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# HD74LV541A

Octal Buffers / Drivers with 3-state Outputs

# HITACHI

ADE-205-278 (Z)

1st Edition  
April 1999

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## Description

The HD74LV541A has eight line drivers with three state outputs in a 20 pin package. When OE1 and OE2 is low level, this drivers set up output is enable. Low-voltage operation is suitable for 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

| OE1 | OE2 | A | Output Y |
|-----|-----|---|----------|
| L   | L   | L | L        |
| L   | L   | H | H        |
| H   | X   | X | Z        |
| X   | H   | X | Z        |

Note: H: High level

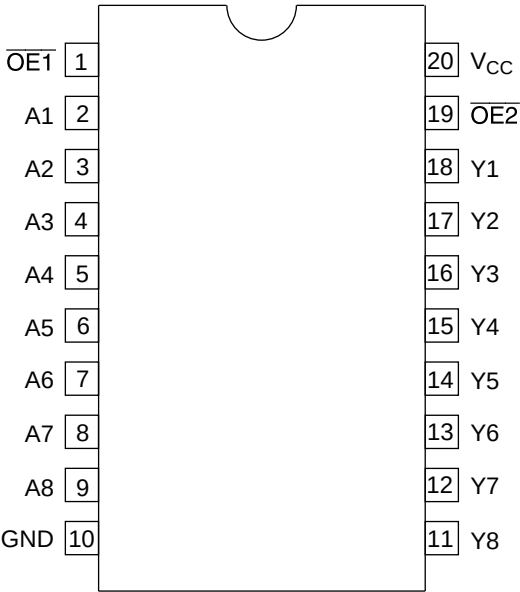
L: Low level

X: Immaterial

Z: High impedance

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## 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 $V_{CC} + 0.5$<br>−0.5 to 7.0 | V    | Output: H or L<br>$V_{CC}$ : OFF or Output: Z |
| Input clamp current                                                                | $I_{IK}$              | −20                                   | mA   | $V_I < 0$                                     |
| Output clamp current                                                               | $I_{OK}$              | ±50                                   | mA   | $V_O < 0$ or $V_O > V_{CC}$                   |
| Continuous output current                                                          | $I_O$                 | ±35                                   | mA   | $V_O = 0$ to $V_{CC}$                         |
| Continuous current through $V_{CC}$ or GND                                         | $I_{CC}$ or $I_{GND}$ | ±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                            | °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°C.

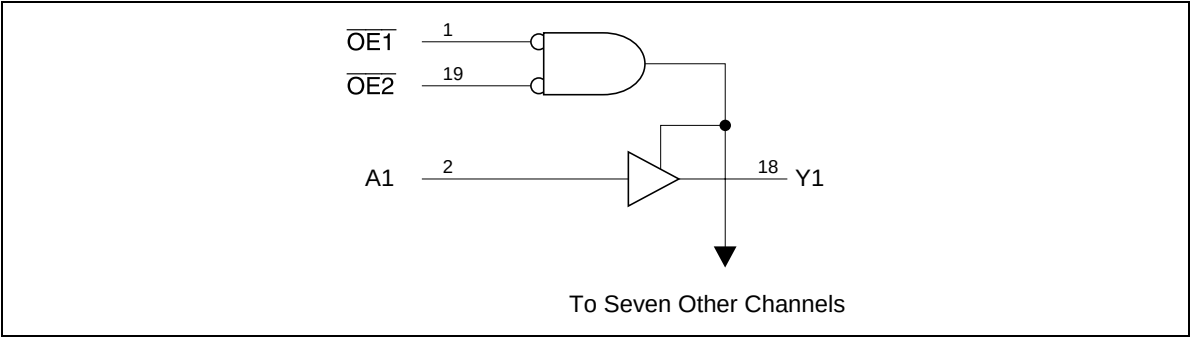
# HD74LV541A

## Recommended Operating Conditions

| Item                               | Symbol          | Min | Max             | Unit | Conditions                     |
|------------------------------------|-----------------|-----|-----------------|------|--------------------------------|
| Supply voltage range               | V <sub>CC</sub> | 2.0 | 5.5             | V    |                                |
| Input voltage range                | V <sub>I</sub>  | 0   | 5.5             | V    |                                |
| Output voltage range               | V <sub>O</sub>  | 0   | V <sub>CC</sub> | V    | H or L                         |
|                                    |                 | 0   | 5.5             |      | High impedance state           |
| Output current                     | I <sub>OH</sub> | —   | −50             | μA   | V <sub>CC</sub> = 2.0 V        |
|                                    |                 | —   | −2              | mA   | V <sub>CC</sub> = 2.3 to 2.7 V |
|                                    |                 | —   | −8              |      | V <sub>CC</sub> = 3.0 to 3.6 V |
|                                    |                 | —   | −16             |      | V <sub>CC</sub> = 4.5 to 5.5 V |
|                                    | I <sub>OL</sub> | —   | 50              | μA   | V <sub>CC</sub> = 2.0 V        |
|                                    |                 | —   | 2               | mA   | V <sub>CC</sub> = 2.3 to 2.7 V |
|                                    |                 | —   | 8               |      | V <sub>CC</sub> = 3.0 to 3.6 V |
|                                    |                 | —   | 16              |      | V <sub>CC</sub> = 4.5 to 5.5 V |
| Input transition rise or fall rate | Δt / Δv         | 0   | 200             | ns/V | V <sub>CC</sub> = 2.3 to 2.7 V |
|                                    |                 | 0   | 100             |      | V <sub>CC</sub> = 3.0 to 3.6 V |
|                                    |                 | 0   | 20              |      | V <sub>CC</sub> = 4.5 to 5.5 V |
| Operating free-air temperature     | T <sub>a</sub>  | −40 | 85              | °C   |                                |

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

## Logic Diagram



## DC Electrical Characteristics

Ta = -40 to 85°C

| Item                     | Symbol           | V <sub>CC</sub> (V)* | Min                   | Typ | Max                   | Unit | Test Conditions                                              |
|--------------------------|------------------|----------------------|-----------------------|-----|-----------------------|------|--------------------------------------------------------------|
| Input voltage            | V <sub>IH</sub>  | 2.0                  | 1.5                   | —   | —                     | V    |                                                              |
|                          |                  | 2.3 to 2.7           | V <sub>CC</sub> × 0.7 | —   | —                     |      |                                                              |
|                          |                  | 3.0 to 3.6           | V <sub>CC</sub> × 0.7 | —   | —                     |      |                                                              |
|                          |                  | 4.5 to 5.5           | V <sub>CC</sub> × 0.7 | —   | —                     |      |                                                              |
|                          | V <sub>IL</sub>  | 2.0                  | —                     | —   | 0.5                   |      |                                                              |
|                          |                  | 2.3 to 2.7           | —                     | —   | V <sub>CC</sub> × 0.3 |      |                                                              |
|                          |                  | 3.0 to 3.6           | —                     | —   | V <sub>CC</sub> × 0.3 |      |                                                              |
|                          |                  | 4.5 to 5.5           | —                     | —   | V <sub>CC</sub> × 0.3 |      |                                                              |
| Output voltage           | V <sub>OH</sub>  | Min to Max           | V <sub>CC</sub> - 0.1 | —   | —                     | V    | I <sub>OH</sub> = -50 µA                                     |
|                          |                  | 2.3                  | 2.0                   | —   | —                     |      | I <sub>OH</sub> = -2 mA                                      |
|                          |                  | 3.0                  | 2.48                  | —   | —                     |      | I <sub>OH</sub> = -8 mA                                      |
|                          |                  | 4.5                  | 3.8                   | —   | —                     |      | I <sub>OH</sub> = -16 mA                                     |
|                          | V <sub>OL</sub>  | Min to Max           | —                     | —   | 0.1                   |      | I <sub>OL</sub> = 50 µA                                      |
|                          |                  | 2.3                  | —                     | —   | 0.4                   |      | I <sub>OL</sub> = 2 mA                                       |
|                          |                  | 3.0                  | —                     | —   | 0.44                  |      | I <sub>OL</sub> = 8 mA                                       |
|                          |                  | 4.5                  | —                     | —   | 0.55                  |      | I <sub>OL</sub> = 16 mA                                      |
| Input current            | I <sub>IN</sub>  | 0 to 5.5             | —                     | —   | ±1                    | µA   | V <sub>IN</sub> = 5.5 V or GND                               |
| Off-state output current | I <sub>OZ</sub>  | 5.5                  | —                     | —   | ±5                    | µA   | V <sub>O</sub> = V <sub>CC</sub> or GND                      |
| Quiescent supply current | I <sub>CC</sub>  | 5.5                  | —                     | —   | 20                    | µA   | V <sub>IN</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0 |
| Output leakage current   | I <sub>OFF</sub> | 0                    | —                     | —   | 5                     | µA   | V <sub>I</sub> or V <sub>O</sub> = 0 V to 5.5 V              |
| Input capacitance        | C <sub>IN</sub>  | 3.3                  | —                     | 3   | —                     | pF   | V <sub>I</sub> = V <sub>CC</sub> or GND                      |

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

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Switching Characteristics

V<sub>CC</sub> = 2.5 ± 0.2 V

| Item                              | Symbol           | Ta = 25°C |      |      | Ta = -40 to 85°C |      | Unit | Test Conditions        | FROM<br>(Input) | TO<br>(Output) |
|-----------------------------------|------------------|-----------|------|------|------------------|------|------|------------------------|-----------------|----------------|
|                                   |                  | Min       | Typ  | Max  | Min              | Max  |      |                        |                 |                |
| Propa-<br>gation<br>delay<br>time | t <sub>PLH</sub> | —         | 7.3  | 11.3 | 1.0              | 13.5 | ns   | C <sub>L</sub> = 15 pF | A               | Y              |
|                                   | t <sub>PHL</sub> | —         | 8.9  | 15.9 | 1.0              | 18.5 |      | C <sub>L</sub> = 50 pF |                 |                |
| Enable<br>time                    | t <sub>ZH</sub>  | —         | 8.5  | 16.6 | 1.0              | 19.5 | ns   | C <sub>L</sub> = 15 pF | OE              | Y              |
|                                   | t <sub>ZL</sub>  | —         | 10.5 | 20.7 | 1.0              | 24.0 |      | C <sub>L</sub> = 50 pF |                 |                |
| Disable<br>time                   | t <sub>HZ</sub>  | —         | 8.4  | 13.1 | 1.0              | 15.0 | ns   | C <sub>L</sub> = 15 pF | OE              | Y              |
|                                   | t <sub>LZ</sub>  | —         | 10.5 | 17.9 | 1.0              | 20.0 |      | C <sub>L</sub> = 50 pF |                 |                |

V<sub>CC</sub> = 3.3 ± 0.3 V

| Item                              | Symbol           | Ta = 25°C |     |      | Ta = -40 to 85°C |      | Unit | Test Conditions        | FROM<br>(Input) | TO<br>(Output) |
|-----------------------------------|------------------|-----------|-----|------|------------------|------|------|------------------------|-----------------|----------------|
|                                   |                  | Min       | Typ | Max  | Min              | Max  |      |                        |                 |                |
| Propa-<br>gation<br>delay<br>time | t <sub>PLH</sub> | —         | 5.2 | 7.0  | 1.0              | 8.5  | ns   | C <sub>L</sub> = 15 pF | A               | Y              |
|                                   | t <sub>PHL</sub> | —         | 6.5 | 10.5 | 1.0              | 12.0 |      | C <sub>L</sub> = 50 pF |                 |                |
| Enable<br>time                    | t <sub>ZH</sub>  | —         | 6.1 | 10.5 | 1.0              | 12.5 | ns   | C <sub>L</sub> = 15 pF | OE              | Y              |
|                                   | t <sub>ZL</sub>  | —         | 8.0 | 14.0 | 1.0              | 16.0 |      | C <sub>L</sub> = 50 pF |                 |                |
| Disable<br>time                   | t <sub>HZ</sub>  | —         | 5.8 | 11.0 | 1.0              | 12.0 | ns   | C <sub>L</sub> = 15 pF | OE              | Y              |
|                                   | t <sub>LZ</sub>  | —         | 7.0 | 15.4 | 1.0              | 17.5 |      | C <sub>L</sub> = 50 pF |                 |                |

Switching Characteristics (cont)

V<sub>CC</sub> = 5.0 ± 0.5 V

| Item                              | Symbol           | Ta = 25°C |     |     | Ta = -40 to 85°C |      | Unit | Test Conditions        | FROM<br>(Input) | TO<br>(Output) |
|-----------------------------------|------------------|-----------|-----|-----|------------------|------|------|------------------------|-----------------|----------------|
|                                   |                  | Min       | Typ | Max | Min              | Max  |      |                        |                 |                |
| Propa-<br>gation<br>delay<br>time | t <sub>PLH</sub> | —         | 3.9 | 5.0 | 1.0              | 6.0  | ns   | C <sub>L</sub> = 15 pF | A               | Y              |
|                                   | t <sub>PHL</sub> | —         | 4.7 | 7.0 | 1.0              | 8.0  |      | C <sub>L</sub> = 50 pF |                 |                |
|                                   |                  | —         | 4.3 | 7.2 | 1.0              | 8.5  | ns   | C <sub>L</sub> = 15 pF | OE              | Y              |
| Enable<br>time                    | t <sub>ZH</sub>  | —         | 4.3 | 7.2 | 1.0              | 8.5  | ns   | C <sub>L</sub> = 15 pF | OE              | Y              |
|                                   | t <sub>ZL</sub>  | —         | 6.3 | 9.2 | 1.0              | 10.5 |      | C <sub>L</sub> = 50 pF |                 |                |
| Disable<br>time                   | t <sub>HZ</sub>  | —         | 3.9 | 7.5 | 1.0              | 8.0  | ns   | C <sub>L</sub> = 15 pF | OE              | Y              |
|                                   | t <sub>LZ</sub>  | —         | 5.3 | 8.8 | 1.0              | 10.0 |      | C <sub>L</sub> = 50 pF |                 |                |

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## Output-skew Characteristics

| Item        | Symbol              | V <sub>CC</sub> = (V) | Ta = 25°C |     | Ta = -40 to 85°C |     | Unit |
|-------------|---------------------|-----------------------|-----------|-----|------------------|-----|------|
|             |                     |                       | Min       | Max | Min              | Max |      |
| Output skew | t <sub>sk (O)</sub> | 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<sub>L</sub> = 50 pF

| Item                          | Symbol          | V <sub>CC</sub> = (V) | Ta = 25°C |      |     | Unit | Test Conditions |
|-------------------------------|-----------------|-----------------------|-----------|------|-----|------|-----------------|
|                               |                 |                       | Min       | Typ  | Max |      |                 |
| Power dissipation capacitance | C <sub>PD</sub> | 3.3                   | —         | 23.5 | —   | pF   | f = 10 MHz      |
|                               |                 | 5.0                   | —         | 27.7 | —   |      |                 |

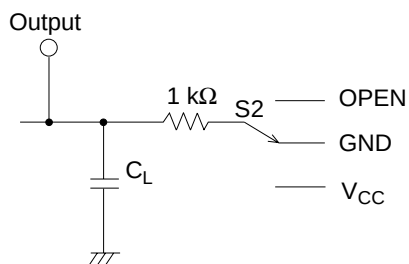
## Noise Characteristics

C<sub>L</sub> = 50 pF

| Item                                          | Symbol              | V <sub>CC</sub> = (V) | Ta = 25°C |      |      | Unit | Test Conditions |
|-----------------------------------------------|---------------------|-----------------------|-----------|------|------|------|-----------------|
|                                               |                     |                       | Min       | Typ  | Max  |      |                 |
| Quiet output, maximum dynamic V <sub>OL</sub> | V <sub>OL (P)</sub> | 3.3                   | —         | 0.4  | 0.8  | V    |                 |
| Quiet output, minimum dynamic V <sub>OL</sub> | V <sub>OL (V)</sub> | 3.3                   | —         | -0.3 | -0.8 |      |                 |
| Quiet output, minimum dynamic V <sub>OH</sub> | V <sub>OH (V)</sub> | 3.3                   | —         | 2.9  | —    |      |                 |
| High-level dynamic input voltage              | V <sub>IH (D)</sub> | 3.3                   | 2.31      | —    | —    |      |                 |
| Low-level dynamic input voltage               | V <sub>IL (D)</sub> | 3.3                   | —         | —    | 0.99 |      |                 |



# Test Circuit

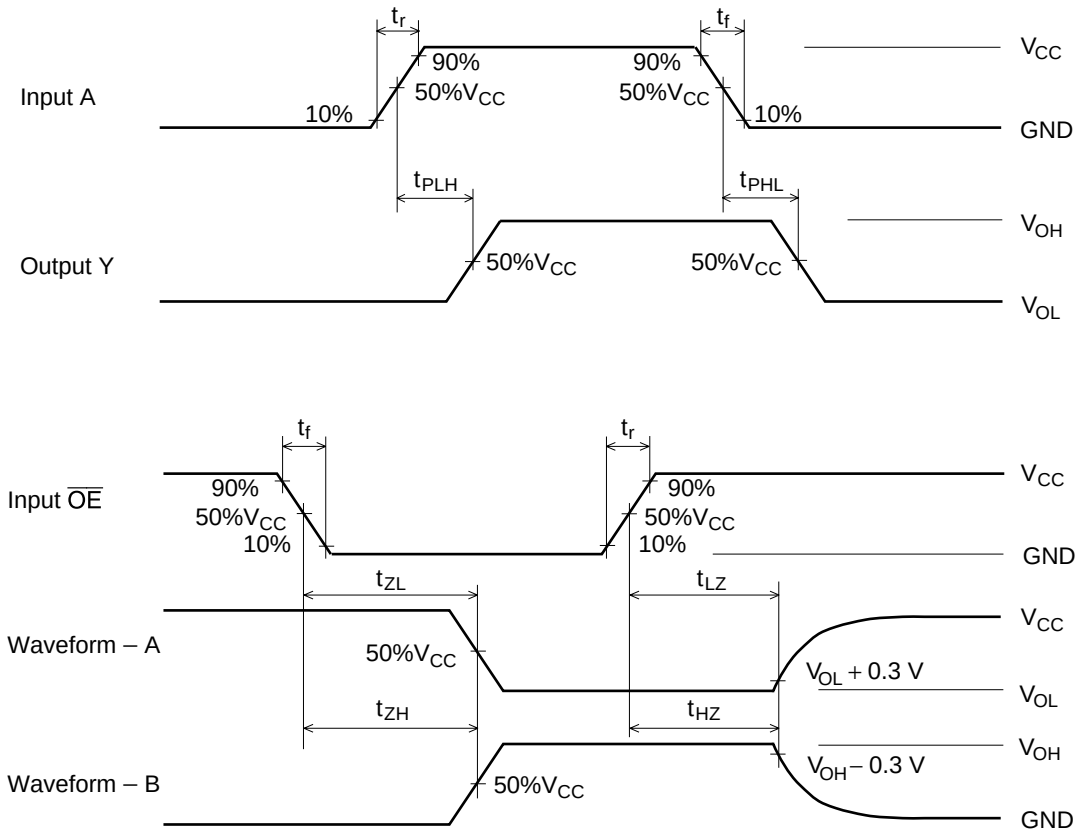


| TEST              | S2              |
|-------------------|-----------------|
| $t_{PLH}/t_{PHL}$ | OPEN            |
| $t_{ZH}/t_{HZ}$   | GND             |
| $t_{ZL}/t_{LZ}$   | V <sub>CC</sub> |

Note:  $C_L$  includes the probe and jig capacitance.

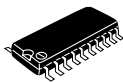
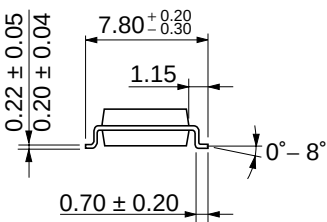
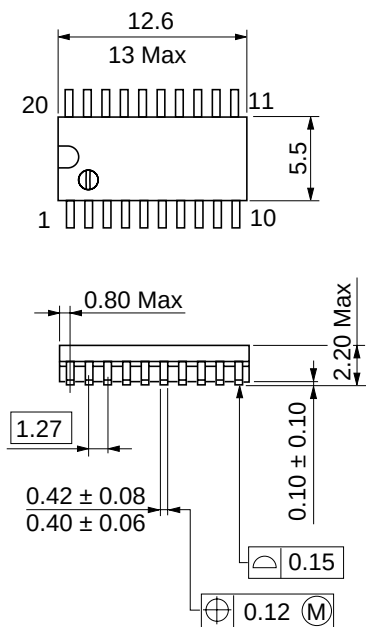
# HD74LV541A

• Waveform



- Notes:
1.  $t_r \leq 3 \text{ ns}$ ,  $t_f \leq 3 \text{ ns}$
  2. Input waveform:  $PRR \leq 1 \text{ MHz}$ , 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

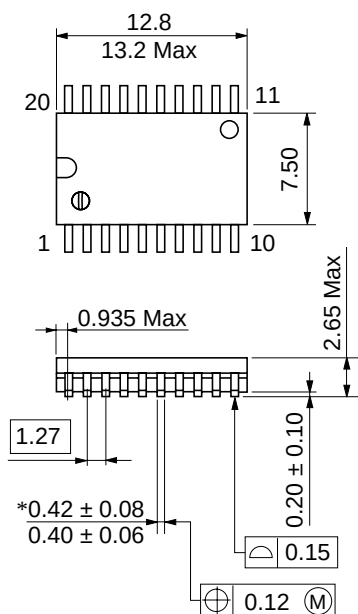
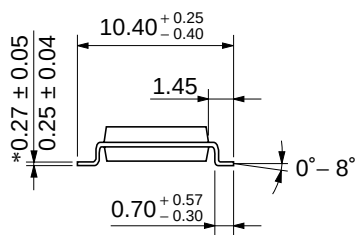
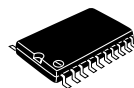


Dimension including the plating thickness  
Base material dimension

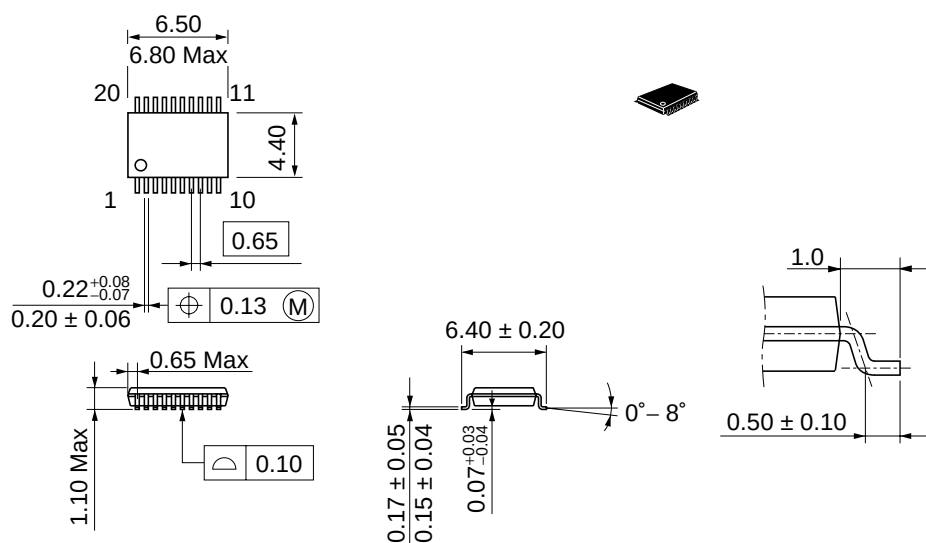
|                          |          |
|--------------------------|----------|
| Hitachi Code             | FP-20DA  |
| JEDEC                    | —        |
| EIAJ                     | Conforms |
| Weight (reference value) | 0.31 g   |

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Unit: mm


$$\frac{\text{*Dimension including the plating thickness}}{\text{Base material dimension}}$$


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



Dimension including the plating thickness  
Base material dimension

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

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