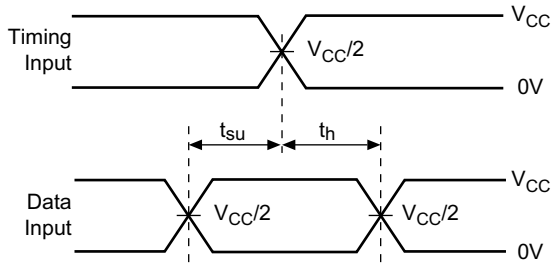
Parameters		Test Conditions	Vcc = 1.8V ±0.15V	Vcc = 2.5V ±0.2V	Vcc = 3.3V ±0.3V	Units
			Typical	Typical	Typical	
Cpd Power Dissipation Capacitance	Outputs Enabled	C_L = 0pF, f = 10 MHz	65	80	100	pF
	Outputs Disabled		40	50	75	pF

PARAMETER MEASUREMENT INFORMATION
V_{CC} = 1.2V and 1.5V ±0.1V

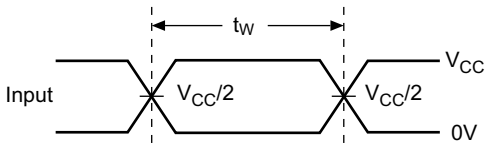


Test	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	2 x V_{CC}
t_{PHZ}/t_{PZH}	GND

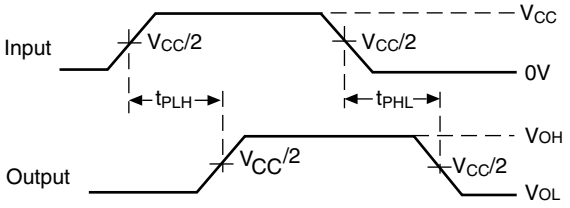
Load Circuit



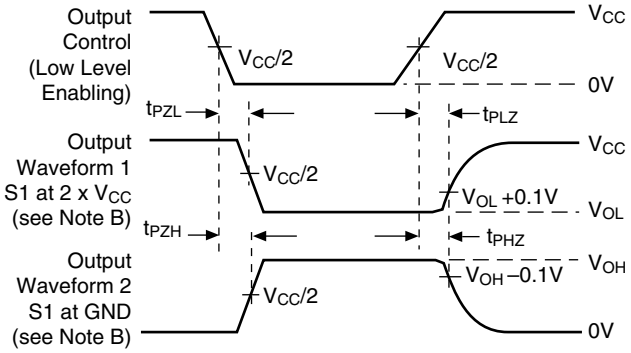
Voltage Waveforms
Setup and Hold Times



Voltage Waveforms
Pulse Duration



Voltage Waveforms
Propagation Delay Times



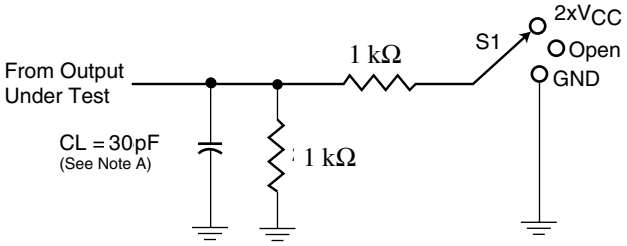
Voltage Waveforms
Enable and Disable Times

Figure 1. Load Circuit and Voltage Waveforms

Notes:

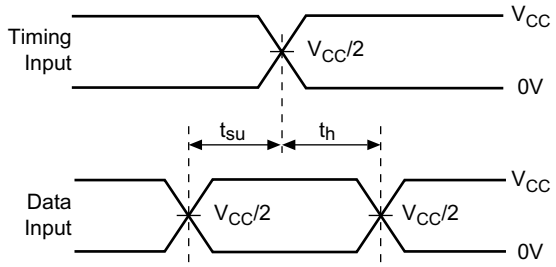
A. C_L includes probe and jig capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
C. All input impulses are supplied by generators having the following characteristics: PRR ≤10 MHz, Z_O = 50Ω, t_R ≤2.0ns, t_F ≤2.0ns.
D. The outputs are measured one at a time with one transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis}
F. t_{PZL} and t_{PZH} are the same as t_{en}
G. t_{PLH} and t_{PHL} are the same as t_{pd}

PARAMETER MEASUREMENT INFORMATION
V_{CC} = 1.8V ±0.15V

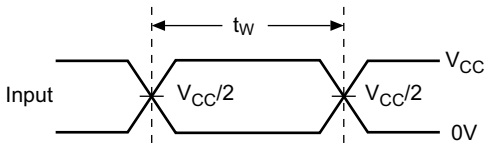


Test	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	2 x V_{CC}
t_{PHZ}/t_{PZH}	GND

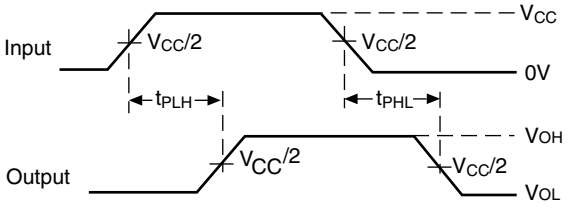
Load Circuit



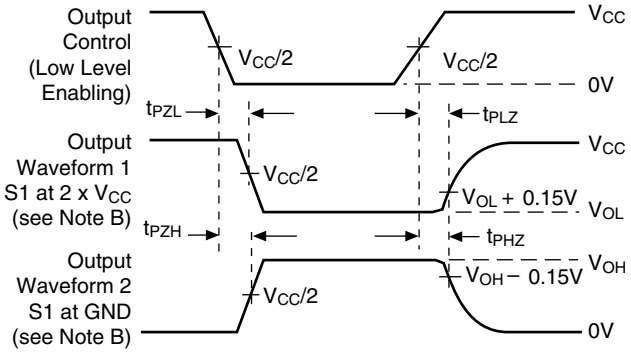
Voltage Waveforms
Setup and Hold Times



Voltage Waveforms
Pulse Duration



Voltage Waveforms
Propagation Delay Times



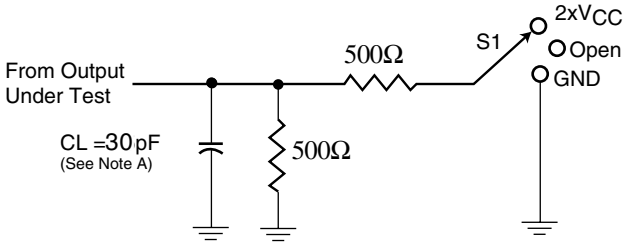
Voltage Waveforms
Enable and Disable Times

Figure 2. Load Circuit and Voltage Waveforms

Notes:

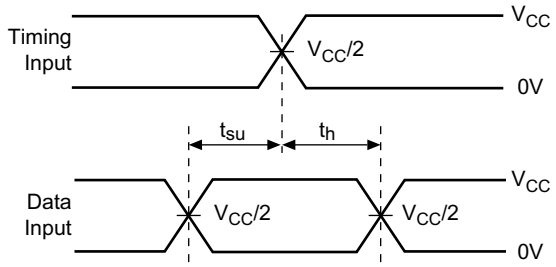
A. C_L includes probe and jig capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
C. All input impulses are supplied by generators having the following characteristics: PRR ≤10 MHz, Z_O = 50Ω, t_R ≤2.0ns, t_F ≤2.0ns.
D. The outputs are measured one at a time with one transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis}
F. t_{PZL} and t_{PZH} are the same as t_{en}
G. t_{PLH} and t_{PHL} are the same as t_{pd}

PARAMETER MEASUREMENT INFORMATION
V_{CC} = 2.5V ± 0.2V

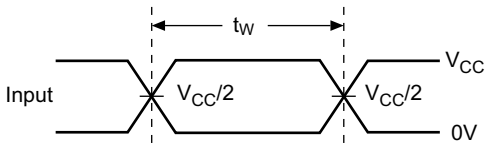


Test	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	2 x V_{CC}
t_{PHZ}/t_{PZH}	GND

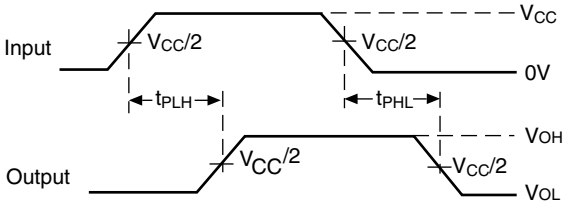
Load Circuit



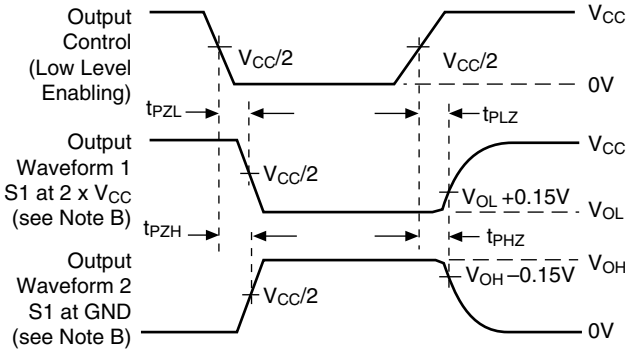
Voltage Waveforms
Setup and Hold Times



Voltage Waveforms
Pulse Duration



Voltage Waveforms
Propagation Delay Times



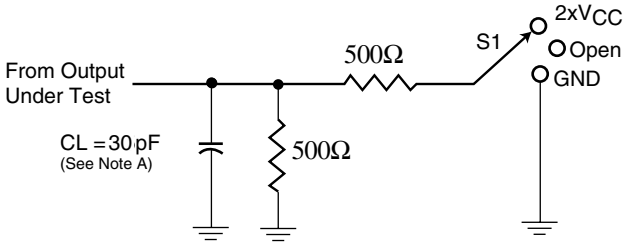
Voltage Waveforms
Enable and Disable Times

Figure 3. Load Circuit and Voltage Waveforms

Notes:

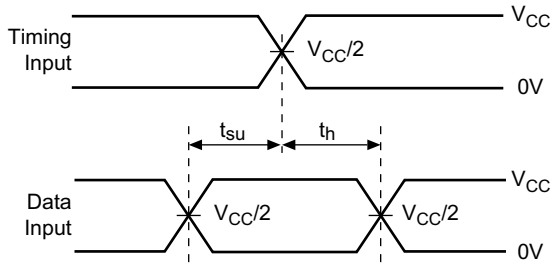
A. C_L includes probe and jig capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
C. All input impulses are supplied by generators having the following characteristics: PRR ≤10 MHz, Z_O = 50Ω, t_R ≤2.0ns, t_F ≤2.0ns.
D. The outputs are measured one at a time with one transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis}
F. t_{PZL} and t_{PZH} are the same as t_{en}
G. t_{PLH} and t_{PHL} are the same as t_{pd}

PARAMETER MEASUREMENT INFORMATION
V_{CC} = 3.3V ± 0.3V

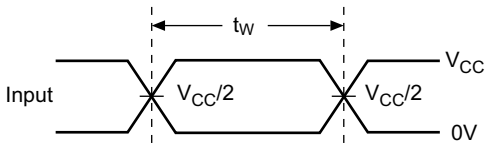


Test	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	2 x V_{CC}
t_{PHZ}/t_{PZH}	GND

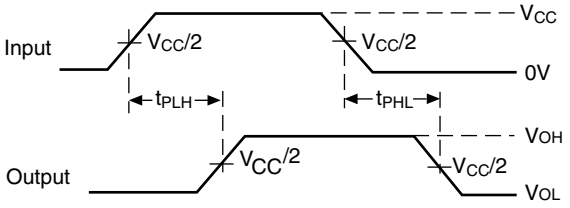
Load Circuit



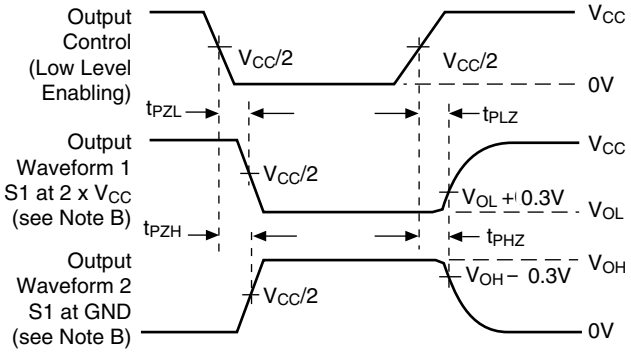
Voltage Waveforms
Setup and Hold Times



Voltage Waveforms
Pulse Duration



Voltage Waveforms
Propagation Delay Times



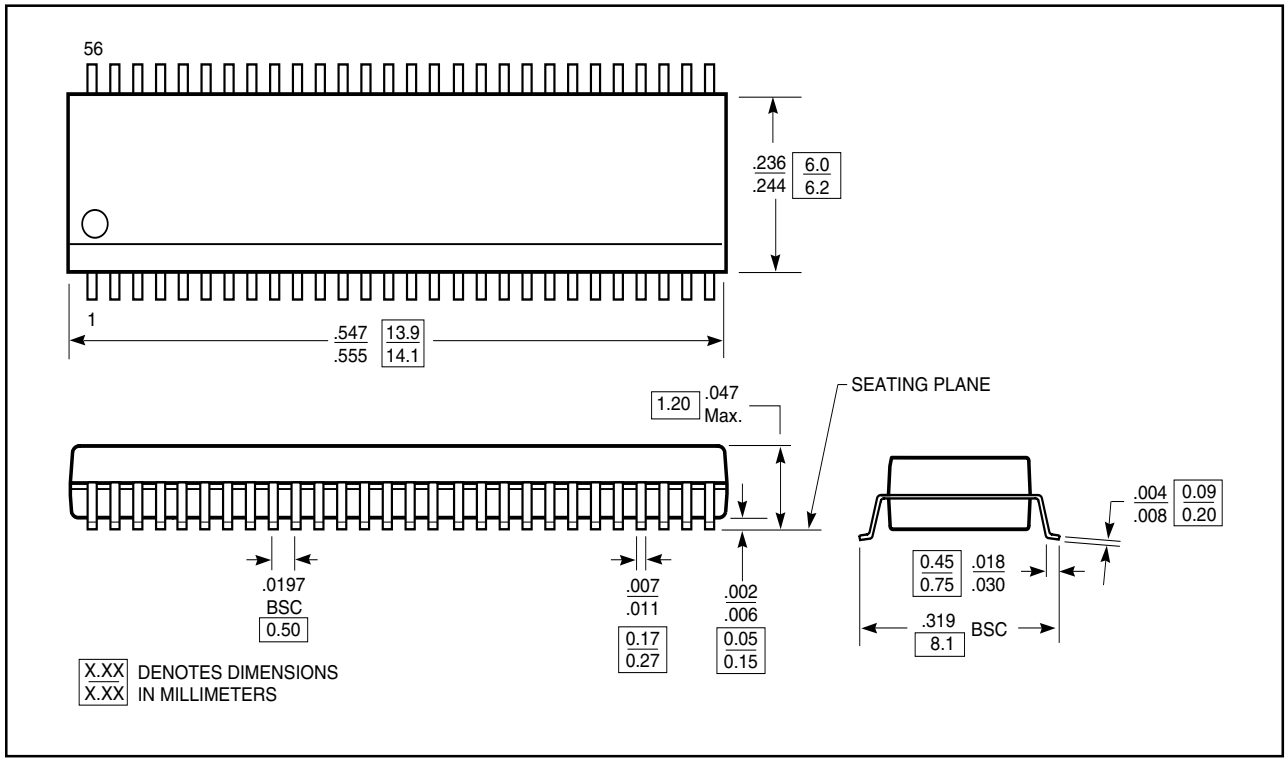
Voltage Waveforms
Enable and Disable Times

Figure 4. Load Circuit and Voltage Waveforms

Notes:

A. C_L includes probe and jig capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
C. All input impulses are supplied by generators having the following characteristics: PRR ≤10 MHz, Z_O = 50Ω, t_R ≤2.0ns, t_F ≤2.0ns.
D. The outputs are measured one at a time with one transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis}
F. t_{PZL} and t_{PZH} are the same as t_{en}
G. t_{PLH} and t_{PHL} are the same as t_{pd}

Package Diagram : 56-pin 240-mil, Wide Plastic TSSOP (A)



Package Diagram : 56-pin 173-mil, Wide Plastic TVSOP (TSSOP) (K)