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April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

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HD74HC93

4-bit Binary Counter

REJ03D0557-0200
(Previous ADE-205-430)
Rev.2.00
Oct 06, 2005

Description

The HD74HC93 is a 4-bit ripple type counter consisting of four master/slave flip-flops that are internally connected to provide separate divide-by-two and divide-by-eight sections. Each section has a separate clock input which initiates state changes of the counter on the high-to-low clock transition. State changes of the Q outputs do not occur simultaneously because of internal ripple delays. Therefore, decoded output signals are subject to decoding spikes and should not be used as clocks or as strobes except when gated with the clock of the HD74HC93. Q_A is the output of the divide-by-two section; Q_B, Q_C, and Q_D are the binary outputs of the divide-by-eight section.

A gated AND asynchronous reset is provided which resets all the flip-flops.

Because the output from the divide-by-two section is not internally connected to the succeeding stages, the devices may be operated in various counting modes:

1. A 4-bit ripple counter – The Q_A output must be externally connected to the clock B input. The input count pulses are applied to the clock A input. Simultaneous divisions of 2, 4, 8 and 16 are performed at the Q_A, Q_B, Q_C and Q_D outputs.
2. A 3-bit ripple counter – The input count pulses are applied to the clock B input. Simultaneous frequency divisions of 2, 4 and 8 are available at the Q_B, Q_C and Q_D outputs. Independent use of the first flip-flop is available if the reset function coincides with reset of the 3-bit ripple-through counter.

Features

- High Speed Operation: t_{pd} (A to Q_A) = 13 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°C)
- Ordering Information

Part Name	Package Type	Package Code (Previous Code)	Package Abbreviation	Taping Abbreviation (Quantity)
HD74HC93P	DILP-14 pin	PRDP0014AB-B (DP-14AV)	P	—
HD74HC93FPEL	SOP-14 pin (JEITA)	PRSP0014DF-B (FP-14DAV)	FP	EL (2,000 pcs/reel)
HD74HC93RPEL	SOP-14 pin (JEDEC)	PRSP0014DE-A (FP-14DNV)	RP	EL (2,500 pcs/reel)

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

Function Table

Reset/Count Function Table

Reset Inputs		Outputs			
R ₀₍₁₎	R ₀₍₂₎	Q _D	Q _C	Q _B	Q _A
H	H	L	L	L	L
L	X	Count			
X	L	Count			

BCD Count Sequence

Count	Outputs			
	Q _D	Q _C	Q _B	Q _A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H
10	H	L	H	L
11	H	L	H	H
12	H	H	L	L
13	H	H	L	H
14	H	H	H	L
15	H	H	H	H

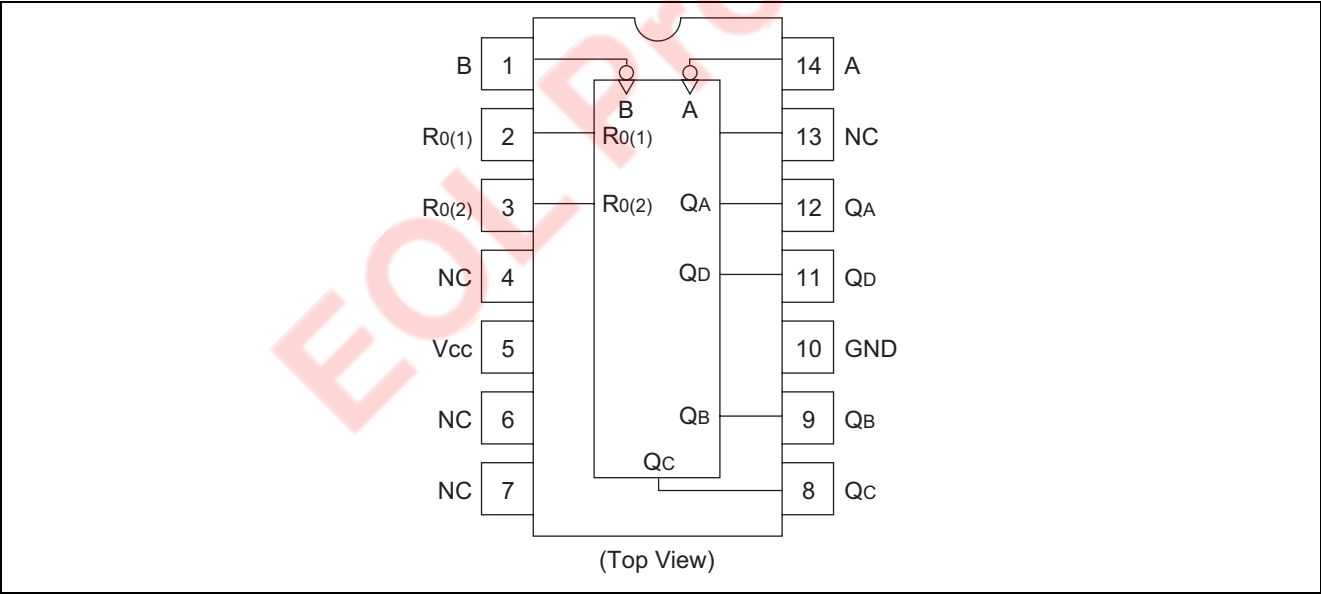
Note: Output Q_A is connected to input B for BCD count.

H : High level

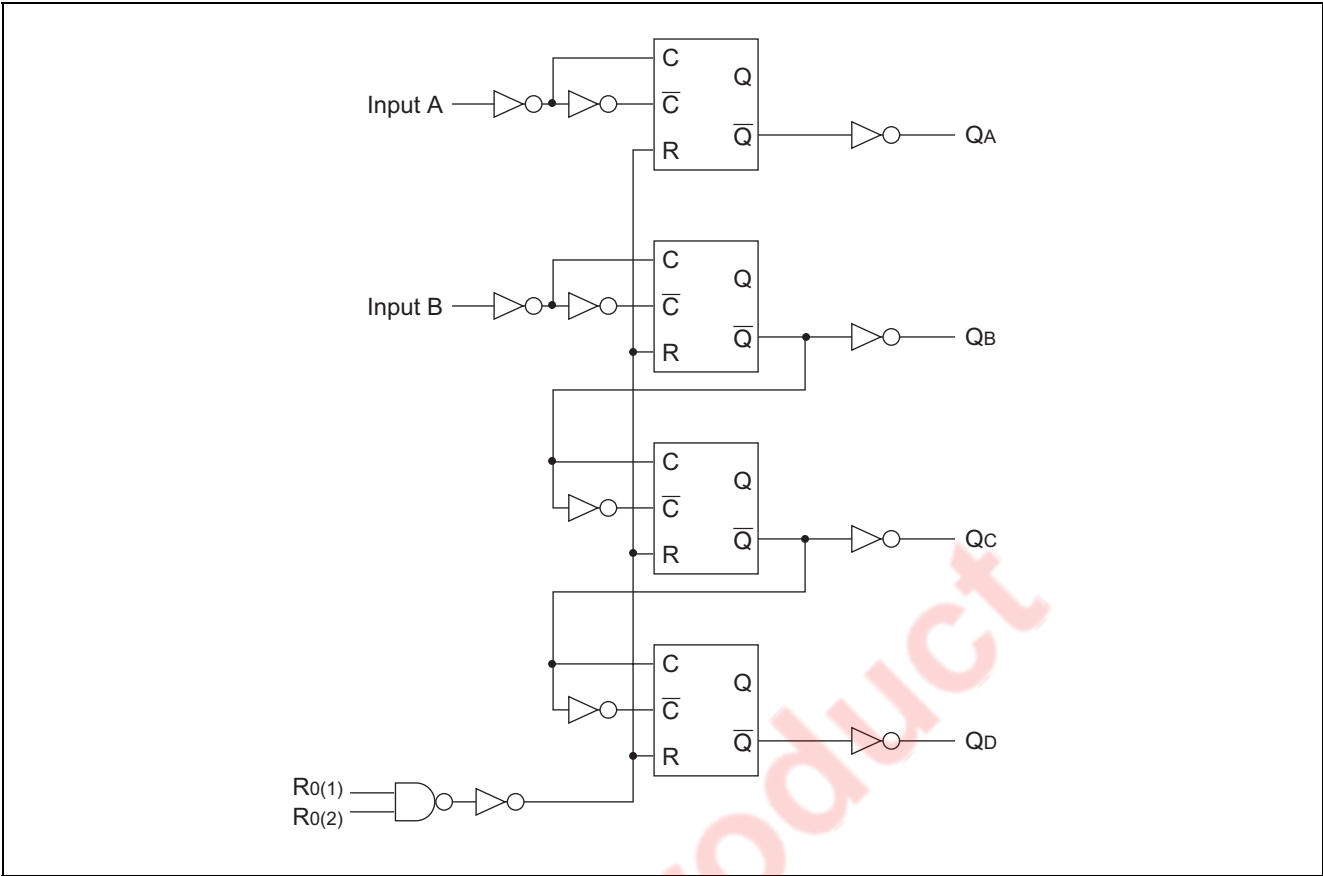
L : Low level

X : Irrelevant

Pin Arrangement



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	°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.

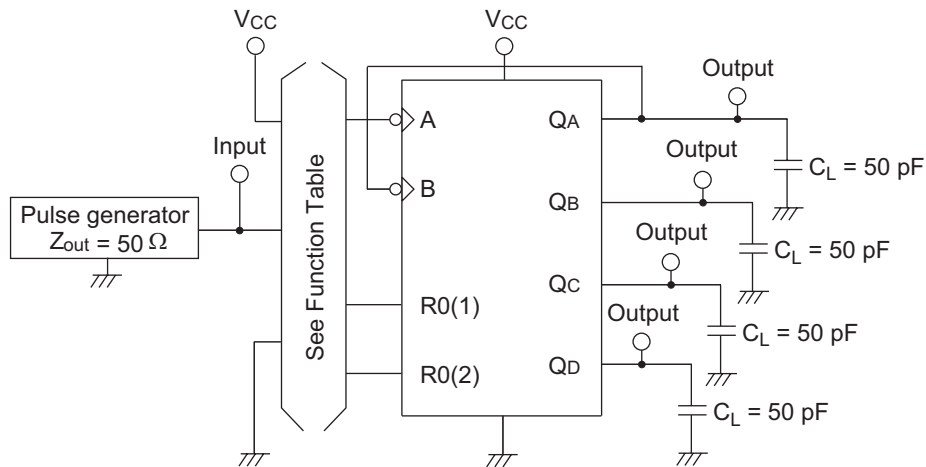
Electrical Characteristics

Item	Symbol	V _{CC} (V)	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
		6.0	—	—	—	—	—			
	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
		6.0	—	—	—	—	—			
Input current	I _{in}	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, I _{out} = 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	—	—	5	—	4	MHz		
		4.5	—	—	27	—	21			
		6.0	—	—	32	—	25			
Propagation delay time	t _{PLH} , t _{PHL}	2.0	—	—	120	—	150	ns	A to Q _A	
		4.5	—	—	13	—	30			
		6.0	—	—	20	—	26			
	t _{PLH} , t _{PHL}	2.0	—	—	340	—	425	ns	A to Q _D	
		4.5	—	—	42	—	85			
		6.0	—	—	58	—	72			
	t _{PLH} , t _{PHL}	2.0	—	—	130	—	165	ns	B to Q _B	
		4.5	—	—	13	—	33			
		6.0	—	—	22	—	28			
	t _{PLH} , t _{PHL}	2.0	—	—	185	—	230	ns	B to Q _C	
		4.5	—	—	21	—	46			
		6.0	—	—	31	—	39			
	t _{PLH} , t _{PHL}	2.0	—	—	220	—	275	ns	B to Q _D	
		4.5	—	—	27	—	55			
		6.0	—	—	37	—	47			
	t _{PLH} , t _{PHL}	2.0	—	—	175	—	220	ns	Set-to-0 to Q _A to D	
		4.5	—	—	13	—	44			
		6.0	—	—	30	—	37			
Output fall time	t _{TLH} , t _{THL}	2.0	—	—	75	—	95	ns		
		4.5	—	—	5	—	19			
		6.0	—	—	13	—	16			
Input capacitance	C _{in}	—	—	5	10	—	10	pF		

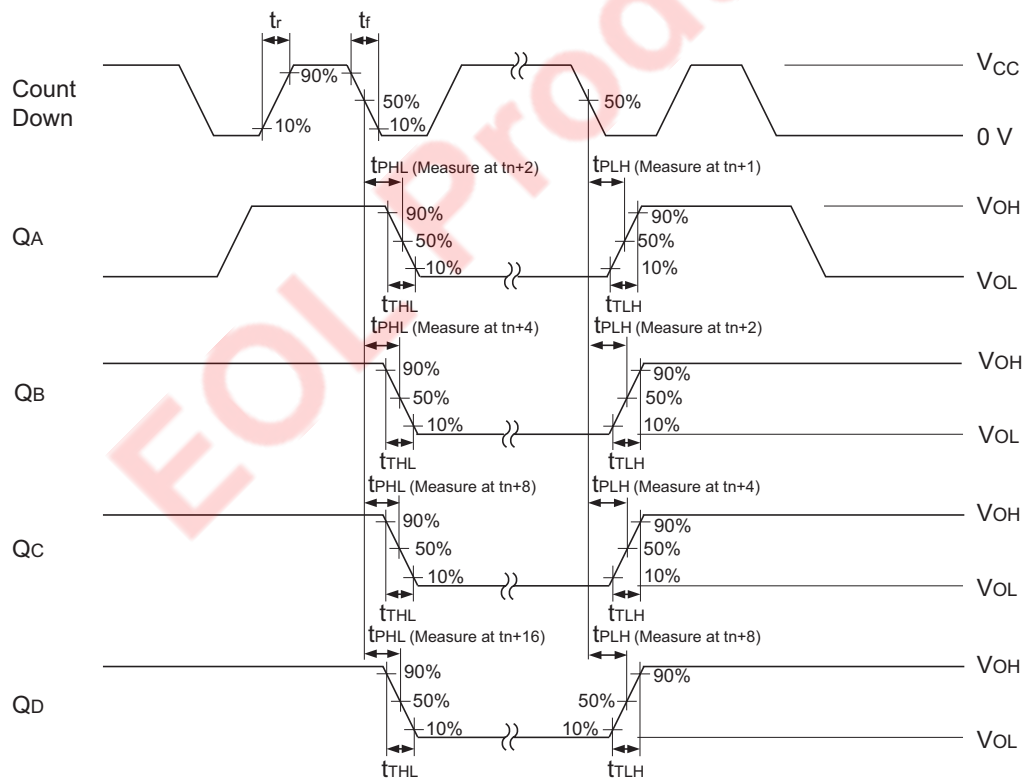
Test Circuit



Note: C_L includes the probe and jig capacitance.

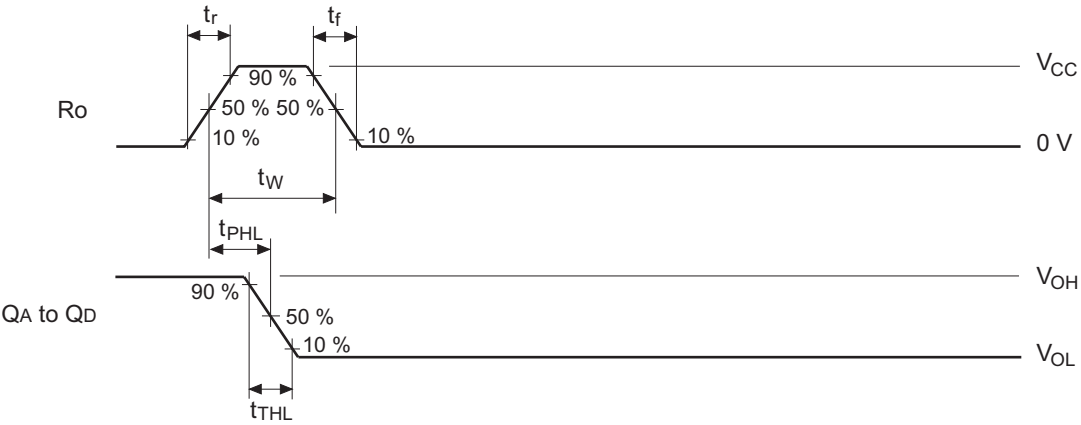
Waveforms

• Waveform – 1



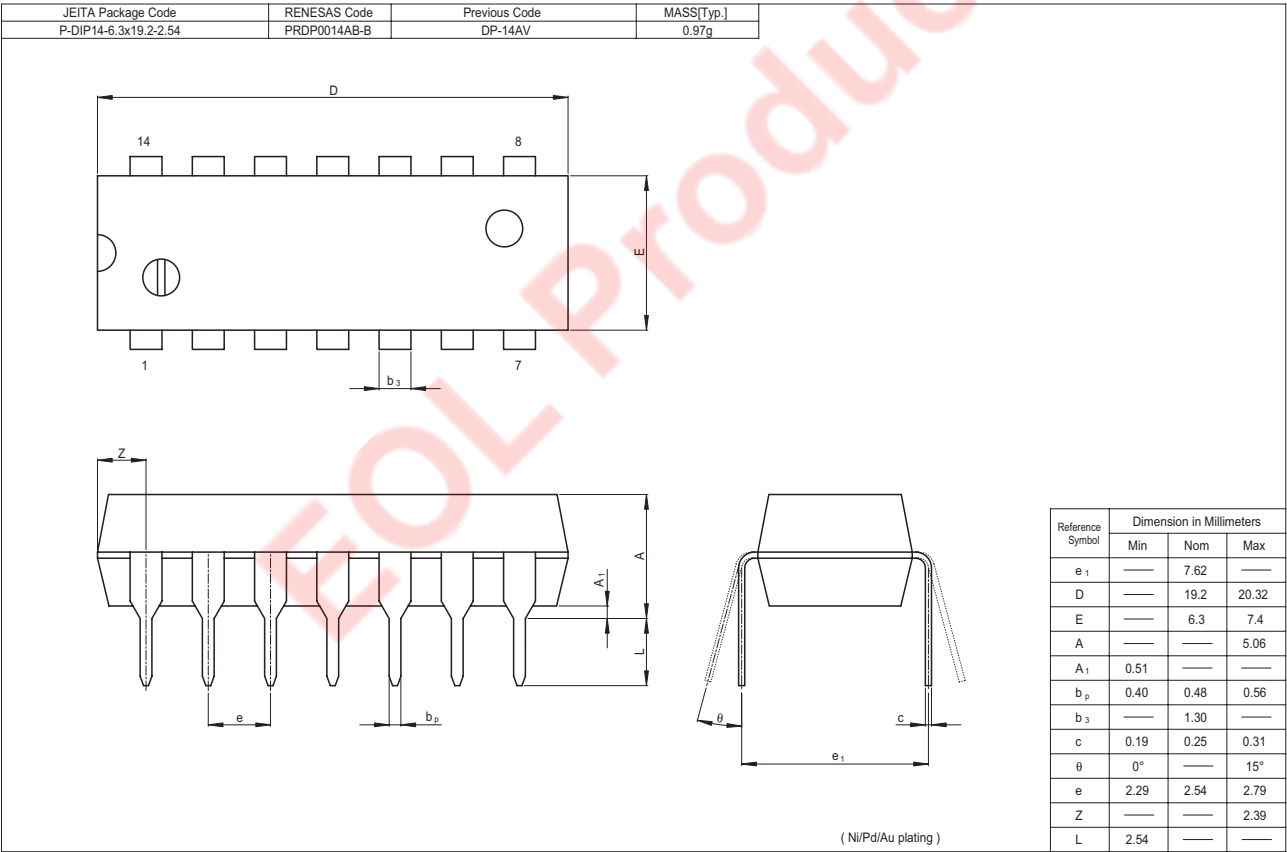
Notes: 1. Input waveform: $PRR \leq 1 \text{ MHz}$, $Z_o = 50 \Omega$, $t_r \leq 6 \text{ ns}$, $t_f \leq 6 \text{ ns}$
 2. t_n is reference bit time when all outputs are low.

• Waveform – 2

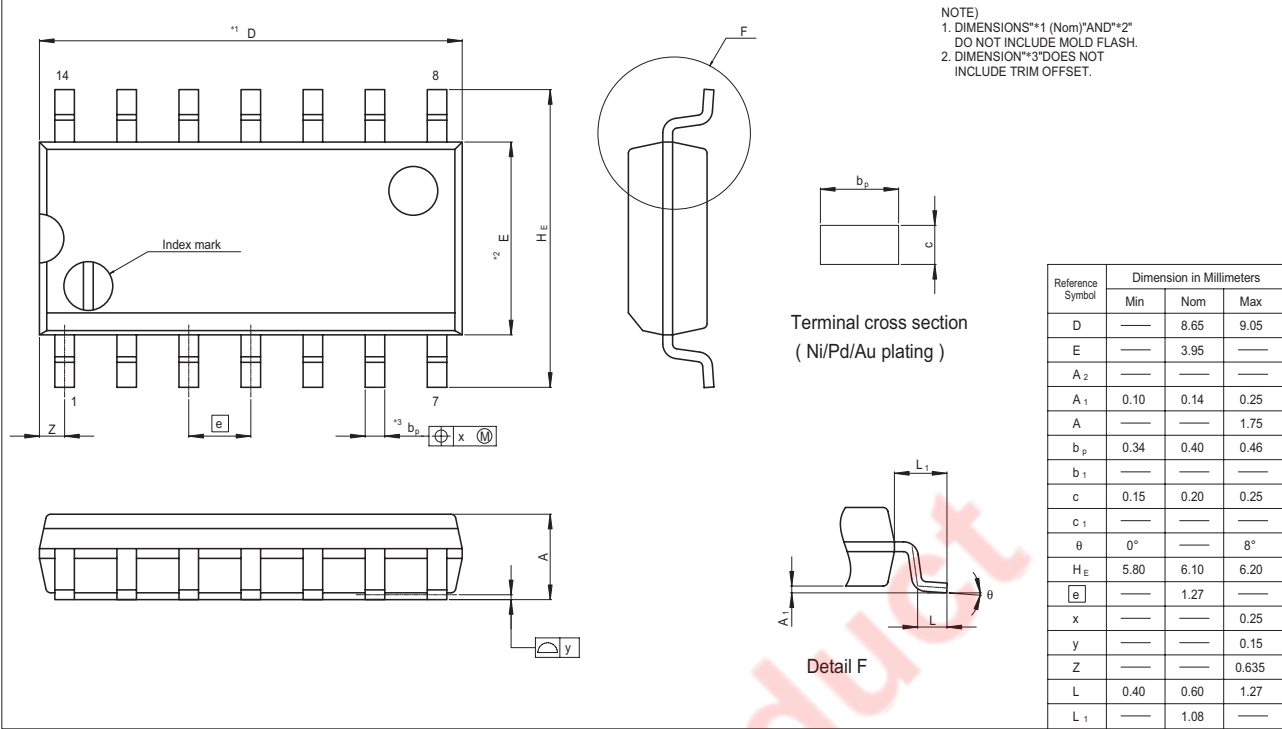


Notes: 1. Input waveform: PRR \leq 1 MHz, $Z_o = 50 \Omega$, $t_r \leq 6 \text{ ns}$, $t_f \leq 6 \text{ ns}$

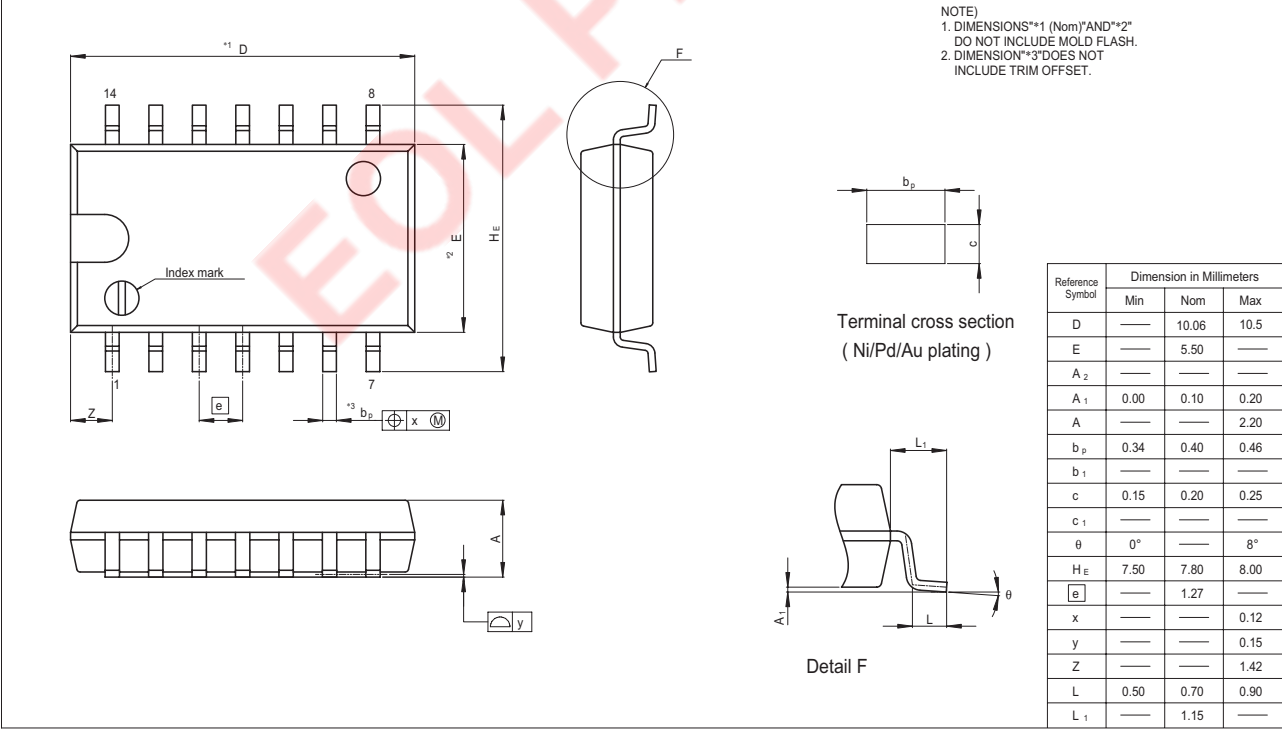
Package Dimensions



JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SOP14-3.95x8.65-1.27	PRSP0014DE-A	FP-14DNV	0.13g



JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SOP14-5.5x10.06-1.27	PRSP0014DF-B	FP-14DAV	0.23g



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