8-Stage Shift-and-Store Bus Register

1. Description

The 74HC4094 is an 8-stage serial shift register. It has a storage latch associated with each stage for strobing data from the serial input to parallel buffered 3-state outputs QP0 to QP7. The parallel outputs may be connected directly to common bus lines. Data is shifted on positive-going clock transitions. The data in each shift register stage is transferred to the storage register when the strobe (STR) input is HIGH. Data in the storage register appears at the outputs whenever the output enable (OE) signal is HIGH.

Two serial outputs (QS1 and QS2) are available for cascading a number of 74HC4094 devices. Serial data is available at QS1 on positive-going clock edges to allow high-speed operation in cascaded systems with a fast clock rise time. The same serial data is available at QS2 on the next negative going clock edge. This is used for cascading 74HC4094 devices when the clock has a slow rise time.

It operates over a recommended V_{DD} power supply range of 3V to 15V referenced to V_{SS} (usually ground). Unused inputs must be connected to V_{DD}, V_{SS}, or another input.

2. Features

- Wide supply voltage range from 3V to 15V
- Fully static operation
- 5V, 10V, and 15V parametric ratings
- Standardized symmetrical output characteristics
- Specified from -40˚C to +105˚C
- Packaging information: DIP16/SOIC16/TSSOP16

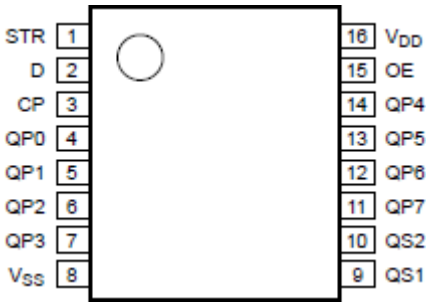
3. Ordering Information

Type Number	Package Type	Packing	Notes
74HC4094N	DIP-16	Tube	
74HC4094D	SOIC-16	Tape & Reel	
74HC4094PW	TSSOP-16	Tape & Reel	

Note: If the physical information is inconsistent with the ordering information, please refer to the actual product.

4. Pinning

Pin Configurations



Pin Description

Pin No.	Pin Name	Description
1	STR	strobe input
2	D	data input
3	CP	clock input
4	QP0	parallel output
5	QP1	parallel output
6	QP2	parallel output
7	QP3	parallel output
8	V_{SS}	ground (0V)
9	QS1	serial output
10	QS2	serial output
11	QP7	parallel output
12	QP6	parallel output
13	QP5	parallel output
14	QP4	parallel output
15	OE	output enable input
16	^{V}DD	supply voltage

Function Table

Input				Parallel output		Serial output	
CP	**OE**	**STR**	**D**	**QP0**	**QPn**	**QS1**	**QS2**
↑	L	X	X	Z	Z	Q6S	NC
↓	L	X	X	Z	Z	NC	Q7S
↑	H	L	X	NC	NC	Q6S	NC
↑	H	H	L	L	QPn-1	Q6S	NC
↑	H	H	H	H	QPn-1	Q6S	NC
↓	H	H	H	NC	NC	NC	Q7S

Note: H=HIGH voltage level; L=LOW voltage level; X=don't care; Z=HIGH-impedance OFF-state;

NC=no change;

↑=positive-going transition;

↓=negative-going transition;

Q6S=the data in register stage 6 before the LOW to HIGH clock transition;

Q7S=the data in register stage 7 before the HIGH to LOW clock transition.

5. Block Diagram

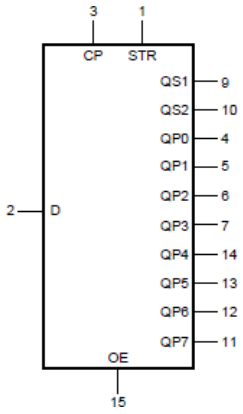


Fig. 1. Logic symbol

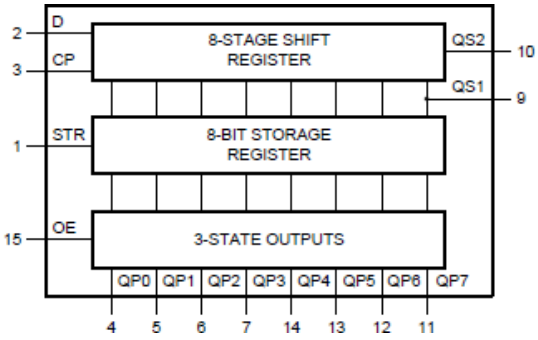


Fig. 2. Functional diagram

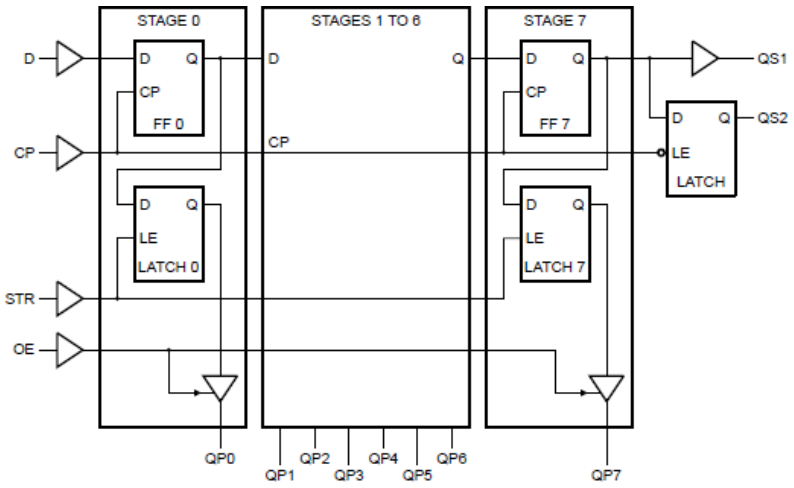


Fig. 3. Logic diagram

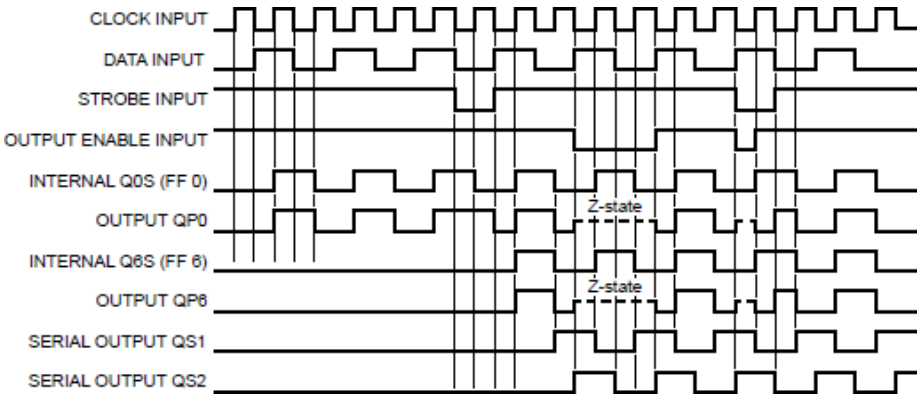


Fig. 4. Timing diagram

6. Electrical Parameter

Absolute Maximum Ratings

(Voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions		Min.	Max.	Unit
supply voltage	V_{DD}	-		-0.5	+18	V
DC input current	I_{IK}	any one input		-	±10	mA
input voltage	V_I	all inputs		-0.5	V_{DD}+0.5	V
storage temperature	T_{stg}	-		-65	+150	˚C
total power dissipation	P_{tot}	-		-	500	mW
device dissipation	P	per output transistor		-	100	mW
Soldering temperature	T_L	10s	DIP	245		˚C
			SOIC	250		˚C

Note:

1 For DIP16 packages: above 70˚C the value of P_{tot} derates linearly with 12mW/K.

2 For SOIC16 packages: above 70˚C the value of P_{tot} derates linearly with 8mW/K.

3 For (T)SSOP16 packages: above 60˚C the value of P_{tot} derates linearly with 5.5mW/K.

7. Recommended Operating Conditions

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
supply voltage	V_{DD}	-	3	-	15	V
ambient temperature	T_{amb}	in free air	-40	-	+105	˚C
data setup time	t_{su}	V_{DD}=5V	125	-	-	ns
		V_{DD}=10V	55	-	-	ns
		V_{DD}=15V	35	-	-	ns
clock pulse width	t_w	V_{DD}=5V	200	-	-	ns
		V_{DD}=10V	100	-	-	ns
		V_{DD}=15V	83	-	-	ns
clock input frequency	f_{max}	V_{DD}=5V	dc	-	1.25	MHz
		V_{DD}=10V		-	2.5	MHz
		V_{DD}=15V		-	3	MHz
clock rise and fall time	t_{rCL}, t_{fCL}	V_{DD}=5V	-	-	15	us
		V_{DD}=10V	-	-	5	us
		V_{DD}=15V	-	-	5	us
strobe setup time	t_w	V_{DD}=5V	200	-	-	ns
		V_{DD}=10V	80	-	-	ns
		V_{DD}=15V	70	-	-	ns

8. Electrical Characteristics

DC Characteristics 1

(T_{amb}=25°C, voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions (V)			T_{amb}=25°C			Unit
		V_O	V_{IN}	V_{DD}	Min.	Typ.	Max.	
supply current	I_{DD}	-	0, 5	5	-	0.04	5	uA
		-	0, 10	10	-	0.04	10	uA
		-	0, 15	15	-	0.04	20	uA
LOW-level output current	I_{OL}	0.4	0, 5	5	0.51	1	-	mA
		0.5	0, 10	10	1.3	2.6	-	mA
		1.5	0, 15	15	3.4	6.8	-	mA
HIGH-level output current	I_{OH}	4.6	0, 5	5	-0.51	-1	-	mA
		2.5	0, 5	5	-1.6	-3.2	-	mA
		9.5	0, 10	10	-1.3	-2.6	-	mA
		13.5	0, 15	15	-3.4	-6.8	-	mA
LOW-level output voltage	V_{OL}	-	0, 5	5	-	0	0.05	V
		-	0, 10	10	-	0	0.05	V
		-	0, 15	15	-	0	0.05	V
HIGH-level output voltage	V_{OH}	-	0, 5	5	4.95	5	-	V
		-	0, 10	10	9.95	10	-	V
		-	0, 15	15	14.95	15	-	V
LOW-level input voltage	V_{IL}	0.5, 4.5	-	5	-	-	1.5	V
		1, 9	-	10	-	-	3	V
		1.5, 13.5	-	15	-	-	4	V
HIGH-level input voltage	V_{IH}	0.5, 4.5	-	5	3.5	-	-	V
		1, 9	-	10	7	-	-	V
		1.5, 13.5	-	15	11	-	-	V
input leakage current	I_I	-	0, 15	15	-	$\pm 1\ 0^{-5}$	±0.1	uA
OFF-state output current	I_{OZ}	0, 15	0, 15	15	-	$\pm 1\ 0^{-4}$	±0.4	uA

DC Characteristics 2

(T_{amb}=-40℃ to +85℃, voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions (V)			T_{amb}=-40℃		T_{amb}=+85℃		Unit
		V_O	V_{IN}	V_{DD}	Min.	Max.	Min.	Max.	
supply current	I_{DD}	-	0, 5	5	-	5	-	150	uA
		-	0, 10	10	-	10	-	300	uA
		-	0, 15	15	-	20	-	600	uA
LOW-level output current	I_{OL}	0.4	0, 5	5	0.61	-	0.42	-	mA
		0.5	0, 10	10	1.5	-	1.1	-	mA
		1.5	0, 15	15	4	-	2.8	-	mA
HIGH-level output current	I_{OH}	4.6	0, 5	5	-0.61	-	-0.42	-	mA
		2.5	0, 5	5	-1.8	-	-1.3	-	mA
		9.5	0, 10	10	-1.5	-	-1.1	-	mA
		13.5	0, 15	15	-4	-	-2.8	-	mA
LOW-level output voltage	V_{OL}	-	0, 5	5	-	0.05	-	0.05	V
		-	0, 10	10	-	0.05	-	0.05	V
		-	0, 15	15	-	0.05	-	0.05	V
HIGH-level output voltage	V_{OH}	-	0, 5	5	4.95	-	4.95	-	V
		-	0, 10	10	9.95	-	9.95	-	V
		-	0, 15	15	14.95	-	14.95	-	V
LOW-level input voltage	V_{IL}	0.5, 4.5	-	5	-	1.5	-	1.5	V
		1, 9	-	10	-	3	-	3	V
		1.5, 13.5	-	15	-	4	-	4	V
HIGH-level input voltage	V_{IH}	0.5, 4.5	-	5	3.5	-	3.5	-	V
		1, 9	-	10	7	-	7	-	V
		1.5, 13.5	-	15	11	-	11	-	V
input leakage current	I_I	-	0, 15	15	-	±0.1	-	±1	uA
OFF-state output current	I_{OZ}	0, 15	0, 15	15	-	±0.4	-	±12	uA

DC Characteristics 3

(T_{amb}=-40℃ to +105℃, voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions (V)			T_{amb}=-40℃		T_{amb}=+105℃		Unit
		V_O	V_{IN}	V_{DD}	Min.	Max.	Min.	Max.	
supply current	I_{DD}	-	0, 5	5	-	5	-	150	uA
		-	0, 10	10	-	10	-	300	uA
		-	0, 15	15	-	20	-	600	uA
LOW-level output current	I_{OL}	0.4	0, 5	5	0.61	-	0.36	-	mA
		0.5	0, 10	10	1.5	-	0.9	-	mA
		1.5	0, 15	15	4	-	2.4	-	mA
HIGH-level output current	I_{OH}	4.6	0, 5	5	-0.61	-	-0.36	-	mA
		2.5	0, 5	5	-1.8	-	-1.15	-	mA
		9.5	0, 10	10	-1.5	-	-0.9	-	mA
		13.5	0, 15	15	-4	-	-2.4	-	mA
LOW-level output voltage	V_{OL}	-	0, 5	5	-	0.05	-	0.05	V
		-	0, 10	10	-	0.05	-	0.05	V
		-	0, 15	15	-	0.05	-	0.05	V
HIGH-level output voltage	V_{OH}	-	0, 5	5	4.95	-	4.95	-	V
		-	0, 10	10	9.95	-	9.95	-	V
		-	0, 15	15	14.95	-	14.95	-	V
LOW-level input voltage	V_{IL}	0.5, 4.5	-	5	-	1.5	-	1.5	V
		1, 9	-	10	-	3	-	3	V
		1.5, 13.5	-	15	-	4	-	4	V
HIGH-level input voltage	V_{IH}	0.5, 4.5	-	5	3.5	-	3.5	-	V
		1, 9	-	10	7	-	7	-	V
		1.5, 13.5	-	15	11	-	11	-	V
input leakage current	I_I	-	0, 15	15	-	±0.1	-	±1	uA
OFF-state output current	I_{OZ}	0, 15	0, 15	15	-	±0.4	-	±12	uA

AC Characteristics

(T_{amb}=25°C, V_{SS}=0V, t_r, t_f=20ns, C_L=50pF, R_L=200kΩ, unless otherwise specified.)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
propagation delay time	t_{PHL}, t_{PLH}	CP to QS1; see Figure 6	V_{DD}=5V	-	300	600	ns
			V_{DD}=10V	-	125	250	ns
			V_{DD}=15V	-	95	190	ns
		CP to QS2; see Figure 6	V_{DD}=5V	-	230	460	ns
			V_{DD}=10V	-	110	220	ns
			V_{DD}=15V	-	75	150	ns
		CP to QPn; see Figure 6	V_{DD}=5V	-	420	840	ns
			V_{DD}=10V	-	195	390	ns
			V_{DD}=15V	-	135	270	ns
		STR to QPn; see Figure 7	V_{DD}=5V	-	290	580	ns
			V_{DD}=10V	-	145	290	ns
			V_{DD}=15V	-	100	200	ns
HIGH to OFF-state/OFF-state to HIGH propagation delay	t_{PHZ}, t_{PZH}	OE to QPn; see Figure 8	V_{DD}=5V	-	140	280	ns
			V_{DD}=10V	-	60	120	ns
			V_{DD}=15V	-	45	90	ns
LOW to OFF-state/OFF -state to LOW propagation delay	tPLZ, tPZL	OE to QPn; see Figure 8	V_{DD}=5V	-	100	200	ns
			V_{DD}=10V	-	50	100	ns
			V_{DD}=15V	-	40	80	ns
pulse width	tW	minimum HIGH strobe pulse; see Figure 7	V_{DD}=5V	-	100	200	ns
			V_{DD}=10V	-	40	80	ns
			V_{DD}=15V	-	35	70	ns
		minimum LOW clock pulse; see Figure 6	V_{DD}=5V	-	100	200	ns
			V_{DD}=10V	-	50	100	ns
			V_{DD}=15V	-	40	83	ns
data setup time	tsu	D to CP; see Figure 9	V_{DD}=5V	-	60	125	ns
			V_{DD}=10V	-	30	55	ns
			V_{DD}=15V	-	20	35	ns
transition time	tt	-	V_{DD}=5V	-	100	200	ns
			V_{DD}=10V	-	50	100	ns
			V_{DD}=15V	-	40	80	ns
clock input rise and fall time	trCL, tfCL	-	V_{DD}=5V	15	-	-	us
			V_{DD}=10V	5	-	-	us
			V_{DD}=15V	5	-	-	us
maximum clock frequency	fmax	see Figure 6	V_{DD}=5V	1.25	2.5	-	MHz
			V_{DD}=10V	2.5	5	-	MHz
			V_{DD}=15V	3	6	-	MHz
input capacitance	C_I	any input		-	5	7.5	pF

9. Testing Circuit

AC Testing Circuit

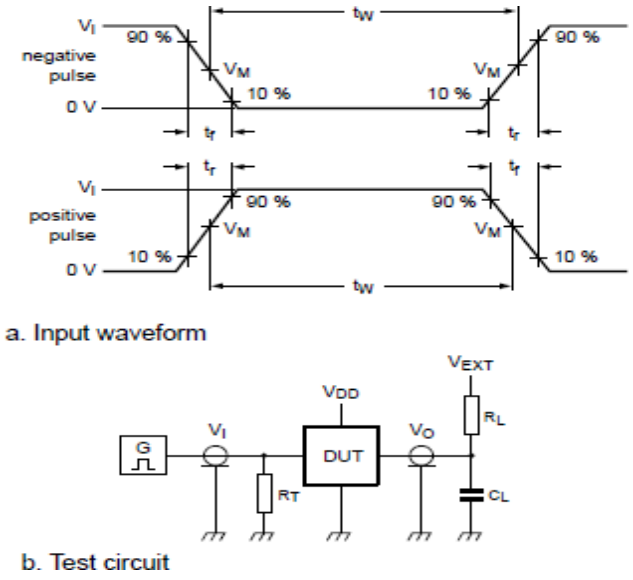


Fig. 5. Test circuit for switching times

Definitions for test circuit:

DUT=Device Under Test.

C_L=Load capacitance including jig and probe capacitance.

R_T=Termination resistance should be equal to the output impedance Z_o of the pulse generator.

R_L=Load resistance.

V_{EXT}=External voltage for measuring switching times.

AC Testing Waveforms

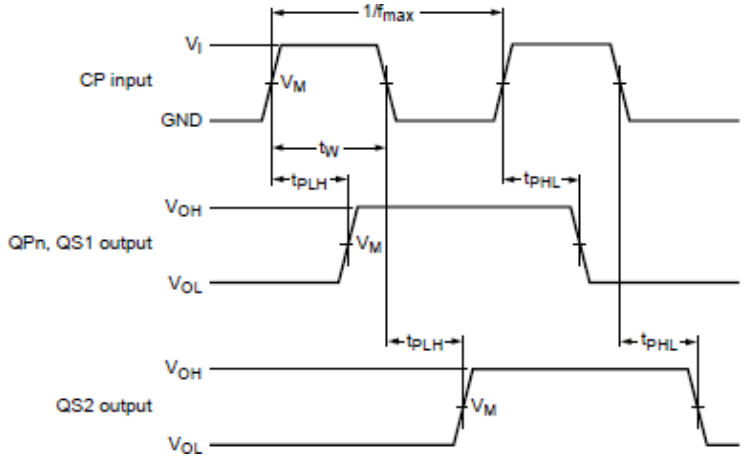


Fig. 6. Clock to outputs propagation delays, and clock pulse width and maximum frequency

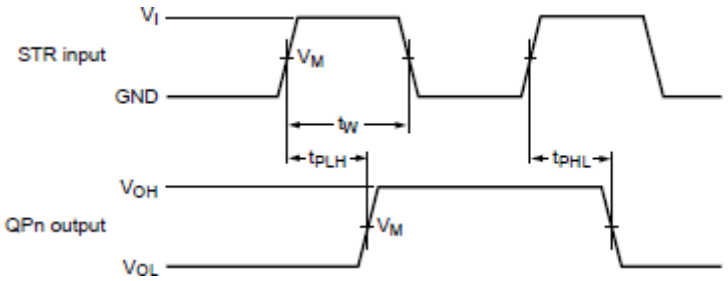


Fig. 7. Strobe to output propagation delays, and strobe pulse width, set up and hold times

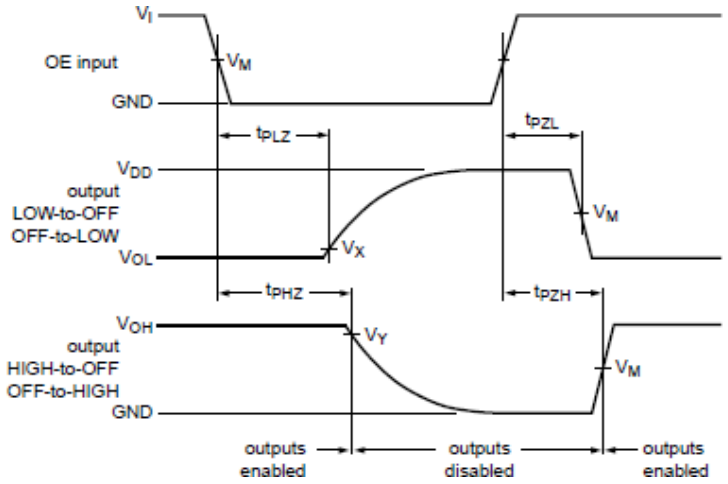


Fig. 8. 3-state output enable and disable times for OE input

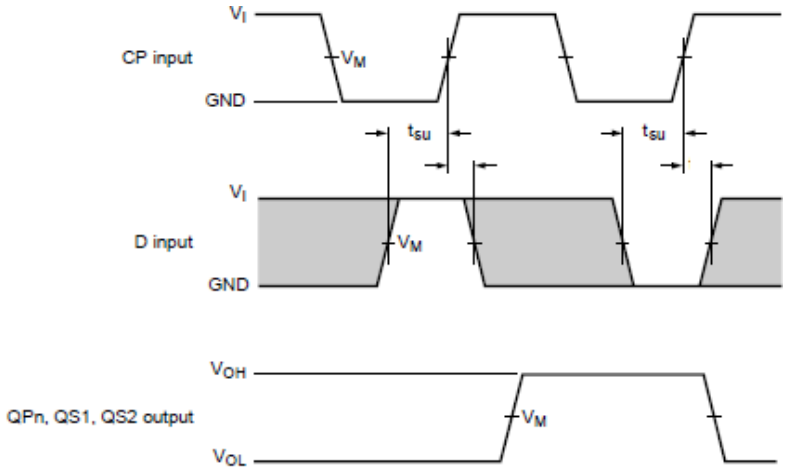


Fig. 9. Data input data set up and hold times

Measurement Points

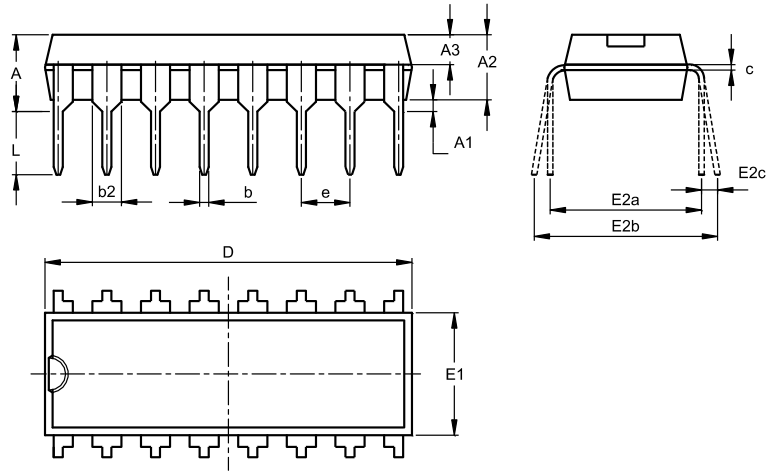
Supply voltage	Input	Output		
V_{DD}	V_M	V_M	V_X	V_Y
5V to 15V	0.5×V_{DD}	0.5×V_{DD}	0.1×V_{DD}	0.9×V_{DD}

Test Data

Supply voltage	Input		Load		V_{EXT}		
V_{DD}	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PHZ}, t_{PZH}	t_{PLZ}, t_{PZL}
5V to 15V	V_{SS} or V_{DD}	≤ 20ns	50pF	1kΩ	open	V_{SS}	V_{DD}

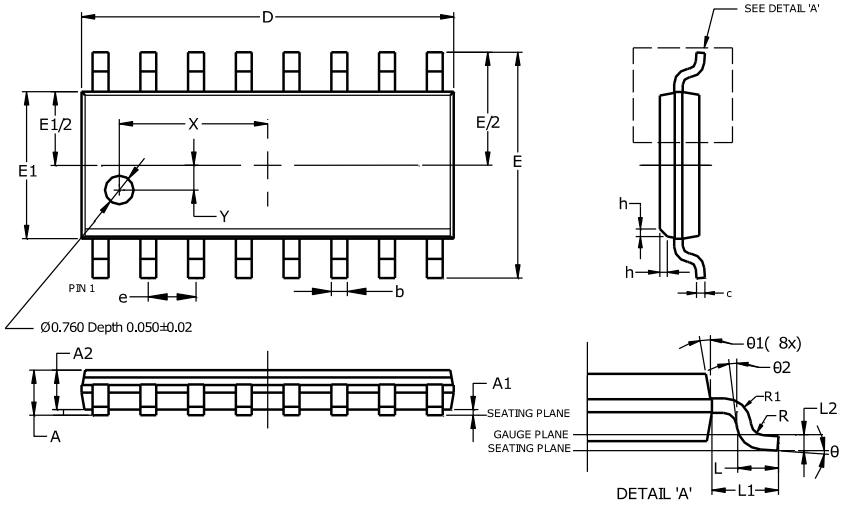
10. Package Outlines

DIP-16



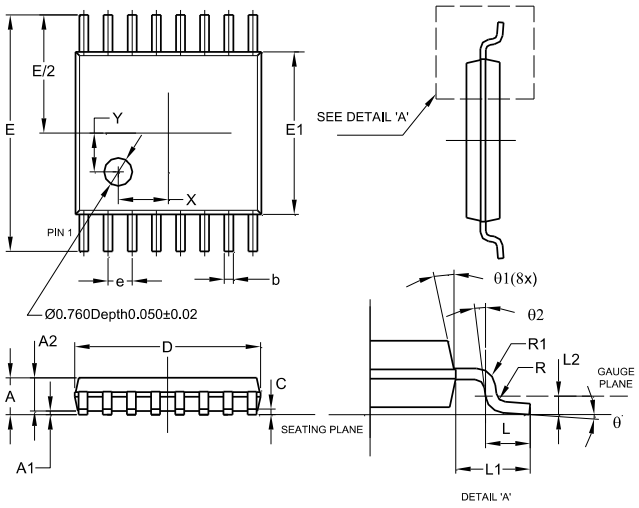
PDIP-16			
Dim	Min	Max	Nom
A	3.60	4.00	3.80
A1	0.51	-	
A2	3.20	3.40	3.30
A3	1.47	1.57	1.52
b	0.44	0.53	–
b2	1.52BSC		
c	0.25	0.31	–
D	18.90	19.30	19.10
E1	6.15	6.55	6.35
E2a	7.62 BSC		
E2b	7.62	9.30	–
E2c	0.00	0.84	–
e	2.54BSC		
L	3.00	–	–
All Dimensions in mm			

SOIC-16



SOIC-16			
Dim	Min	Max	Typ
A	--	1.260	--
A1	0.10	0.23	--
A2	1.02	--	--
b	0.31	0.51	--
c	0.10	0.25	--
D	9.80	10.00	--
E	5.90	6.10	--
E1	3.80	4.00	--
e	1.27 BSC		
h	0.15	0.25	0.20
L	0.40	1.27	--
L1	1.04 REF		
L2	0.25 BSC		
R	0.07	--	--
R1	0.07	--	--
X	3.945 REF		
Y	0.661 REF		
θ	0°	8°	--
θ1	5°	15°	--
θ2	0°	--	--
All Dimensions in mm			

TSSOP-16



TSSOP-16			
Dim	**Min**	**Max**	**Typ**
A	-	1.08	-
A1	0.05	0.15	-
A2	0.80	0.93	-
b	0.19	0.30	-
c	0.09	0.20	-
D	4.90	5.10	-
E	6.40 BSC		
E1	4.30	4.50	-
e	0.65 BSC		
L	0.45	0.75	-
L1	1.00 REF		
L2	0.25 BSC		
R / R1	0.09	-	-
X	-	-	1.350
Y	-	-	1.050
θ	0°	8°	-
θ1	5°	15°	-
θ2	0°	-	-
All Dimensions in mm			

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