

HD74HC192, HD74HC193

Synchronous Up/Down Decade Counter (Dual Clock Lines)

Synchronous Up/Down 4-bit Binary Counter (Dual Clock Lines)

REJ03D0588-0300

Rev.3.00

Jan 31, 2006

Description

The HD74HC192 is a decade counter, and the HD74HC193 is a binary counter. Both counters have two separate clock inputs, an up count input and a down count input. All outputs of the flip-flops are simultaneously triggered on the low to high transition of either clock while the other input is held high. The direction of counting is determined by which input is clocked.

These counters may be preset by entering the desired data on the data A, data B, data C, and data D inputs. When the load input is taken low the data is loaded independently of either clock input. This feature allows the counters to be used as divide-by-n counters by modifying the count length with the preset inputs.

In addition both counters can also be cleared. This is accomplished by inputting a high on the clear input. All 4 internal stages are set to a low level independently of either count input.

Both a borrow and carry output are provided to enable cascading of both up and down counting functions. The borrow output produces a negative going pulse when the counter underflows and the carry outputs a pulse when the counter overflows. The counters can be cascaded by connecting the carry and borrow outputs of one device to the count up and count down inputs, respectively, of the next device.

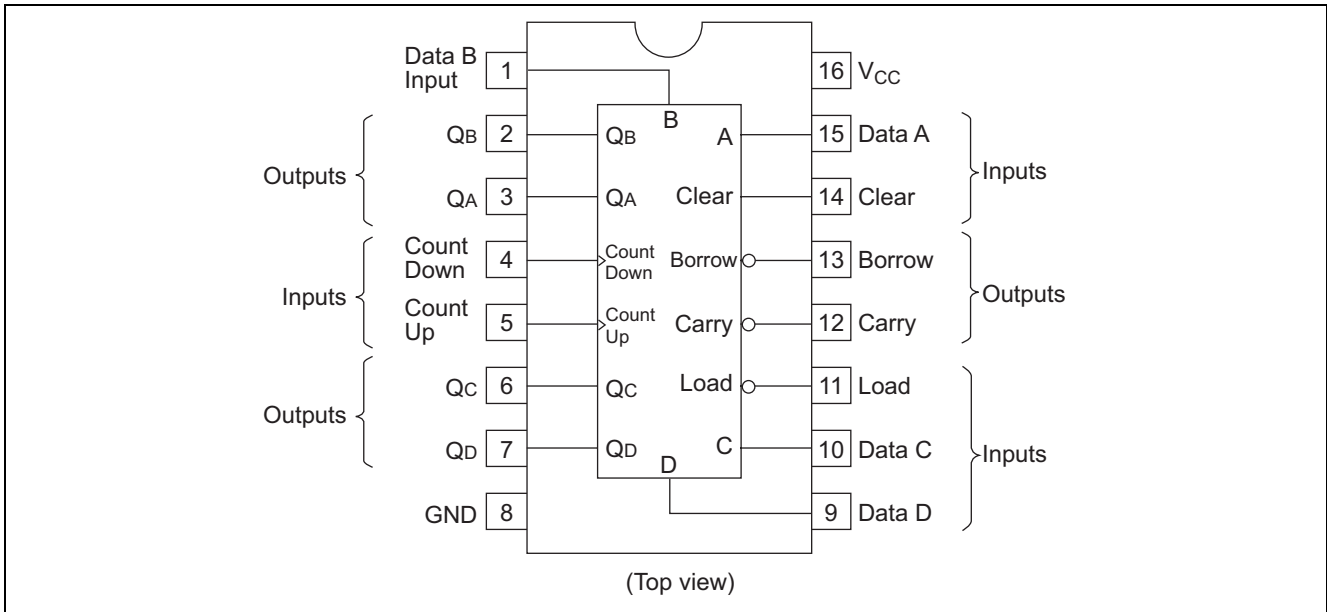
Features

- High Speed Operation: t_{pd} (Clock Up or Count Down to Q) = 21 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 ($T_a = 25^\circ\text{C}$)
- Ordering Information

Part Name	Package Type	Package Code (Previous Code)	Package Abbreviation	Taping Abbreviation (Quantity)
HD74HC192P HD74HC193P	DILP-16 pin	PRDP0016AE-B (DP-16FV)	P	—
HD74HC192FPEL HD74HC193FPEL	SOP-16 pin (JEITA)	PRSP0016DH-B (FP-16DAV)	FP	EL (2,000 pcs/reel)

Note: Please consult the sales office for the above package availability.

Pin Arrangement

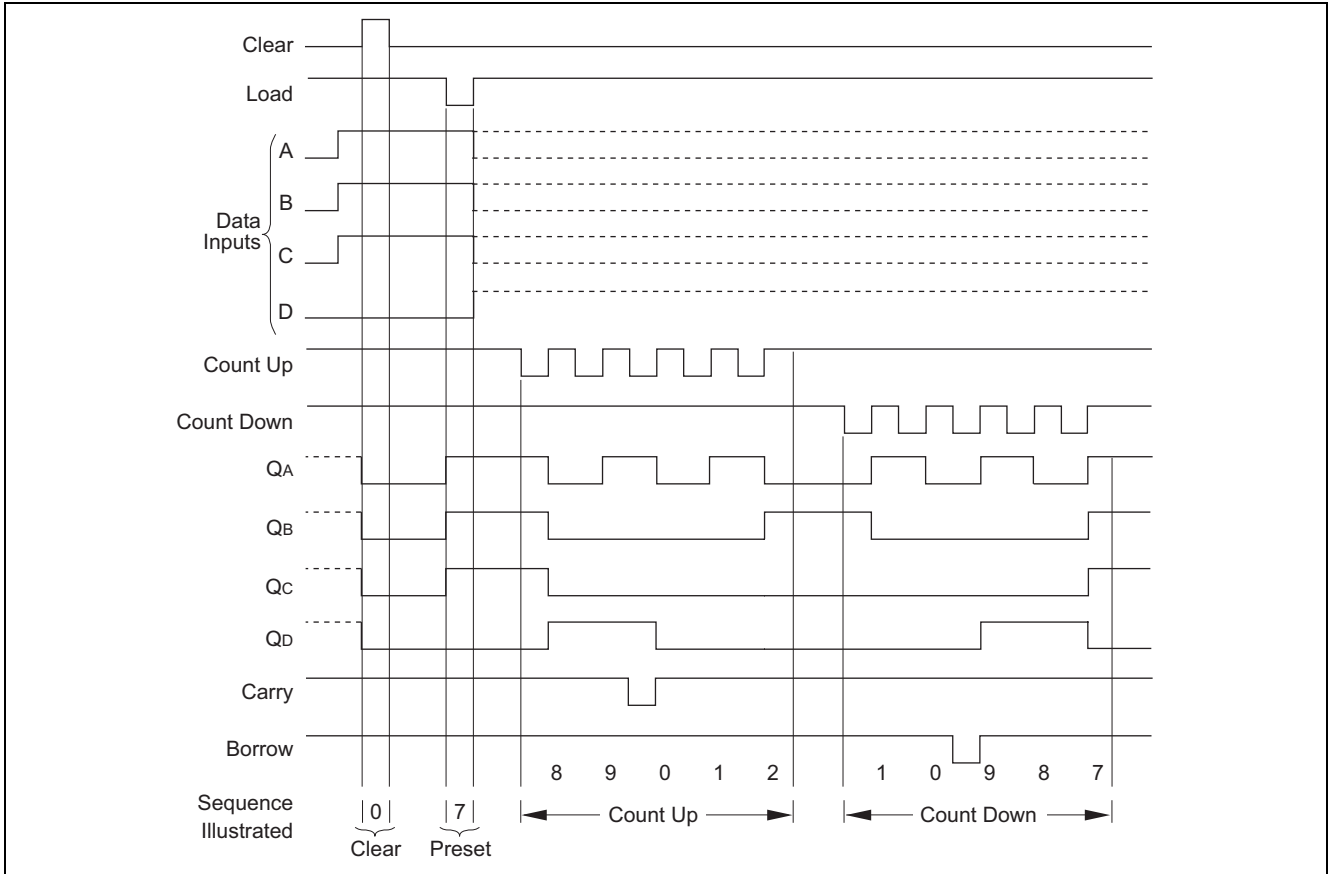


Timing Chart

HD74HC192

Illustrated below is the following sequence:

1. Clear outputs to zero.
2. Load (preset) to binary seven.
3. Count up to eight, nine, zero, one and two.
4. Count down to one, zero, borrow, nine, eight and seven.

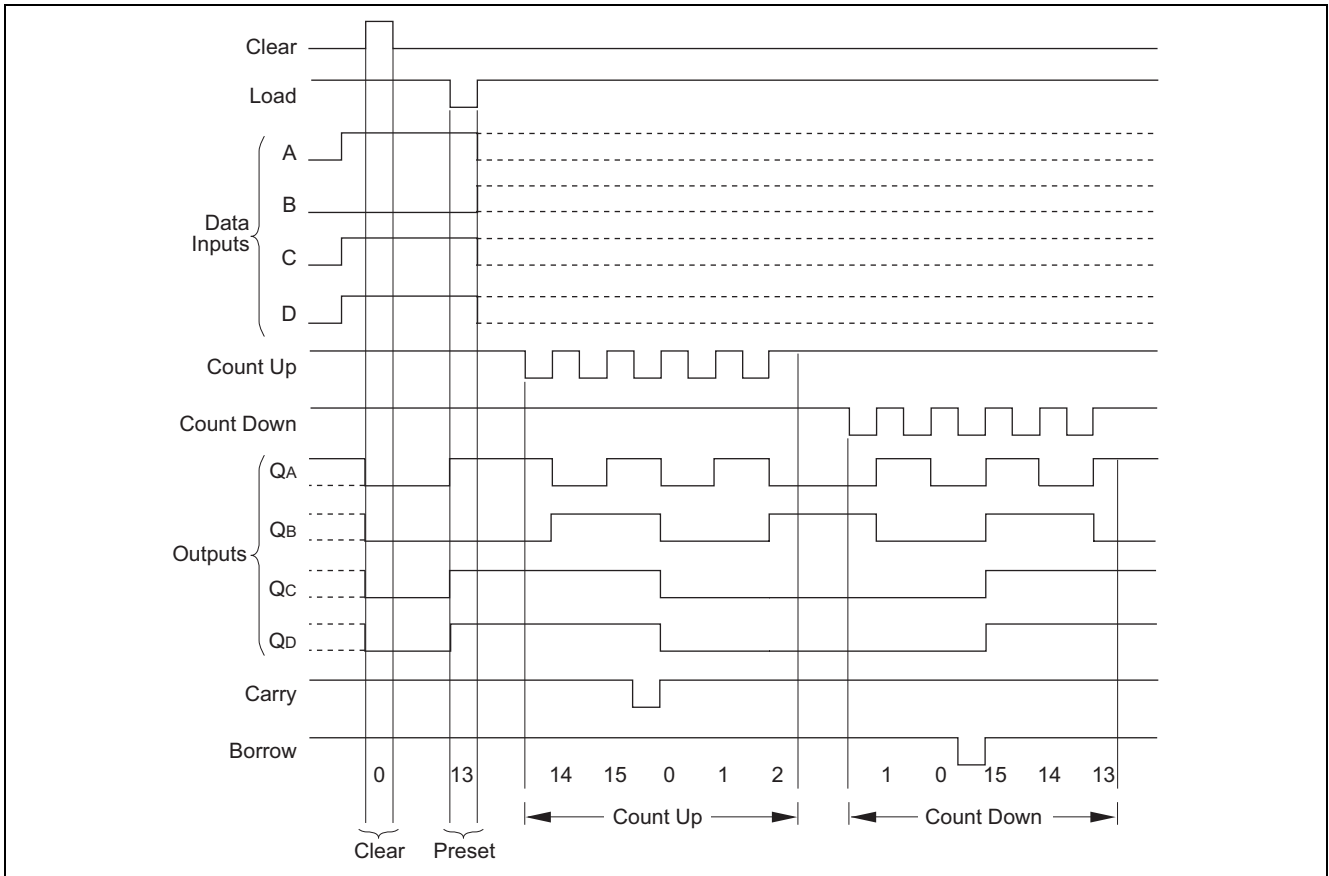


Timing Chart

HD74HC193

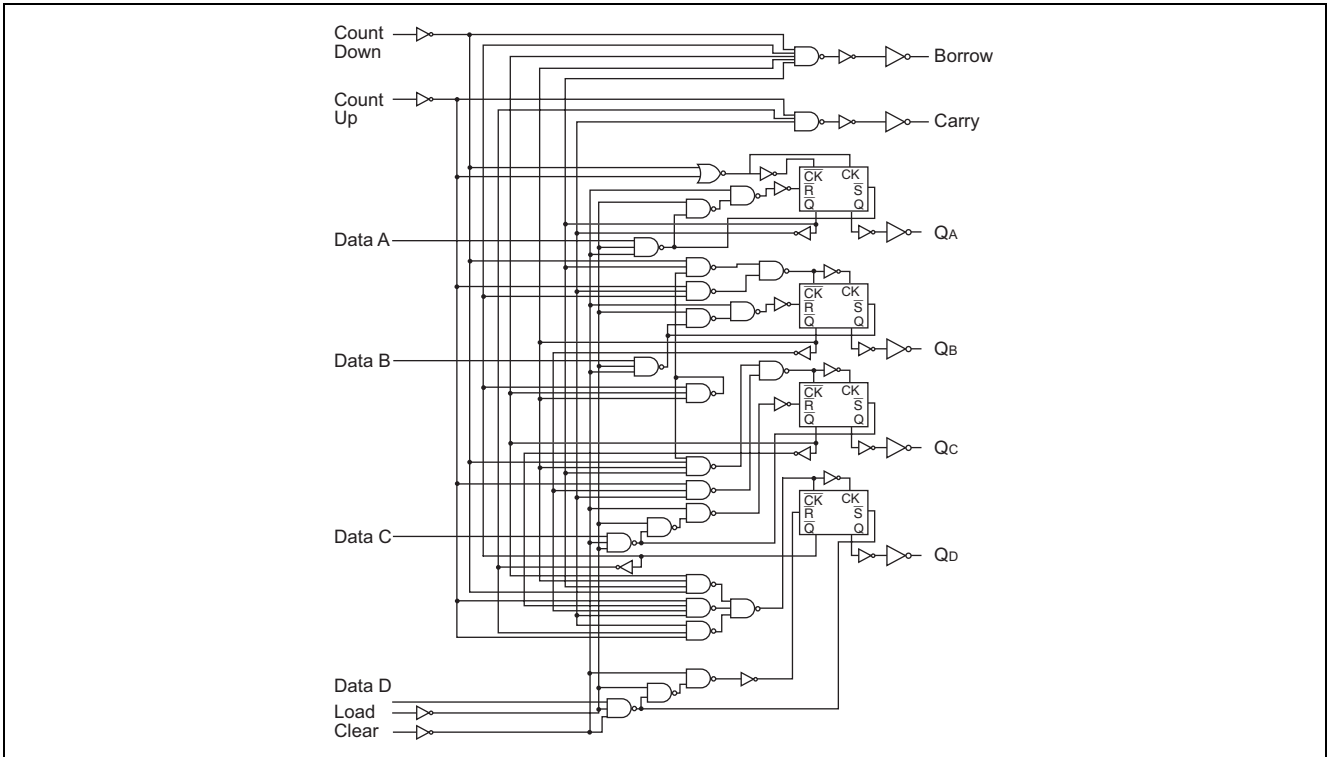
Illustrated below is the following sequence:

1. Clear outputs to zero.
2. Load (preset) to binary thirteen.
3. Count up to fourteen, fifteen, zero, one and two.
4. Count down to one, zero, borrow, fifteen and thirteen.

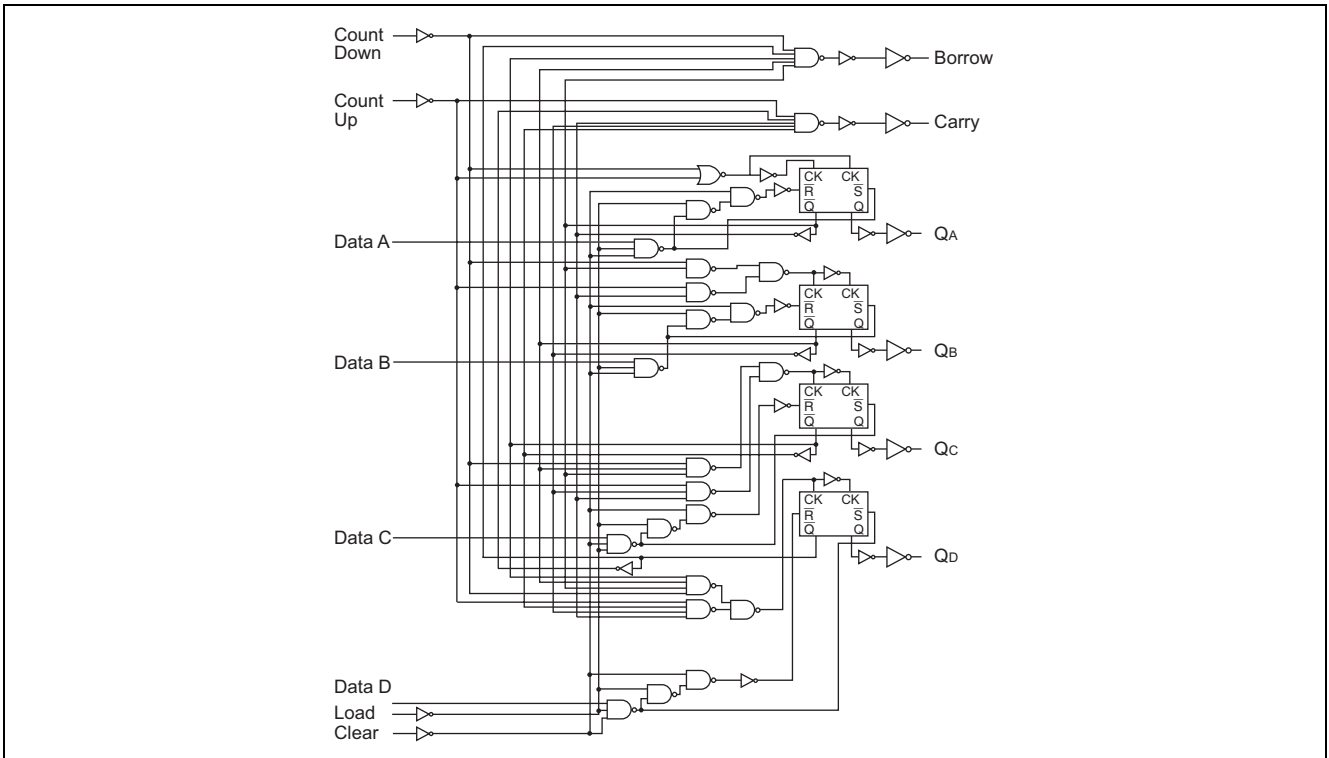


Logic Diagram

HD74HC192



HD74HC193



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	°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		$V_{CC} = 6.0\text{ V}$

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

Electrical Characteristics

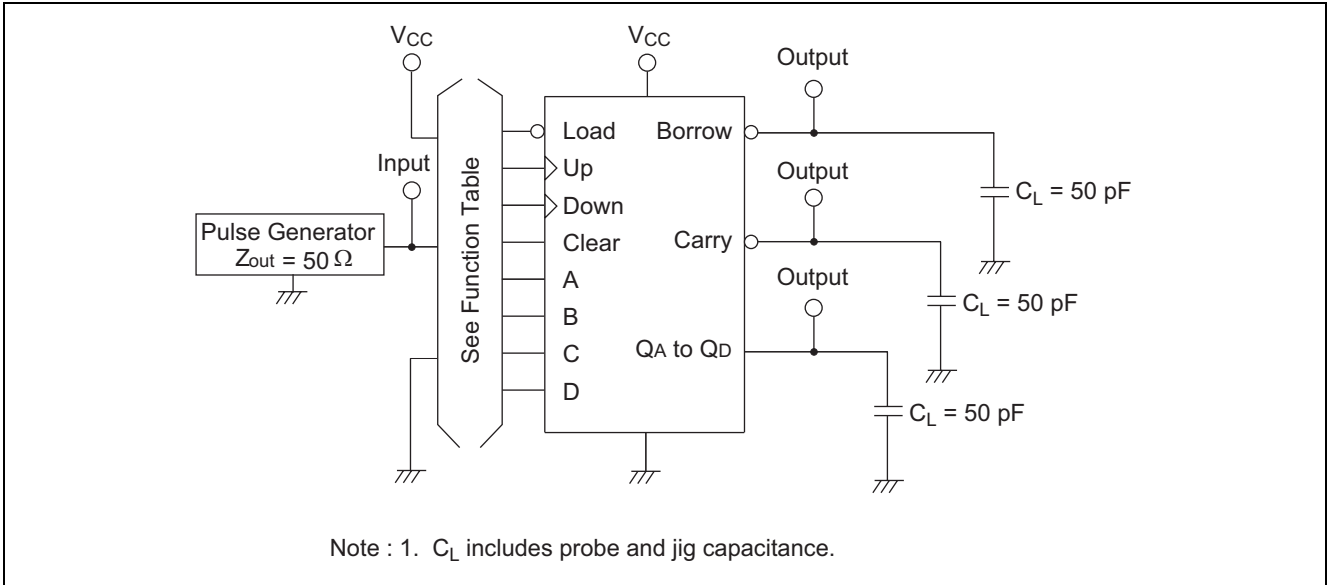
Item	Symbol	V_{CC} (V)	$T_a = 25^\circ\text{C}$			$T_a = -40\text{ to }+85^\circ\text{C}$		Unit	Test Conditions	
			Min	Typ	Max	Min	Max			
Input voltage	V_{IH}	2.0	1.5	—	—	1.5	—	V		
		4.5	3.15	—	—	3.15	—			
		6.0	4.2	—	—	4.2	—			
	V_{IL}	2.0	—	—	0.5	—	0.5	V		
		4.5	—	—	1.35	—	1.35			
		6.0	—	—	1.8	—	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	—			
		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

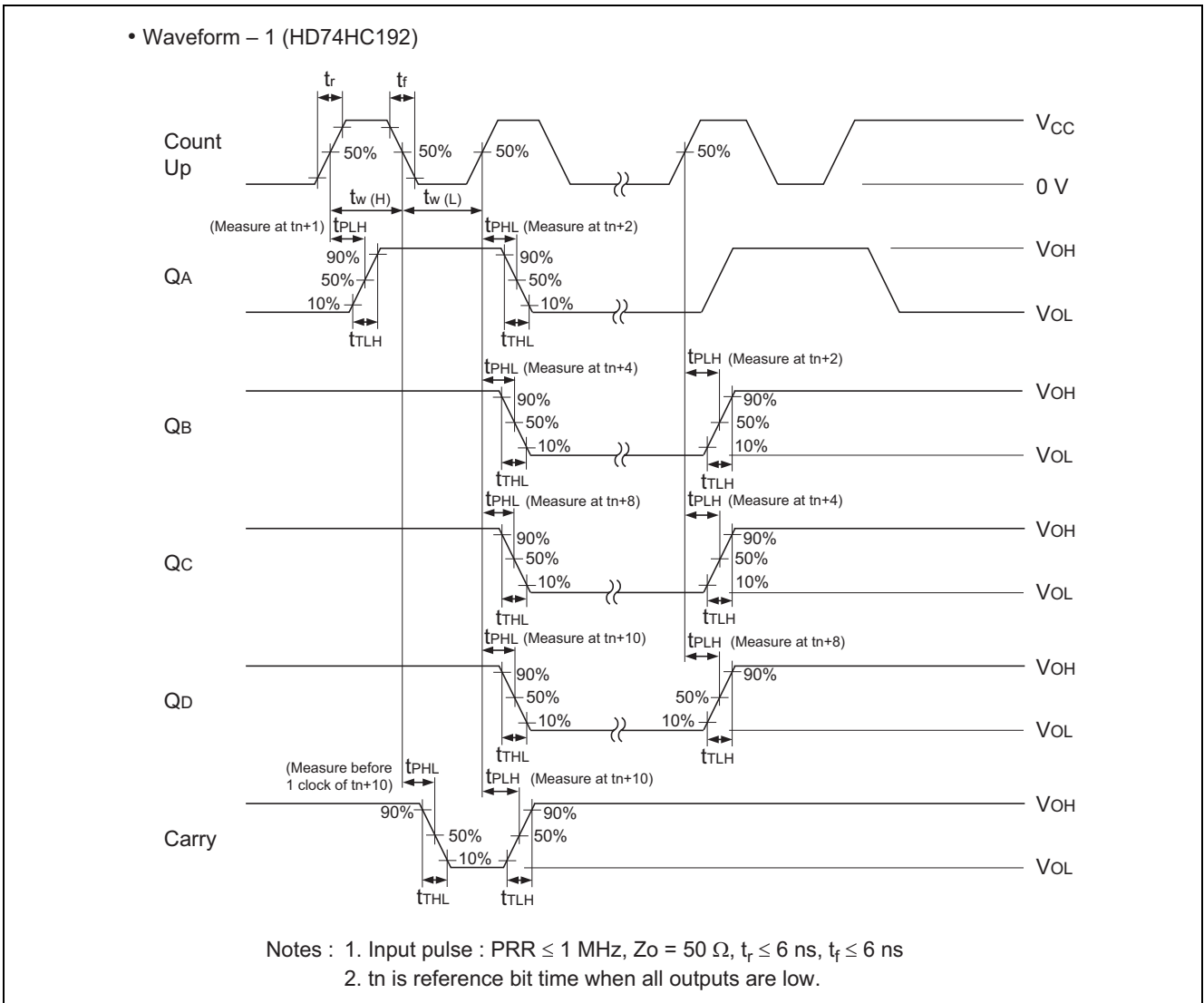
(C_L = 50 pF, Input t_r = t_f = 6 ns)

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	—	—	4	—	3	MHz			
		4.5	—	—	20	—	16				
		6.0	—	—	24	—	19				
Propagation delay time	t _{PLH}	2.0	—	—	140	—	175	ns	Count up to Carry		
		4.5	—	14	28	—	35				
		6.0	—	—	24	—	30				
		t _{PHL}	2.0	—	—	130	—			165	
			4.5	—	15	26	—			33	
			6.0	—	—	22	—			28	
	t _{PLH}	2.0	—	—	130	—	165	ns	Count down to Borrow		
		4.5	—	14	26	—	33				
		6.0	—	—	22	—	28				
		t _{PHL}	2.0	—	—	130	—			165	
			4.5	—	15	26	—			33	
			6.0	—	—	22	—			28	
	t _{PLH}	2.0	—	—	215	—	270	ns	Count up or down to Q		
		4.5	—	21	43	—	54				
		6.0	—	—	37	—	46				
		t _{PHL}	2.0	—	—	275	—			345	
			4.5	—	21	55	—			69	
			6.0	—	—	47	—			59	
	t _{PLH}	2.0	—	—	230	—	290	ns	Load to Q		
		4.5	—	17	46	—	58				
		6.0	—	—	39	—	49				
		t _{PHL}	2.0	—	—	290	—			365	
			4.5	—	23	58	—			73	
			6.0	—	—	49	—			62	
t _{PHL}	2.0	—	—	265	—	335	ns	Clear to Q			
	4.5	—	24	53	—	66					
	6.0	—	—	45	—	56					
Pulse width	t _w	2.0	80	—	—	100	—	ns			
		4.5	16	8	—	20	—				
		6.0	14	—	—	17	—				
Hold time	t _h	2.0	5	—	—	5	—	ns	Data to Load		
		4.5	5	-3	—	5	—				
		6.0	5	—	—	5	—				
Setup time	t _{su}	2.0	100	—	—	125	—	ns	Data to Load		
		4.5	20	4	—	25	—				
		6.0	17	—	—	21	—				
Removal time	t _{rem}	2.0	50	—	—	65	—	ns	Clear to Clock		
		4.5	10	-1	—	13	—				
		6.0	9	—	—	11	—				
Output rise/fall time	t _{TLH} , t _{THL}	2.0	—	—	75	—	95	ns			
		4.5	—	5	15	—	19				
		6.0	—	—	13	—	16				
Input capacitance	C _{in}	—	—	5	10	—	10	pF			

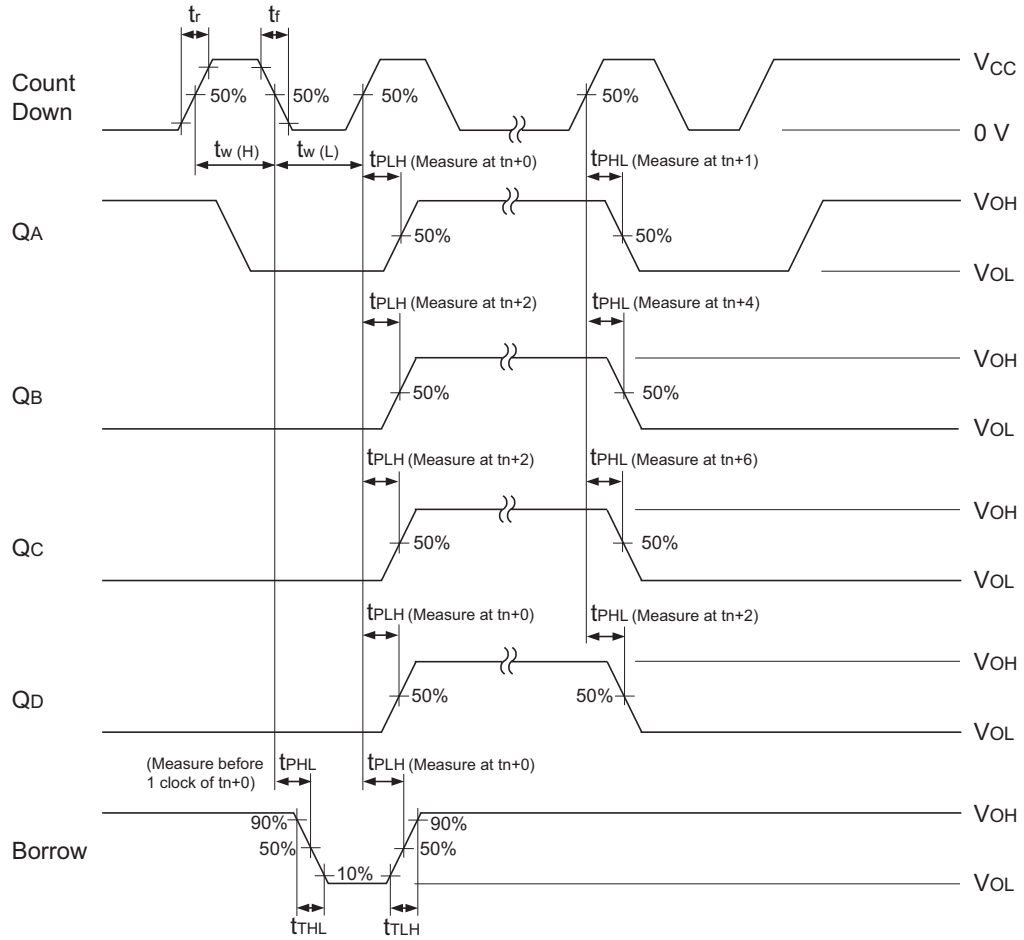
Test Circuit



Waveforms

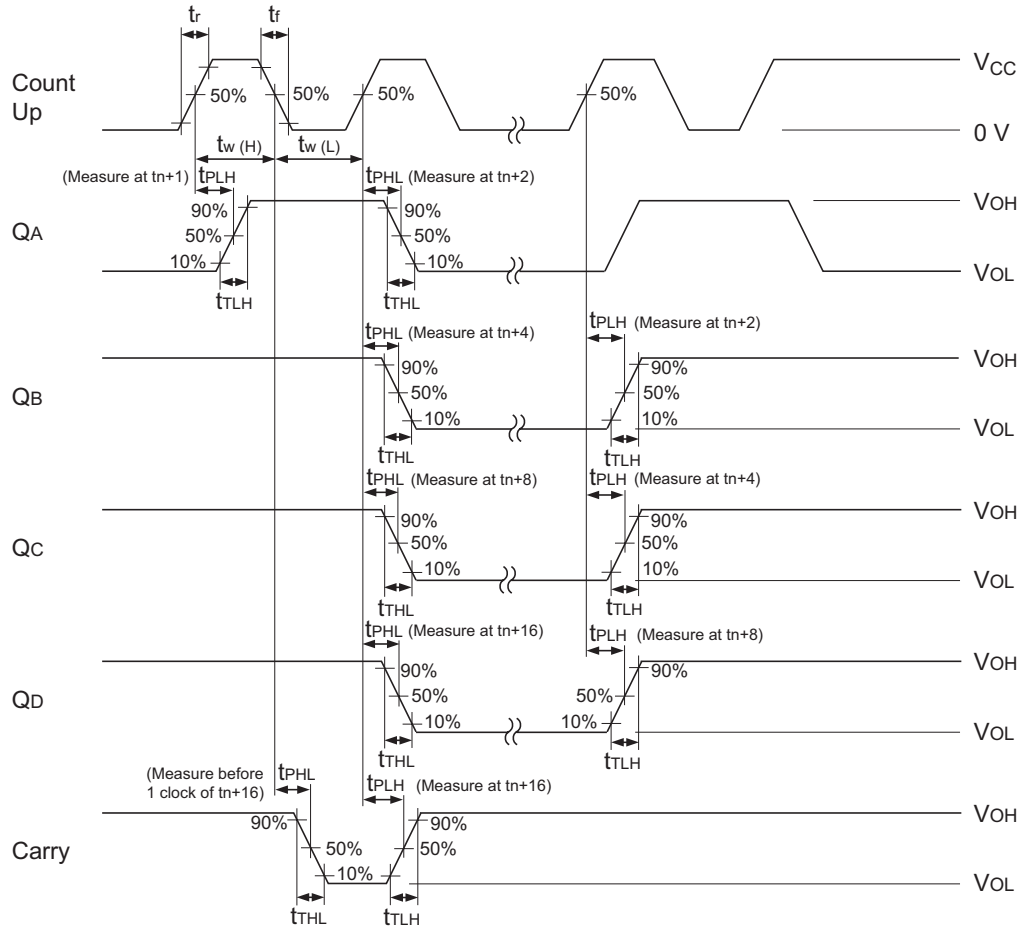


• Waveform – 2 (HD74HC192)



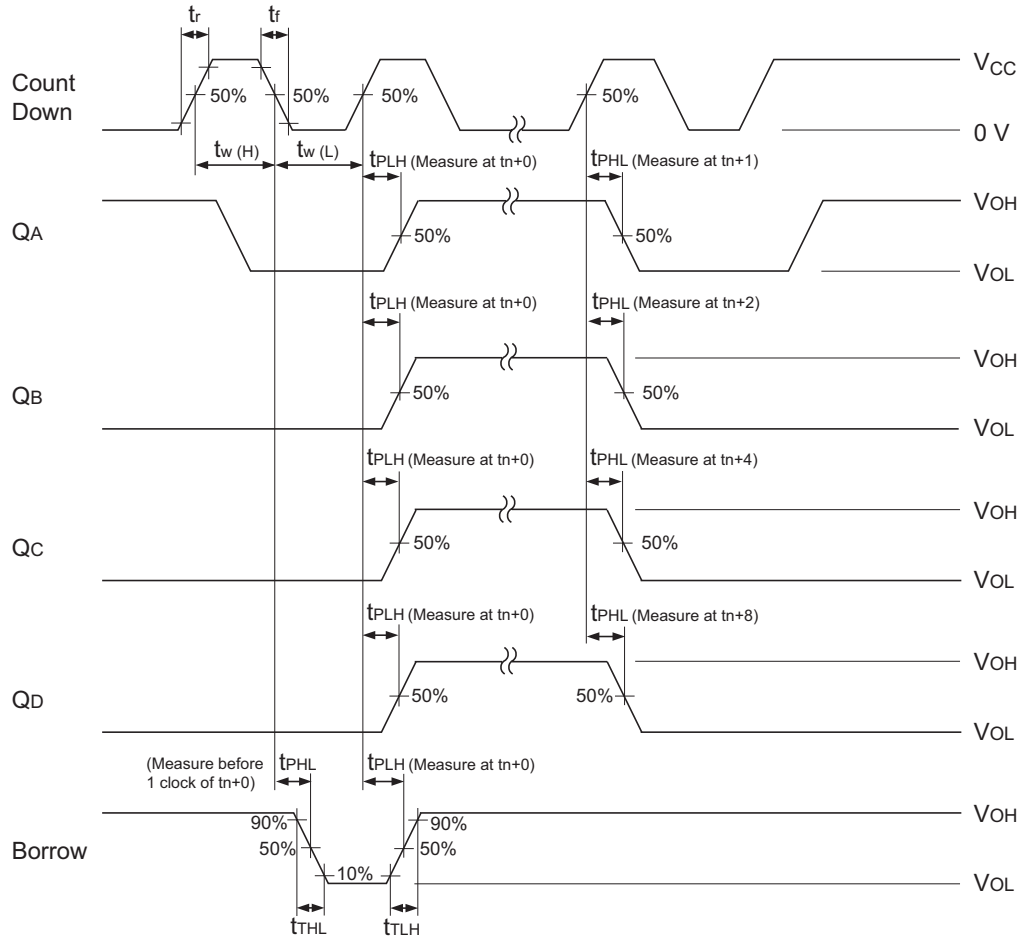
- Notes : 1. Input pulse : $PRR \leq 1 \text{ MHz}$, $Z_o = 50 \Omega$, $t_r \leq 6 \text{ ns}$, $t_f \leq 6 \text{ ns}$
 2. t_n is reference bit time when outputs are H, L, L, H

• Waveform – 3 (HD74HC193)



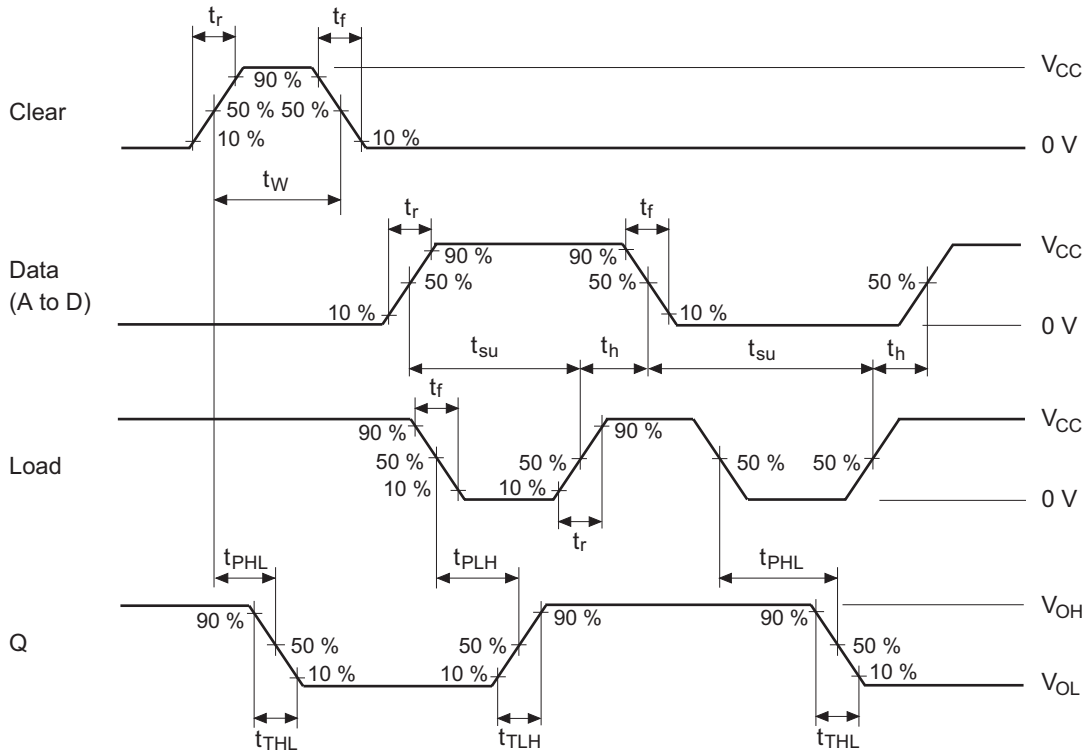
- Notes : 1. Input pulse : $PRR \leq 1 \text{ MHz}$, $Z_o = 50 \Omega$, $t_r \leq 6 \text{ ns}$, $t_f \leq 6 \text{ ns}$
 2. t_n is reference bit time when all outputs are low.

• Waveform – 4 (HD74HC193)



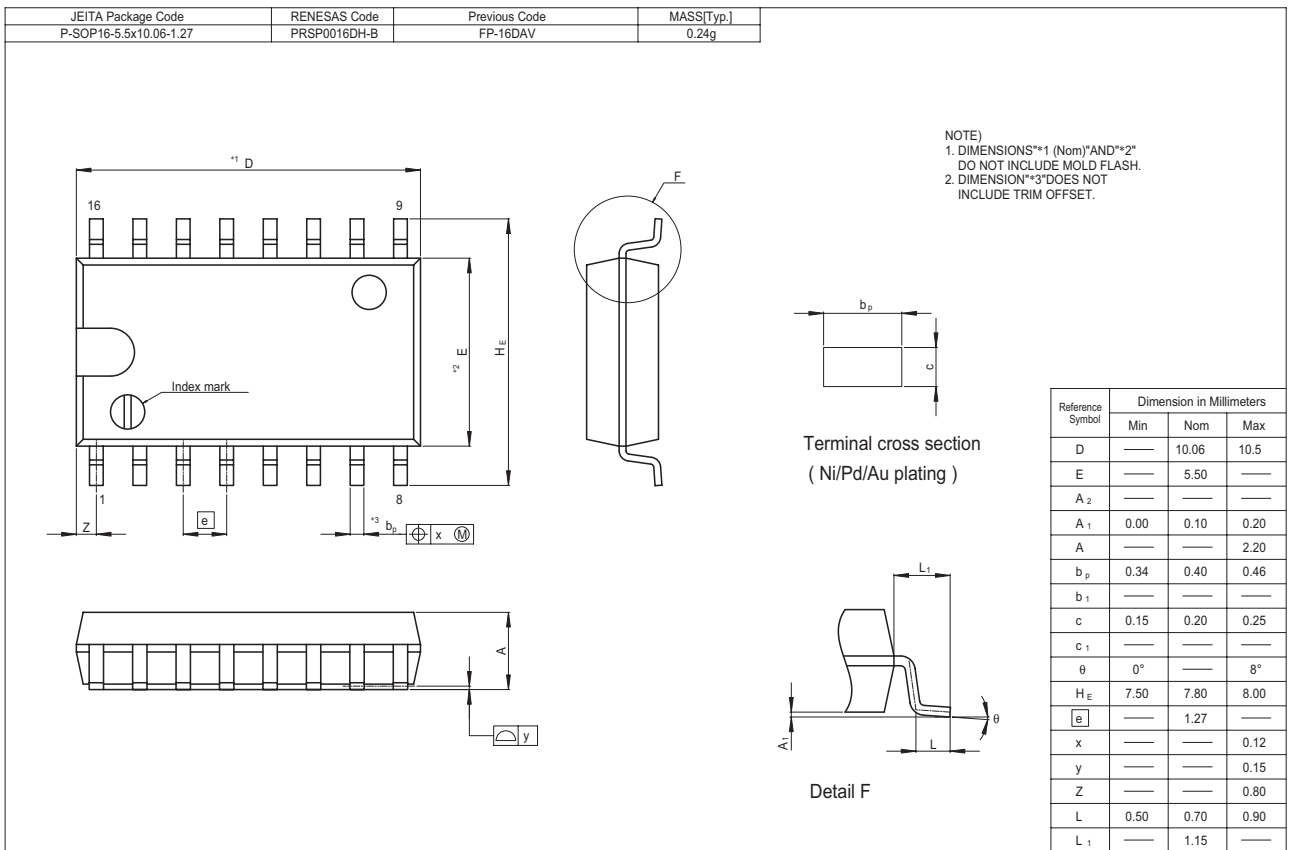
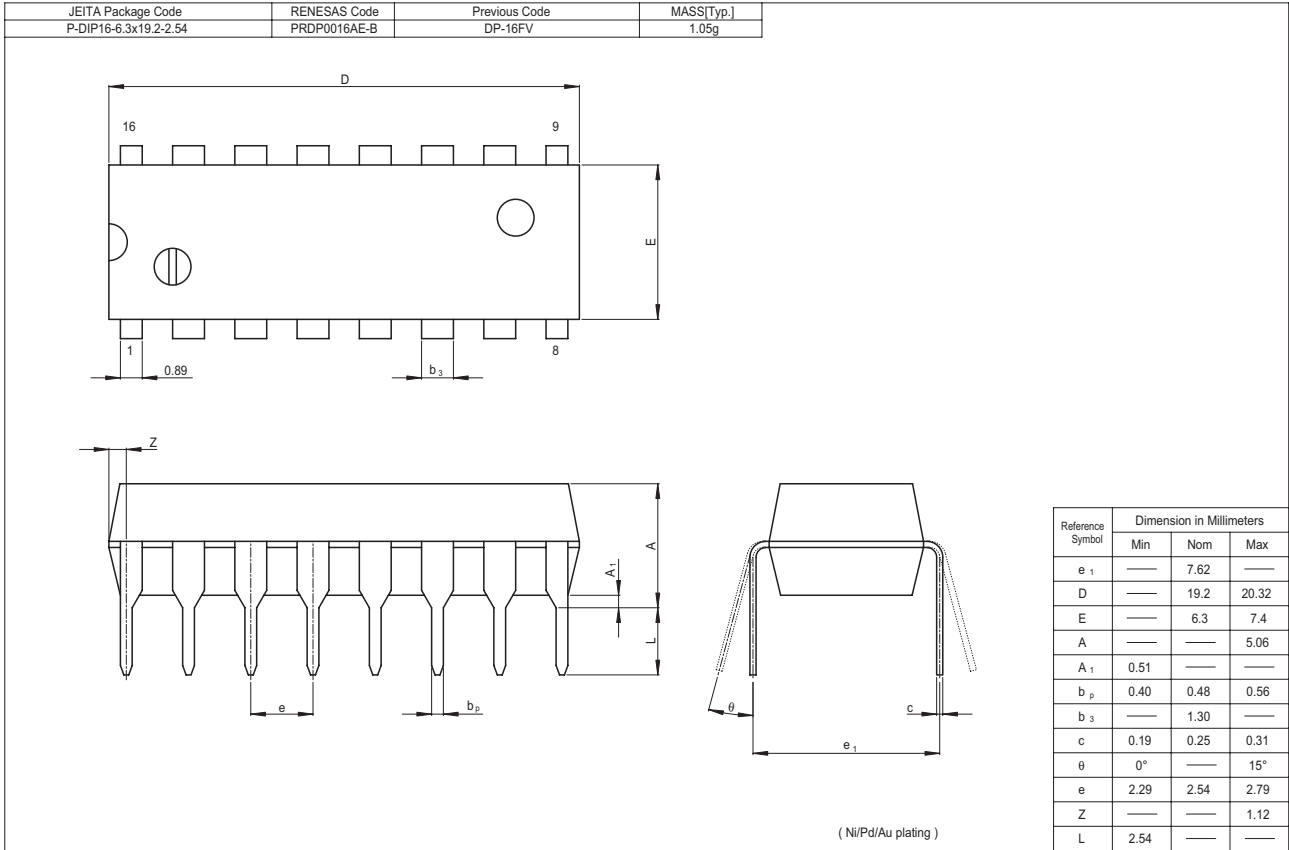
- Notes : 1. Input pulse : $PRR \leq 1 \text{ MHz}$, $Z_o = 50 \Omega$, $t_r \leq 6 \text{ ns}$, $t_f \leq 6 \text{ ns}$
 2. t_n is reference bit time when outputs are H, L, L, H

• Waveform – 5



- Notes : 1. Load Input Pulse : PRR \leq 1 MHz, $Z_o = 50 \Omega$, $t_r \leq 6$ ns, $t_f \leq 6$ ns
 2. Data Input Pulse : PRR \leq 500 kHz, $Z_o = 50 \Omega$, $t_r \leq 6$ ns, $t_f \leq 6$ ns

Package Dimensions



Keep safety first in your circuit designs!

1. Renesas Technology Corp. puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corp. product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Renesas Technology Corp. or a third party.
 2. Renesas Technology Corp. assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
 3. All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Renesas Technology Corp. without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor for the latest product information before purchasing a product listed herein.
The information described here may contain technical inaccuracies or typographical errors.
Renesas Technology Corp. assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.
Please also pay attention to information published by Renesas Technology Corp. by various means, including the Renesas Technology Corp. Semiconductor home page (<http://www.renesas.com>).
 4. When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Renesas Technology Corp. assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
 5. Renesas Technology Corp. semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
 6. The prior written approval of Renesas Technology Corp. is necessary to reprint or reproduce in whole or in part these materials.
 7. If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
 8. Please contact Renesas Technology Corp. for further details on these materials or the products contained therein.
-



RENESAS SALES OFFICES

<http://www.renesas.com>

Refer to "<http://www.renesas.com/en/network>" for the latest and detailed information.

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