

HD74HC194

4-bit Bidirectional Universal Shift Register

REJ03D0589-0200
(Previous ADE-205-466)
Rev.2.00
Jan 31, 2006

Description

This bidirectional shift register is designed to incorporate virtually all of the features a system designer may want in a shift register. It features parallel inputs, parallel outputs, right shift and left shift serial inputs, operating mode control inputs, and a direct overriding clear line. The register has four distinct modes of operation: parallel (broadside) load, shift right (in the direction Q_A toward Q_D); shift left; inhibit clock (do nothing).

Synchronous parallel loading is accomplished by applying the four bits of data and taking both mode control inputs, S_0 and S_1 , high. The data are loaded into their respective flip-flops and appear at the outputs after the positive transition of the clock input. During loading, serial data flow is inhibited. Shift right is accomplished synchronously with the rising edge of the clock pulse when S_0 is high and S_1 is low. Serial data for this mode is entered at the shift right data input. When S_0 is low and S_1 is high, data shifts left synchronously and new data is entered at the shift left serial input. Clocking of the flip-flops is inhibited when both mode control inputs are low. The mode control inputs should be changed only when the clock input is high.

Features

- High Speed Operation: t_{pd} (Clock to Q) = 12 ns typ ($C_L = 50$ pF)
- High Output Current: Fanout of 10 LSTTL Loads
- Wide Operating Voltage: $V_{CC} = 2$ to 6 V
- Low Input Current: 1 μ A max
- Low Quiescent Supply Current: I_{CC} (static) = 4 μ A max
- Ordering Information

Part Name	Package Type	Package Code (Previous Code)	Package Abbreviation	Taping Abbreviation (Quantity)
HD74HC194P	DILP-16 pin	PRDP0016AE-B (DP-16FV)	P	—

Function Table

Operating Mode	Inputs										Outputs			
	Clear	Mode		Clock	Serial		Parallel							
		S ₁	S ₀		Shift Left	Shift Right	A	B	C	D	Q _A	Q _B	Q _C	Q _D
Clear	L	X	X	X	X	X	X	X	X	X	L	L	L	L
Parallel load	H	H	H	\uparrow	X	X	a	b	c	d	a	b	c	d
Shift right	H	L	H	\uparrow	X	H	X	X	X	X	H	Q _{An}	Q _{Bn}	Q _{Cn}
	H	L	H	\uparrow	X	L	X	X	X	X	L	Q _{An}	Q _{Bn}	Q _{Cn}
Shift left	H	H	L	\uparrow	H	X	X	X	X	X	Q _{Bn}	Q _{Cn}	Q _{Dn}	H
	H	H	L	\uparrow	L	X	X	X	X	X	Q _{Bn}	Q _{Cn}	Q _{Dn}	L
Hold	H	L	L	X	X	X	X	X	X	X	Q _{A0}	Q _{B0}	Q _{C0}	Q _{D0}
	H	X	X	L	X	X	X	X	X	X	Q _{A0}	Q _{B0}	Q _{C0}	Q _{D0}
	H	X	X	H	X	X	X	X	X	X	Q _{A0}	Q _{B0}	Q _{C0}	Q _{D0}

H : high level (Steady state)

L : low level (Steady state)

X : don't care

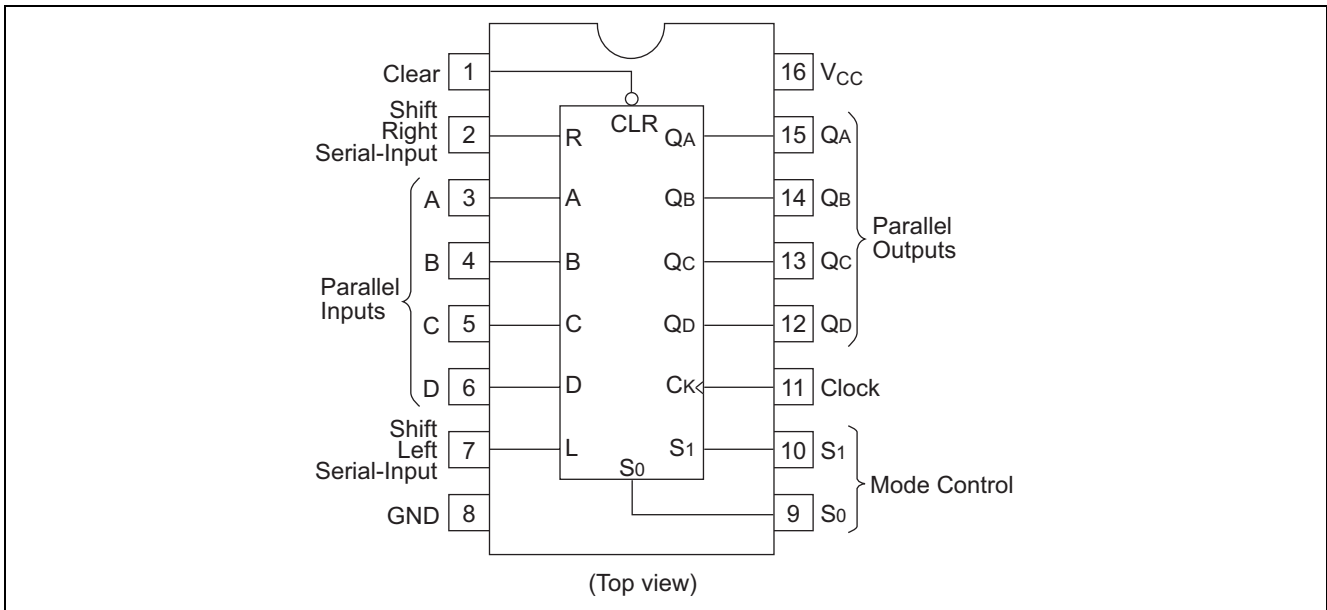
\uparrow : transition from low to high level.

a, b, c, d : the level of steady-state input at inputs A, B, C or D respectively.

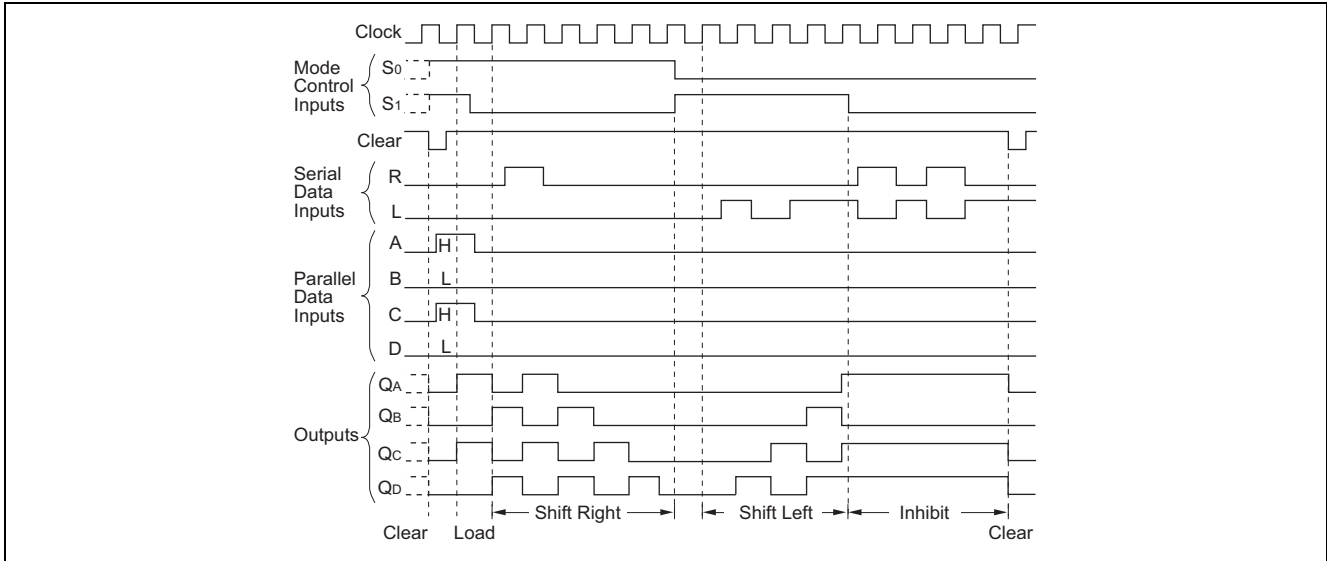
Q_{A0}, Q_{B0}, Q_{C0}, Q_{D0} : the level of Q_A, Q_B, Q_C or Q_D respectively, before the indicated steady-state input conditions were established.

Q_{An}, Q_{Bn}, Q_{Cn}, Q_{Dn} : the level of Q_A, Q_B, Q_C or Q_D respectively before the most recent \uparrow transition of the clock.

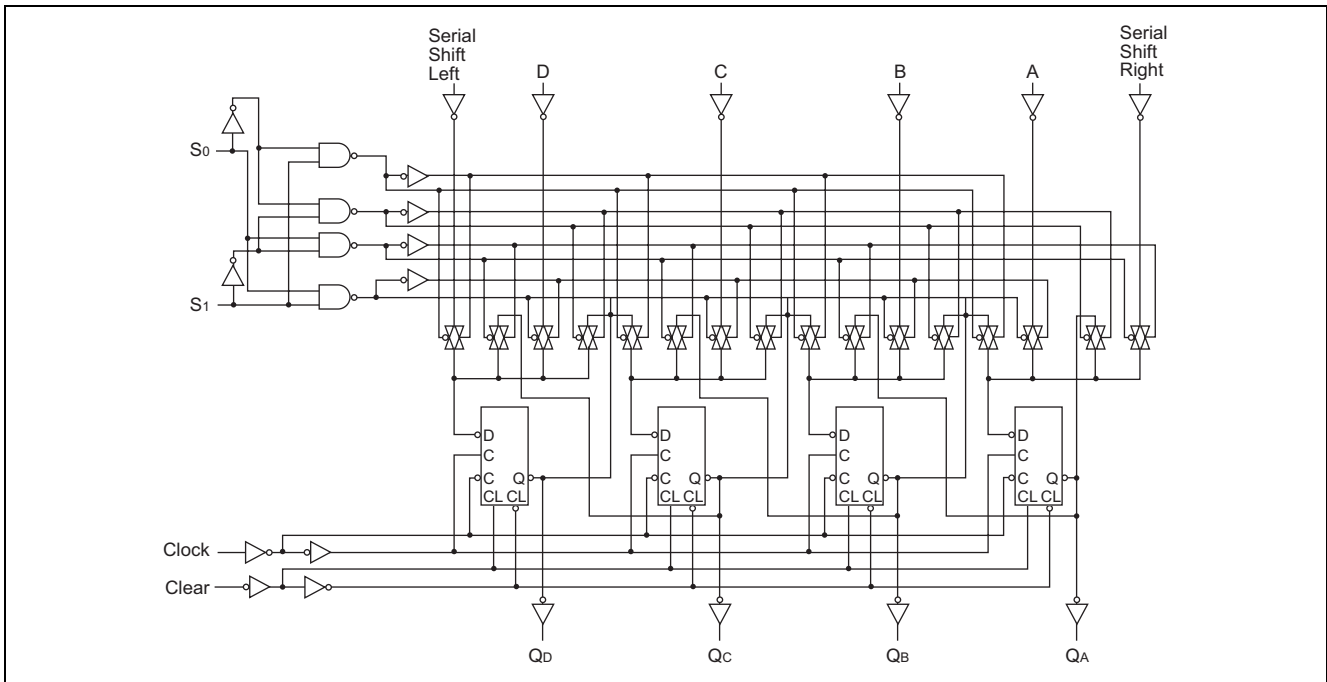
Pin Arrangement



Timing Diagram



Logic Diagram



Absolute Maximum Ratings

Item	Symbol	Ratings	Unit
Supply voltage range	V_{CC}	-0.5 to 7.0	V
Input / Output voltage	V_{IN}, V_{OUT}	-0.5 to $V_{CC} + 0.5$	V
Input / Output diode current	I_{IK}, I_{OK}	± 20	mA
Output current	I_O	± 25	mA
V_{CC}, GND current	I_{CC} or I_{GND}	± 50	mA
Power dissipation	P_T	500	mW
Storage temperature	T_{stg}	-65 to +150	$^{\circ}C$

Note: The absolute maximum ratings are values, which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.

Recommended Operating Conditions

Item	Symbol	Ratings	Unit	Conditions
Supply voltage	V_{CC}	2 to 6	V	
Input / Output voltage	V_{IN}, V_{OUT}	0 to V_{CC}	V	
Operating temperature	T_a	-40 to 85	°C	
Input rise / fall time ^{*1}	t_r, t_f	0 to 1000	ns	$V_{CC} = 2.0\text{ V}$
		0 to 500		$V_{CC} = 4.5\text{ V}$
		0 to 400		$V_{CC} = 6.0\text{ V}$

Notes: 1. This item guarantees maximum limit when one input switches.
 Waveform: Refer to test circuit of switching characteristics.

Electrical Characteristics

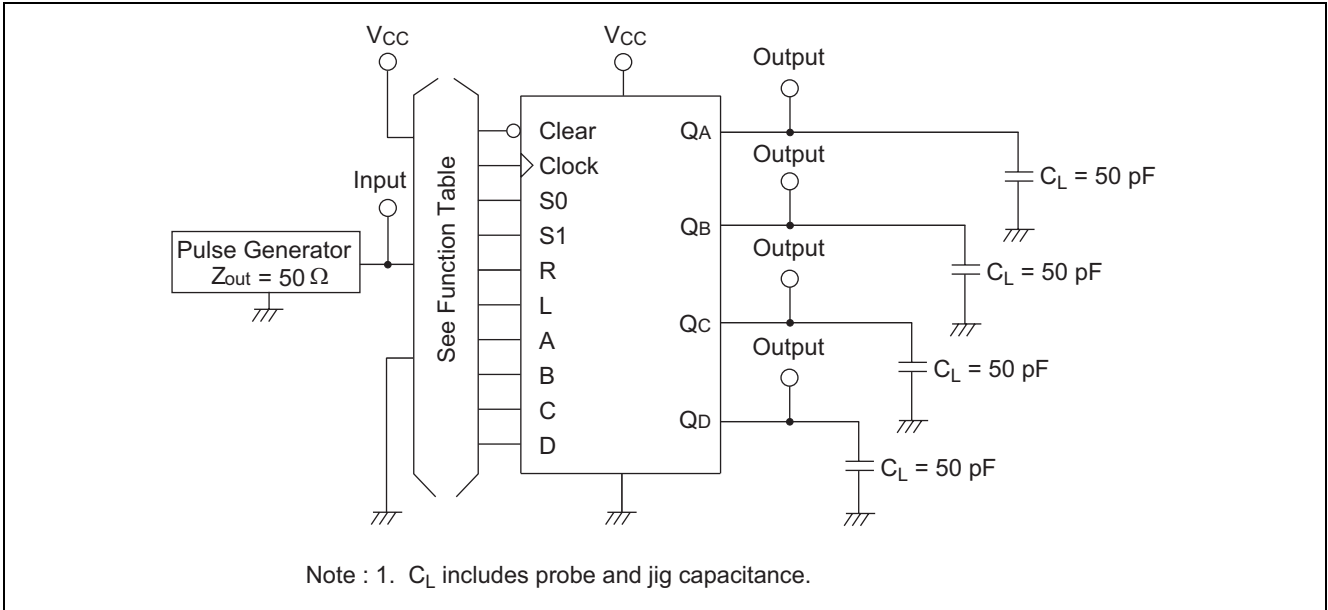
Item	Symbol	V_{CC} (V)	$T_a = 25^\circ\text{C}$			$T_a = -40\text{ to }+85^\circ\text{C}$		Unit	Test Conditions	
			Min	Typ	Max	Min	Max			
Input voltage	V_{IH}	2.0	1.5	—	—	1.5	—	V		
		4.5	3.15	—	—	3.15	—			
		6.0	4.2	—	—	4.2	—			
	V_{IL}	2.0	—	—	0.5	—	0.5	V		
		4.5	—	—	1.35	—	1.35			
		6.0	—	—	1.8	—	1.8			
Output voltage	V_{OH}	2.0	1.9	2.0	—	1.9	—	V	$V_{in} = V_{IH}$ or V_{IL}	$I_{OH} = -20\ \mu\text{A}$
		4.5	4.4	4.5	—	4.4	—			$I_{OH} = -4\ \text{mA}$
		6.0	5.9	6.0	—	5.9	—			$I_{OH} = -5.2\ \text{mA}$
		4.5	4.18	—	—	4.13	—			
		6.0	5.68	—	—	5.63	—			
	V_{OL}	2.0	—	0.0	0.1	—	0.1	V	$V_{in} = V_{IH}$ or V_{IL}	$I_{OL} = 20\ \mu\text{A}$
		4.5	—	0.0	0.1	—	0.1			
		6.0	—	0.0	0.1	—	0.1			
		4.5	—	—	0.26	—	0.33			$I_{OL} = 4\ \text{mA}$
		6.0	—	—	0.26	—	0.33			$I_{OL} = 5.2\ \text{mA}$
Input current	I_{in}	6.0	—	—	± 0.1	—	± 1.0	μA	$V_{in} = V_{CC}$ or GND	
Quiescent supply current	I_{CC}	6.0	—	—	4.0	—	40	μA	$V_{in} = V_{CC}$ or GND, $I_{out} = 0\ \mu\text{A}$	

Switching Characteristics

(C_L = 50 pF, Input t_r = t_f = 6 ns)

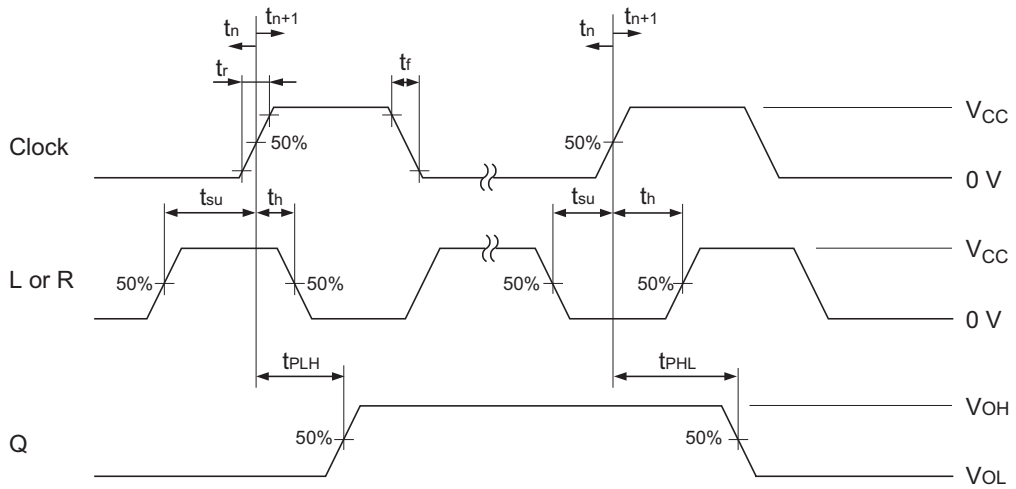
Item	Symbol	V _{CC} (V)	Ta = 25°C			Ta = -40 to +85°C		Unit	Test Conditions
			Min	Typ	Max	Min	Max		
Maximum clock frequency	f _{max}	2.0	—	—	6	—	5	ns	
		4.5	—	—	30	—	24		
		6.0	—	—	35	—	28		
Propagation delay time	t _{PHL}	2.0	—	—	140	—	175	ns	Clock to Q
		4.5	—	12	28	—	35		
		6.0	—	—	24	—	30		
	t _{PLH}	2.0	—	—	140	—	175	ns	
		4.5	—	12	28	—	35		
		6.0	—	—	24	—	30		
	t _{PHL}	2.0	—	—	150	—	190	ns	Clear to Q
		4.5	—	13	30	—	38		
		6.0	—	—	26	—	33		
Pulse width	t _w	2.0	80	—	—	100	—	ns	Clock or Clear
		4.5	16	6	—	20	—		
		6.0	14	—	—	17	—		
Setup time	t _{su}	2.0	100	—	—	125	—	ns	A, B, C or D to Clock
		4.5	20	7	—	25	—		
		6.0	17	—	—	21	—		
	t _{su}	2.0	150	—	—	187	—	ns	Mode controls to Clock
		4.5	30	17	—	37	—		
		6.0	25	—	—	31	—		
Hold time	t _h	2.0	0	—	—	0	—	ns	Any input
		4.5	0	-4	—	0	—		
		6.0	0	—	—	0	—		
Removal time	t _{rem}	2.0	25	—	—	31	—	ns	Clear inactive to Clock
		4.5	5	1	—	6	—		
		6.0	4	—	—	5	—		
Output rise/fall time	t _{TLH}	2.0	—	—	75	—	95	ns	
	t _{THL}	4.5	—	5	15	—	19		
	t _{THL}	6.0	—	—	13	—	16		
Input capacitance	C _{in}	—	—	5	10	—	10	pF	

Test Circuit



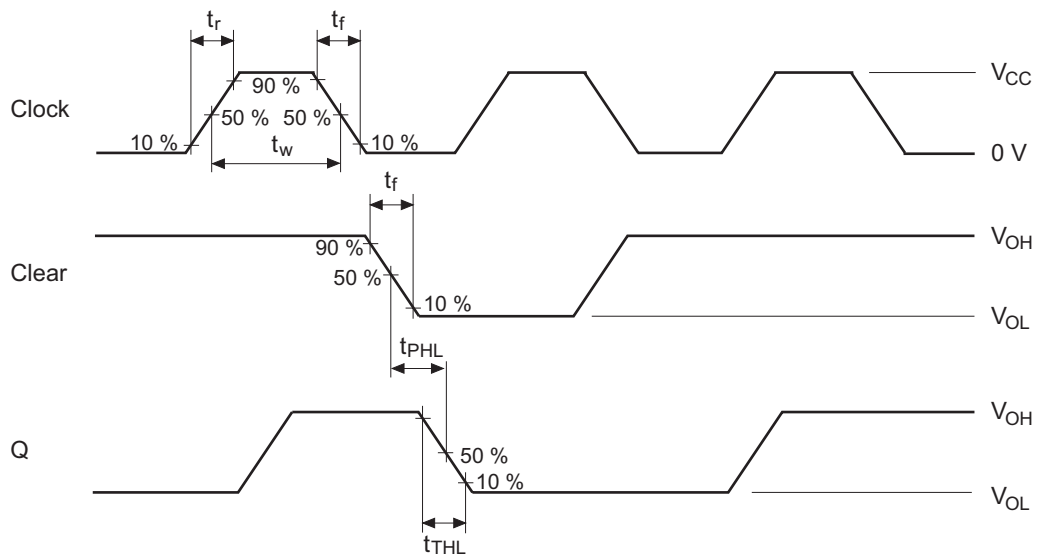
Waveforms

• Waveform – 1



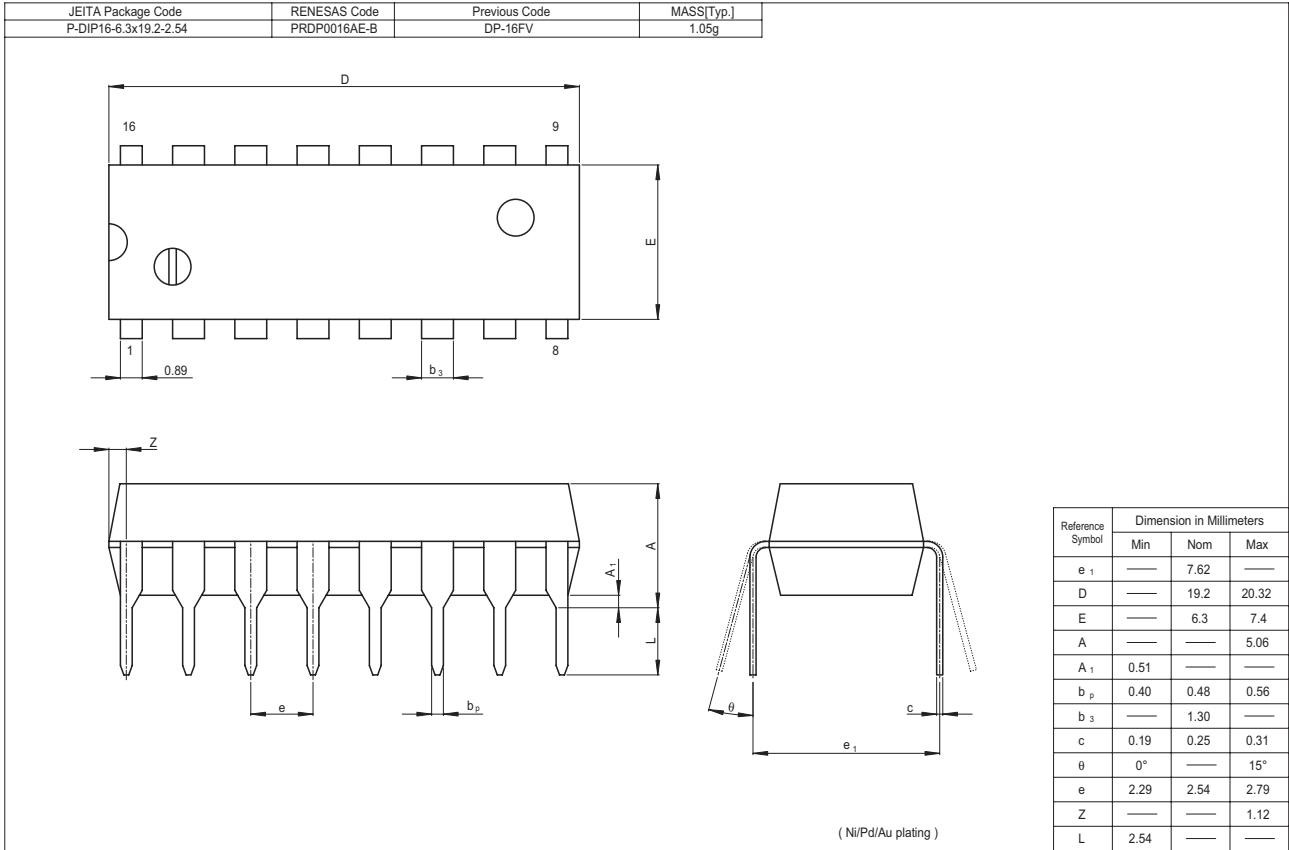
- Notes : 1. For right shift, measure QA at t_{n+1} , QB at t_{n+2} , QC at t_{n+3} , QD at t_{n+4} , respectively.
 For left shift, measure QA at t_{n+4} , QB at t_{n+3} , QC at t_{n+2} , QD at t_{n+1} , respectively.
 2. Input pulse : $PRR \leq 1 \text{ MHz}$, $Z_o = 50 \Omega$, $t_r \leq 6 \text{ ns}$, $t_f \leq 6 \text{ ns}$

• Waveform – 2



- Note : 1. Input pulse : $PRR \leq 1 \text{ MHz}$, $Z_o = 50 \Omega$, $t_r \leq 6 \text{ ns}$, $t_f \leq 6 \text{ ns}$

Package Dimensions



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Renesas Technology America, Inc.

450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

Renesas Technology Europe Limited

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

Renesas Technology (Shanghai) Co., Ltd.

Unit 205, AZIA Center, No.133 Yincheng Rd (n), Pudong District, Shanghai 200120, China
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7898

Renesas Technology Hong Kong Ltd.

7th Floor, North Tower, World Finance Centre, Harbour City, 1 Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2730-6071

Renesas Technology Taiwan Co., Ltd.

10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

Renesas Technology Singapore Pte. Ltd.

1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001

Renesas Technology Korea Co., Ltd.

Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

Renesas Technology Malaysia Sdn. Bhd

Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jalan Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510