

# HD74LV373A

## Octal D-type Transparent Latches with 3-state Outputs

# HITACHI

ADE-205-274 (Z)

1st Edition

April 1999

### Description

The HD74LV373A has eight D type latches with three state outputs in a 20 pin package. When the latch enables input is high, the Q outputs will follow the D inputs. When the latch enables goes low, data at the D inputs will be retained at the outputs until latch enable returns high again. When a high logic level is applied to the output control input, all outputs go to a high impedance state, regardless of what signals are present at the other inputs and the state of the storage elements. Low-voltage and high-speed operation is suitable for the battery-powered products (e.g., notebook computers), and the low-power consumption extends the battery life.

### Features

- $V_{CC} = 2.0\text{ V}$  to  $5.5\text{ V}$  operation
- All inputs  $V_{IH}$  (Max.) =  $5.5\text{ V}$  (@ $V_{CC} = 0\text{ V}$  to  $5.5\text{ V}$ )
- All outputs  $V_O$  (Max.) =  $5.5\text{ V}$  (@ $V_{CC} = 0\text{ V}$ )
- Typical  $V_{OL}$  ground bounce  $< 0.8\text{ V}$  (@ $V_{CC} = 3.3\text{ V}$ ,  $T_a = 25^\circ\text{C}$ )
- Typical  $V_{OH}$  undershoot  $> 2.3\text{ V}$  (@ $V_{CC} = 3.3\text{ V}$ ,  $T_a = 25^\circ\text{C}$ )
- Output current  $\pm 8\text{ mA}$  (@ $V_{CC} = 3.0\text{ V}$  to  $3.6\text{ V}$ ),  $\pm 16\text{ mA}$  (@ $V_{CC} = 4.5\text{ V}$  to  $5.5\text{ V}$ )

### Function Table

#### Inputs

$\overline{OE}$	LE	D	Output Q
H	X	X	Z
L	H	L	L
L	H	H	H
L	L	X	$Q_0$

Note: H: High level

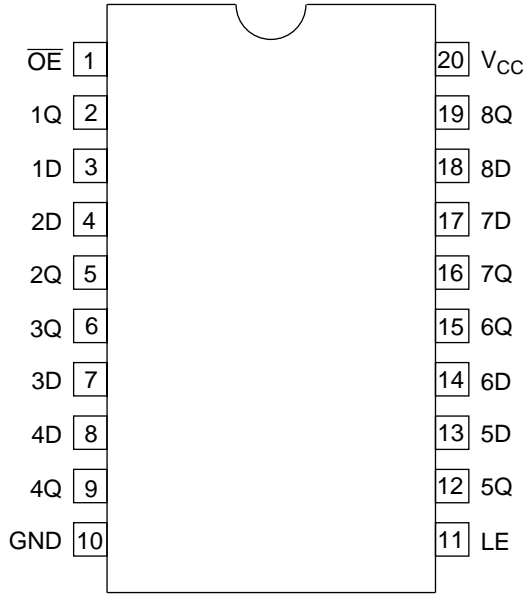
L: Low level

X: Immaterial

Z: High impedance

$Q_0$ : Output level before the indicated steady state input conditions were established.

## Pin Arrangement



(Top view)

**Absolute Maximum Ratings**

Item	Symbol	Ratings	Unit	Conditions
Supply voltage range	$V_{CC}$	-0.5 to 7.0	V	
Input voltage range* <sup>1</sup>	$V_I$	-0.5 to 7.0	V	
Output voltage range* <sup>1,2</sup>	$V_O$	-0.5 to $V_{CC} + 0.5$ -0.5 to 7.0	V	Output: H or L $V_{CC}$ : OFF or Output: Z
Input clamp current	$I_{IK}$	-20	mA	$V_I < 0$
Output clamp current	$I_{OK}$	$\pm 50$	mA	$V_O < 0$ or $V_O > V_{CC}$
Continuous output current	$I_O$	$\pm 35$	mA	$V_O = 0$ to $V_{CC}$
Continuous current through $V_{CC}$ or GND	$I_{CC}$ or $I_{GND}$	$\pm 70$	mA	
Maximum power dissipation at $T_a = 25^\circ\text{C}$ (in still air)* <sup>3</sup>	$P_T$	835	mW	SOP
		757		TSSOP
Storage temperature	$T_{stg}$	-65 to 150	$^\circ\text{C}$	

Notes: 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.

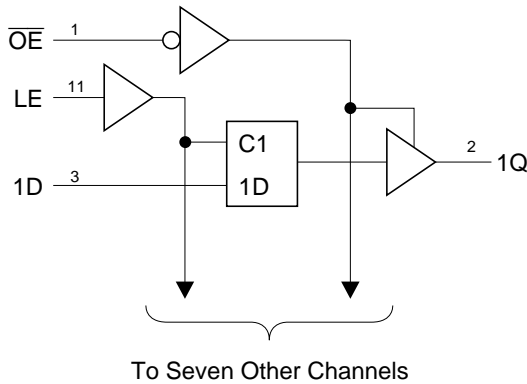
1. The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. This value is limited to 5.5 V maximum.
3. The maximum package power dissipation was calculated using a junction temperature of  $150^\circ\text{C}$ .

## Recommended Operating Conditions

Item	Symbol	Min	Max	Unit	Conditions
Supply voltage range	$V_{CC}$	2.0	5.5	V	
Input voltage range	$V_I$	0	5.5	V	
Output voltage range	$V_O$	0	$V_{CC}$	V	H or L
		0	5.5		High impedance state
Output current	$I_{OH}$	—	-50	$\mu A$	$V_{CC} = 2.0 V$
		—	-2	mA	$V_{CC} = 2.3 \text{ to } 2.7 V$
		—	-8		$V_{CC} = 3.0 \text{ to } 3.6 V$
		—	-16	$V_{CC} = 4.5 \text{ to } 5.5 V$	
	$I_{OL}$	—	50	$\mu A$	$V_{CC} = 2.0 V$
		—	2	mA	$V_{CC} = 2.3 \text{ to } 2.7 V$
		—	8		$V_{CC} = 3.0 \text{ to } 3.6 V$
		—	16	$V_{CC} = 4.5 \text{ to } 5.5 V$	
Input transition rise or fall rate	$\Delta t / \Delta v$	0	200	ns/V	$V_{CC} = 2.3 \text{ to } 2.7 V$
		0	100		$V_{CC} = 3.0 \text{ to } 3.6 V$
		0	20		$V_{CC} = 4.5 \text{ to } 5.5 V$
Operating free-air temperature	$T_a$	-40	85	$^{\circ}C$	

Note: Unused or floating inputs must be held high or low.

## Logic Diagram



**DC Electrical Characteristics**

- $T_a = -40$  to  $85^\circ\text{C}$

Item	Symbol	$V_{CC}$ (V)*	Min	Typ	Max	Unit	Test Conditions
Input voltage	$V_{IH}$	2.0	1.5	—	—	V	
		2.3 to 2.7	$V_{CC} \times 0.7$	—	—		
		3.0 to 3.6	$V_{CC} \times 0.7$	—	—		
		4.5 to 5.5	$V_{CC} \times 0.7$	—	—		
	$V_{IL}$	2.0	—	—	0.5		
		2.3 to 2.7	—	—	$V_{CC} \times 0.3$		
		3.0 to 3.6	—	—	$V_{CC} \times 0.3$		
		4.5 to 5.5	—	—	$V_{CC} \times 0.3$		
Output voltage	$V_{OH}$	Min to Max	$V_{CC} - 0.1$	—	—	V	$I_{OH} = -50 \mu\text{A}$
		2.3	2.0	—	—		$I_{OH} = -2 \text{ mA}$
		3.0	2.48	—	—		$I_{OH} = -8 \text{ mA}$
		4.5	3.8	—	—		$I_{OH} = -16 \text{ mA}$
	$V_{OL}$	Min to Max	—	—	0.1		$I_{OL} = 50 \mu\text{A}$
		2.3	—	—	0.4		$I_{OL} = 2 \text{ mA}$
		3.0	—	—	0.44		$I_{OL} = 8 \text{ mA}$
		4.5	—	—	0.55		$I_{OL} = 16 \text{ mA}$
Input current	$I_{IN}$	0 to 5.5	—	—	$\pm 1$	$\mu\text{A}$	$V_{IN} = 5.5 \text{ V or GND}$
Off-state output current	$I_{OZ}$	5.5	—	—	$\pm 5$	$\mu\text{A}$	$V_O = V_{CC} \text{ or GND}$
Quiescent supply current	$I_{CC}$	5.5	—	—	20	$\mu\text{A}$	$V_{IN} = V_{CC} \text{ or GND, } I_O = 0$
Output leakage current	$I_{OFF}$	0	—	—	5	$\mu\text{A}$	$V_I \text{ or } V_O = 0 \text{ to } 5.5 \text{ V}$
Input capacitance	$C_{IN}$	3.3	—	2.9	—	pF	$V_I = V_{CC} \text{ or GND}$

Note: For conditions shown as Min or Max, use the appropriate values under recommended operating conditions.

## Switching Characteristics

- $V_{CC} = 2.5 \pm 0.2 \text{ V}$

$T_a = 25^\circ\text{C}$                        $T_a = -40 \text{ to } 85^\circ\text{C}$

Item	Symbol	$T_a = 25^\circ\text{C}$			$T_a = -40 \text{ to } 85^\circ\text{C}$		Unit	Test Conditions	FROM	TO
		Min	Typ	Max	Min	Max			(Input)	(Output)
Propagation delay time	$t_{PLH}$	—	8.3	15.2	1.0	17.0	ns	$C_L = 15 \text{ pF}$	D	Q
	$t_{PHL}$	—	9.1	15.7	1.0	19.0			LE	
		—	10.4	18.0	1.0	21.0		$C_L = 50 \text{ pF}$	D	
		—	11.1	18.6	1.0	22.0			LE	
Enable time	$t_{ZH}$	—	8.9	15.8	1.0	19.0	ns	$C_L = 15 \text{ pF}$	$\overline{OE}$	Q
	$t_{ZL}$	—	10.9	18.8	1.0	22.0		$C_L = 50 \text{ pF}$		
Disable time	$t_{HZ}$	—	6.2	12.6	1.0	15.0	ns	$C_L = 15 \text{ pF}$	$\overline{OE}$	Q
	$t_{LZ}$	—	8.3	17.4	1.0	19.0		$C_L = 50 \text{ pF}$		
Setup time	$t_{SU}$	4.5	—	—	5.0	—	ns		Data before LE ↓	
Hold time	$t_h$	1.5	—	—	1.5	—	ns		Data after LE ↓	
Pulse width	$t_w$	6.0	—	—	6.5	—	ns		LE "H"	

**Switching Characteristics (cont)**

- $V_{CC} = 3.3 \pm 0.3 \text{ V}$

**Ta = 25°C**                      **Ta = -40 to 85°C**

Item	Symbol	Ta = 25°C			Ta = -40 to 85°C		Unit	Test Conditions	FROM	TO
		Min	Typ	Max	Min	Max			(Input)	(Output)
Propagation delay time	$t_{PLH}$	—	5.8	11.4	1.0	13.5	ns	$C_L = 15 \text{ pF}$	D	Q
	$t_{PHL}$	—	6.4	11.0	1.0	13.0			LE	
		—	7.3	14.9	1.0	17.0		$C_L = 50 \text{ pF}$	D	
		—	7.8	14.5	1.0	16.5			LE	
Enable time	$t_{ZH}$	—	6.3	11.4	1.0	13.5	ns	$C_L = 15 \text{ pF}$	$\overline{OE}$	Q
	$t_{ZL}$	—	7.7	14.9	1.0	17.0		$C_L = 50 \text{ pF}$		
Disable time	$t_{HZ}$	—	4.7	10.0	1.0	12.0	ns	$C_L = 15 \text{ pF}$	$\overline{OE}$	Q
	$t_{LZ}$	—	6.0	13.2	1.0	15.0		$C_L = 50 \text{ pF}$		
Setup time	$t_{SU}$	4.0	—	—	4.0	—	ns		Data before LE ↓	
Hold time	$t_h$	1.0	—	—	1.0	—	ns		Data after LE ↓	
Pulse width	$t_w$	5.0	—	—	5.0	—	ns		LE "H"	

## Switching Characteristics (cont)

- $V_{CC} = 5.0 \pm 0.5 \text{ V}$

Item	Symbol	Ta = 25°C			Ta = -40 to 85°C		Unit	Test Conditions	FROM (Input)	TO (Output)
		Min	Typ	Max	Min	Max				
Propagation delay time	$t_{PLH}$	—	4.1	7.2	1.0	8.5	ns	$C_L = 15 \text{ pF}$	D	Q
	$t_{PHL}$	—	4.5	7.2	1.0	8.5			LE	
		—	5.1	9.2	1.0	10.5		$C_L = 50 \text{ pF}$	D	
		—	5.5	9.2	1.0	10.5			LE	
Enable time	$t_{ZH}$	—	4.5	8.1	1.0	9.5	ns	$C_L = 15 \text{ pF}$	$\overline{OE}$	Q
	$t_{ZL}$	—	5.5	10.1	1.0	11.5		$C_L = 50 \text{ pF}$		
Disable time	$t_{HZ}$	—	3.3	7.2	1.0	8.5	ns	$C_L = 15 \text{ pF}$	$\overline{OE}$	Q
	$t_{LZ}$	—	4.0	9.2	1.0	10.5		$C_L = 50 \text{ pF}$		
Setup time	$t_{SU}$	4.0	—	—	4.0	—	ns		Data before LE ↓	
Hold time	$t_h$	1.0	—	—	1.0	—	ns		Data after LE ↓	
Pulse width	$t_w$	5.0	—	—	5.0	—	ns		LE "H"	



## Output-skew Characteristics

- $C_L = 50 \text{ pF}$

Item	Symbol	$V_{CC} = (V)$	$T_a = 25^\circ\text{C}$		$T_a = -40 \text{ to } 85^\circ\text{C}$		Unit
			Min	Max	Min	Max	
Output skew	$t_{sk(O)}$	2.3 to 2.7	—	2.0	—	2.0	ns
		3.0 to 3.6	—	1.5	—	1.5	
		4.5 to 5.5	—	1.0	—	1.0	

Note: Skew between any outputs of the same package switching in the same direction. This parameter is warranted but not production tested.

## Operating Characteristics

- $C_L = 50 \text{ pF}$

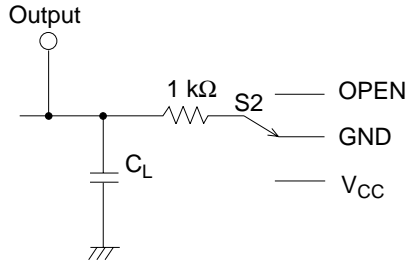
Item	Symbol	$V_{CC} = (V)$	$T_a = 25^\circ\text{C}$			Unit	Test Conditions
			Min	Typ	Max		
Power dissipation capacitance	$C_{PD}$	3.3	—	16.6	—	pF	$f = 10 \text{ MHz}$
		5.0	—	18.2	—		

## Noise Characteristics

- $C_L = 50 \text{ pF}$

Item	Symbol	$V_{CC} = (V)$	$T_a = 25^\circ\text{C}$			Unit	Test Conditions
			Min	Typ	Max		
Quiet output, maximum dynamic $V_{OL}$	$V_{OL(P)}$	3.3	—	0.6	0.8	V	
Quiet output, minimum dynamic $V_{OL}$	$V_{OL(V)}$	3.3	—	-0.6	-0.8		
Quiet output, minimum dynamic $V_{OH}$	$V_{OH(V)}$	3.3	—	2.9	—		
High-level dynamic input voltage	$V_{IH(D)}$	3.3	2.31	—	—		
Low-level dynamic input voltage	$V_{IL(D)}$	3.3	—	—	0.99		

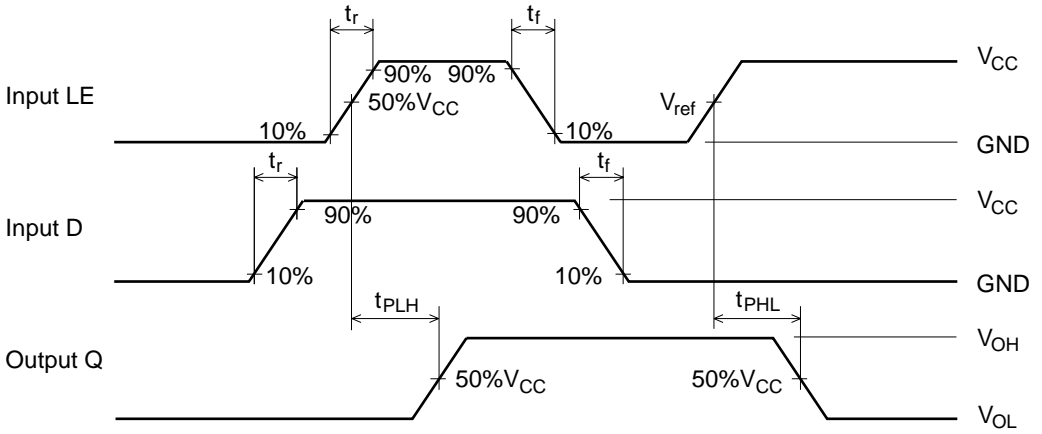
## Test Circuit



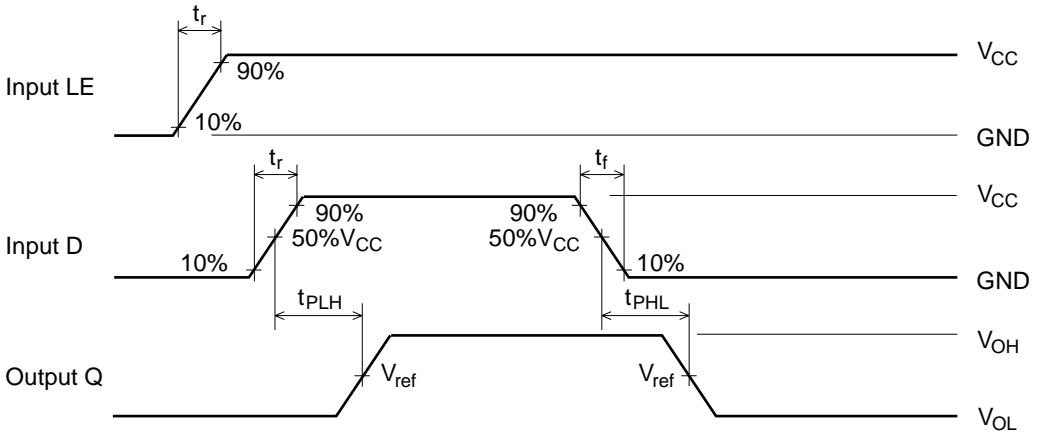
TEST	S2
$t_{PLH}/t_{PHL}$	OPEN
$t_{ZH}/t_{HZ}$	GND
$t_{ZL}/t_{LZ}$	V <sub>CC</sub>

Note: C<sub>L</sub> includes the probe and jig capacitance.

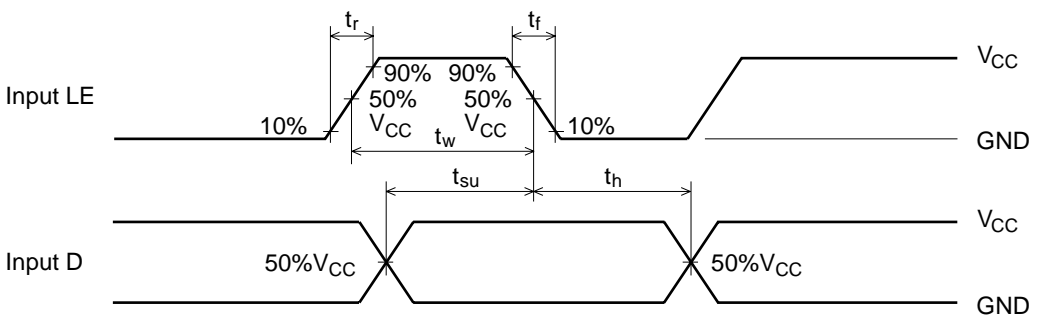
• Waveform – 1



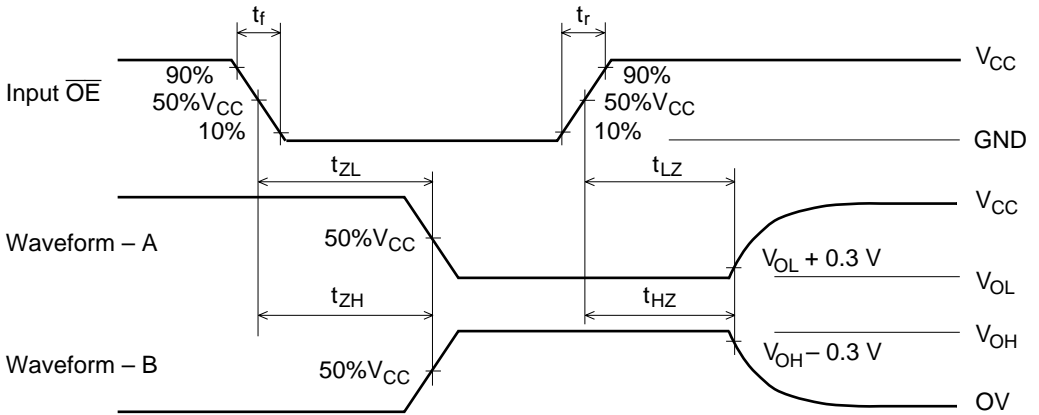
• Waveform – 2



• Waveform – 3



## • Waveform – 4



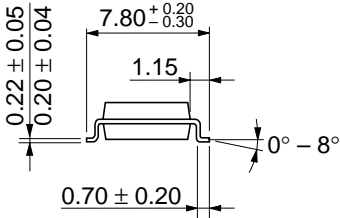
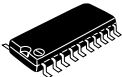
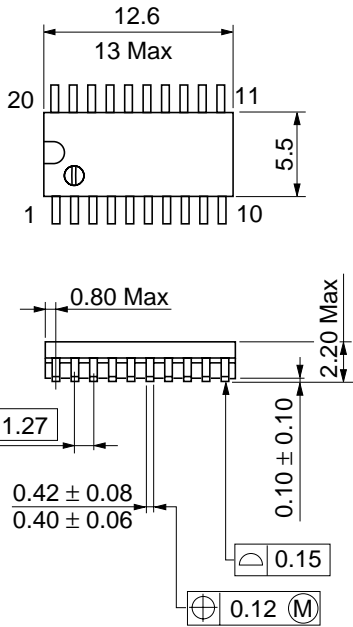
Notes: 1.  $t_f \leq 3 \text{ ns}$ ,  $t_r \leq 3 \text{ ns}$

2. Input waveform:  $\text{PRR} \leq 1 \text{ MHz}$ , duty cycle 50%

3. Waveform-A is for an output with internal conditions such that the output is low except when disabled by the output control.

4. Waveform-B is for an output with internal conditions such that the output is high except when disabled by the output control.

Package Dimensions

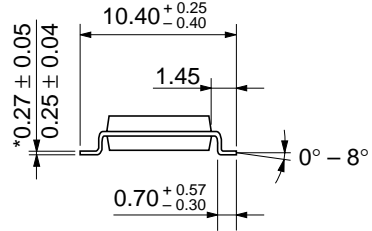
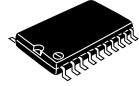
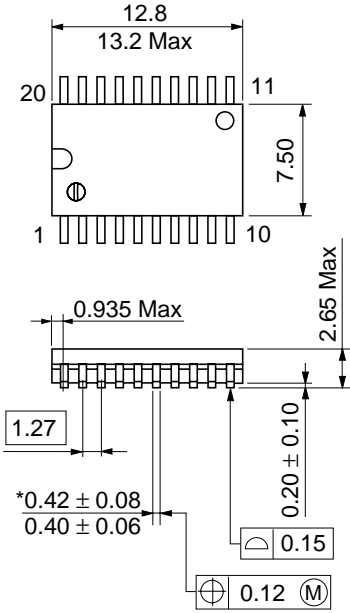


Dimension including the plating thickness  
Base material dimension

Hitachi Code	FP-20DA
JEDEC	—
EIAJ	Conforms
Weight (reference value)	0.31 g

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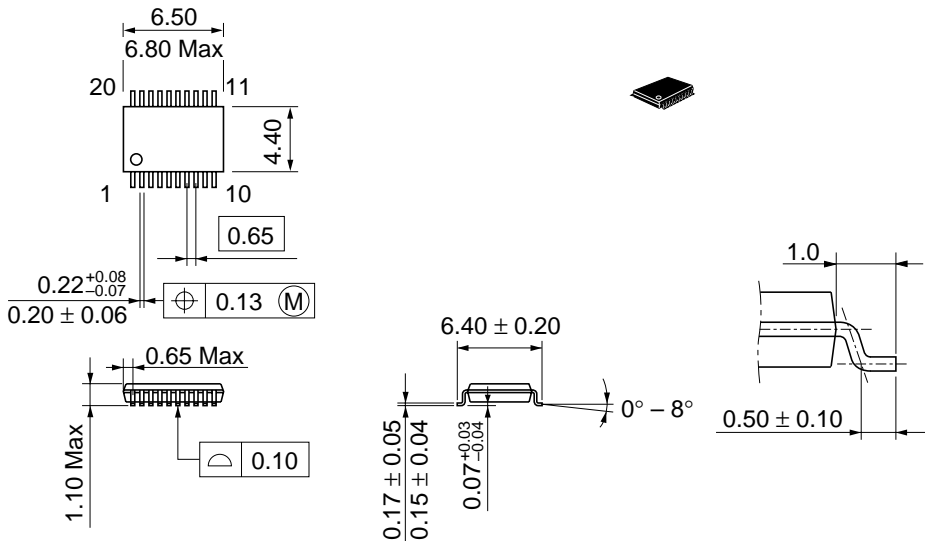
Unit: mm



\*Dimension including the plating thickness  
 Base material dimension

Hitachi Code	FP-20DB
JEDEC	Conforms
EIAJ	—
Weight (reference value)	0.52 g

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Dimension including the plating thickness  
Base material dimension

Hitachi Code	TTP-20DA
JEDEC	—
EIAJ	—
Weight (reference value)	0.07 g

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