# HD14013B

Dual D-type Flip Flop

The HD14013B dual type D flip-flop has independent Data, (D), Direct Set, (S), Direct Reset, (R), and Clock (C) inputs and complementary outputs (Q and Q̄). These devices may be used as shift register elements or as type T flip-flops for counter and toggle Applications

■ FEATURES
- Static Operation
- Quiescent Current = 2nA/pkg typ @5V
- Supply Voltage Range = 3 to 18V
- Toggle Rate = 4MHz typ @5V
- Logic Edge-clocked Flip-Flop Design ... Logic state is retained indefinitely with clock level either high or low; information is transferred to the output only on the positive-going edge of the clock pulse.
- Pin-for-pin Replacement for CD4013B and MC14013B

■ LOGIC DIAGRAM (1/2)

■ PIN ARRANGEMENT

(Top View)
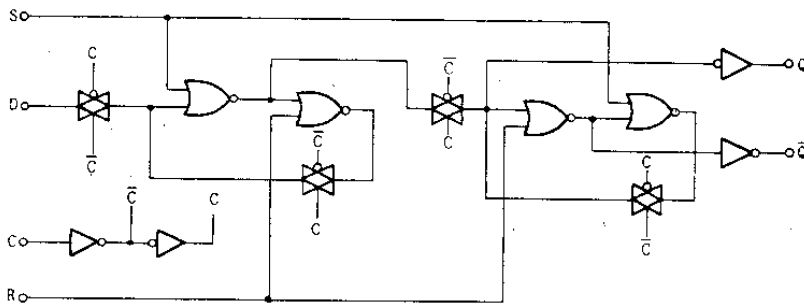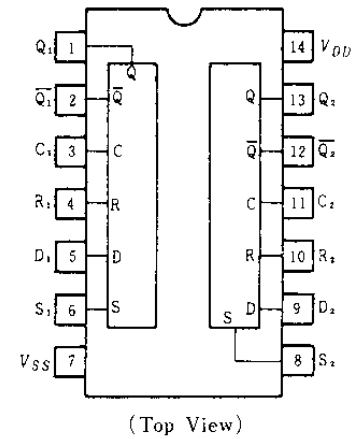
■ TRUTH TABLE

Clock*	Data	Reset	Set	Q	Q̄
⤒	0	0	0	0	1
⤒	1	0	0	1	0
⤓	×	0	0	Q	Q̄
×	×	1	0	0	1
×	×	0	1	1	0
×	×	1	1	1	1

× : Don't Care
* : Level Change

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■ ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	$V_{DD}(V)$	Test Conditions	−40°C		25°C			85°C		Unit
				min	max	min	typ	max	min	max	
Output Voltage	V_{OL}	5.0	$V_{in}=V_{DD}$ or 0	—	0.05	—	0	0.05	—	0.05	V
		10		—	0.05	—	0	0.05	—	0.05	
		15		—	0.05	—	0	0.05	—	0.05	
	V_{OH}	5.0	$V_{in}=0$ or V_{DD}	4.95	—	4.95	5.0	—	4.95	—	V
		10		9.95	—	9.95	10	—	9.95	—	
		15		14.95	—	14.95	15	—	14.95	—	
Input Voltage	V_{IL}	5.0	$V_{out}=4.5$ or 0.5 V	—	1.5	—	2.25	1.5	—	1.5	V
		10	$V_{out}=9.0$ or 1.0 V	—	3.0	—	4.50	3.0	—	3.0	
		15	$V_{out}=13.5$ or 1.5 V	—	4.0	—	6.75	4.0	—	4.0	
	V_{IH}	5.0	$V_{out}=0.5$ or 4.5 V	3.5	—	3.5	2.75	—	3.5	—	V
		10	$V_{out}=1.0$ or 9.0 V	7.0	—	7.0	5.50	—	7.0	—	
		15	$V_{out}=1.5$ or 13.5 V	11.0	—	11.0	8.25	—	11.0	—	
Output Drive Current	I_{OH}	5.0	$V_{OH}=2.5$ V	−1.0	—	−0.8	−1.7	—	−0.6	—	mA
		5.0	$V_{OH}=4.6$ V	−0.2	—	−0.16	−0.36	—	−0.12	—	
		10	$V_{OH}=9.5$ V	−0.5	—	−0.4	−0.9	—	−0.3	—	
		15	$V_{OH}=13.5$ V	−1.4	—	−1.2	−3.5	—	−1.0	—	
	I_{OL}	5.0	$V_{OL}=0.4$ V	0.52	—	0.44	0.88	—	0.36	—	mA
		10	$V_{OL}=0.5$ V	1.3	—	1.1	2.25	—	0.9	—	
		15	$V_{OL}=1.5$ V	3.6	—	3.0	8.8	—	2.4	—	
Input Current	I_{in}	15		—	±0.1	—	±0.00001	±0.3	—	±1.0	μA
Input Capacitance	C_{in}		$V_{in}=0$	—	—	—	5.0	7.5	—	—	pF
Quiescent Current	I_{DD}	5.0	Zero Signal, per Package	—	4.0	—	0.002	4.0	—	30	μA
		10		—	8.0	—	0.004	8.0	—	60	
		15		—	16	—	0.006	16	—	120	
Total Supply Current*	I_T	5.0	Dynamic+I_{DD}, per Gate, $C_L=50$pF, $f=1$ kHz	—	—	—	0.75	—	—	—	μA
		10		—	—	—	1.5	—	—	—	
		15		—	—	—	2.3	—	—	—	

* To calculate total supply current at frequency other than 1kHz.

  (a $V_{DD}=5.0$ V $I_T=(0.75\mu\text{A/kHz})f+I_{DD}$ (a $V_{DD}=10$ V $I_T=(1.5\mu\text{A/kHz})f+I_{DD}$ (a $V_{DD}=15$ V $I_T=(2.3\mu\text{A/kHz})f+I_{DD}$

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■SWITCHING CHARACTERISTICS $(C_L=50pF, Ta=25°C)$

Characteristic			Symbol	$V_{DD}(V)$	min	typ	max	Unit
Output Rise Time			t_r	5.0	—	180	360	ns
				10	—	90	180	
				15	—	65	130	
Output Fall Time			t_f	5.0	—	180	250	ns
				10	—	70	150	
				15	—	60	100	
Propagation Delay Time	Clock		t_{PLH}, t_{PHL}	5.0	—	175	350	ns
				10	—	80	200	
				15	—	70	150	
	Set			5.0	—	250	450	ns
				10	—	115	200	
				15	—	75	150	
	Reset			5.0	—	350	450	
				10	—	100	200	
				15	—	75	150	
Setup Time			$t_{setup\,H}$ $t_{setup\,L}$	5.0	40	20	—	ns
				10	20	10	—	
				15	15	7.5	—	
Clock Pulse Width			PW_{CH}, PW_{CL}	5.0	250	125	—	ns
				10	100	50	—	
				15	70	35	—	
Clock Pulse Frequency			PRF	5.0	—	4.0	2.0	MHz
				10	—	10	5.0	
				15	—	14	7.0	
Clock Pulse Rise and Fall Time			t_r, t_f	5.0	—	—	15	μs
				10	—	—	5.0	
				15	—	—	4.0	
Set and Reset Pulse Width			PW_S PW_R	5.0	250	125	—	ns
				10	100	50	—	
				15	70	35	—	

■DYNAMIC SIGNAL WAVEFORMS

● Data, Clock, and Output   ● Set, Reset, and Output
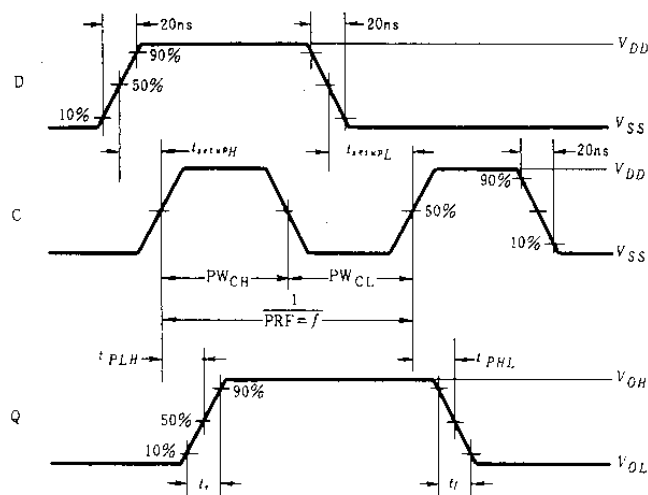
Note) Inputs R and S low.
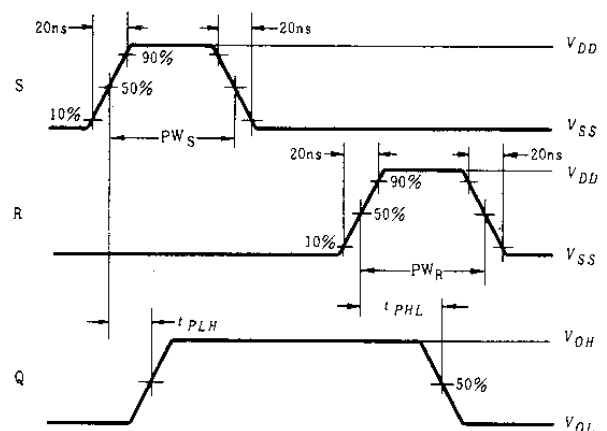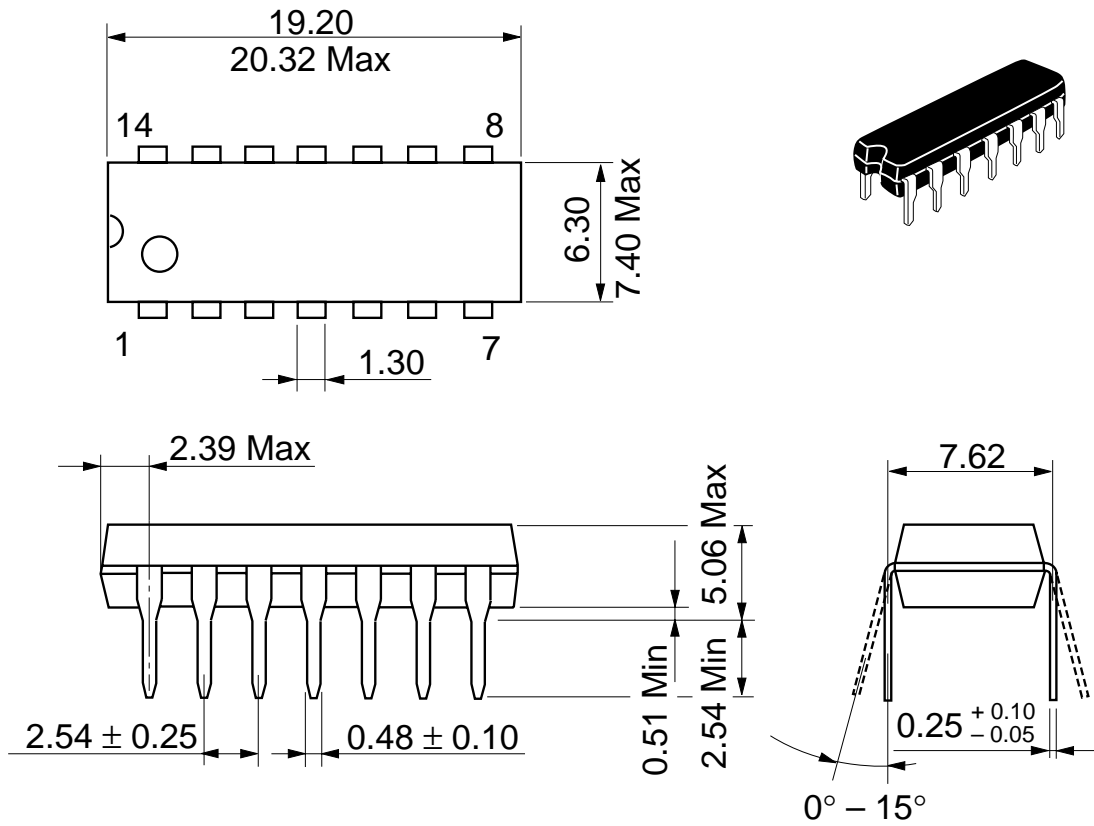
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Unit: mm

Hitachi Code	DP-14
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	0.97 g

Unit: mm

10.06
10.5 Max

14 ▯▯▯▯▯▯▯ 8

1 ▯▯▯▯▯▯▯ 7

5.5

1.42 Max

2.20 Max

1.27

$*0.42 \pm 0.08$
0.40 ± 0.06

0.10 ± 0.10

| ◠ | 0.15 |

| ⊕ | 0.12 Ⓜ |

$*0.22 \pm 0.05$
0.20 ± 0.04

$7.80 ^{+\ 0.20}_{-\ 0.30}$

1.15

$0° - 8°$

0.70 ± 0.20
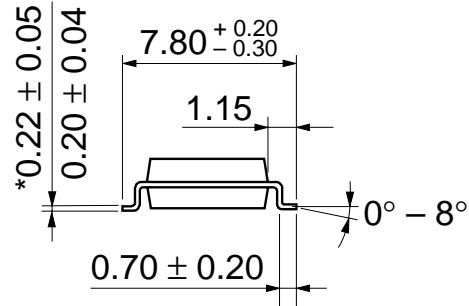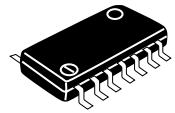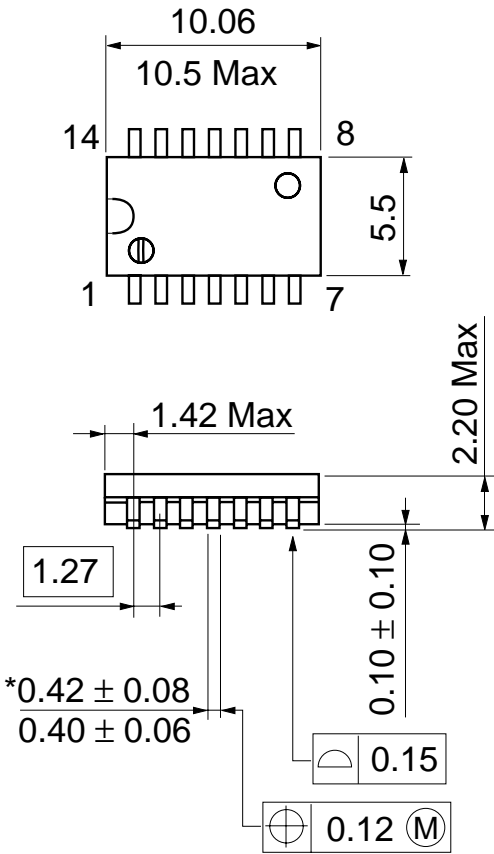
*Dimension including the plating thickness
Base material dimension

Hitachi Code	FP-14DA
JEDEC	—
EIAJ	Conforms
Weight (reference value)	0.23 g

Unit: mm

8.65
9.05 Max

14 8

3.95

1 7

1.75 Max

0.635 Max

$0.14^{+0.11}_{-0.04}$

1.27

*0.40 ± 0.06

△ 0.15

⊕ 0.25 (M)

*0.20 ± 0.05

$6.10^{+0.10}_{-0.30}$

1.08

0° − 8°

$0.60^{+0.67}_{-0.20}$
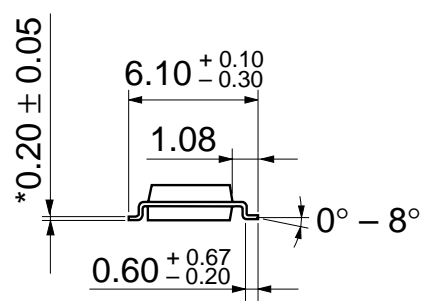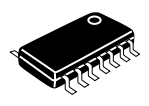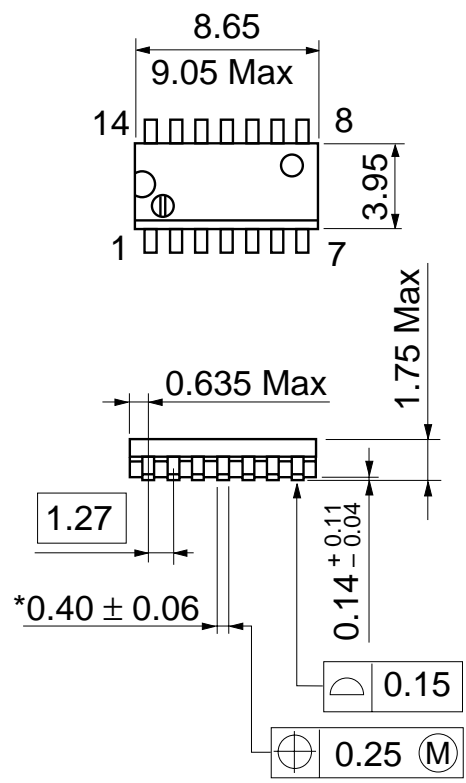
*Pd plating

Hitachi Code	FP-14DN
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	0.13 g

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