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.

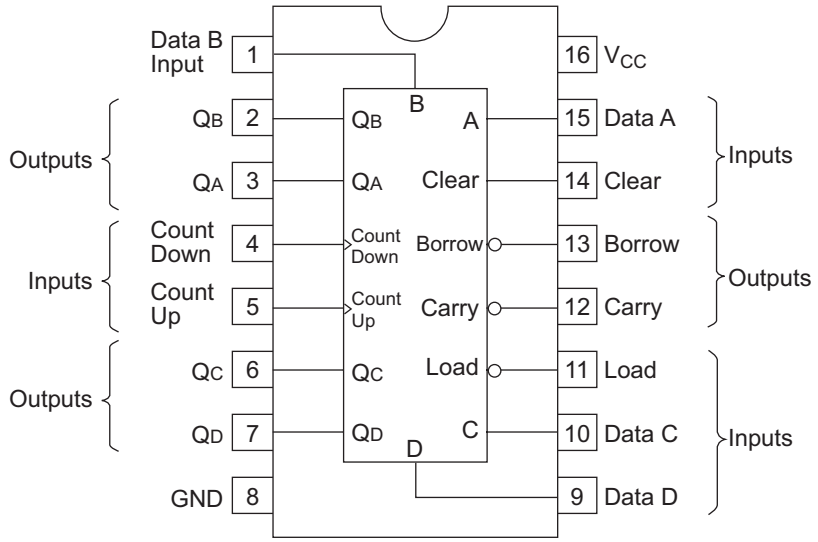
Features

- 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 µA max
- Low Quiescent Supply Current: I_{CC} (static) = 4 µA max (Ta = 25°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

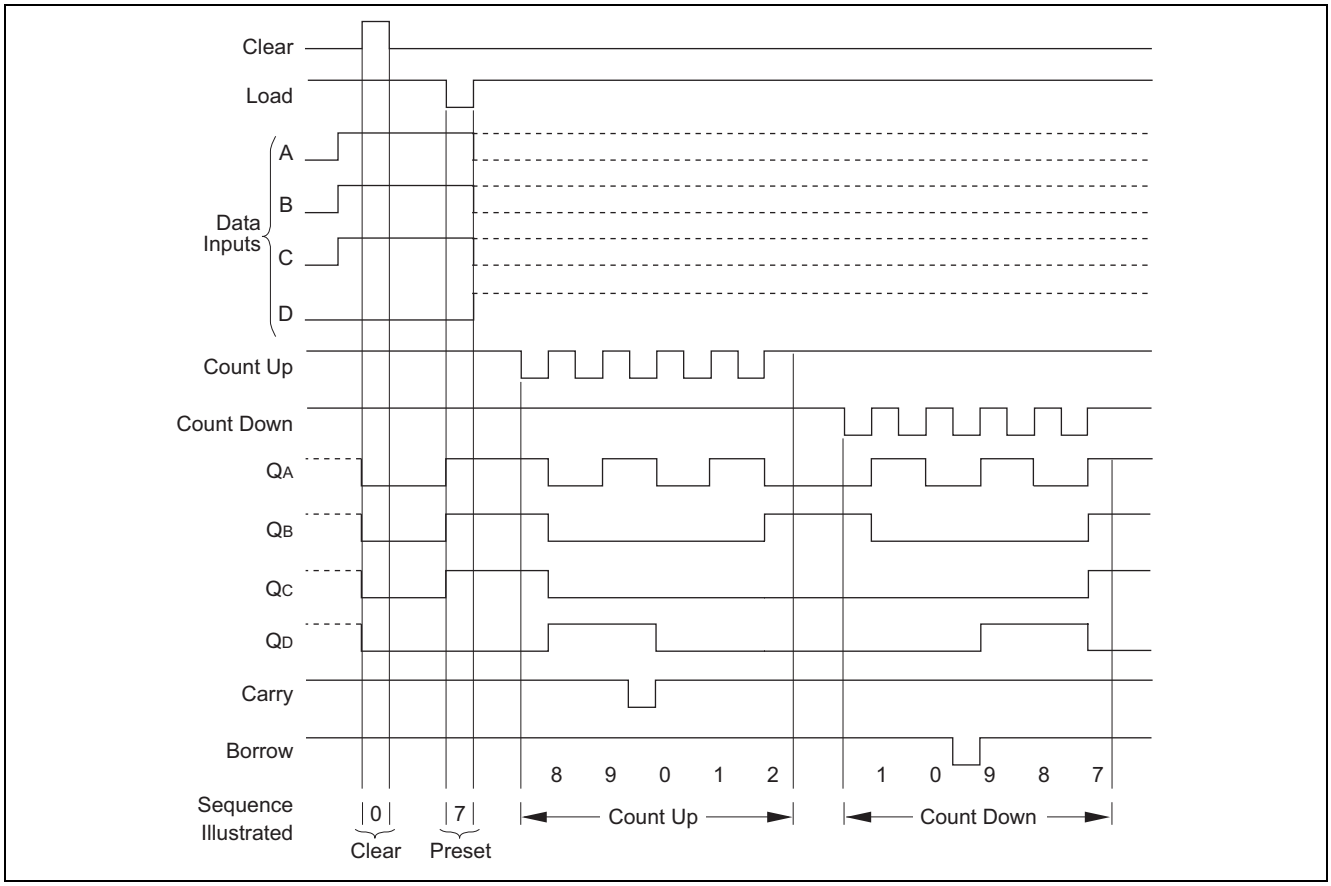


Timing Chart

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.

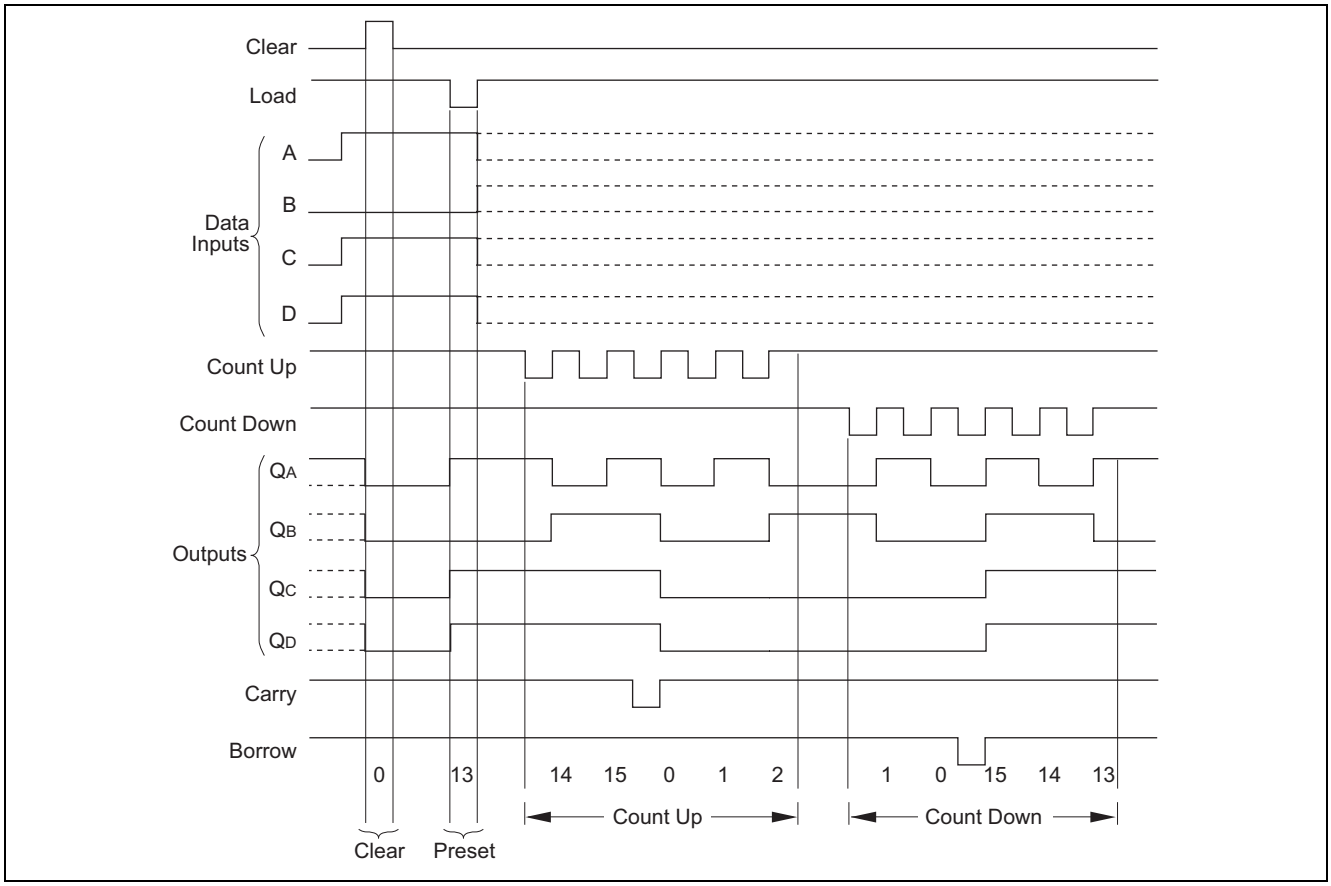


Timing Chart

HD74HC193

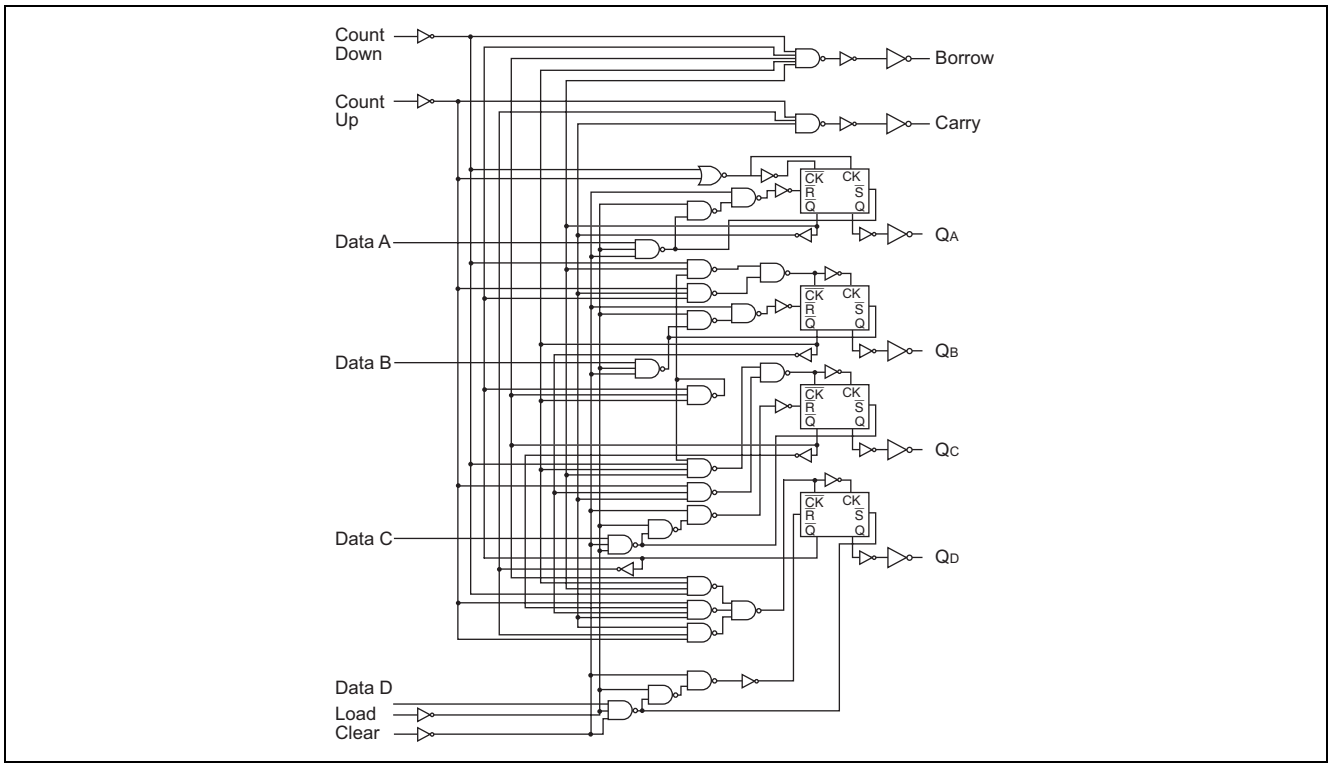
Illustrated below is the following sequence:

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.

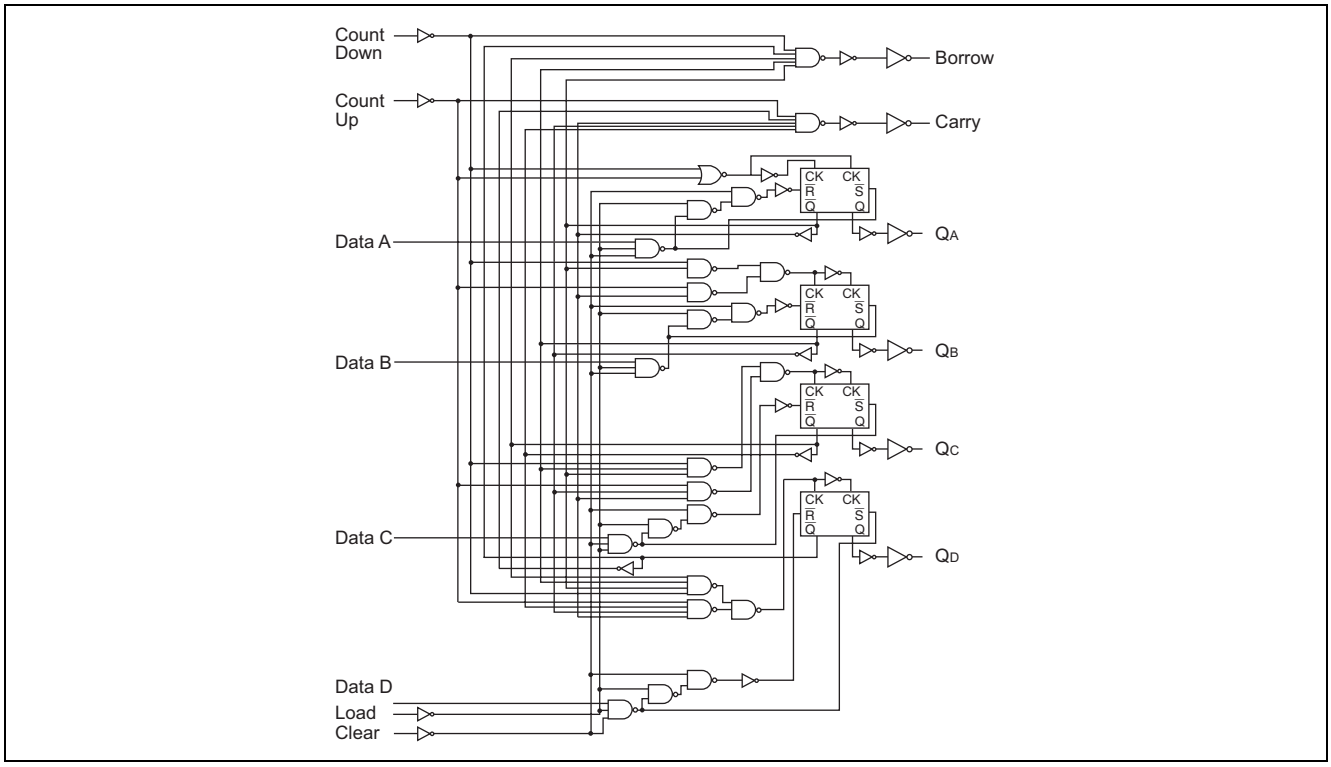


Logic Diagram

HD74HC192



HD74HC193



Absolute Maximum Ratings

Item	Symbol	Ratings	Unit
Supply voltage range	V_{CC}	–0.5 to 7.0	V
Input / Output voltage	Vin, Vout	–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	Tstg	–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	Ta	–40 to 85	°C	
Input rise / fall time*1	t_r, t_f	0 to 1000	ns	V_{CC} = 2.0 V
		0 to 500		V_{CC} = 4.5 V
		0 to 400		V_{CC} = 6.0 V

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

Electrical Characteristics

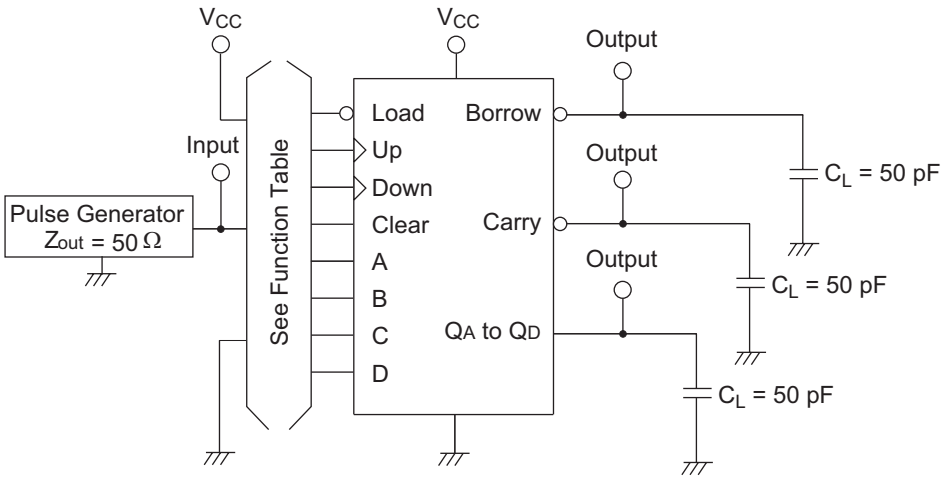
Item	Symbol	V_{CC} (V)	Ta = 25°C			Ta = –40 to+85°C		Unit	Test Conditions	
			Min	Typ	Max	Min	Max			
Input voltage	V_{IH}	2.0	1.5	—	—	1.5	—	V		
		4.5	3.15	—	—	3.15	—			
		6.0	4.2	—	—	4.2	—			
	V_{IL}	2.0	—	—	0.5	—	0.5	V		
		4.5	—	—	1.35	—	1.35			
		6.0	—	—	1.8	—	1.8			
Output voltage	V_{OH}	2.0	1.9	2.0	—	1.9	—	V	Vin = V_{IH} or V_{IL}	I_{OH} = –20 µA
		4.5	4.4	4.5	—	4.4	—			
		6.0	5.9	6.0	—	5.9	—			
		4.5	4.18	—	—	4.13	—			I_{OH} = –4 mA
		6.0	5.68	—	—	5.63	—			I_{OH} = –5.2 mA
	V_{OL}	2.0	—	0.0	0.1	—	0.1	V	Vin = V_{IH} or V_{IL}	I_{OL} = 20 µA
		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 mA
		6.0	—	—	0.26	—	0.33			I_{OL} = 5.2 mA
Input current	Iin	6.0	—	—	±0.1	—	±1.0	µA	Vin = V_{CC} or GND	
Quiescent supply current	I_{CC}	6.0	—	—	4.0	—	40	µA	Vin = V_{CC} or GND, Iout = 0 µA	

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	Cin	—	—	5	10	—	10	pF	

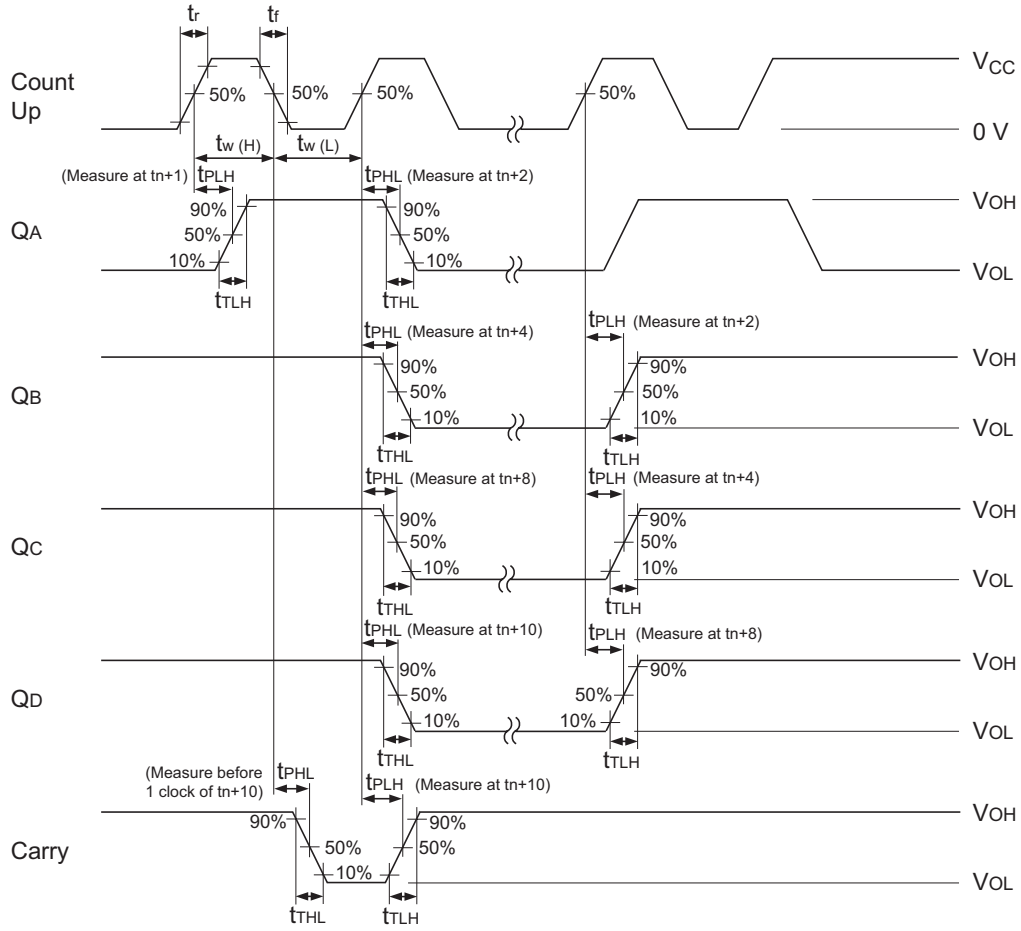
Test Circuit



Note : 1. C_L includes probe and jig capacitance.

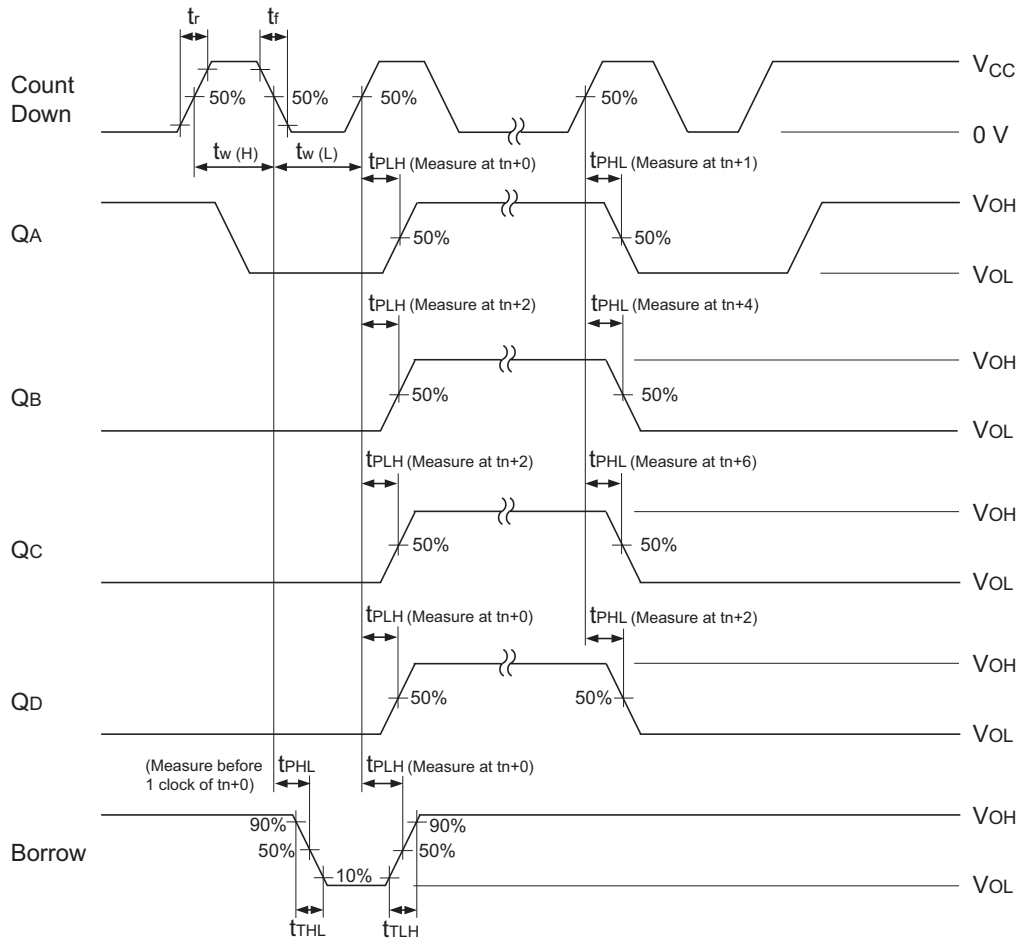
Waveforms

• Waveform – 1 (HD74HC192)



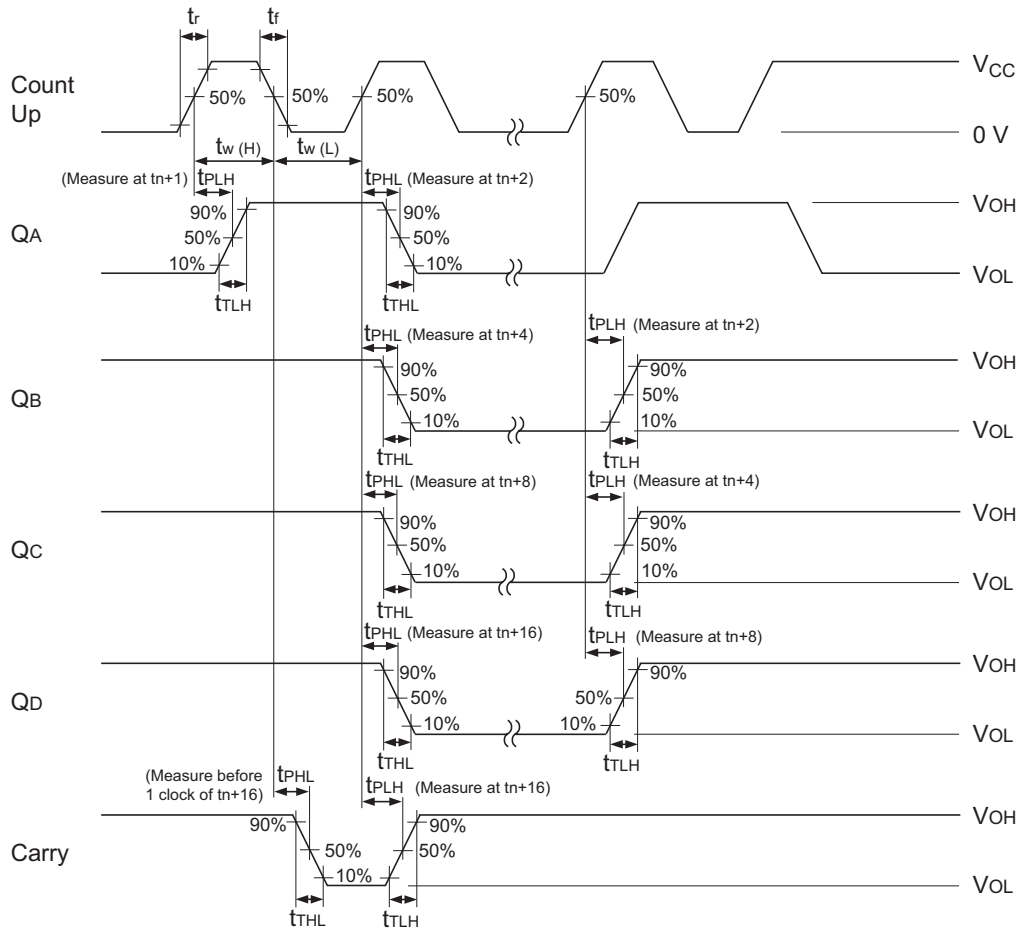
Notes : 1. Input pulse : PRR ≤ 1 MHz, Zo = 50 Ω, t_r ≤ 6 ns, t_f ≤ 6 ns
2. tn is reference bit time when all outputs are low.

• Waveform – 2 (HD74HC192)



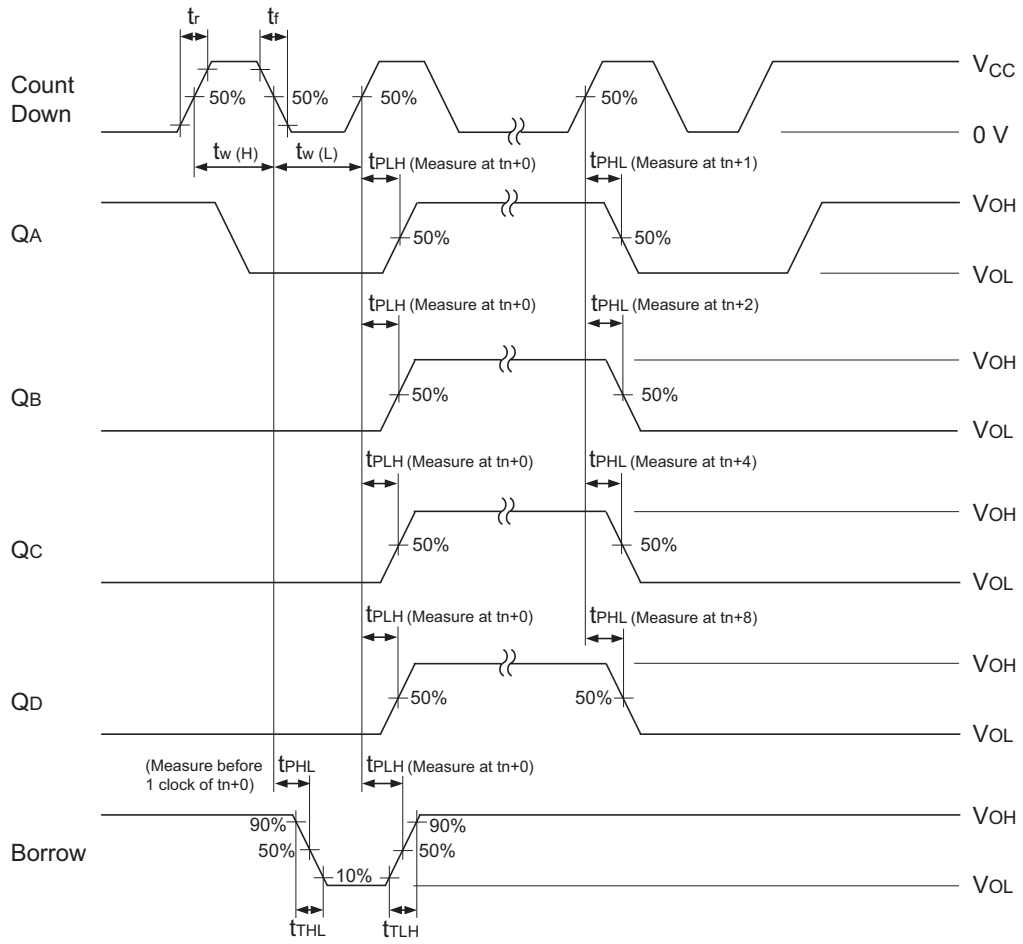
Notes : 1. Input pulse : PRR ≤ 1 MHz, Zo = 50 Ω, t_r ≤ 6 ns, t_f ≤ 6 ns
2. tn is reference bit time when outputs are H, L, L, H

• Waveform – 3 (HD74HC193)



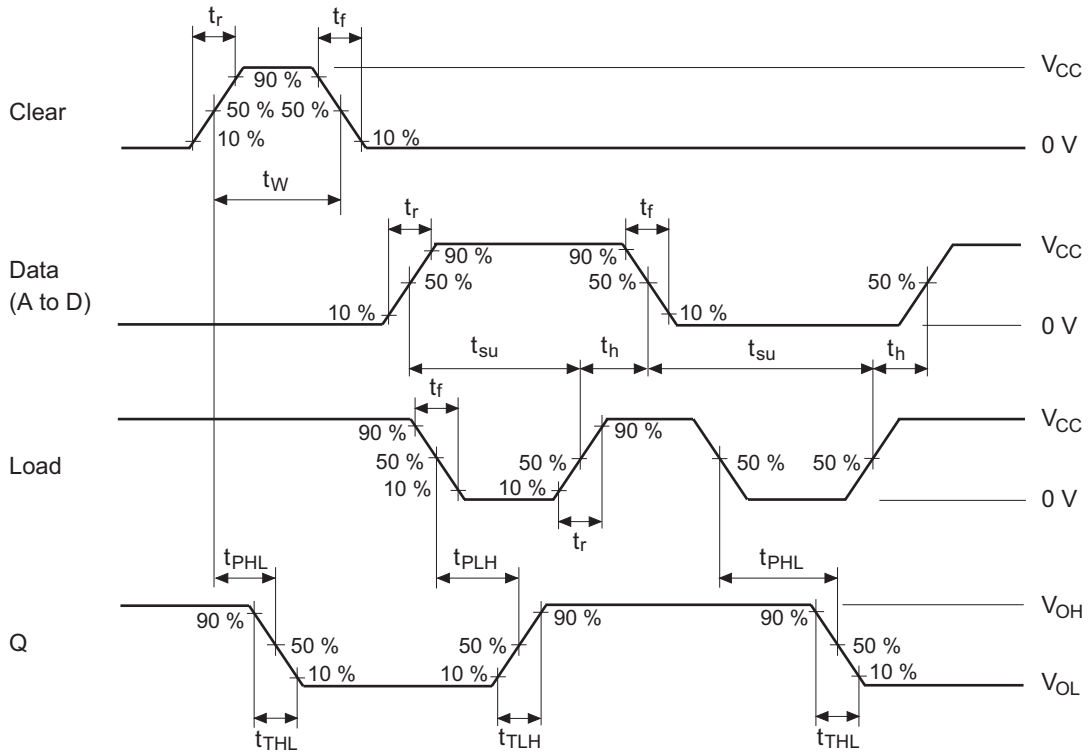
Notes : 1. Input pulse : PRR ≤ 1 MHz, Zo = 50 Ω, t_r ≤ 6 ns, t_f ≤ 6 ns
2. tn is reference bit time when all outputs are low.

• Waveform – 4 (HD74HC193)



Notes : 1. Input pulse : PRR ≤ 1 MHz, Zo = 50 Ω, t_r ≤ 6 ns, t_f ≤ 6 ns
2. tn is reference bit time when outputs are H, L, L, H

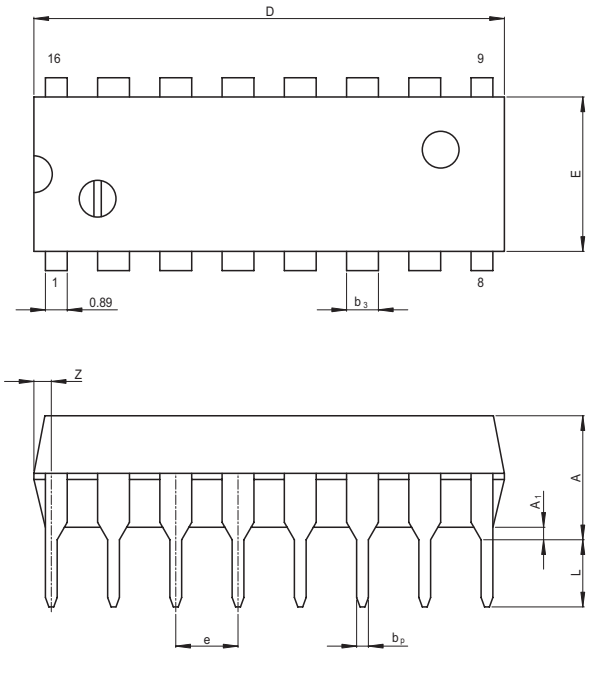
• Waveform – 5



Notes : 1. Load Input Pulse : PRR ≤ 1 MHz, Zo = 50 Ω, t_r ≤ 6 ns, t_f ≤ 6 ns
2. Data Input Pulse : PRR ≤ 500 kHz, Zo = 50 Ω, t_r ≤ 6 ns, t_f ≤ 6 ns

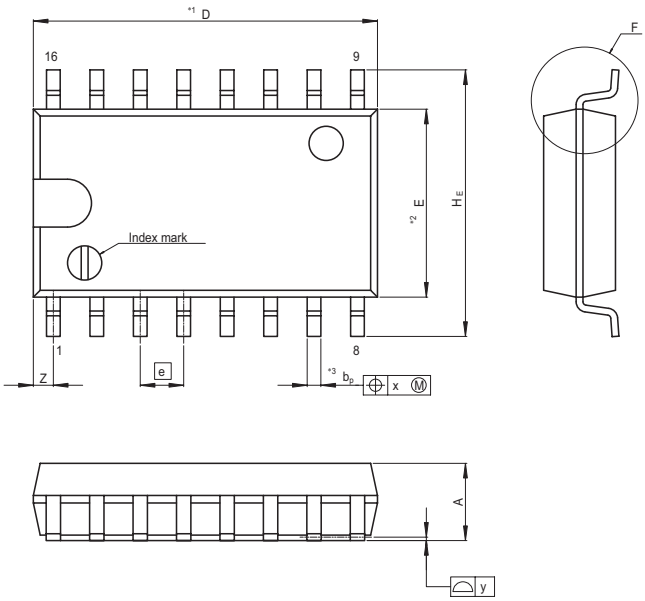
Package Dimensions

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-DIP16-6.3x19.2-2.54	PRDP0016AE-B	DP-16FV	1.05g

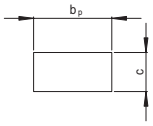


Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
e 1	—	7.62	—
D	—	19.2	20.32
E	—	6.3	7.4
A	—	—	5.06
A 1	0.51	—	—
b p	0.40	0.48	0.56
b 3	—	1.30	—
c	0.19	0.25	0.31
θ	0°	—	15°
e	2.29	2.54	2.79
Z	—	—	1.12
L	2.54	—	—

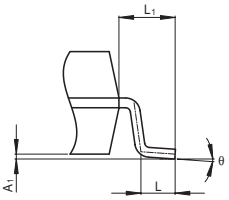
JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SOP16-5.5x10.06-1.27	PRSP0016DH-B	FP-16DAV	0.24g



NOTE)
1. DIMENSIONS"*1 (Nom)"AND"*2"
   DO NOT INCLUDE MOLD FLASH.
2. DIMENSION"*3"DOES NOT
   INCLUDE TRIM OFFSET.



Terminal cross section
(Ni/Pd/Au plating)



Detail F

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	—	10.06	10.5
E	—	5.50	—
A 2	—	—	—
A 1	0.00	0.10	0.20
A	—	—	2.20
b p	0.34	0.40	0.46
b 1	—	—	—
c	0.15	0.20	0.25
c 1	—	—	—
θ	0°	—	8°
H E	7.50	7.80	8.00
e	—	1.27	—
x	—	—	0.12
y	—	—	0.15
Z	—	—	0.80
L	0.50	0.70	0.90
L 1	—	1.15	—

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